Rovibronic ground state molecules in an optical lattice

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Abstract

Ultracold samples of molecules are ideally suited for fundamental studies in physics and chemistry. For many of the proposed experiments full control over the molecular wave function in the rovibronic ground state is needed. Our starting point for the creation of groundstate molecules is a Bose-Einstein condensate of cesium atoms, loaded into a 3D optical lattice. Weakly bound molecules are produced by a magnetic field ramp over a Feshbach resonance (Fig. 1). By going into the Mott-insulator state before the association, we assure nearly perfect shielding against inelastic collisions and a high production efficiency. We report on our experimental results on the molecular spectroscopy for all four transitions [1, 2, 3] and the transfer of the molecules to different weakly and deeply bound states [1, 4, 5], especially the rovibronic ground state [5]. We show the properties such as lifetime or polarisibility of the different molecular states in the optical lattice [4, 5] and our final steps towards a Bose-Einstein condensate of rovibronic ground state molecules.

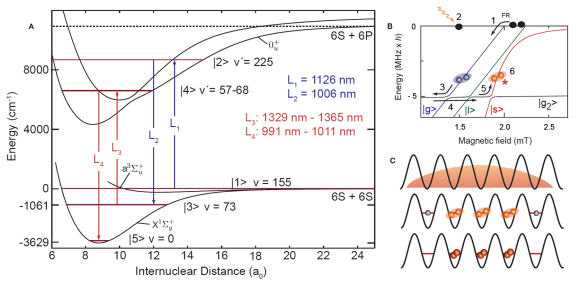

Figure 1: **A** Molecular level scheme for Cs_2. The weakly bound Feshbach level |1> is transferred to the rovibrational level $|3>= |v = 73>$ and further to the rovibronic ground state $|5>= |v = 0>$ of the singlet $X^1\Sigma_g^+$ potential in the presence of an optical lattice.**B** Zeeman diagram showing all relevant molecular levels for initial Feshbach state preparation. The molecules are produced on a g-wave Feshbach resonance and are then transferred to the weakly bound s-wave state |1> (6) for the STIRAP transfer. **C** Lattice based ground state transfer. Top: The BEC is adiabatically loaded into the three-dimensional optical lattice. Middle: Doubly occupied sites are converted to Feshbach molecules. Bottom: The molecules are transferred to deeply bound rovibrational levels.

References

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