Gaussian Beam

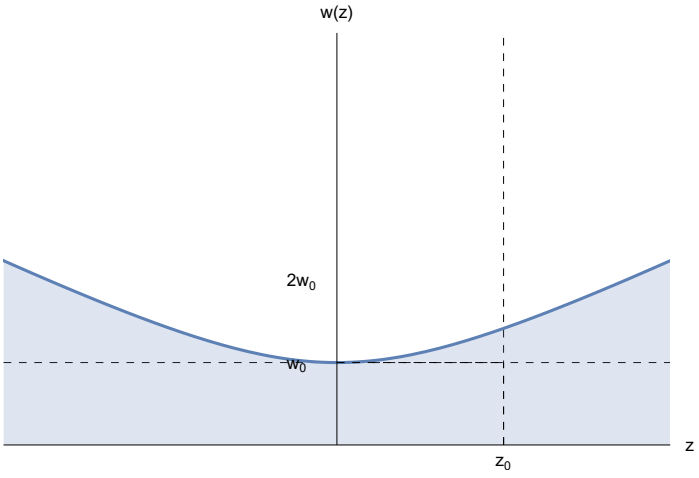
Beam Radius w(z) vs z

In[•]:=
```
w[z_, w0_, zR_] := w0 Sqrt[1 + (z / zR) ^2]

w0 = 1.0;  (*Initial beam waist radius*)
zR = 5.0;  (*Rayleigh range*)

Plot[w[z, w0, zR], {z, -10, 10}, PlotRange → {{-10, 10}, {0, 5}},
 AxesLabel → {"z", "w(z)"},
 Filling → Axis, (*Fills area below the curve*)
 Epilog → {Text[Subscript["w", "0"], {-1.5, w0}, {-1, 0}],
  Text[Subscript["2w", "0"], {-1.5, 2 w0}, {-1, 0}],
  Text["zR", {zR, -0.2}, {0, -1}], Dashed,
  Line[{{zR, 0}, {zR, w0}}], (*Dashed line at zR*)Dashed,
  Line[{{0, w0}, {zR, w0}}] (*Dashed line at w0*)},
 Ticks → {{{zR, Subscript["z", "0"]}}, None},
 GridLines → {{zR}, {w0}},
 GridLinesStyle → Directive[Black, Dashed]]
```

Out[•]=

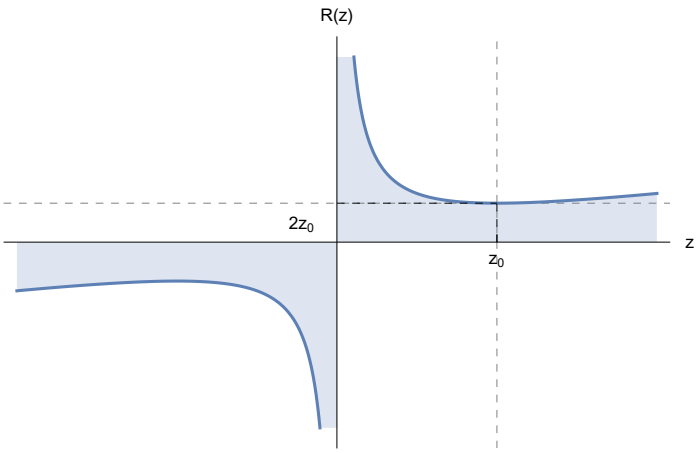


Radius of wavefront

In[•]:=
```
zR = 5.0;  (*Rayleigh range*)
R[z_] := z * (1 + (zR / z) ^ 2)

Plot[R[z], {z, -10, 10}, PlotRange → Automatic, AxesLabel → {"z", "R(z)"},
 GridLinesStyle → Directive[Gray, Dashed], Filling → Axis, Epilog →
  {Text[Subscript["2z", "0"], {-1.5, zR}, {-1, 0}], Dashed, Line[{{zR, 0}, {zR, 2 zR}}],
   (*Dashed line at zR*)Dashed, Line[{{0, 2 zR}, {zR, 2 zR}}] (*Dashed line at 2z0*)},
 Ticks → {{{zR, Subscript["z", "0"]}}, None}, GridLines → {{zR}, {2 zR}},
 GridLinesStyle → Directive[Black, Dashed]]
```

Out[•]=



SetDelayed: Tag List in ≪1≫[z_] is Protected.

Intensity of Gaussian Beam

```
(*Parameters*)I0 = 1.0;      (*Peak intensity*)
w0 = 1.0;      (*Beam waist at z=0*)
zR = Pi * w0^2 / 1.0; (*Rayleigh range*)


(*Beam waist as a function of z*)
w[z_] := w0 * Sqrt[1 + (z / zR) ^2]

(*Intensity formula*)
intensity[p_, z_] := I0 * (w0 / w[z]) ^2 * Exp[- (2 p^2) / w[z] ^2]

(*Plot the intensity*)
Plot3D[intensity[p, z], {p, -5, 5}, {z, -10, 10}, PlotRange → All,
 AxesLabel → {"p", "z", "Intensity"}, ColorFunction → "SunsetColors",
 PlotLabel → "Gaussian Beam Intensity", PlotPoints → 500]
```

Out[•]=