SEMINAIRE ISMO

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Photoionization Cross-Sections for Astrophysical and Plasma Applications

Photoionization of atomic and molecular species is an important process in determining the ionization balance and hence the abundances of elements in photo-ionized astrophysical nebulae. It has recently become possible to detect neutron n-capture elements (atomic number Z>30) in a large number of ionized nebulae. These elements are produced by slow or rapid n -capture nucleosynthesis (the s -process and r -process, respectively). Measuring the abundances of these elements helps to reveal their dominant production sites in the Universe, as well as details of stellar structure, mixing and nucleosynthesis. These astrophysical observations provide an impetus to determine the photoionization and recombination properties of n -capture elements. Planetary nebulae (PNe) progenitor stars may experience s-process nucleosynthesis, in which case their nebulae will exhibit enhanced abundances of trans-iron elements. The level of s - process enrichment for individual elements is strongly sensitive to the physical conditions in the stellar interior. Accurate assessment of elemental abundances in astrophysical nebulae can be made from the direct comparison of the observed spectra with synthetic non-local thermodynamic equilibrium (NLTE) spectra, if the atomic data for electron and photon interaction processes are known with sufficient accuracy. Experiments on trans-Fe and astrophysical important atomic and molecular ionic species at third and fourth generation synchrotron radiation facilities; Advanced Light Source (ALS) in Berkeley, California, USA, SOLEIL in Saint-Aubin, France, ASTRID II in Aarhus, Denmark and PETRA III, in Hamburg, Germany, have all highlighted the need for high quality theoretical work to fully interpret experimental results. Recently developed methods for atomic systems using parallel computing architectures (incorporating the necessary relativistic effects within a Dirac-equation formulation) has been used to perform detailed photoionization cross-section calculations on a variety of atomic species, e.g.; Fe, Se, Kr, Ar, Xe, W, Cl, Si, S , Zn, Rb, Ca, N and O in neutral or low stages of ionization. Where possible we compare our theoretical results with ongoing experiments being performed in the valence and x-ray photon energy ranges at third and fourth generation synchrotron facilities and with satellite observations. Such comparisons serve as the ultimate benchmark in order to have confidence in the atomic and molecular data incorporated into databases and modelling codes such as CLOUDY, XSTAR, CHIANTI and ATOMDB.

Mardi 23 avril 2019 à 11 h

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