Problem Set 8
Theoretical Solid State Physics (SoSe2017)

Due: Due Thursday, June 15, 2017; **at the beginning of class**

The concept of a Chern insulator (though not the term) was first introduced in a paper by Duncan Haldane [Phys. Rev. Lett. **61**, 2015 (1988)]. In this problem set, you will work through this landmark paper. We have already discussed much of the physics content in terms of a simpler model in class. Unlike this simpler model which is defined on a square lattice, Haldane's model is defined on a hexagonal lattice which you already discussed when you looked at the problem on graphene.

Problem 1: Spectrum of the Haldane model

Derive Eq. (1) of the paper and discuss the spectrum as well as the phase diagram of the model.

Problem 2: Low-energy theory

Derive Eqs. (2) and (3) of the paper.

Problem 3: Dirac equations in a magnetic field

Solve the Dirac equation in a uniform magnetic field and derive Eqs. (4).