# Quantum properties of squeezed magnons in ferro- and antiferromagnets

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Exotic quasiparticles have been observed in complex spin systems exhibiting spin ice rules, skyrmions and so on. Here, we discuss the emergence of novel quasiparticles, mediated by magnetic dipolar interactions or anisotropies, that have been hiding in simpler spin systems with uniformly ordered ground states. These quasiparticles exhibit a spin ranging from zero to above 1 and display a variety of interesting quantum properties [1]. Of particular interest is our finding that the eigenmodes in an easy-axis antiferromagnet are spin-zero quasiparticles instead of the widely believed spin-1 magnons [2]. These unusual properties originate from a competition between quantum mechanical squeezing (increasing the spin) and hybridization (decreasing the spin). In antiferromagnet, the magnons are in highly entangled two-mode-squeezed state that might be a resource for quantum information. We suggest that the quantum properties can be detected by noise correlations of spin transport across a magnet/non-magnetic conductor interface [3]. In the simple case of ferromagnets with non-integer "effective spin" above bar, we show that spin-current noise measurement can reveal this fundamental quantum phenomenon [1] in full analogy to the effective charge known e.g., in the fractional quantum Hall regime, that has been experimentally determined via shot noise measurements. Further details of the spatial coherence are seen in the spin current-cross correlations.

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[3] A. Kamra and W. Belzig, Spin pumping and shot noise in ferrimagnets: bridging ferro- and antiferromagnets, Phys. Rev. Lett. 119, 197201 (2017).