Particle spectrograph

Wave operator and propagator

xAct`PSALTer`Private`GraphicsCollage[Join[

MapThread[xAct`PSALTer`Private`WignerGrid[{#1}, {#2}, {#3}, {#4}, {#5}]],
Grid[MapThread[If[#1 =!= Null, Null, #1, #1] &][{#2, #1, Null}] &,
{BlockDiagonalMatrix[Flatten[0,3]], BlockDiagonalMatrix[Flatten[False,3]]},2]], {AspectRatio → Automatic}], Join[530, {AspectRatio → Automatic},

Join[MapThread[
If[!#1 === 0, xAct`PSALTer`Private`PrintParticle[First[#1], First[#2], #4, #3,2 #4+1],0 &,
[MapThread[xAct`PSALTer`Private`PSALTerParallelSubmit[
xAct`PSALTer`Private`MassiveGhost[#1, #2, #3]] &,
[MapThread[ConstantArray[#1, Length[#2]] &, {MapThread[Times, {Flatten[{}, {1, 2}], {}}, {}, {},
1}, {{}, {}, {}, {}},2], {}, {}, {Even, Odd}, {0,0}]], 0]

Massless particle

Pole residue: {{1}, {1}}.Replace[xAct`PSALTer`Private`MakeSaturatedMatrix[
Total[MapThread[xAct`PSALTer`Private`PSALTerParallelSubmit[
xAct`PSALTer`Private`ConstrainLightcone[#1, #2]] &,
{xAct`PSALTer`Private`Repartition[xAct`PSALTer`Private`Repartition[
Flatten[{}, {1, 2}], 1], 10, ExpandAll →False], 10,
ExpandAll →False], 200], xAct`PSALTer`Private`MakeFreeSourceVariables[
IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}]], {}],
xAct`PSALTer`Private`MakeFreeSourceVariables[
IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}]], {}]]],
IdentityMatrix[]], MapThread[#1 → #2&,
{Tally[Total[MapThread[xAct`PSALTer`Private`PSALTerParallelSubmit[
xAct`PSALTer`Private`ConstrainLightcone[#1, #2]] &,
{xAct`PSALTer`Private`Repartition[xAct`PSALTer`Private`Repartition[
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200], xAct`PSALTer`Private`Repartition[
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IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
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IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}]]]]]]]}]]], {2}], {{1}, {1}} > 0

Polarisations: 1

Quartic pole

Pole residue: ∅ < {{1}, {1}}.Replace[xAct`PSALTer`Private`MakeSaturatedMatrix[
Total[MapThread[xAct`PSALTer`Private`PSALTerParallelSubmit[
xAct`PSALTer`Private`ConstrainLightcone[#1, #2]] &,
{xAct`PSALTer`Private`Repartition[
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200], xAct`PSALTer`Private`Repartition[
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IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}]], {},
xAct`PSALTer`Private`MakeFreeSourceVariables[
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xAct`PSALTer`Private`ClassName, {}]], {}]]]],
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{Tally[Total[MapThread[xAct`PSALTer`Private`PSALTerParallelSubmit[
xAct`PSALTer`Private`ConstrainLightcone[#1, #2]] &,
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xAct`PSALTer`Private`ClassName, {}], {},
xAct`PSALTer`Private`MakeFreeSourceVariables[
IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}], {}]]]]]}]],
{}}], {2}].{{1}, {1}} && {{1}, {1}} > 0].Replace[
xAct`PSALTer`Private`MakeSaturatedMatrix[
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MapThread[
xAct`PSALTer`Private`PSALTerParallelSubmit[
xAct`PSALTer`Private`ConstrainLightcone[#1, #2]] &,
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200], xAct`PSALTer`Private`Repartition[
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xAct`PSALTer`Private`ClassName, {}]], {},
xAct`PSALTer`Private`MakeFreeSourceVariables[
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xAct`PSALTer`Private`ClassName, {}]], {}]]]]],
IdentityMatrix[]], MapThread[#1 → #2&,
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xAct`PSALTer`Private`ConstrainLightcone[#1, #2]] &,
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200], xAct`PSALTer`Private`Repartition[
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xAct`PSALTer`Private`ClassName, {}]], {},
xAct`PSALTer`Private`MakeFreeSourceVariables[
IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}]]]]}]]}]], {2}].{{1}, {1}} > 0

Polarisations: 1

Hexic pole

Pole residue: ∅ < {{1}, {1}}.Replace[xAct`PSALTer`Private`MakeSaturatedMatrix[
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10, ExpandAll →False], 10, ExpandAll →False],
200], xAct`PSALTer`Private`Repartition[
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xAct`PSALTer`Private`ClassName, {}]], {},
xAct`PSALTer`Private`MakeFreeSourceVariables[
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xAct`PSALTer`Private`ClassName, {}]]]]}]]}]], {2}].{{1}, {1}} && {{1}, {1}}.Replace[
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200], xAct`PSALTer`Private`Repartition[
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xAct`PSALTer`Private`MakeFreeSourceVariables[
IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}]]]]}]]}]], {2}].{{1}, {1}} > 0]], {500}]]

Polarisations: 1

Massive and massless spectra

xAct`PSALTer`Private`GraphicsCollage[

Join[MapThread[
If[!#1 === 0, xAct`PSALTer`Private`PrintParticle[First[#1], First[#2], #4, #3,2 #4+1],0 &,
{MapThread[xAct`PSALTer`Private`PSALTerParallelSubmit[
xAct`PSALTer`Private`MassiveGhost[#1, #2, #3]] &,
{MapThread[ConstantArray[#1, Length[#2]] &, {MapThread[Times, {Flatten[{}, {1, 2}], {}}, {}, {},
1}, {{}, {}, {}, {}},2], {}, {}, {Even, Odd}, {0,0}]], 0]

, Join[0, Gather[

Massless particle

Pole residue: {{1}, {1}}.Replace[xAct`PSALTer`Private`MakeSaturatedMatrix[
Total[MapThread[xAct`PSALTer`Private`PSALTerParallelSubmit[
xAct`PSALTer`Private`ConstrainLightcone[#1, #2]] &,
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ExpandAll →False], 200], xAct`PSALTer`Private`Repartition[
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xAct`PSALTer`Private`ClassName, {}]], {},
xAct`PSALTer`Private`MakeFreeSourceVariables[
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xAct`PSALTer`Private`ClassName, {}]], {}]]]],
IdentityMatrix[]], MapThread[#1 → #2&,
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xAct`PSALTer`Private`ConstrainLightcone[#1, #2]] &,
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200], xAct`PSALTer`Private`Repartition[
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xAct`PSALTer`Private`MakeFreeSourceVariables[
IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}]]]]}]]}]], {2}].{{1}, {1}} > 0

Polarisations: 1

Quartic pole

Pole residue: ∅ < {{1}, {1}}.Replace[xAct`PSALTer`Private`MakeSaturatedMatrix[
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200], xAct`PSALTer`Private`Repartition[
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IdentityMatrix[]], MapThread[#1 → #2&,
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IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}]], {},
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xAct`PSALTer`Private`ClassName, {}]]]]}]]}]], {2}].{{1}, {1}} && {{1}, {1}}.Replace[
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xAct`PSALTer`Private`MakeFreeSourceVariables[
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xAct`PSALTer`Private`ClassName, {}]]]]}]]}]], {2}].{{1}, {1}} > 0

Polarisations: 1

Hexic pole

Pole residue: ∅ < {{1}, {1}}.Replace[xAct`PSALTer`Private`MakeSaturatedMatrix[
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200], xAct`PSALTer`Private`Repartition[
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xAct`PSALTer`Private`ClassName, {}]], {}]]]],
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xAct`PSALTer`Private`MakeFreeSourceVariables[
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xAct`PSALTer`Private`ClassName, {}]]]]}]]}]], {2}].{{1}, {1}} > 0]],

Polarisations: 1

Join[MapThread[
If[!#1 === 0, xAct`PSALTer`Private`PrintParticle[First[#1], First[#2], #4, #3,2 #4+1],0 &,
{MapThread[xAct`PSALTer`Private`PSALTerParallelSubmit[
xAct`PSALTer`Private`MassiveGhost[#1, #2, #3]] &,
{MapThread[ConstantArray[#1, Length[#2]] &, {MapThread[Times, {Flatten[{}, {1, 2}], {}}, {}, {},
1}, {{}, {}, {}, {}},2], {}, {}, {Even, Odd}, {0, 0}]], 0]

Join[530, {AspectRatio → Automatic}], {

Massless particle

Pole residue: {{1}, {1}}.Replace[xAct`PSALTer`Private`MakeSaturatedMatrix[
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ExpandAll →False], 200], xAct`PSALTer`Private`Repartition[
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xAct`PSALTer`Private`MakeFreeSourceVariables[
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xAct`PSALTer`Private`ClassName, {}]], {}]]]],
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IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}]]]]}]]}]], {2}].{{1}, {1}} > 0

Polarisations: 1

Quartic pole

Pole residue: ∅ < {{1}, {1}}.Replace[xAct`PSALTer`Private`MakeSaturatedMatrix[
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200], xAct`PSALTer`Private`Repartition[
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xAct`PSALTer`Private`ClassName, {}]]]]}]]}]], {2}].{{1}, {1}} > 0

Polarisations: 1

Hexic pole

Pole residue: ∅ < {{1}, {1}}.Replace[xAct`PSALTer`Private`MakeSaturatedMatrix[
Total[MapThread[xAct`PSALTer`Private`PSALTerParallelSubmit[
xAct`PSALTer`Private`ConstrainLightcone[#1, #2]] &,
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10, ExpandAll →False], 10, ExpandAll →False],
200], xAct`PSALTer`Private`Repartition[
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200], xAct`PSALTer`Private`Repartition[
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IdentityMatrix[xAct`PSALTer`Private`RescaleNullVector[
xAct`PSALTer`Private`ClassName, {}]]]]}]]}]], {2}].{{1}, {1}} > 0]], {500}]]

Polarisations: 1

Unitarity conditions