Sonderforschungsbereich TRR 160
Kohärente Manipulation wechselwirkender Spinanregungen
in maßgeschneiderten Halbleitern

Seminarankündigung

Donnerstag, 10.06.2021, 12:00 Uhr
- online -

"Designing with spins: nanopatterning multidimensional spin textures for magnonics"

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Abstract:

Recently, nanoscale spin textures such as structured domains, domain walls and vortices, have raised interest as versatile active components in spintronic devices.
In this framework, we demonstrated that nanopatterning spin textures via thermally assisted magnetic scanning probe lithography (tam-SPL) allows the stabilization, in exchange bias systems, of 2D domains with arbitrary shape and spin configuration, 1D domain walls and 0D magnetic solitons such as vortices with tailored topology and position.
At the same time, spin waves represent a promising avenue for implementing unconventional wave-based computing platforms. However, combining controlled generation, manipulation and long-distance propagation of submicrometric wavelength spin waves is an outstanding challenge.
Here, first we show the channeling and steering of spin-waves in arbitrarily shaped nanomagnonic waveguides based on straight and curved domain walls, and a prototypic nanomagnonic circuit comprising two converging waveguides, allowing for the tunable spatial superposition and interference of confined spin-wave modes.
Then, we present an optically inspired platform for controlling the generation, propagation, and interference of short-wavelength spin waves, using nanopatterned spin textures in synthetic antiferromagnets, at remanence. We demonstrate the spatial engineering of spin-wave wavefronts, the directional emission and focusing of spin-wave beams, and the generation of robust interference patterns which span multiple times the wavelength. Furthermore, we show that SAF allows to combine concepts borrowed from optics, with phenomena naturally arising from the nonreciprocal spin wave dispersion, such as resilience to spurious back reflections.
The ability to finely control the spin texture of magnetic materials opens up a range of new possibilities for both basic studies and developing energy-efficient unconventional computing concepts.