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Progress Report

CALCULATING THE SIMULTANEOUS EFFECT OF ION DYNAMICS AND OSCILLATING ELECTRIC FIELDS ON STARK PROFILES

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Oscillating electric fields can change the radiative properties of plasmas, with e.g. changes in the line shape. Such fields can be generated by an external source, as e.g. a microwave generator or laser radiation, with the aim of diagnosing or heating the plasma. They may also be created inside the plasma, resulting from a nonthermal effect driven by a plasma instability. For this case a current interest is the diagnostic of energetic particle beams in tokamak edge plasmas, with the potential use of the line shape changes (Meireni et al. 2018) caused by the generated Langmuir waves. The effect of oscillating fields on spectral line shapes has been studied since several decades by using approaches based on kinetic theory and retaining the quantum effects of the emitting particles (Baranger and Mozer 1961, Lisitsa 2014). We study here with a computer simulation the simultaneous effect of ion dynamics and oscillating electric fields on hydrogen Stark profiles. Ion dynamics is well known to affect the central region of the first Lyman and Balmer lines for e.g. plasma densities of 10^{19} to 10^{23} m^{-3} and temperatures of the order of the eV or larger, corresponding to many laboratory, fusion and astrophysical plasmas. Reliable models for ion dynamics are based on a computer simulation coupled to a numerical integration of the Schrödinger equation for the emitter evolution operator (Ferri 2014). We discuss here some of the features of the models required in the different situations considered: fixed or sampled oscillating electric field magnitudes, fixed direction or randomly oriented oscillating field, effect of a simulation of the electrons, comparison to a convolution model.

References

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