Quantum Physics

Multi-channel modelling of the formation of vibrationally cold polar KRb molecules

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We describe the theoretical advances that influenced the experimental creation of vibrationally and translationally cold polar ^{40}K^{87}Rb molecules \cite{nphys08,science08}. Cold molecules were created from very-weakly bound molecules formed by magnetic field sweeps near a Feshbach resonance in collisions of ultra-cold ^{40}K and ^{87}Rb atoms. Our analysis include the multi-channel bound-state calculations of the hyperfine and Zeeman mixed X$^1\Sigma^+$ and a$^3\Sigma^+$ vibrational levels. We find excellent agreement with the hyperfine structure observed in experimental data. In addition, we studied the spin-orbit mixing in the intermediate state of the Raman transition. This allowed us to investigate its effect on the vibrationally-averaged transition dipole moment to the lowest ro-vibrational level of the X$^1\Sigma^+$ state. Finally, we obtained an estimate of the polarizability of the initial and final ro-vibrational states of the Raman transition near frequencies relevant for optical trapping of the molecules.

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