Abstract

We observe long-range “trilobite-like” states of ultracold $^{85}$Rb$_2$ molecules in which a novel form of chemical bonding occurs: an ultracold ground state atom is bound by the attraction of the Rydberg electron, with its Rydberg electronic wavefunction in np Rydberg atomic levels with $n = 7-12$ [1]. Unlike earlier work by others at much higher $n$ formed by photoassociation, our observations involve bound-bound transitions excited in the ultraviolet where the upper state autoionizes to produce Rb$^2+$, which is detected by time-of-flight mass spectroscopy. The lower state in these observations is primarily $v''= 35, J''= 1$ of the metastable $a^3\Sigma_{u^+}$ state. The important upper electronic states are calculated to be a $3\Pi_g$ and a $3\Sigma_{g^+}$ state, each with a deep short range well and a shallow long range well and an intermediate barrier between the two wells [2]. Recently we have improved our resolution by over a factor of 100 and now see well-defined structure in lines that were unresolved in ref. [1]. Our latest data and analysis will be discussed.

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