Dynamic Nano-Phase Fluctuations in CMR Materials
-----Jahn-Teller Phonon Anomaly
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Microscopic phase inhomogeneities or dynamic phase fluctuations on nanometer-length scale may be the essential ingredient for exotic macroscopic phenomena in highly correlated electron systems. $La_{0.7}Ca_{0.3}MnO_3$, one of the "colossal" magnetoresitive (CMR) materials, exhibits a ferromagnetic-metal to paramagnetic-insulator transition at a temperature of 140K (T_C). Our inelastic neutron scattering experiments reveal the *dynamic* phase fluctuations which cause the de-coherence of phonon excitations as $T \rightarrow T_C$ (see the figure), thus providing evidence of local phase separation associated with the nano-scale polaron or charge/orbital ordering in the material.

We have also observed a strong magnon-phonon coupling in these CMR materials which causes anomalous magnon softening and damping when the magnon and phonons merge.

* Jiandi Zhang et al., PRL 86, 3823 (2001).

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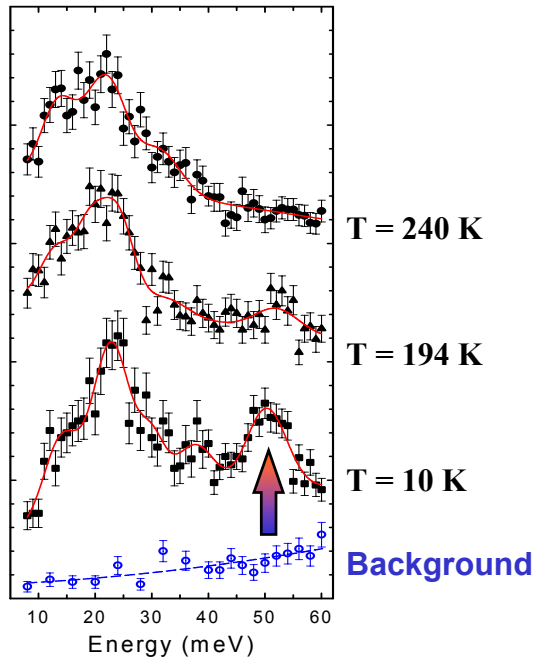

Temperature-dependent inelastic neutron scattering spectra of $La_{0.7}Ca_{0.3}MnO_3$. A Jahn-Teller active optical phonon (see the marked peak) exhibits continuous but anomalous damping with increasing temperature in the ferromagnetic phase and collapses above T_C, attributed to the growing *dynamic* phase segregation as $T \rightarrow T_C$ which causes the de-coherence of phonon excitation.