OPTICAL PUMPING AND ELECTRON SPIN RESONANCE OF SINGLE ^{87}Rb ATOMS ON HELIUM NANODROPLETS

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Our recent development of electron spin resonance (ESR) spectroscopy on superfluid helium nanodroplets (He_N) provides a sensitive tool to investigate interactions between a surface located alkali-metal atom and an ESR silent species inside the droplet[a]. Highest sensitivity is expected for alkali-metal atoms with large hyperfine coupling. We present hyperfine resolved ESR spectra of single ^{87}Rb (hyperfine constant $a_{\mathrm{HFS}} = 3417\,\mathrm{MHz}$) atoms isolated on He_N[b]. In accordance with our previous work on ^{85}Rb ($a_{\mathrm{HFS}} = 1012\,\mathrm{MHz}$) we find a droplet size dependent increase of a_{HFS} between 400 and 450 ppm, due to the electronic perturbation by the helium environment. The process of optical pumping and of optical detection on He_N is investigated in detail in order to optimize the ESR signal. A simple model for optical pumping on He_N is presented, which agrees well with the experimental results.

[a] M. Koch, G. Auböck, C. Callegari, and W.E. Ernst, Phys. Rev. Lett. **103**, 035302 (2009)
[b] A. Volk, J. Poms, M. Koch, and W.E. Ernst, J. Phys. Chem. A, in press