Atomic data for beam-stimulated plasma spectroscopy in fusion plasmas

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Energetic neutral beams of hydrogen and deuterium are extensively used for heating and diagnostics of fusion plasmas. The excited states of hydrogen atoms are strongly affected by the strong fields in the plasma. The Zeeman effect for spectral lines of cold atoms emitted at the plasma edge and the motional Stark effect (MSE) for the injected high-energy atoms put forward new demands on the atomic (primarily collisional) data for the field-modified states of neutrals.

We present the current status of collisional atomic data for the parabolic states of hydrogen atoms which are required for the accurate modeling of MSE. Unlike the field-free emission of hydrogen lines, where only atomic data averaged over the magnetic numbers *m* are needed, calculation of collisional data in a translational electric field is more complicated. It is shown that the collisional data require knowledge of the density matrix of excitation including the off-diagonal matrix elements. Comparison between atomic-orbital close-coupling method and eikonal, Glauber and Born approximations is presented. For excitation from the ground state the data are in agreement for higher energies (higher than 100-200 keV/u) while at lower energies significant discrepancies are found.

The new atomic data between the parabolic states of atomic hydrogen were utilized in a collisional-radiative model for H parabolic states extended to n=10. In addition to proton- and electron-impact excitations and radiative processes, collisional and field-induced ionizations were included as well. The ratio between the σ- and π- components and beam-emission rate coefficients were calculated in a quasi-steady state approximation. A good agreement with the experimental data from JET was found which points out to strong deviations from the statistical distribution for the *m*-component populations. The non-statistical effects will also be discussed in detail.