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Bose-Einstein Condensation and Superfluidity of Magnons in Yttrium Iron Garnet

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Abstract:

Magnons undergo Bose-Einstein condensation (BEC) at room temperature in films of Yttrium Iron Garnet (YIG).

Unlike other quasiparticle BEC systems, this system has a spectrum with two degenerate minima, which makes it possible for the system to have two condensates in momentum space. Recent Brillouin Light Scattering studies for a microwave-pumped YIG film of thickness d=5 μm and field H=1 kOe discovered a low-contrast interference pattern at the characteristic wave vector Q of the magnon energy minimum. In this talk I show that this modulation pattern can be quantitatively explained as due to unequal but coherent Bose-Einstein condensation of magnons into the two energy minima. Our theory predicts a transition from a high-contrast symmetric state to a low-contrast non-symmetric state on varying the d and H, and a new type of collective oscillation. Theory also predicts the coherence of the two condensates with two possible phase trappings. Non-dissipative spin current associated with the condensate is expected to be much larger than the dissipative spin current associated with normal magnons, despite the fact that the normal magnon density is by a factor a few hundreds larger than the condensate (superfluid) density at room temperature.