DISTINGUISHED LECTURE SERIES

Summer Term 2021

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Nano-Magnonics: From Room to Cryogenic Temperatures

Spin waves, and their quanta magnons, are of great interest as potential data carriers in future low-energy computing devices [1]. The phase of a spin wave provides an additional degree of freedom, while the scalability of structures and wavelengths down to the nanometer regime are further advantages.

In the first part of my talk, an overview of the recent highlights in three research directions will be presented: (i) miniaturization of the lateral dimensions of the magnonic waveguides down to 50 nm and investigations of spin-wave properties in them [2, 3], (ii) utilization of spin-orbit phenomena in magnonic nano-structures [4, 5], and (iii) the realization of magnonic circuits using conventional [6] and inverse-design magnonics approach [7]. The current status of magnon-based computing, as well as future perspectives, will be addressed.

In the second part of the talk, the recent results in the direction of cryogenic magnonics will be presented. In the original study performed in the frames of Spin+X during the first funding period, we have shown that magnons can be efficiently scattered by the array of Abrikosov vortices (fluxons) in the attached superconductive layer [8]. Static and slowly moving (with a velocity around 0.3 km/s) arrays of fluxons were investigated. In the following, we used the direct-write dirty superconductor with perfect edge to achieve ultra-fast vortex motion with velocities > 15 km/s [9]. Finally, the Cherenkov radiation of propagating spin waves by the fast-moving vortices was achieved and proven by microwave detection [10].

Cryogenic magnonics opens a way towards quantum magnonics operating with single magnons at mK temperatures.

This research has been supported by ERC StG 678309 MagnonCircuits.

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Date: **Monday, April 19, 2021**
Time: **04:00 pm**
Venue: **Online via Zoom (Webinar ID: 839 8666 9997)**