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Magnetism in complex oxides probed by transverse susceptibility and magnetocaloric effect[1]

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Magnetic oxides exhibit rich complexity in their fundamental physical properties determined by the intricate interplay between structural, electronic and magnetic degrees of freedom. The common theme that is often present in many systems is the strong magnetostructural coupling and possible spin frustration induced by lattice geometry. In this talk, we will demonstrate the relatively unconventional experimental methods of RF transverse susceptibility (TS) and magnetocaloric effect (MCE) as being powerful probes of multiple magnetic transitions, glassy phenomena and ground state magnetic properties in three classes of oxides including $Pr_{0.5}Sr_{0.5}CoO_3$, $LuFe_2O_4$ and mixed phase manganite (La,Pr,Ca)MnO_3. The TS experiments reveal a coupled structural/magnetocrystalline anisotropy transition in $Pr_{0.5}Sr_{0.5}CoO_3$ driven by Pr-O hybridization and the nature of this transition is also clarified in MCE experiments. These results point to the existence of an entirely new class of phenomena in the cobaltites due to the unique interplay between structure and magnetic anisotropy. In $LuFe_2O_4$, our experiments show the emergence of a complex phase diagram with ferrimagnetic clusters undergoing two glass transitions followed by kinetic arrest at low temperature. Finally, in LPCMO, we will discuss the subtle balance between coexistence of ferromagnetic metal (FMM), charge-ordered insulator (COI) and paramagnetic insulator (PMI) phases that are highly sensitive to strain and dimensionality.

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