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Optic phonon anomaly as a precursor to polaron formation in a layered CMR manganite. DMITRY REZNIK, FRANK WEBER, Forschungszentrum Karlsruhe, NADIR ALIOUANE, DIMITRI ARGYRIOU, Hahn-Meitner Institut, MARCUS BRADEN, Physikalisches Institut, Universität zu Köln, WINFRIED REICHARDT, Forschungszentrum Karlsruhe — We found evidence of a precursor effect to polaron formation in the bond stretching phonons in the bilayer CMR manganite $\text{La}_{2-2x}\text{Sr}_{1+2x}\text{Mn}_2\text{O}_7$ at 10K. Inelastic neutron scattering measurements of these phonons in the XX0 direction show that both the transverse and longitudinal branches broaden abruptly from $X=0.15$, where they are resolution limited, to $X=0.25$ where $\text{FWHM}=13\text{meV}$. They then narrow again on approach to the zone boundary ($X=0.5$). The shell model predicts a downward dispersion following the cosine function for the transverse branch and upward dispersion for the longitudinal branch, which is exactly what is observed in undoped cuprates. But in $\text{La}_{2-2x}\text{Sr}_{1+2x}\text{Mn}_2\text{O}_7$ both branches show a steep downward dispersion above $x=0.15$. The anomalous dispersion and broadening can be understood as a precursor effect to the CMR transition at 125K because they appear at the same wavevectors as the polaron peaks in the same compound observed above 125K near $q=(0.27,0.27,0)$. This behavior is very unusual, because such precursor effects have previously been associated with phase transitions where charge order appears on cooling, not on heating as in CMR manganites.

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