

Physics of Musical Sound

Class 5

Read Chapter 4

Homework due Friday

Properties of Waves

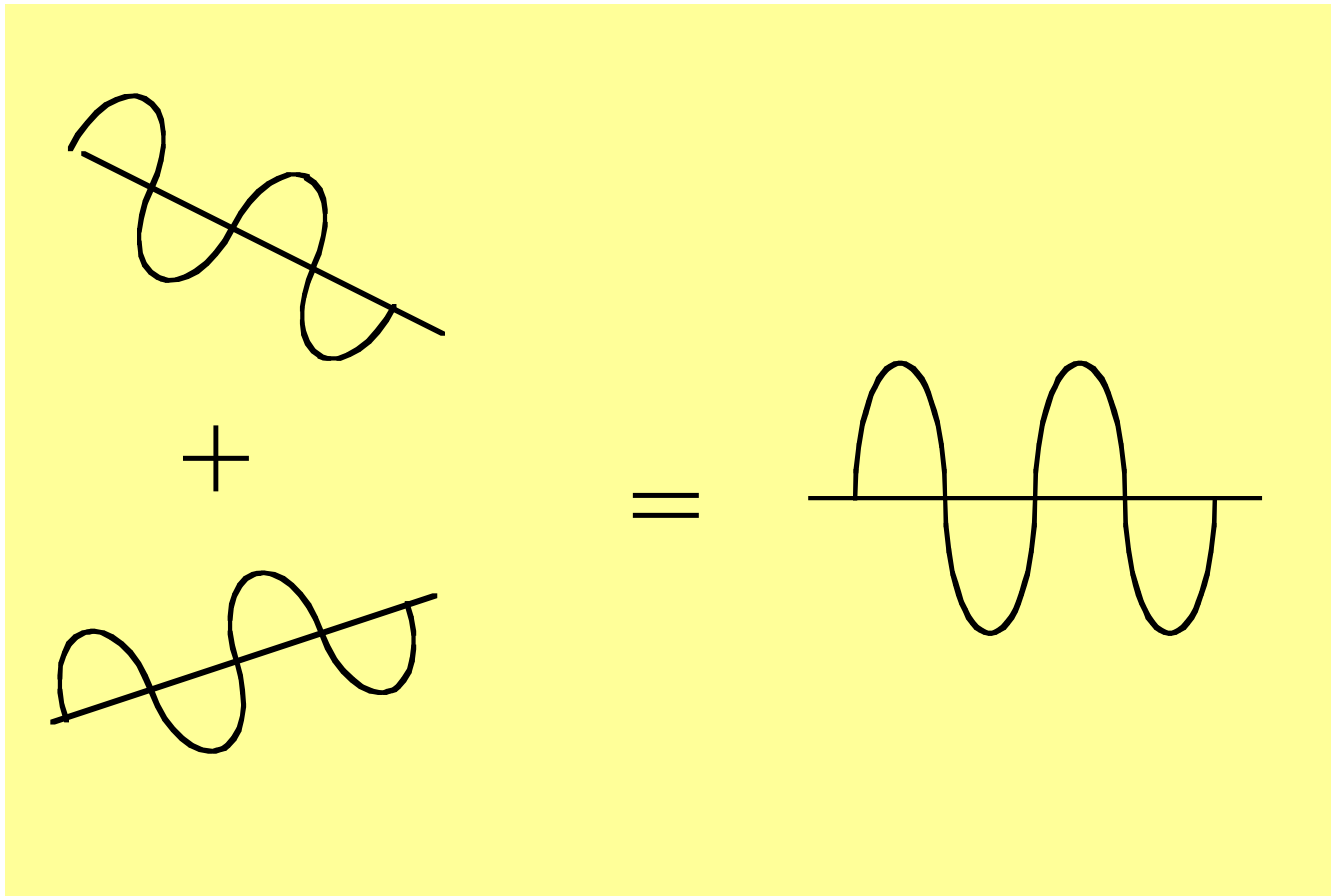
- Superposition
 - When two waves meet they do not interact at all. The disturbance from two waves is exactly the sum of the individual disturbances. That is, for a sound wave, the total pressure $P(x,t)$ can be written in terms of the individual pressures $P_1(x,t)$ and $P_2(x,t)$
$$P(x,t) = P_1(x,t) + P_2(x,t).$$
 - We call this **Superposition** of the waves and say that the relationship is **Linear**.

Properties of Waves

- Interference
 - If same wave travels to a place by two different paths then when the waves cross you get interference.
 - If waves line up perfectly then you get **constructive interference** and the resulting sound is louder than either wave.
 - If one wave is $\lambda/2$ behind the other then the waves cancel and you get **destructive interference**. Result softer than either.

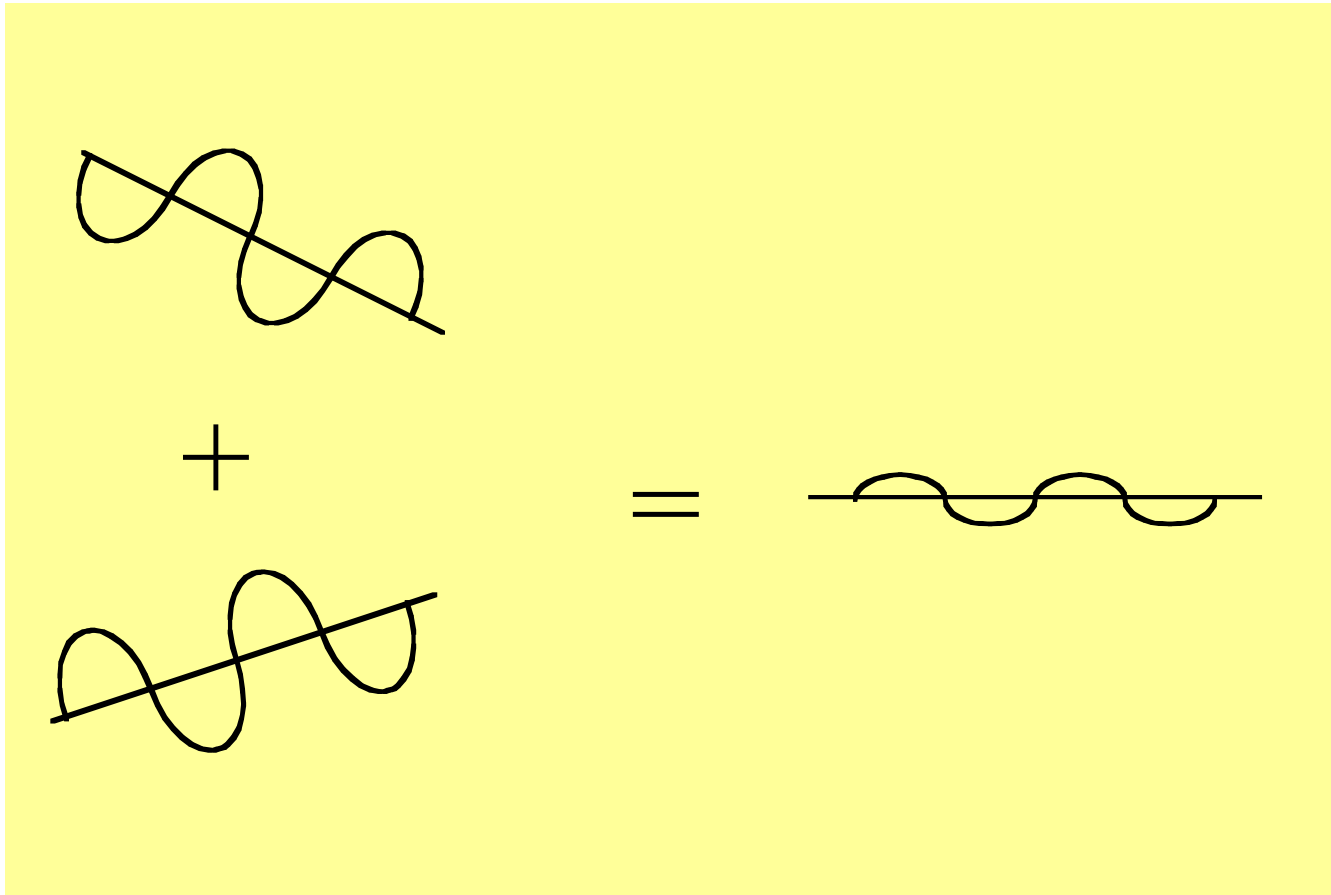
Properties of Waves

- Constructive Interference



Properties of Waves

- Destructive Interference

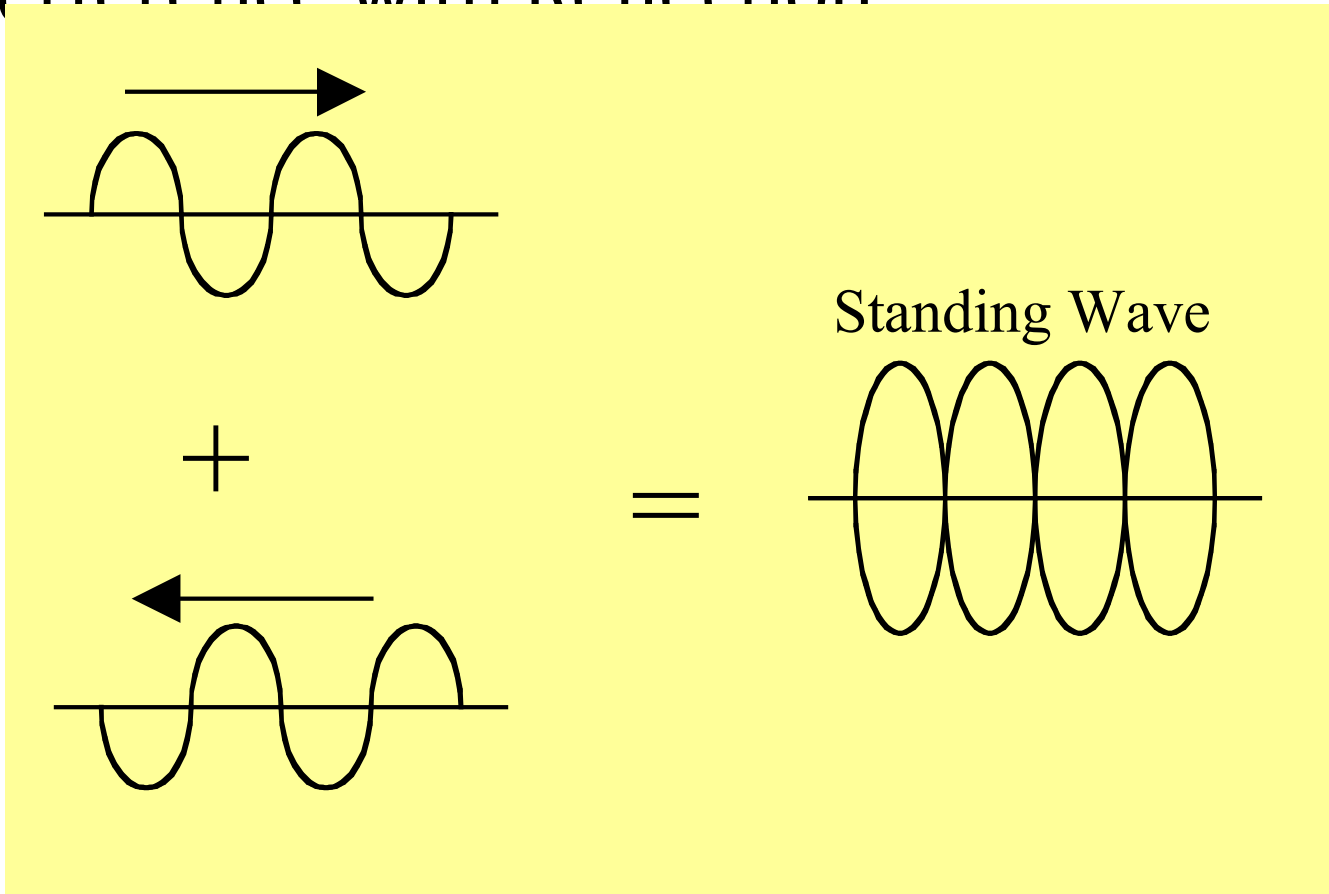


Properties of Waves

- Beats
 - If two waves with different frequencies f_1 and f_2 arrive at same place hear beats if frequencies are close enough.
 - Beats are at difference frequency $|f_1 - f_2|$.
 - Once frequencies get far enough apart hear a musical interval.
 - Is a fuzzy region between!

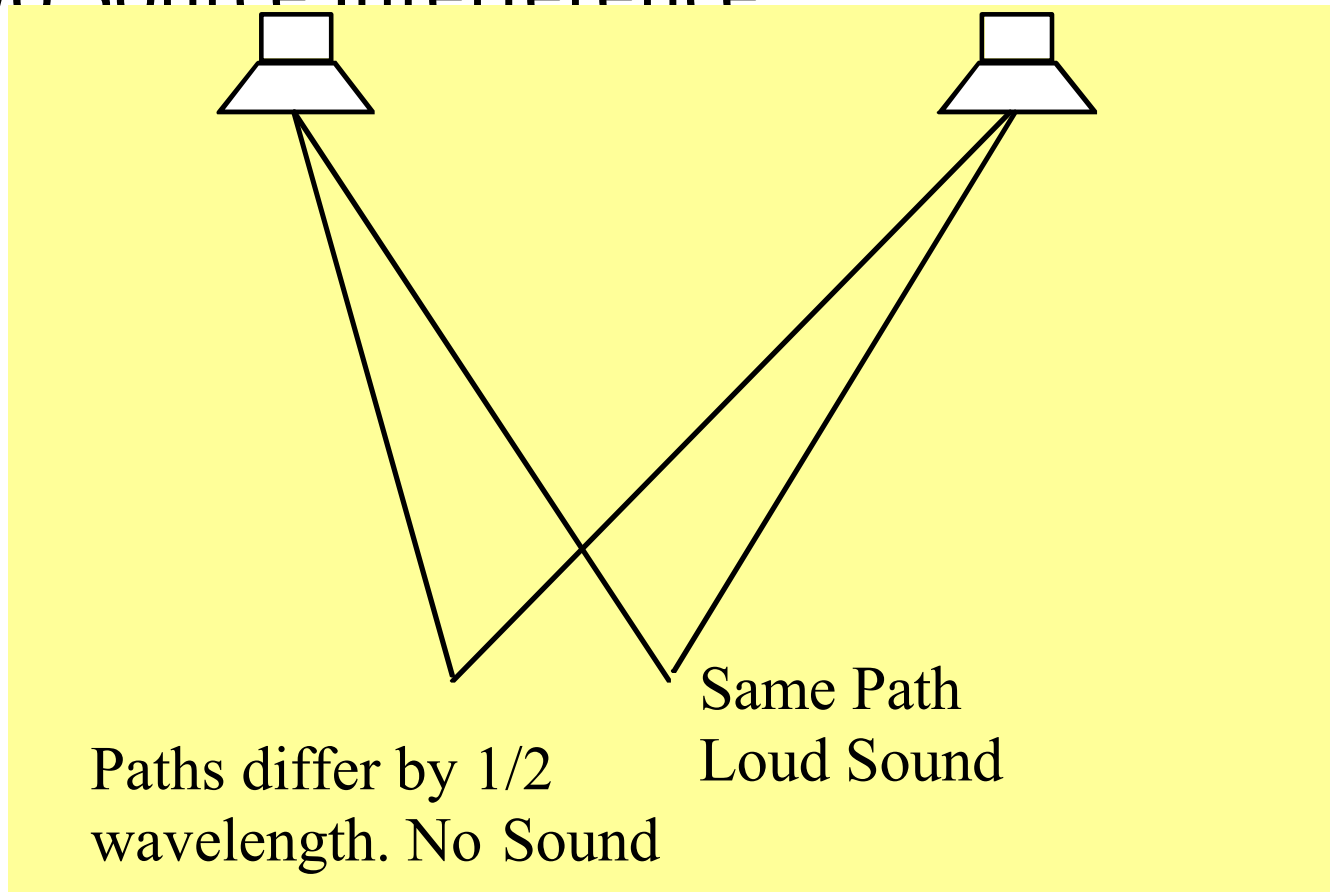
Properties of Waves

- Interference with Reflection



Properties of Waves

- Two Source Interference



Properties of Waves

- Interference Problems
 - Plane surfaces in a concert hall give rise to specular reflections that interfere with direct sound to give loud and soft spots in the hall.
 - We hear the effects of interference as the production of **beats** in the sound. These are noticeable loud/soft variations either in space as you move your head or in time, if sources have different frequencies.