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Evolution of the CO-OO and AF ordering in the single-layer manganite $Pr_{1-x}Ca_{1+x}MnO_4$ near half doping FENG YE, J. A. FERNANDEZ-BACA, Oak Ridge National Lab., SONGXUE CHI, PENGCHENG DAI, Univ. of Tennessee, Knoxville, J. W. LYNN, NIST Center for Neutron Research, R. MATHIEU, Y. KANEKO, ERATO-SSS, Y. TOKURA , Univ. of Tokyo — Manganese oxides have attracted considerable attention due to the CMR effect observed in the perovskite manganite $A_{1-x}A'_xMnO_3$ near $x = 0.3$. A peculiar charge/orbital (CO-OO) accompanied by antiferromagnetic (AF) order occurs when the carrier concentration is close to half doping (x=0.5). To understand the interplay between the charge, lattice and spin degrees of freedom in such insulating state, we used elastic neutron scattering to study the evolution of the CO-OO as well as the AF correlations in the single-layer manganite $Pr_{1-x}Ca_{1+x}MnO_4$ ($x = 0.40$, 0.45 and 0.50). Upon cooling, all three samples exhibit long-range CO-OO near 300 K. However, only the $x = 0.50$ system displays long-range AF order at low temperatures. The CE-type AF correlations are quickly suppressed and become short-ranged as more e_g electrons are introduced to the MnO_2 plane. More interestingly, the CO-OO and AF order associated with Mn^{3+} ions appears at incommensurate positions while the AF order associated with Mn^{4+} ions remains commensurate. Our observations indicate that the orbital physics play an important role in the understanding of the electronic and magnetic properties of doped manganites.

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