Mott Transition and Multiferroic Behavior in $PbCrO_3$

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$PbCrO_3$ is an especially interesting highly-correlated electron system, as it is believed to provide the only experimental example of a Mott transition [1] generated by a strong screening of the Coulomb potential that is associated with a lattice contraction.

At low pressures, this material is a cubic paramagnet with an anomalously large unit cell that transitions to an antiferromagnet at T_N ~ 190 K. Increasing the pressure above 1.6 GPa results in an isostructural transition with a reduced cell volume and, therefore, an increased screening of the Coulomb potential, which in turn leads to a Mott transition.

A ferroelectric transition occurs at T_C ~ 65-80 K, below which the low temperature state exhibits magnetic frustration of the magnetic moments on the Cr atoms. This drives spatial variations of the local magnetization and eventually results in ferroelectricity. The dielectric susceptibility of the low temperature phase was measured at the MagLab's High B/T facility using a specialized high-sensitivity dielectric cell. *The electric susceptibility observed down to 50 mK depends strongly on the applied DC field (up to 6T) and on the frequency, suggesting strong magneto-electric effects.*

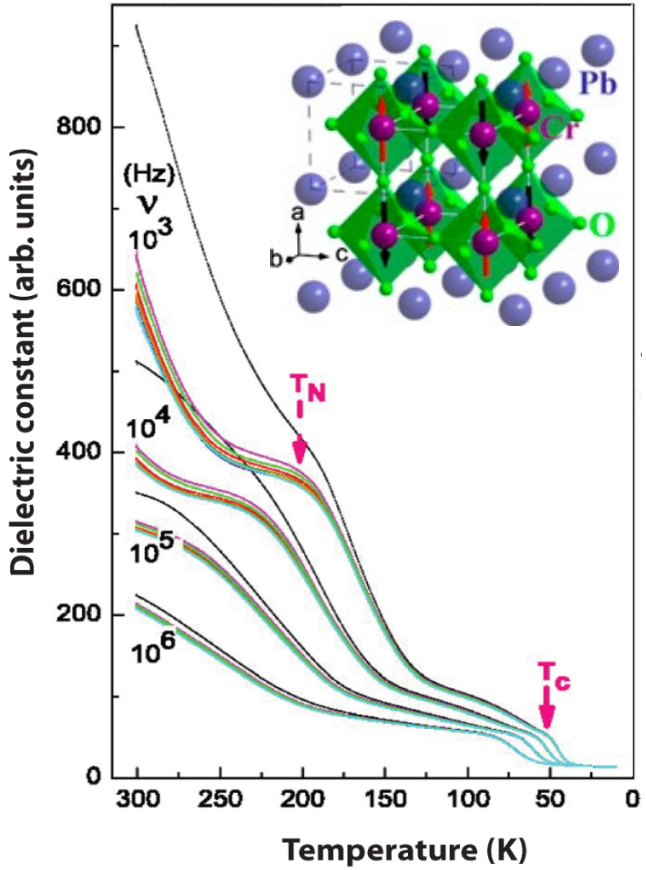

Figure: Temperature dependence of the dielectric susceptibility for PbCrO3 at different frequencies, showing both the Neel transition (T_N) and the ferroelectric transition (T_C). Note the temperature scale has been reversed, with zero at the right.

References

[1] N. F. Mott, Rep. Prog. Phys. 47(8), 909 (1984)

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