DAMOP09-2009-000865

Abstract for an Invited Paper
for the DAMOP09 Meeting of
the American Physical Society

Recent result in slow ion-atom and ion-molecule collisions[1]

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Slow collisions of ions with atoms and molecules have been of great interest to basic atomic physics and play an important role in the early universe. Collisions resulting in charge exchange have long played an important role in the ionization equilibrium of magnetically confined plasmas. Moreover, the discovery of x rays from cometary and planetary atmospheres has highlighted the role of charge exchange processes in planetary science, solar, and astrophysics. As a result, laboratory studies have expanded to include high-resolution measurements of the x-ray emission associated with slow ion-atom and ion-molecule collisions. For example, laboratory measurements of the K-shell x-ray emission of Fe were conducted to understand the mechanism for x-ray production in the galactic ridge; measurements of the x-ray emission of L-shell sulfur ions colliding with molecules are now underway to understand the origins of Jupiter's auroral emission. Laboratory x-ray measurements have also uncovered some significant differences with predictions from atomic theory - the principal quantum number into which capture takes place is one to multiple levels higher than predicted, and the observed intensity pattern can differ significantly from predictions, especially at the lower collision energies. Measurements employing different experimental techniques, however, have yielded intensity patterns that differ quite strongly from each other and add further to the puzzles that remain to be solved before the physics of slow ion-atom and ion-molecule collisions is fully understood.

[1]Work was performed under the auspices of the U S Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 and supported in part by NASA's Planetary Atmospheres Program.