International Interaction Game

Quantum-like Signorino's Backward Induction Model

Quantum Extension of Signorino's International Interaction Game Model

Quantum-like Backward Induction Functions

In[1]:=
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(*Quantum Extension of Signorino's International Interaction Game
 Model Based on the classical implementation in signorino_model.m*)
(*Quantum Backward Induction Functions*)
q10quantum[theta1_, theta2_, U2War1_, U2Cap2_, l1_ : 1, l2_ : 1] := Module[
  {numerator, denominator, exponentialFactor}, numerator = Exp[l2 * U2War1];
  denominator = Exp[l2 * U2War1] + Exp[l2 * U2Cap2];
  exponentialFactor = I * theta2;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notq10quantum[theta1_, theta2_, U2War1_, U2Cap2_, l1_ : 1, l2_ : 1] := Module[
  {numerator, denominator, exponentialFactor}, numerator = Exp[l2 * U2War1];
  denominator = Exp[l2 * U2War1] + Exp[l2 * U2Cap2];
  exponentialFactor = I * theta2;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]

q11quantum[theta1_, theta2_, U2War1_, U2Cap2_, l1_ : 1, l2_ : 1] := Module[
  {numerator, denominator, exponentialFactor}, numerator = Exp[l2 * U2War1];
  denominator = Exp[l2 * U2War1] + Exp[l2 * U2Cap2];
  exponentialFactor = I * theta2;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notq11quantum[theta1_, theta2_, U2War1_, U2Cap2_, l1_ : 1, l2_ : 1] := Module[
  {numerator, denominator, exponentialFactor}, numerator = Exp[l2 * U2War1];
  denominator = Exp[l2 * U2War1] + Exp[l2 * U2Cap2];
  exponentialFactor = I * theta2;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]

p8quantum[theta1_, theta2_, U1War2_, U1Cap1_, l1_ : 1, l2_ : 1] := Module[
  {numerator, denominator, exponentialFactor}, numerator = Exp[l1 * U1War2];
  denominator = Exp[l1 * U1War2] + Exp[l1 * U1Cap1];
  exponentialFactor = I * theta1;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notp8quantum[theta1_, theta2_, U1War2_, U1Cap1_, l1_ : 1, l2_ : 1] := Module[
  {numerator, denominator, exponentialFactor}, numerator = Exp[l1 * U1War2];
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  denominator = Exp[l1 * U1War2] + Exp[l1 * U1Cap1];
  exponentialFactor = I * theta1;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]

p12quantum[theta1_, theta2_, U1War2_, U1Cap1_, l1_ : 1, l2_ : 1] := Module[
  {numerator, denominator, exponentialFactor}, numerator = Exp[l1 * U1War2];
  denominator = Exp[l1 * U1War2] + Exp[l1 * U1Cap1];
  exponentialFactor = I * theta1;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notp12quantum[theta1_, theta2_, U1War2_, U1Cap1_, l1_ : 1, l2_ : 1] := Module[
  {numerator, denominator, exponentialFactor}, numerator = Exp[l1 * U1War2];
  denominator = Exp[l1 * U1War2] + Exp[l1 * U1Cap1];
  exponentialFactor = I * theta1;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]

q9quantum[theta1_, theta2_, U1War2_,
  U1Cap1_, U2War2_, U2Cap1_, U2Nego_, l1_ : 1, l2_ : 1] :=
 Module[{p12val, notp12val, UP2N12, numerator, denominator, exponentialFactor},
  p12val = p12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp12val = notp12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP2N12 = p12val * U2War2 + notp12val * U2Cap1;
  numerator = Exp[l2 * UP2N12];
  denominator = Exp[l2 * UP2N12] + Exp[l2 * U2Nego];
  exponentialFactor = I * theta2;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notq9quantum[theta1_, theta2_, U1War2_,
  U1Cap1_, U2War2_, U2Cap1_, U2Nego_, l1_ : 1, l2_ : 1] :=
 Module[{p12val, notp12val, UP2N12, numerator, denominator, exponentialFactor},
  p12val = p12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp12val = notp12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP2N12 = p12val * U2War2 + notp12val * U2Cap1;
  numerator = Exp[l2 * UP2N12];
  denominator = Exp[l2 * UP2N12] + Exp[l2 * U2Nego];
  exponentialFactor = I * theta2;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]

p7quantum[theta1_, theta2_, U1War1_,
  U1Cap2_, U2War1_, U2Cap2_, U1Nego_, l1_ : 1, l2_ : 1] :=
 Module[{q11val, notq11val, UP1N11, numerator, denominator, exponentialFactor},
  q11val = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq11val = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP1N11 = q11val * U1War1 + notq11val * U1Cap2;
  numerator = Exp[l1 * UP1N11];
  denominator = Exp[l1 * UP1N11] + Exp[l1 * U1Nego];
  exponentialFactor = I * theta1;
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  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notp7quantum[theta1_, theta2_, U1War1_,
  U1Cap2_, U2War1_, U2Cap2_, U1Nego_, l1_ : 1, l2_ : 1] :=
 Module[{q11val, notq11val, UP1N11, numerator, denominator, exponentialFactor},
  q11val = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq11val = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP1N11 = q11val * U1War1 + notq11val * U1Cap2;
  numerator = Exp[l1 * UP1N11];
  denominator = Exp[l1 * UP1N11] + Exp[l1 * U1Nego];
  exponentialFactor = I * theta1;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]

q6quantum[theta1_, theta2_, U1War1_, U1War2_, U1Cap1_, U1Cap2_, U2War2_,
  U2Cap1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_, l1_ : 1, l2_ : 1] :=
 Module[{p8val, notp8val, UP2N8, q11val, notq11val, U2N11,
   UP2N7, numerator, denominator, exponentialFactor},
  p8val = p8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp8val = notp8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP2N8 = p8val * U2War2 + notp8val * U2Cap1;
  q11val = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq11val = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  U2N11 = q11val * U2War1 + notq11val * U2Cap2;
  UP2N7 =
   p7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2] *
     U2N11 + notp7quantum[theta1, theta2, U1War1,
      U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2] * U2Nego;
  numerator = Exp[l2 * UP2N8];
  denominator = Exp[l2 * UP2N8] + Exp[l2 * UP2N7];
  exponentialFactor = I * theta2;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notq6quantum[theta1_, theta2_, U1War1_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_, l1_ : 1, l2_ : 1] :=
 Module[{p8val, notp8val, UP2N8, q11val, notq11val, U2N11,
   UP2N7, numerator, denominator, exponentialFactor},
  p8val = p8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp8val = notp8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP2N8 = p8val * U2War2 + notp8val * U2Cap1;
  q11val = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq11val = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  U2N11 = q11val * U2War1 + notq11val * U2Cap2;
  UP2N7 =
   p7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2] *
     U2N11 + notp7quantum[theta1, theta2, U1War1,
      U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2] * U2Nego;
  numerator = Exp[l2 * UP2N8];
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  denominator = Exp[l2 * UP2N8] + Exp[l2 * UP2N7];
  exponentialFactor = I * theta2;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]

p5quantum[theta1_, theta2_, U1Cap1_, U2Cap1_, U1Cap2_, U2Cap2_, U1War1_,
  U2War1_, U1War2_, U2War2_, U1Nego_, U2Nego_, l1_ : 1, l2_ : 1] :=
 Module[{p12val, notp12val, UP1N12, q10val, notq10val, UP1N10, q9val,
   notq9val, UP1N9, numerator, denominator, exponentialFactor},
  p12val = p12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp12val = notp12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP1N12 = p12val * U1War2 + notp12val * U1Cap1;
  q10val = q10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq10val = notq10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP1N10 = q10val * U1War1 + notq10val * U1Cap2;
  q9val =
   q9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  notq9val =
   notq9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  UP1N9 = q9val * UP1N12 + notq9val * U1Nego;
  numerator = Exp[l1 * UP1N10];
  denominator = Exp[l1 * UP1N10] + Exp[l1 * UP1N9];
  exponentialFactor = I * theta1;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notp5quantum[theta1_, theta2_, U1Cap1_, U2Cap1_, U1Cap2_, U2Cap2_,
  U1War1_, U2War1_, U1War2_, U2War2_, U1Nego_, U2Nego_, l1_ : 1, l2_ : 1] :=
 Module[{p12val, notp12val, UP1N12, q10val, notq10val, UP1N10, q9val,
   notq9val, UP1N9, numerator, denominator, exponentialFactor},
  p12val = p12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp12val = notp12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP1N12 = p12val * U1War2 + notp12val * U1Cap1;
  q10val = q10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq10val = notq10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP1N10 = q10val * U1War1 + notq10val * U1Cap2;
  q9val =
   q9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  notq9val =
   notq9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  UP1N9 = q9val * UP1N12 + notq9val * U1Nego;
  numerator = Exp[l1 * UP1N10];
  denominator = Exp[l1 * UP1N10] + Exp[l1 * UP1N9];
  exponentialFactor = I * theta1;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]

p4quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_, U2War2_, U2Cap1_,
  U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_, U1Acq1_, l1_ : 1, l2_ : 1] :=
 Module[{q11val, notq11val, UP1N11, p8val, notp8val, UP1N8, p7val, notp7val,
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   UP1N7, q6val, notq6val, UP1N6, numerator, denominator, exponentialFactor},
  q11val = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq11val = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP1N11 = q11val * U1War1 + notq11val * U1Cap2;
  p8val = p8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp8val = notp8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP1N8 = p8val * U1War2 + notp8val * U1Cap1;
  p7val =
   p7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  notp7val =
   notp7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  UP1N7 = p7val * UP1N11 + notp7val * U1Nego;
  q6val = q6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  notq6val = notq6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  UP1N6 = q6val * UP1N8 + notq6val * UP1N7;
  numerator = Exp[l1 * UP1N6];
  denominator = Exp[l1 * UP1N6] + Exp[l1 * U1Acq1];
  exponentialFactor = I * theta1;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notp4quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_, U2War2_, U2Cap1_,
  U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_, U1Acq1_, l1_ : 1, l2_ : 1] :=
 Module[{q11val, notq11val, UP1N11, p8val, notp8val, UP1N8, p7val, notp7val,
   UP1N7, q6val, notq6val, UP1N6, numerator, denominator, exponentialFactor},
  q11val = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq11val = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP1N11 = q11val * U1War1 + notq11val * U1Cap2;
  p8val = p8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp8val = notp8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP1N8 = p8val * U1War2 + notp8val * U1Cap1;
  p7val =
   p7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  notp7val =
   notp7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  UP1N7 = p7val * UP1N11 + notp7val * U1Nego;
  q6val = q6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  notq6val = notq6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  UP1N6 = q6val * UP1N8 + notq6val * UP1N7;
  numerator = Exp[l1 * UP1N6];
  denominator = Exp[l1 * UP1N6] + Exp[l1 * U1Acq1];
  exponentialFactor = I * theta1;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]
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q3quantum[theta1_, theta2_, U1Cap1_, U2Cap1_, U1Cap2_, U2Cap2_, U1War1_,
  U2War1_, U1War2_, U2War2_, U1Nego_, U2Nego_, U2Acq2_, l1_ : 1, l2_ : 1] :=
 Module[{p12val, notp12val, UP2N12, q10val, notq10val, UP2N10, q9val, notq9val,
   UP2N9, p5val, notp5val, UP2N5, numerator, denominator, exponentialFactor},
  p12val = p12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp12val = notp12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP2N12 = p12val * U2War2 + notp12val * U2Cap1;
  q10val = q10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq10val = notq10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP2N10 = q10val * U2War1 + notq10val * U2Cap2;
  q9val =
   q9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  notq9val =
   notq9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  UP2N9 = q9val * UP2N12 + notq9val * U2Nego;
  p5val = p5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  notp5val = notp5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  UP2N5 = p5val * UP2N10 + notp5val * UP2N9;
  numerator = Exp[l2 * UP2N5];
  denominator = Exp[l2 * UP2N5] + Exp[l2 * U2Acq2];
  exponentialFactor = I * theta2;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notq3quantum[theta1_, theta2_, U1Cap1_, U2Cap1_, U1Cap2_, U2Cap2_, U1War1_,
  U2War1_, U1War2_, U2War2_, U1Nego_, U2Nego_, U2Acq2_, l1_ : 1, l2_ : 1] :=
 Module[{p12val, notp12val, UP2N12, q10val, notq10val, UP2N10, q9val, notq9val,
   UP2N9, p5val, notp5val, UP2N5, numerator, denominator, exponentialFactor},
  p12val = p12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp12val = notp12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP2N12 = p12val * U2War2 + notp12val * U2Cap1;
  q10val = q10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq10val = notq10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP2N10 = q10val * U2War1 + notq10val * U2Cap2;
  q9val =
   q9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  notq9val =
   notq9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  UP2N9 = q9val * UP2N12 + notq9val * U2Nego;
  p5val = p5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  notp5val = notp5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  UP2N5 = p5val * UP2N10 + notp5val * UP2N9;
  numerator = Exp[l2 * UP2N5];
  denominator = Exp[l2 * UP2N5] + Exp[l2 * U2Acq2];
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  exponentialFactor = I * theta2;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]

q2quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_, U2War2_, U2Cap1_, U1War1_,
  U2War1_, U2Cap2_, U1Nego_, U2Nego_, U1Acq1_, U2Acq1_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{q11val, notq11val, UP2N11, p7val, notp7val, UP2N7,
   p8val, notp8val, UP2N8, q6val, notq6val, UP2N6, p4val,
   notp4val, UP2N4, numerator, denominator, exponentialFactor},
  q11val = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq11val = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP2N11 = q11val * U2War1 + notq11val * U2Cap2;
  p7val =
   p7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  notp7val =
   notp7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  UP2N7 = p7val * UP2N11 + notp7val * U2Nego;
  p8val = p8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp8val = notp8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP2N8 = p8val * U2War2 + notp8val * U2Cap1;
  q6val = q6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  notq6val = notq6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  UP2N6 = q6val * UP2N8 + notq6val * UP2N7;
  p4val = p4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  notp4val = notp4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  UP2N4 = p4val * UP2N6 + notp4val * U2Acq1;
  numerator = Exp[l2 * UP2N4];
  denominator = Exp[l2 * UP2N4] + Exp[l2 * U2SQ];
  exponentialFactor = I * theta2;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notq2quantum[theta1_, theta2_, U1War2_, U1Cap1_,
  U1Cap2_, U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_,
  U1Nego_, U2Nego_, U1Acq1_, U2Acq1_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{q11val, notq11val, UP2N11, p7val, notp7val, UP2N7,
   p8val, notp8val, UP2N8, q6val, notq6val, UP2N6, p4val,
   notp4val, UP2N4, numerator, denominator, exponentialFactor},
  q11val = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq11val = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP2N11 = q11val * U2War1 + notq11val * U2Cap2;
  p7val =
   p7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  notp7val =
   notp7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
```

```
  UP2N7 = p7val * UP2N11 + notp7val * U2Nego;
  p8val = p8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp8val = notp8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP2N8 = p8val * U2War2 + notp8val * U2Cap1;
  q6val = q6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  notq6val = notq6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  UP2N6 = q6val * UP2N8 + notq6val * UP2N7;
  p4val = p4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  notp4val = notp4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  UP2N4 = p4val * UP2N6 + notp4val * U2Acq1;
  numerator = Exp[l2 * UP2N4];
  denominator = Exp[l2 * UP2N4] + Exp[l2 * U2SQ];
  exponentialFactor = I * theta2;
  Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]

p1quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_,
  U1Acq1_, U2Acq1_, U1Acq2_, U2Acq2_, U1SQ_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{p12val, notp12val, UP1N12, q11val, notq11val, UP1N11, q9val,
   notq9val, UP1N9, p7val, notp7val, UP1N7, p8val, notp8val, UP1N8,
   q10val, notq10val, UP1N10, q6val, notq6val, UP1N6, p5val, notp5val,
   UP1N5, p4val, notp4val, UP1N4, q3val, notq3val, UP1N3, q2val,
   notq2val, UP1N2, numerator, denominator, exponentialFactor},
  p12val = p12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp12val = notp12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP1N12 = p12val * U1War1 + notp12val * U1Cap1;
  q11val = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq11val = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP1N11 = q11val * U1War1 + notq11val * U1Cap2;
  q9val =
   q9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  notq9val =
   notq9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  UP1N9 = q9val * UP1N12 + notq9val * U1Nego;
  p7val =
   p7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  notp7val =
   notp7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  UP1N7 = p7val * UP1N11 + notp7val * U1Nego;
  p8val = p8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp8val = notp8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP1N8 = p8val * U1War2 + notp8val * U1Cap1;
  q10val = q10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
```

```
  notq10val = notq10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP1N10 = q10val * U1War1 + notq10val * U1Cap2;
  q6val = q6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  notq6val = notq6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  UP1N6 = q6val * UP1N8 + notq6val * UP1N7;
  p5val = p5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  notp5val = notp5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  UP1N5 = p5val * UP1N10 + notp5val * UP1N9;
  p4val = p4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  notp4val = notp4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  UP1N4 = p4val * UP1N6 + notp4val * U1Acq1;
  q3val = q3quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2, U2Cap2,
    U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, U2Acq2, l1, l2];
  notq3val = notq3quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2, U2Cap2,
    U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, U2Acq2, l1, l2];
  UP1N3 = q3val * UP1N5 + notq3val * U1Acq2;
  q2val = q2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1,
    U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
  notq2val = notq2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1,
    U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
  UP1N2 = q2val * UP1N4 + notq2val * U1SQ;
  numerator = Exp[l1 * UP1N3];
  denominator = Exp[l1 * UP1N3] + Exp[l1 * UP1N2];
  exponentialFactor = I * theta1;
  Sqrt[numerator / denominator] * Exp[exponentialFactor]]

notp1quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_,
  U1Acq1_, U2Acq1_, U1Acq2_, U2Acq2_, U1SQ_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{p12val, notp12val, UP1N12, q11val, notq11val, UP1N11, q9val,
   notq9val, UP1N9, p7val, notp7val, UP1N7, p8val, notp8val, UP1N8,
   q10val, notq10val, UP1N10, q6val, notq6val, UP1N6, p5val, notp5val,
   UP1N5, p4val, notp4val, UP1N4, q3val, notq3val, UP1N3, q2val,
   notq2val, UP1N2, numerator, denominator, exponentialFactor},
  p12val = p12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp12val = notp12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  UP1N12 = p12val * U1War1 + notp12val * U1Cap1;
  q11val = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notq11val = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  UP1N11 = q11val * U1War1 + notq11val * U1Cap2;
  q9val =
```

```
 q9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
notq9val =
 notq9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
UP1N9 = q9val * UP1N12 + notq9val * U1Nego;
p7val =
 p7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
notp7val =
 notp7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
UP1N7 = p7val * UP1N11 + notp7val * U1Nego;
p8val = p8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
notp8val = notp8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
UP1N8 = p8val * U1War2 + notp8val * U1Cap1;
q10val = q10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
notq10val = notq10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
UP1N10 = q10val * U1War1 + notq10val * U1Cap2;
q6val = q6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
  U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
notq6val = notq6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
  U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
UP1N6 = q6val * UP1N8 + notq6val * UP1N7;
p5val = p5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
  U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
notp5val = notp5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
  U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
UP1N5 = p5val * UP1N10 + notp5val * UP1N9;
p4val = p4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
  U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
notp4val = notp4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
  U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
UP1N4 = p4val * UP1N6 + notp4val * U1Acq1;
q3val = q3quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2, U2Cap2,
  U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, U2Acq2, l1, l2];
notq3val = notq3quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2, U2Cap2,
  U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, U2Acq2, l1, l2];
UP1N3 = q3val * UP1N5 + notq3val * U1Acq2;
q2val = q2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1,
  U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
notq2val = notq2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1,
  U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
UP1N2 = q2val * UP1N4 + notq2val * U1SQ;
numerator = Exp[l1 * UP1N3];
denominator = Exp[l1 * UP1N3] + Exp[l1 * UP1N2];
exponentialFactor = I * theta1;
Sqrt[1 - numerator / denominator] * Exp[exponentialFactor]]
```

In[25]:=

Outcome Functions

In[26]:=
```
SQquantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_,
  U1Acq1_, U2Acq1_, U1Acq2_, U2Acq2_, U1SQ_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{notp1, notq2}, notp1 = notp1quantum[theta1, theta2, U1War2,
    U1Cap1, U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  notq2 = notq2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1,
    U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
  notp1 * notq2]

ACQ1quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_,
  U1Acq1_, U2Acq1_, U1Acq2_, U2Acq2_, U1SQ_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{notp1, q2, notp4}, notp1 = notp1quantum[theta1, theta2, U1War2,
    U1Cap1, U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  q2 = q2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1, U1War1,
    U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
  notp4 = notp4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  notp1 * q2 * notp4]

ACQ2quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_,
  U1Acq1_, U2Acq1_, U1Acq2_, U2Acq2_, U1SQ_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{p1, notq3}, p1 = p1quantum[theta1, theta2, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  notq3 = notq3quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2, U2Cap2,
    U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, U2Acq2, l1, l2];
  p1 * notq3]

NEGOquantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_,
  U1Acq1_, U2Acq1_, U1Acq2_, U2Acq2_, U1SQ_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{p1, notp1, q2, q3, p4, notp5, notq6, notp7, notq9},
  p1 = p1quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2,
    U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego,
    U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  notp1 = notp1quantum[theta1, theta2, U1War2,
    U1Cap1, U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  q2 = q2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1, U1War1,
    U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
```

```
  q3 = q3quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2, U2Cap2,
    U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, U2Acq2, l1, l2];
  p4 = p4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  notp5 = notp5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  notq6 = notq6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  notp7 =
   notp7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  notq9 =
   notq9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  notp1 * q2 * p4 * notq6 * notp7 + p1 * q3 * notp5 * notq9]

CAP1quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_,
  U1Acq1_, U2Acq1_, U1Acq2_, U2Acq2_, U1SQ_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{notp1, q2, p4, q6, notp8, p1, q3, notp5, q9, notp12},
  notp1 = notp1quantum[theta1, theta2, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  q2 = q2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1, U1War1,
    U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
  p4 = p4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  q6 = q6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  notp8 = notp8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  p1 = p1quantum[theta1, theta2, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  q3 = q3quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2, U2Cap2,
    U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, U2Acq2, l1, l2];
  notp5 = notp5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  q9 = q9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  notp12 = notp12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp1 * q2 * p4 * q6 * notp8 + p1 * q3 * notp5 * q9 * notp12]

CAP2quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_,
  U1Acq1_, U2Acq1_, U1Acq2_, U2Acq2_, U1SQ_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{notp1, q2, p4, notq6, p7, notq11, p1, q3, p5, notq10},
  notp1 = notp1quantum[theta1, theta2, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  q2 = q2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1, U1War1,
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    U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
  p4 = p4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  notq6 = notq6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  p7 = p7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  notq11 = notq11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  p1 = p1quantum[theta1, theta2, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  q3 = q3quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2, U2Cap2,
    U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, U2Acq2, l1, l2];
  p5 = p5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  notq10 = notq10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  notp1 * q2 * p4 * notq6 * p7 * notq11 + p1 * q3 * p5 * notq10]

WAR1quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_,
  U1Acq1_, U2Acq1_, U1Acq2_, U2Acq2_, U1SQ_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{notp1, p1, q2, p4, notq6, p7, q11, q3, q10, p5},
  notp1 = notp1quantum[theta1, theta2, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  p1 = p1quantum[theta1, theta2, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  q2 = q2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1, U1War1,
    U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
  p4 = p4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  notq6 = notq6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  p7 = p7quantum[theta1, theta2, U1War1, U1Cap2, U2War1, U2Cap2, U1Nego, l1, l2];
  q11 = q11quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  q3 = q3quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2, U2Cap2,
    U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, U2Acq2, l1, l2];
  q10 = q10quantum[theta1, theta2, U2War1, U2Cap2, l1, l2];
  p5 = p5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  notp1 * q2 * p4 * notq6 * p7 * q11 + p1 * q3 * p5 * q10]

WAR2quantum[theta1_, theta2_, U1War2_, U1Cap1_, U1Cap2_,
  U2War2_, U2Cap1_, U1War1_, U2War1_, U2Cap2_, U1Nego_, U2Nego_,
  U1Acq1_, U2Acq1_, U1Acq2_, U2Acq2_, U1SQ_, U2SQ_, l1_ : 1, l2_ : 1] :=
 Module[{notp1, p1, q2, p4, q6, p8, q3, notp5, q9, p12},
  notp1 = notp1quantum[theta1, theta2, U1War2, U1Cap1,
```

```
    U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  p1 = p1quantum[theta1, theta2, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U1War1, U2War1, U2Cap2, U1Nego,
    U2Nego, U1Acq1, U2Acq1, U1Acq2, U2Acq2, U1SQ, U2SQ, l1, l2];
  q2 = q2quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2, U2Cap1, U1War1,
    U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, U2Acq1, U2SQ, l1, l2];
  p4 = p4quantum[theta1, theta2, U1War2, U1Cap1, U1Cap2, U2War2,
    U2Cap1, U1War1, U2War1, U2Cap2, U1Nego, U2Nego, U1Acq1, l1, l2];
  q6 = q6quantum[theta1, theta2, U1War1, U1War2, U1Cap1,
    U1Cap2, U2War2, U2Cap1, U2War1, U2Cap2, U1Nego, U2Nego, l1, l2];
  p8 = p8quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  q3 = q3quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2, U2Cap2,
    U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, U2Acq2, l1, l2];
  notp5 = notp5quantum[theta1, theta2, U1Cap1, U2Cap1, U1Cap2,
    U2Cap2, U1War1, U2War1, U1War2, U2War2, U1Nego, U2Nego, l1, l2];
  q9 = q9quantum[theta1, theta2, U1War2, U1Cap1, U2War2, U2Cap1, U2Nego, l1, l2];
  p12 = p12quantum[theta1, theta2, U1War2, U1Cap1, l1, l2];
  notp1 * q2 * p4 * q6 * p8 + p1 * q3 * notp5 * q9 * p12]
```

Aux Functions

calculateQuantumOutcome

In[34]:=

```
calculateQuantumOutcome[data_,
  rowIndex_Integer, theta1_ : 0, theta2_ : 0, l1_ : 1, l2_ : 1] :=
 Module[{utils, quantumAmplitudes, finalProbabilities, outcomes, outcomeProbs,
   maxVal, maxOutcomes, prediction, roundedProbs},

  utils = extractUtilities[data, rowIndex];
  If[utils === $Failed,
   Return[$Failed]];

  (*Compute quantum probability amplitudes*)
  quantumAmplitudes =
   Quiet[{
     SQquantum[theta1, theta2,
      utils["U1War2"], utils["U1Cap1"], utils["U1Cap2"],
      utils["U2War2"], utils["U2Cap1"],
      utils["U1War1"], utils["U2War1"], utils["U2Cap2"],
      utils["U1Nego"], utils["U2Nego"],
      utils["U1Acq1"], utils["U2Acq1"], utils["U1Acq2"],
      utils["U2Acq2"], utils["U1SQ"], utils["U2SQ"], l1, l2],

     ACQ1quantum[theta1, theta2,
      utils["U1War2"], utils["U1Cap1"], utils["U1Cap2"],
      utils["U2War2"], utils["U2Cap1"],
```

```
    utils["U1War1"], utils["U2War1"], utils["U2Cap2"],
    utils["U1Nego"], utils["U2Nego"],
    utils["U1Acq1"], utils["U2Acq1"], utils["U1Acq2"],
    utils["U2Acq2"], utils["U1SQ"], utils["U2SQ"], l1, l2],

   ACQ2quantum[theta1, theta2, utils["U1War2"],
    utils["U1Cap1"], utils["U1Cap2"], utils["U2War2"], utils["U2Cap1"],
    utils["U1War1"], utils["U2War1"], utils["U2Cap2"], utils["U1Nego"],
    utils["U2Nego"], utils["U1Acq1"], utils["U2Acq1"], utils["U1Acq2"],
    utils["U2Acq2"], utils["U1SQ"], utils["U2SQ"], l1, l2],

   NEGOquantum[theta1, theta2, utils["U1War2"],
    utils["U1Cap1"], utils["U1Cap2"], utils["U2War2"], utils["U2Cap1"],
    utils["U1War1"], utils["U2War1"], utils["U2Cap2"], utils["U1Nego"],
    utils["U2Nego"], utils["U1Acq1"], utils["U2Acq1"], utils["U1Acq2"],
    utils["U2Acq2"], utils["U1SQ"], utils["U2SQ"], l1, l2],

   CAP1quantum[theta1, theta2, utils["U1War2"],
    utils["U1Cap1"], utils["U1Cap2"], utils["U2War2"], utils["U2Cap1"],
    utils["U1War1"], utils["U2War1"], utils["U2Cap2"], utils["U1Nego"],
    utils["U2Nego"], utils["U1Acq1"], utils["U2Acq1"], utils["U1Acq2"],
    utils["U2Acq2"], utils["U1SQ"], utils["U2SQ"], l1, l2],

   CAP2quantum[theta1, theta2, utils["U1War2"],
    utils["U1Cap1"], utils["U1Cap2"], utils["U2War2"], utils["U2Cap1"],
    utils["U1War1"], utils["U2War1"], utils["U2Cap2"], utils["U1Nego"],
    utils["U2Nego"], utils["U1Acq1"], utils["U2Acq1"], utils["U1Acq2"],
    utils["U2Acq2"], utils["U1SQ"], utils["U2SQ"], l1, l2],

   WAR1quantum[theta1, theta2, utils["U1War2"],
    utils["U1Cap1"], utils["U1Cap2"], utils["U2War2"], utils["U2Cap1"],
    utils["U1War1"], utils["U2War1"], utils["U2Cap2"], utils["U1Nego"],
    utils["U2Nego"], utils["U1Acq1"], utils["U2Acq1"], utils["U1Acq2"],
    utils["U2Acq2"], utils["U1SQ"], utils["U2SQ"], l1, l2],

   WAR2quantum[theta1, theta2, utils["U1War2"],
    utils["U1Cap1"], utils["U1Cap2"], utils["U2War2"], utils["U2Cap1"],
    utils["U1War1"], utils["U2War1"], utils["U2Cap2"], utils["U1Nego"],
    utils["U2Nego"], utils["U1Acq1"], utils["U2Acq1"], utils["U1Acq2"],
    utils["U2Acq2"], utils["U1SQ"], utils["U2SQ"], l1, l2]
  }];

(*Calculate final probabilities directly from amplitudes*)
finalProbabilities = Abs[#] ^ 2 & /@ quantumAmplitudes;

(*Normalize probabilities*)
finalProbabilities = finalProbabilities / Total[finalProbabilities];
```

```
outcomes = {"SQ", "ACQ1", "ACQ2", "NEGO", "CAP1", "CAP2", "WAR1", "WAR2"};

(*Create outcome probabilities association for prediction*)
outcomeProbs =
 Association[MapThread[Rule, {outcomes, finalProbabilities}]];

(*Round probabilities to 4 decimal places for comparison*)
roundedProbs =
 Association[# → Round[outcomeProbs[#], 0.0001] & /@ Keys[outcomeProbs]];
maxVal = Max[Values[roundedProbs]];
maxOutcomes = Keys[Select[roundedProbs, # == maxVal &]];
(*Randomly select one if there are ties*)
prediction = RandomChoice[maxOutcomes];

Association[
 "SQ" → finalProbabilities[[1]],
 "ACQ1" → finalProbabilities[[2]],
 "ACQ2" → finalProbabilities[[3]],
 "NEGO" → finalProbabilities[[4]],
 "CAP1" → finalProbabilities[[5]],
 "CAP2" → finalProbabilities[[6]],
 "WAR1" → finalProbabilities[[7]],
 "WAR2" → finalProbabilities[[8]],
 "prediction" → prediction,
 "groundtruth" → utils["groundtruth"],
 "utilities" → utils,
 "theta1" → theta1,
 "theta2" → theta2,
 "l1" → l1, "l2" → l2,
 "total" → Total[finalProbabilities]]]
```

getFirstNEntries

In[35]:=
```
getFirstNEntries[resultAllData_, N_Integer] := Module[{extractedEntries},
  (*Input validation*)
  If[! ListQ[resultAllData],
   Print["Error: resultAllData must be a list"];
   Return[$Failed]
  ];

  If[N ≤ 0,
   Print["Error: N must be a positive integer"];
   Return[$Failed]
  ];

  If[Length[resultAllData] == 0,
```

```
 Print["Warning: resultAllData is empty"];
 Return[{}]
];

(*Extract only the specified components from each entry*)
extractedEntries =
 Table[Module[{entry, utils},
   entry = resultAllData[[i]];
   utils =
    If[KeyExistsQ[entry, "utilities"], entry["utilities"], Association[]];

   Association[
    "SQ" → If[KeyExistsQ[entry, "SQ"], Round[entry["SQ"], 0.0001], 0],
    "ACQ1" → If[KeyExistsQ[entry, "ACQ1"], Round[entry["ACQ1"], 0.0001], 0],
    "ACQ2" → If[KeyExistsQ[entry, "ACQ2"], Round[entry["ACQ2"], 0.0001], 0],
    "NEGO" → If[KeyExistsQ[entry, "NEGO"], Round[entry["NEGO"], 0.0001], 0],
    "CAP1" → If[KeyExistsQ[entry, "CAP1"], Round[entry["CAP1"], 0.0001], 0],
    "CAP2" → If[KeyExistsQ[entry, "CAP2"], Round[entry["CAP2"], 0.0001], 0],
    "WAR1" → If[KeyExistsQ[entry, "WAR1"], Round[entry["WAR1"], 0.0001], 0],
    "WAR2" → If[KeyExistsQ[entry, "WAR2"], Round[entry["WAR2"], 0.0001], 0],
    "prediction" →
     If[KeyExistsQ[entry, "prediction"], entry["prediction"], "UNKNOWN"],
    "groundtruth" →
     If[KeyExistsQ[entry, "groundtruth"], entry["groundtruth"], "UNKNOWN"],
    "Agent1" → If[KeyExistsQ[utils, "Agent1"], utils["Agent1"], "UNKNOWN"],
    "Agent2" → If[KeyExistsQ[utils, "Agent2"], utils["Agent2"], "UNKNOWN"]]
  ], {i, Min[N, Length[resultAllData]]}
 ];

(*Return extracted entries with informative message*)
If[N ≥ Length[resultAllData],
 Print["Note: Requested ", N, " entries but only ", Length[resultAllData],
  " available. Returning all entries with extracted components."];
 Return[extractedEntries],
 Print["Returning first ", N, " entries out of ",
  Length[resultAllData], " total entries with extracted components."];
 Return[extractedEntries]]]
```

processQuantumDataset

In[36]:=
```
(*Process Quantum Dataset*)
processQuantumDataset[data_, theta1_ : 0, theta2_ : 0, l1_ : 1, l2_ : 1] :=
 Module[{results, i}, If[data === $Failed,
   Print["Error: Invalid data passed to processQuantumDataset"];
   Return[{}]];
  Print["Processing ", data["nrows"], " rows with quantum model..."];
  Print["Parameters: θ1=", theta1,
   ", θ2=", theta2, ", λ1=", l1, ", λ2=", l2];
  results = {};
  Do[Module[{result},
    If[Mod[i, 50] == 0, Print["Processing row ", i, "/", data["nrows"]]];
    result = calculateQuantumOutcome[data, i, theta1, theta2, l1, l2];
    If[result =!= $Failed, AppendTo[results, result],
     Print["Warning: Failed to process row ", i]]], {i, 1, data["nrows"]}];
  Print["Successfully processed ",
   Length[results], " out of ", data["nrows"], " rows"];
  results]
```

calculateQuantumAccuracy

In[37]:=
```
calculateQuantumAccuracy[results_] :=
 Module[{predTruth, correct}, If[Length[results] == 0,
   Print["Warning: No results to calculate accuracy from"];
   Return[0]];
  predTruth = extractPredictionsAndGroundtruth[results];
  If[Length[predTruth["predictions"]] == 0,
   Print["Warning: No valid predictions found"];
   Return[0]];
  correct =
   MapThread[Equal, {predTruth["predictions"], predTruth["groundtruth"]}];
  N[Count[correct, True] / Length[correct]]]
```

plotQuantumConfusionMatrix

In[38]:=
```
plotQuantumConfusionMatrix[results_, theta1_ : 0,
  theta2_ : 0, l1_ : 1, l2_ : 1, title_ : "Quantum Confusion Matrix"] :=
 Module[{predictions, groundTruths, outcomes, confusionData,
   accuracy, predTruth}, If[Length[results] == 0,
   Print["Warning: No results provided for confusion matrix"];
   Return[Null]];
  predTruth = extractPredictionsAndGroundtruth[results];
  predictions = predTruth["predictions"];
  groundTruths = predTruth["groundtruth"];
  If[Length[predictions] == 0, Print["Warning: No valid predictions found"];
   Return[Null]];
  accuracy = N[Count[MapThread[Equal, {predictions, groundTruths}], True] /
     Length[results]];
  outcomes = {"ACQ1", "ACQ2", "CAP1", "CAP2", "NEGO", "SQ", "WAR1"};
  confusionData = Table[Count[MapThread[List, {groundTruths, predictions}],
     {actualOutcome, predictedOutcome}],
    {actualOutcome, outcomes}, {predictedOutcome, outcomes}];
  Print[Style[title, 16, Bold]];
  Print[Style["θ1 = " <> ToString[theta1] <> " θ2 = " <>
     ToString[theta2] <> " λ1 = " <> ToString[l1] <> " λ2 = " <>
     ToString[l2] <> " | Accuracy = " <> ToString[N[accuracy]], 14]];
  Print[""];
  Grid[Prepend[MapThread[Prepend, {confusionData, outcomes}],
    Prepend[outcomes, Style["Actual \\ Predicted", Bold]]], Frame → All,
   Alignment → Center, Background → {None, {LightBlue, None}},
   ItemStyle → {Automatic, {Bold, Automatic}}, Spacings → {2, 1},
   FrameStyle → Thick, Dividers → {{2 → Thick}, {2 → Thick}}]]
```

loadData

In[39]:=
```
loadData[filename_String] :=
 Module[{rawData, headers, dataRows, groundtruth, utilityData,
   cleanedData, requiredColumns, missingColumns},

  Print["Loading CSV file: ", filename];
  rawData = Import[filename, "CSV"];

  If[Head[rawData] =!= List || Length[rawData] < 2,
   Print["Error: Could not load CSV file or file is empty"];
   Return[$Failed]
  ];

  headers = First[rawData];
  dataRows = Rest[rawData];

  Print["Loaded ", Length[dataRows],
   " rows with ", Length[headers], " columns"];
  cleanedData =
   Map[Function[row, Map[Function[cell, If[NumericQ[cell], cell, If[
          StringQ[cell] && StringMatchQ[cell, NumberString], ToExpression[cell],
          cell]]], row]], dataRows];
  groundtruth = cleanedData[[All, -1]];

  utilityData =
   Association[Table[headers[[i]] → cleanedData[[All, i]], {i, Length[headers]}]];

  requiredColumns = {"wrTu1wr2", "wrTu1cp1", "wrTu1cp2", "wrTu1wr1", "wrTu1neg",
    "wrTu1ac1", "wrTu1ac2", "wrTu1sq", "wrTu2wr2", "wrTu2cp1", "wrTu2wr1",
    "wrTu2cp2", "wrTu2neg", "wrTu2ac1", "wrTu2ac2", "wrTu2sq"};
  missingColumns = Select[requiredColumns, ! KeyExistsQ[utilityData, #] &];

  If[Length[missingColumns] > 0,
   Print["Warning: Missing required columns: ", missingColumns];
  ];

  Association[
   "groundtruth" → groundtruth,
   "data" → utilityData,
   "nrows" → Length[cleanedData],
   "headers" → headers,
   "filename" → filename]
 ]
```

extractUtilities

In[40]:=
```
extractUtilities[data_, rowIndex_Integer] := Module[{row, utils},
  If[rowIndex < 1 || rowIndex > data["nrows"],
```

```
 Print["Error: Row index ",
  rowIndex, " out of range [1, ", data["nrows"], "]"];
 Return[$Failed]
];

row = data["data"];
utils = Association[];

(*Player 1 utilities*)
utils["U1War2"] = If[KeyExistsQ[row, "wrTu1wr2"] &&
    NumericQ[row["wrTu1wr2"][[rowIndex]]], row["wrTu1wr2"][[rowIndex]], 0.0];
utils["U1Cap1"] = If[KeyExistsQ[row, "wrTu1cp1"] &&
    NumericQ[row["wrTu1cp1"][[rowIndex]]], row["wrTu1cp1"][[rowIndex]], 0.0];
utils["U1Cap2"] = If[KeyExistsQ[row, "wrTu1cp2"] &&
    NumericQ[row["wrTu1cp2"][[rowIndex]]], row["wrTu1cp2"][[rowIndex]], 0.0];
utils["U1War1"] = If[KeyExistsQ[row, "wrTu1wr1"] &&
    NumericQ[row["wrTu1wr1"][[rowIndex]]], row["wrTu1wr1"][[rowIndex]], 0.0];
utils["U1Nego"] = If[KeyExistsQ[row, "wrTu1neg"] &&
    NumericQ[row["wrTu1neg"][[rowIndex]]], row["wrTu1neg"][[rowIndex]], 0.0];
utils["U1Acq1"] = If[KeyExistsQ[row, "wrTu1ac1"] &&
    NumericQ[row["wrTu1ac1"][[rowIndex]]], row["wrTu1ac1"][[rowIndex]], 0.0];
utils["U1Acq2"] = If[KeyExistsQ[row, "wrTu1ac2"] &&
    NumericQ[row["wrTu1ac2"][[rowIndex]]], row["wrTu1ac2"][[rowIndex]], 0.0];
utils["U1SQ"] = If[KeyExistsQ[row, "wrTu1sq"] &&
    NumericQ[row["wrTu1sq"][[rowIndex]]], row["wrTu1sq"][[rowIndex]], 0.0];

(*Player 2 utilities*)
utils["U2War2"] = If[KeyExistsQ[row, "wrTu2wr2"] &&
    NumericQ[row["wrTu2wr2"][[rowIndex]]], row["wrTu2wr2"][[rowIndex]], 0.0];
utils["U2Cap1"] = If[KeyExistsQ[row, "wrTu2cp1"] &&
    NumericQ[row["wrTu2cp1"][[rowIndex]]], row["wrTu2cp1"][[rowIndex]], 0.0];
utils["U2War1"] = If[KeyExistsQ[row, "wrTu2wr1"] &&
    NumericQ[row["wrTu2wr1"][[rowIndex]]], row["wrTu2wr1"][[rowIndex]], 0.0];
utils["U2Cap2"] = If[KeyExistsQ[row, "wrTu2cp2"] &&
    NumericQ[row["wrTu2cp2"][[rowIndex]]], row["wrTu2cp2"][[rowIndex]], 0.0];
utils["U2Nego"] = If[KeyExistsQ[row, "wrTu2neg"] &&
    NumericQ[row["wrTu2neg"][[rowIndex]]], row["wrTu2neg"][[rowIndex]], 0.0];
utils["U2Acq1"] = If[KeyExistsQ[row, "wrTu2ac1"] &&
    NumericQ[row["wrTu2ac1"][[rowIndex]]], row["wrTu2ac1"][[rowIndex]], 0.0];
utils["U2Acq2"] = If[KeyExistsQ[row, "wrTu2ac2"] &&
    NumericQ[row["wrTu2ac2"][[rowIndex]]], row["wrTu2ac2"][[rowIndex]], 0.0];
utils["U2SQ"] = If[KeyExistsQ[row, "wrTu2sq"] &&
    NumericQ[row["wrTu2sq"][[rowIndex]]], row["wrTu2sq"][[rowIndex]], 0.0];
utils["Agent1"] =
 If[KeyExistsQ[row, "ISOShNm1"], row["ISOShNm1"][[rowIndex]], "Unknown"];
utils["Agent2"] =
 If[KeyExistsQ[row, "ISOShNm2"], row["ISOShNm2"][[rowIndex]], "Unknown"];
```

```
(*Additional information*)
utils["groundtruth"] = data["groundtruth"][[rowIndex]];
utils["ccode1"] = If[KeyExistsQ[row, "ccode1"] &&
    NumericQ[row["ccode1"][[rowIndex]]], row["ccode1"][[rowIndex]], 0];
utils["ccode2"] = If[KeyExistsQ[row, "ccode2"] &&
    NumericQ[row["ccode2"][[rowIndex]]], row["ccode2"][[rowIndex]], 0];
utils["year"] = If[KeyExistsQ[row, "year"] && NumericQ[row["year"][[rowIndex]]],
  row["year"][[rowIndex]], 0];
utils]
```

extractPredictionsAndGroundtruth

In[41]:=
```
extractPredictionsAndGroundtruth[results_] :=
 Module[{predictions, groundTruth, outcomes},
  outcomes = {"ACQ1", "ACQ2", "CAP1", "CAP2", "NEGO", "SQ", "WAR1"};
  predictions =
   Table[
    Module[{outcomeProbs, maxVal, maxOutcome},
     outcomeProbs =
      Association[
       "ACQ1" → If[KeyExistsQ[results[[i]], "ACQ1"] &&
          NumericQ[results[[i]]["ACQ1"]], results[[i]]["ACQ1"], 0],
       "ACQ2" → If[KeyExistsQ[results[[i]], "ACQ2"] &&
          NumericQ[results[[i]]["ACQ2"]], results[[i]]["ACQ2"], 0],
       "CAP1" → If[KeyExistsQ[results[[i]], "CAP1"] &&
          NumericQ[results[[i]]["CAP1"]], results[[i]]["CAP1"], 0],
       "CAP2" → If[KeyExistsQ[results[[i]], "CAP2"] &&
          NumericQ[results[[i]]["CAP2"]], results[[i]]["CAP2"], 0],
       "NEGO" → If[KeyExistsQ[results[[i]], "NEGO"] &&
          NumericQ[results[[i]]["NEGO"]], results[[i]]["NEGO"], 0],
       "SQ" → If[KeyExistsQ[results[[i]], "SQ"] &&
          NumericQ[results[[i]]["SQ"]], results[[i]]["SQ"], 0],
       "WAR1" → If[KeyExistsQ[results[[i]], "WAR1"] &&
          NumericQ[results[[i]]["WAR1"]], results[[i]]["WAR1"], 0]
       ];

     (*Find outcome with maximum probability*)
     maxVal = Max[Values[outcomeProbs]];
     maxOutcome = First[Keys[Select[outcomeProbs, # == maxVal &]]];
     maxOutcome], {i, Length[results]}];

  groundTruth = Table[If[KeyExistsQ[results[[i]], "groundtruth"],
     results[[i]]["groundtruth"], "UNKNOWN"], {i, Length[results]}];
  Association[
   "predictions" → predictions,
   "groundtruth" → groundTruth]]
```

Optimization Functions

In[42]:=
```
(*Grid Search Function for Optimal Theta Parameters*)
gridSearchQuantumThetas[data_, theta1Range_List,
  theta2Range_List, l1_ : 1, l2_ : 1, verbose_ : True] :=
 Module[{results, bestAccuracy, bestTheta1, bestTheta2, totalCombinations,
   currentCombination, startTime, gridResults, theta1Values, theta2Values},
  (*Input validation*)If[data === $Failed || ! KeyExistsQ[data, "nrows"],
   Print["Error: Invalid data provided"];
   Return[$Failed]];
  (*Extract theta values from ranges*)theta1Values = theta1Range;
  theta2Values = theta2Range;
```

```
totalCombinations = Length[theta1Values] * Length[theta2Values];
currentCombination = 0;
bestAccuracy = 0;
bestTheta1 = First[theta1Values];
bestTheta2 = First[theta2Values];
If[verbose, Print["Starting grid search over ",
  totalCombinations, " parameter combinations..."];
 Print["Theta1 range: ", theta1Values];
 Print["Theta2 range: ", theta2Values];
 Print["Lambda1 = ", l1, ", Lambda2 = ", l2];
 Print["Dataset size: ", data["nrows"], " rows"];
 Print[""];];
startTime = AbsoluteTime[];
gridResults = {};
(*Grid search loop*)
Do[Module[{currentResults, currentAccuracy, elapsedTime,
   estimatedTotal, estimatedRemaining}, currentCombination++;
  If[verbose &&
    Mod[currentCombination, Max[1, Floor[totalCombinations / 20]]] == 0,
   elapsedTime = AbsoluteTime[] - startTime;
   estimatedTotal = elapsedTime * totalCombinations / currentCombination;
   estimatedRemaining = estimatedTotal - elapsedTime;
   Print["Progress: ", currentCombination, "/", totalCombinations,
    " (", N[100 * currentCombination / totalCombinations, 3], "%)"];
   Print["Elapsed: ", N[elapsedTime / 60, 2],
    " min, Estimated remaining: ", N[estimatedRemaining / 60, 2], " min"];
   Print["Current best: θ1=", bestTheta1,
    ", θ2=", bestTheta2, ", Accuracy=", N[bestAccuracy, 4]];
   Print[""];];
  (*Calculate results for current theta combination*)currentResults =
   Quiet[processQuantumDataset[data, theta1, theta2, l1, l2]];
  If[Length[currentResults] > 0,
   currentAccuracy = calculateQuantumAccuracy[currentResults];
   (*Store result*)AppendTo[gridResults, Association["theta1" → theta1,
     "theta2" → theta2, "accuracy" → currentAccuracy, "l1" → l1, "l2" → l2]];
   (*Update best parameters if current is better*)
   If[currentAccuracy > bestAccuracy, bestAccuracy = currentAccuracy;
    bestTheta1 = theta1;
    bestTheta2 = theta2;
    If[verbose,
     Print["New best found: θ1=", theta1, ", θ2=", theta2, ", Accuracy=",
      N[currentAccuracy, 4]];];];, (*Handle failed calculation*)
   If[verbose, Print["Warning: Failed to calculate results for θ1=",
     theta1, ", θ2=", theta2];];
   AppendTo[gridResults, Association["theta1" → theta1, "theta2" → theta2,
     "accuracy" → 0, "l1" → l1, "l2" → l2, "failed" → True]];];],
 {theta1, theta1Values}, {theta2, theta2Values}];
```

```
  If[verbose, Print["Grid search completed!"];
   Print["Total time: ", N[(AbsoluteTime[] - startTime) / 60, 2], " minutes"];
   Print["Best parameters found:"];
   Print["  θ1 = ", bestTheta1];
   Print["  θ2 = ", bestTheta2];
   Print["  Accuracy = ", N[bestAccuracy, 4]];
   Print[""];];
  (*Return comprehensive results*)
  Association["bestTheta1" → bestTheta1, "bestTheta2" → bestTheta2,
   "bestAccuracy" → bestAccuracy, "allResults" → gridResults,
   "totalCombinations" → totalCombinations, "l1" → l1, "l2" → l2]]

(*Helper function to create parameter ranges*)
createThetaRange[min_, max_, steps_] :=
 If[steps == 1, {min}, Range[min, max, (max - min) / (steps - 1)]]

(*Function to visualize grid search results*)
visualizeGridSearchResults[gridSearchResults_] :=
 Module[{validResults, heatmapData, theta1Values,
   theta2Values, accuracyMatrix, minAcc, maxAcc, tickLabels1,
   tickLabels2, theta1Ticks, theta2Ticks, bestIndex, plot},
  (*Check if this is a proper grid search result structure*)
  If[! AssociationQ[gridSearchResults] ||
    ! KeyExistsQ[gridSearchResults, "allResults"], Print["Error: Input must
      be a grid search results Association with 'allResults' key"];
   Print[
    "Use gridSearchQuantumThetas[] to generate proper grid search results"];
   Return[Null];];
  validResults =
   Select[gridSearchResults["allResults"], ! KeyExistsQ[#, "failed"] &];
  If[Length[validResults] == 0, Print["No valid results to visualize"];
   Return[Null];];
  theta1Values = Sort[DeleteDuplicates[#["theta1"] & /@ validResults]];
  theta2Values = Sort[DeleteDuplicates[#["theta2"] & /@ validResults]];
  (*Create accuracy matrix for heatmap*)
  accuracyMatrix = Table[Module[{matchingResult}, matchingResult =
      SelectFirst[validResults, #["theta1"] == theta1 && #["theta2"] == theta2 &];
     If[matchingResult === Missing["NotFound"], 0, matchingResult[
       "accuracy"]]], {theta1, theta1Values}, {theta2, theta2Values}];
  (*Calculate min/max for better color scaling*)
  minAcc = Min[Flatten[accuracyMatrix]];
  maxAcc = Max[Flatten[accuracyMatrix]];
  (*Create proper tick labels*)tickLabels1 = Table[
    {i, NumberForm[N[theta1Values[[i]], 3], {4, 3}]}, {i, Length[theta1Values]}];
  tickLabels2 = Table[
    {i, NumberForm[N[theta2Values[[i]], 3], {4, 3}]}, {i, Length[theta2Values]}];
  (*Find position of best result for highlighting*)
```

```
bestIndex = Position[accuracyMatrix, maxAcc];
Print[Style["Grid Search Results Visualization", 16, Bold]];
Print[Style[StringJoin["Parameter Space: ",
   ToString[Length[theta1Values]], " × ", ToString[Length[theta2Values]],
   " = ", ToString[Length[validResults]], " combinations"], 14]];
Print[Style[StringJoin["Best Parameters: θ₁ = ", ToString[
    NumberForm[N[gridSearchResults["bestTheta1"], 4], {5, 4}]], ", θ₂ = ",
   ToString[NumberForm[N[gridSearchResults["bestTheta2"], 4], {5, 4}]],
   " → Accuracy = ", ToString[
    NumberForm[N[gridSearchResults["bestAccuracy"], 4], {5, 4}]], " (",
   ToString[NumberForm[100 * N[gridSearchResults["bestAccuracy"]], {5, 2}]],
   "%)"], 14, RGBColor[0.1, 0.5, 0.1]]];
Print[Style[
  StringJoin["Accuracy Range: ", ToString[NumberForm[N[minAcc], {4, 3}]],
   " - ", ToString[NumberForm[N[maxAcc], {4, 3}]]], 12, Gray]];
Print[""];
(*Create improved heatmap*)
plot = ArrayPlot[Transpose[accuracyMatrix], (*Professional color scheme*)
  ColorFunction → (Blend[{RGBColor[0.2, 0.2, 0.4], (*Dark blue for low
        values*)RGBColor[0.3, 0.6, 0.8], (*Medium blue*)RGBColor[0.9,
        0.9, 0.3], (*Yellow for medium values*)RGBColor[0.9, 0.6, 0.1],
       (*Orange*)RGBColor[0.8, 0.2, 0.2]  (*Red for high values*)}, #] &),
  ColorFunctionScaling → True, (*Proper labels and ticks*)
  PlotLabel → Style["Parameter Optimization Heatmap", 16, Bold],
  FrameLabel → {Style["θ₁ (Player 1 Quantum Phase)", 14, Bold],
    Style["θ₂ (Player 2 Quantum Phase)", 14, Bold]},
  (*Custom ticks with actual parameter values*)
  FrameTicks → {{tickLabels2, None}, (*Bottom ticks for theta2*)
    {tickLabels1, None}  (*Left ticks for theta1*)},
  (*Plot options*)AspectRatio → Automatic, ImageSize → {500, 400},
  Frame → True, FrameStyle → Black, PlotRangePadding → None,
  (*Color bar legend*)PlotLegends → Placed[BarLegend[
     {Blend[{RGBColor[0.2, 0.2, 0.4], RGBColor[0.3, 0.6, 0.8], RGBColor[0.9,
          0.9, 0.3], RGBColor[0.9, 0.6, 0.1], RGBColor[0.8, 0.2, 0.2]}, #] &,
      {minAcc, maxAcc}}, LegendLabel → Style["Accuracy", 12, Bold],
     LegendMarkerSize → 200], Right]];
(*Add text annotations for best points if there are few enough points*)
If[Length[validResults] ≤ 25,
 plot = Show[plot, Graphics[{White, EdgeForm[{Thick, Black}],
     Table[Module[{acc, pos1, pos2}, acc = accuracyMatrix[[i, j]];
       pos1 = j; pos2 = i;
       If[acc == maxAcc, {Red, EdgeForm[{Thick, Red}], Rectangle[{pos1 - 0.4,
            pos2 - 0.4}, {pos1 + 0.4, pos2 + 0.4}]}, If[acc > 0.8 * maxAcc,
         Text[Style[NumberForm[acc, {3, 3}], 10, Bold, White], {pos1, pos2}],
         Text[Style[NumberForm[acc, {3, 3}], 9, Black], {pos1, pos2}]]]],
      {i, Length[theta1Values]}, {j, Length[theta2Values]}]}]]];
(*Display summary statistics*)
```

```
  Print[Style["Summary Statistics:", 14, Bold]];
  Print["• Mean Accuracy: ",
   NumberForm[Mean[Flatten[accuracyMatrix]], {4, 3}]];
  Print["• Standard Deviation: ",
   NumberForm[StandardDeviation[Flatten[accuracyMatrix]], {4, 3}]];
  Print["• Improvement over Random: ",
   NumberForm[100 * (maxAcc - 1 / 7), {4, 2}], "% points"];
  plot]

(*Function to get top N parameter combinations*)
getTopParameterCombinations[gridSearchResults_, n_ : 5] :=
 Module[{validResults, sortedResults}, validResults =
   Select[gridSearchResults["allResults"], ! KeyExistsQ[#, "failed"] &];
  sortedResults = Reverse[SortBy[validResults, #["accuracy"] &]];
  Take[sortedResults, Min[n, Length[sortedResults]]]]

(*For a focused search around your current parameters:*)
focusedSearchAroundCurrent[data_, currentTheta1_, currentTheta2_,
  rangeSize_ : 1.0, gridSize_ : 5] := Module[{theta1Range, theta2Range, results},
  Print["Running focused search around θ1=",
   currentTheta1, ", θ2=", currentTheta2];
  theta1Range = createThetaRange[
    currentTheta1 - rangeSize, currentTheta1 + rangeSize, gridSize];
  theta2Range = createThetaRange[
    currentTheta2 - rangeSize, currentTheta2 + rangeSize, gridSize];
  Print["θ1 range: ", theta1Range];
  Print["θ2 range: ", theta2Range];
  results =
   gridSearchQuantumThetas[data, theta1Range, theta2Range, 1, 1, True];
  Print["Focused search completed. Visualizing results..."];
  visualizeGridSearchResults[results];
  results]

(*Simple function to analyze current results *)
analyzeCurrentResults[quantumResults_List] :=
 Module[{accuracy, sampleResult, theta1Val, theta2Val, predTruth},
  If[Length[quantumResults] == 0, Print["No results to analyze"];
   Return[$Failed];];
  (*Get sample result to extract theta values*)
  sampleResult = First[quantumResults];
  theta1Val = sampleResult["theta1"];
  theta2Val = sampleResult["theta2"];
  (*Calculate accuracy*)accuracy = calculateQuantumAccuracy[quantumResults];
  (*Get predictions and ground truth*)
  predTruth = extractPredictionsAndGroundtruth[quantumResults];
  Print["=== Quantum Model Analysis ==="];
  Print["Parameters: θ1 = ", N[theta1Val, 4], " (", theta1Val, ")"];
```

```
  Print["           θ2 = ", N[theta2Val, 4], " (", theta2Val, ")"];
  Print["Total cases: ", Length[quantumResults]];
  Print["Accuracy: ", N[accuracy, 4], " (", N[100 * accuracy, 2], "%)"];
  Print[""];
  (*Show outcome distribution*)Module[{outcomes, counts},
   outcomes = {"SQ", "ACQ1", "ACQ2", "NEGO", "CAP1", "CAP2", "WAR1", "WAR2"};
   counts =
    Table[Count[predTruth["predictions"], outcome], {outcome, outcomes}];
   Print["Prediction distribution:"];
   Do[If[counts[[i]] > 0, Print["  ", outcomes[[i]], ": ", counts[[i]],
      " (", N[100 * counts[[i]] / Length[predTruth["predictions"]], 1],
      "%)"]], {i, Length[outcomes]}];];
  Print[""];
  (*Show confusion matrix*)plotQuantumConfusionMatrix[quantumResults,
   theta1Val, theta2Val, 1, 1, "Current Quantum Model Results"];
  Association["accuracy" → accuracy, "theta1" → theta1Val,
   "theta2" → theta2Val, "totalCases" → Length[quantumResults],
   "predictions" → predTruth["predictions"],
   "groundTruth" → predTruth["groundtruth"]]]
```

Experiments

Balanced Dataset

Setting 1: Lamda1 = 1 | Lambda2 = 1

In[48]:=
```
datasetPath =
 "/Users/162191/Documents/GitHub/quantum_international_interaction_game/
   dataset/balanced_data.csv"
(* "D:\\home\\Documents\\Github\\quantum_international_interaction_game\\
   dataset\\balanced_data.csv"; *)
data = loadData[datasetPath];
```

Out[48]=
```
/Users/162191/Documents/GitHub/quantum_international_interaction_game/dataset/
  balanced_data.csv

Loading CSV file:
 /Users/162191/Documents/GitHub/quantum_international_interaction_game/dataset/
   balanced_data.csv

Loaded 579 rows with 149 columns
```

In[50]:=
```
gridsize = 8;
l1 = 1;
l2 = 1;
theta1Range = createThetaRange[0, 2 * Pi, gridsize];
theta2Range = createThetaRange[0, 2 * Pi, gridsize];
```

In[55]:=
```
gridResults = gridSearchQuantumThetas[data, theta1Range, theta2Range, l1, l2];
Print["Best parameters: θ1=",
  gridResults["bestTheta1"], ", θ2=", gridResults["bestTheta2"]];
Print["Best accuracy: ", gridResults["bestAccuracy"]];
```

```
Starting grid search over 64 parameter combinations...
```

Theta1 range: $\left\{0, \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, 2\pi\right\}$

Theta2 range: $\left\{0, \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, 2\pi\right\}$

```
Lambda1 = 1, Lambda2 = 1
Dataset size: 579 rows


Processing 579 rows with quantum model...
Parameters: θ1=0, θ2=0, λ1=1, λ2=1
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
New best found: θ1=0, θ2=0, Accuracy=0.174439
Processing 579 rows with quantum model...
```

Parameters: $\theta 1=0, \theta 2=\frac{2\pi}{7}, \lambda 1=1, \lambda 2=1$

```
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
```

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.184801

Progress: 3/64 (4.69%)

Elapsed: 0.79 min, Estimated remaining: 16. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.184801

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 6/64 (9.38%)

Elapsed: 2.1 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.184801

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=2\pi$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 9/64 (14.1%)

Elapsed: 3.5 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.184801

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=0$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 12/64 (18.8%)

Elapsed: 4.9 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.184801

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 15/64 (23.4%)

Elapsed: 6.4 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.184801

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.205527

Progress: 18/64 (28.1%)

Elapsed: 7.7 min, Estimated remaining: 20. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.205527

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 21/64 (32.8%)

Elapsed: 9.2 min, Estimated remaining: 19. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.205527

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.207254

Progress: 24/64 (37.5%)

Elapsed: 11. min, Estimated remaining: 18. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=0$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 27/64 (42.2%)

Elapsed: 12. min, Estimated remaining: 17. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 30/64 (46.9%)

Elapsed: 14. min, Estimated remaining: 15. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 33/64 (51.6%)

Elapsed: 15. min, Estimated remaining: 14. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=0$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 36/64 (56.3%)

Elapsed: 16. min, Estimated remaining: 13. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 39/64 (60.9%)

Elapsed: 18. min, Estimated remaining: 12. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=0$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 42/64 (65.6%)

Elapsed: 19. min, Estimated remaining: 10. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{6\,\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 45/64 (70.3%)

Elapsed: 21. min, Estimated remaining: 8.8 min

Current best: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{4\,\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{8\,\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{10\,\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 48/64 (75.0%)

Elapsed: 22. min, Estimated remaining: 7.5 min

Current best: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{4\,\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=2\,\pi$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=0$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{2\,\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 51/64 (79.7%)

Elapsed: 24. min, Estimated remaining: 6.1 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 54/64 (84.4%)

Elapsed: 25. min, Estimated remaining: 4.7 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=2\,\pi$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 57/64 (89.1%)

Elapsed: 27. min, Estimated remaining: 3.3 min

Current best: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{4\,\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\,\pi$, $\theta 2=0$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 60/64 (93.8%)

Elapsed: 28. min, Estimated remaining: 1.9 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1 = 2\pi$, $\theta 2 = \frac{8\pi}{7}$, $\lambda 1 = 1$, $\lambda 2 = 1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1 = 2\pi$, $\theta 2 = \frac{10\pi}{7}$, $\lambda 1 = 1$, $\lambda 2 = 1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 63/64 (98.4%)

Elapsed: 30. min, Estimated remaining: 0.47 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=2\pi$, $\lambda 1=1$, $\lambda 2=1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Grid search completed!

Total time: 31. minutes

Best parameters found:

$$\theta 1 = \frac{6\pi}{7}$$

$$\theta 2 = \frac{4\pi}{7}$$

Accuracy = 0.214162

Best parameters: $\theta 1 = \frac{6\pi}{7}$, $\theta 2 = \frac{4\pi}{7}$

Best accuracy: 0.214162

In[58]:=
```
analyzeCurrentResults[gridResults]
```

Out[58]=

```
analyzeCurrentResults[
 ⟨| bestTheta1 → 6 π/7, bestTheta2 → 4 π/7, bestAccuracy → 0.214162,
  allResults → {
    ‹| theta1 → 0, theta2 → 0, accuracy → 0.174439, l1 → 1, l2 → 1 |›,
    ⟨| theta1 → 0, theta2 → 2 π/7, accuracy → 0.184801, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 0, theta2 → 4 π/7, accuracy → 0.160622, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 0, theta2 → 6 π/7, accuracy → 0.170984, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 0, theta2 → 8 π/7, accuracy → 0.170984, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 0, theta2 → 10 π/7, accuracy → 0.160622, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 0, theta2 → 12 π/7, accuracy → 0.184801, l1 → 1, l2 → 1 |⟩,
    ‹| theta1 → 0, theta2 → 2 π, accuracy → 0.174439, l1 → 1, l2 → 1 |›,
    ⟨| theta1 → 2 π/7, theta2 → 0, accuracy → 0.17962, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 2 π/7, theta2 → 2 π/7, accuracy → 0.15544, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 2 π/7, theta2 → 4 π/7, accuracy → 0.17962, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 2 π/7, theta2 → 6 π/7, accuracy → 0.162349, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 2 π/7, theta2 → 8 π/7, accuracy → 0.139896, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 2 π/7, theta2 → 10 π/7, accuracy → 0.151986, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 2 π/7, theta2 → 12 π/7, accuracy → 0.177893, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 2 π/7, theta2 → 2 π, accuracy → 0.17962, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 4 π/7, theta2 → 0, accuracy → 0.205527, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 4 π/7, theta2 → 2 π/7, accuracy → 0.158895, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 4 π/7, theta2 → 4 π/7, accuracy → 0.160622, l1 → 1, l2 → 1 |⟩,
    ⟨| theta1 → 4 π/7, theta2 → 6 π/7, accuracy → 0.141623, l1 → 1, l2 → 1 |⟩,
```

$$\left\langle\left| \text{theta1} \to \frac{4\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.146805, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{4\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.151986, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{4\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.207254, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{4\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.205527, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.160622, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.143351, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.214162, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.146805, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.143351, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.200345, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.200345, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.160622, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.160622, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.200345, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.200345, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.143351, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.146805, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.214162, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.143351, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.160622, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.205527, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.207254, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.151986, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.146805, \text{l1} \to 1, \text{l2} \to 1 \right|\right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.141623, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.160622, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.158895, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.205527, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.17962, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.177893, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.151986, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.139896, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.162349, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.17962, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.15544, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.17962, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\langle| \text{theta1} \to 2\,\pi, \text{theta2} \to 0, \text{accuracy} \to 0.174439, \text{l1} \to 1, \text{l2} \to 1 |\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.184801, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.160622, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.170984, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.170984, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.160622, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.184801, \text{l1} \to 1, \text{l2} \to 1 \right| \right\rangle,$$

$$\langle| \text{theta1} \to 2\,\pi, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.174439, \text{l1} \to 1, \text{l2} \to 1 |\rangle \Big\},$$

$$\text{totalCombinations} \to 64, \text{l1} \to 1, \text{l2} \to 1 \left| \right\rangle \Big]$$

In[59]:=
```
visualizeGridSearchResults[gridResults]
```

Grid Search Results Visualization

Parameter Space: 8 × 8 = 64 combinations

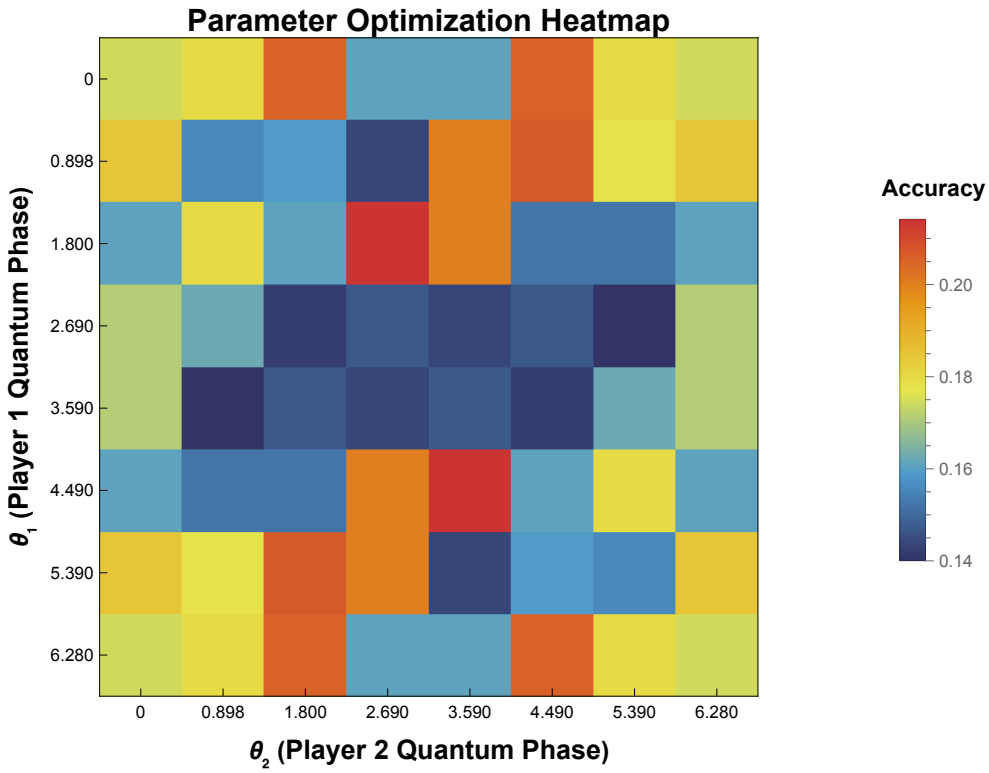
Best Parameters: $\Theta_1 = 2.6930$, $\Theta_2 = 1.7950$ → Accuracy = 0.2142 (21.42%)

Accuracy Range: 0.140 – 0.214

Summary Statistics:

- Mean Accuracy: 0.170
- Standard Deviation: 0.021
- Improvement over Random: 7.13% points

Out[59]=



In[60]:=
```
l1 = 1;
l2 = 1;
theta1 = N[gridResults["bestTheta1"]];
theta2 = N[gridResults["bestTheta2"]];
```

In[64]:=
```
results = processQuantumDataset[data, theta1, theta2, l1, l2];
```

```
Processing 579 rows with quantum model...
Parameters: θ1=2.69279, θ2=1.7952, λ1=1, λ2=1
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
```

In[65]:=
```
getFirstNEntries[results, 3]
```

```
Returning first 3 entries out of 579 total entries with extracted components.
```

Out[65]=
```
{ ⟨| SQ → 0.2588, ACQ1 → 0.0831, ACQ2 → 0.0406, NEGO → 0.0188, CAP1 → 0.1083,
    CAP2 → 0.0633, WAR1 → 0.2335, WAR2 → 0.1935, prediction → SQ,
    groundtruth → SQ, Agent1 → ESTONIA, Agent2 → UNITED KINGDOM |⟩ ,
  ⟨| SQ → 0.0416, ACQ1 → 0.0066, ACQ2 → 0.395, NEGO → 0.044, CAP1 → 0.0342,
    CAP2 → 0.1183, WAR1 → 0.1283, WAR2 → 0.232, prediction → ACQ2,
    groundtruth → SQ, Agent1 → FRANCE, Agent2 → CHILE |⟩ ,
  ⟨| SQ → 0.4087, ACQ1 → 0.0728, ACQ2 → 0.0789, NEGO → 0.1262, CAP1 → 0.0068,
    CAP2 → 0.0279, WAR1 → 0.2706, WAR2 → 0.0081, prediction → SQ,
    groundtruth → SQ, Agent1 → ARGENTINA, Agent2 → FRANCE |⟩ }
```

In[66]:=
```
accuracy = calculateQuantumAccuracy[results];
Print["Final Accuracy: ", N[accuracy]];
```

```
Final Accuracy: 0.214162
```

In[68]:=
```
plotQuantumConfusionMatrix[results, theta1, theta2,
 l1, l2, "Quantum-Like Signorino Model Confusion Matrix"]
```

Quantum-Like Signorino Model Confusion Matrix

$\theta 1 = 2.69279$ $\theta 2 = 1.7952$ $\lambda 1 = 1$ $\lambda 2 = 1$ | Accuracy = 0.214162

Out[68]=

Actual \ Predicted	ACQ1	ACQ2	CAP1	CAP2	NEGO	SQ	WAR1
ACQ1	0	2	2	0	0	0	2
ACQ2	0	52	2	0	0	24	21
CAP1	0	18	6	0	0	12	20
CAP2	0	45	3	0	0	27	24
NEGO	0	26	7	0	0	39	27
SQ	0	27	4	0	0	41	27
WAR1	0	38	4	0	0	32	25

Setting 2: Lambda1 = 0.5 | Lambda2 = 0.5

In[69]:=
```
datasetPath =
 "/Users/162191/Documents/GitHub/quantum_international_interaction_game/
    dataset/balanced_data.csv"
(* "D:\\home\\Documents\\Github\\quantum_international_interaction_game\\
    dataset\\balanced_data.csv"; *)
data = loadData[datasetPath];
```

Out[69]=

/Users/162191/Documents/GitHub/quantum_international_interaction_game/dataset/balanced_data.csv

Loading CSV file:
/Users/162191/Documents/GitHub/quantum_international_interaction_game/dataset/balanced_data.csv

Loaded 579 rows with 149 columns

In[71]:=
```
gridsize = 8;
l1 = 0.5;
l2 = 0.5;
theta1Range = createThetaRange[0, 2 * Pi, gridsize];
theta2Range = createThetaRange[0, 2 * Pi, gridsize];
```

In[76]:=
```
gridResults = gridSearchQuantumThetas[data, theta1Range, theta2Range, l1, l2];
Print["Best parameters: θ1=",
  gridResults["bestTheta1"], ", θ2=", gridResults["bestTheta2"]];
Print["Best accuracy: ", gridResults["bestAccuracy"]];
```

Starting grid search over 64 parameter combinations...

Theta1 range: $\left\{0, \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, 2\pi\right\}$

Theta2 range: $\left\{0, \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, 2\pi\right\}$

Lambda1 = 0.5, Lambda2 = 0.5

Dataset size: 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=0$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=0$, $\theta 2=0$, Accuracy=0.17962

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.183074

Progress: 3/64 (4.69%)

Elapsed: 0.81 min, Estimated remaining: 16. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.183074

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 6/64 (9.38%)

Elapsed: 2.2 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.183074

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=2\pi$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 9/64 (14.1%)

Elapsed: 3.5 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.183074

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=0$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 12/64 (18.8%)

Elapsed: 4.9 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.183074

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 15/64 (23.4%)

Elapsed: 6.5 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.183074

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.200345

Progress: 18/64 (28.1%)

Elapsed: 7.9 min, Estimated remaining: 20. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 21/64 (32.8%)

Elapsed: 9.4 min, Estimated remaining: 19. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 24/64 (37.5%)

Elapsed: 11. min, Estimated remaining: 18. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=0$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 27/64 (42.2%)

Elapsed: 12. min, Estimated remaining: 17. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 30/64 (46.9%)

Elapsed: 14. min, Estimated remaining: 16. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 33/64 (51.6%)

Elapsed: 15. min, Estimated remaining: 14. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=0$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 36/64 (56.3%)

Elapsed: 17. min, Estimated remaining: 13. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 39/64 (60.9%)

Elapsed: 18. min, Estimated remaining: 12. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=0$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 42/64 (65.6%)

Elapsed: 20. min, Estimated remaining: 10. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{6\,\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 45/64 (70.3%)

Elapsed: 21. min, Estimated remaining: 8.9 min

Current best: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{8\,\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{10\,\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 48/64 (75.0%)

Elapsed: 23. min, Estimated remaining: 7.6 min

Current best: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=2\,\pi$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=0$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{2\,\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 51/64 (79.7%)

Elapsed: 24. min, Estimated remaining: 6.2 min

Current best: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{4\,\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{6\,\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{8\,\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 54/64 (84.4%)

Elapsed: 26. min, Estimated remaining: 4.8 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 57/64 (89.1%)

Elapsed: 27. min, Estimated remaining: 3.4 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=0$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 60/64 (93.8%)

Elapsed: 29. min, Estimated remaining: 1.9 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 63/64 (98.4%)

Elapsed: 30. min, Estimated remaining: 0.48 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.229706

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.5$, $\lambda 2=0.5$

Processing row 50/579

Processing row 100/579

Processing row 150/579

```
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Processing 579 rows with quantum model...
Parameters: θ1=2 π, θ2=2 π, λ1=0.5, λ2=0.5
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Grid search completed!
Total time: 31. minutes
Best parameters found:
```

$$\theta 1 = \frac{6\,\pi}{7}$$

$$\theta 2 = \frac{12\,\pi}{7}$$

```
Accuracy = 0.229706
```

Best parameters: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$

```
Best accuracy: 0.229706
```

In[79]:=
```
analyzeCurrentResults[gridResults]
```

Out[79]=

```
analyzeCurrentResults[
 ⟨|bestTheta1 → 6 π/7, bestTheta2 → 12 π/7, bestAccuracy → 0.229706,
  allResults → {<|theta1 → 0, theta2 → 0, accuracy → 0.17962, l1 → 0.5, l2 → 0.5|>,
```

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{2\pi}{7},\ \text{accuracy} \to 0.183074,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{4\pi}{7},\ \text{accuracy} \to 0.158895,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{6\pi}{7},\ \text{accuracy} \to 0.174439,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{8\pi}{7},\ \text{accuracy} \to 0.174439,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{10\pi}{7},\ \text{accuracy} \to 0.158895,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{12\pi}{7},\ \text{accuracy} \to 0.183074,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\langle | \text{theta1} \to 0,\ \text{theta2} \to 2\pi,\ \text{accuracy} \to 0.17962,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 | \rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.176166,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\pi}{7},\ \text{theta2} \to \frac{2\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\pi}{7},\ \text{theta2} \to \frac{4\pi}{7},\ \text{accuracy} \to 0.181347,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\pi}{7},\ \text{theta2} \to \frac{6\pi}{7},\ \text{accuracy} \to 0.174439,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\pi}{7},\ \text{theta2} \to \frac{8\pi}{7},\ \text{accuracy} \to 0.131261,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\pi}{7},\ \text{theta2} \to \frac{10\pi}{7},\ \text{accuracy} \to 0.162349,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\pi}{7},\ \text{theta2} \to \frac{12\pi}{7},\ \text{accuracy} \to 0.181347,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\pi}{7},\ \text{theta2} \to 2\pi,\ \text{accuracy} \to 0.176166,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.200345,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\pi}{7},\ \text{theta2} \to \frac{2\pi}{7},\ \text{accuracy} \to 0.157168,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\pi}{7},\ \text{theta2} \to \frac{4\pi}{7},\ \text{accuracy} \to 0.162349,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\pi}{7},\ \text{theta2} \to \frac{6\pi}{7},\ \text{accuracy} \to 0.170984,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\pi}{7},\ \text{theta2} \to \frac{8\pi}{7},\ \text{accuracy} \to 0.146805,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\pi}{7},\ \text{theta2} \to \frac{10\pi}{7},\ \text{accuracy} \to 0.17962,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\pi}{7},\ \text{theta2} \to \frac{12\pi}{7},\ \text{accuracy} \to 0.200345,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\pi}{7},\ \text{theta2} \to 2\pi,\ \text{accuracy} \to 0.200345,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.162349,\ \text{l1} \to 0.5,\ \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\pi}{7}, \text{theta2} \to \frac{2\pi}{7}, \text{accuracy} \to 0.151986, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\pi}{7}, \text{theta2} \to \frac{4\pi}{7}, \text{accuracy} \to 0.207254, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\pi}{7}, \text{theta2} \to \frac{6\pi}{7}, \text{accuracy} \to 0.148532, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\pi}{7}, \text{theta2} \to \frac{8\pi}{7}, \text{accuracy} \to 0.139896, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\pi}{7}, \text{theta2} \to \frac{10\pi}{7}, \text{accuracy} \to 0.205527, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\pi}{7}, \text{theta2} \to \frac{12\pi}{7}, \text{accuracy} \to 0.229706, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\pi}{7}, \text{theta2} \to 2\pi, \text{accuracy} \to 0.162349, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.162349, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\pi}{7}, \text{theta2} \to \frac{2\pi}{7}, \text{accuracy} \to 0.229706, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\pi}{7}, \text{theta2} \to \frac{4\pi}{7}, \text{accuracy} \to 0.205527, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\pi}{7}, \text{theta2} \to \frac{6\pi}{7}, \text{accuracy} \to 0.139896, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\pi}{7}, \text{theta2} \to \frac{8\pi}{7}, \text{accuracy} \to 0.148532, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\pi}{7}, \text{theta2} \to \frac{10\pi}{7}, \text{accuracy} \to 0.207254, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\pi}{7}, \text{theta2} \to \frac{12\pi}{7}, \text{accuracy} \to 0.151986, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\pi}{7}, \text{theta2} \to 2\pi, \text{accuracy} \to 0.162349, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.200345, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\pi}{7}, \text{theta2} \to \frac{2\pi}{7}, \text{accuracy} \to 0.200345, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\pi}{7}, \text{theta2} \to \frac{4\pi}{7}, \text{accuracy} \to 0.17962, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\pi}{7}, \text{theta2} \to \frac{6\pi}{7}, \text{accuracy} \to 0.146805, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\pi}{7}, \text{theta2} \to \frac{8\pi}{7}, \text{accuracy} \to 0.170984, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\pi}{7}, \text{theta2} \to \frac{10\pi}{7}, \text{accuracy} \to 0.162349, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\pi}{7}, \text{theta2} \to \frac{12\pi}{7}, \text{accuracy} \to 0.157168, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\pi}{7}, \text{theta2} \to 2\pi, \text{accuracy} \to 0.200345, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.176166, \text{l1} \to 0.5, \text{l2} \to 0.5 \right| \right\rangle,$$

```
    ⟨| theta1 → 12 π/7, theta2 → 2 π/7, accuracy → 0.181347, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 4 π/7, accuracy → 0.162349, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 6 π/7, accuracy → 0.131261, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 8 π/7, accuracy → 0.174439, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 10 π/7, accuracy → 0.181347, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 12 π/7, accuracy → 0.172712, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 2 π, accuracy → 0.176166, l1 → 0.5, l2 → 0.5 |⟩,
    ‹| theta1 → 2 π, theta2 → 0, accuracy → 0.17962, l1 → 0.5, l2 → 0.5 |›,
    ⟨| theta1 → 2 π, theta2 → 2 π/7, accuracy → 0.183074, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 2 π, theta2 → 4 π/7, accuracy → 0.158895, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 2 π, theta2 → 6 π/7, accuracy → 0.174439, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 2 π, theta2 → 8 π/7, accuracy → 0.174439, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 2 π, theta2 → 10 π/7, accuracy → 0.158895, l1 → 0.5, l2 → 0.5 |⟩,
    ⟨| theta1 → 2 π, theta2 → 12 π/7, accuracy → 0.183074, l1 → 0.5, l2 → 0.5 |⟩,
    ‹| theta1 → 2 π, theta2 → 2 π, accuracy → 0.17962, l1 → 0.5, l2 → 0.5 |›},
  totalCombinations → 64, l1 → 0.5, l2 → 0.5 |⟩]
```

In[80]:=
```
visualizeGridSearchResults[gridResults]
```

Grid Search Results Visualization

Parameter Space: 8 × 8 = 64 combinations

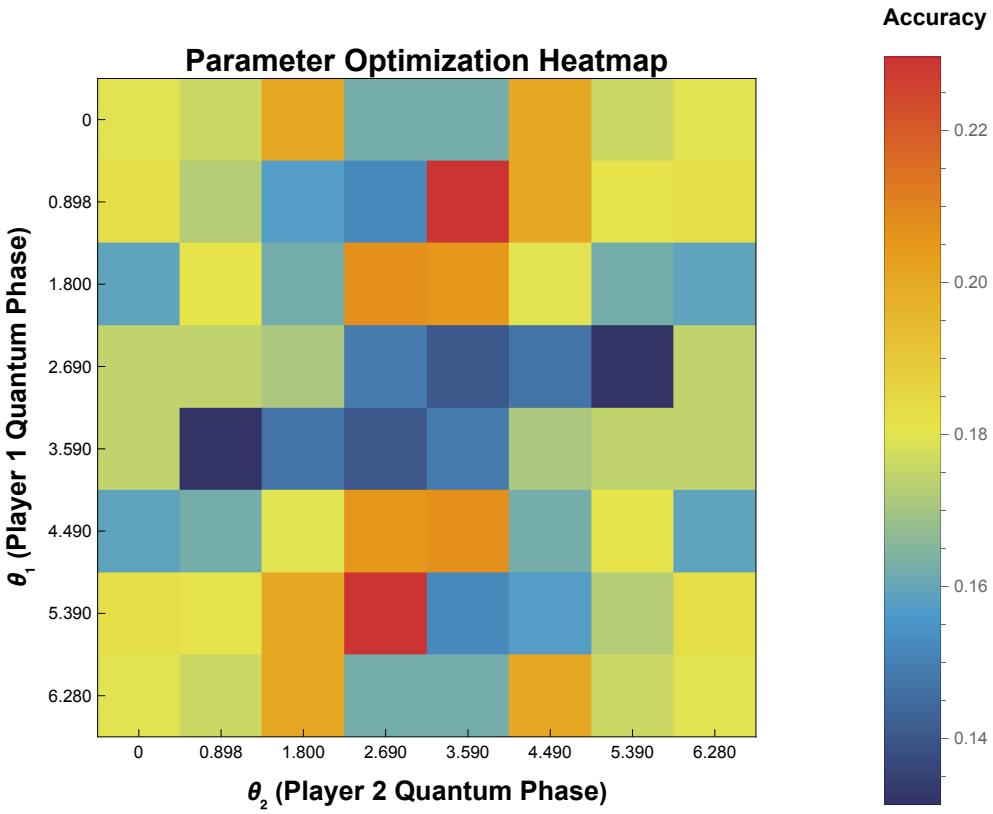
Best Parameters: Θ_1 = 2.6930, Θ_2 = 5.3860 → Accuracy = 0.2297 (22.97%)

Accuracy Range: 0.131 – 0.230

Summary Statistics:

- Mean Accuracy: 0.174
- Standard Deviation: 0.021
- Improvement over Random: 8.68% points

Out[80]=



In[81]:=
```
theta1 = N[gridResults["bestTheta1"]];
theta2 = N[gridResults["bestTheta2"]];
```

In[83]:=
```
results = processQuantumDataset[data, theta1, theta2, l1, l2];
```

```
Processing 579 rows with quantum model...
Parameters: θ1=2.69279, θ2=5.38559, λ1=0.5, λ2=0.5
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
```

In[84]:=
```
getFirstNEntries[results, 3]
```

```
Returning first 3 entries out of 579 total entries with extracted components.
```

Out[84]=
```
{ ⟨| SQ → 0.2657, ACQ1 → 0.066, ACQ2 → 0.1649, NEGO → 0.0247, CAP1 → 0.1121,
    CAP2 → 0.0742, WAR1 → 0.1426, WAR2 → 0.1498, prediction → SQ,
    groundtruth → SQ, Agent1 → ESTONIA, Agent2 → UNITED KINGDOM |⟩ ,
  ⟨| SQ → 0.0687, ACQ1 → 0.0445, ACQ2 → 0.1936, NEGO → 0.022, CAP1 → 0.1047,
    CAP2 → 0.144, WAR1 → 0.1499, WAR2 → 0.2726, prediction → WAR2,
    groundtruth → SQ, Agent1 → FRANCE, Agent2 → CHILE |⟩ ,
  ⟨| SQ → 0.4018, ACQ1 → 0.0844, ACQ2 → 0.1221, NEGO → 0.0388, CAP1 → 0.0825,
    CAP2 → 0.0439, WAR1 → 0.1369, WAR2 → 0.0897, prediction → SQ,
    groundtruth → SQ, Agent1 → ARGENTINA, Agent2 → FRANCE |⟩ }
```

In[85]:=
```
accuracy = calculateQuantumAccuracy[results];
Print["Final Accuracy: ", N[accuracy]];
```

```
Final Accuracy: 0.229706
```

In[87]:=
```
plotQuantumConfusionMatrix[results, theta1, theta2,
 l1, l2, "Quantum-Like Signorino Model Confusion Matrix"]
```

Quantum-Like Signorino Model Confusion Matrix

$\theta 1 = 2.69279$ $\theta 2 = 5.38559$ $\lambda 1 = 0.5$ $\lambda 2 = 0.5$ | Accuracy = 0.229706

Out[87]=

Actual \ Predicted	ACQ1	ACQ2	CAP1	CAP2	NEGO	SQ	WAR1
ACQ1	0	3	2	0	0	1	0
ACQ2	0	68	0	0	0	28	3
CAP1	0	32	6	0	0	16	2
CAP2	0	58	1	0	0	39	1
NEGO	0	36	7	0	0	52	4
SQ	0	41	3	0	0	53	2
WAR1	0	54	6	0	0	33	6

Setting 3: Lambda1 = 2 | Lambda2 = 2

In[88]:=
```
datasetPath =
  "/Users/162191/Documents/GitHub/quantum_international_interaction_game/
    dataset/balanced_data.csv";
(*"D:\\home\\Documents\\Github\\quantum_international_interaction_game\\
   dataset\\balanced_data.csv";*)
data = loadData[datasetPath];
```

```
Loading CSV file:
 /Users/162191/Documents/GitHub/quantum_international_interaction_game/dataset/
   balanced_data.csv
```

```
Loaded 579 rows with 149 columns
```

In[90]:=
```
gridsize = 8;
l1 = 2;
l2 = 2;
theta1Range = createThetaRange[0, 2 * Pi, gridsize];
theta2Range = createThetaRange[0, 2 * Pi, gridsize];
```

In[95]:=
```
gridResults = gridSearchQuantumThetas[data, theta1Range, theta2Range, l1, l2];
Print["Best parameters: θ1=",
  gridResults["bestTheta1"], ", θ2=", gridResults["bestTheta2"]];
Print["Best accuracy: ", gridResults["bestAccuracy"]];
```

```
Starting grid search over 64 parameter combinations...
```

Theta1 range: $\left\{0, \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, 2\pi\right\}$

Theta2 range: $\left\{0, \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, 2\pi\right\}$

```
Lambda1 = 2, Lambda2 = 2
```

```
Dataset size: 579 rows


Processing 579 rows with quantum model...
```

Parameters: $\theta 1=0$, $\theta 2=0$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=0$, $\theta 2=0$, Accuracy=0.176166

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 3/64 (4.69%)

Elapsed: 0.84 min, Estimated remaining: 17. min

Current best: $\theta 1=0$, $\theta 2=0$, Accuracy=0.176166

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 6/64 (9.38%)

Elapsed: 2.2 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=0$, Accuracy=0.176166

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{10\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{12\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=2\,\pi$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 9/64 (14.1%)

Elapsed: 3.6 min, Estimated remaining: 22. min

Current best: $\theta 1=0$, $\theta 2=0$, Accuracy=0.176166

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=0$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 12/64 (18.8%)

Elapsed: 5.0 min, Estimated remaining: 22. min

Current best: $\theta 1=0$, $\theta 2=0$, Accuracy=0.176166

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 15/64 (23.4%)

Elapsed: 6.6 min, Estimated remaining: 22. min

Current best: $\theta 1=0$, $\theta 2=0$, Accuracy=0.176166

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.177893

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Progress: 18/64 (28.1%)

Elapsed: 8.1 min, Estimated remaining: 21. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

```
Processing 579 rows with quantum model...
Parameters: θ1=4π/7, θ2=2π/7, λ1=2, λ2=2
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Processing 579 rows with quantum model...
Parameters: θ1=4π/7, θ2=4π/7, λ1=2, λ2=2
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Processing 579 rows with quantum model...
Parameters: θ1=4π/7, θ2=6π/7, λ1=2, λ2=2
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
```

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 21/64 (32.8%)

Elapsed: 9.6 min, Estimated remaining: 20. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 24/64 (37.5%)

Elapsed: 11. min, Estimated remaining: 19. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=0$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 27/64 (42.2%)

Elapsed: 13. min, Estimated remaining: 17. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 30/64 (46.9%)

Elapsed: 14. min, Estimated remaining: 16. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 33/64 (51.6%)

Elapsed: 16. min, Estimated remaining: 15. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=0$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 36/64 (56.3%)

Elapsed: 17. min, Estimated remaining: 13. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 39/64 (60.9%)

Elapsed: 19. min, Estimated remaining: 12. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=0$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 42/64 (65.6%)

Elapsed: 20. min, Estimated remaining: 10. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{2\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{4\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{6\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 45/64 (70.3%)

Elapsed: 21. min, Estimated remaining: 9.1 min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 48/64 (75.0%)

Elapsed: 23. min, Estimated remaining: 7.7 min

Current best: $\theta 1=\frac{4\,\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=2\,\pi$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=0$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{2\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 51/64 (79.7%)

Elapsed: 24. min, Estimated remaining: 6.2 min

Current best: $\theta 1=\frac{4\,\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{4\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{6\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{8\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 54/64 (84.4%)

Elapsed: 26. min, Estimated remaining: 4.8 min

Current best: $\theta 1=\frac{4\,\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{10\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=2\,\pi$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 57/64 (89.1%)

Elapsed: 28. min, Estimated remaining: 3.4 min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=0$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 60/64 (93.8%)

Elapsed: 29. min, Estimated remaining: 1.9 min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 63/64 (98.4%)

Elapsed: 30. min, Estimated remaining: 0.48 min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=2$, $\lambda 2=2$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

```
Successfully processed 579 out of 579 rows
Processing 579 rows with quantum model...
Parameters: θ1=2 π, θ2=2 π, λ1=2, λ2=2
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Grid search completed!
Total time: 31. minutes
Best parameters found:
  θ1 = 4 π/7
  θ2 = 0
  Accuracy = 0.207254

Best parameters: θ1=4 π/7, θ2=0
Best accuracy: 0.207254
```

In[98]:=
```
analyzeCurrentResults[gridResults]
```

Out[98]=

```
analyzeCurrentResults[
 ⟨|bestTheta1 → 4 π/7, bestTheta2 → 0, bestAccuracy → 0.207254,
  allResults → {⟨|theta1 → 0, theta2 → 0, accuracy → 0.176166, l1 → 2, l2 → 2|⟩,
    ⟨|theta1 → 0, theta2 → 2 π/7, accuracy → 0.150259, l1 → 2, l2 → 2|⟩,
    ⟨|theta1 → 0, theta2 → 4 π/7, accuracy → 0.157168, l1 → 2, l2 → 2|⟩,
    ⟨|theta1 → 0, theta2 → 6 π/7, accuracy → 0.169257, l1 → 2, l2 → 2|⟩,
    ⟨|theta1 → 0, theta2 → 8 π/7, accuracy → 0.169257, l1 → 2, l2 → 2|⟩,
    ⟨|theta1 → 0, theta2 → 10 π/7, accuracy → 0.157168, l1 → 2, l2 → 2|⟩,
```

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.150259,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\langle| \text{theta1} \to 0,\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.176166,\ \text{l1} \to 2,\ \text{l2} \to 2 |\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.172712,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.145078,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.157168,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.153713,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.143351,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.148532,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.177893,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.172712,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.207254,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.16753,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.158895,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.16753,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.146805,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.16753,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.176166,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.207254,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.169257,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.151986,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.2038,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.153713,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.132988,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.189983,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.202073,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.169257,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.169257,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.202073,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.189983,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.132988,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.153713,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.2038,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.151986,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.169257,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.207254,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.176166,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.16753,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.146805,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.16753,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.158895,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.16753,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.207254,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.172712,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.177893,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.148532,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.143351,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.153713,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.157168,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.145078,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.172712,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\langle | \text{theta1} \to 2\,\pi,\ \text{theta2} \to 0,\ \text{accuracy} \to 0.176166,\ \text{l1} \to 2,\ \text{l2} \to 2 | \rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi,\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.150259,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi,\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.157168,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi,\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.169257,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi,\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.169257,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi,\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.157168,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi,\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.150259,\ \text{l1} \to 2,\ \text{l2} \to 2 \right| \right\rangle,$$

$$\langle | \text{theta1} \to 2\,\pi,\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.176166,\ \text{l1} \to 2,\ \text{l2} \to 2 | \rangle \Big\},$$

$$\text{totalCombinations} \to 64,\ \text{l1} \to 2,\ \text{l2} \to 2 \left| \right\rangle \Big]$$

In[99]:=
```
visualizeGridSearchResults[gridResults]
```

Grid Search Results Visualization

Parameter Space: 8 × 8 = 64 combinations

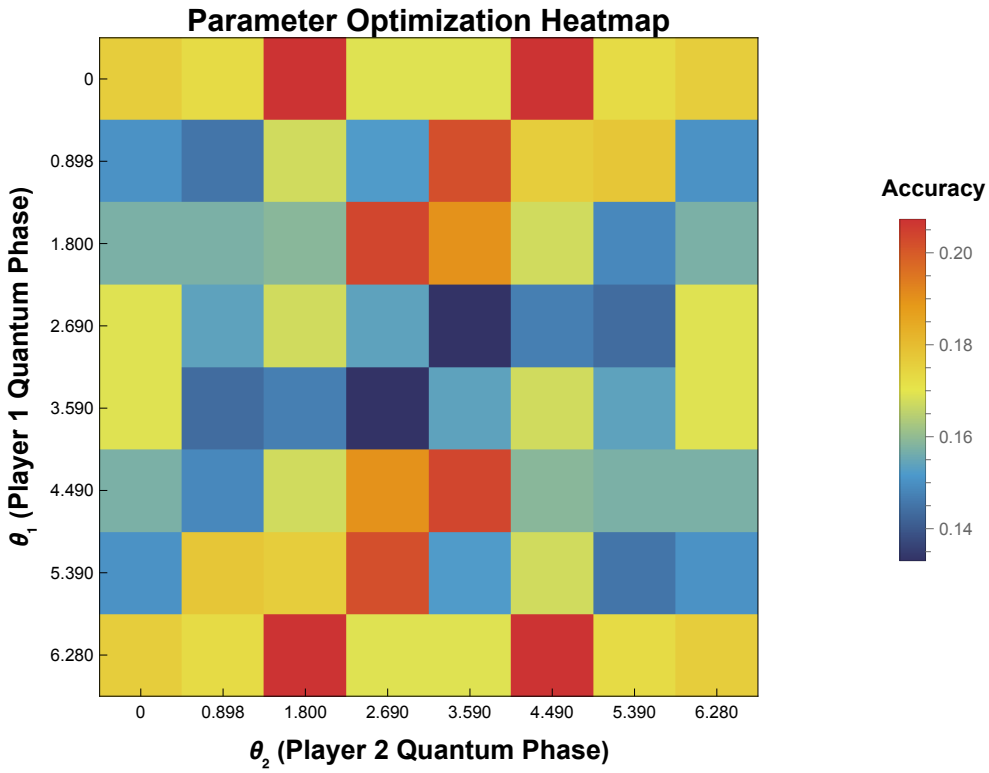
Best Parameters: Θ_1 = 1.7950, Θ_2 = 0 → Accuracy = 0.2073 (20.73%)

Accuracy Range: 0.133 - 0.207

Summary Statistics:

- Mean Accuracy: 0.167
- Standard Deviation: 0.019
- Improvement over Random: 6.44% points

Out[99]=



In[100]:=

```
theta1 = N[gridResults["bestTheta1"]];
theta2 = N[gridResults["bestTheta2"]];
```

In[102]:=

```
results = processQuantumDataset[data, theta1, theta2, l1, l2];
```

```
Processing 579 rows with quantum model...
Parameters: θ1=1.7952, θ2=0., λ1=2, λ2=2
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
```

In[103]:=

```
getFirstNEntries[results, 3]
```

```
Returning first 3 entries out of 579 total entries with extracted components.
```

Out[103]=

```
{ ⟨| SQ → 0.1857, ACQ1 → 0.0032, ACQ2 → 0.0306, NEGO → 0.1633, CAP1 → 0.0974,
    CAP2 → 0.0143, WAR1 → 0.1946, WAR2 → 0.311, prediction → WAR2,
    groundtruth → SQ, Agent1 → ESTONIA, Agent2 → UNITED KINGDOM |⟩,
  ⟨| SQ → 0.0003, ACQ1 → 0.0645, ACQ2 → 0.0191, NEGO → 0.042, CAP1 → 0.0026,
    CAP2 → 0.3465, WAR1 → 0.4075, WAR2 → 0.1175, prediction → WAR1,
    groundtruth → SQ, Agent1 → FRANCE, Agent2 → CHILE |⟩,
  ⟨| SQ → 0.2018, ACQ1 → 0.0001, ACQ2 → 0.1144, NEGO → 0.1956, CAP1 → 0.0108,
    CAP2 → 0.0049, WAR1 → 0.4575, WAR2 → 0.0151, prediction → WAR1,
    groundtruth → SQ, Agent1 → ARGENTINA, Agent2 → FRANCE |⟩ }
```

In[104]:=

```
accuracy = calculateQuantumAccuracy[results];
Print["Final Accuracy: ", N[accuracy]];
```

```
Final Accuracy: 0.207254
```

In[106]:=

```
plotQuantumConfusionMatrix[results, theta1, theta2,
 l1, l2, "Quantum-Like Signorino Model Confusion Matrix"]
```

Quantum-Like Signorino Model Confusion Matrix

$\theta 1 = 1.7952$ $\theta 2 = 0.$ $\lambda 1 = 2$ $\lambda 2 = 2$ | Accuracy = 0.207254

Out[106]=

Actual \ Predicted	ACQ1	ACQ2	CAP1	CAP2	NEGO	SQ	WAR1
ACQ1	0	0	3	0	0	1	2
ACQ2	2	10	1	0	6	14	66
CAP1	0	1	5	0	4	5	41
CAP2	1	5	1	0	5	17	70
NEGO	3	5	11	0	10	16	54
SQ	2	5	4	0	7	27	54
WAR1	1	3	4	0	8	15	68

Setting 4: Lambda1 = 0.1 | Lambda2 = 0.1

In[107]:=

```
datasetPath =
  "/Users/162191/Documents/GitHub/quantum_international_interaction_game/
    dataset/balanced_data.csv";
(*"D:\\home\\Documents\\Github\\quantum_international_interaction_game\\
   dataset\\balanced_data.csv";*)
data = loadData[datasetPath];
```

```
Loading CSV file:
 /Users/162191/Documents/GitHub/quantum_international_interaction_game/dataset/
   balanced_data.csv
Loaded 579 rows with 149 columns
```

In[109]:=

```
gridsize = 8;
l1 = 0.1;
l2 = 0.1;
theta1Range = createThetaRange[0, 2 * Pi, gridsize];
theta2Range = createThetaRange[0, 2 * Pi, gridsize];
```

In[114]:=

```
gridResults = gridSearchQuantumThetas[data, theta1Range, theta2Range, l1, l2];
Print["Best parameters: θ1=",
  gridResults["bestTheta1"], ", θ2=", gridResults["bestTheta2"]];
Print["Best accuracy: ", gridResults["bestAccuracy"]];
```

```
Starting grid search over 64 parameter combinations...
Theta1 range: {0, 2π/7, 4π/7, 6π/7, 8π/7, 10π/7, 12π/7, 2π}
Theta2 range: {0, 2π/7, 4π/7, 6π/7, 8π/7, 10π/7, 12π/7, 2π}
Lambda1 = 0.1, Lambda2 = 0.1
Dataset size: 579 rows
```

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=0$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=0$, $\theta 2=0$, Accuracy=0.170984

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.172712

Progress: 3/64 (4.69%)

Elapsed: 0.83 min, Estimated remaining: 17. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.172712

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 6/64 (9.38%)

Elapsed: 2.2 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.172712

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=2\pi$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 9/64 (14.1%)

Elapsed: 3.5 min, Estimated remaining: 22. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.172712

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=0$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{2\pi}{7}$, $\theta 2=0$, Accuracy=0.177893

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 12/64 (18.8%)

Elapsed: 4.9 min, Estimated remaining: 21. min

Current best: $\theta 1=\frac{2\pi}{7}$, $\theta 2=0$, Accuracy=0.177893

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 15/64 (23.4%)

Elapsed: 6.4 min, Estimated remaining: 21. min

Current best: $\theta 1=\frac{2\pi}{7}$, $\theta 2=0$, Accuracy=0.177893

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.212435

Progress: 18/64 (28.1%)

Elapsed: 7.8 min, Estimated remaining: 20. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.212435

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 21/64 (32.8%)

Elapsed: 9.2 min, Estimated remaining: 19. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.212435

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 24/64 (37.5%)

Elapsed: 11. min, Estimated remaining: 18. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.212435

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=0$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 27/64 (42.2%)

Elapsed: 12. min, Estimated remaining: 17. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.212435

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 30/64 (46.9%)

Elapsed: 14. min, Estimated remaining: 15. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.212435

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 33/64 (51.6%)

Elapsed: 15. min, Estimated remaining: 14. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=0$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 36/64 (56.3%)

Elapsed: 17. min, Estimated remaining: 13. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 39/64 (60.9%)

Elapsed: 18. min, Estimated remaining: 12. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=0$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 42/64 (65.6%)

Elapsed: 20. min, Estimated remaining: 10. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 45/64 (70.3%)

Elapsed: 21. min, Estimated remaining: 8.9 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 48/64 (75.0%)

Elapsed: 23. min, Estimated remaining: 7.5 min

Current best: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=2\,\pi$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=0$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 51/64 (79.7%)

Elapsed: 24. min, Estimated remaining: 6.1 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 54/64 (84.4%)

Elapsed: 26. min, Estimated remaining: 4.7 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 57/64 (89.1%)

Elapsed: 27. min, Estimated remaining: 3.3 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=0$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\,\pi$, $\theta 2=\frac{4\,\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 60/64 (93.8%)

Elapsed: 28. min, Estimated remaining: 1.9 min

Current best: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\,\pi$, $\theta 2=\frac{6\,\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\,\pi$, $\theta 2=\frac{8\,\pi}{7}$, $\lambda 1=0.1$, $\lambda 2=0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1 = 2\pi$, $\theta 2 = \frac{10\pi}{7}$, $\lambda 1 = 0.1$, $\lambda 2 = 0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 63/64 (98.4%)

Elapsed: 30. min, Estimated remaining: 0.47 min

Current best: $\theta 1 = \frac{6\pi}{7}$, $\theta 2 = \frac{12\pi}{7}$, Accuracy=0.217617

Processing 579 rows with quantum model...

Parameters: $\theta 1 = 2\pi$, $\theta 2 = \frac{12\pi}{7}$, $\lambda 1 = 0.1$, $\lambda 2 = 0.1$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

```
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Processing 579 rows with quantum model...
Parameters: θ1=2 π, θ2=2 π, λ1=0.1, λ2=0.1
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Grid search completed!
Total time: 31. minutes
Best parameters found:
  θ1 = 6 π / 7
  θ2 = 12 π / 7
  Accuracy = 0.217617

Best parameters: θ1=6 π/7, θ2=12 π/7
Best accuracy: 0.217617
```

In[117]:=

```
analyzeCurrentResults[gridResults]
```

Out[117]=

```
analyzeCurrentResults[
 ⟨|bestTheta1 → 6 π/7, bestTheta2 → 12 π/7, bestAccuracy → 0.217617,
  allResults → {⟨|theta1 → 0, theta2 → 0, accuracy → 0.170984, l1 → 0.1, l2 → 0.1|⟩,
    ⟨|theta1 → 0, theta2 → 2 π/7, accuracy → 0.172712, l1 → 0.1, l2 → 0.1|⟩,
```

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.160622,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.160622,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\langle| \text{theta1} \to 0,\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.170984,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 |\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.177893,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.162349,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.170984,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.170984,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.16753,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.162349,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.176166,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.177893,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.212435,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.158895,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.164076,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.189983,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.189983,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.212435,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.158895,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.158895,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.202073,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.165803,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.164076,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.19171,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.217617,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.158895,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.158895,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.217617,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.19171,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.164076,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.165803,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.202073,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.158895,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.158895,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.212435,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.189983,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.189983,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.164076,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.158895,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.212435,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.177893,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.176166,\ \text{l1} \to 0.1,\ \text{l2} \to 0.1 \right| \right\rangle,$$

```
    ⟨| theta1 → 12 π/7, theta2 → 4 π/7, accuracy → 0.162349, l1 → 0.1, l2 → 0.1 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 6 π/7, accuracy → 0.16753, l1 → 0.1, l2 → 0.1 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 8 π/7, accuracy → 0.170984, l1 → 0.1, l2 → 0.1 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 10 π/7, accuracy → 0.170984, l1 → 0.1, l2 → 0.1 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 12 π/7, accuracy → 0.162349, l1 → 0.1, l2 → 0.1 |⟩,
    ⟨| theta1 → 12 π/7, theta2 → 2 π, accuracy → 0.177893, l1 → 0.1, l2 → 0.1 |⟩,
    ‹| theta1 → 2 π, theta2 → 0, accuracy → 0.170984, l1 → 0.1, l2 → 0.1 |›,
    ⟨| theta1 → 2 π, theta2 → 2 π/7, accuracy → 0.172712, l1 → 0.1, l2 → 0.1 |⟩,
    ⟨| theta1 → 2 π, theta2 → 4 π/7, accuracy → 0.160622, l1 → 0.1, l2 → 0.1 |⟩,
    ⟨| theta1 → 2 π, theta2 → 6 π/7, accuracy → 0.172712, l1 → 0.1, l2 → 0.1 |⟩,
    ⟨| theta1 → 2 π, theta2 → 8 π/7, accuracy → 0.172712, l1 → 0.1, l2 → 0.1 |⟩,
    ⟨| theta1 → 2 π, theta2 → 10 π/7, accuracy → 0.160622, l1 → 0.1, l2 → 0.1 |⟩,
    ⟨| theta1 → 2 π, theta2 → 12 π/7, accuracy → 0.172712, l1 → 0.1, l2 → 0.1 |⟩,
    ‹| theta1 → 2 π, theta2 → 2 π, accuracy → 0.170984, l1 → 0.1, l2 → 0.1 |›},
  totalCombinations → 64, l1 → 0.1, l2 → 0.1 |⟩]
```

In[118]:=

```
visualizeGridSearchResults[gridResults]
```

Grid Search Results Visualization

Parameter Space: 8 × 8 = 64 combinations

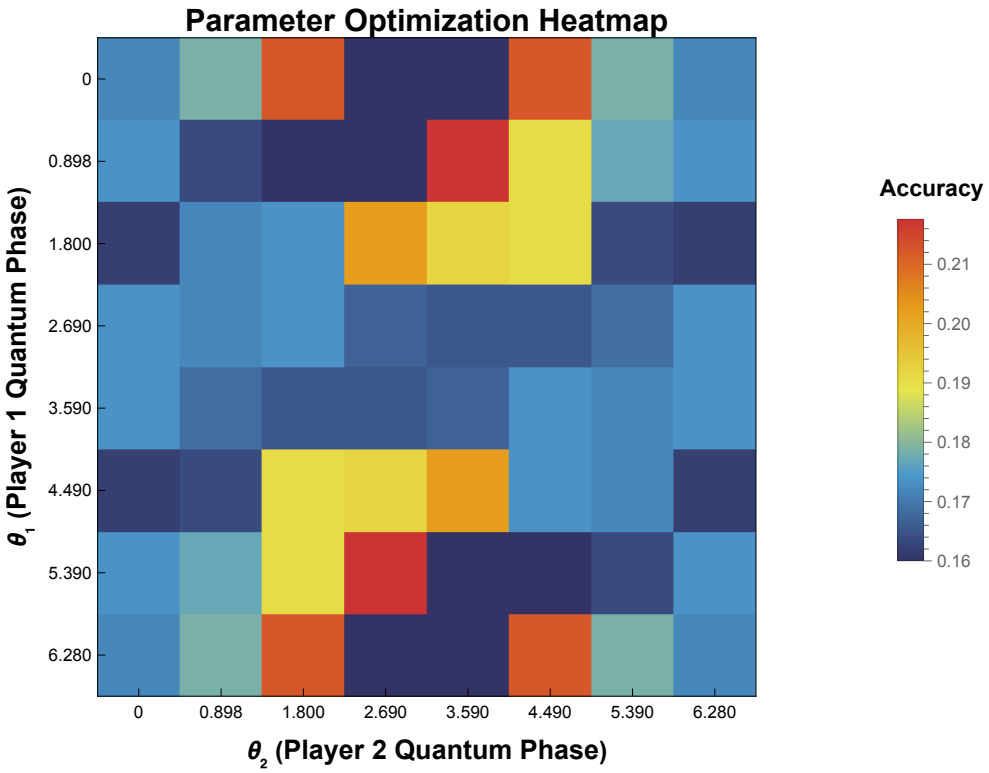
Best Parameters: Θ_1 = 2.6930, Θ_2 = 5.3860 → Accuracy = 0.2176 (21.76%)

Accuracy Range: 0.159 - 0.218

Summary Statistics:

- Mean Accuracy: 0.175
- Standard Deviation: 0.016
- Improvement over Random: 7.48% points

Out[118]=



In[119]:=

```
theta1 = N[gridResults["bestTheta1"]];
theta2 = N[gridResults["bestTheta2"]];
```

In[121]:=

```
results = processQuantumDataset[data, theta1, theta2, l1, l2];
```

```
Processing 579 rows with quantum model...
Parameters: θ1=2.69279, θ2=5.38559, λ1=0.1, λ2=0.1
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
```

In[122]:=

```
getFirstNEntries[results, 3]
```

```
Returning first 3 entries out of 579 total entries with extracted components.
```

Out[122]=

```
{ ⟨| SQ → 0.2507, ACQ1 → 0.1076, ACQ2 → 0.2332, NEGO → 0.016, CAP1 → 0.1205,
    CAP2 → 0.0675, WAR1 → 0.0769, WAR2 → 0.1277, prediction → SQ,
    groundtruth → SQ, Agent1 → ESTONIA, Agent2 → UNITED KINGDOM |⟩ ,
  ⟨| SQ → 0.2111, ACQ1 → 0.1087, ACQ2 → 0.2418, NEGO → 0.0137,
    CAP1 → 0.1245, CAP2 → 0.0744, WAR1 → 0.0751, WAR2 → 0.1507,
    prediction → ACQ2, groundtruth → SQ, Agent1 → FRANCE, Agent2 → CHILE |⟩ ,
  ⟨| SQ → 0.2656, ACQ1 → 0.1127, ACQ2 → 0.227, NEGO → 0.0171, CAP1 → 0.1176,
    CAP2 → 0.0623, WAR1 → 0.0781, WAR2 → 0.1196, prediction → SQ,
    groundtruth → SQ, Agent1 → ARGENTINA, Agent2 → FRANCE |⟩ }
```

In[123]:=

```
accuracy = calculateQuantumAccuracy[results];
Print["Final Accuracy: ", N[accuracy]];
```

```
Final Accuracy: 0.217617
```

In[125]:=

```
plotQuantumConfusionMatrix[results, theta1, theta2,
 l1, l2, "Quantum-Like Signorino Model Confusion Matrix"]
```

Quantum-Like Signorino Model Confusion Matrix

$\theta 1 = 2.69279$ $\theta 2 = 5.38559$ $\lambda 1 = 0.1$ $\lambda 2 = 0.1$ | Accuracy = 0.217617

Out[125]=

Actual \ Predicted	ACQ1	ACQ2	CAP1	CAP2	NEGO	SQ	WAR1
ACQ1	0	4	0	0	0	2	0
ACQ2	0	66	0	0	0	33	0
CAP1	0	33	0	0	0	23	0
CAP2	0	54	0	0	0	45	0
NEGO	0	35	0	0	0	64	0
SQ	0	39	0	0	0	60	0
WAR1	0	56	0	0	0	43	0

Setting 5: Lambda1 = 10 | Lambda2 = 10

In[126]:=

```
datasetPath =
  "/Users/162191/Documents/GitHub/quantum_international_interaction_game/
    dataset/balanced_data.csv";
(*"D:\\home\\Documents\\Github\\quantum_international_interaction_game\\
   dataset\\balanced_data.csv";*)
data = loadData[datasetPath];
```

```
Loading CSV file:
 /Users/162191/Documents/GitHub/quantum_international_interaction_game/dataset/
   balanced_data.csv
```

```
Loaded 579 rows with 149 columns
```

In[128]:=

```
gridsize = 8;
l1 = 10;
l2 = 10;
theta1Range = createThetaRange[0, 2 * Pi, gridsize];
theta2Range = createThetaRange[0, 2 * Pi, gridsize];
```

In[133]:=

```
gridResults = gridSearchQuantumThetas[data, theta1Range, theta2Range, l1, l2];
Print["Best parameters: θ1=",
  gridResults["bestTheta1"], ", θ2=", gridResults["bestTheta2"]];
Print["Best accuracy: ", gridResults["bestAccuracy"]];
```

```
Starting grid search over 64 parameter combinations...
```

Theta1 range: $\left\{0, \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, 2\pi\right\}$

Theta2 range: $\left\{0, \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, 2\pi\right\}$

```
Lambda1 = 10, Lambda2 = 10
```

```
Dataset size: 579 rows
```

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=0$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=0$, $\theta 2=0$, Accuracy=0.164076

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Progress: 3/64 (4.69%)

Elapsed: 0.82 min, Estimated remaining: 17. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 6/64 (9.38%)

Elapsed: 2.2 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=2\pi$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 9/64 (14.1%)

Elapsed: 3.5 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=0$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 12/64 (18.8%)

Elapsed: 4.9 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 15/64 (23.4%)

Elapsed: 6.4 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 18/64 (28.1%)

Elapsed: 7.8 min, Estimated remaining: 20. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 21/64 (32.8%)

Elapsed: 9.2 min, Estimated remaining: 19. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 24/64 (37.5%)

Elapsed: 11. min, Estimated remaining: 18. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=0$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 27/64 (42.2%)

Elapsed: 12. min, Estimated remaining: 17. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 30/64 (46.9%)

Elapsed: 14. min, Estimated remaining: 15. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 33/64 (51.6%)

Elapsed: 15. min, Estimated remaining: 14. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=0$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 36/64 (56.3%)

Elapsed: 17. min, Estimated remaining: 13. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 39/64 (60.9%)

Elapsed: 18. min, Estimated remaining: 12. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=0$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 42/64 (65.6%)

Elapsed: 20. min, Estimated remaining: 10. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{2\,\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{4\,\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{6\,\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 45/64 (70.3%)

Elapsed: 21. min, Estimated remaining: 8.9 min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 48/64 (75.0%)

Elapsed: 23. min, Estimated remaining: 7.6 min

Current best: $\theta 1=0$, $\theta 2=\frac{2\,\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=2\,\pi$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=0$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{2\,\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 51/64 (79.7%)

Elapsed: 24. min, Estimated remaining: 6.1 min

Current best: $\theta 1=0$, $\theta 2=\frac{2\,\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{4\,\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 54/64 (84.4%)

Elapsed: 26. min, Estimated remaining: 4.7 min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{10\,\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=2\,\pi$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 57/64 (89.1%)

Elapsed: 27. min, Estimated remaining: 3.3 min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=0$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 60/64 (93.8%)

Elapsed: 28. min, Estimated remaining: 1.9 min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 63/64 (98.4%)

Elapsed: 30. min, Estimated remaining: 0.47 min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.200345

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=10$, $\lambda 2=10$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

```
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Processing 579 rows with quantum model...
Parameters: θ1=2 π, θ2=2 π, λ1=10, λ2=10
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Grid search completed!
Total time: 31. minutes
Best parameters found:
  θ1 = 0
  θ2 = 2 π / 7
  Accuracy = 0.200345

Best parameters: θ1=0, θ2=2 π / 7
Best accuracy: 0.200345
```

In[136]:=

```
analyzeCurrentResults[gridResults]
```

Out[136]=

```
analyzeCurrentResults[
 ⟨|bestTheta1 → 0, bestTheta2 → 2 π / 7, bestAccuracy → 0.200345,
  allResults → {⟨|theta1 → 0, theta2 → 0, accuracy → 0.164076, l1 → 10, l2 → 10|⟩,
    ⟨|theta1 → 0, theta2 → 2 π / 7, accuracy → 0.200345, l1 → 10, l2 → 10|⟩,
    ⟨|theta1 → 0, theta2 → 4 π / 7, accuracy → 0.162349, l1 → 10, l2 → 10|⟩,
    ⟨|theta1 → 0, theta2 → 6 π / 7, accuracy → 0.16753, l1 → 10, l2 → 10|⟩,
```

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.16753,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.162349,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.200345,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\langle | \text{theta1} \to 0,\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.164076,\ \text{l1} \to 10,\ \text{l2} \to 10 | \rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.177893,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.181347,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.164076,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.17962,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.138169,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.146805,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.186528,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.177893,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.196891,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.151986,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.157168,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.131261,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.141623,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.188256,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.196891,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.160622,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.158895,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.164076,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.143351,\ \text{l1} \to 10,\ \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.139896, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.172712, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.196891, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.160622, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.160622, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.196891, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.172712, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.139896, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.143351, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.164076, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.158895, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.160622, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.196891, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.188256, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.141623, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.131261, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.157168, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.172712, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.151986, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.196891, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.177893, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.186528, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.146805, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.138169, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.17962, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.164076, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.181347, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.177893, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\langle\!| \text{theta1} \to 2\,\pi, \text{theta2} \to 0, \text{accuracy} \to 0.164076, \text{l1} \to 10, \text{l2} \to 10 |\!\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.200345, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.162349, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.16753, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.16753, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.162349, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.200345, \text{l1} \to 10, \text{l2} \to 10 \right| \right\rangle,$$

$$\langle\!| \text{theta1} \to 2\,\pi, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.164076, \text{l1} \to 10, \text{l2} \to 10 |\!\rangle \Big\},$$

$$\text{totalCombinations} \to 64, \text{l1} \to 10, \text{l2} \to 10 \left| \right\rangle \Big]$$

In[137]:=

```
visualizeGridSearchResults[gridResults]
```

Grid Search Results Visualization

Parameter Space: 8 × 8 = 64 combinations

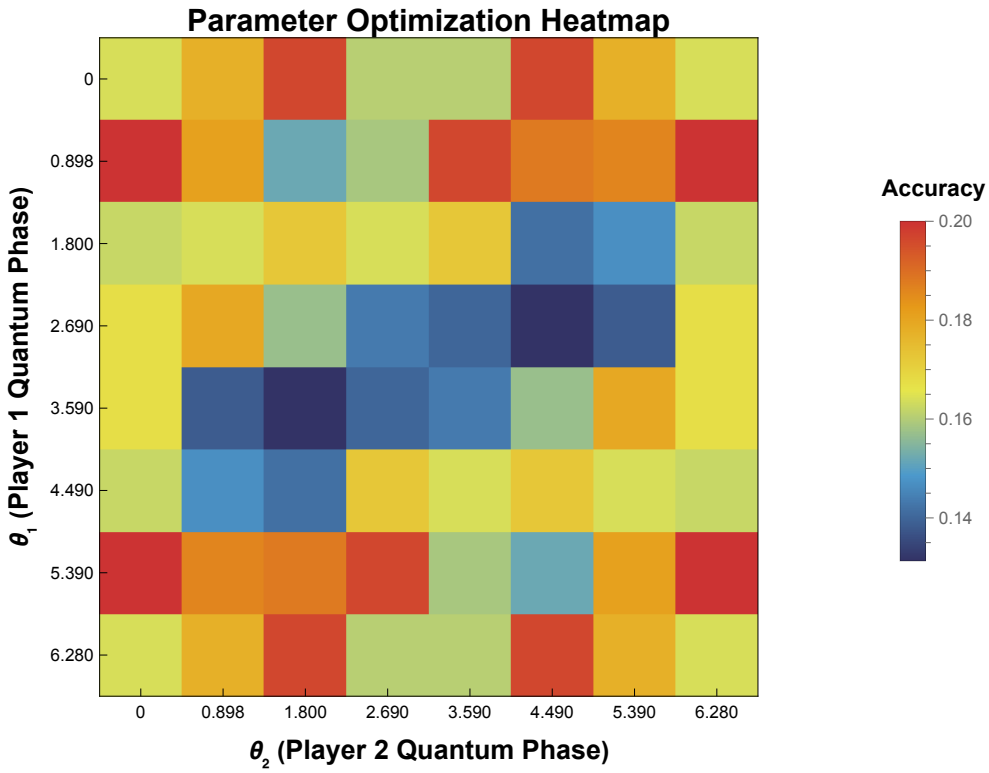
Best Parameters: $\Theta_1 = 0$, $\Theta_2 = 0.8976$ → Accuracy = 0.2003 (20.03%)

Accuracy Range: 0.131 – 0.200

Summary Statistics:

- Mean Accuracy: 0.168
- Standard Deviation: 0.019
- Improvement over Random: 5.75% points

Out[137]=



In[138]:=

```
theta1 = N[gridResults["bestTheta1"]];
theta2 = N[gridResults["bestTheta2"]];
```

In[140]:=

```
results = processQuantumDataset[data, theta1, theta2, l1, l2];
```

```
Processing 579 rows with quantum model...
Parameters: θ1=0., θ2=0.897598, λ1=10, λ2=10
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
```

In[141]:=

```
getFirstNEntries[results, 3]
```

```
Returning first 3 entries out of 579 total entries with extracted components.
```

Out[141]=

```
{ ⟨| SQ → 0.4237, ACQ1 → 0.0014, ACQ2 → 0., NEGO → 0.3614,
    CAP1 → 0.0003, CAP2 → 0., WAR1 → 0.1118, WAR2 → 0.1014, prediction → SQ,
    groundtruth → SQ, Agent1 → ESTONIA, Agent2 → UNITED KINGDOM |⟩,
  ⟨| SQ → 0.0013, ACQ1 → 0., ACQ2 → 0.9969, NEGO → 0.0007, CAP1 → 0.,
    CAP2 → 0.0003, WAR1 → 0.0008, WAR2 → 0., prediction → ACQ2,
    groundtruth → SQ, Agent1 → FRANCE, Agent2 → CHILE |⟩,
  ⟨| SQ → 0., ACQ1 → 0., ACQ2 → 0., NEGO → 0., CAP1 → 0.0001,
    CAP2 → 0., WAR1 → 0.9994, WAR2 → 0.0005, prediction → WAR1,
    groundtruth → SQ, Agent1 → ARGENTINA, Agent2 → FRANCE |⟩ }
```

In[142]:=

```
accuracy = calculateQuantumAccuracy[results];
Print["Final Accuracy: ", N[accuracy]];
```

```
Final Accuracy: 0.200345
```

In[144]:=

```
plotQuantumConfusionMatrix[results, theta1, theta2,
 l1, l2, "Quantum-Like Signorino Model Confusion Matrix"]
```

Quantum-Like Signorino Model Confusion Matrix

$\theta 1 = 0.$ $\theta 2 = 0.897598$ $\lambda 1 = 10$ $\lambda 2 = 10$ | Accuracy = 0.200345

Out[144]=

Actual \ Predicted	ACQ1	ACQ2	CAP1	CAP2	NEGO	SQ	WAR1
ACQ1	1	3	0	0	1	0	1
ACQ2	2	51	0	0	19	6	21
CAP1	3	20	0	0	12	8	13
CAP2	2	41	0	0	24	9	23
NEGO	8	22	0	0	26	12	31
SQ	5	26	0	0	20	10	38
WAR1	3	32	0	0	22	14	28

Setting 6: Lambda1 = 0.0001 | Lambda2 = 0.0001

In[145]:=

```
datasetPath =
  "/Users/162191/Documents/GitHub/quantum_international_interaction_game/
    dataset/balanced_data.csv";
(*"D:\\home\\Documents\\Github\\quantum_international_interaction_game\\
   dataset\\balanced_data.csv";*)
data = loadData[datasetPath];
```

```
Loading CSV file:
 /Users/162191/Documents/GitHub/quantum_international_interaction_game/dataset/
   balanced_data.csv
```

```
Loaded 579 rows with 149 columns
```

In[147]:=

```
gridsize = 8;
l1 = 0.0001;
l2 = 0.0001;
theta1Range = createThetaRange[0, 2 * Pi, gridsize];
theta2Range = createThetaRange[0, 2 * Pi, gridsize];
```

In[152]:=

```
gridResults = gridSearchQuantumThetas[data, theta1Range, theta2Range, l1, l2];
Print["Best parameters: θ1=",
  gridResults["bestTheta1"], ", θ2=", gridResults["bestTheta2"]];
Print["Best accuracy: ", gridResults["bestAccuracy"]];
```

```
Starting grid search over 64 parameter combinations...
```

Theta1 range: $\left\{0, \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, 2\pi\right\}$

Theta2 range: $\left\{0, \frac{2\pi}{7}, \frac{4\pi}{7}, \frac{6\pi}{7}, \frac{8\pi}{7}, \frac{10\pi}{7}, \frac{12\pi}{7}, 2\pi\right\}$

```
Lambda1 = 0.0001, Lambda2 = 0.0001
```

```
Dataset size: 579 rows
```

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=0$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=0$, $\theta 2=0$, Accuracy=0.170984

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.172712

Progress: 3/64 (4.69%)

Elapsed: 0.81 min, Estimated remaining: 16. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.172712

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 6/64 (9.38%)

Elapsed: 2.2 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.172712

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=0$, $\theta 2=2\pi$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 9/64 (14.1%)

Elapsed: 3.5 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.172712

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=0$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 12/64 (18.8%)

Elapsed: 4.9 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.172712

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 15/64 (23.4%)

Elapsed: 6.4 min, Estimated remaining: 21. min

Current best: $\theta 1=0$, $\theta 2=\frac{2\pi}{7}$, Accuracy=0.172712

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{2\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.176166

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{2\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Progress: 18/64 (28.1%)

Elapsed: 7.7 min, Estimated remaining: 20. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 21/64 (32.8%)

Elapsed: 9.2 min, Estimated remaining: 19. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 24/64 (37.5%)

Elapsed: 11. min, Estimated remaining: 18. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{4\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=0$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 27/64 (42.2%)

Elapsed: 12. min, Estimated remaining: 17. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 30/64 (46.9%)

Elapsed: 14. min, Estimated remaining: 15. min

Current best: $\theta 1=\frac{4\pi}{7}$, $\theta 2=0$, Accuracy=0.207254

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

New best found: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{6\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 33/64 (51.6%)

Elapsed: 15. min, Estimated remaining: 14. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=0$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 36/64 (56.3%)

Elapsed: 16. min, Estimated remaining: 13. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 39/64 (60.9%)

Elapsed: 18. min, Estimated remaining: 12. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{8\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=0$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 42/64 (65.6%)

Elapsed: 19. min, Estimated remaining: 10. min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 45/64 (70.3%)

Elapsed: 21. min, Estimated remaining: 8.8 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 48/64 (75.0%)

Elapsed: 22. min, Estimated remaining: 7.5 min

Current best: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{10\,\pi}{7}$, $\theta 2=2\,\pi$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=0$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 51/64 (79.7%)

Elapsed: 24. min, Estimated remaining: 6.1 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{6\,\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\,\pi}{7}$, $\theta 2=\frac{8\,\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 54/64 (84.4%)

Elapsed: 25. min, Estimated remaining: 4.7 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=\frac{12\pi}{7}$, $\theta 2=2\pi$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 57/64 (89.1%)

Elapsed: 27. min, Estimated remaining: 3.3 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=0$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{2\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{4\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 60/64 (93.8%)

Elapsed: 28. min, Estimated remaining: 1.9 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{6\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{8\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{10\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

Processing row 300/579

Processing row 350/579

Processing row 400/579

Processing row 450/579

Processing row 500/579

Processing row 550/579

Successfully processed 579 out of 579 rows

Progress: 63/64 (98.4%)

Elapsed: 30. min, Estimated remaining: 0.47 min

Current best: $\theta 1=\frac{6\pi}{7}$, $\theta 2=\frac{12\pi}{7}$, Accuracy=0.214162

Processing 579 rows with quantum model...

Parameters: $\theta 1=2\pi$, $\theta 2=\frac{12\pi}{7}$, $\lambda 1=0.0001$, $\lambda 2=0.0001$

Processing row 50/579

Processing row 100/579

Processing row 150/579

Processing row 200/579

Processing row 250/579

```
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Processing 579 rows with quantum model...
Parameters: θ1=2 π, θ2=2 π, λ1=0.0001, λ2=0.0001
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
Grid search completed!
Total time: 31. minutes
Best parameters found:
```

$$\theta 1 = \frac{6\,\pi}{7}$$

$$\theta 2 = \frac{12\,\pi}{7}$$

```
  Accuracy = 0.214162
```

Best parameters: $\theta 1=\frac{6\,\pi}{7}$, $\theta 2=\frac{12\,\pi}{7}$

```
Best accuracy: 0.214162
```

In[155]:=

```
analyzeCurrentResults[gridResults]
```

Out[155]=

```
analyzeCurrentResults[
  ⟨|bestTheta1 → 6 π/7, bestTheta2 → 12 π/7, bestAccuracy → 0.214162, allResults →
    {<| theta1 → 0, theta2 → 0, accuracy → 0.170984, l1 → 0.0001, l2 → 0.0001 |>,
```

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.160622,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.160622,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to 0,\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\langle| \text{theta1} \to 0,\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.170984,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 |\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.170984,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.150259,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.170984,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.169257,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.164076,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.16753,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.176166,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{2\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.170984,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.207254,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{2\,\pi}{7},\ \text{accuracy} \to 0.157168,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{4\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{6\,\pi}{7},\ \text{accuracy} \to 0.172712,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{8\,\pi}{7},\ \text{accuracy} \to 0.164076,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{10\,\pi}{7},\ \text{accuracy} \to 0.184801,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to \frac{12\,\pi}{7},\ \text{accuracy} \to 0.186528,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{4\,\pi}{7},\ \text{theta2} \to 2\,\pi,\ \text{accuracy} \to 0.207254,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7},\ \text{theta2} \to 0,\ \text{accuracy} \to 0.160622,\ \text{l1} \to 0.0001,\ \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.165803, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.195164, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.165803, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.164076, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.19171, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.214162, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{6\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.160622, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.160622, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.214162, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.19171, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.164076, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.165803, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.195164, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.165803, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{8\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.160622, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.207254, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.186528, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.184801, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.164076, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.172712, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.172712, \right.\right.$$
$$\left.\left. \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle, \left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \right.\right.$$
$$\left.\left. \text{accuracy} \to 0.157168, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle \left| \text{theta1} \to \frac{10\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.207254, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right| \right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to 0, \text{accuracy} \to 0.170984, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.176166, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.16753, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.164076, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.169257, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.170984, \right.\right.$$
$$\left.\left. \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle, \left\langle\left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to \frac{12\,\pi}{7}, \right.\right.$$
$$\left.\left. \text{accuracy} \to 0.150259, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to \frac{12\,\pi}{7}, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.170984, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\langle| \text{theta1} \to 2\,\pi, \text{theta2} \to 0, \text{accuracy} \to 0.170984, \text{l1} \to 0.0001, \text{l2} \to 0.0001 |\rangle,$$

$$\left\langle\left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{2\,\pi}{7}, \text{accuracy} \to 0.172712, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{4\,\pi}{7}, \text{accuracy} \to 0.160622, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{6\,\pi}{7}, \text{accuracy} \to 0.172712, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{8\,\pi}{7}, \text{accuracy} \to 0.172712, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{10\,\pi}{7}, \text{accuracy} \to 0.160622, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\left\langle\left| \text{theta1} \to 2\,\pi, \text{theta2} \to \frac{12\,\pi}{7}, \text{accuracy} \to 0.172712, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \right|\right\rangle,$$

$$\langle| \text{theta1} \to 2\,\pi, \text{theta2} \to 2\,\pi, \text{accuracy} \to 0.170984, \text{l1} \to 0.0001, \text{l2} \to 0.0001 |\rangle\Big\},$$

$$\text{totalCombinations} \to 64, \text{l1} \to 0.0001, \text{l2} \to 0.0001 \left|\right\rangle\Big]$$

In[156]:=

```
visualizeGridSearchResults[gridResults]
```

Grid Search Results Visualization

Parameter Space: 8 × 8 = 64 combinations

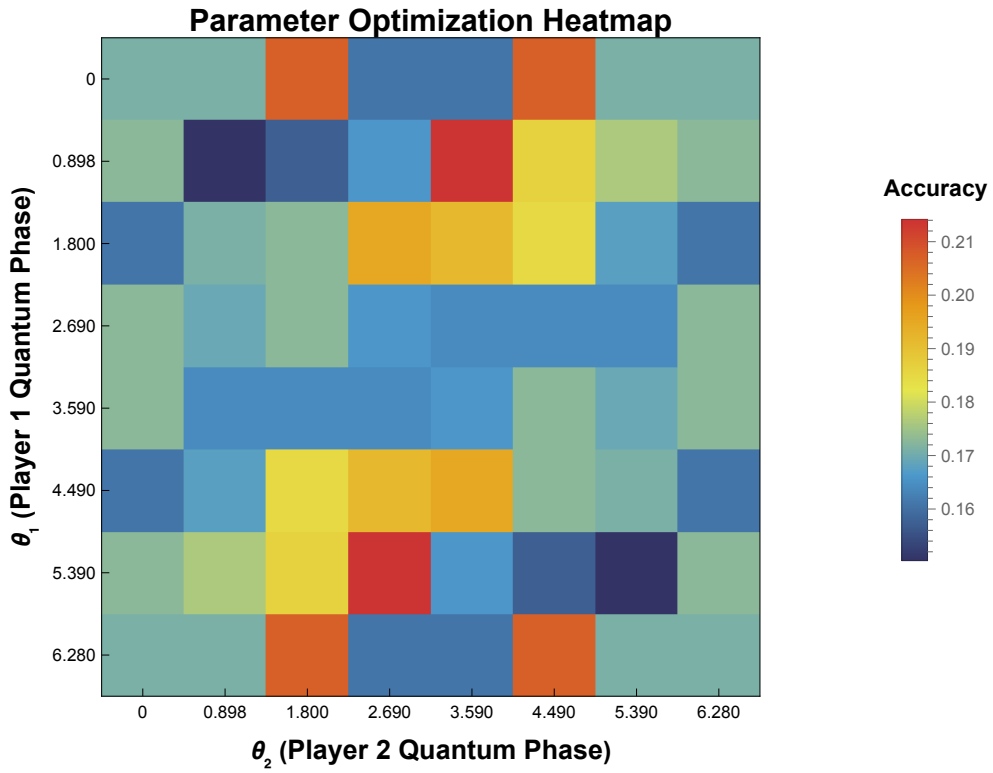
Best Parameters: Θ_1 = 2.6930, Θ_2 = 5.3860 → Accuracy = 0.2142 (21.42%)

Accuracy Range: 0.150 - 0.214

Summary Statistics:

- Mean Accuracy: 0.174
- Standard Deviation: 0.015
- Improvement over Random: 7.13% points

Out[156]=



In[157]:=

```
theta1 = N[gridResults["bestTheta1"]];
theta2 = N[gridResults["bestTheta2"]];
```

In[159]:=

```
results = processQuantumDataset[data, theta1, theta2, l1, l2];
```

```
Processing 579 rows with quantum model...
Parameters: θ1=2.69279, θ2=5.38559, λ1=0.0001, λ2=0.0001
Processing row 50/579
Processing row 100/579
Processing row 150/579
Processing row 200/579
Processing row 250/579
Processing row 300/579
Processing row 350/579
Processing row 400/579
Processing row 450/579
Processing row 500/579
Processing row 550/579
Successfully processed 579 out of 579 rows
```

In[160]:=

```
getFirstNEntries[results, 3]
```

```
Returning first 3 entries out of 579 total entries with extracted components.
```

Out[160]=

```
{ ⟨| SQ → 0.2457, ACQ1 → 0.1228, ACQ2 → 0.2457, NEGO → 0.0139, CAP1 → 0.1228,
    CAP2 → 0.0631, WAR1 → 0.0631, WAR2 → 0.1228, prediction → ACQ2,
    groundtruth → SQ, Agent1 → ESTONIA, Agent2 → UNITED KINGDOM |⟩ ,
  ⟨| SQ → 0.2457, ACQ1 → 0.1228, ACQ2 → 0.2457, NEGO → 0.0139,
    CAP1 → 0.1228, CAP2 → 0.0631, WAR1 → 0.0631, WAR2 → 0.1229,
    prediction → SQ, groundtruth → SQ, Agent1 → FRANCE, Agent2 → CHILE |⟩ ,
  ⟨| SQ → 0.2457, ACQ1 → 0.1228, ACQ2 → 0.2457, NEGO → 0.0139, CAP1 → 0.1228,
    CAP2 → 0.0631, WAR1 → 0.0631, WAR2 → 0.1228, prediction → ACQ2,
    groundtruth → SQ, Agent1 → ARGENTINA, Agent2 → FRANCE |⟩ }
```

In[161]:=

```
accuracy = calculateQuantumAccuracy[results];
Print["Final Accuracy: ", N[accuracy]];
```

```
Final Accuracy: 0.214162
```

In[163]:=

```
plotQuantumConfusionMatrix[results, theta1, theta2,
 l1, l2, "Quantum-Like Signorino Model Confusion Matrix"]
```

Quantum-Like Signorino Model Confusion Matrix

$\theta 1 = 2.69279$ $\theta 2 = 5.38559$ $\lambda 1 = 0.0001$ $\lambda 2 = 0.0001$ | Accuracy = 0.214162

Out[163]=

Actual \ Predicted	ACQ1	ACQ2	CAP1	CAP2	NEGO	SQ	WAR1
ACQ1	0	4	0	0	0	2	0
ACQ2	0	63	0	0	0	36	0
CAP1	0	30	0	0	0	26	0
CAP2	0	54	0	0	0	45	0
NEGO	0	33	0	0	0	66	0
SQ	0	38	0	0	0	61	0
WAR1	0	55	0	0	0	44	0