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## Novel insight into Tb<sub>2</sub>Ti<sub>2</sub>O<sub>7</sub> Flavor modes and mixed dipolar-quadrupolar phases

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Tb<sub>2</sub>Ti<sub>2</sub>O<sub>7</sub> has remained an enigma in condensed matter physics, and more specifically in the field of frustrated magnetism, for about two decades [1]. This material evades long-range order down to temperature as low as 20 mK and its ground state exhibits puzzling diffuse magnetic scattering [2,3]. Its low energy spin dynamics includes, on the one hand, an exciton located at about  $\hbar\omega = 1.5$  meV, which shows a significant dispersion [4]; on the other hand, Tb<sub>2</sub>Ti<sub>2</sub>O<sub>7</sub> also hosts an exotic low energy collective mode ( $\approx 0.3$  meV), which is believed to be a hybrid dipolar-quadrupolar mode [5,6].

Using polarized inelastic neutron scattering measurements, I will present a review of the characteristics of this low-energy mode, its dispersion, the evolution of its spectral weight in the Brillouin zone and its temperature dependence. I will then describe RPA simulations, based on a Hamiltonian, which includes both dipolar and quadrupolar couplings [7], yielding spin dynamics which compare quite well with those data. The best set of couplings suggest that Tb<sub>2</sub>Ti<sub>2</sub>O<sub>7</sub> is one of the very rare examples of quantum spin ice, yet very close to several ordered phases, especially a planar antiferromagnetic dipolar phase and a purely quadrupolar one [8,9].

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