Contribution ID: **29**

Type: **Invited Talk**

Accumulation of hybrid magneto-elastic quasi-particles in a ferrimagnet

Saturday 25 February 2017 08:36 (36 minutes)

It is known that an ensemble of magnons, quanta of a spin wave, can be prepared as a Bose gas of weakly interacting quasi-particles with conservation of the particle number. The external pumping of magnons into the system causes an increase in the chemical potential of a thermalized magnon gas. When it becomes equal to the minimal magnon energy a magnon Bose-Einstein condensate (BEC) may form at this spectral point. However, magnon-phonon scattering processes can significantly modify this scenario. Our observations of the magnon BEC in a single-crystal film of yttrium iron garnet (Y3Fe5O12) by means of wavevector-resolved Brillouin Light Scattering (BLS) spectroscopy resulted in the discovery of a novel condensation phenomenon mediated by magneto-elastic interaction: A spontaneous accumulation of hybrid magneto-elastic bosonic quasi-particles at the intersection of the lowest spin-wave mode and a transversal acoustic wave.
This accumulation is the result of a bottleneck in the downward spectral flow of the pumped magnons. The accumulation occurs in a spectral point whose position is determined by the passage from the magnon to the phonon branch and, thus, depends on the strength of the magneto-elastic interaction. As opposed to the classical magnon BEC, the accumulated magneto-elastic bosons have significantly non-zero group velocity (about 200 m/s in our experiment) and, thus, possess strong radiation losses. As a result, the density of these particles depends on their travel path through the thermalized cloud of the pumped magnons and consequently on the width of the pumping area.
The developed theoretical model describes the experimentally observed peak of hybrid magneto-elastic quasi-particles. Moreover, it proves the saturation effect in accumulation of quasi-particles: An increase in the pumping power leads to the increase of the magnon BEC population and a following reduction of the bottleneck effect.
The work is supported by the Deutsche Forschungsgemeinschaft within the SFB/TR 49 "Condensed Matter Systems with Variable Many-Body Interactions", by EU-FET (Grant In-Spin 612759), and by the Graduate School Material Sciences in Mainz (MAINZ) through DFG funding of the Excellence Initiative (GSC-266).

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