OBSERVATION OF BLUE-DETUNED PHOTOASSOCIATION TO THE 2 (0_g^+) STATE OF $^{85}\mathrm{Rb}_2$ VIA REMPI

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We report photoassociation of ultracold atoms to vibrational levels blue of the $^{85}\mathrm{Rb}_2$ $5s+5p_{1/2}$ asymptote, in the previously-unobserved 2 (0_g^+) Hund's case (c) state that corresponds to the 2 $^1\Sigma_g^+$ state in Hund's case (a). These excited-state ultracold molecules decay to the $a\,^3\Sigma_u^+$ state and are detected by pulsed REMPI through the 2 $^3\Sigma_g^+$ state. We also see an order of magnitude enhancement in the $v' = 111,\ J' = 5$ ro-vibrational level of the 2 (0_g^+) state and present evidence for resonant coupling between this level and the $v' = 155$ of the 2 (1_g) state, seen earlier in photoassociative trap loss[a]. Following photoassociation to the observed levels of the 2 (0_g^+) state, spontaneous decay populates vibrational levels approximately halfway up the $a\,^3\Sigma_u^+$ potential well, including levels $v'' = 18$ though $v'' = 24$. This pathway complements the blue-detuned photoassociation technique previously developed by this group[b], which accesses the bottom of the a state potential. This work is supported by the NSF and AFOSR.

[a] R. A. Cline, J. D. Miller, and D. J. Heinzen, Phys. Rev. Lett. **73**, 632 (1994)

[b] M. A. Bellos, *et. al.*, Phys. Chem. Chem. Phys. **13**, 18880 (2011)