Large nuclear polarization of ^{31}P in silicon

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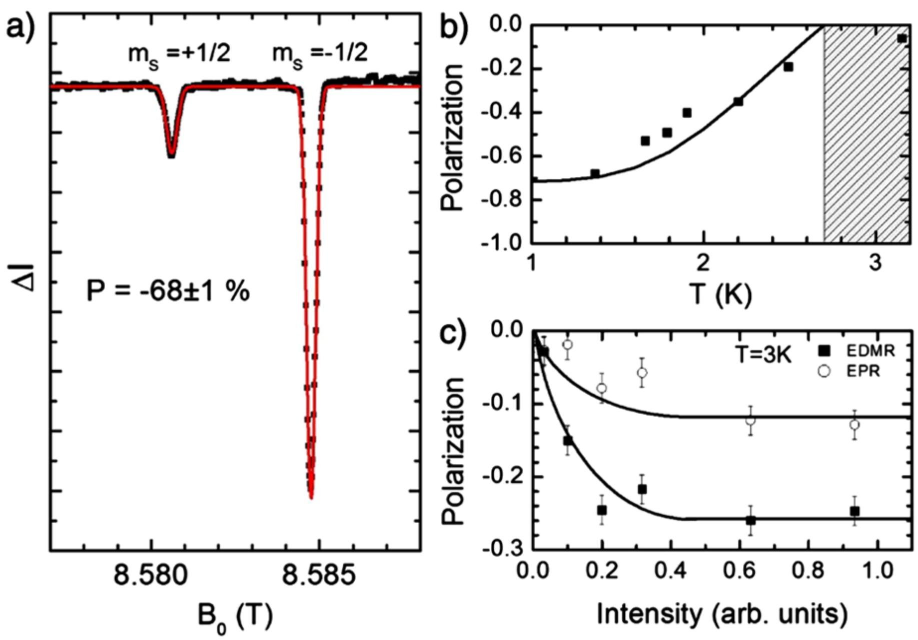

a) Electrically detected EPR of the two hyperfine components of phosphorous shallow donors in Silicon. The intensity reflects the population in each nuclear spin state. b) Temperature dependence of maximum polarization c) Polarization as a function of the light intensity. Polarization levels are higher for centers closer to the surface (EDMR) as compared to the bulk (EPR).

A new method for obtaining nuclear spin hyper-polarization was experimentally demonstrated, and at high fields and low temperatures very large polarizations have been reached. By exploiting a non-equilibrium Overhauser process, driven by un-polarized white light irradiation, we obtain more than 68% negative nuclear polarization of phosphorus (^{31}P) donors in crystalline silicon, corresponding to a nuclear spin temperature of -5 mK. This unexpected discovery came out of a high field study of electrically-detected magnetic resonance as a read-out mechanism for quantum computation. The very high nuclear polarization is reached after about 2.5 minutes of light irradiation, at a temperature of 1.37 K and a magnetic field of 8.5 T. The ability to obtain such large polarizations is significant for applications like quantum information processing and magnetic resonance imaging.

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For more details: McCamey et al., *Phys Rev. Lett*. **102**, 027601 (2009)