

Coupled Resonance

Beat Frequency

A LIGO-SEC interactive version 3.14

Gently push pendulum A (perpendicular to the horizontal string), and watch what happens.

Every time pendulum A swings, it pushes on the string, which in turn pushes on Pendulum B – transmitting energy to pendulum B. According to Newton's 3rd law (Equal and Opposite Force), pendulum B pushes back on Pendulum A, slowing it down and taking energy from it! This happens very regularly – so regularly it can be calculated.

Pull Pendulum A and Pendulum B to the same side and let them swing – they should swing without changing their swing (much) – this is a stable swing. Do steps 1-3.

- 1) Time 10 swings.
- 2) You've got the period of 10 swings, so divide by 10 to get the period of one swing (the number of seconds per swing).
- 3) Invert this to get the frequency (the number of swings per second).

	# Swings	Total Time	Period of 1 Swing	Frequency
Same Side				
Opposite Side				

Pull Pendulum A and Pendulum B to opposite sides and let them swing – they should swing without changing their swing (much) – this is a stable swing. Do steps 1-3 again for this situation.

Subtract the frequency for opposite side swinging from the frequency for same side swinging. That's the beat frequency. Invert ($1/\text{frequency} = \text{period}$) this to find the beat period (how long it takes to make one complete transfer of energy from pendulum A to pendulum B and back to pendulum A again. Check to see if you were accurate by swinging just one pendulum.

- A) Time 10 (or if you're impatient, just 5) complete energy transfers if you can.
- B) Divide the time by 10 (or 5 if you were impatient) to see if the actual beat period matches your calculated beat period!