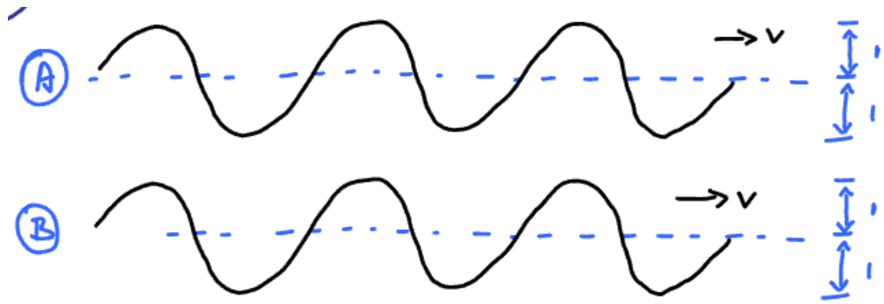
Physics 102 – Spring 2014 – Recitation module 5

Waves A and B travel in space together. How would the wave appear that results from the interference of A and B?



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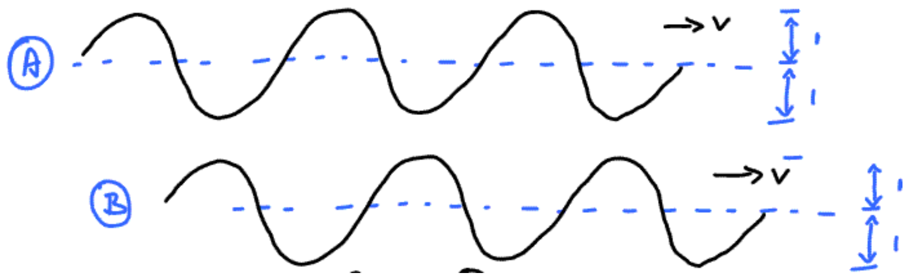


Watch this youtube clip of a star wars space battle - http://www.youtube.com/watch?v=lchA-lwqrPw

Entertaining? Yes. Physically accurate? No. What is wrong with this scene from the point of view of physics as we know it?

Check out these scenes of Wile E. Coyote

http://www.youtube.com/watch?v=Gq_bjaI0NTo

http://www.youtube.com/watch?v=57HiGcMSu28

What's wrong with each of these scenes physically?

Is it a good thing that there are inaccurate depictions of science for the sake of successful entertainment?

How long does it take light to travel from New York to San Francisco (a distance of approximately 5000 kilometers)?

What is the wavelength of a radio wave that has a frequency of 1 MHz?

What is the wavelength of blueish light having a frequency of 6×10^{14} Hz?

How many times per second does the electric field oscillate back and forth in such light?

Red light has a wavelength of 700 nm. Light in a vacuum travels at 3×10^{8} m/s. What is the frequency of red light?

Every gradeschooler knows that if you mix yellow with blue you can get green … Does this mean that if I shoot a beam of yellow light (λ=550 nm) into a beam of blue light (λ=450 nm) that I get a beam of green light (λ=500 nm)? Why or why not?

Your TA can supply you with a slinky. PLEASE TAKE CARE NOT TO STRETCH THE SLINKY TOO MUCH OR IT WILL NOT RECOIL PROPERLY … EVER AGAIN … AND WILL BE RUINED.

Two members of your group should lightly stretch the slinky a distance of 3 or 4 meters. Your TA will demonstrate the difference between a "transverse" wave and a "longitudinal" wave on the slinky. Water waves, waves on strings, and light waves are all transverse waves. Sound waves are longitudinal waves.

Have the person at one end of the slinky move their end up and down (or side to side) smoothly at a fixed frequency. The wave moving down the slinky will interfere with the wave returning after being reflected at the other end. It is possible to get these waves to interfere in such a way that "standing wave" patterns are formed.

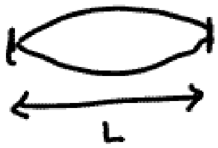
Can you form a “standing wave” with zero nodes? If this were a string on a violin or a guitar or a piano, this vibration would correspond to the fundamental frequency of that string.

Can you form the “standing wave” with one node, corresponding to the first harmonic vibration of the “string”?

Can you form the “standing wave” with one node, corresponding to the first harmonic vibration of the “string”?

Do not attempt to form higher harmonic vibrations. You’ll end up hurting the slinky or one of your classmates.

For a string (or slinky) of length L, what frequencies (or periods) give standing waves? The following is an analysis of this problem:



0 nodes

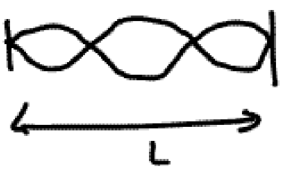
$$L = \frac{1}{2}\lambda \qquad v = \lambda\nu \qquad \lambda = v/\nu$$

$$L = \frac{1}{2}\frac{v}{\nu} \rightsquigarrow \nu = \frac{1}{2}\frac{v}{L}$$

1 node

$$L = \lambda \qquad \nu = \frac{2}{2}\frac{v}{L}$$

$$L = \frac{v}{\nu}$$



2 nodes

$$L = \frac{3\lambda}{2} \qquad \nu = \frac{3}{2}\frac{v}{L}$$

$$L = \frac{3}{2}\frac{v}{\nu}$$

⋮

$$\boxed{\nu_n = \frac{n}{2}\frac{v}{L}}$$

frequencies that will resonate on String (or Slinky) of length L

$n = 1, 2, 3 \ldots$

V is the speed of propagation of the wave on the string. That speed depends on the tension and the mass of the string. This is why the pitch of a stringed instrument changes when the string is tightened or loosened.

With what you have at hand, can you design an experiment to see if the relationship above seems to work for waves on a slinky? Discuss it with your TA and try it out!

What argument does Nick Bostrom use to infer that we are most likely living in a simulation?

How is it an advanced society might not end up running simulations like those discussed in Bostrom's article?

Is the computational multiverse a scientific concept?

Suppose we discovered strong scientific evidence that we ARE living in a simulation? What would happen?