Standing waves and Normal modes

Pre-reading: §16.1

Standing Waves

• Formed through reflection + superposition of waves moving in opposite directions

• Contains ‘nodes’ (no displacement) and ‘anti-nodes’ (maximum displacement)

• “Normal Mode”: property of a system in which all particles move sinusoidally at same freq.

• Lowest freq. normal mode: ‘fundamental’
Higher freq. normal modes: ‘harmonics’/‘overtones’

§15.8
Longitudinal Waves

• Displacement is in direction of wave motion
• Need to distinguish particles from pressure

Sound as Pressure Wave

Three ways to describe sound waves

Pressure is 90° out of phase with displacement!
Longitudinal Standing Waves

- Waves reflect at open or closed end
- Need to distinguish displacement of particles from pressure
- Node: no displacement
- Anti-node: **Time-averaged** location where max displacement is reached
- Displ. node = Pressure anti-node
  Displ. anti-node = Pressure node

\[ f_n = \frac{n \nu}{2L}, \quad n = 1, 2, 3, \ldots \]

\[ f_n = \frac{n \nu}{4L}, \quad n = 1, 3, 5, \ldots \]
Next lecture

Sound waves
and
Perception of sound

Read §16.1–16.3