Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

"Bose-Einstein condensation and strange superfluidity of magnons"

Valery Pokrovsky, Texas A&M University

Abstract: We analyze the symmetry and coherence properties of the magnon Bose-Einstein condensate in Yttirum Iron Garnet films at room temperature discovered in 2006. In Ref.[1] we argued that the magnon dipolar interaction results in spontaneous violation of the spatial reflection symmetry and the order parameter phase trapping. Both the symmetry of the condensate and the trapped phase may be changed by varying magnetic field in thinner films. Since the magnon condensate is coherent a natural question to pose is whether the condensate exhibits superfluidity.[2] There are two main obstacles for superfluidity in this system. The first one is that the normal magnon density exceeds the condensate density by a factor of order 100. However, our analysis shows that the velocity of the superfluid component is many orders of magnitude larger than that of the normal part at the same field gradients. Thus, the spin currents in the system are mainly due to condensate, i.e. superfluid in nature. The second obstacle is that the phase trapping behavior is inconsistent with the free motion in which phase must grow linearly with coordinate. Thus, the current and the number of magnons are not conserved locally. However, accounting for the transfer of the spin momentum to the lattice, we show that these quantities are conserved globally. At high kinetic energy the deviation from the conventional superfluidity becomes small. In view of these ideas, the recent observation of a coherent transfer of the condensate to large distances (S.O. Demokritov et al., private communication) can be interpreted as a manifestation of superfluidity.

[1] F. Li, W.M. Saslow and V.L. Pokrovsky, Scientific Reports 3, 1372 (2013).
[2] C, Sun, T. Nattermann and V. L. Pokrovsky, Superfluidity of magnons in ferromagnetic films. In press.

12:00pm
Monday, June 27, 2016
Duboc Room (4-331)

Host: Leonid Levitov