V Serb. Conf. on Spectral Line Shapes in Astrophysics
Vršac, 6-10. June, 2005.
Program and Abstracts

Invited lecture

INTERACTION POTENTIALS FOR SPECTRAL LINE SHAPES IN PLASMA

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In the standard formalism of Stark impact broadening of spectral lines and of cross sections, the electrostatic Coulomb potential is used to describe the interaction between the perturbing electrons and the emitting atom. Electronic correlations (screening effects) are usually taken into account by introducing a cut-off in the interaction when the electron-atom distance exceeds the Debye radius. A more consistent treatment to describe collective effects is the Debye-Hückel potential where the two-particle Coulomb field is shielded by the ensemble of the surrounding electrons. This is a good approximation only for high temperature and low density plasmas (weakly non ideal plasmas), while for strongly non ideal plasmas, the Coulomb cut-off potential or the ion sphere potential are more appropriate. These potentials, which can be written as the Coulomb potential with one or two correcting terms, are used for Stark impact broadening. New semi-classical collisional functions are derived for both the transition probability and the cross section, using the classical path approximation.

The Coulomb potential is expanded in multipolar components and only the long range part is retained in the perturbation theory and in addition only the dipole term is retained for the calculation of the cross-sections between the levels that are dipolar electric transitions.

Using the parametrization of the straight path trajectory in the collision frame, the semi-classical collisional functions for isolated neutral lines $A(z)$ and $a(z)$ are expressed in terms of the modified Bessel functions $K_0(z)$ and $K_1(z)$, these functions are revised when using the cutoff or ion sphere potential.

We have compared the effects of the Coulomb, cut-off and ion sphere potentials on the different collisional functions. The numerical results show that the increase in the screening leads to a decrease in these functions, especially for the lower values of the impact parameter.

We investigate also a full quantum model based on quasiparticles treatment to describe the electron ion interaction in a non ideal plasma. We developed this simplified quantum formalism of the emission which take into account the interaction between particles such that it becomes applicable to a weakly non ideal plasma. We give analytic expression of the line width and explain the non linearity of the width via the density observed in some experiments.