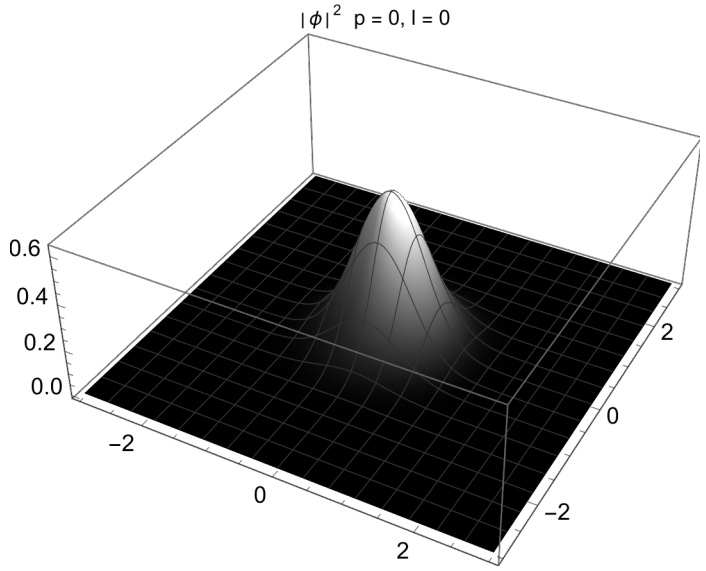
LG Modes understanding graphs

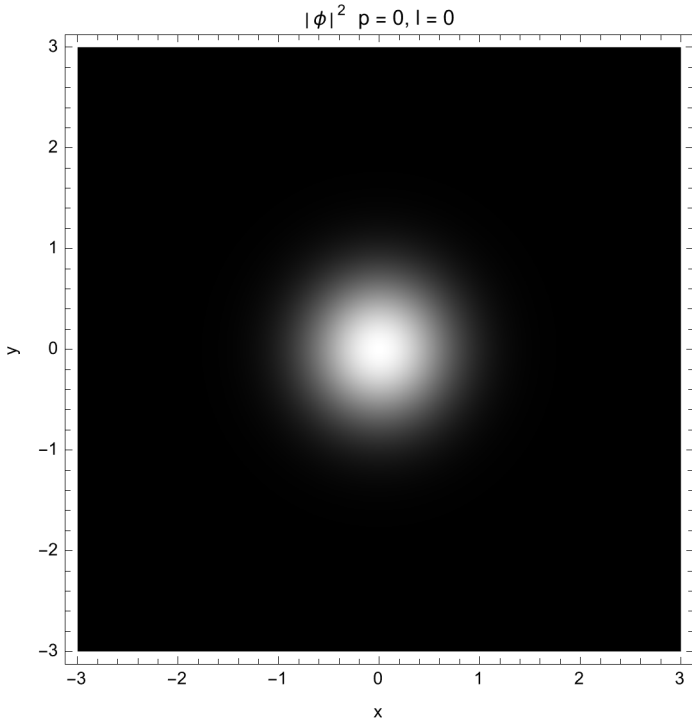
In[•]:=
```
LG[r_, ϕ_, p_, l_, w_] := Sqrt[(2 p !) / (π (p + Abs[l]) !)] (1 / w) * Exp[-r^2 / w^2]
  ((r Sqrt[2]) / w)^Abs[l] * LaguerreL[p, Abs[l], (2 r^2) / w^2] Exp[-I l ϕ]
Plot3D[LG[Sqrt[x^2 + y^2], ArcTan[x, y], 0, 0, 1]^2 // Abs, {x, -3, 3},
 {y, -3, 3}, PlotRange → All, ColorFunction → GrayLevel, PlotPoints → 100,
 Exclusions → None, PlotLabel → Row[{Abs[ϕ]^2, "  p = 0, l = 0"}](*,
 FrameLabel→{{"y",None},{"x",None}}*), AxesStyle → Directive[Black, 12]]
```

Out[•]=



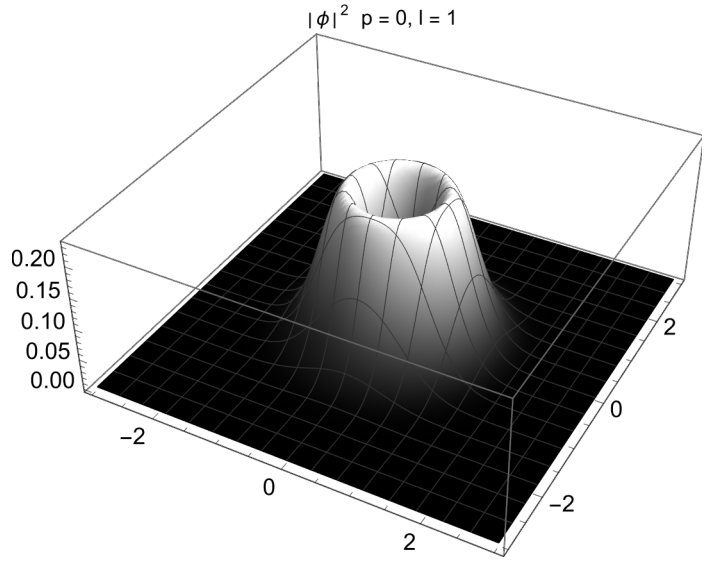
In[•]:=
```
LG[r_, ϕ_, p_, l_, w_] := Sqrt[(2 p !) / (π (p + Abs[l]) !)] (1 / w) * Exp[-r^2 / w^2]
  ((r Sqrt[2]) / w)^Abs[l] * LaguerreL[p, Abs[l], (2 r^2) / w^2] Exp[-I l ϕ]
DensityPlot[LG[Sqrt[x^2 + y^2], ArcTan[x, y], 0, 0, 1]^2 // Abs, {x, -3, 3},
 {y, -3, 3}, PlotRange → All, ColorFunction → GrayLevel, PlotPoints → 100,
 Exclusions → None, PlotLabel → Row[{Abs[ϕ]^2, "  p = 0, l = 0"}],
 FrameLabel → {{"y", None}, {"x", None}}, AxesStyle → Directive[Black, 12]]
```

Out[•]=



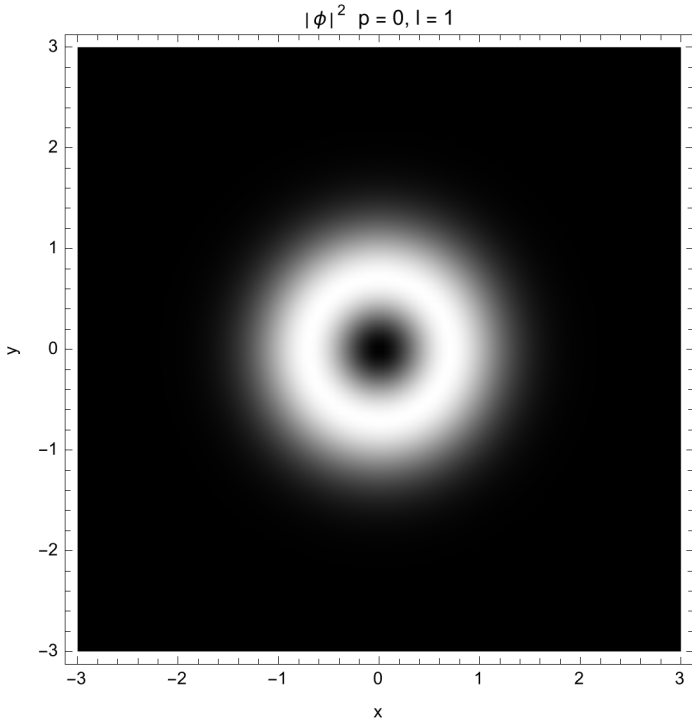
In[•]:=
```
LG[r_, ϕ_, p_, l_, w_] := Sqrt[(2 p !) / (π (p + Abs[l]) !)] (1 / w) * Exp[-r^2 / w^2]
  ((r Sqrt[2]) / w)^Abs[l] * LaguerreL[p, Abs[l], (2 r^2) / w^2] Exp[-I l ϕ]
Plot3D[LG[Sqrt[x^2 + y^2], ArcTan[x, y], 0, 1, 1]^2 // Abs, {x, -3, 3},
 {y, -3, 3}, PlotRange → All, ColorFunction → GrayLevel, PlotPoints → 100,
 Exclusions → None, PlotLabel → Row[{Abs[ϕ]^2, "  p = 0, l = 1"}](*,
 FrameLabel→{{"y",None},{"x",None}}*), AxesStyle → Directive[Black, 12]]
```

Out[•]=



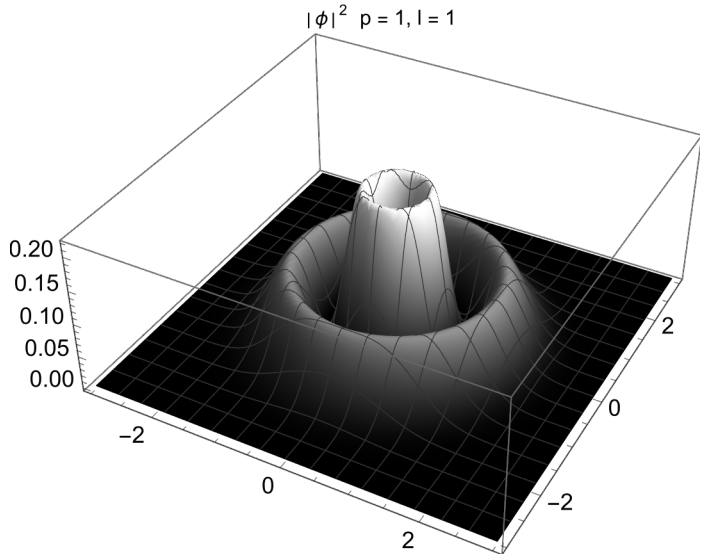
In[•]:=
```
LG[r_, ϕ_, p_, l_, w_] := Sqrt[(2 p !) / (π (p + Abs[l]) !)] (1 / w) * Exp[-r^2 / w^2]
  ((r Sqrt[2]) / w)^Abs[l] * LaguerreL[p, Abs[l], (2 r^2) / w^2] Exp[-I l ϕ]
DensityPlot[LG[Sqrt[x^2 + y^2], ArcTan[x, y], 0, 1, 1]^2 // Abs, {x, -3, 3},
 {y, -3, 3}, PlotRange → All, ColorFunction → GrayLevel, PlotPoints → 100,
 Exclusions → None, PlotLabel → Row[{Abs[ϕ]^2, "  p = 0, l = 1"}],
 FrameLabel → {{"y", None}, {"x", None}}, AxesStyle → Directive[Black, 12]]
```

Out[•]=



In[•]:=
```
LG[r_, ϕ_, p_, l_, w_] := Sqrt[(2 p !) / (π (p + Abs[l]) !)] (1 / w) * Exp[-r^2 / w^2]
  ((r Sqrt[2]) / w)^Abs[l] * LaguerreL[p, Abs[l], (2 r^2) / w^2] Exp[-I l ϕ]
Plot3D[LG[Sqrt[x^2 + y^2], ArcTan[x, y], 1, 1, 1]^2 // Abs, {x, -3, 3},
 {y, -3, 3}, PlotRange → All, ColorFunction → GrayLevel, PlotPoints → 100,
 Exclusions → None, PlotLabel → Row[{Abs[ϕ]^2, "  p = 1, l = 1"}](*,
 FrameLabel→{{"y",None},{"x",None}}*), AxesStyle → Directive[Black, 12]]
```

Out[•]=



In[•]:=
```
LG[r_, ϕ_, p_, l_, w_] := Sqrt[(2 p !) / (π (p + Abs[l]) !)] (1 / w) * Exp[-r^2 / w^2]
  ((r Sqrt[2]) / w)^Abs[l] * LaguerreL[p, Abs[l], (2 r^2) / w^2] Exp[-I l ϕ]
DensityPlot[LG[Sqrt[x^2 + y^2], ArcTan[x, y], 1, 1, 1]^2 // Abs, {x, -3, 3},
 {y, -3, 3}, PlotRange → All, ColorFunction → GrayLevel, PlotPoints → 100,
 Exclusions → None, PlotLabel → Row[{Abs[ϕ]^2, "  p = 1, l = 1"}],
 FrameLabel → {{"y", None}, {"x", None}}, AxesStyle → Directive[Black, 12]]
```

Out[•]=

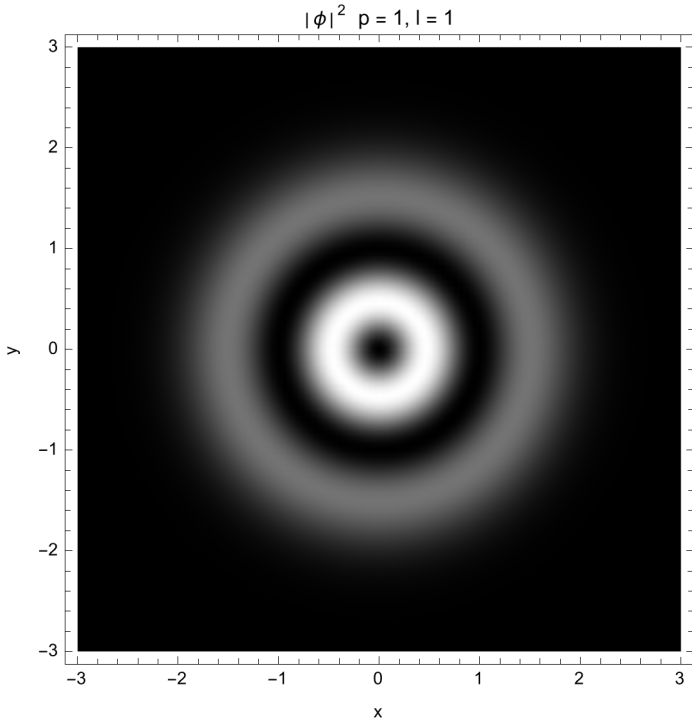


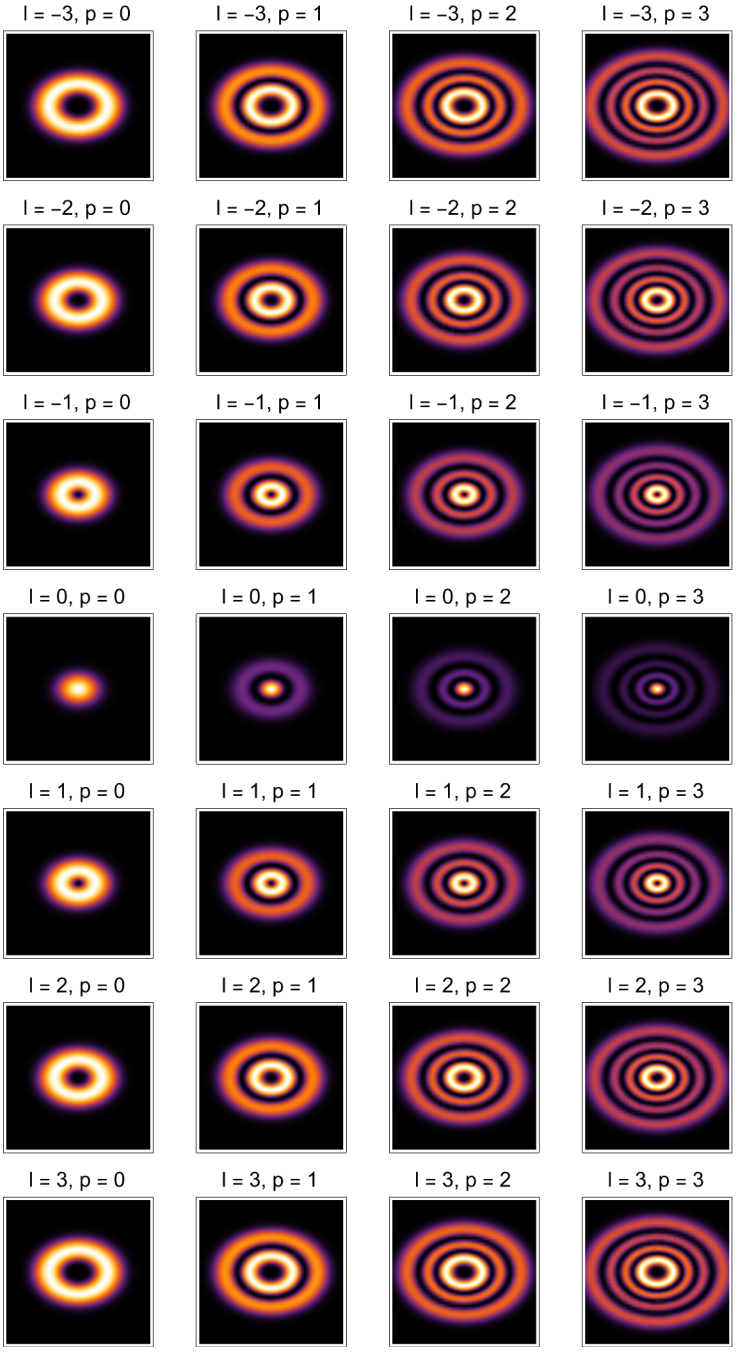
Table of intensity profiles

In[•]:=
```
LG[r_, ϕ_, p_, l_, w_] := Sqrt[(2 p !) / (π (p + Abs[l]) !)] (1 / w) * Exp[-r^2 / w^2]
  ((r Sqrt[2]) / w)^Abs[l] * LaguerreL[p, Abs[l], (2 r^2) / w^2] Exp[I l ϕ]

DensityPlotGrid[lRange_, pRange_] :=
 GraphicsGrid[Table[DensityPlot[LG[Sqrt[x^2 + y^2], ArcTan[x, y], p, l, 1]^2 // Abs,
    {x, -3, 3}, {y, -4, 4}, PlotRange → All, ColorFunction → "SunsetColors",
    PlotPoints → 50, Exclusions → None, FrameTicks → None,
    PlotLabel → Row[{"l = ", l, ", p = ", p}]], {l, lRange}, {p, pRange}]]

lRange = Range[-3, 3];
pRange = Range[0, 3];
DensityPlotGrid[lRange, pRange]
```

Out[•]=


l = −3, p = 0
l = −3, p = 1
l = −3, p = 2
l = −3, p = 3
l = −2, p = 0
l = −2, p = 1
l = −2, p = 2
l = −2, p = 3
l = −1, p = 0
l = −1, p = 1
l = −1, p = 2
l = −1, p = 3
l = 0, p = 0
l = 0, p = 1
l = 0, p = 2
l = 0, p = 3
l = 1, p = 0
l = 1, p = 1
l = 1, p = 2
l = 1, p = 3
l = 2, p = 0
l = 2, p = 1
l = 2, p = 2
l = 2, p = 3
l = 3, p = 0
l = 3, p = 1
l = 3, p = 2
l = 3, p = 3