Magnon condensation in a dense nitrogen-vacancy spin ensemble - DTU Orbit
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The feasibility of creating a Bose-Einstein condensate of magnons using a dense ensemble of nitrogen-vacancy spin defects in diamond is investigated. Through assessing a density-dependent spin-exchange interaction strength and the magnetic phase-transition temperature \( T_c \) using the Sherrington-Kirkpatrick model, the minimum temperature-dependent concentration for magnetic self-ordering is estimated. For a randomly dispersed spin ensemble, the calculated average exchange constant exceeds the average dipole interaction strengths for concentrations approximately greater than 70 ppm, while \( T_c \) is estimated to exceed 10 mK beyond 90 ppm, reaching 300 K at a concentration of approximately 450 ppm. On this basis, the existence of dipole-exchange spin waves and their plane-wave dispersion is postulated and estimated using a semiclassical magnetostatic description. This is discussed along with a \( T_c \)-based estimate of the four-magnon scattering rate, which indicates magnons and their condensation may be detectable in thin films for concentrations greater than 90 ppm.

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