

Mott transition, Hubbard model and superconductivity: an introduction

A.-M. S Tremblay
Département de physique and RQMP
Université de Sherbrooke
Sherbrooke, QC J1K 2R1, Canada

In this introduction, I will first recall some of the successes of standard Solid State physics, in particular the BCS theory of superconductivity. I will then explain the Mott metal-insulator transition and why it is such a strong departure from textbook physics. This will lead us to understand why physicists are so puzzled by superconducting states that appear in the vicinity of a Mott transition. I will then introduce the Hubbard model as the simplest model that contains the physics of the Mott transition and ask whether it can also explain superconductivity near a Mott transition. High-temperature superconductors and layered organic superconductors are cases in point that illustrate respectively the case of doping control and the case of interaction strength control. I will explain Dynamical Mean-Field Theory and some of its extensions, one of the most popular methods to treat that kind of problem. We will end with a discussion of some of the latest results and open questions. I will assume that the student is familiar with second quantization, phase transitions and some elementary notions of many-body theory.