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Coexistence of diffuse liquid-like scattering and emergent coherent mode in $Fe_{1+y}Te$ IGOR ZALIZNYAK, DAVID FOBES, ZHIJUN XU, GENDA GU, JOHN TRANQUADA, Brookhaven Natl Lab, ANDREI SAVICI, OVIDIU GARLEA, DOUGLAS ABERNATHY, Oak Ridge National Lab — Neutron scattering in the chalcogenide parent material FeTe reveals diffuse dynamical magnetic response, suggesting dynamical correlation length of only 1-2 lattice repeats. The wave-vector structure of magnetic fluctuations can be best described by a liquid-like state with local order in the form of weakly correlated, co-aligned four-spin plaquettes. Additionally, this dynamical magnetism is extremely robust. It survives to temperatures well above the Neel ordering T $\sim$ 60 K, and even exhibits unusual temperature-induced enhancement. More surprisingly, no coherent excitation was seen to emerge when system is cooled into magnetically ordered state. Nevertheless, spin-wave theory has been applied to interpret the measured spectra, but the agreement of its predictions with the experiment was found to be marginal at best. Here we report the discovery of a coherent magnetic excitation in the magnetically ordered state at low temperature, which coexists with the diffuse, liquid-like magnetic response. This resolves puzzle of surprising absence of coherent excitations associated with magnetic order in FeTe, where emergence of sharp electronic resonance near the Fermi energy has been observed by ARPES. This work was supported by the US DOE under Contract DE-AC02-98CH10886.

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