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【714】Spin wave dynamics in ultrathin yttrium iron garnet measured with x-ray microscopy

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Magnonics, the study and development of devices utilising collective spin excitations, is a rapidly growing field, covering both fundamental topics (antiferromagnetism, quasiparticle condensates) and technological applications (MRAM, spintronics). Yttrium iron garnet (YIG) is a ferrimagnetic insulator with the lowest known magnon damping factor of any material. This low damping leads to a prevalence of nonlinear effects and notably the room temperature Bose-Einstein condensation (BEC) of magnons first reported by Demokritov et al in 2006, and subject of a number of investigations since. Ultrathin structures will be required for applications but remain largely unexplored. Here I report on the design, fabrication and characterization of microwave devices based on such ultrathin structures (YIG thickness˜100 nm). The spin wave dynamics were measured using both Brillouin Light Scattering (BLS) and time resolved scanning transmission x-ray microscopy (TR-STXM), locked in phase with microwave stimulation of the devices. A number of milestones are reached for our novel devices. First, we have explicitly measured the spin wave dispersion in YIG, and demonstrated the existence of the finite momentum minimum required for magnon BEC. Second, the BLS data demonstrate that the condensate exists in our samples. These results are a key development towards adding condensate phenomena to the thin film magnonics toolbox.

Authors: Dr BAILEY, Joe (PSI Villigen & EPFL); WINTZ, Sebastian (PSI Villigen & Helmhotz-Zentrum Dresden-Rossendorf); FINIZIO, Simone (PSI Villigen); FÖRSTER, J. (MPI Stuttgart); BAUMGAERTL, Korbinian (EPFL); WEIGAND, M. (MPI Stuttgart); DUBS, Carsten (INNOVENT e.V., Technologieentwicklung Jena); SCHÜTZ, G. (MPI Stuttgart); GRUNDLER, Dirk (EPFL); Dr RAABE, Jörg (Paul Scherrer Institute); AEPPLI, Gabriel (PSI Villigen, EPFL & ETH Zürich)

Presenter: Dr BAILEY, Joe (PSI Villigen & EPFL)

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