Electron collision properties and UV spectroscopy of H_2, HD, O, and H

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UV observations of diffuse molecular clouds and stellar atmospheres made by IUE, HST, Astro, FUSE and EUVE require accurate high resolution measurements of electron impact cross sections and oscillator strengths. The Laboratory Astrophysics program at the Jet Propulsion Laboratory concentrates on the measurement of the electron collision properties of atomic and molecular hydrogen, two species composing 90% of the ISM. The most recent developments for laboratory work are a 3m vacuum UV spectrometer ($\lambda/\Delta\lambda = 50000$), specialized discharge chambers for the production of atomic species, and installation of electrostatically focused electron guns.

Medium resolution ($\lambda/\Delta\lambda \sim 25000$) measurements of the H_2 Lyman and Werner systems have been obtained with the 3m facility in the 110 – 170 nm region (*Liu et al.*, 1995) allowing accurate comparison with the *Abgrall et al.*(1993a,b,c), and *Abgrall et al.*(1997) calculations of the rotational line strengths. Similar work on HD in the FUV and H_2 in the EUV to study the higher Rydberg states $^1\Sigma_u^+$ (B, B$'$, B$''$) and $^1\Pi_u$ (C, D, D$'$, D$''$) are underway. The electron impact cross sections of the H_2 Lyman and Werner systems have been reanalyzed in recent work (*Liu et al.*, in preparation), providing a much improved measure of the cross sections of the two systems. Our recent study of the Lyman continuum has revised by 15% the dissociation yield of this process, which represents the primary destruction path of H_2 in diffuse clouds.

Accurate ($< 10\%$) electron impact cross section measurement of the H(2p) resonance state of atomic hydrogen has been obtained over the range 0.020 – 1.8 keV (*James et al.*, 1997). This work is currently continuing to include the higher Rydberg states.

A new facility has been developed for producing an atomic oxygen beam, attached to a spectrometer with dual exit ports for simultaneous UV/Visible studies. The measurements are expected to provide definitive electron collision strength measurements of the atomic oxygen electronic direct and cascade cross sections of the important $^{3,5}S$ electronic states.

References:

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