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2275.3 cm\(^{-1}\) and 2272.5 cm\(^{-1}\) which correspond to threshold energies for the dissociating molecular states to 3P\(^{\bf I}\) and 3P\(^{\bf II}\) sodium atomic levels respectively. The ground state dissociation energy of the NO\(_2\) molecule has been estimated and is in good agreement with the recent experimental and theoretical values.

* Supported by the NSRDB, Pakistan and the ICTP, Trieste, (Italy) under the ICAC scheme.

16:18
G7 10 Subthermal Molecular Spin-Orbit Distributions in the Atmosphere, P.S. ARMSTRONG\(^1\), S.J. LIPSON, W.A.M. BLUMBERG, J.A. DODD\(^1\), J.R. LOWELL, and R.M. NADILE, Phillips Laboratory, Hanscom AFB, MA, and \*'Stewart Radiance Laboratory, Bedford, MA. -- The populations in the two spin-orbit manifolds of nitric oxide in the earth's thermosphere have been found to depart by as much as a factor of two (or hundreds of degrees K) from the ratio expected from thermal equilibrium. Absolute spin-orbit specific densities of NO\(^{\bf I}\) (v=1) have been determined from high-resolution (1 cm\(^{-1}\)) ICR limb spectra obtained in the CIRRIS 1A Space Shuttle experiment for the 100-200 km region. Nonlinear least-squares spectral fitting was used to analyze the NO\(^{\bf II}\)\((v=1)\) emissions near 5.375 μm. The subthermal population ratio represents a third degree of freedom, along with vibration and rotation, that is not in equilibrium with the local kinetic temperature. The subthermal distributions most likely result from NO\(^{\bf v=0}\) + O collisions, which are the major source of NO\(^{\bf v=1}\) in the thermosphere. Thus, the present measurements provide new information on ON + O collision dynamics and the dissociation of the NO\(_2\) transition states, suggesting a relationship with subthermal NO\(^{\bf v=0}\) sublevel distributions observed in NO\(_2\) photodissociation. It may be possible to use observed spin-orbit population ratios as diagnostic probes of NO\(^{\bf v}\) collisional and chemiluminescent excitation mechanisms, and for the reinterpretation of prior atmospheric NO measurements.

This work was supported by the Air Force Office of Scientific Research and the Ballistic Missile Defense Organization.

16:30
G7 11 Electronic Mass Scaling and Badger's Rule. J.D. MORGAN III, D.R. HERSCHBACH, Dept. of Chemistry, Harvard University. -- In 1934 R.M. Badger\(^*\) observed that for the great majority of ground and excited states of molecules, harmonic stretching constants are approximately proportional to the inverse cube of the bond length \(R\). Since then much numerical fitting of experimental data has been done to verify and refine 'Badger's Rule', but its theoretical justification has remained elusive. Insight into the origin of Badger's Rule is gained by imagining the electronic mass \(m\) to be a continuous variable. In a system of heavy particles (such as nuclei) and light particles of a single kind (such as electrons or muons) of mass \(m\), all interacting by Coulombic potentials, a simple scaling argument implies that the energy levels are proportional to \(m\), neglecting non-adiabatic effects, and the typical length scales are proportional to \(1/m\). Thus a harmonic stretching constant, which is the second derivative of the energy with respect to the bond distance, is proportional to \(m^2\), which in turn is proportional to \(R^{-3}\). The monatomic case, with \(m\approx 207\, m_e\), illustrates the robustness of Badger's Rule even in regimes undreamt of in the 1930's.


G7 14 Molecular Spectroscopy of Supernaturally Cooled Transient Species. P. MISRA, X. ZHU, M.N. KAMAL and A.H. NUR, Howard University. -- Transient molecular species, namely the alkoxo and alkylthio radicals, have been generated in a supersonic beam and probed with a tunable dye laser. Well-resolved laser excitation and wavelength-resolved emission spectra of the jet-cooled radicals have been recorded. Molecular parameters characterizing both the ground and excited electronic states have been determined following a comprehensive vibronic and rotational analyses of the laser-induced fluorescence spectra.

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TUESDAY AFTERNOON

SESSION G8: DAMOP: RYDBERG ATOMS
Tuesday afternoon, 19 April 1994
Washington Room B at 14:30
W. Cook, presiding

14:30
G8 1 Steps in the Microwave Ionization of Highly Excited Hydrogen Atoms. S. Y. LUIE AND J. E. BAYFIELD, University of Pittsburgh. -- Quasi-

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