Physics 202 Lab 4
Waves on Strings

May 6, 2013

Equipment

- 2-meter stick
- Elastic string
- Mechanical vibrators
- Power amplifiers with cord
- Scissors
- Physics string
- Banana plug & clip
- Clamps with pulley
- Clamps with metal bar
- Hanging weight sets

For all waves, the wave speed, v, is equal to the product of the frequency, f, and the wavelength, λ:

$$v = f\lambda \tag{1}$$

For waves in a string, the wave speed, v, is determined by

$$v = \sqrt{T/\mu} \tag{2}$$

where T is the tension in the string, and μ is the mass per length, or linear density of the string ($\mu = m/L$).

Initial Set-Up

Set up a standing wave in the string by varying the tension and the frequency. Make sure that you don't hang so much weight from the end of the string that it stretches the string by a noticeable amount. You will be able to achieve the best result by fine-tuning the frequency until you clearly see a standing wave of maximum amplitude.

Calculate the wavelength of the standing wave by dividing the length of the string that is vibrating, by the number of full wavelengths it contains.

Calculate the wave speed using equation 1.

Find the Harmonics

Now, considering the total length of the vibrating string, calculate the wavelengths of the first 10 harmonics for your system.

For each wavelength, use the wave speed, v, for your system to determine the corresponding harmonic frequency.

Now adjust the mechanical vibrator to each of these frequencies, in turn, and verify that these are indeed the first ten harmonic frequencies of your system.

Verify Linear Density

Now using equation 2, with the value for v that you calculated, and the tension in the string ($T = mg$), solve for μ, the linear density of the string.

Now, remove the string from the setup, measure its mass and its entire length (undo any knots), and compare your value for μ obtained in this manner, to the value obtained in the previous step

Rinse and repeat

Repeat the previous steps for a different type of string.