HIGH RESOLUTION SPECTRAL STUDIES OF SOME DIATOMIC MOLECULES OF ASTROPHYSICAL INTEREST

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ABSTRACT. Laboratory studies have been made on molecules of astrophysical interest such as AlO, CO, CrO, SiS, NH^+ and OH. Vibrational and rotational constants have been determined more accurately in the various electronic states.

Laboratory studies of molecular spectra are essential for identifying molecules in stellar atmospheres, in interstellar medium and in the planetary atmosphere. The interplay between molecular spectroscopy and astrophysics has often been emphasized (1,2). In our laboratory we have carried out high resolution spectral studies of molecules of astrophysical interest such as AlO, CrO, SiS, NH^+, CO and OH.

The presence of AlO was detected in cool stars and sun-spots through the identification of $B^2\Sigma^+ - X^2\Sigma^+$ transition in blue-green region. The intensity of the 0-0 band in Mira stars is highly variable and at times the band appears in emission. It is suggested that if another electronic transition such as $A^2\Pi_i - X^2\Sigma^+$ is observed in the stellar spectra, alongwith the blue-green transition, it would be possible to understand the temperature changes in the stellar atmosphere and the excitation mechanism. Luck and Lambert (3) have calculated the 1-0 band of the $A^2\Pi_i - X^2\Sigma^+$ transition and looked for it in the stellar spectra. They attributed their negative results to the inaccurate rotational constants of the $A^2\Pi_i$ state. We have made an extensive study of four electronic transitions viz. $E^2\Delta_i - A^2\Pi_i$, $C^2\Pi_r - X^2\Sigma^+$, $C^2\Pi_r - A^2\Pi_i$ and $D^2\Sigma^+ - A^2\Pi_i$ of AlO (4), and obtained accurate rotational constants for the $A^2\Pi_i$ state which would help in the positive identification of the $A^2\Pi_i - X^2\Sigma^+$ transition in stellar atmosphere. Our studies have also resulted in an unambiguous analysis of the rotational structure of v = 0,1 and 2 of the $C^2\Pi_r$ state. Prior to our studies no reliable rotational constants existed for the $C^2\Pi_r$ state (5).

Similar studies have been done on the high resolution spectra of several molecules like CrO (6), NH^+ (7), SiS (8,9,10). Theoretical

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expressions for the rotational line intensities are derived for a $^2\Sigma - ^2\Pi$ transition and applied to OH molecule (11). From isotope shift studies of CO the Kaplan bands are shown to belong to the v' = 2 progression of the 3rd positive system $b^3\Sigma^+ - a^3\Pi$, thus confirming the speculation of Schmid and Gero (12,13,14).

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