HIGHLY EXCITED STATES OF Cs ATOMS ON HELIUM NANODROPLETS

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Cs atoms on the surface of helium nanodroplets have been excited to high lying nS (n = 8-11), nP (n = 8-11), and nD (n = 6-10) levels. A two-step excitation scheme[a] via the $6^2P_{1/2}(^2\Pi_{1/2})$ state using two cw lasers was applied. This intermediate state has the advantage that a large fraction of the excited Cs atoms does not desorb from the helium nanodroplets. An absorption spectrum was recorded by detecting laser induced fluorescence light from the $6^2P_{3/2} \rightarrow 6^2S_{1/2}$ transition. The pseudo-diatomic model for helium nanodroplets doped with single alkali-metal atoms holds for the observed spectrum. An investigation of spectral trends shows that the n'^{2}P(Π)←$6^2P_{1/2}(^2\Pi_{1/2})$ and n'^{2}D(Δ)←$6^2P_{1/2}(^2\Pi_{1/2})$ (n' > 9) transitions are lower in energy than the corresponding free-atom transitions. This indicates that the Cs*–He_N potential becomes attractive for these highly excited states.
Our results suggest a possibility of generating an artificial super-atom with a positive ion core inside a helium nanodroplet and the electron outside, which will be subject to future experiments.

[a] M. Theisen, F. Lackner, F. Ancilotto, C. Callegari, and W.E. Ernst, Eur. Phys. J. D 61, 403-408 (2011)