Beats: a demonstration with rubber bands

A chain of rubber bands is stretched between two fixed supports ~80 cm apart.

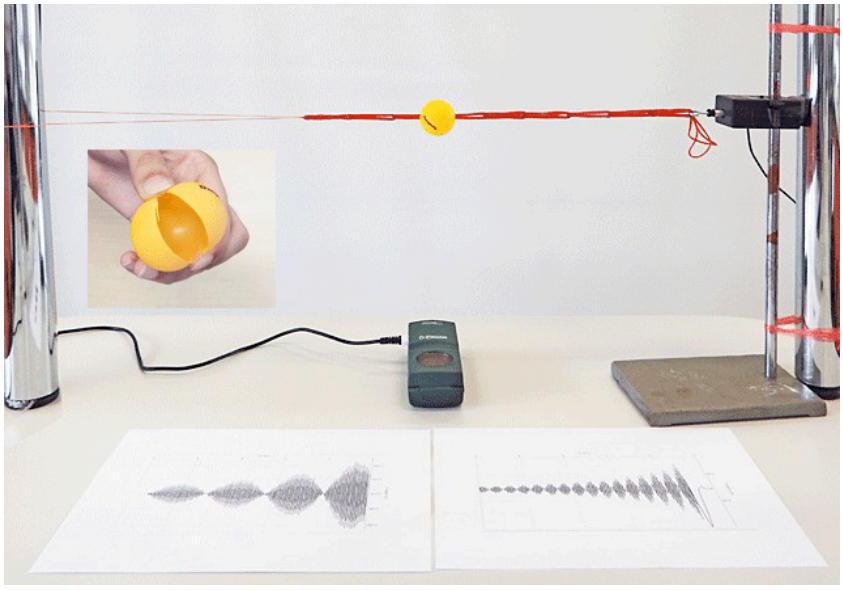
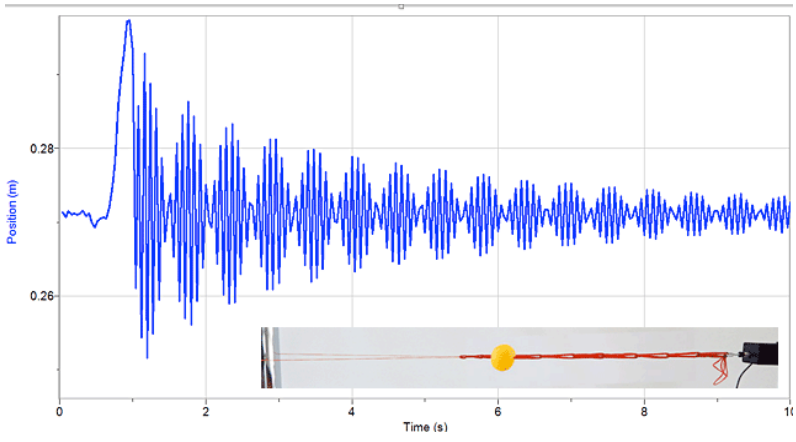


Fig 1

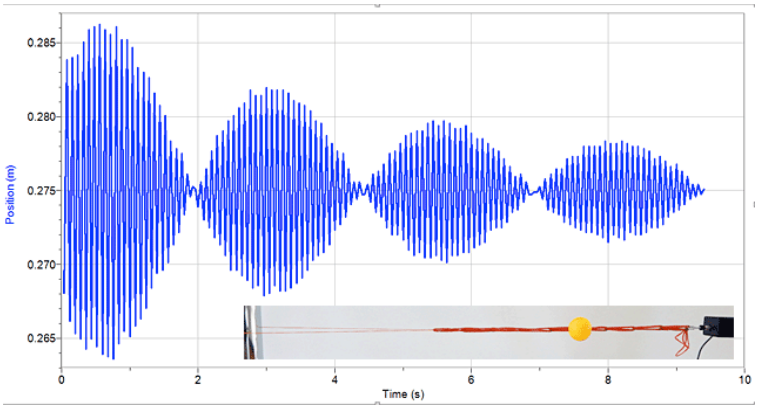
The rubber on the right is a double linked chain (four strands), and on the left is a single rubber band (two strands). The hook of a force probe has been used as the right hand attachment. The tension is adjusted to be around 5 N. The ping pong ball has been cut along a semicircle and will open when squeezed (inset). The ball acts as an ultrasound reflector and doubles as a fine adjustment.

Tension in the rubber is adjusted so that an oscillation becomes a combination of two motions of nearly the same frequency. Beats are shown below.



Graph 1

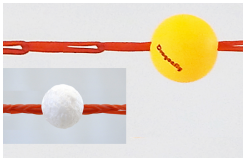
Moving the ball to the right lowers the beat frequency in this particular case.



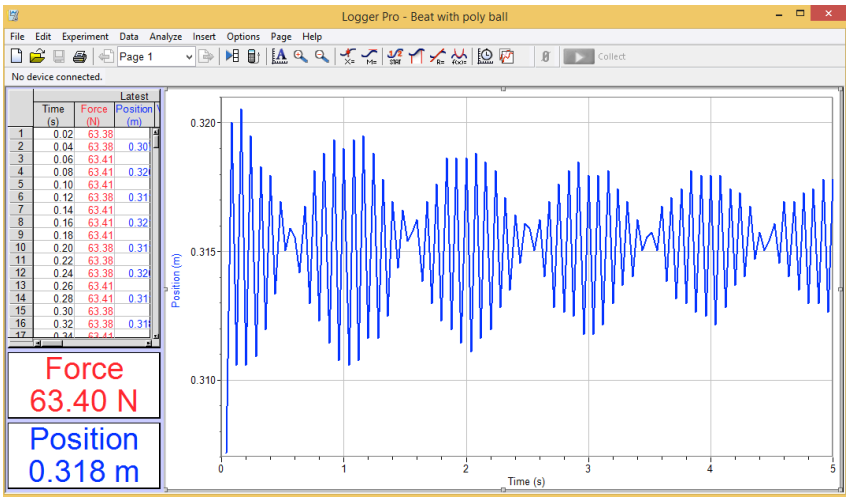
Graph 2

The beat frequency is sensitive to the tension in the rubber, the position of the ball, and the relative lengths of the rubber sections. ***If you do this demonstration it is essential that it be set up before you need to use it.***

It is left as a research challenge for students to determine the origin of the two oscillations that add to form the beat. In particular, whether the discontinuity in density per unit length acts as a partly open or partly closed boundary. The mass of the table tennis ball (2.4 g) was 15% of the mass of the rubber. A beat with a smaller, lighter (0.9 g) polystyrene ball and the same rubber bands and tension is shown below.



A beat with a polystyrene ball is shown below.



Graph 3