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### **Trompe L'oeil Ferromagnetism<sup>1</sup>**

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The characteristics of ferro-(ferri)magnetism with non-zero magnetization include magnetic attraction, magnetic circular dichroism, and magneto-optical Kerr (MOKE), Faraday, and various anomalous Hall-type (Hall, Etingshausen, Nernst, and thermal Hall) effects. Non-magnetic or antiferromagnetic materials in external electric fields or other environments (called specimen constituents) can share symmetry operational similarity (SOS) with magnetization in relation to broken symmetries. These specimen constituents can be associated with non-zero magnetization and/or show ferromagnetism-like behaviors, so we say that they exhibit Trompe L'oeil Ferromagnetism. Examples include linear magnetoelectric materials such as  $\text{Cr}_2\text{O}_3$  under electric fields, Faraday effect in chiral materials such as tellurium with current flow, magnetic field induced by the motion of Neel- or Bloch-type ferroelectric walls, and magneto-optical Kerr (MOKE), Faraday effect, and/or anomalous Hall-type effects in certain antiferromagnets such as  $\text{Cr}_2\text{O}_3$ ,  $\text{MnPSe}_3$ ,  $\text{Mn}_4(\text{Nb,Ta})_2\text{O}_9$ , and  $\text{Mn}_3(\text{Sn,Ge,Ga})$ . A large number of new specimen constitutes having SOS with Magnetization will be discussed, and require future experimental verification of their ferromagnetism-like behaviors, and also theoretical understanding of possible microscopic mechanisms.

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