PH 366 Day 10:
Simulations and Monte Carlo

10 Feb 2025

Simulations

Computer simulations of a physical model

Use findings to build knowledge of the physical system

Use model to develop simulation

Existing physics **knowledge**

Develop **theoretical model** of how a physical system works

Observations a physical system in the world
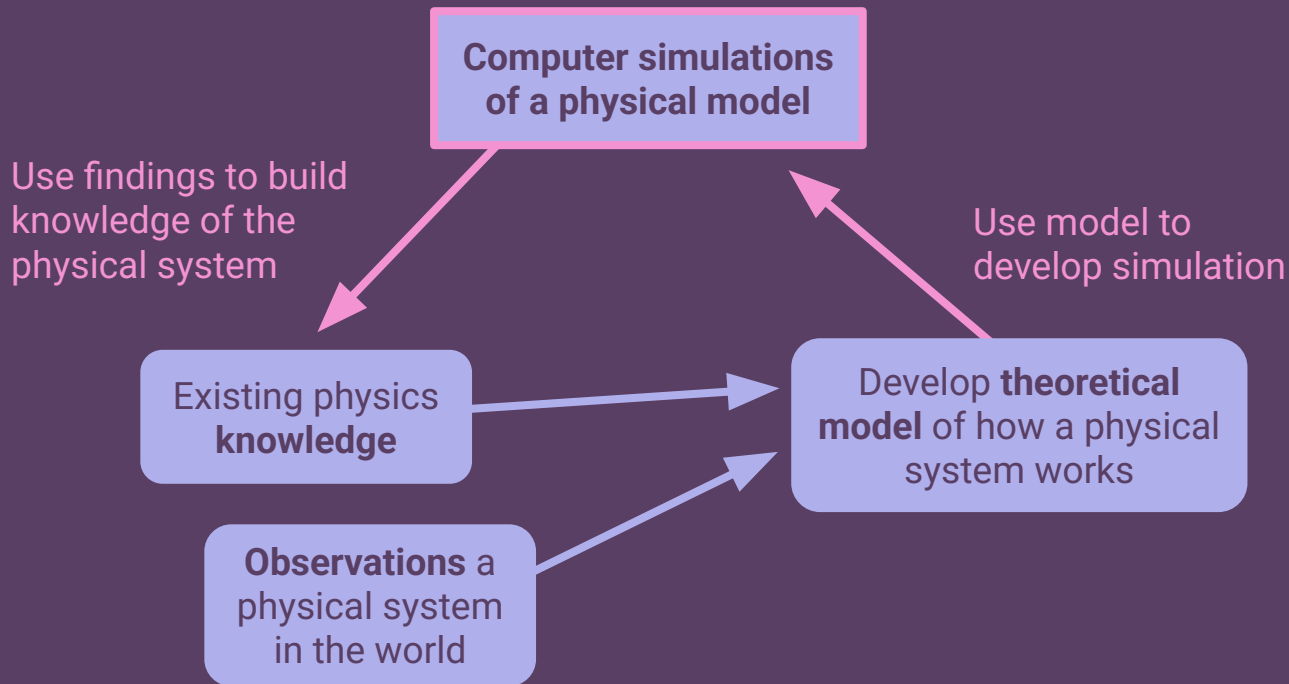
Monte Carlo Simulations

Monte Carlo: Using computer-generated "randomness" to simulate the behavior of physical systems with a **large number** of individual units
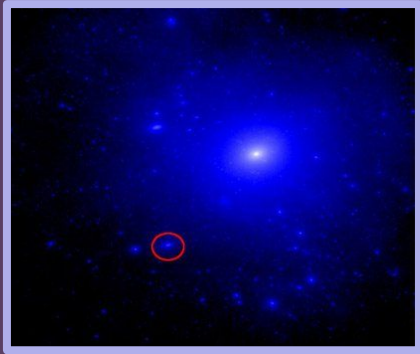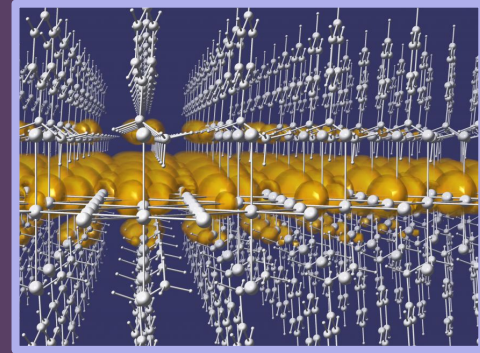

Large numbers

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Can compute statistics and probability

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Can use probability to describe "random" behavior

Metropolis – A Monte Carlo Algorithm

1. Establish an initial configuration of a system
2. Randomly generate a possible change to the system
3. Calculate the probability of accepting that change
4. Accept or reject the change based on that probability
5. Go back to **Step 2** and repeat the algorithm

Metropolis Algorithm for a Spin Lattice

1. Establish a random 2D array of spins
2. Randomly choose a spin
3. Calculate the probability of flipping that spin
   - *Today: probability is fixed at 50%*
4. Decide whether to flip the spin
   - *Today: flip a coin to decide*
5. Go back to **Step 2** and repeat the algorithm