Creation of ultracold Bosonic ^{39}K^{133}Cs Molecules in the rovibrational ground state

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The creation of ultracold heteronuclear molecules by assembly from precooled atoms has led to the realization of molecular gases with electric dipole-dipole interactions in the quantum degenerate regime [1, 2], with exciting possibilities in the study of many-body dynamics, quantum computation and quantum simulation. One bialkali molecule that has yet to be realized in the ultracold regime is KCs. It offers a dipole moment of 1.92 D, is chemically stable under collisions, and has both bosonic and fermionic isotopologues.

We report on the creation of a trapped sample of bosonic ^{39}K^{133}Cs molecules in their rovibronic ground state. We first describe our method for producing an ultracold mixture of ^{39}K and ^{133}Cs. Our cooling strategy is based on an established technique for ^{39}K [3], with modifications to allow sympathetic cooling of Cs. A narrow region of overlapping Feshbach resonances near 557G makes it possible to mix and cool the two species close to the degenerate regime. We then create up to 7500 weakly bound molecules at a temperature of 0.75 μK by magnetoassociation on an interspecies Feshbach resonance at 362G [4]. By means of one- and two-photon spectroscopy, and guided by predictions from theory [5], we have found and characterized an excited molecular state in the spin-orbit coupled $A^1\Sigma_0 - b^3\Pi$ potential with a narrow natural linewidth of $2\pi \times 80(6)$ kHz. Using this intermediate excited state, we perform stimulated Raman adiabatic passage to the rovibrational ground state with a one-way efficiency of 71%. Similar to other bialkali molecule experiments, we observe a two-body decay with a loss coefficient in rough agreement with the predicted universal loss rate [6].

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References

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