Optical trapping wavelengths of bialkali molecules in an optical lattice

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The last few years have seen spectacular advances in the field of atomic quantum gases. More recently the goal of many physicists is to perform similar experiments on cold molecular species which will allow a series of fundamental studies in physics and chemistry [1,2]. An important prerequisite for all proposed molecular quantum gas experiments is the control of the internal and external degrees of freedom of the molecules. This is done by loading and manipulating the molecules in the presence of an optical lattice which provides full control over the motional wavefunction and prevents collisional loss [3,4].

In this work our motivation is to find optimal parameters for trapping of bialkali molecules in an optical lattice. We have calculated dynamic polarizabilities of bialkali molecules subject to an oscillating electric field, using accurate potential curves and electronic transition dipole moments from advanced quantum chemistry computations [5].

The creation of the sample of ground-state molecules relies on an adiabatic population transfer from weakly-bound molecules created on a Feshbach resonance towards the lowest rovibrational level a their ground state. We show that for particular wavelengths of the optical lattice, called "magic wavelength", the polarizability of the ground-state molecule is equal to the one of the Feshbach molecule. Such a coincidence ensures that both the initial and final states are favorably trapped by the lattice light, allowing optimal transfer in agreement with experimental observation. A systematic investigation of those magic wavelength for the ten heteronuclear bialkali molecules will be presented.

References

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