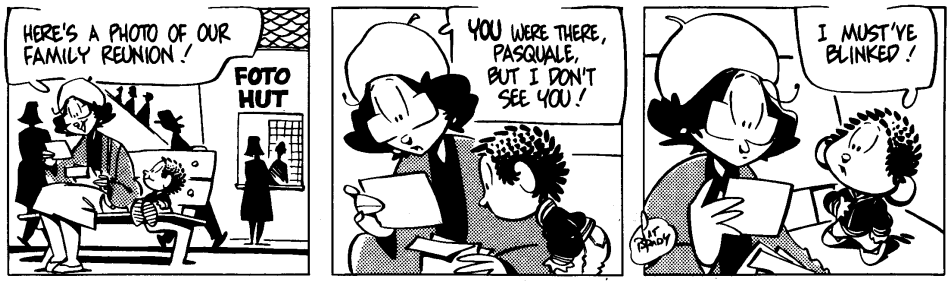
May 1, 2013 Physics 132 Prof. E. F. Redish

- **Theme Music: Kronos Quartet**
  Tashweesh (Interference)
- **Cartoon: Pat Brady**
  Rose is Rose



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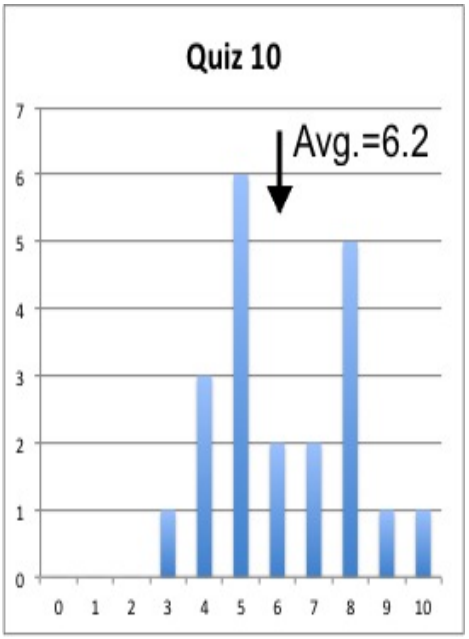
	10.1	10.2.1	10.2.2	10.3
A	0%	0%	10%	5%
B	5%	10%	67%	57%
C	24%	33%	5%	0%
D	0%	57%	19%	33%
E	57%			5%
F	19%			



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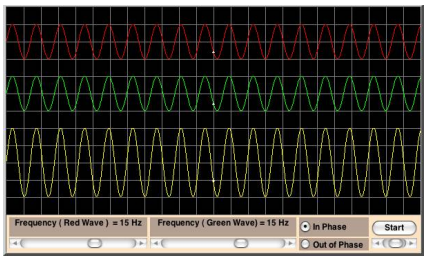
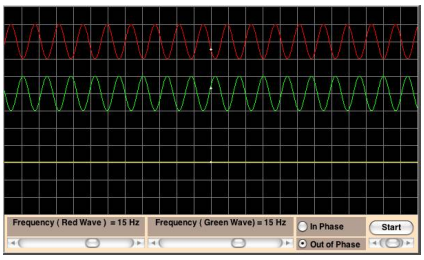
Foothold wave ideas: Huygens' Principle

- The critical structure for waves are the lines or surfaces of equal phases: wavefronts.
- Each point on the surface of a wavefront acts as a point source for outgoing spherical waves (wavelets).
- The sum of the wavelets produces a new wavefront.
- The waves are slower in a denser medium.
- The reflection principle and Snell's law follow from the assumptions of the wave model.

Beats

- When we add two waves of the same frequency,
  - if their phases differ by 0, 2π, 4π, …. they add (constructive interference).
  - if their phases differ by π, 3π, 5π, …. they cancel





Phase difference and path difference

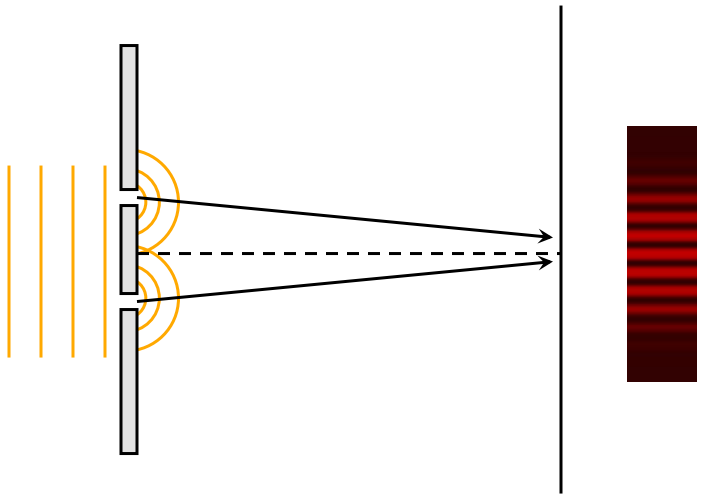
- Our two waves from different sources have a phase difference, because we are different distances from the two sources.

$$y = A\sin(kr_1 - \omega t) + A\sin(kr_2 - \omega t)$$
$$y = A\sin(\phi_1 - \omega t) + A\sin(\phi_2 - \omega t)$$
$$\phi_1 - \phi_2$$

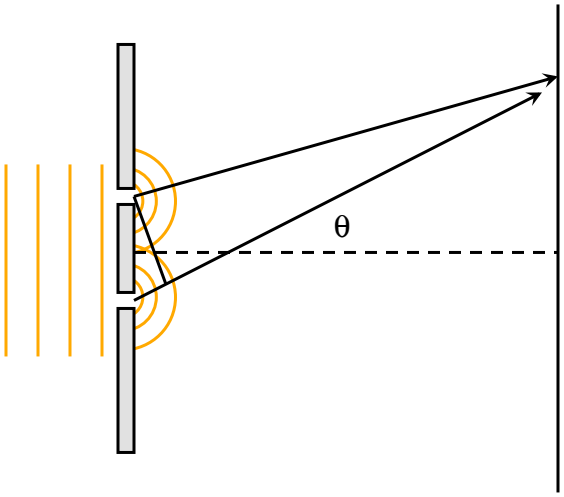
- The phase difference depends on the path difference:

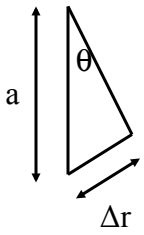
$$\phi_1 - \phi_2 = kr_1 - kr_2 = k(r_1 - r_2) = k\Delta r = 2\pi\frac{\Delta r}{\lambda}$$

A First Test: Interference



A First Test: Interference

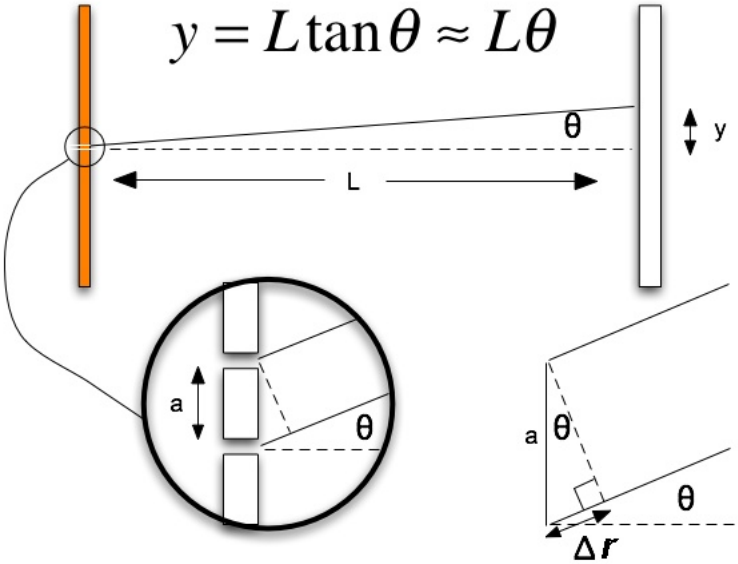




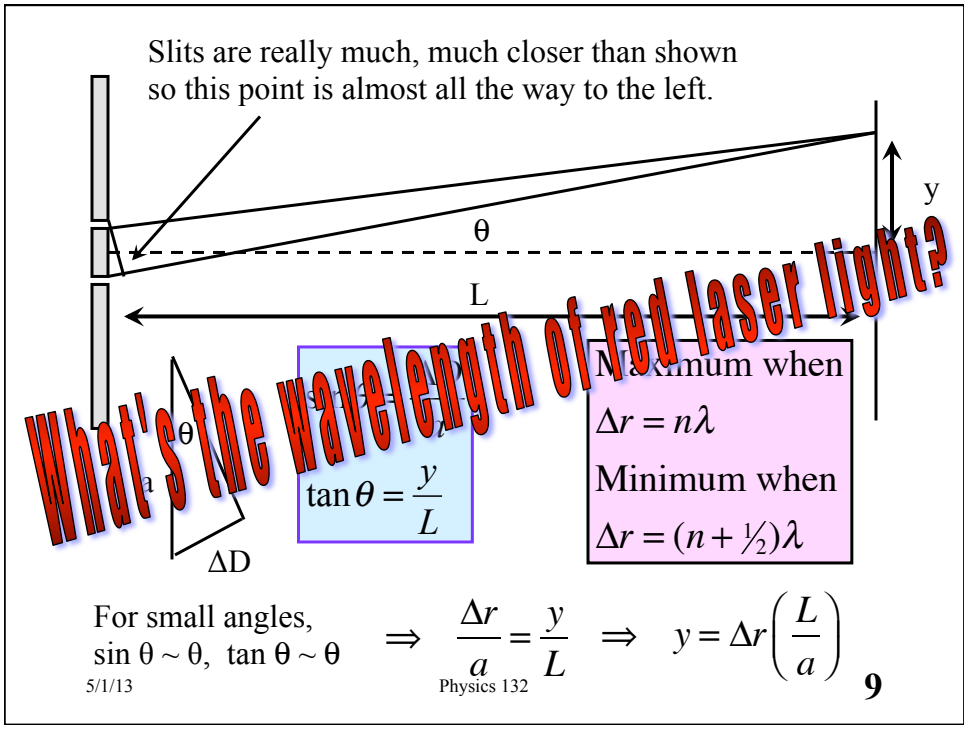
When $\Delta r = n\lambda$, waves add.

When $\Delta r = (n+1/2)\lambda$, waves cancel

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



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


Slits are really much, much closer than shown
so this point is almost all the way to the left.
y
θ
L
a
θ
ΔD
What's the wavelength of red laser light?
Maximum when
$\Delta r = n\lambda$
Minimum when
$\Delta r = (n + \frac{1}{2})\lambda$
$\tan\theta = \frac{y}{L}$
For small angles,
sin θ ~ θ, tan θ ~ θ
$\Rightarrow \quad \frac{\Delta r}{a} = \frac{y}{L} \quad \Rightarrow \quad y = \Delta r\left(\frac{L}{a}\right)$
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