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Neutron scattering study of novel magnetic order in $Na_{0.5}CoO_2$.[1]

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The layered sodium cobaltates, Na_xCoO_2, have attracted much recent attention, due to their unusual thermodynamic properties, as well as the recent discovery of superconductivity in the hydrated composition. These strongly correlated systems exhibit a rich electronic phase diagram as a function of sodium doping, x. A particularly intriguing insulating phase is realized at x=1/2, featuring a long range sodium order, a metal-insulator phase transition at 51 K, and a magnetic ordering transition at 88 K. We present polarized and unpolarized neutron scattering measurements of the magnetic order in single crystals of $Na_{0.5}CoO_2$. Our data indicate that below $T_N = 88$ K the spins form a novel antiferromagnetic pattern within the CoO2 planes, consisting of alternating rows of ordered and non-ordered Co ions. The domains of magnetic order are closely coupled to the domains of Na ion order, consistent with such a two-fold symmetric spin arrangement. Magnetoresistance and anisotropic susceptibility measurements further support this model for the electronic ground state.

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