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Ultracold Atoms, Mixtures, and Molecules[1]

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Atom control through laser cooling and trapping techniques has opened up a large range of activity within atomic physics over the last two decades. This spans highly accurate atomic clocks, precision inertial sensors, and quantum many-body systems including the Bose-Einstein Condensate and the Fermi superfluid. The precise control extends to internal and motional states of atoms, as well as to inter-atomic interactions. A major avenue of current investigation is the achievement of similar control over molecules. We perform cooling and simultaneous trapping of two different atomic species, lithium and ytterbium, at microKelvin temperatures. This forms a starting point for experiments probing aspects of superfluidity in ultracold mixtures, and the synthesis of dipolar molecules through interspecies resonances. Dipolar molecules are predicted to give rise to new many-body phases, and are also strong candidates for quantum information processing applications. Ground state polar LiYb is also a promising candidate for a sensitive test of time reversal symmetry. I will present our experimental progress and future plans with this system.

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