Frustration in the Hubbard model: a quantum cluster study

AN-DRIY NEVIDOMSKYY, University of Sherbrooke, Quebec, Canada, CHRISTIAN SCHEIBER, Technical University of Graz, Austria, DAVID SENECHAL, University of Sherbrooke, Quebec, Canada — The role of frustration in the Hubbard model is studied on the square lattice with nearest and next-nearest neighbour hoppings $t$ and $t'$ using the Variational cluster perturbation theory (VCPT, see [1]). We find two phases with long-range magnetic order: the usual antiferromagnet (AF1) phase, stable at small $t'/t$, and the so-called superantiferromagnetic phase (AF2) for large frustration. These are separated by a phase with no magnetic order. We also find d-wave superconductivity ($d_{x^2-y^2}$) for small values of $U \leq 4t$ and sufficiently weak frustration. The Mott-Hubbard transition is discussed in this context. We also compare the classical phase diagram obtained from the large-$U$ expansion with that of the frustrated $J_1$-$J_2$ Heisenberg model.