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Orbital Order and Spontaneous Orthorhombicity in Iron Pnictides¹

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Phase diagram of the Iron Pnictide families of superconductors show a tetragonal to orthorhombic transition, sometimes coincident with the antiferromagnetic phase transition and sometimes at temperatures clearly above the antiferromagnetic phase transition. Inelastic neutron scattering spectra show exchange constants with strong spatial anisotropy. Recent photoemission measurements in mechanically detwinned samples show clear evidence of unequal orbital occupation and strikingly different spectra for dxz and dyz iron orbitals. Scanning Tunneling Microscopy and transport measurements have also shown substantial orthorhombicity in these materials. We discuss a simple microscopic picture for coupled spin and orbital degrees of freedom as the root cause for such an anisotropy and discuss the extent to which this picture can be distinguished from spin-frustration induced Ising nematic fluctuations as being the dominant driver for this phenomena.

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