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Fractional excitations in the square-lattice quantum antiferromagnet H.M. RØNNOW, EPFL Lausanne, M. MOURIGAL, Georgia Institute of Technology, B. DALLA PIAZZA, EPFL Lausanne, N.B. CHRISTENSEN, Technical University of Denmark, G.J. NILSEN, Institut Laue-Langevin, T.G. PERRING, Rutherford Appleton Laboratory, M. ENDERLE, Institut Laue-Langevin, D.F. MCMORROW, University College of London, D.A. IVANOV, ETH Zurich and University of Zurich — The quantum square-lattice Heisenberg antiferromagnet (QSLHAF) exhibits a striking anomaly of hitherto unknown origin in its magnetic excitation spectrum. This quantum effect manifests itself for excitations propagating with the specific wavevector (π,0). We used polarized neutron spectroscopy to fully characterize the magnetic fluctuations in the metal-organic compound $Cu(DCOO)_2{\cdot}4D_2O$ (CFTD), a known realization of the QSLHAF model. Our experiments reveal an isotropic excitation continuum at the anomaly, which we analyse theoretically using Gutzwiller-projected trial wave functions [1]. The excitation continuum is accounted for by the existence of pairs of fractional S = 1/2 quasiparticles that deconfine over intermediate length-scales. Away from the anomalous wavevector, these fractional excitations are bound and form conventional magnons. Our results reveal the existence of fractional quasiparticles in the high-energy spectrum of a quasi-two-dimensional antiferromagnet, even in the absence of frustration.
[1] B. Dalla Piazza *et al.*, to appear in Nature Physics (December 2014)

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