LINE SHAPE MODELING FOR MAGNETIC FUSION AND ASTROPHYSICAL PLASMAS: AN OVERVIEW OF RECENT RESULTS

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Abstract. A selection of problems related to the modeling of Stark broadening is considered, for astrophysical and laboratory plasma diagnostic applications. At the atomic level, a proper description of a line shape requires the ion microfield evolution be accounted for during the time of interest of the transition under consideration; this is the so-called ion dynamics issue. In addition, the lines presenting a structure such as Hβ can exhibit an asymmetry due to presence of multipolar interactions, which is significant at high density regimes and must be retained in calculations. Some observed spectra from magnetized plasmas also exhibit lines with a Zeeman triplet structure due to both linear and quadratic terms in the Hamiltonian, which must also be retained in calculations. We give a review of these problems and present new spectra calculations. A focus is put on plasma conditions relevant to stellar atmospheres and magnetic fusion experiments. We present calculations and also report on line shape fittings which have been performed for diagnostic applications. We have recently developed models for retaining the effect of collective electric fields on the line shapes of hydrogen. Langmuir waves are an example of such fields which are present in equilibrium and can be strongly amplified by density gradients or by beams of fast electrons. We present results of a computer simulation showing the changes in the line shape resulting from electronic Langmuir waves with a magnitude of the order of the mean plasma microfield.