## Quantum Physics

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

Svetlana Kotochigova, Eite Tiesinga, Paul S. Julienne

(Submitted on 12 Jan 2009)

We describe the theoretical advances that influenced the experimental creation of vibrationally and translationally cold polar $\$^{\wedge}\{40\} \$ K \$ \wedge\{87\}$ \$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 \$^ $\{87\} \$ R b$ atoms. Our analysis include the multi-channel bound-state calculations of the hyperfine and Zeeman mixed X $\$^{\wedge} 11$ Sigma^${ }^{\wedge} \$$ and $a^{\$}{ }^{\wedge} 3 \backslash$ Sigma^${ }^{\wedge}+\$$ 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 vibrationallyaveraged transition dipole moment to the lowest ro-vibrational level of the $\mathrm{X} \$ \wedge 1 \backslash$ 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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Comments: 14 pages, 9 figures
Subjects: Quantum Physics (quant-ph)
Cite as: arXiv:0901.1486v1 [quant-ph]

## Submission history

From: Svetlana Kotochigova [view email]
[v1] Mon, 12 Jan 2009 00:26:22 GMT (174kb,D)
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