Experimental Studies of the NaCs $5\Sigma_0^+$ and $1(a)3\Sigma^+$ States

Seth T. Ashman  
*Providence College, sashman@providence.edu*

Brett McGeehan  
*Lehigh University*

Christopher Wolfe  
*Lehigh University*

Carl Faust  
*Lehigh University*

John Huennekens  
*Lehigh University*

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Experimental Studies of the NaCs $5^3\Pi_0$ and $1(a)^3\Sigma^+$ States

S. Ashman, B. M. McGeehan, C. M. Wolfe, C. E. Faust, J. Huenneke

Lehigh University, 16 Memorial Drive East, Bethlehem, PA 18015

Abstract

We present experimental studies of excited electronic states of the NaCs molecule that are continuously isobars to our previously reported electronically excited NaK molecules. In particular, we report on the excited states, the data that have been obtained with the 22P$_J$ electronic state are used to obtain Bohm-Kulander-Rick (BKR) and Inverse Photodetachment (IPD) potential curves for this state. Benchmark curves are also obtained through rotational levels of electronically excited states in the transition-fold of the NaK molecule. All of the NaCs state data are reported herein. The electronic state potential we fit to the experimental data for NaCs is also being used to fit the electronic transition dipole moment, $\mu(R)$, as a function of internuclear separation, R, for transitions bound by electronic transitions.

NaCs Theoretical Potentials*

Goals

- Map excited state potentials
- Determine $5^3\Pi_0$ potential energy curve
- Map repulsive wall of the aF$_2$ state
- Determine transition dipole moment function, $\mu(R)$, for transitions between levels of the $5^3\Pi_0$ and aF$_2$ states
- Study collisional energy transfer
- Study hyperfine structure

Transition Dipole Moment and Selection Rules

Experimental Setup

Franck-Condon Factors A$^2\Sigma^+ \rightarrow X^2\Pi$

Double Resonance Excitation

Collisionsal Population Transfer

Resolved $\lambda L$, Fluorescence Spectra

Modified $\Delta\Sigma$, Repulsive Wall

Spectra Simulation using BCont:

Fit of Relative Transition Dipole Moment Function

Spectra of Other NaCs Excited States Under Investigation

Hyperfine Structure

*The NaCs $5^3\Pi_0$, aF$_2$ relative transition dipole moment function, $\mu(R)$, has been isobarically fitted to a modified version of the BKR program, BCont, by R. J. LeRoy at the U. of Waterloo. Fundamental exponential hyperfine splittings, obtained this way, have been used with the MOOD program to adjust the repulsive wall of the lower state and the transition dipole moment functions. Fundamental transitions of the global fitting procedure may be used in order to estimate a lower transition dipole moment and a lower repulsive wall.