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Assembling Ultracold Polar Molecules From Single Atoms LEE R LIU, NICHOLAS R HUTZLER, YICHAO YU, JESSIE T ZHANG, KANG-KUEN NI, Harvard University — Ultracold polar molecules are promising candidates for studying quantum many-body phenomena and building quantum information systems, due to their long-range, anisotropic, and tunable interactions. This calls for a technique to create low entropy samples of ultracold polar molecules with a large dipole moment. The lowest entropy molecular gas to date was created from atomic quantum gases in bulk or in optical lattices. The entropy is limited by that of the constituent atomic gases. We propose a method that addresses this limitation by assembling sodium cesium (NaCs) molecules from individually manipulated atoms. First, we load single Na and Cs atoms in separate optical tweezers from MOTs. We will cool them to their motional ground state using Raman sideband cooling and then merge them into a single tweezer. The tweezer confinement provides enhanced wavefunction overlap between the atom pair and molecule states. Using coherent two-photon techniques, we will then transfer the atom pair into a molecule. Our method offers reduced apparatus complexity and cycle time, single-site manipulation and imaging resolution, and should be readily extended to different species.

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