Physics / Materials Science and Engineering Department

Magnetic Matchmaking: Hybrid Magnon Modes

Prof. Axel Hoffmann
Department of Materials Science and Engineering
University of Illinois at Urbana-Champaign

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Hybrid dynamic excitations have gained increased interest due to their potential impact on coherent information processing. Towards this end, magnons, the fundamental excitation quanta of magnetically ordered systems, are of particular interest, since they can be easily tuned by external magnetic fields and interact with a wide range of other excitations, such as microwave and optical photons, phonons, and other magnons.[1] This in turn may open up new pathways for hybrid quantum information systems.[2] We have explored recently the integration of permalloy ($Ni_{80}Fe_{20}$) thin film structures into hybrid magnon systems. By combining permalloy structures with high-quality superconducting microwave resonators, we demonstrated strong magnon-photon coupling in co-planar, on-chip geometry, which is readily scalable to more complex devices.[3] Furthermore, we demonstrated strong coupling of permalloy magnons to standing magnon modes in yttrium iron garnet films, which revealed the importance of damping-like torques originating from spin pumping.[4] Lastly, we demonstrated how the coupling between magnons in Ni and surface acoustic waves in $LiNbO_3$ can be used to modulate phonon propagation.[5,6]

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References:

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Dr. Axel Hoffmann has obtained his Diploma degree in physics from the RWTH Aachen in 1994 and his PhD degree in physics from the University of California – San Diego in 1999. Subsequently he worked at the Los Alamos National Laboratory as a postdoctoral fellow. In 200 1 he joined the Argonne National Laboratory as a staff scientist, and became in 2014 the Senior Group Leader of the Magnetic Thin Film Group. In 2019 he joined the Department of Materials Science an Engineering at the University of Illinois at Urbana-Champaign as a Founder Professor. His research interests encompass a wide variety of magnetism related subjects, including basic properties of magnetic heterostructures, spin-transport in novel geometries, and magnetization dynamics. He is an Associate Editor for the Journal of Applied Physics and a fellow of the American Physical Society, American Vacuum Society, and IEEE.

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Email: kn52@drexel.edu

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