Orbital selective crossovers and phase diagram of the asymmetric Hubbard model

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We study the phase diagram of the asymmetric Hubbard model, which is characterized by different hopping parameters for the two spin or equivalently, orbital projections of a fermion. This model is expected to provide a good description of a mass-imbalanced cold fermionic mixture in optical lattices. We use the dynamical mean field theory to study various physical properties of this system. We show how orbital-selective physics, observed in multi-orbital strongly correlated electron systems, can arise in such a simple model. We also find that below an ordering temperature T_o, which is a function of both the interaction and hopping asymmetry, the system exhibits staggered long ranged order. For generic asymmetry, this orbital order is accompanied by a true charge density wave order for all values of the hopping asymmetry. We discuss the behaviours of the order parameters and various physical quantities including the thermodynamics. Finally, we propose a new method for cooling fermionic atoms in optical lattices, by exploiting the properties of the model.

[1] E. A. Winograd, R. Chitra, and M. J. Rozenberg, Phys. Rev. B **84**, 233102 (2011).
[2] E. A. Winograd, R. Chitra, and M. J. Rozenberg, (2012) to be submitted.