RUBIDIUM ATOMS ON HELIUM DROPLETS: ANALYSIS OF AN EXOTIC RYDBERG COMPLEX

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Rubidium atoms on the surface of superfluid helium droplets have been excited into Rydberg states. The excitation spectrum of the Rb-He$_N$ system has been recorded from the 5^2D state manifold up to the ionization threshold[a] by resonant three-photon-ionization time-of-flight spectroscopy[b]. The observation of droplet size dependent shifts of excited states with respect to bare atom states is explained by a decreased quantum defect and a lowered ionization threshold. Within the scope of a Rydberg model[c] we demonstrate that quantum defects and ionization thresholds are constant for each specific Rydberg series, which confirms the Rydberg character of excited Rubidium states on helium droplets. A set of six Rydberg series could be identified. Individual Rydberg states are observed with effective principle quantum numbers up to $n^* \approx 19$ and $l \leq 3$, for which the expectation value of the electron orbital radius is about ten times larger than the droplet radius.

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[c] J.E. Murphy, J.M. Berg, A.J. Merer, N.A. Harris, and R.W. Field, Phys. Rev. Lett. 65, 1861 (1990)