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Spin Wave Transport in Microscopic Magnetic Structures[1]

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The coherent transport of spin information is one of the great challenges in condensed matter physics and is of fundamental importance for the development of spintronic devices. Spin waves carry angular momentum and can be utilized to transport spin information over distances much larger than the spin diffusion length in metals. Recent experiments showing that spin waves can be manipulated via spin currents and vice versa due to spin torque, spin pumping, spin Hall and spin Seebeck effects have drawn great attention to the transport properties of spin waves. Fundamental topics are spin-wave propagation characteristics in microstructures with reduced dimensionality[2,3], realization of spin-wave transport in two-dimensional waveguides, including directional changes along the spin-wave propagation path[4], and the effect of nonlinear damping mechanisms when spin waves are spatially confined in microstructures. We use phase- and time-resolved Brillouin light scattering microscopy to address these topics in micron-sized spin-wave conduits made from permalloy. These experiments allow us to develop a simple model for calculating dispersion relations in spin-wave conduits. This model can be applied to understand how spin waves are transported in conduits with broken translation symmetry and how nonlinear damping via four-magnon-scattering is enhanced due to spatial confinement.

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