STRONTIUM NARROW LINE PHOTOASSOCIATION IN AN OPTICAL LATTICE

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We report recent results of photoassociation spectroscopy performed on the $^1S_0$-$^3P_1$ intercombination line of ^{88}Sr trapped in a magic wavelength optical lattice. The long lifetime of $^3P_1$ permitted the study of nine least-bound states associated with the 0_u and 1_u molecular potentials. We investigated the crossover region between dipole-dipole and van der Waals interactions, and constrained the excited state C_6 coefficients as well as the $^3P_1$ lifetime (21.5(2) μs).

Narrow line photoassociation in the lattice allowed us to observe thermal line shapes even at microkelvin temperatures. In addition, our experiment was sensitive to dimensional effects relevant to ultracold collisions of atoms trapped in the Lamb-Dicke regime in optical lattices. The magic wavelength technique enabled precision Doppler-free spectroscopy of the narrow molecular lines.

We showed that the least-bound state should enable extensive, low-loss optical tuning of the very small ground state scattering length. In addition, the deepest bound states we observed have unusually large Franck-Condon overlaps with the ground state molecular wavefunctions, potentially leading to efficient cold molecule production.

1T. Zelevinsky, M. Boyd, A. Ludlow, T. Ido, J. Ye, R. Ciury lo, P. Naidon and P. Julienne, *Phys. Rev. Lett.* 96, 203201 (2006).