# Physics with Neutrons I

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**Exercise sheet 6**

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wiki.mlz-garching.de/n-lecture05:index

## 1 Neutron scattering from phonons

From your solid state physics course you should remember the dispersion relation for phonons. Calculate the dispersion of an acoustic phonon of a linear chain of atoms with a lattice constant of $a = 2\,\text{Å}$. The measured velocity of sound is assumed to be $2300\,\text{m/s}$. Draw the scattering triangle for an inelastic neutron scattering experiment with $k_f = 2.57\,\text{Å}^{-1}$ at the boundary of the $2^{\text{nd}}$ Brillouin zone. Consider phonon creation and annihilation.

## 2 Normal modes of a diatomic chain

Consider the normal modes of a linear chain, in which the force constants between nearest-neighbor atoms alternate between $C$ and $10C$. Let the masses be equal and the nearest-neighbor distance be $a/2$. Find $\omega(k)$ at $k = 0$ and $k = \pi/a$