High resolution spectroscopy on alkali-alkaline earth molecules

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The mixed alkali-alkaline earth molecules have recently attracted the interest of the scientific community due to possible applications in the field of cold and ultracold molecules, in fundamental physics, quantum computing etc.. The combination of an alkali and an alkaline earth atom leads to molecules which have permanent electric and as well magnetic dipole moments and by this offer opportunities for manipulation of their states by external fields. On the theoretical side, several ab intitio calculations [1-4] have been published on atomic combinations like LiCa, LiSr, SrRb by various groups, reflecting the increasing interest [5,6] by experimentalists working with cold and ultracold alkali and/or alkaline earth atoms. On the experimental side, not so much is known about molecular electronic states. Up to now the ground state and two electronically excited states of LiCa [7-9] and few states of BaLi [10] have been characterized.

After the spectroscopic work on LiCa [8,9] we have successfully recorded the near infrared spectra of SrLi and CaK. The molecules were created in a heatpipe with the locations of the alkali and alkaline earth metals kept at different temperatures, this way accounting for the different vapour pressures. The thermal emission was dispersed by a high resolution Fourier transform spectrometer. The assignment of the dense spectrum was made possible by shining a beam of a diode laser into the sample tuned to a molecular line.

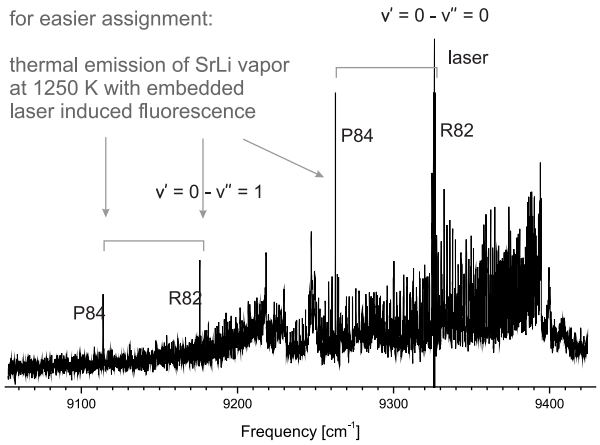

Figure 1: *Example: part of the near infrared emission spectrum of SrLi with laser induced fluorescence for marking related transitions.*

This trick allowed to find and assign those transitions connected with the laser excitation. An example of the recorded spectrum for LiSr is shown in figure 1. The present report will focus on the $2^2\Sigma^+$ - $X^2\Sigma^+$ transition of SrLi. The IR spectrum of CaK looks very similar in the overall appearance like LiSr, but its assignment is presently hindered by the lack of an appropriate laser. First spectral structures, which are probably attributable to SrRb were also observed.

References

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