Dynamical fractal in a clean topological magnet

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Fractals -- objects with non-integer dimensions -- occur in manifold settings and length scales in nature, ranging from snowflakes and lightning strikes to natural coastlines. Much effort has been expended to generate fractals for use in many-body physics. Here, we identify an emergent dynamical fractal in a disorder-free, stoichiometric three-dimensional magnetic crystal in thermodynamic equilibrium.

This talk starts with a brief introduction to topological magnetism, and goes on to explain how the above phenomenon is born from constraints – arising from a combination of topology and symmetry – on the dynamics of the magnetic monopole excitations in spin ice, which restrict them to move on the fractal. This observation explains the anomalous exponent found in magnetic noise experiments in the spin ice compound Dy2Ti2O7. The capacity of spin ice to exhibit such striking phenomena holds promise of further surprising discoveries in the cooperative dynamics of even simple topological many-body systems.

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References

[1] J. Hallen, S. Grigera, A. Tennant, C. Castelnovo, R. Moessner, Science 378, 1218 (2022)