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Magnetic monopoles in spin ices and spin excitations in other pyrochlores¹

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Exotic excitations go along with the unusual ground states of frustrated magnets. One of the most striking examples occurs in dipolar spin ice, where the dipole moment of the underlying electronic spin degrees of freedom fractionalises into magnetic monopoles. This constitutes possibly the first instance of fractionalisation in a three-dimensional material. It enables us to account for a mysterious phase transition observed experimentally in spin ice in a magnetic field, which is a liquid-gas transition of the magnetic monopoles. These monopoles can also be detected by other means, e.g., in an experiment modelled after the celebrated Stanford magnetic monopole search. We also discuss other instances of unusual pyrochlore excitations.

¹in collaboration with Claudio Castelnovo (Oxford) and Shivaaji Sondhi (Princeton)