Atomic processes relevant for high-temperature plasmas

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In this meeting I will present the projects of the group LIBPhys-UNL that are relevant for high-temperature plasma physics, particularly, of high interest for fusion-plasma research.

We performed high-precision measurements of X-ray transitions in a high-temperature plasma generated by an electron cyclotron resonance ion source (ECRIS). High-precision measurements were performed with a vacuum double flat crystal spectrometer that, due to its geometrical setup, provides accurate (few ppm at few keV) and absolute measurements [1, 2]. I present briefly the spectrometer and latest measurements [3]. This spectrometer provides accurate x-ray standards in narrow transitions of highly charged ions that can be used to energy-calibrate microcalorimeters dedicated for diagnostic x-ray lines in a fusion-generated plasma.

We measured the details of electron collision and recombination cross-sections of highly charged iron and tungsten produced by an electron beam ion trap (EBIT). Typical measurement cycles compressed a wide range of electron beam energies (300 eV to 1150 eV), which probed many atomic processes, including radiative recombination, dielectronic recombination, collisional excitation and resonant electron scattering. I present the latest results of experimental cross-sections for this range electron of beam energy of atomic lines in iron that are of astrophysical interest [4]. Preliminary results and discussion concerning fusion-plasma research are also provided for tungsten, giving special attention to the less-known atomic process of resonant electron scattering.

Of interest in fusion-plasma research, I also present a compact and simple theoretical expression for evaluating ionization cross sections for a wide range of energies and charge states. This expression is based on the binary-encounter Bethe model [5, 6] and requires only incident energy and shell information (binding energy and quantum numbers). Work is in process to provide a user-friendly website with this data accessible for the plasma and atomic scientific community.

References

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