Ferroelectricity and magnetism are inherently difficult to incorporate into single phase materials due to their contraindicated nature. Here we present guidelines used to identify two new materials which demonstrate coupling of magnetism and polar behavior.

**Competing Interactions**

Competing magnetic interactions lead to complex magnetic structures which can couple to the lattice to relieve the frustration.

![Diagram showing competing interactions](image)

Lone pairs localize in one of the sp³ hybrid orbitals much like what is seen in NH₃.

High polarizability of lone pairs is a good indicator for ferroelectric instabilities.

**Spin-Orbit Coupling from Orbital Degeneracy**

Spin-orbit coupling increases as Zᵣ so heavier rare earths are ideal, but the spins order at very low temperatures.

Co⁺ in an octahedral crystal field demonstrates the largest spin-orbit coupling constant of any 3d transition metal.

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**References**

B. C. Melot et al arXiv: 1003.3702

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