19.9: A Note on the Physics of These Waves

For wavelength long compared to the interparticle spacing, $\Omega \cong vk$ these are like sound waves (and indeed they are what are called **acoustic phonons** in a crystal). As the wavelength shortens, the wave eigenstates are moving more slowly, remember the group velocity of a wavepacket goes as $d\Omega/dk$. This is because there is some Bragg reflection of the waves by the lattice. At $ka=\pi$, we have a standing wave. This is the highest energy mode, with even numbered sites all in sync with each other, and the odd numbered sites all half a cycle behind, so the restoring force experienced by an atom as a function of displacement is the maximum possible.

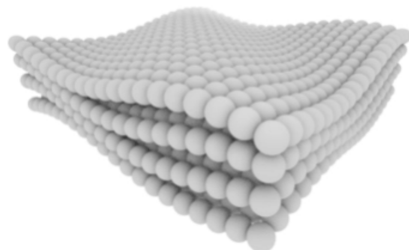

Figure 19.9.1: Collective motions called phonons (Public Domain; Sean Kelley via NIST)