3. String Resonance

PURPOSE AND BACKGROUND

THEORY AND EXPERIMENT

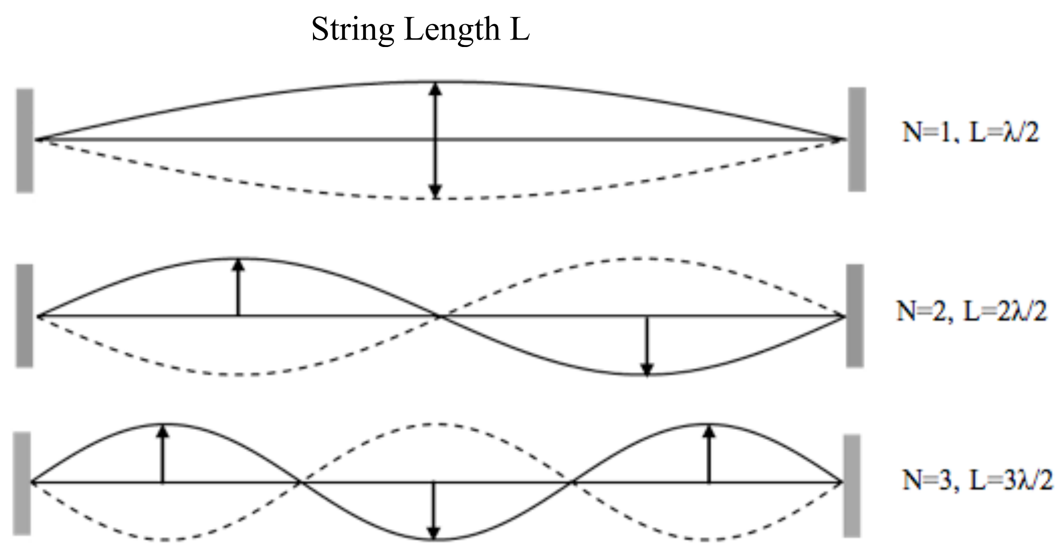

Figure 1: Vibrations of a string. The wavelengths of the standing wave resonance modes are $\lambda_N = 2L/N$ and the frequencies are $f_N = v/\lambda_N = Nv/2L = Nf_1$, where N is the harmonic number, v the velocity of the wave along the string, and f_1 the fundamental frequency.

Table 1. Linear Mass Density of Guitar Strings

String diameter	Linear Mass Density μ (g/m)
0.010in (0.254mm)	0.39 g/m
0.014in (0.356mm)	0.78 g/m
0.017in (0.432mm)	1.12 g/m
0.020in (0.508mm)	1.50 g/m
0.022in (0.559mm)	1.84 g/m

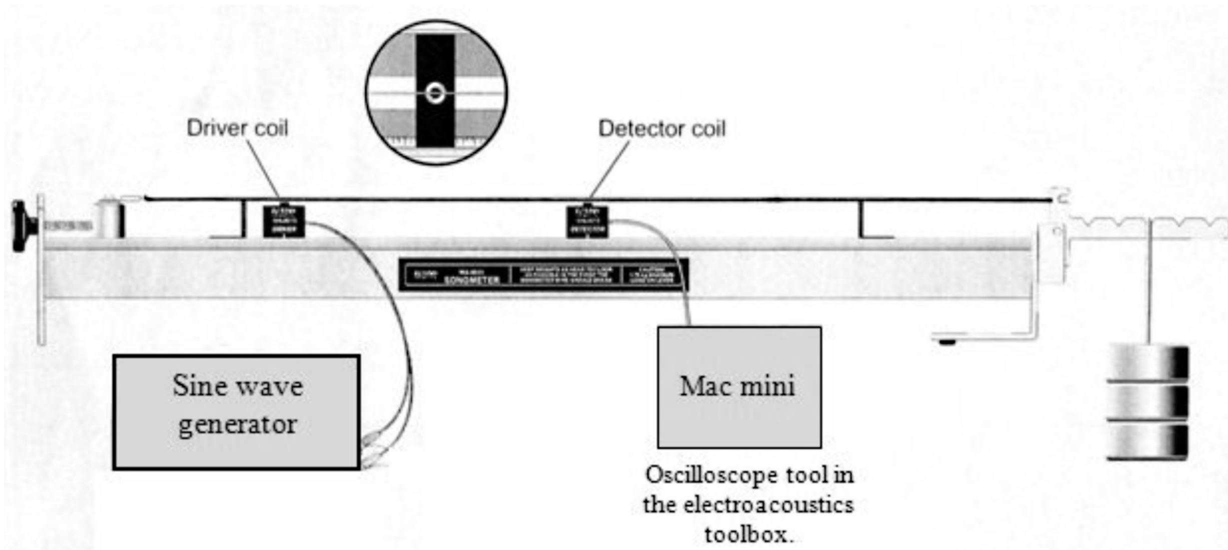

Figure 2: PASCO Sonometer Model WA-9611 for studying vibrating strings. The string is excited with a Driver Coil and the vibrational modes are analyzed with a Detector Coil. The sine wave generator activates the Driver Coil. The vibrating string induces a voltage in the Detector Coil. The latter is connected to the Mac computer. The"Oscilloscope Tool" in the Electroacoustics Toolbox is used to observe the signal.

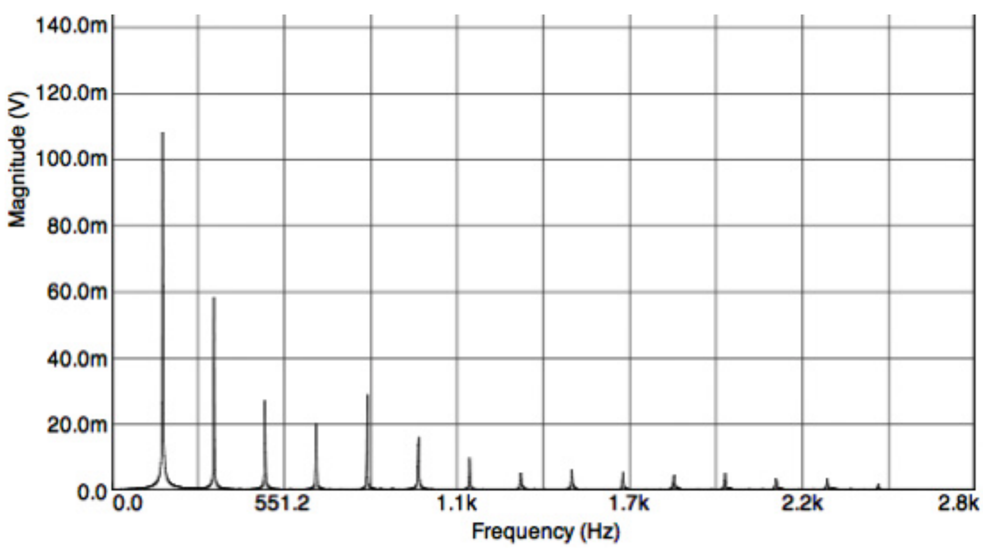

Figure 3: Sonometer string excited with a driver coil placed near one of the two bridges and harmonics recorded with an electromagnetic detector coil.

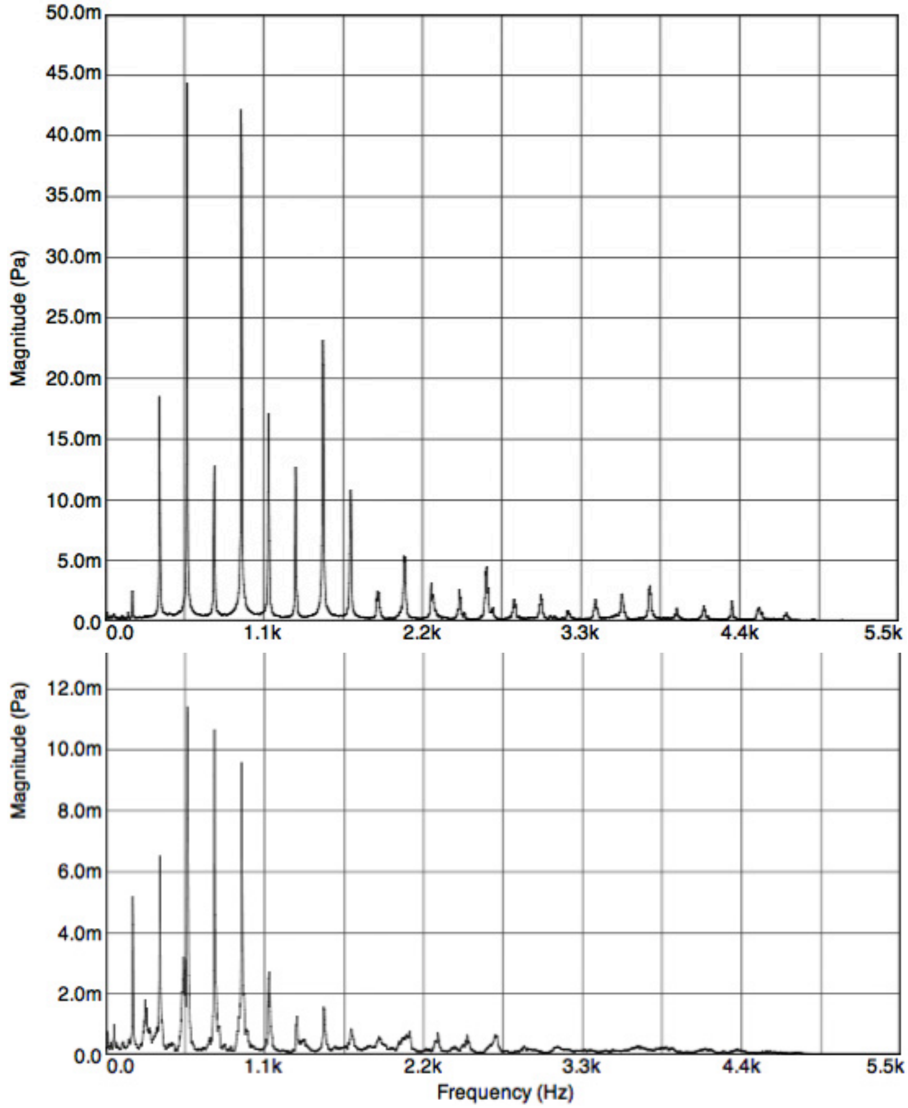

Figure 4: Sound spectrum form the G3 open string of a violin. Top figure: Spectrum from bowed string. Bottom figure: Spectrum from plucked string. Note that the bowed string has more pronounced higher harmonics resulting in a richer sound.

Table 2: Standing waves on a string

	Calculated f	Observed f	Location of Detector Coil	Location of Driver Coil	Number of Nodes	Number of Antinodes
Fundamental						
1st Overtone						
2nd Overtone						
3rd Overtone						