In[1]:=
```
Needs["MaTeX`"];
```

In[2]:=
```
l1 = .025;
l2 = .001;
s = l1 / 2;
```

In[5]:=
```
SetDirectory[
 "C:\\Users\\user-pc\\Documents\\Docs Guillem\\PhD ICFO\\Projects\\PIEWS\\Final"];
(* Link to the data file *)
```

Spin-1

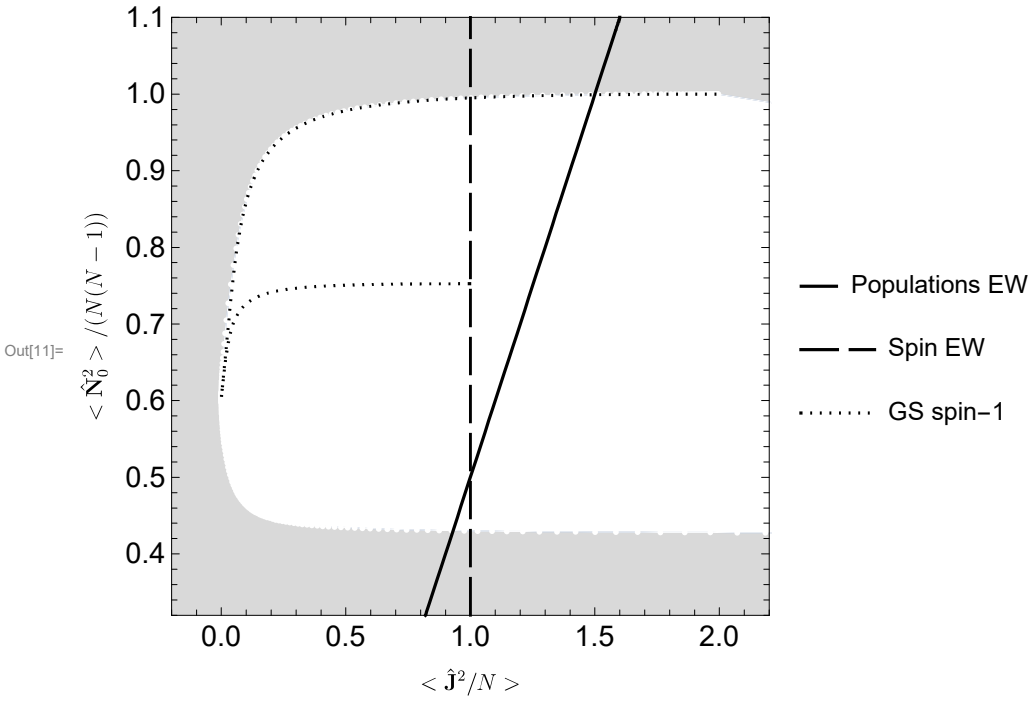
In[6]:=

```
GSSpin1 = Transpose[Transpose@{First[First[Import["x_spin1_N100_iso.mat"]]],
     First[First[Import["y_spin1_N100_iso.mat"]]]}];
FeasSpin1 = Transpose[Import["FeasSpin1_iso.mx"]];
FeasSpin2 = Transpose[Import["FeasSpin2_N24_iso.mx"]];
GSSpin2 = Import["GSSpin2_N24_iso.mx"];

t = -0.5;

Spin1Iso = Show[
  ConvexHullMesh[Transpose@{FeasSpin1[[1]], FeasSpin1[[2]] + t},
   MeshCellStyle → {2 → Opacity[1, White], EdgeForm[]}],
  Plot[x + t, {x, 0.82, 1.6}, PlotStyle → {Black}, PlotLegends → {"Populations EW"}],
  ListLinePlot[
   Transpose@{ConstantArray[1, 11], N@Subdivide[0.82, 1.6, 10] + t} , PlotRange → All,
   PlotStyle → {Black, AbsoluteDashing[{20, 5}]}, PlotLegends → {"Spin EW"}],
  ListLinePlot[Transpose@{GSSpin1 [[1]], GSSpin1 [[2]] + t},
   PlotStyle → {Black, Dotted}, PlotLegends → {"GS spin-1"}],
  Frame → True, PlotRange → {{-0.2, 2.2}, {0.82 + t, 1.6 + t}}, TicksStyle → Large,
  BaseStyle → FontSize → 15, AspectRatio → 1, Axes → False, FrameLabel →
   {MaTeX["<\hat{\mathbf{J}}^2/N>"], MaTeX["<\hat{\mathbf{N}}_0^2>/(N(N-1))"]},
  Prolog → {LightGray, Rectangle[Scaled[{0, 0}], Scaled[{1, 1}]]}]
```

Out[11]=



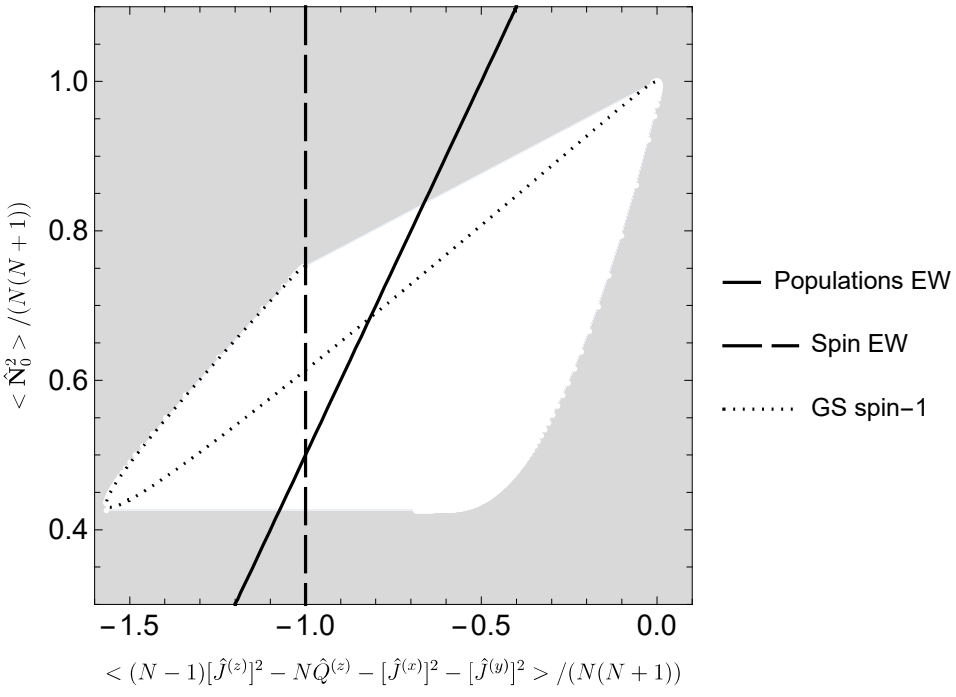
In[12]:=

```
FeasSpin1BA = Import["FeasSpin1_N100_BA.mx"];
FeasSpin2BA = Import["FeasSpin2_N24_BA.mx"];
xGSSpin1 = First[First[Import["x_spin1_N100_BA.mat"]]];
yGSSpin1 = First[First[Import["y_spin_1_N100_BA.mat"]]];

t = 3 / 2;

Spin1BA = Show[
  ConvexHullMesh[
   Transpose@{Transpose[FeasSpin1BA][[1]], Transpose[FeasSpin1BA][[2]] + t},
   MeshCellStyle → {2 → Opacity[1, White], EdgeForm[]}],
  Plot[x + t, {x, -1.2, -0.4}, PlotStyle → {Black}, PlotLegends → {"Populations EW"}],
  (*ListLinePlot[
   Transpose@{Transpose[FeasSpin1BA][[1]],Transpose[FeasSpin1BA][[2]]+t},
   PlotStyle→{Red,Dashed},PlotRange→All,PlotLegends→{"Feasible spin-1"}],
  Plot[x+t,{x,-2,0},PlotStyle→{Black,Dotted,Thickness[0.01]},
   PlotLegends→{"Populations EW"}]*)
  ListLinePlot[Transpose@{ConstantArray[-1, 11], N@Subdivide[-0.4, -1.2, 10] + t} ,
   PlotStyle → {Black, AbsoluteDashing[{20, 5}]}, PlotLegends → {"Spin EW"}],
  ListLinePlot[Transpose@{xGSSpin1, yGSSpin1 + t}, PlotStyle → {Black, Dotted},
   PlotLegends → {"GS spin-1"}, PlotRange → All],
  Frame → True, PlotRange → {{-1.6, 0.1}, {-0.4 + t, -1.2 + t}}, TicksStyle → Large,
  BaseStyle → FontSize → 15,  AspectRatio → 1, Axes → False, FrameLabel → {MaTeX[
     "<(N-1)[\hat{J}^{(z)}]^2-N\hat{Q}^{(z)}-[\hat{J}^{(x)}]^2-[\hat{J}^{(y)}]^2>/
       (N(N+1))"], MaTeX["<\hat{\mathbf{N}}_0^2 >/(N(N+1))"]},
  Prolog → {LightGray, Rectangle[Scaled[{0, 0}], Scaled[{1, 1}]]}]
```

Out[17]=



Spin-2

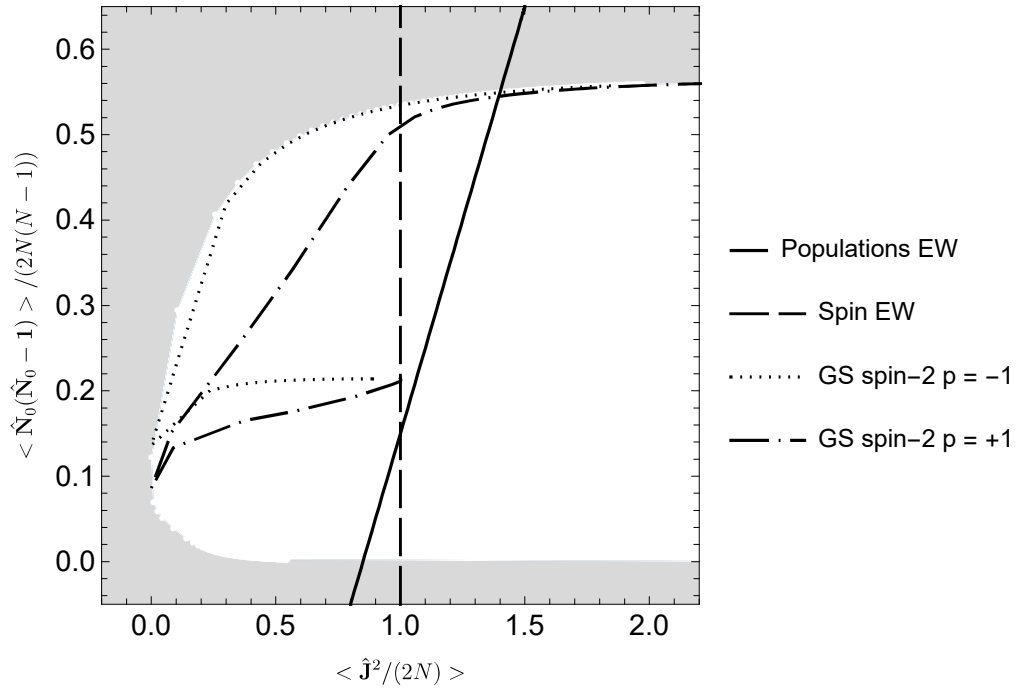
In[18]:=

```
GSSpin1 = Transpose[Transpose@{First[First[Import["x_spin1_N100_iso.mat"]]],
     First[First[Import["y_spin1_N100_iso.mat"]]]}];
FeasSpin1 = Transpose[Import["FeasSpin1_iso.mx"]];
FeasSpin2 = Transpose[Import["FeasSpin2_N24_iso.mx"]];
GSSpin2 = Import["GSSpin2_N24_iso.mx"];
GSSpin2Nem = Import["GSSpin2_N24_iso_j1pm1qm10to10.mx"];
GSSpin2Sin = Import["GSSpin2_N24_iso_j1p1qm10to10.mx"];

t = -0.85;

Spin2Iso = Show[
  ConvexHullMesh[Transpose@{FeasSpin2[[1]], FeasSpin2[[2]] + t},
   MeshCellStyle → {2 → Opacity[1, White], EdgeForm[]}],
  Plot[x + t, {x, 0.80, 1.5}, PlotStyle → {Black}, PlotLegends → {"Populations EW"}],
  ListLinePlot[
   Transpose@{ConstantArray[1, 11], N@Subdivide[0.80, 1.5, 10] + t} , PlotRange → All,
   PlotStyle → {Black, AbsoluteDashing[{20, 5}]}, PlotLegends → {"Spin EW"}],
  ListLinePlot[Transpose@{Transpose[GSSpin2Nem] [[1]],
     Transpose[GSSpin2Nem] [[2]] + t}, PlotStyle → {Black, Dotted},
   PlotLegends → {"GS spin-2 p = -1"}, PlotRange → All],
  ListLinePlot[Transpose@{Transpose[GSSpin2Sin] [[1]],
     Transpose[GSSpin2Sin] [[2]] + t},
   PlotStyle → {Black, AbsoluteDashing[{20, 5, 1, 5}]},
   PlotLegends → {"GS spin-2 p = +1"}, PlotRange → All],
  Frame → True, PlotRange → {{-0.2, 2.2}, {0.80 + t, 1.5 + t}},
  TicksStyle → Large, BaseStyle → FontSize → 15, AspectRatio → 1,
  Axes → False, FrameLabel → {MaTeX["<\hat{\mathbf{J}}^2/(2N)>"],
    MaTeX["<\hat{\mathbf{N}}_0(\hat{\mathbf{N}}_0-\mathbf{1})>/(2N(N-1))"]},
  Prolog → {LightGray, Rectangle[Scaled[{0, 0}], Scaled[{1, 1}]]},
  PlotRange → {{0, 2}, {0.82 + t, 1.5 + t}}]
```

Out[25]=


0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.5
1.0
1.5
2.0
$< \hat{\mathbf{N}}_0(\hat{\mathbf{N}}_0 - \mathbf{1}) > /(2N(N-1))$
$< \hat{\mathbf{J}}^2/(2N) >$
Populations EW
Spin EW
GS spin−2 p = −1
GS spin−2 p = +1