RYDBERG STATES OF Rb AND Cs ATOMS ON HELIUM NANODROPLETS: A RYDBERG-RITZ ANALYSIS

FLORIAN LACKNER, GÜNTER KROIS and WOLFGANG E. ERNST, *Institute of Experimental Physics, Graz University of Technology, Petersgasse 16, A-8010 Graz, Austria*.

Rydberg series of Rb and Cs atoms on the surface of helium nanodroplets[a] (He_N) have been studied by resonance enhanced multi-photon ionization spectroscopy and laser induced fluorescence spectroscopy. The recorded excitation spectra[bc] are analyzed by using a Rydberg-Ritz approach. The dependence of the quantum defects on the principal quantum number within a Rydberg series gives insight into the interaction between the alkali atom's valence electron and the superfluid helium droplet. For higher excited states a screening of the valence electron from the alkali atom core by the helium droplet is observed. For lower states the strength of the screening effect decreases and the quantum defects are found to lie closer to free atom values. In addition, the large spin-orbit (SO) constant of the Cs–He_N nP($^2\Pi$) states allows a detailed study of the influence of the helium droplet on the SO splitting as function of the principal quantum number. Within the pseudo-diatomic picture the alkali-He_N system represents a diatomic molecule. The coupling of the Cs valence electrons spin and the orbital angular momentum with the intermolecular axis, which is defined by the connection between the droplet center and the alkali nucleus, depends on the strength of the atomic SO interaction. While the splitting of the $6^2P_{1/2}(^2\Pi_{1/2})$ and $6^2P_{3/2}(^2\Pi_{3/2})$ components has an atom-like character (Hund's case (c) coupling), the SO splitting of higher n states is lower than the atomic value (Hund's case (a) coupling).

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