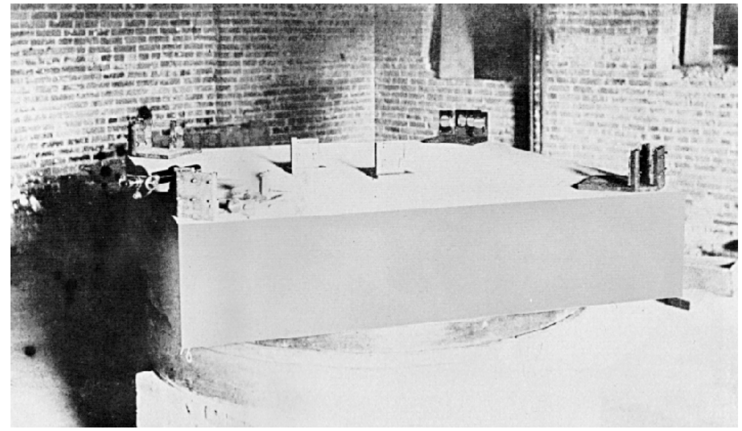
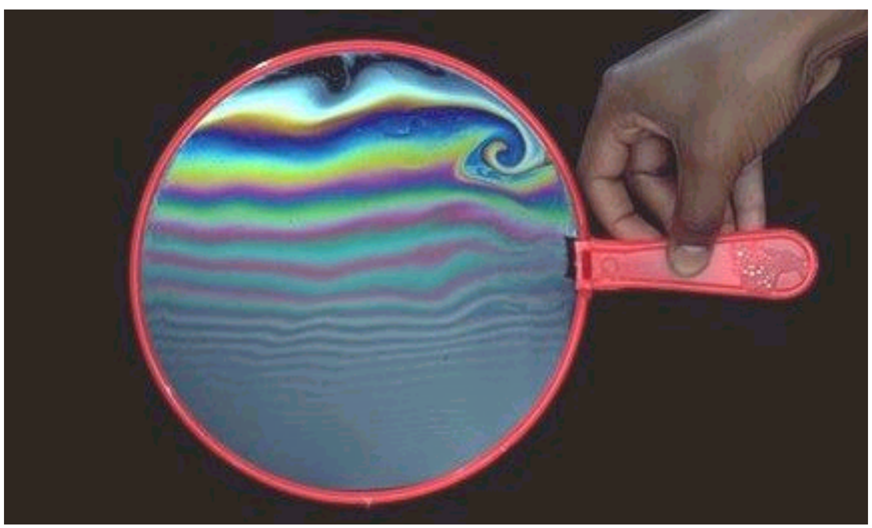
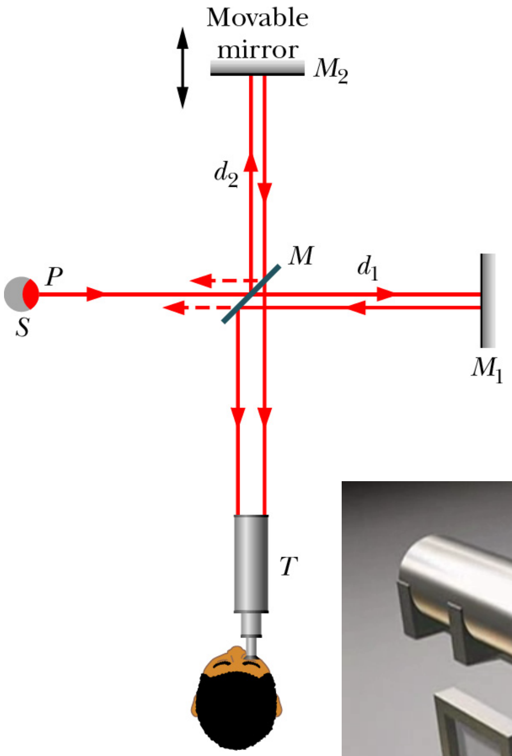


Interference

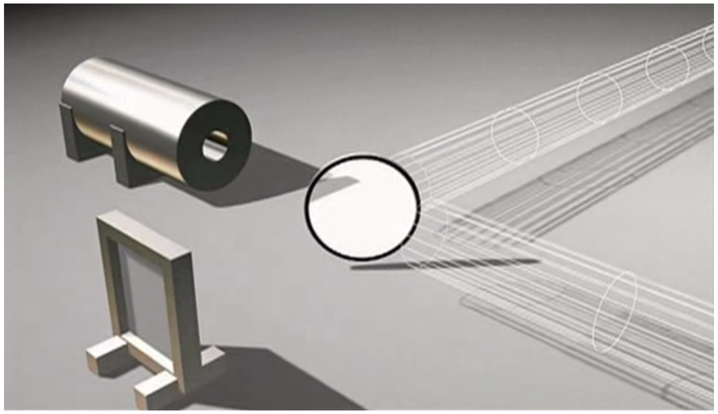


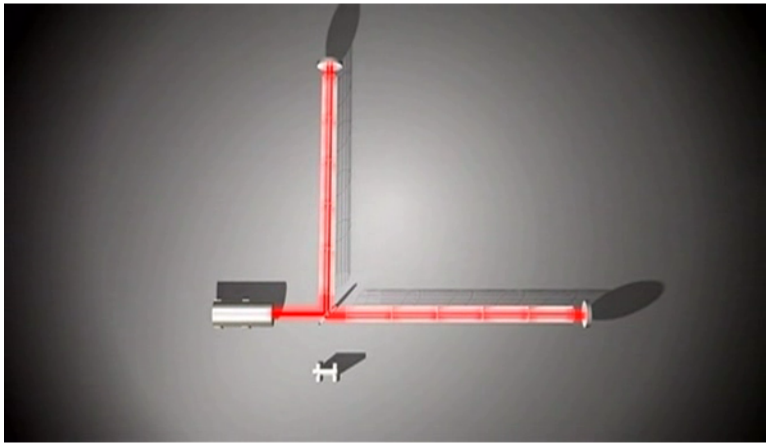
Michelson interferometers:

As we saw in the previous example, interference is a spectacular way of measuring small distances (like the thickness of a soap bubble), since we are able to resolve distances of the order of the wavelength of the light (for instance, for yellow light, we are talking about 0.5 of a millionth of a meter, 500nm). This has therefore technological applications.



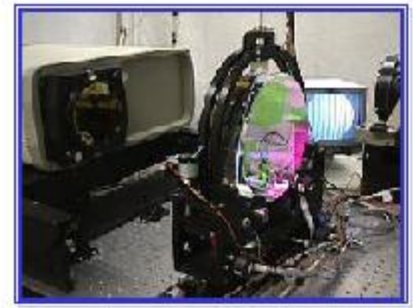
In the Michelson interferometer, light from a source (at the left, in the picture) hits a semi-plated mirror. Half of it goes through to the right and half goes upwards. The two halves are bounced back towards the half plated mirror, interfere, and the interference can be seen by the observer at the bottom. The observer will see light if the two distances travelled d_1 and d_2 are equal, and will see darkness if they differ by half a wavelength.

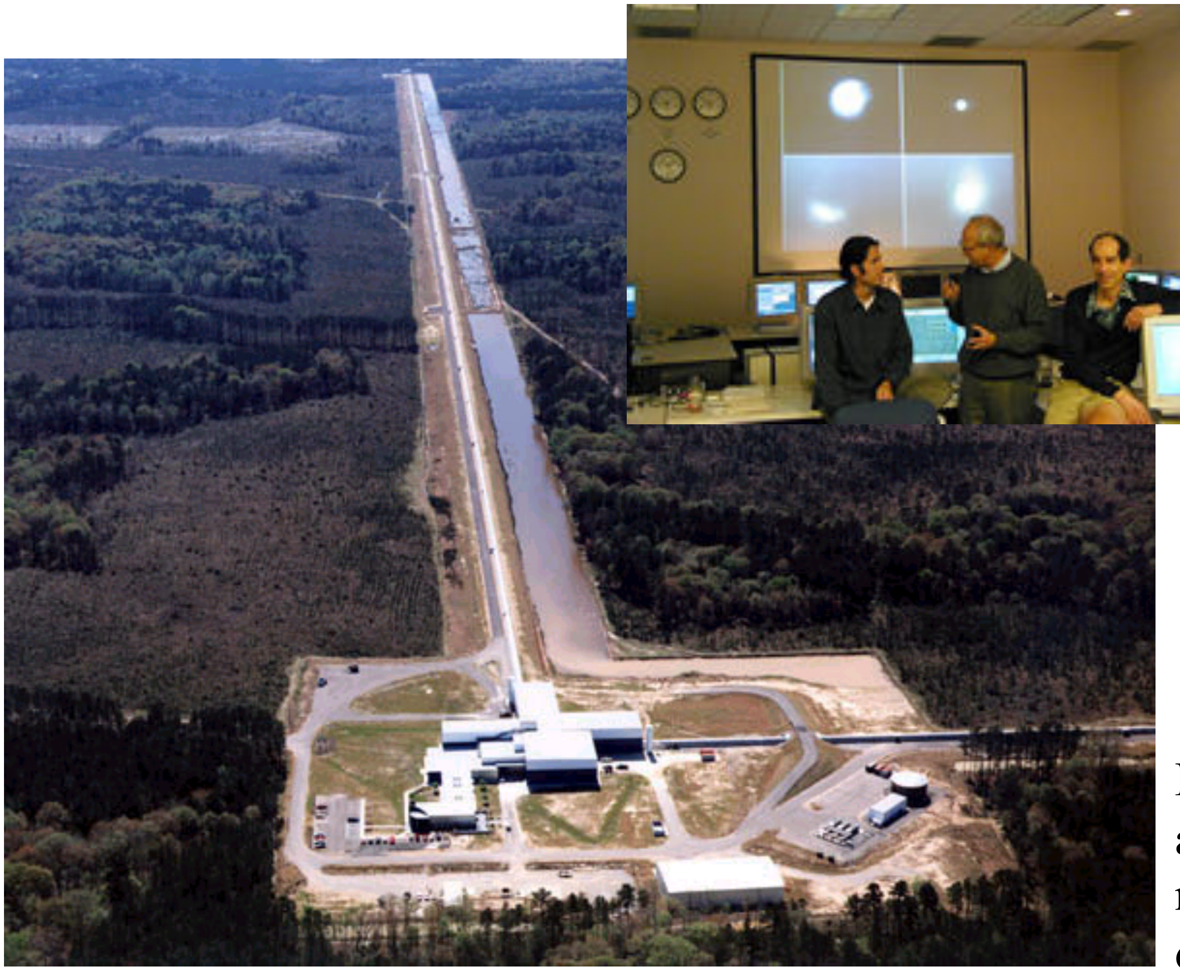




Einstein’s messengers (einsteinsmessengers.org)

The largest Michelson interferometer in the world is in Livingston, LA, in LSU owned land (it is operated by a project funded by the National Science Foundation run by Caltech and MIT, and LSU collaborates in the project).



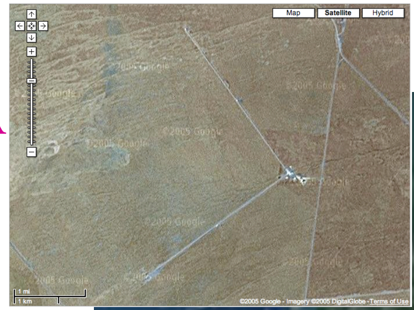


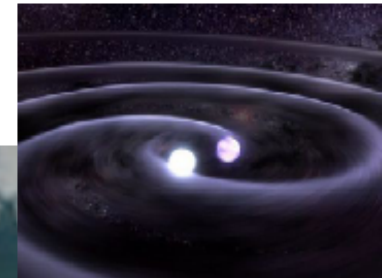
Mirrors are suspended with wires and isolated from the ground motion. The interferometer will detect ripples in the distance between the mirrors.

http://www.ligo-la.caltech.edu

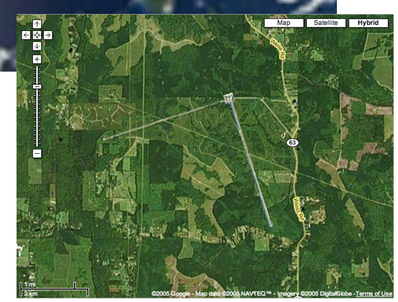
The LIGO project

Hanford, WA





Lunch time at LSC Summit



Hundreds of people working on the experiment and looking at the data:

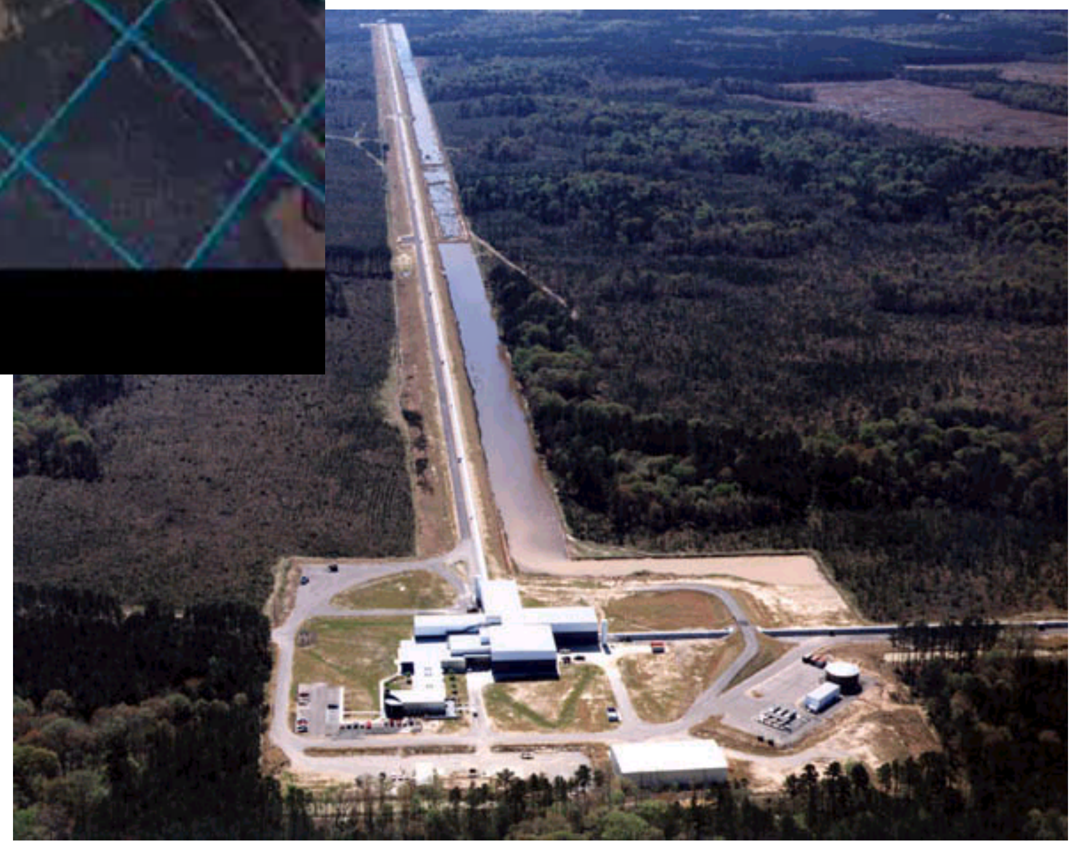
LIGO Scientific Collaboration

www.ligo.org

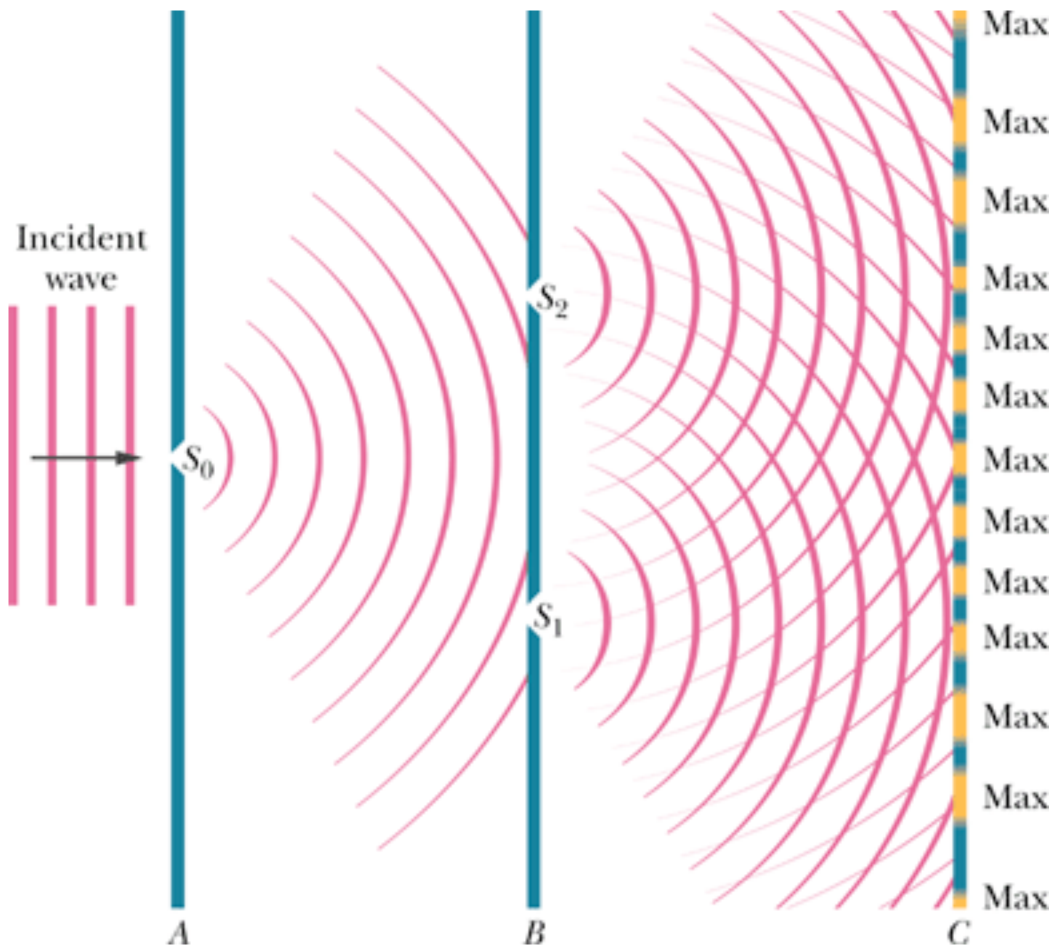
Livingston, LA

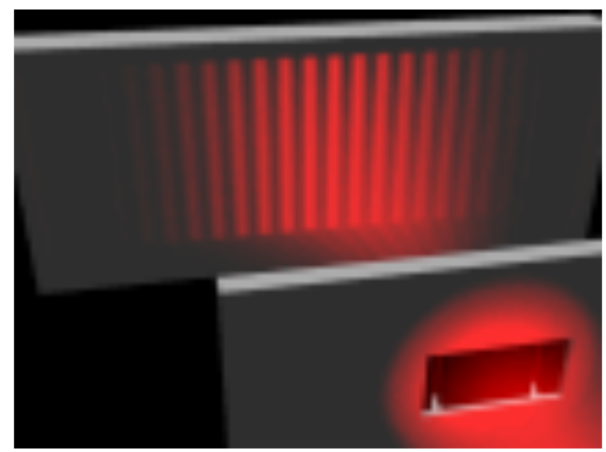
http://www.amnh.org/sciencebulletins/?sid=a.f.gravity.20041101&src=l

American Museum of Natural History Science Bulletins
Gravity: Making Waves

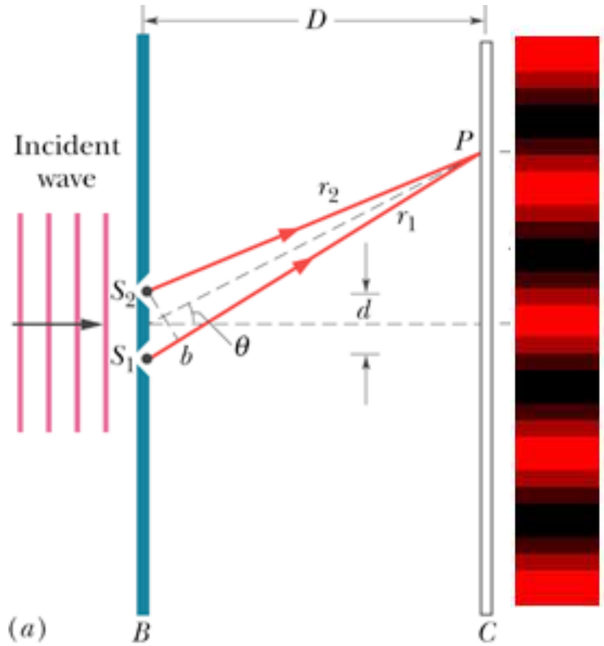


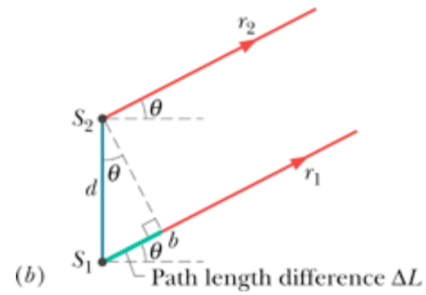
Young's double slit experiment





Young's double slit experiment





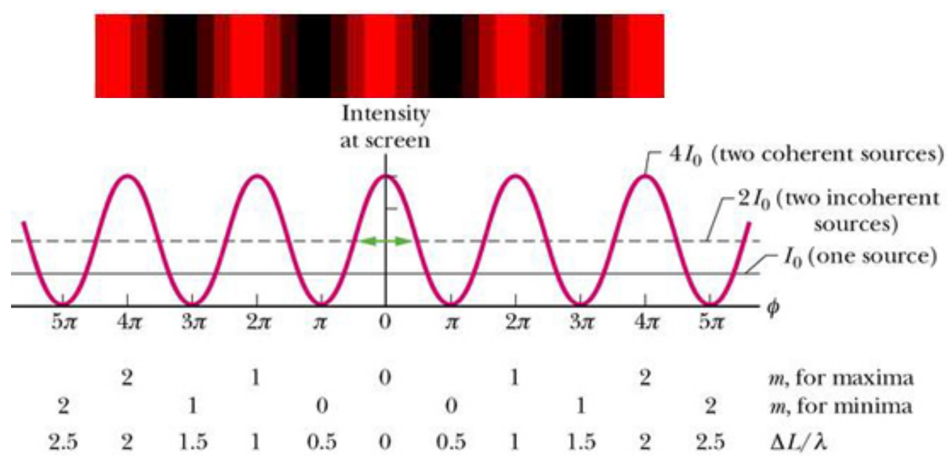
Path difference: $\Delta L = d \sin \theta$

Bright fringe: $\Delta L = m\lambda = d \sin \theta$

Dark fringe: $\Delta L = (m+1/2)\lambda = d \sin \theta$

The intensity on the screen is

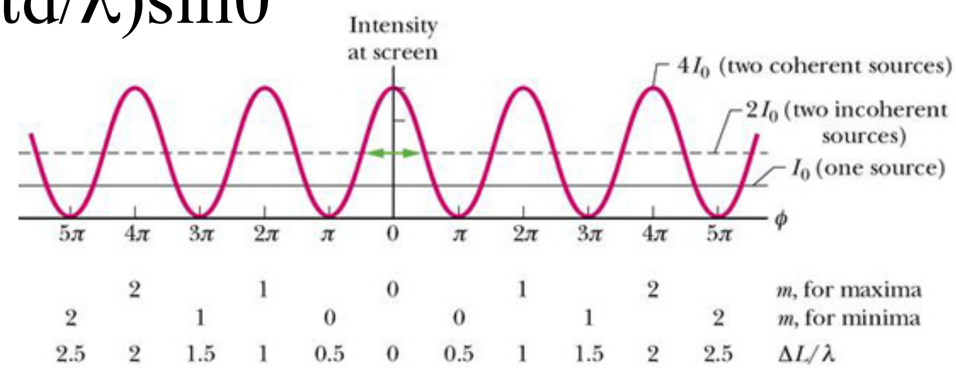
$I/I_0 = 4\cos^2\phi/2$ with $\phi = (2\pi d/\lambda)\sin\theta$



Bright fringe: $\Delta L = m\lambda = d \sin \theta$

Dark fringe: $\Delta L = (m+1/2)\lambda = d \sin \theta$

$I/I_0 = 4\cos^2\phi/2$ with $\phi = (2\pi d/\lambda)\sin\theta$

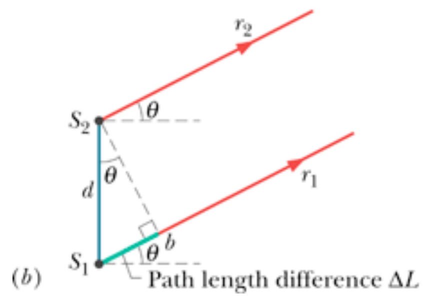


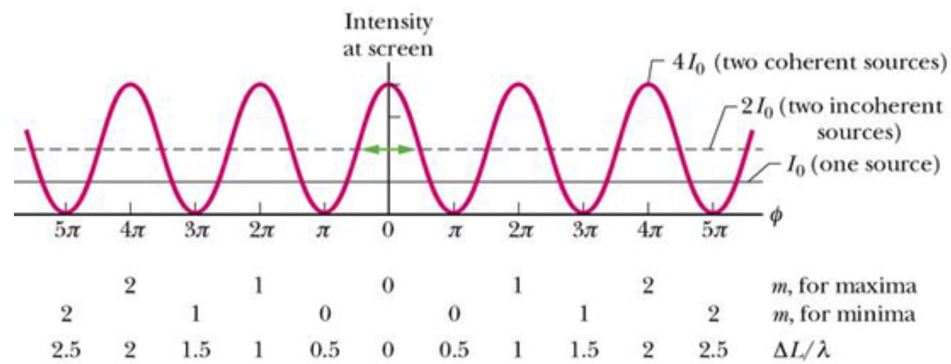
Does the spacing between fringes in a two-slit interference pattern increase, decrease, or stay the same if (a) the slit separation is increased, (b) the color of the light is switched from red to blue, and (c) the whole apparatus is submerged in cooking sherry? (d) If the slits are illuminated with white light, then at any side maximum, does the blue component or the red component peak closer to the central maximum?

Bright fringe: $\Delta L = m\lambda = d \sin\theta$

Dark fringe: $\Delta L = (m+1/2)\lambda = d \sin\theta$

$I/I_0 = 4\cos^2\phi/2$ with $\phi = (2\pi d/\lambda)\sin\theta$





In a double-slit experiment, the fourth-order maximum for a wavelength of 450 nm occurs at an angle of $\theta = 90°$. Thus, it is on the verge of being eliminated from the pattern because θ cannot exceed 90° in Eq. 35-14. (a) What range of wavelengths in the visible range (400 nm to 700 nm) are not present in the third-order maxima? To eliminate all of the visible light in the fourth-order maximum, (b) should the slit separation be increased or decreased and (c) what least change in separation is needed?