

Investigation of the $A^1\Sigma^+$ state in the LiCs molecule

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Recently there has been considerable progress in production of cold diatomic molecules. Mixed alkali dimers are of particular interest here because their permanent dipole moments allow to manipulate them by external fields, and among them LiCs molecule has the largest dipole moment [1]. As several experimental techniques related to cold molecules involve optical excitation either in the formation or detection stages, a need of precise spectroscopic characterisation of molecular states has much increased, particularly for the low lying excited states, correlated to the first excited asymptote $\text{Li}(2s) + \text{Cs}(6p)$. In view of the raising interest in LiCs, it is rather surprising that the first excited state of singlet symmetry, $A^1\Sigma^+$, has never been observed. The reason for this neglect may be that the $A^1\Sigma^+ \leftarrow X^1\Sigma^+$ band system is placed in near infrared part of the spectrum.

For a number of years we have been involved in investigation of alkali dimers using the polarisation labelling method. This double resonance technique surmounts the difficulty of resolving highly congested molecular spectra: with a proper choice of frequencies and polarisations of two laser beams, interacting with a molecular sample, only transitions from few known rovibrational levels in the ground state are observed. This selectivity is particularly useful when studying spectra of molecules which contain heavy species like cesium or rubidium.

In this contribution we present an experimental observation of the $A^1\Sigma^+$ state in LiCs molecule. In a two-colour polarization labelling experiment we measured the $A \leftarrow X$ band system which turned out to be strongly perturbed, most probably by the neighbouring $b^3\Pi$ state. Therefore we characterize the $A^1\Sigma^+$ state in two ways: by separate sets of molecular constants describing it in a level-by-level manner and by a potential energy curve averaged over local perturbations. The molecular potential is generated with the pointwise Inverted Perturbation Approach (IPA) method [2] and is compared with results of theoretical calculations [3].

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