

Abstract Submitted
for the DAMOP16 Meeting of
The American Physical Society

Ultracold molecules from the bottom-up JESSIE T ZHANG, NICHOLAS R HUTZLER, LEE R LIU, YICHAO YU, KANG-KUEN NI, Harvard University — Ultracold polar molecules exhibit strong, long-range, and tunable dipole-dipole interactions that may be utilized for a wide range of studies in quantum simulation and quantum information processing. To realize the full potential of these studies, it is desirable to have a low entropy sample of ultracold polar molecules with full control over both internal and external states, as well as inter-particle interactions. We work toward this goal with a new, bottom-up approach using the highly polar NaCs molecule. The key steps of our scheme are trapping single Na and Cs atoms in optical dipole traps, cooling the atoms to their motional ground state using Raman sideband cooling, and finally coherently transferring them to ground state NaCs molecules via a two-photon process. This approach should enable creation of low entropy samples with full control over all degrees of freedom, as well as realizing the possibility of single-site read-out and manipulation of molecules.

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Date submitted: 29 Jan 2016

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