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High-resolution spectrum of fractional excitations in $Ce_2Sn_2O_7$

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A correlated liquid state was reported in the pyrochlore $Ce_2Sn_2O_7$. Its nature remained elusive, but with additional knowledge on the crystal-electric field scheme, the case of cerium pyrochlores was further investigated based on degrees of freedom having both magnetic dipole and magnetic octupole components. A number of recent studies all point towards a quantum spin ice (QSI) based on a manifold of ice-rule correlated octupoles to be stabilized in these materials. Theorists had conceptualized such an octupolar QSI, where quantum dynamics is endowed by couplings between other components of the 'dipole-octupole'pseudo-spins.
This talk reviews findings reported so far on $Ce_2Sn_2O_7$, puts these in perspective with results on other cerium pyrochlores, and presents new experimental data that further hint at cerium pyrochlores being genuine representatives of QSI –the model 3D quantum spin liquid. In particular, we argue that excitations observed in Time-Of-Flight spectroscopy are associated with the fractional excitations of QSI. Using backscattering experiments performed on IN16B, we further confirm this conclusion. The improved energy resolution allows detailed comparisons with theories for spinon dynamics in QSI. It is predicted that the alternative vacuum of this condensed matter system is drastically different from that of our Universe, with phenomena arising from strong light-matter interactions. We observe a gapped spectrum with an edge structure corroborating the predictions for the effects of photons on the production of matter excitations.

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