Creation of ^{87}RbCs molecules in the rovibrational ground state

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Ultracold and quantum degenerate mixtures of two or more atomic species open up many new research avenues, including the formation of ultracold heteronuclear ground-state molecules possessing a permanent electric dipole moment [1]. The anisotropic, long range dipole-dipole interactions between such molecules offer many potential applications, including novel schemes for quantum information processing [2] and simulation [3]. Heteronuclear ground-state molecules have been created in KRb [4] and, very recently, in RbCs [5]. Here we present our recent results including, the complete Feshbach spectroscopy of an ultracold ^{85}Rb-Cs mixture [6] and the formation of ultracold Cs_2 and ^{87}RbCs Feshbach molecules [7,8]. Finally we show a simple design for a tuneable, narrow-linewidth, two-colour laser system [9] and demonstrate transfer of the ^{87}RbCs Feshbach molecules into the rovibrational ground state via Stimulated Raman Adiabatic Passage (STIRAP) [10].

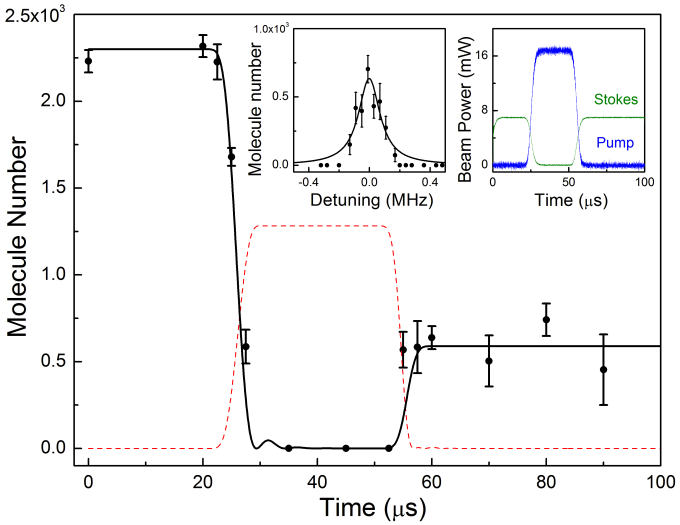

Figure 1: *STIRAP transfer between the Feshbach and rovibrational ground states. Plotted is the number of molecules remaining in the Feshbach state when both STIRAP lasers are switched off at various points during the routine. From this, we measure a one-way efficiency of* 50%. *A model is shown based on the measured Rabi frequencies (not including laser noise), with the Feshbach- and ground-state populations shown in black solid and red dashed lines respectively. Left inset: The same STIRAP sequence as a function of Stokes detuning. Right inset: The pump and Stokes beam powers during the STIRAP pulse sequence.*

References

[1] L.D. Carr et al., *New J. Phys.* **11(5)**, 055049 (2009)
[2] D. DeMille, *Phys. Rev. Lett.* **88**, 067901 (2002)
[3] A. Micheli et al., *Nat. Phys. 2*, **341** (2006)
[4] K.-K. Ni et al., *Science* **322**, 5899 (2008)
[5] T. Takekoshi et al., *Phys. Rev. Lett.* **113**, 205301 (2014)
[6] H-W. Cho et al.,*Phys. Rev. A* **87**, 010703(R) (2013)
[7] M.P. Köppinger et al. *New J. Phys.* **16** 115016 (2014)
[8] M.P. Köppinger et al. *Phys. Rev. A* **89**, 033604 (2014)
[9] P.D. Gregory et al. *New J. Phys.* **17**, 055006 (2015)
[10] P.K. Molony et al., *Phys. Rev. Lett.* **113**, 255301 (2014)