Magnons in Spin-Polarized Atomic Hydrogen Gas

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We report on experimental study of electron spin waves (magnons) in the gas of spin-polarized hydrogen. The gas is in the quantum regime, when the thermal de-Broglie wavelength is much larger than the characteristic scale of atomic interactions. We compress the H gas to densities $\approx 10^{18}$ cm^{-3} and temperatures 200-500 mK in a strong magnetic field of 4.6 T. Spin waves are generated and studied by means of CW and pulsed electron spin resonance (ESR) at 128 GHz. We observed several narrow peaks superimposed on the main ESR peak, with strength and position depending on the gas density and static magnetic field profile. The behavior of magnons, spin 1 quasiparticles, is described by the wave equation similar to the Schródinger equation with the static magnetic field playing a role of potential energy. For H gas density exceeding some critical value we found a strong and narrow magnon line corresponding to the maximum of magnetic field. In the free induction decays of pulsed ESR this is seen as a long coherent precession of electron spins, similar to the homogeneously precessing domain in superfluid ^{3}He. Accumulation of magnons in the lowest energy state may be also explained in terms of their BEC, as it was recently performed for magnons in ferromagnets and ^{3}He. We discuss a second type of magnons possible in H gas: due to the dipolar interactions, similar to the magnetostatic (Walker) modes in ferromagnets.