Magnetic resonance study of H atoms in solid H_2 at temperatures below 1 K

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We present our recent experiments with H atoms embedded in solid H_2 at temperatures below 1 K and discuss future experiments. Solid H_2 films were created by slow recombination of H atoms in the gas phase[1] or by direct deposition from H_2 vapor.[2] Atomic populations inside the H_2 films were created by running a pulsed low power r.f. discharge in the sample cell. We achieved record high H concentrations exceeding 3×10^{19} cm^{-3}. The samples were characterized by means of magnetic resonance: electron spin resonance (ESR) and electron-nuclear double resonance (ENDOR) in a magnetic field of 4.6 T. We observed density dependent broadening and shifts of the ESR lines due to the dipolar interactions and found two narrow ENDOR transitions shifted to the red. The steady state hyperfine level populations of H were found to deviate substantially from Boltzmann statistics below 1 K. We plan to implement cold atom and molecule beam epitaxy to improve sample quality and to increase H density. Experiments with deuterium may reveal phenomena related to quantum statistics. We also plan to study quantum diffusion of the impurity atoms and to investigate possible supersolid behaviour of the samples.

[1]J. Ahokas *et al.*, Phys. Rev. B 81, 104516 (2010)
[2]J. Järvinen *et al.*, J. Low Temp. Phys. 162, 96 (2011)