

Outline for Day 9

Office hours: 1:30 - 5

In which we learn how more about how warticles work

- Fourier analysis
- How to make a particle with a wave
- Heisenberg Uncertainty Relationship
- Worksheet

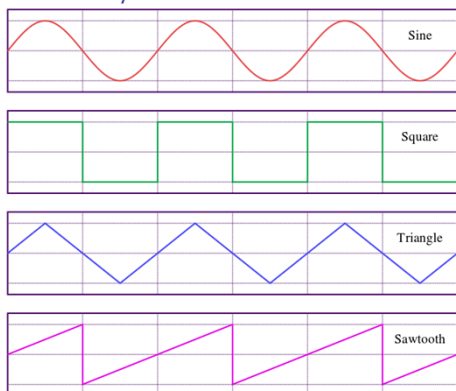
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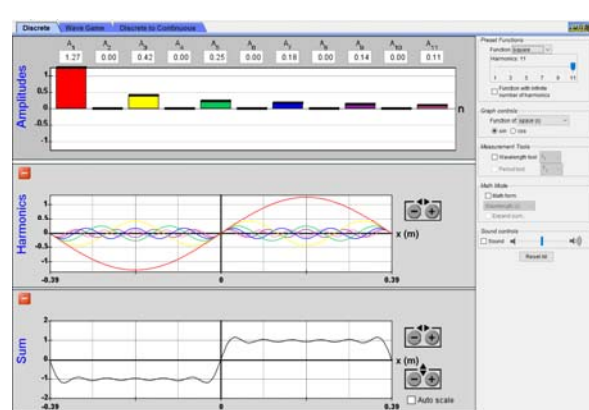
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Fourier Analysis – Fun with Sines and Cosines



Use Phet to make square wave

Recipe for a Square Wave



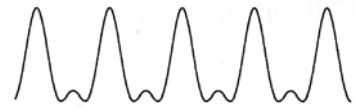
Fourier Analysis

Making a Square Wave with Fourier Analysis

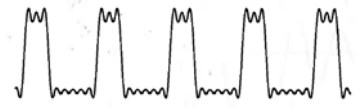
First term



First 3 terms



First 8 terms



First 30 terms



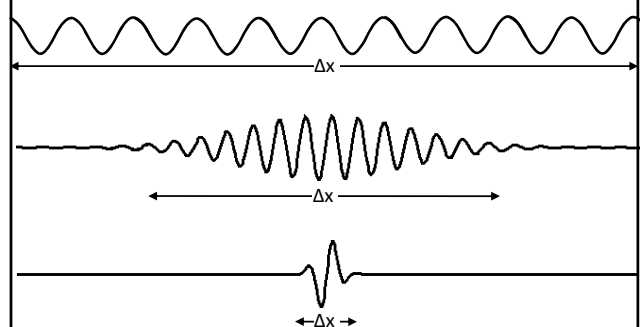
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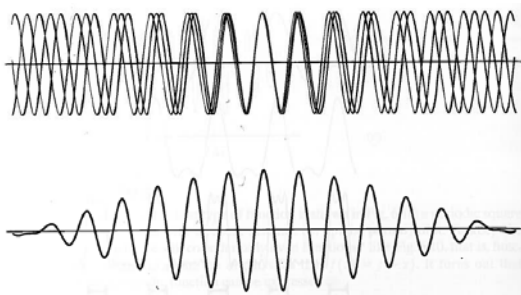
- Fourier analysis
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How to Make a Particle with a Wave



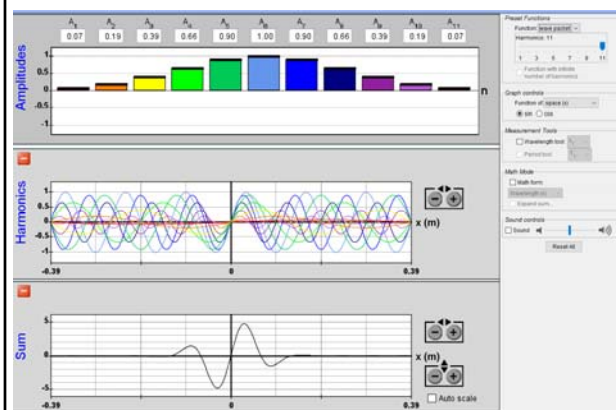
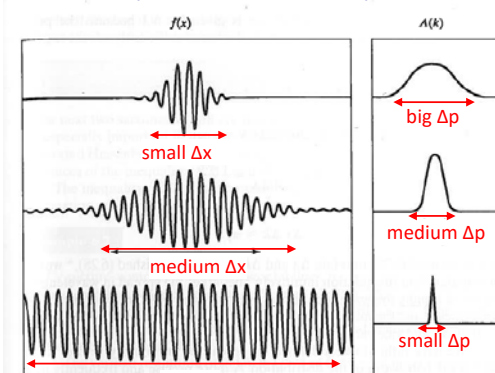
348

How to Make a Particle with a Wave



Phet wave packet

How to Make a Wave Packet

Relationship between Δx and Δp 

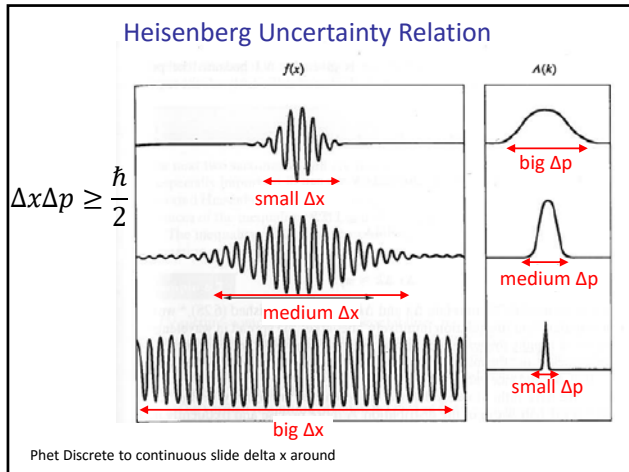
Phet Discrete to continuous slide delta x around

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Heisenberg Uncertainty Relation

$$\Delta x \Delta p \geq \frac{\hbar}{2}$$

If you know really well where a particle is (Δx is small), then you don't know how fast it is going. (Δp is big).

If you know really well how fast a particle is going (Δp is small), then you don't know where it is. (Δx is big).

Zero-Point Energy

$$\Delta x \Delta p \geq \frac{\hbar}{2}$$

If you confine a particle to a small region like an atom (Δx is small), then you don't know how fast it is going and so could be going pretty fast. (Δp is big). And so particles confined to small regions have lots of momentum and lots of (zero-point) energy.

Examples 6.4 and 6.5 in your book.