

Band Filling Control of the Dzyaloshinskii-Moriya Interaction in Weakly Ferromagnetic Insulators

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The antisymmetric exchange interaction, a.k.a Dzyaloshinskii-Moriya interaction (DMI), is responsible for the stabilisation of various exotic noncollinear magnetic ground states, such as spin spirals and skyrmions. It was first introduced to explain the spontaneous magnetisation in weak ferromagnets, in which spins are slightly canted away from the collinear antiferromagnetic order.

We re-examined four isostructural weak ferromagnets, FeBO_3 and MCO_3 ($M = \text{Mn, Co, Ni}$), by means of a novel X-ray diffraction method providing the sign of the DMI [1], and discovered a spectacular reversal of the sign of DMI with the filling of the 3d band of the transition metal [2].

[1] Dmitrienko, Ovchinnikova, Collins, Nisbet, Beutier, Kvashnin, Mazurenko, Lichtenstein, and Katsnelson, *Nat. Phys.* **10**, 202 (2014).

[2] Beutier, Collins, Dimitrova, Dmitrienko, Katsnelson, Kvashnin, Lichtenstein, Mazurenko, Nisbet, Ovchinnikova, and Pincini, *Phys. Rev. Lett.* **119**, 167201 (2017).

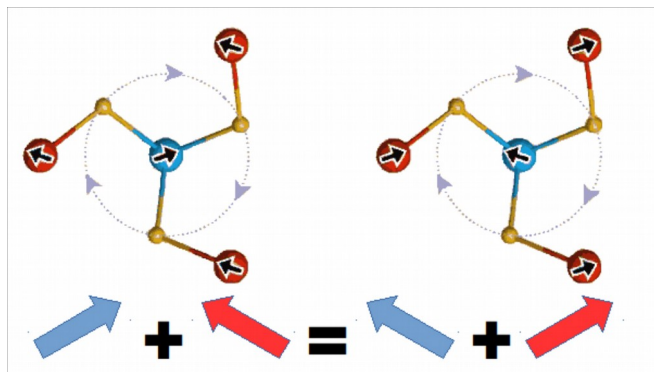


Figure: The two possible magnetic structures in the isostructural weak ferromagnets FeBO_3 and MCO_3 ($M = \text{Mn, Co, Ni}$). Both have the same net magnetization, yet opposite signs of DMI.