Magnetization process and ordering of the $S = 1/2$ pyrochlore Heisenberg antiferromagnet in a magnetic field

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We study the $S = 1/2$ pyrochlore Heisenberg antiferromagnet in a magnetic field. Using large scale density-matrix renormalization group calculations for clusters with up to 128 spins, we find indications for a finite triplet gap, causing a threshold field to nonzero magnetization in the magnetization curve. We obtain a robust saturation field consistent with a magnon crystal, although the corresponding 5/6 magnetization plateau is very slim and possibly unstable. Most remarkably, there is a pronounced and apparently robust 1/2 magnetization plateau where the ground state breaks the rotational symmetry of the lattice, exhibiting *oppositely polarized* spins on alternating kagomé and triangular planes. Reminiscent of the kagomé ice plateau of the pyrochlore Ising antiferromagnet known as spin ice, it arises via a much more subtle 'quantum order-by-disorder' mechanism. [1]

References:

[1] I. Hagymási, R. Schäfer, R. Moessner, and D. J. Luitz, Phys. Rev. B **106**, L060411 (2022)