A Charge Density Wave Transition in Non Superconducting Na$_{0.35}$CoO$_2$·1.3H$_2$O

R.A. FISHER, H. FU, D.-H. LEE, N. OESCHLER, N.E. PHILLIPS, LBNL and University of California, Berkeley, R.J. CAVA, M.-L. FOO, Princeton University — For most superconducting samples of Na$_{0.35}$CoO$_2$·1.3H$_2$O the transition to the superconducting state occurs near 4.5 K. For some non-superconducting samples a different transition, near 7 K, shows the existence of another ordering that competes with the electron pairing of the superconducting state. Specific-heat measurements in zero field and 9 T show that the 7-K transition is essentially independent of field, which is suggestive of a CDW transition. The specific-heat anomaly is consistent with a CDW on 1/4 of the Fermi surface and an order parameter with a temperature dependence similar to that of the BCS transition. A theoretical study using a band-structure fit to ARPES data for Na$_{0.3}$CoO$_2$ supports the presence of CDW order. Under renormalization group flow an onsite plus nearest-neighbor Hubbard interaction leads to an effective low-energy electron-electron interaction containing scattering processes that favor a CDW with waves of period $3\frac{1}{2}a$, where $a$ is the lattice constant. A mean-field analysis confirms that this effective low-energy interaction can lead to real-space density modulations with period $3\frac{1}{2}a$. 

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