

Physics Simulations in Python

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Harmonic Piston with Gas

This simulation shows that temperature is really just a form of kinetic energy. The gas particles float around at random within a piston and carry some small amount of kinetic energy. Each time they collide with the piston, there is an elastic collision and the particle passes a small bit of momentum to the piston according to the equation $m_1 v_1 + m_2 v_2 = m_{1f} v_{1f} + m_{2f} v_{2f}$. At the end of the simulation, we show a graph with the location of the piston as well as the velocity as a function of time, as well as a graph of the kinetic and potential energies and show that their sum is constant due to conservation of energy. Note how the graph of the velocity of the piston is not continuous due to the collisions.

Diatomic Chain

This simulation shows a 1 dimensional chain of alternating types of atoms and their interactions with each other. When even one atom is out of equilibrium this causes an interaction in all of the chain passing along its disturbance. All the atoms are approximately a harmonic relation so we can describe them as masses in a chain connected by springs. In this simulation, we have assumed the "spring" (which is really just electrical forces) are the same between every atom. Here we see that the forces on mass n are given by the equation $F_n = m_n \ddot{x}_n = \kappa(x_{n-1} - \delta x_n) - \kappa(\delta x_n - x_{n+1})$ where κ is the spring constant and δx_n is how far mass n is from its equilibrium point.

Si Crystal

The layout of a silicon crystal can be difficult to imagine. It is similar to an FCC lattice, but not quite. I have plotted all of the points in the unit lattice and then shown how they layer one on top of the next to form the crystal.