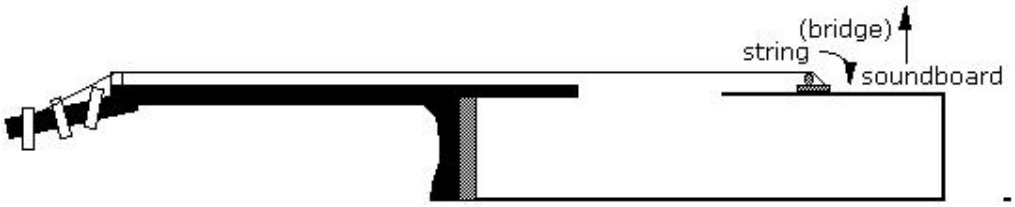

Figure 3: High Frequencies

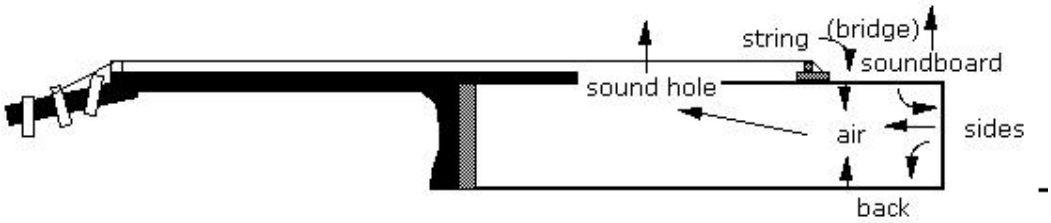

Figure 4: Low Frequencies

3.3 The Guitar As a System of Coupled Vibrators

The guitar can be considered as a system of coupled vibrators. This refers to an interaction between two or more vibrating elements. The plucked strings radiate only a small amount of sound directly, but they excite the bridge and top plate, which in turn transfers energy to the air cavity, ribs and back plate. If these these elements interact well, the whole system is said to be *strongly coupled*. The higher frequency sounds are produced by string interaction with the bridge and then the sound board, whereas the lower frequencies are essentially driven by the internal air cavity/sound hole and ribs/back coupling effects, as can be seen in figures 3 and 4.

3.4 The Air Inside and the Helmholtz Resonance

The air inside the body is quite important, especially for the low range on the instrument. It can vibrate a little like the air in a bottle when you blow across the top. In fact if you sing a note somewhere between $F\#2$ and A_2 (it depends on the guitar) while holding your ear close to the sound hole, you will hear the air in the body resonating. The Helmholtz resonance of a guitar is due to the air at the soundhole oscillating, driven by the springiness of the air inside the body. Let's analyse this more in detail, using the concept of blowing air across the top of an open bottle. The air in the body of a guitar works in almost the same way.