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Excitation and detection of propagating spin waves at the single magnon level. ALEXY KARENOWSKA, ANDREW PATTERSON, MICHAEL PETERER, EINAR MAGNÚSSON, PETER LEEK, University of Oxford — The fields of spin-wave dynamics and magnonics have made substantial contributions to our understanding of fundamental magnetism, and are increasingly widely acknowledged to be areas of solid-state physics with significant technological potential. To date however, experimental activity has focused on the study and possible application of room-temperature systems operating within classical limits. Here, we report a series of experiments in which we demonstrate, for the first time, the excitation and detection of propagating spin waves at the single magnon level. Our results, which have been obtained at cryogenic temperatures using an yttrium iron garnet spin-wave waveguide, serve as evidence that the experimental tools now exist to permit us to create microwave (i.e. GHz frequency) quantum circuits incorporating dispersive magnon systems. This allows us to anticipate the possibility both of exploring quantum aspects of magnon physics with new experimental clarity, and of examining how this physics — in particular, the magnon's highly tunable dispersion, its readily accessible nonlinearity, and its capacity to couple to optical excitations and electron-based spintronic systems — might have a role to play in new microwave quantum technologies.

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