```
(* Data import *)
SetDirectory[NotebookDirectory[]];

NamDataH = Import["H/Rhos.txt", "Table"];
NamDataV = Import["V/Rhos.txt", "Table"];
NamDataD = Import["D/Rhos.txt", "Table"];
NamDataA = Import["A/Rhos.txt", "Table"];
NamDataR = Import["R/Rhos.txt", "Table"];
NamDataL = Import["L/Rhos.txt", "Table"];

Rho[i_, NamData0_] := {{NamData0[[4 + 16 i, 1]], NamData0[[5 + 16 i, 1]]},
    {NamData0[[6 + 16 i, 1]], NamData0[[7 + 16 i, 1]]}} +
  {{NamData0[[9 + 16 i, 1]], NamData0[[10 + 16 i, 1]]},
    {NamData0[[11 + 16 i, 1]], NamData0[[12 + 16 i, 1]]}} * I

RhoListH = ParallelTable[Rho[i, NamDataH], {i, 0, NamDataH[[1, 1]] - 1}];
RhoListV = ParallelTable[Rho[i, NamDataV], {i, 0, NamDataV[[1, 1]] - 1}];
RhoListD = ParallelTable[Rho[i, NamDataD], {i, 0, NamDataD[[1, 1]] - 1}];
RhoListA = ParallelTable[Rho[i, NamDataA], {i, 0, NamDataA[[1, 1]] - 1}];
RhoListR = ParallelTable[Rho[i, NamDataR], {i, 0, NamDataR[[1, 1]] - 1}];
RhoListL = ParallelTable[Rho[i, NamDataL], {i, 0, NamDataL[[1, 1]] - 1}];

(*Target states*)
StateH = {{1}, {0}};
StateV = {{0}, {1}};
StateD = (1 / (2 ^ (1 / 2))) {{1}, {1}};
StateA = (1 / (2 ^ (1 / 2))) {{1}, {-1}};
StateR = (1 / (2 ^ (1 / 2))) {{1}, {I}};
StateL = (1 / (2 ^ (1 / 2))) {{1}, {-I}};
States = {StateH, StateV, StateD, StateA, StateR, StateL};

StateToRho[i_] := States[[i]].ConjugateTranspose[States[[i]]]
Rhos = ParallelTable[StateToRho[i], {i, 1, Dimensions[States][[1]]}];
Dimensions[Rhos];

sigma2 = {{0, 1}, {1, 0}};
sigma3 = {{0, -I}, {I, 0}};
sigma1 = {{1, 0}, {0, -1}};
sigma = {sigma1, sigma2, sigma3};
BlochStates[i_, x_] := ConjugateTranspose[States[[x]]].sigma[[i]].States[[x]]
BlochlistStates =
  ParallelTable[Re[BlochStates[i, x][[1, 1]]], {x, 1, Dimensions[States][[1]]}, {i, 1, 3}];

RhoToBloch[Rho_, i_, j_] := Re[Tr[Rho[[i]].sigma[[j]]]]

(* Fidelity *)
```

```
In[ ]:= Fidelity[Rho1_, Rho2_, i_, j_] :=
         Re[Tr[MatrixPower[MatrixPower[Rho1[[i]], 1 / 2].Rho2[[j]].MatrixPower[Rho1[[i]], 1 / 2], 1 / 2]]^
          2

In[ ]:= FidelityListH = ParallelTable[
            Fidelity[Rhos, RhoListH, i, j], {j, 1, Dimensions[RhoListH][[1]]}, {i, 1, 1}];
        FidelityListV = ParallelTable[Fidelity[Rhos, RhoListV, i, j],
            {j, 1, Dimensions[RhoListV][[1]]}, {i, 2, 2}];
        FidelityListD = ParallelTable[Fidelity[Rhos, RhoListD, i, j],
            {j, 1, Dimensions[RhoListD][[1]]}, {i, 3, 3}];
        FidelityListA = ParallelTable[Fidelity[Rhos, RhoListA, i, j],
            {j, 1, Dimensions[RhoListA][[1]]}, {i, 4, 4}];
        FidelityListR = ParallelTable[Fidelity[Rhos, RhoListR, i, j],
            {j, 1, Dimensions[RhoListR][[1]]}, {i, 5, 5}];
        FidelityListL = ParallelTable[Fidelity[Rhos, RhoListL, i, j],
            {j, 1, Dimensions[RhoListL][[1]]}, {i, 6, 6}];

In[ ]:= (* H *)
        Mean[FidelityListH]
        StandardDeviation[FidelityListH]

Out[ ]= {0.999705}

Out[ ]= {0.0000236401}

In[ ]:= (* V *)
        Mean[FidelityListV]
        StandardDeviation[FidelityListV]

Out[ ]= {0.999651}

Out[ ]= {0.0000145061}

In[ ]:= (* D *)
        Mean[FidelityListD]
        StandardDeviation[FidelityListD]

Out[ ]= {0.99959}

Out[ ]= {0.0000357322}

In[ ]:= (* A *)
        Mean[FidelityListA]
        StandardDeviation[FidelityListA]

Out[ ]= {0.998617}

Out[ ]= {0.0000310306}
```

```
In[ ]:= (* R *)
        Mean[FidelityListR]
        StandardDeviation[FidelityListR]
Out[ ]= {0.998913}
Out[ ]= {4.73333 × 10^-6}

In[ ]:= (* L *)
        Mean[FidelityListL]
        StandardDeviation[FidelityListL]
Out[ ]= {0.996917}
Out[ ]= {0.000140897}

In[ ]:= (* Purity *)

In[ ]:= Purity[Rho_] := Re[Tr[MatrixPower[Rho, 2]]]

In[ ]:= PurityListH = ParallelTable[Purity[RhoListH[[i]]], {i, 1, Dimensions[RhoListH][[1]]}];
        PurityListV = ParallelTable[Purity[RhoListV[[i]]], {i, 1, Dimensions[RhoListV][[1]]}];
        PurityListD = ParallelTable[Purity[RhoListD[[i]]], {i, 1, Dimensions[RhoListD][[1]]}];
        PurityListA = ParallelTable[Purity[RhoListA[[i]]], {i, 1, Dimensions[RhoListA][[1]]}];
        PurityListR = ParallelTable[Purity[RhoListR[[i]]], {i, 1, Dimensions[RhoListR][[1]]}];
        PurityListL = ParallelTable[Purity[RhoListL[[i]]], {i, 1, Dimensions[RhoListL][[1]]}];

In[ ]:= (* H *)
        Mean[PurityListH]
        StandardDeviation[PurityListH]
Out[ ]= 1.
Out[ ]= 2.47788 × 10^-8

In[ ]:= (* V *)
        Mean[PurityListV]
        StandardDeviation[PurityListV]
Out[ ]= 0.999996
Out[ ]= 2.05045 × 10^-6

In[ ]:= (* D *)
        Mean[PurityListD]
        StandardDeviation[PurityListD]
Out[ ]= 1.
Out[ ]= 6.46309 × 10^-8
```

In[ ]:=
```
(* A *)
Mean[PurityListA]
StandardDeviation[PurityListA]
```

Out[ ]= 0.997442

Out[ ]= 0.0000425234

In[ ]:=
```
(* R *)
Mean[PurityListR]
StandardDeviation[PurityListR]
```

Out[ ]= 0.998484

Out[ ]= 0.0000124013

In[ ]:=
```
(* L *)
Mean[PurityListL]
StandardDeviation[PurityListL]
```

Out[ ]= 0.995257

Out[ ]= 0.000076883

In[ ]:=
```
(* Angles *)
BlochListH = ParallelTable[RhoToBloch[RhoListH, i, j],
   {i, 1, Dimensions[RhoListH][[1]]}, {j, 1, Dimensions[sigma][[1]]}];
BlochListV = ParallelTable[RhoToBloch[RhoListV, i, j],
   {i, 1, Dimensions[RhoListV][[1]]}, {j, 1, Dimensions[sigma][[1]]}];
BlochListD = ParallelTable[RhoToBloch[RhoListD, i, j],
   {i, 1, Dimensions[RhoListD][[1]]}, {j, 1, Dimensions[sigma][[1]]}];
BlochListA = ParallelTable[RhoToBloch[RhoListA, i, j],
   {i, 1, Dimensions[RhoListA][[1]]}, {j, 1, Dimensions[sigma][[1]]}];
BlochListR = ParallelTable[RhoToBloch[RhoListR, i, j],
   {i, 1, Dimensions[RhoListR][[1]]}, {j, 1, Dimensions[sigma][[1]]}];
BlochListL = ParallelTable[RhoToBloch[RhoListL, i, j],
   {i, 1, Dimensions[RhoListL][[1]]}, {j, 1, Dimensions[sigma][[1]]}];
```

```
In[ ]:= AnglesH = Table[VectorAngle[BlochListH[[i]], BlochlistStates[[1]]],
          {i, 1, Dimensions[BlochListH][[1]]}];
        AnglesV = Table[VectorAngle[BlochListV[[i]], BlochlistStates[[2]]],
          {i, 1, Dimensions[BlochListV][[1]]}];
        AnglesD = Table[VectorAngle[BlochListD[[i]], BlochlistStates[[3]]],
          {i, 1, Dimensions[BlochListD][[1]]}];
        AnglesA = Table[VectorAngle[BlochListA[[i]], BlochlistStates[[4]]],
          {i, 1, Dimensions[BlochListA][[1]]}];
        AnglesR = Table[VectorAngle[BlochListR[[i]], BlochlistStates[[5]]],
          {i, 1, Dimensions[BlochListR][[1]]}];
        AnglesL = Table[VectorAngle[BlochListL[[i]], BlochlistStates[[6]]],
          {i, 1, Dimensions[BlochListL][[1]]}];

In[ ]:= (* H *)
        Mean[AnglesH];
        UnitConvert[% rad, "AngularDegrees"] / 2
        StandardDeviation[AnglesH];
        UnitConvert[% rad, "AngularDegrees"] / 2

Out[ ]= 0.98324°

Out[ ]= 0.0387031°

In[ ]:= (* V *)
        Mean[AnglesV];
        UnitConvert[% rad, "AngularDegrees"] / 2
        StandardDeviation[AnglesV];
        UnitConvert[% rad, "AngularDegrees"] / 2

Out[ ]= 1.0673°

Out[ ]= 0.0210992°

In[ ]:= (* D *)
        Mean[AnglesD];
        UnitConvert[% rad, "AngularDegrees"] / 2
        StandardDeviation[AnglesD];
        UnitConvert[% rad, "AngularDegrees"] / 2

Out[ ]= 1.15882°

Out[ ]= 0.0506217°
```

```
In[ ]:= (* A *)
        Mean[AnglesA];
        UnitConvert[% rad, "AngularDegrees"]/2
        StandardDeviation[AnglesA];
        UnitConvert[% rad, "AngularDegrees"]/2
```

```
Out[ ]= 0.579309°
```

```
Out[ ]= 0.0297151°
```

```
In[ ]:= (* R *)
        Mean[AnglesR];
        UnitConvert[% rad, "AngularDegrees"]/2
        StandardDeviation[AnglesR];
        UnitConvert[% rad, "AngularDegrees"]/2
```

```
Out[ ]= 1.03877°
```

```
Out[ ]= 0.00418923°
```

```
In[ ]:= (* L *)
        Mean[AnglesL];
        UnitConvert[% rad, "AngularDegrees"]/2
        StandardDeviation[AnglesL];
        UnitConvert[% rad, "AngularDegrees"]/2
```

```
Out[ ]= 1.52256°
```

```
Out[ ]= 0.11253°
```

```
In[ ]:= (* AVG - all states together *)
```

```
In[ ]:= (* Fidelity *)
        Mean[Join[FidelityListH, FidelityListV,
          FidelityListD, FidelityListA, FidelityListR, FidelityListL]]
        StandardDeviation[Join[FidelityListH, FidelityListV,
          FidelityListD, FidelityListA, FidelityListR, FidelityListL]]
```

```
Out[ ]= {0.998888}
```

```
Out[ ]= {0.000986325}
```

```
In[ ]:= (* Purity *)
        Mean[Join[PurityListH , PurityListV ,
          PurityListD , PurityListA , PurityListR , PurityListL ]]
        StandardDeviation [Join[PurityListH , PurityListV ,
          PurityListD , PurityListA , PurityListR , PurityListL ]]
Out[ ]= 0.998509
Out[ ]= 0.00176599

In[ ]:= (* Angles *)
        Mean[Join[AnglesH , AnglesV , AnglesD , AnglesA , AnglesR , AnglesL ]];
        UnitConvert [% rad , "AngularDegrees "] / 2
        StandardDeviation [Join[AnglesH , AnglesV , AnglesD , AnglesA , AnglesR , AnglesL ]];
        UnitConvert [% rad , "AngularDegrees "] / 2
Out[ ]= 1.05821°
Out[ ]= 0.286164°

In[ ]:= (* States Bloch coortinates *)
        (* H *)

In[ ]:= Mean[Transpose [BlochListH ][[1]]]
        StandardDeviation [Transpose [BlochListH ][[1]]]
        Mean[Transpose [BlochListH ][[2]]]
        StandardDeviation [Transpose [BlochListH ][[2]]]
        Mean[Transpose [BlochListH ][[3]]]
        StandardDeviation [Transpose [BlochListH ][[3]]]
Out[ ]= 0.99941
Out[ ]= 0.0000472802
Out[ ]= 0.0279755
Out[ ]= 0.00143891
Out[ ]= 0.0198621
Out[ ]= 0.000404948

In[ ]:= (* V *)
```

```
In[ ]:= Mean[Transpose[BlochListV][[1]]]
        StandardDeviation[Transpose[BlochListV][[1]]]
        Mean[Transpose[BlochListV][[2]]]
        StandardDeviation[Transpose[BlochListV][[2]]]
        Mean[Transpose[BlochListV][[3]]]
        StandardDeviation[Transpose[BlochListV][[3]]]
Out[ ]= -0.999301
Out[ ]= 0.0000290122
Out[ ]= -0.0355335
Out[ ]= 0.000884752
Out[ ]= 0.0111503
Out[ ]= 0.00040223
In[ ]:= (* D *)
In[ ]:= Mean[Transpose[BlochListD][[1]]]
        StandardDeviation[Transpose[BlochListD][[1]]]
        Mean[Transpose[BlochListD][[2]]]
        StandardDeviation[Transpose[BlochListD][[2]]]
        Mean[Transpose[BlochListD][[3]]]
        StandardDeviation[Transpose[BlochListD][[3]]]
Out[ ]= -0.040432
Out[ ]= 0.00175897
Out[ ]= 0.99918
Out[ ]= 0.0000714643
Out[ ]= -0.000414781
Out[ ]= 0.0007037
In[ ]:= (* A *)
```

```
In[ ]:= Mean[Transpose[BlochListA][[1]]]
        StandardDeviation[Transpose[BlochListA][[1]]]
        Mean[Transpose[BlochListA][[2]]]
        StandardDeviation[Transpose[BlochListA][[2]]]
        Mean[Transpose[BlochListA][[3]]]
        StandardDeviation[Transpose[BlochListA][[3]]]
```

```
Out[ ]= -0.00787381
```

```
Out[ ]= 0.000616918
```

```
Out[ ]= -0.997234
```

```
Out[ ]= 0.0000620611
```

```
Out[ ]= -0.0185587
```

```
Out[ ]= 0.00103225
```

```
In[ ]:= (* R *)
```

```
In[ ]:= Mean[Transpose[BlochListR][[1]]]
        StandardDeviation[Transpose[BlochListR][[1]]]
        Mean[Transpose[BlochListR][[2]]]
        StandardDeviation[Transpose[BlochListR][[2]]]
        Mean[Transpose[BlochListR][[3]]]
        StandardDeviation[Transpose[BlochListR][[3]]]
```

```
Out[ ]= -0.0191558
```

```
Out[ ]= 0.000518719
```

```
Out[ ]= -0.0307083
```

```
Out[ ]= 0.000249088
```

```
Out[ ]= 0.997827
```

```
Out[ ]= 9.46666 × 10^-6
```

```
In[ ]:= (* L *)
```

```
In[ ]:= Mean[Transpose[BlochListL][[1]]]
        StandardDeviation[Transpose[BlochListL][[1]]]
        Mean[Transpose[BlochListL][[2]]]
        StandardDeviation[Transpose[BlochListL][[2]]]
        Mean[Transpose[BlochListL][[3]]]
        StandardDeviation[Transpose[BlochListL][[3]]]
```

```
Out[ ]= 0.023296

Out[ ]= 0.00224426

Out[ ]= 0.0474562

Out[ ]= 0.00324805

Out[ ]= -0.993833

Out[ ]= 0.000281794
```