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Lifetime of spin excitations in non-collinear quantum antiferromagnets[1]

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Non-collinearity of spins in the ordered quantum antiferromagnets can be induced by external field or by frustrating interactions. We demonstrate that the spin-wave excitations in a wide class of non-collinear antiferromagnets have finite lifetime even at $T = 0$ due to spontaneous two-magnon decays. We present a detailed analysis of the dynamics of the $S = 1/2$ Heisenberg antiferromagnet in the triangular lattice in zero field and in the square lattice in high magnetic field. We show that the spectra of these systems are overdamped in most of the Brillouin zone due to such decays. Their spectra also exhibit threshold-like singularities which lead to further enhancement of the decay rates along special contours in the momentum space. Such an enhancement of damping in certain regions of the Brillouin zone can be used in the analysis of the neutron-scattering data to distinguish the decay-induced spin-wave broadening from the other scenarios that can yield broad spectra of spin excitations. We extend our study to the magnetic field-induced BEC phases, common to many quantum antiferromagnets. We demonstrate that the lifetime effects in the spin excitation spectra are crucial for the understanding of the thermal transport anomalies in these systems.

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