PHOTOASSOCIATION SPECTROSCOPY OF $^{85}Rb_2$ NEAR ITS DISSOCIATION LIMIT

R. S. FREELAND, PH. COURTEILLE, C. C. TSAI, and D. J. HEINZEN, *Dept. of Physics, The University of Texas, Austin, TX ,78712*; J. M. VOGELS, F. A. VAN ABEELEN, and B. J. VERHAAR, *Dept. of Physics, Eindhoven University of Technology, Eindhoven, The Netherlands*.

We present results which probe the structure of $^{85}Rb_2$ very near its lowest dissociation limit. To obtain these results, we used two different variations of photoassociation spectroscopy of laser-cooled and trapped ^{85}Rb atoms. First, we have determined the positions of twelve of the highest vibrational levels of $^{85}Rb_2$, all bound by less than 0.7 cm^{-1}, with two-color (free-bound-bound) photoassociation spectroscopy. The levels lie in an energy range for which singlet and triplet states are strongly mixed by the hyperfine interaction. We found that we could accurately describe these states with a novel coupled-channels inverse perturbation analysis. In a second experiment, we have carried out Zeeman-resolved photoassociation spectroscopy. This technique allowed us to probe the energy range in the lowest part of the electronic ground state continuum, which lies between the dissociation limits corresponding to different hyperfine states of the separated atoms. With this method, we have observed a Feshbach scattering resonance in the continuum for the first time, which we find can be tuned to zero energy with a magnetic field.