DAMOP10-2010-000041

Abstract for an Invited Paper
for the DAMOP10 Meeting of
the American Physical Society

The Atomic and Molecular Universe: Collisions in Hot Plasmas to the Building Blocks of Life[1]

ARA CHUTJIAN, JPL/Caltech, Pasadena, CA

Basic atomic and molecular collision phenomena are operative at the core of an enormous range of astrophysical plasmas, including the interstellar medium (ISM), protostellar regions, stars, our Sun, and planetary atmospheres, ionospheres, & magnetospheres. Laboratory measurements of cross sections and lifetimes are needed to establish plasma charge-state distributions. A required database includes absolute electron- impact excitation, ionization, and recombination cross sections in highly-charged ions (HCIs); photoionization cross sections; and absolute single- and multiple charge-exchange cross sections between a neutral target and an HCI, as when a solar/stellar wind meets a circumstellar cloud or passing comet to generate X- rays via charge exchange. Since satellites and spacecraft often detect photons from the astronomical object, the infrared-to-X- ray emissions are governed by a balance between collisional excitation and radiative decay, so that accurate lifetimes, branching fractions, and Einstein A and B coefficients are also needed. On yet another level, observations in the infrared-to-millimeter wave region from, for example, the Green Bank Telescope, Spitzer, Sofia, Herschel, and the James Webb Telescope provide information on molecular formation in the ISM and protostellar regions. Over 144 atomic, molecular, and ionic species have been identified to date. Recent laboratory results will be given on formation of some of these polyatomic molecules in superthermal, ground-state H- and O-atom collisions with simple, grain-adsorbed species, and results compared to the impressive array of space spectroscopic data.

[1]Presentation is made together with J. A. MacAskill, S. M. Madzunkov, and J. Simcic, JPL/Caltech.