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Anomalous spin-waves in triangular lattice antiferromagnets[1]
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The distinct features of spin-wave excitations in the triangular-lattice antiferromagnet are (i) finite lifetime at zero temperature due to spontaneous two-magnon decays, (ii) strong renormalization of magnon energies $\varepsilon_{\mathbf{k}}$ with respect to the harmonic result, and (iii) logarithmic singularities in the decay rate $\Gamma_{\mathbf{k}}$. Detailed quantitative results are obtained for the magnon spectrum of the spin-1/2 model using both the on-shell and off-shell solutions of the Dyson's equation. In the low-energy limit magnons remain well-defined excitations but with anomalous decay rates. At high energies, magnons are heavily damped with decay rates reaching $(2\Gamma_{\mathbf{k}}/\varepsilon_{\mathbf{k}}) \sim 0.3$. The on-shell solution shows logarithmic singularities in $\Gamma_{\mathbf{k}}$ with the concomitant jump-like discontinuities in $\mathrm{Re}[\varepsilon_{\mathbf{k}}]$ along certain contours in the momentum space. Such singularities are even more prominent in the magnon spectral function $A(\mathbf{k}, \omega)$. Although the off-shell solution removes such log-singularities, the decay rates remain strongly enhanced. We also discuss the role of higher-order corrections and show that such singularities may lead to complete disappearance of the spectrum in the vicinity of certain $\mathbf{k}$-points. We conclude that magnon decays and singularities must be prominent in a wide class of noncollinear antiferromagnets.

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