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Observation of a gapless linear dispersion at quantum criticality in the Ising chain ferromagnet $CoNb_2O_6$ in transverse field[1] IVELISSE CABRERA, JORDAN D. THOMPSON, RADU COLDEA, DHARMALINGAM PRABHAKARAN, Clarendon Laboratory, Department of Physics, University of Oxford, Oxford OX1 3PU, United Kingdom, ROBERT I. BEWLEY, TATIANA GUIDI, ISIS Facility, Rutherford Appleton Laboratory, Chilton, Didcot, Oxon OX11 0QX, United Kingdom — The Ising chain in transverse field is one of the canonical paradigms for a continuous field-driven quantum phase transition between spontaneous magnetic order and a quantum paramagnet. The mechanism driving this phase transition has long been predicted to involve the closing of the spin gap, or minimum excitation energy, at the quantum critical point, where a characteristic linear dispersion is expected at low energies. We report single-crystal neutron diffraction and inelastic neutron scattering measurements that unveil how the magnetic order and excitations evolve in the very close proximity of the quantum critical point in the quasi-1D Ising chain ferromagnet $CoNb_2O_6$. Near criticality, we observe an essentially gapless spectrum with an almost perfectly-linear dispersion along the chain direction. Below the critical field, the frustrated interchain couplings stabilize 3D incommensurate spin-density-wave order, as observed through diffraction measurements. To our knowledge, this is the first time that essentially-gapless, linearly dispersive excitations have been observed in the very close proximity of a transverse field-tuned quantum critical point.

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