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LiK B¹Π potential: combining short and long-range data

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Abstract

We present spectroscopic measurements of the long range states of the ⁶Li⁴⁰K molecule near its Li(4²S_{1/2}) + K(4²P_{3/2}) asymptote which in combination with existing data in the short range lead to the full characterization of the B¹Π potential with high spectroscopic resolution. This survey was conducted in the context of identifying a suitable pathway for the efficient two-photon transfer to the absolute ro-vibronic ground state of ⁶Li⁴⁰K heteronuclear dimers.

Starting from weakly bound ultracold Feshbach molecules, we performed one-photon loss spectroscopy of the high-lying levels of the B¹Π potential. Tunable diode lasers were utilized to access several excited states and their frequencies were measured by means of a wavemeter. In the first step, a total of twenty-five vibrational lines were observed close to the asymptote which were combined with existing data from photo association spectroscopy¹. Extrapolation of the latter led to the assignment of our observed lines to vibrational levels in the spin-orbit coupled potentials near the dissociation threshold.

For our Hund's case (c) molecules, a complete set of data is presented for the Ω=1^{up} state, by combining the long-range measurements with data from the short-range states of the B¹Π potential from heat-pipe spectroscopy of the ⁷Li³⁹K molecule². Using mass scaling, we modelled the short-range and the long-range part of the potential simultaneously and produced the Rydberg-Klein-Rees (RKR) curve for the complete potential. The vibrational energies and the rotational constants were defined in terms of Dunham representation and compared with a mixed near-dissociation / Dunham expansion³. The improved empirical curve for the long-range part of the Ω=1^{up} state is depicted in Fig.1.

Fig. 1: RKR curves of the Ω=1^{up} state. Comparison between the Dunham representation (red) and mixed near-dissociation/Dunham expansion (blue).

Keywords: molecular spectra, long-range states, RKR potential

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