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Spin-wave interactions in quantum antiferromagnets NILS HASSELMANN, PETER KOPIETZ, Institut für Theoretische Physik, Universität Frankfurt, Germany — We study spin-wave interactions in quantum antiferromagnets in terms of Hermitian field operators representing staggered and ferromagnetic transverse spin fluctuations. In this parameterization, the two-body interaction vertex between staggered spin fluctuations vanishes at long wavelengths. We derive a new effective action for the staggered fluctuations and show that the quantum critical point separating the renormalized classical from the quantum disordered regime in $D > 1$ dimensions is characterized by an anomalous dimension of the field operator $\eta = D - 1$. We further use this technique to derive the effective long-wavelength Euclidean action for the antiferromagnetic spin-waves of ordered antiferromagnets subject to a magnetic field. We point out, that the magnetic field dependence of the spin-wave dispersion predicted by the usual $O(3)$ nonlinear sigma model disagrees with spin-wave theory. We argue that the nonlinear sigma-model does not take into account all relevant spin-wave interactions and derive a modified effective action for the spin-waves which contains an additional quartic interaction. At zero temperature the corresponding vertex is relevant in the renormalization group sense below three dimensions.

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