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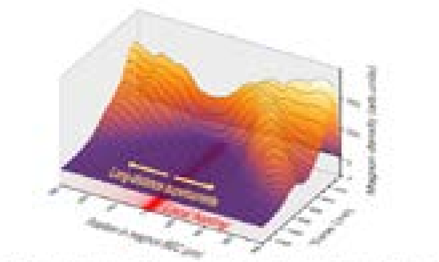
## Magnonic supercurrents

Finding new ways for fast and efficient processing and transfer of data is one the most challenging tasks nowadays. Elementary spin excitations - magnons (spin wave quanta) - open up a very promising direction of high-speed and low-power information processing. Magnons are bosons, and thus they are able to form spontaneously a spatially extended, coherent ground state, a Bose-Einstein condensate (BEC), which can be established independently of the magnon excitation mechanism even at room temperature. Recently we have succeeded to create magnon supercurrents by introducing a time-dependent spatial phase gradient into its wave function. The experiment was done in a single-crystal film of yttrium iron garnet ($Y_3Fe_5O_{12}$, YIG). The temporal evolution of the magnon BEC formed in a parametrically populated magnon gas was studied by means of time- and wavevector-resolved Brillouin light scattering spectroscopy. It has been found that local heating in the focal point of a probing laser beam leads to the excessive decay of the BEC, which is associated with the outflow of condensed magnons driven by a thermal gradient. Furthermore, I will demonstrate non-local probing of a magnon supercurrent (see Figure), which provides direct evidence of the condensate propagation driven by a phase gradient. The occurrence of the supercurrent directly confirms the phase coherency of the magnon condensate and opens door to studies in the general field of magnonic macroscopic quantum transport phenomena at room temperature as a novel approach in the field of information processing.



Time-space population diagram of the magnon Bose-Einstein condensate (BEC) with external continuous heating by a blue laser. The magnon BEC is pushed out from the hot focal spot. It propagates along the pumping microstrip and perpendicularly to the bias magnetic field through the "cold" magnon BEC over distances of hundred micrometers.

## Recent Publications

1. Bozhko D.A., Serga A.A., Clausen P., Vasyuchka V.I., Heussner F., Melkov G.A., Pomyalov A., L'vov V.S., and Hillebrands B. (2016): Supercurrent in a room-temperature Bose-Einstein magnon condensate, Nature Physics 12, 1057.
2. Bozhko D.A., Clausen P., Melkov G.A., L'vov V.S., Pomyalov A., Vasyuchka V.I., Chumak A.V., Hillebrands B., and Serga A.A. (2017) Bottleneck Accumulation of Hybrid Magnetoelastic Bosons, Physical Review Letters 118, 237201.
3. Kreil A. J. E., Bozhko D. A., Musiienko-Shmarova H. Yu., Vasyuchka V.I., L'vov V.S., Pomyalov A., Hillebrands B., and Serga A.A. (2018) From Kinetic Instability to Bose-Einstein Condensation and Magnon Supercurrents, Physical Review Letters 121, 077203.
4. Noack T.B., Musiienko-Shmarova H.Yu., Langner T., Heussner F., Lauer V., Heinz B., Bozhko D.A., Vasyuchka V.I., Pomyalov A., L'vov V.S., Hillebrands B., and Serga A.A. (2018) Spin Seebeck effect and ballistic transport of quasi-acoustic magnons in room-temperature yttrium iron garnet films, Journal of Physics D: Applied Physics 51, 234003.

5. Mihalceanu L., Vasyuchka V.I., Bozhko D.A., Langner T., Nechiporuk A.Yu., Romanyuk V.F., Hillebrands B., and Serga A.A. (2018) Temperature dependent relaxation of dipole-exchange magnons in yttrium iron garnet films, Physical Review B 97, 214405.

## Biography

Dmytro A Bozhko has completed his PhD in the year 2017 in the University of Kaiserslautern. Now he is Postdoctoral researcher in the group Magnetismus at the University of Kaiserslautern. His areas of expertise are spintronics, magnonics and Brillouin light scattering. He made significant contribution to development of the area of magnon gases and condensates, in particular to the discovery of magnon supercurrents - macroscopic quantum transport phenomenon at room temperature.

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**Notes:**