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Magnon-induced long-range correlations and their neutron-scattering signature in quantum magnets[1] S BHARADWAJ, D BELITZ, Univ of Oregon, T. R. KIRKPATRICK, Univ of Maryland, College Park — In the ordered phases of classical ferromagnets (FMs) and antiferromagnets (AFMs), the long-range correlations induced by the magnons lead to a singular wavenumber dependence of the longitudinal order-parameter susceptibility: $\chi_L \sim 1/k^{4-d}$ for $2 < d < 4$.[1,2] We investigate the quantum analog of this singularity. In a quantum AFM at $T = 0$, we find $\chi_L \sim k^{d-3}$ for $1 < d < 3$, consistent with naive power counting. The analogous result for a quantum FM, k^{d-2}, is absent if the magnon damping is neglected. This is due to the lack of magnon number fluctuations in the quantum FM ground state.[3] Magnon damping due to quenched disorder restores the expected nonanalyticity. We also calculate the longitudinal part of the dynamical structure factor, which is directly measurable via neutron scattering. In both FMs and AFMs, we find a logarithmic singularity at the magnon frequency that vanishes as $T \to 0$. However, the AFM case has a nonzero contribution at $T = 0$. This difference is also related to the the different entanglement entropies of the two magnetically ordered phases.

1. V.G. Vaks et al., JETP 26, 647 (1968).

2. E. Brezin and D.J. Wallace, PRB 7, 1967 (1973).

3. S. Bharadwaj et al., PRB 94, 144404 (2016).

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Sripoorna Bharadwaj
Univ of Oregon

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