May 3, 2013  
Physics 132  
Prof. E. F. Redish

■ Theme Music:  
Carl Clements  
Diffraction

■ Cartoon:  
Pat Brady  
Rose is Rose

Foothold ideas:  
EM waves

■ Point source:  
- An oscillating charge sends out a sphere of oscillating EM wave.

■ Wavelets:  
- Any point in space with an oscillating EM wave sends out a sphere of oscillating EM wave.

■ Superposition:  
- The resulting pattern at any point is the sum of the waves received.
Analysis of models

- Model 1:
  - One slit (where we can neglect the width) produces an outgoing oscillating EM wave.

- Model 2:
  - Two slits (where we can neglect the width) add together and the result depends on where you are (2 slit pattern)

- Model 3:
  - One slit (where we cannot neglect the width): Each bit of the slit acts like a narrow slit source. You have to add them all together to get the result (1 slit pattern)

- Model 4:
  - Two slits (where we cannot neglect the width): the two patterns multiply together.

\[ y = L \tan \theta \approx L \theta \]

\[ \Delta r = a \sin \theta \approx a \theta \]
Slits are really much, much closer than shown so this point is almost all the way to the left.

For small angles, $\sin \theta \sim \theta$, $\tan \theta \sim \theta$  
\[
\frac{\Delta r}{a} = \frac{y}{L} \quad \Rightarrow \quad y = \Delta r \left( \frac{L}{a} \right)
\]

Maximum when
\[
\Delta r = \lambda, \ 2\lambda, \ 3\lambda, ... = n\lambda
\]

Minimum when
\[
\Delta r = \frac{1}{2} \lambda, \ \frac{3}{2} \lambda, \ \frac{5}{2} \lambda, ... = (n + \frac{1}{2})\lambda
\]