OPTICALLY-DETECTED MAGNETIC RESONANCE OF ALKALI ATOMS ISOLATED ON HELIUM NANO-DROPLETS

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Sharp, hyperfine-resolved, ESR spectra of alkali atoms isolated on helium nanodroplets are measured by optically-detected magnetic resonance (ODMR). A net spin polarization is created inside a magnetic field ($B = 0.2$ to 4.2 T) by a pump laser beam. Microwave radiation in a resonant cavity at 9.4 GHz causes a spin transition which is detected by a probe laser beam. For ultimate precision the spectrum of free atoms is concurrently measured and serves as a reference.
The shift of the ESR lines on the droplet with respect to free atoms directly reflects the distortion of the valence-electron wavefunction due to the He nanodroplet. While the electron g-factor remains unchanged within experimental uncertainties (< 5 ppm), the increase of the hyperfine constant (typically $+400$ ppm) is consistent with an increase of the Fermi contact interaction. We are able to follow this change as a function of droplet size attesting the sensitivity of the method for the measurement of chemical shifts. The observation of Rabi oscillations indicates a long decoherence time and proves our ability to perform coherent manipulation of the spin.