

Übungen zur **Physik der weichen Materie** , Serie 1, FS 2021

Besprechung am 09.03.21

Aufgaben

1. What is condensed matter?

Read the paper "More is different" by Phil Anderson and discuss it during the tutorial session. Some questions you might want to keep in mind during this discussion are:

What actually is a "fundamental" law of nature?

Can there be a "theory of everything" at all?

What examples of "emergent" phenomena do you know?

2. What is a solid?

Consider a crystalline solid, a glass and a liquid. Schematically draw for all of these:

a) The structure factor

b) The local pair correlation function of particle locations

c) The mean square displacement of the particle locations as a function of time

Which of these can you use to distinguish a solid from a liquid?

3. Fourier transforms and reciprocal space

a) Show that a convolution is a multiplication in Fourier space.

b) Show that the structure factor is related to the pair correlation via a Fourier transform.

4. Elasticity

a) Prove the relation between the shear and Young's modulus for homogeneous materials: $G = \frac{E}{2(1+\nu)}$, where ν is Poisson's ratio.

b) Solve a Burgher's model for an applied stress, which sets in at time zero and then is constant for a time T before being relaxed to zero. Show that the solution corresponds to that given on page 26 of chapter 2 of the slides.

February 1, 2021