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**Quantum criticality of dipolar spin chains** ALDO ISIDORI, ANNIKA RUPPEL, ANDREAS KREISEL, PETER KOPIETZ, Institute for Theoretical Physics, University of Frankfurt, 60438 Frankfurt, Germany, ALEXANDER MAI, REINHARD M. NOACK, Physics Department, University of Marburg, 35032 Marburg, Germany — We show that a one-dimensional chain of Heisenberg spins, interacting with long-range dipolar forces in a magnetic field perpendicular to the chain, exhibits a quantum critical point belonging to the two-dimensional Ising universality class. Within linear spin-wave theory (corresponding to the so-called Gaussian approximation) the long-wavelength magnon dispersion is characterized by a logarithmic singularity in the magnon velocity for vanishing momenta, due to the long range nature of dipolar interactions in one-dimension. However, in the vicinity of the critical point this logarithmic correction is renormalized to zero by the effects of quantum fluctuations, signaling the reemergence of scale invariance, in accordance with the Ising critical scenario. The quantum critical regime where linear spin-wave theory breaks down is studied using two independent non-perturbative methods, namely the density-matrix renormalization group (DMRG) and the functional renormalization group (FRG). The Ginzburg regime where non-Gaussian fluctuations are important is found to be rather narrow on the ordered side of the transition, and very broad on the disordered side.

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