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Controlling structural complexity as a path towards new multifunctional correlated materials

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Perovskite ABO_3 oxides display an amazing variety of phenomena that can be altered by subtle changes in the chemistry and internal structure. Most undergo non-polar structural distortions associated with a rotation of the BO_6 octahedra about one or more of the crystal axes. These distortions are well known to control the charge/orbital, magnetic and electronic degrees of freedom. This strong coupling represents an opportunity to understand and create new functional materials that respond to an external perturbation in a useful way. For example, if octahedral rotations can be designed to induce ferroelectricity, an applied electric field would be able to directly couple to the BO_6 octahedra, thereby controlling emergent phenomena such as magnetism, and possibly controlling metal/insulator transition. In this talk I will discuss our recent work in this area, highlighting the opportunities and the challenges to realizing such materials.