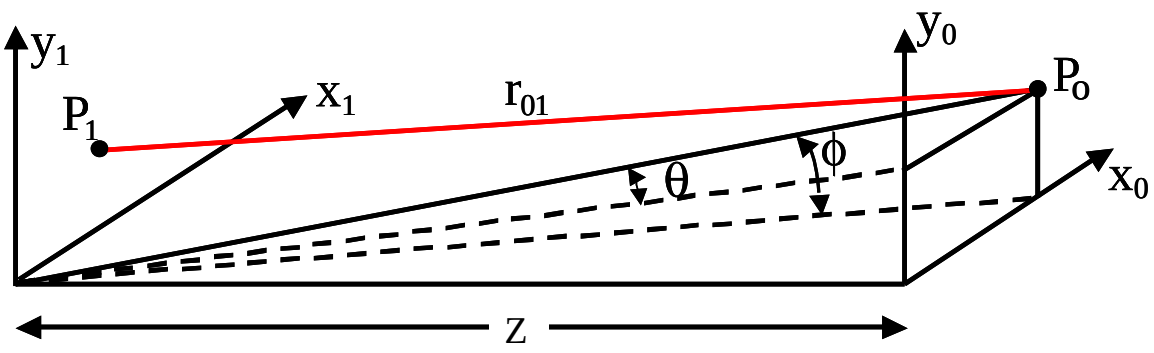
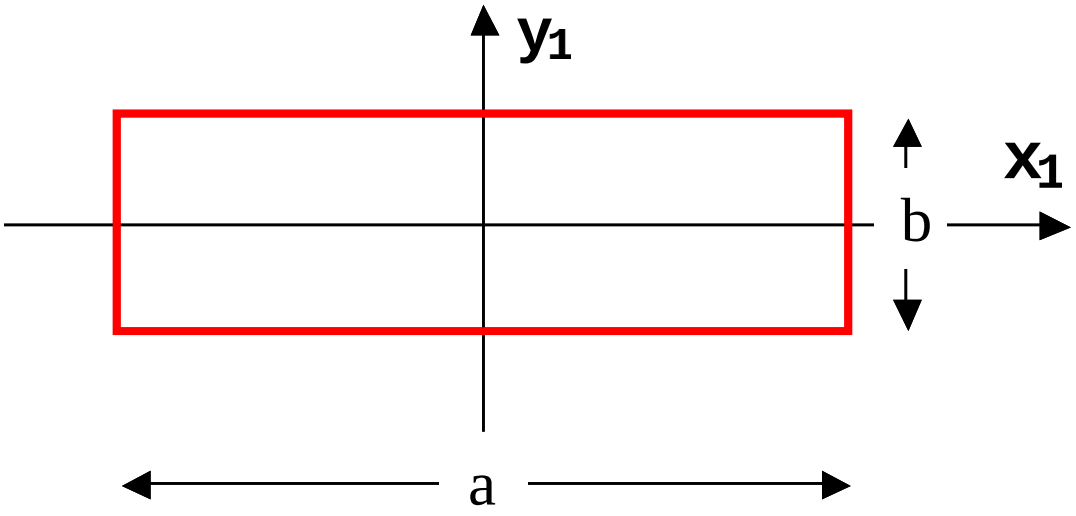
Fraunhofer Diffraction Pattern of Rectangular Aperture

Experimental Diagram



Aperture



Intensity Distribution

$$I_\theta = I_o \frac{\text{Sin}[\alpha]^2}{\alpha^2} \frac{\text{Sin}[\beta]^2}{\beta^2}$$

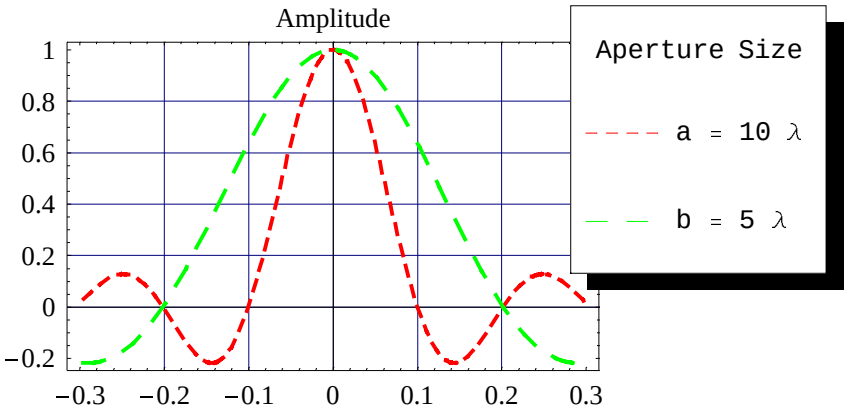
```
α = π a Sin[θ] / λ ;      β = π b Sin[ϕ] / λ ;

amplitude[θ_, ϕ_] := a_o (Sin[π a Sin[θ] / λ] / (π a Sin[θ] / λ)) (Sin[π b Sin[ϕ] / λ] / (π b Sin[ϕ] / λ));

amplitude[0, ϕ_] := a_o Sin[π b Sin[ϕ] / λ] / (π b Sin[ϕ] / λ);

amplitude[θ_, 0] := a_o Sin[π a Sin[θ] / λ] / (π a Sin[θ] / λ);

amplitude[0, 0] := a_o;
intensity[θ_, ϕ_] := amplitude[θ, ϕ]^2;
```

Input parameters

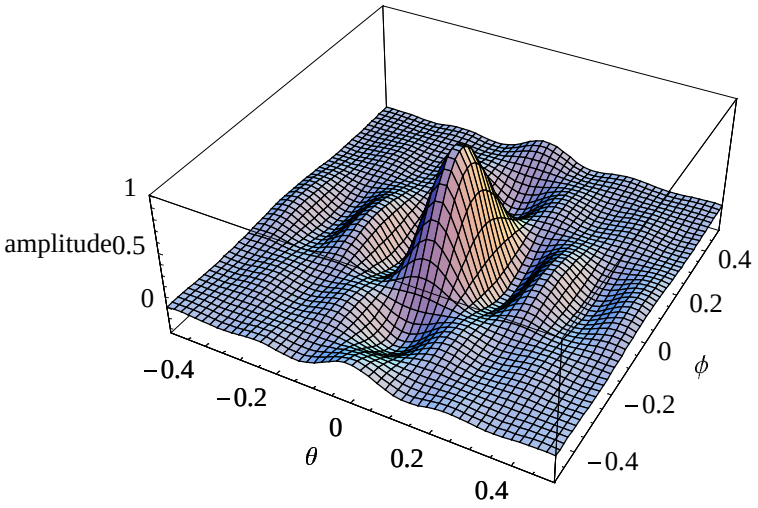
```
a = 10 λ;   b = 5 λ;   a_o = 1;
```

Plots

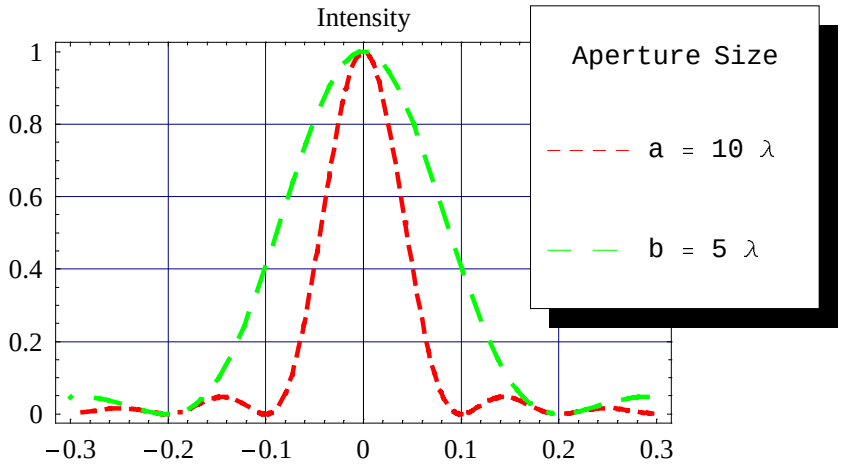
```
Plot[{amplitude[θ, 0], amplitude[0, θ]}, {θ, -.3, .3},
  PlotLabel → "Amplitude", PlotRange → All, AxesOrigin → {0, 0},
  Frame → True, GridLines → Automatic, DefaultFont → {"Times-Roman", 10},
  PlotStyle → {{RGBColor[1, 0, 0], Dashing[{.02, .02}], Thickness[.008]},
    {RGBColor[0, 1, 0], Dashing[{.04, .04}], Thickness[.008]}},
  Background → RGBColor[1, 1, 1], PlotLegend -> {"a = 10 λ", "b = 5 λ"},
  LegendPosition -> {.8, -.2},
  LegendLabel -> "Aperture Size"];
```



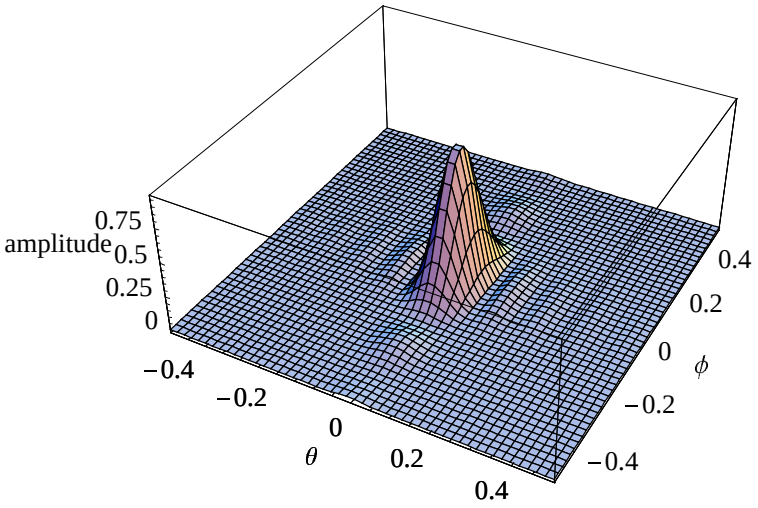
```
Plot3D[amplitude[θ, ϕ], {θ, -.5, .5}, {ϕ, -.5, .5},
  PlotPoints -> 50, AxesLabel -> {"θ", "ϕ", "amplitude"},
  DefaultFont → {"Times-Roman", 10}, PlotRange -> All, Background → White];
```




```
Plot[{intensity[θ, 0], intensity[0, θ]}, {θ, -.3, .3},
  PlotLabel → "Intensity", PlotRange → All, AxesOrigin → {0, 0},
  Frame → True, GridLines → Automatic, DefaultFont → {"Times-Roman", 10},
  PlotStyle → {{RGBColor[1, 0, 0], Dashing[{.02, .02}], Thickness[.008]},
    {RGBColor[0, 1, 0], Dashing[{.04, .04}], Thickness[.008]}},
  Background → RGBColor[1, 1, 1], PlotLegend -> {"a = 10 λ", "b = 5 λ"},
  LegendPosition -> {.5, -.2},
  LegendLabel -> "Aperture Size"];
```



```
Plot3D[intensity[θ, ϕ], {θ, -.5, .5}, {ϕ, -.5, .5},
  PlotPoints -> 50, AxesLabel -> {"θ", "ϕ", "amplitude"},
  DefaultFont → {"Times-Roman", 10}, PlotRange -> All, Background → White];
```




```
DensityPlot[intensity[θ, ϕ], {θ, -.5, .5}, {ϕ, -.5, .5},
Mesh -> False, PlotPoints -> 200, Axes -> True,
AxesLabel -> {"θ", "ϕ"}, PlotLabel -> "Intensity",
  DefaultFont → {"Times-Roman", 10}, Background → White];
```