Experiment 3

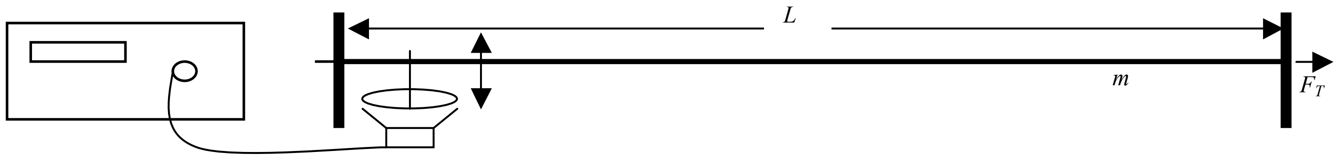
Vibrating Strings

In this experiment you shake a stretched flexible string. When you shake rhythmically at the correct frequency, the string forms a large **standing wave** pattern. The vibrating string **resonates** at certain frequencies, which are determined by the properties of the system. You use your observations to determine the **wave speed** on the string.

Preliminaries.

This experiment investigates the resonance conditions of a simple system consisting of a taut cord fixed at the ends and connected to an external driving mechanism.

Figure 1. Schematic for Standing Waves Experiment



Introduction

1) What does theory tell us about the speed of a transverse wave on a string? What does it depend on? How will we measure the properties of the string that are necessary to determine the theoretical speed of a wave on the string?

What happens when a generated wave hits a (fixed) boundary and reflects back? Can you explain how a standing wave is formed when the reflected wave interferes with the incident wave? What does your theory tell you about the allowed wavelengths of a standing wave on a string fixed at both ends? Please make a drawing showing the nodes and antinodes. What are the allowed frequencies?

We are able to measure the frequency with which we excite the string, and the wavelength. This will yield the experimental speed of the wave on a string. How you determine the wave speed from experimental measurement of λ and f. Should the wave speed change with different selected values of f?

Procedure.

• Make sure you know what measurements you are going to take

• Set up standing waves of different frequencies using the speaker driver. How will you identify a resonant frequency? You should try making the amplitude as small as possible and then make it bigger. Setting it too high may damage the speaker!! Is it easier to identify the resonant frequency with small driving amplitude or large driving amplitude? Find out!

• Calculate the wavelength from the average distance between nodes.

• Look for at least four other resonant frequencies. Record the frequency and the wavelength for each standing wave.

• Graph the data with the "wavelength" on the vertical axis and "frequency" on the horizontal axis.

• Make another graph so that there is a linear relationship (it can be fit with a straight line). How will you measure the experimental wave speed from this graph?

• Calculate the theoretical wave speed from string properties.

• State if your experimental results support the predominant theory. Does the experimental measurement of wave speed match the theoretical wave speed within expected uncertainties?

4. Suppose you redo the experiment with the same cord pulled to a longer length. Explain how the

following quantities change: string tension, mass density, wave speed, wavelengths of standing waves, frequencies of standing waves. How would your straight line graph change with this new system?

PVS. 4/14