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Monopole-limited nucleation of magnetism in $Eu_2Ir_2O_7$

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The arrangement of magnetic moments at the vertices of a pyrochlore lattice - composed of corner-sharing tetrahedra - leads to a great variety of electronic ground states for $R_2M_2O_7$ materials. Here, we present an in-depth analysis of muon-spin spectroscopy measurements of $Eu_2Ir_2O_7$ under the effect of the $Eu_{1-x}Bi_x$ isovalent and diamagnetic substitution [1] as well as of external pressure [2]. Below T_N, $Eu_2Ir_2O_7$ shows a topologically non-trivial 4-in/4-out order where the Ir^{4+} magnetic moments all point inwards or outwards the tetrahedron they are located at (magnetic hedgehog monopole). Our results evidence an anomalous correlation between the magnetic volume fraction and the order parameter only for stoichiometric $Eu_2Ir_2O_7$, pointing towards highly unconventional properties of the magnetic phase developing therein [3]. We argue that magnetism in $Eu_2Ir_2O_7$ develops based on the nucleation of magnetic droplets at T_N, whose successive growth is limited by the need of a continuous generation of magnetic hedgehog monopoles [3].

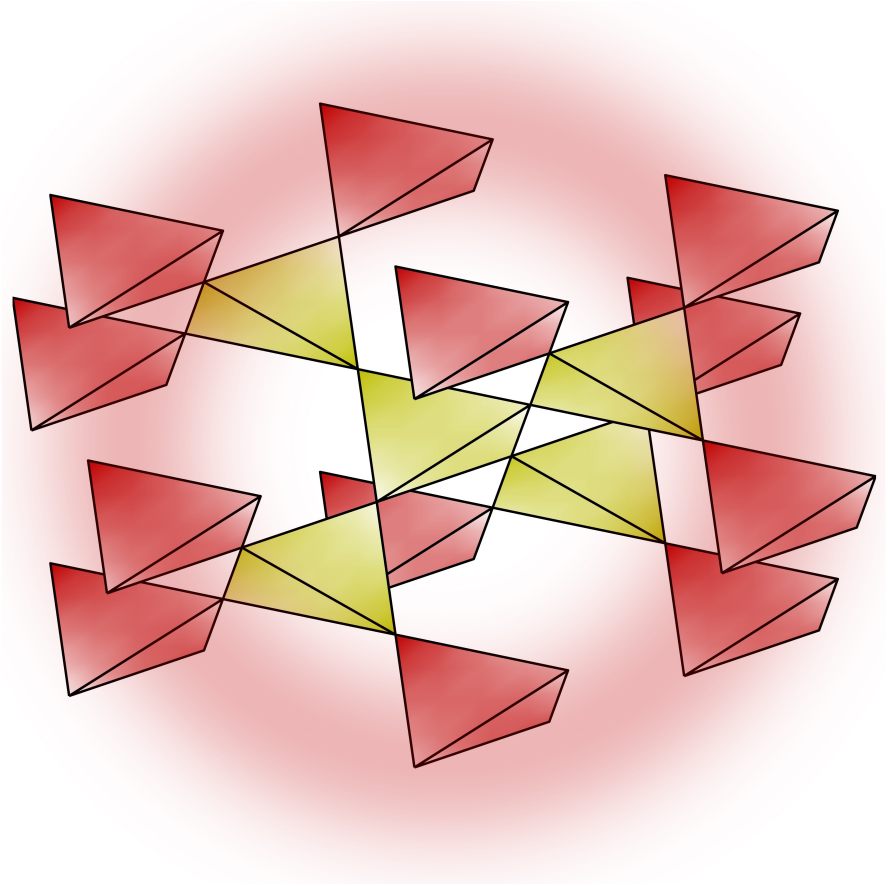

Figure 1: Nucleation of magnetism radiating from topologically non-trivial ordered tetrahedra (yellow) immersed in topologically trivial paramagnetic tetrahedra (red).

[1] P. Telang *et al.*, *Physical Review B* **99** 201112(R) (2019).

[2] G. Prando *et al.*, *Physical Review B* **93** 104422 (2016).

[3] G. Prando *et al.*, *Physical Review B* **101** 174435 (2020).

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