Ferromagnetism, paramagnetism and a Curie-Weiss metal in
NaxCoO2

JAIME MERINO, Universidad Autónoma de Madrid, BEN POWELL, ROSS MCKENZIE, University of Queensland — Motivated by the unconventional properties and rich phase diagram of Na$_x$CoO$_2$ we consider the electronic and magnetic properties of a two-dimensional Hubbard model on an isotropic triangular lattice doped with electrons away from half-filling. Dynamical mean-field theory (DMFT) calculations predict that for negative inter-site hopping amplitudes ($t < 0$) and an on-site Coulomb repulsion, $U$, comparable to the bandwidth, the system displays properties typical of a weakly correlated metal. In contrast, for $t > 0$ a large enhancement of the effective mass, itinerant ferromagnetism and a metallic phase with a Curie-Weiss magnetic susceptibility are found in a broad electron doping range. The transport and magnetic properties measured in Na$_x$CoO$_2$ are consistent with DMFT predictions of a metal close to the Mott insulator and we discuss the role of Na ordering in driving the system towards the Mott transition. We propose that the Curie-Weiss metal phase observed in Na$_x$CoO$_2$ is a consequence of the crossover from “bad metal” with incoherent quasiparticles at temperatures $T > T^*$ and Fermi liquid behavior with enhanced parameters below $T^*$, where $T^*$ is a low energy coherence scale induced by strong local Coulomb electron correlations. Our analysis shows that the one band Hubbard model on a triangular lattice is not enough to describe the unusual properties of Na$_x$CoO$_2$.

Jaime Merino
Universidad Autónoma de Madrid

Date submitted: 25 Nov 2006

Electronic form version 1.4