Electronic structure of correlated electron systems home work for 4<sup>th</sup> lecture.

- 1. Describe a possible repair process for the chain of flipped spins left behind a propagating hole in 2 dimensions. Would a second hole closely following behind the first hole also repair the damage and lower the total energy?
- 2. What are the total spin states and energies of 3 spins at the corners of a triangle coupling via a Heisenberg exchange interaction? Recall that Hamiltonian commutes with the total spin.
- 3. In a two diemsional square lattice spin 1/2 Neel antiferromagnet U>>t how many times would one have to complete a trajectory of a hole around the smallest square placket of sites before the system would return to its original state?
- 4. What is the singlet -triplet splitting for 2 electrons or two holes ( i.e. missing electrons from otherwise full s atomic orbitals) and for U>>>t the nearest neighbor hoping integral . Describe the physics involved in this splitting.
- 5. Calculate the total energy per spin of an infinite lattice of spins of 1/2 with an antiferromagnetic exchange interaction independent of the distance between the spins . Compare this to the ground state energy of the same problem but with a ferromagnetic infinite range exchange. Why is the one linear in the number of spins and the other one quadratic?