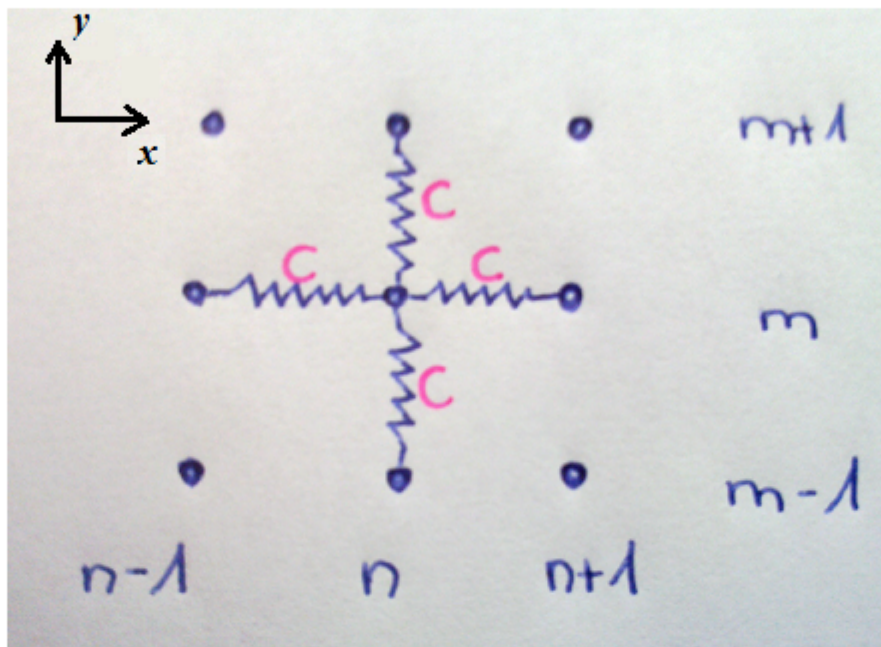
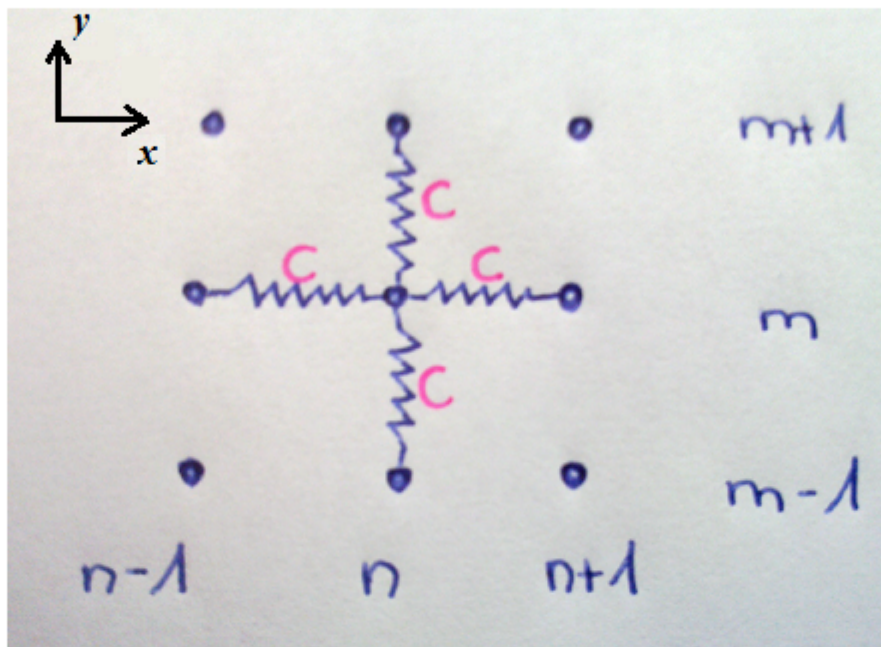


Assignment - Q1



- Consider the 2D square lattice shown above (with lattice constant a). We are interested in modeling transverse phonon with wavevector in the xy plane and atomic displacements out of plane (along z).
- We'll assume that interactions are limited to the nearest neighbors and that the spring constant C is the same along x and y

Assignment - Q1

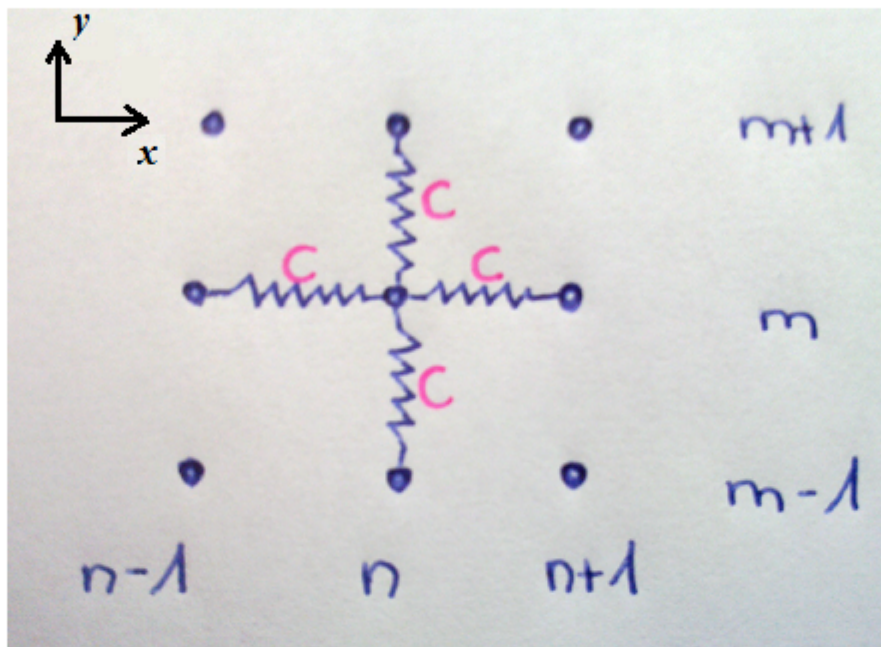


1. Find the expression for the force F on the center atom (n, m)

Hint: The force should be a function of out of plane displacements

$$u_{n+1,m}, u_{n,m}, u_{n-1,m}, u_{n,m+1}, u_{n,m-1}$$

Assignment - Q1

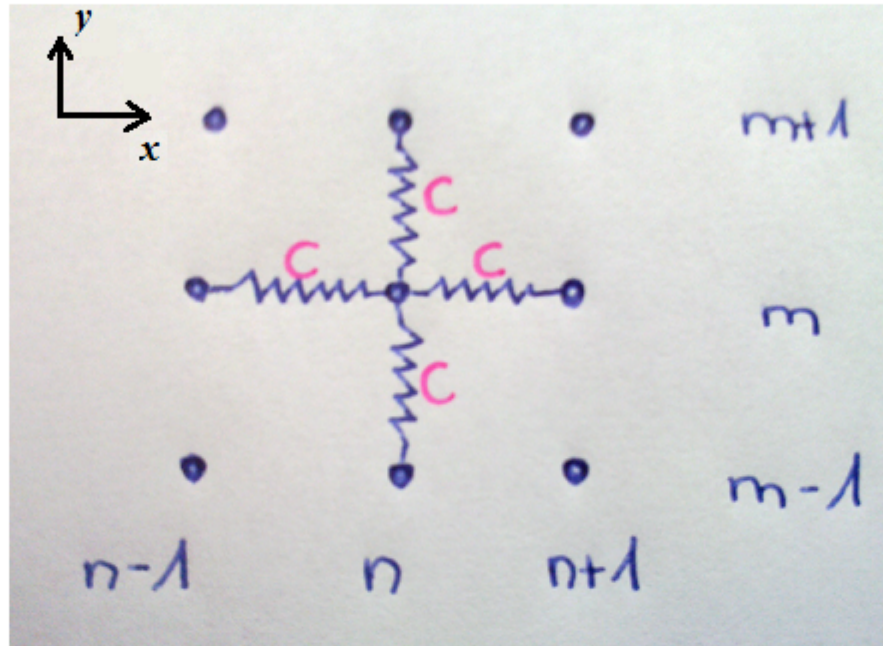


2. Write down the equation of motion for the center atom
3. Assuming that the solution is a traveling wave with the form

$$u_{n,m} = u_0 \exp [i(nk_x a + mk_y a - \omega t)],$$

Find the dispersion relation $\omega(k)$

Assignment - Q1



4. Describe the dispersion relation. You may plot the function if helpful.

Assignment - Q2

Why is inelastic scattering by neutrons typically used for measuring of phonon dispersion relations? Is there an advantage over use of x-rays or electrons?