Inhomogeneous nuclear spin polarization induced by helicity-modulated optical excitation of fluorine-bound electron spins in ZnSe

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In a ZnSe:F epilayer dynamic nuclear polarization (DNP) of the ^{77}Se and ^{67}Zn isotopes with nonzero nuclear spin was observed by all-optical means. The DNP is driven by the optically induced electron spin polarization due to the resulting Knight field. Moreover, the electron spin polarization, induced by excitation of the donor-bound exciton, can be measured by the Kerr rotation technique. In the regime of resonant spin amplification (RSA) the interplay between the electron and nuclear spin systems can be precisely investigated by the Overhauser field resulting in a dispersion-like shift of the RSA peaks. The shift of the RSA peaks cannot be explained by a single dispersive curve, but requires a spatially inhomogeneous Knight field. The DNP process was studied with different parameters and techniques to gain a better understanding, mainly of which electron spin polarization component the DNP is driven. The DNP is described in terms of the spin temperature approach, leading to nuclear spin cooling.

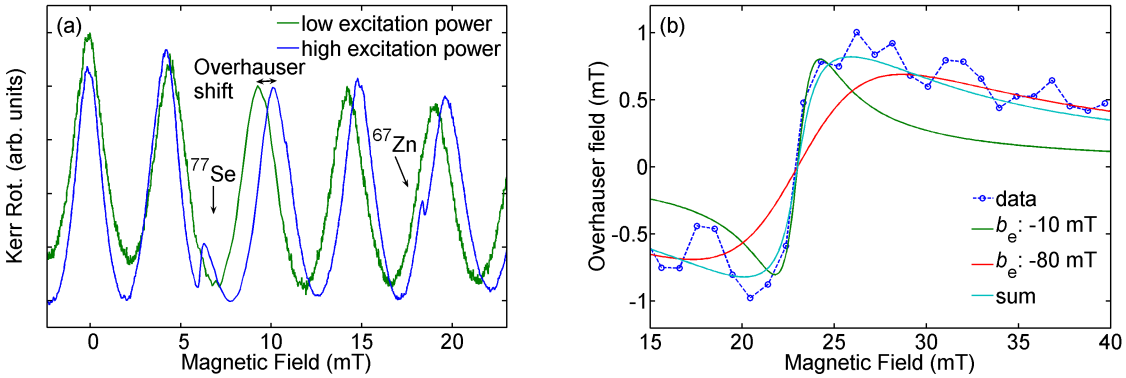

Figure 1: (a) RSA spectra for high and low laser excitation power. The positions of the ^{77}Se and ^{67}Zn resonances are marked by arrows. The shift of the RSA resonances due to nuclear polarization is shown by a horizontal double arrow. (b) The shift of the RSA resonances due to nuclear polarization is shown against the external magnetic field. The dispersive shape of the curve is compared with two theoretical fits and the sum of both curves, showing the development of the spatial inhomogeneous Knight field b_e.

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