STARK EFFECT MODELING IN THE DETAILED OPACITY CODE SCO-RCG

J.-C. Pain[1], F. Gilleron[1] and D. Gilles[2]
[1]CEA, DAM, DIF, F-91297 Arpajon, France
[2]CEA, DSM, IRFU, F-91191 Gif-sur-Yvette, France
jean-christophe.pain@cea.fr

In hot dense plasmas encountered for instance in inertial confinement fusion, the line broadening resulting from Stark effect can be used as a diagnostics of electronic temperature and density. The capability of the detailed opacity code SCO-RCG [1] was recently extended to K-shell spectroscopy (hydrogen- and helium-like ions), following an approach proposed by Gilles and Peyrusse [2]. Neglecting non-diagonal terms in dipolar and collision operators, the line profile can be written as a sum of Lorentzian functions associated to the Stark components. The lines $Ly_{\alpha,\beta,\gamma,...}$ are obtained from the well-known description of H-like ions in parabolic coordinates [3,4] within SO(4) symmetry. Relativistic fine-structure of the Ly_α line is included by diagonalizing the Hamiltonian matrix associated to quantum states having the same principal quantum number. For the lines of He-like ions, the direct singlet-triplet mixing is neglected, and each state is described by an approximate two-electron wavefunction [3]. Such an approximation is valid for highly charged ions when the electron-nucleus interaction overcomes the Coulomb electron-electron repulsion. For He_α, both the resonance and intercombination ($1s2p\ ^3P$ - $1s^2$) lines are taken into account. It is possible, in SCO-RCG, to test different micro-field distributions (depending on the ionic coupling parameter and the electronic screening constant) obtained for instance from Monte Carlo simulations [5] or relying on the combination of the APEX (Adjustable Parameter EXponential) method [6] with a variational HNC (HyperNetted Chain) approach [7]. The code enables one to study the decoupling between T_e and T_i or the role of satellite lines (such as Li-like $1sn\ell n\ell' \rightarrow 1s^2 n\ell$ lines). Comparisons with Stark profiles resulting from simpler and widely-used semi-empirical models [8,9] will be presented.

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