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Magnon gases and condensates[1]

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A magnon gas is an excellent model for the investigation of interacting bosonic particles. Its potential is due to the wide controllability of the magnon density as well as of the spectral properties influencing the magnon-magnon interaction. The recent observation of Bose-Einstein condensation of magnons at room temperature demonstrates this clearly. The most effective mechanism to inject magnons into the gas is parametric pumping which creates a condensate of photon-coupled magnon pairs, referred to as a p-magnon condensate. The role of the p-magnon condensate formed at half of the pumping frequency is manifold: it serves both as an energy source and as a strong disturbing factor for the entire spin-wave system. Formation, thermalization and disintegration of the p-magnon condensate as well as its interaction with the Bose-Einstein condensate (BEC) of magnons constitute a hot topic of research. To investigate the evolution of these two condensates we use time- and wavevector-sensitive Brillouin light scattering spectroscopy in combination with conventional microwave techniques. The talk focuses in particular on the behavior of the parametrically driven magnetic medium after the pump source is switched off. This defines the important problem of the pump-free evolution of a non-equilibrium magnon system. I report on the experimental discovery of the direct disruptive influence of the p-magnon condensate on the BEC of magnons. The sharp increase in the intensity of the BEC simultaneously with the fast decay of the p-magnon condensate caused by the shutdown of the pump field is a manifestation of this phenomenon. Furthermore, the application of a second pump pulse, while the BEC is freely relaxing, results in the re-population of the p-magnon condensate and in a subsequent decrease of the BEC density. The thermalization of the additionally injected portion of p-magnons restores the equilibrium BEC density, which jumps up again after the end of the second pump pulse. The presented experiments establish the first observation of the interaction between two physically different condensates of Bose particles.

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