WHAT IS THE B' STATE OF Na_3?

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In the visible wavelength region, four electronic transitions of the sodium trimer were detected by Broyer et al.[a] While the $A-X$ and $B-X$ systems were studied at rotational resolution[b] , the $B'-X$ bands between 550 and 590 nm have not even been vibrationally analyzed. The B' state life time was previously determined to be only $7ns$ [c] , a cause for difficulties in recording the congested bands with high resolution resonant two-photon ionization spectroscopy. By using well assigned rotational transitions in the $A-X$ system in an OODR scheme, we scanned a portion of the $B'-X$ system. Even without a rotational analysis, the rotational line pattern and especially the density of rotational states within a vibronic band help to identify different vibronic sequences. So far 15 bands could be organized into series characterized by integer vibronic angular momentum quantum numbers j.

The following picture evolves from our interpretation: the B' state derives from the upper two surfaces of the three surface potential which is due to primarily pseudo Jahn-Teller coupling of a $^2E'$ and a $^2A_1'$ state. To an accuracy of a few wavenumbers, the vibronic band positions have been fit to a pseudo Jahn-Teller Hamiltonian yielding the energy separations between the interacting E and A states as 130 cm^{-1} as well as the ratio of the curvatures of the unperturbed potentials.

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[a] M. Broyer, G. Delacretaz, P. Labastie, R.L. Whetten, J.P. Wolf and L. Wöste, Z. Phys. D3, 131 (1986).

[b] D.T. Vituccio, O. Golonzka and W.E. Ernst, J. Mol. Spectrosc. 184, 237-249 (1997) and refs. therein.

[c] M. Broyer, G. Delacretaz, N. Guoquan, J.P. Wolf and L. Wöste, Chem. Phys. Lett. 145, 232 (1988).