UCCS Physics Seminar
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Electric control of the magnon phase

Studying the control of magnon transport characteristics using an electric field is an exciting and important direction of modern magnonics [1]. Exploring new findings of interactions between electric fields and magnons is promising for novel magnonic applications, which will allow for efficient phase manipulation of magnon currents.

Our team in Kaiserslautern investigated the influence of a strong electric field on the phase of propagating spin waves in yttrium iron garnet (YIG) films. The experiment was performed in different spin-wave excitation geometries when volume and surface magnetostatic spin waves were excited. With the help of a vector network analyzer, the phase shift of the transmitted spin waves, which is sensitive to different external influences, was precisely measured.

In the first step, by observing the electrically induced phase shifts of the backward volume waves, we determined the contribution of linear and quadratic magnetoelectric effects for the used YIG film. Further, the obtained magnetoelectric coefficients were used to approximate the phase shifts of the surface spin waves. It turned out that this approximation can be successfully implemented only in the presence of an additional phase shift, which depends on the magnon wave number, the spin-wave propagation path length, and the electric field strength. This shift reached a value of 1.2°, comparable to the shift caused by the magnetoelectric effects. We interpret this additional phase shift as the influence of the magnon Aharonov-Casher effect, which consists of the geometrical accumulation of the phase of spin waves as they pass through an electric field region.

[1] P. Pirro, V. I. Vasyuchka, A. A. Serga, and B. Hillebrands, *Advances in coherent magnonics*, Nat. Rev. Mater. **6**, 1114 (2021).

Biography

Vitaliy Vasyuchka received the master degree in radiophysics and electronics from the Faculty of Radiophysics, Taras Shevchenko National University of Kyiv, Ukraine, in 2003, and the Ph.D. degree in radiophysics from the same university in 2007.

He was a post-doctoral fellow in the group of Prof. B. Hillebrands at the University of Kaiserslautern, Germany from 2008 to 2011. From 2011 to 2017, as a principal investigator, he led the project “Magnon mediated heat and spin transport in magnetic insulators” in the frame of the Priority Program 1538 “Spin Caloric Transport.” From 2017 to 2021, as a research associate, he was working in Kaiserslautern on investigation of magnon Bose-Einstein condensates. Since 2022, he is a lecturer (Akademischer Rat) in the group of Prof. M. Weiler at the Department of Physics, University of Kaiserslautern, Germany.

His research focuses on experimental investigations of linear and nonlinear magnetization dynamics in fields of magnonics, spin caloritronics, and magnon spintronics.