Abstract submitted to the
Conference on Concepts in Electron Correlation
September 24 - 30, 2008 Hvar, Croatia

Strong Correlations and Inhomogeneity in Optical Lattices

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Submitted : 11-09-2008

Cold atoms in optical lattices offer a new laboratory where quantum many-body phenomena can be realized. One key advantage of cold gases is the tunability of interactions, quantum statistics and geometry. In this talk I will focus on two recent developments:
I) Random optical potentials (e.g. speckle) have already been applied to realize the disordered Bose-Hubbard model, raising questions about the nature and extent of the Bose glass phase. I will present a new stochastic mean-field approach which describes the Bose glass in the thermodynamic limit.
II) Ultracold gases are generically inhomogeneous and strongly correlated quantum systems. Any type of long-range order will thus be crucially modified by the presence of a harmonic trap. I will discuss antiferromagnetic ordering of cold fermions in the trap, analyzed within a recently developed extended dynamical mean-field algorithm.