TWO-STEP EXCITATION OF Rb AND Cs ATOMS ON He NANODROPLETS

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We present the first sequential excitation of atom-doped helium nanodroplets. Rubidium atoms on the surface of a helium nanodroplet are selectively excited to the $5^2P_{1/2}$ state so as not to desorb from the droplet.[a] From there they are excited by a laser pulse to the $5^2D$ state; a laser-induced fluorescence (LIF) spectrum is recorded by monitoring the $6^2P \rightarrow 5^2S_{1/2}$ emission. We find some difference in the LIF spectrum as compared to that of the two-photon one-color direct excitation spectrum $5^2D \leftarrow 5^2S_{1/2}$. This indicates that the system does relax vibrationally during the lifetime of the $5^2P_{1/2}$ state. To model the LIF spectra we calculate the energy levels of the Rb atom as a function of its distance $R$ from the center of the droplet. The Franck-Condon factors of the resulting potential energy curves agree with the experimental findings.

A similar behavior has been found for cesium. New measurements predict that it also stays bound on the surface of the droplet in its $6^2P_{1/2}$ state. From there we further excited Cs monomers into their $6^2D$ state, where also the LIF spectrum is recorded by watching the $7^2P \rightarrow 6^2S_{1/2}$ emission.

In the future these states can be used as a springboard to reach high-lying $^2S$ and $^2D$ states, and possibly create an artificial super-atom.[b]

[a] G. Auböck, J. Nagl, C. Callegari, and W. E. Ernst, Phys. Rev. Lett. 101, 035301 (2008)

[b] F. Ancilotto, M. Pi, R. Mayol, M. Barranco, and K. Lehmann, J. Phys. Chem. A 111, 12695-12701 (2007)