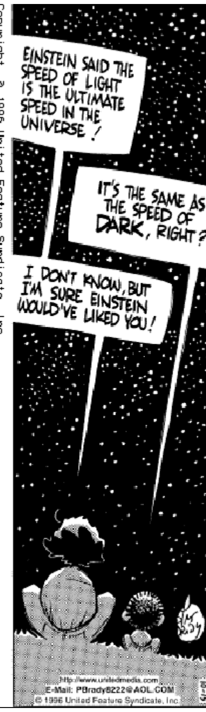
May 3, 2013

Physics 132
Prof. E. F. Redish

- **Theme Music:**
  Carl Clements
  Diffraction
- **Cartoon:**
  Pat Brady
  Rose is Rose



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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.

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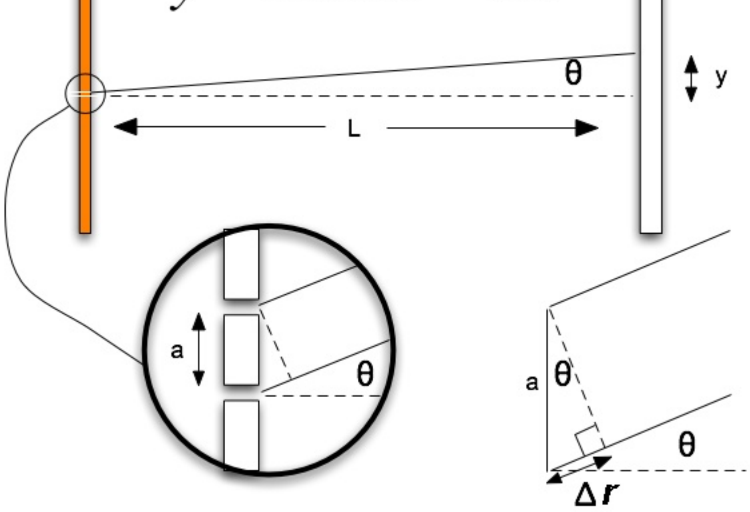
Analysis of models

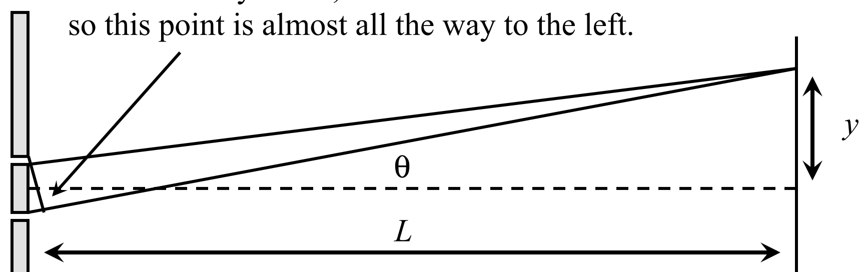
- Model 1:
  - One slit (where we can neglect the width) produces an outgoing oscillating EM wave.
- Model 2:
  - Two slits (where we can neglect the width) add together and the result depends on where you are (2 slit pattern)
- Model 3:
  - One slit (where we cannot neglect the width): Each bit of the 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.

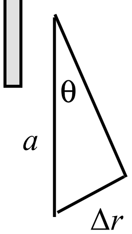
$$y = L\tan\theta \approx L\theta$$



$$\Delta r = a\sin\theta \approx a\theta$$

Slits are really much, much closer than shown so this point is almost all the way to the left.





$$\sin\theta = \frac{\Delta r}{a}$$

$$\tan\theta = \frac{y}{L}$$

Maximum when

$$\Delta r = \lambda,\ 2\lambda,\ 3\lambda, \ldots = n\lambda$$

Minimum when

$$\Delta r = \tfrac{1}{2}\lambda,\ \tfrac{3}{2}\lambda,\ \tfrac{5}{2}\lambda, \ldots = (n + \tfrac{1}{2})\lambda$$

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

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