

ATELIER SUR L'INFORMATION QUANTIQUE ET LA PHYSIQUE STATISTIQUE  
18-21 OCTOBRE 2011

WORKSHOP ON QUANTUM INFORMATION IN QUANTUM MANY-BODY PHYSICS  
OCTOBER 18-21, 2011

## Successes and limitations of dynamical mean field theory

André-Marie Tremblay\*

Andre-Marie.Tremblay@USherbrooke.ca

---

Dynamical mean-field theory and its cluster extensions are amongst the most widely used methods to study interacting fermions on a lattice. In this talk, I will first describe the method, showing how the many-body problem is mapped onto the problem of a single site, or cluster, hybridized with a bath of non-interacting electrons whose properties are determined self-consistently. I will describe a few Monte Carlo and exact diagonalization solvers for the embedded cluster problem. Improvements to these solvers coming from quantum information would be welcome. Then I will describe a few problems that have been tackled with dynamical mean-field theory, including the phase diagram of high-temperature superconductors and of layered organic superconductors. It will be shown how the interaction-induced metal-insulator transition, known as the Mott transition, influences the phase diagrams. There are limitations to this method : the restriction to short correlation lengths, the difficulty to identify topologically ordered phases and order parameters that are not quadratic in fermions. Other limitations of the method will appear when I discuss vertex corrections for transport properties and analytical continuation.

---

\*Département de physique, Université de Sherbrooke, 2500 boul. de l'Université, Sherbrooke, QC J1K 2R1, CANADA.