A TRANSITION SCHEME FOR OBSERVING SODIUM DIMER RYDBERG STATES AND PRODUCING STATE-SELECTED ULTRACOLD MOLECULAR IONS BY ALL-OPTICAL TRIPLE RESONANCE SPECTROSCOPY

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The $X\,^1\Sigma_g^+(1,J''') \longrightarrow A\,^1\Sigma_u^+(1,J'') \longrightarrow 3\,^1\Sigma_g^+(0,J') \longrightarrow nl\,^1\Lambda_u^+(0,J)$ transition scheme is used to study high n sodium dimer rydberg states. The spectrum is simplest when the intermediate state has $J' = 0$ which implies $J = 1$. Analysis of our data yield an ionization potential of 39478.13±0.03cm^{-1}, implying a molecular ion dissociation energy of $D_0^0(Na_2^+)$=7914.19±0.03cm^{-1}. The same transition scheme can be used to detect ultracold ground state molecules $Na_2(v = 0, J = 0)$ and to produce ultracold ground state molecule ions $Na_2^+(v^+ = 0, N^+ = 0)$.