

---

# PHYSICS 126 EXPERIMENT NO. 7

## STANDING WAVES

---

In this experiment, standing waves will be observed in a vibrating string. The wavelengths of the waves and the tension in the string will be measured. From these measurements and the frequency of the wave, the mass per unit length of the string will be determined.

The velocity of transverse traveling waves in a stretched string is given by

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

where **T** is the tension in the string and  $\mu$  is the mass per unit length of the string. The wavelength of the wave is then

$$\lambda = \frac{v}{f} = \frac{1}{f} \sqrt{T/\mu}$$

where **f** is the frequency of the wave.

In your apparatus, a 60 Hz traveling wave is generated by a vibrating reed attached to one end of the string. The tension in the string is generated by a weight hung from the other end of the string. (See Fig. 1) The traveling wave is reflected back along the string at the pulley, and this reflected wave is reflected again at the vibrator.

When the second reflected wave is in phase with the original wave, a standing wave pattern will be observed in the string. The distance between nodes is one-half the wavelength of the wave.

1. Place a 100 g mass on the end of the string. Adjust the position of the vibrating reed until a stable, standing wave pattern is observed. Measure the wavelength  $\lambda$  of the wave, and estimate the uncertainty.
2. Try to make standing wave patterns for several different positions of the reed (each different by  $1/2$  wavelength).
3. Repeat the above procedures using at least three other masses

Plot  $\lambda^2$  as a function of  $\mathbf{T}$ , the tension of the string, and from the slope of this curve (and your knowledge of the frequency!), determine  $\mu$ , the mass per unit length of the string. Estimate the uncertainty in this result. Compare with the mass per unit length determined by weighing a known length of string.

4. Repeat the procedure using a piece of copper wire in place of the string.

Q1. What do you expect to change?

