I – Enfisul
Palestra 1
Dia 25/11 – 9:00

Prof. Dr. Raimundo R. dos Santos
Instituto de Física – Universidade Federal do Rio de Janeiro

Mott Regions and Entanglement of Fermionic Atoms on a Two-Dimentional Optical Lattice

In experiments with ultracold atomic gases in optical lattices, the presence of a confining potential (trap) causes the atomic density to vary across the lattice. One important consequence is that different many-body phases can coexist within the trap. In a trapped three-dimensional Fermi gas, for instance, a core with atoms in an insulating Mott state surrounded by a metallic phase has been experimentally observed [1]; this arrangement has led to the proposal of a cooling protocol to observe antiferromagnetism in the Mott core [2]. Here we consider a two-dimensional system of trapped fermionic atoms, represented by the Hubbard model on a square lattice. We use Lanczos diagonalization in the grand-canonical ensemble to extract the ground state properties; in order to eliminate finite-size effects in the small 2D clusters considered (number of sites, Ns = 8; 10), signaled by plateaux in the density vs: chemical potential plots [3], we have performed averages over twisted boundary conditions [4] and resorted to a local density approximation (LDA). With this, we have been able to study the evolution of the metallic-Mott coexistence with the trap curvature, as well as with the strength of the on-site repulsion. We have established that Mott cores evolve to Mott rings as the trap curvature increases, and we also show that the area of these regions can be cast in the form of a universal function, once the area and the trap curvature are properly scaled. We also discuss the onset of antiferromagnetic correlations and the entanglement properties; the relation between the von Neumann entropy and charge fluctuations is also established.

References:
[1] U. Schneider et al., Science 322, 1520 (2008).
[2] T. Paiva et al., Phys. Rev. Lett. 107, 086401 (2011).
[3] R. Mondaini, K. Bouadim, T.Paiva, and R. R. dos Santos, Phys. Rev.B 85, 125127 (2012).
[4] C. Lin, F. H. Zong and D. M. Ceperley, Phys. Rev. E 64, 016702 (2001).

24-26 Novembro 2013
Curitiba/PR