Abstract Submitted
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Fractional spinon excitations in the quantum Heisenberg antiferromagnetic chain material $CuSO_4.5D_2O$ MARTIN MOURIGAL, Johns Hopkins, MECHTHILD ENDERLE, ILL Grenoble, AXEL KLÖPPERPIEPER, U. of Saarbrücken, JEAN-SÉBASTIEN CAUX, U. of Amsterdam, ANNE STUNAULT, ILL Grenoble, HENRIK RØNNOW, EPFL Lausanne — One of the simplest quantum many-body systems is the spin-1/2 Heisenberg antiferromagnetic chain, a linear array of interacting magnetic moments. Its exact ground state is a macroscopic singlet entangling all spins in the chain. Its elementary excitations, called spinons, are fractional spin-1/2 quasiparticles created and detected in pairs by neutron scattering. Theoretical predictions show that two-spinon states exhaust only 71% of the spectral weight and higher-order spinon states, yet to be experimentally located, are predicted to participate in the remaining. By accurate absolute normalization of our inelastic neutron scattering data on the spin-1/2 Heisenberg antiferromagnetic chain compound $CuSO_4.5D_2O$, we account for the full spectral weight to within 99(8)% [1]. Our data thus establish and quantify the existence of higher-order spinon states. The observation that, within error bars, the experimental line shape resembles a rescaled two-spinon one with similar boundaries allows us to develop a simple picture for understanding multi-spinon excitations.

[1] Nature Physics **9**, 435–441 (2013)

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