Experimental and Theoretical Studies of Pressure Broadened Alkali-Metal Atom Resonance Lines

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Abstract

The pressure-broadened absorption lines of the alkali-metal atoms are prominent in the spectra of L-dwarfs and T-dwarfs. In particular, the resonance lines of sodium and potassium are each observed to be broadened by many tens of nm on either side of line center due to collisions with helium and molecular hydrogen in the atmospheres. Accurate broadening parameters are necessary for modeling atmospheric opacities. Validated models can be used to characterize properties such as metallicity and effective temperature of dwarfs or predict spectra of irradiated extrasolar giant planets, in advance of missions such as TPF-C. We are undertaking a program of experimental and theoretical studies of the pressure broadening of Na and K by He and H_2. The experiment utilizes a hot cell and spectrometer to yield absorption spectra over the visible spectrum at temperatures of around 900 K and perturber gas pressures of up to several hundred torr. The atomic densities are known precisely using the anomalous dispersion (or "hook") method. The theoretical calculations utilize accurate molecular potential energies and transition dipole moments and fully quantum-mechanical methods. We will present our results and comparisons to available data, where available. Supported by NASA under award NAG5-12751.

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