VII SERBIAN CONFERENCE ON SPECTRAL LINE SHAPES IN ASTROPHYSICS
15-19 June 2009, Zrenjanin, Serbia
Book of Abstracts, Eds. L. Č. Popović, M. S. Dimitrijević, D. Jevremović and D. Ilić
Serbian Astronomical Society and Astronomical Observatory, Belgrade, 2009

Invited lecture

SPECTRAL LINE SHAPES MODELING IN LABORATORY AND ASTROPHYSICAL PLASMAS

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Astrophysicists share with laboratory plasma physicists an interest for the details of line shapes emitted in plasmas. Many studies have demonstrated that an exhaustive analysis of spectral line shapes provides invaluable informations on the emitters environment. Ongoing progresses in observations drive a parallel effort in the modeling, since there can be no accurate diagnostic without a deep understanding of the emitter interaction with the plasma. We will illustrate with several examples some of the tools used in our laboratory for modeling the line shapes emitted in weakly coupled plasmas. An old problem concerns the many body dynamic interactions with the emitter occuring in a large range of plasma conditions. We will present some of the tools which are useful, on the one hand for an accurate and ab-initio type description of the line shape, and on the other hand for obtaining a large amount of profiles by a computer efficient model for a real time diagnostic. Interesting application conditions of these models concern magnetized plasmas found in astrophysics or magnetic fusion plasmas. For multi tesla magnetic fields, there can be a complex interplay of Stark and Zeeman effect, and line shape models in plasma conditions of interest in astrophysics and magnetic fusion will be discussed. A more recently studied problem of general interest is the modeling of spectra observed in a plasma with spatially and temporally fluctuating parameters, a common situation in astrophysical conditions. Magnetic fusion plasmas and some laboratory experiments also experience such conditions due to drift wave turbulence. We have identified plasma conditions for which a simple statistical model can be applied for a calculation of the apparent line shape in such plasmas. Results will be shown for both Doppler and Stark dominated profiles.