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Spectra and Autoionization Lifetimes of Long-Range Rydberg Molecular States of $^{85}Rb_2$ RYAN CAROLLO, EDWARD EYLER, PHILLIP GOULD, WILLIAM STWALLEY, Department of Physics, University of Connecticut, Storrs, CT 06269-3046 — We present high-resolution autoionization data and modeling of the $7p$ long-range Rydberg molecular states in $^{85}Rb_2$. Our process excites a photoassociation resonance in the $1\,(0_g^-)$ state which decays to $v'' = 35$ and 36 long-range levels of the $a\,^3\Sigma_u^+$ state and to the continuum. These bound molecules are then excited via a single UV photon to target states below the $5s + 7p$ asymptote by a frequency-doubled pulse-amplified CW laser with narrow linewidth, ~ 150 MHz. The long-range portion of the bonding potential is formed by the scattering interaction of the Rydberg electron of a perturbed $7p$ atom scattering from a nearby ground-state atom. We use time-of-flight to selectively measure molecular ions, which are formed via autoionization. Using a hyperfine model of the $a\,^3\Sigma_u^+$ and its coupling to the $X\,^1\Sigma_g^+$ state[1], we are able to place an upper limit on the autoionization linewidth of 450 MHz, corresponding to a lifetime $\geq 3.5 \times 10^{-10}$ s. Excited-state hyperfine structure suggests a still-lower linewidth (and thus longer lifetime), but its contribution is not yet fully understood. This work is supported by NSF and AFOSR.

[1]E. Tiemann, private communication (2015)

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