LMU München **SS 2013**

Lehrstuhl für Theoretische Nanophysik
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1st Exercise Sheet Many-Body Physics

Will be discussed on Tue, April 30.

Exercise 1: Ideal Fermi gas

Express the Fermi energy (and fermi momentum) in terms of the density of a two-component free Fermi gas in one, two and three dimensions at zero temperature. Compute the energy, specific heat, and pressure of this gas.

Exercise 2: Holstein-Primakoff bosons

Work out all steps explicitly in the derivation of the spectrum of an antiferromagnet after application of a Holstein-Primakoff transformation, as discussed in class. In particular, perform the Bogoliubov transformation.

Exercise 3: Tight binding models

- Consider a square lattice on which particles can hop between any two neighboring sites with hopping amplitude t. Obtain the single particle dispersion $\epsilon(k)$ by going over to momentum space.
- Repeat for a hexagonal lattice, relevant for graphene. Recall that a hexagonal lattice has two atoms per unit cell. Plot the dispersion $\epsilon(k)$.