# PHOTOASSOCIATIVE SPECTROSCOPY OF ATOMIC STRONTIUM

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The presence of two valence electrons in alkaline-earth atoms like strontium creates many interesting questions and opportunities for studies of ultracold collosions and quantum degenerate gases. I will describe photoassociative spectroscopy of $^{88}$Sr and $^{86}$Sr in an intercombination-line magneto-optical trap. Photoassociative transitions are driven with a laser red-detuned by 600 MHz to 1400 GHz from the $^1S_0$-$^1P_1$ atomic resonance at 461nm. Small detuning[1] explores a regime in which the molecular state lifetime is on the order of the vibrational period. Individual transitions are resolvable in this regime because of the low temperature of the atoms (~5-10 μK) and strontium's simple level structure. At larger detuning[2], modulations in the photoassocation transition amplitude reflect the structure of the ground state collisional wave function. A minimum in the transition amplitude for $^{86}$Sr at -494 GHz allows us to determine the ground state s-wave scattering lengths 610 $a_0 < a_{86} < 2300$ $a_0$ for $^{86}$Sr and a much smaller value of -1 $a_0 < a_{88} < 13$ $a_0$ for $^{88}$Sr.

*In collaboration with P. Pellegrini, R. Côté, Y. N. Martinez, P. G. Mickelson, and S. B. Nagel.

[1] "Photoassociative Spectroscopy at Long Range in Ultracold Strontium," S. B. Nagel, P. G. Mickelson, A. D. Saenz, Y. N. Martinez, Y. C. Chen, T. C. Killian, P. Pellegrini, and R. Côté, *Phys. Rev. Lett.* 94, 083004, (2005).

[2] "Spectroscopic Determination of the s-Wave Scattering Lengths of $^{86}$Sr and $^{88}$Sr," P. G. Mickelson, Y. N. Martinez, D. Saenz, S. B. Nagel, Y. C. Chen, T. C. Killian, P. Pellegrini, and R. Côté, *Phys. Rev. Lett.* 95, 223002 (2005).