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Computer simulation of Stark profiles accounting for oscillating electric fields

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Oscillating electric fields are found in many kinds of plasmas. In laboratory and fusion plasmas, they are often generated by an external source, such as a laser or a microwave generator. In such plasmas and in astrophysical plasmas, oscillating fields can also be excited by a local fluctuation, and be amplified by a plasma instability, generating non-thermal plasma waves such as Langmuir waves. We here address the effect of oscillating electric fields on the line shapes emitted by hydrogen atoms in plasmas. This effect has long been studied, and the existence of satellites structures on the line shape has been observed and analyzed, e.g. [1]. In this work, we present new calculations simultaneously taking account of the plasma electric microfield and an oscillating electric field. Due in particular to ion dynamics, the atom is submitted to a complex dynamics difficult to take into account with an analytic approach. We propose the use of a computer simulation of the ion motion providing the ion electric microfield in addition to an oscillating electric field. The electronic field can also be simulated or included in the Hamiltonian by a collision operator. The total field is applied to an emitter for which we solve the Schrödinger equation in order to obtain the quantum evolution operator for one history of the total electric field. This evolution operator allows the calculation of the emitter dipole autocorrelation function once a large number of histories have been calculated. We present different hydrogen lines for plasma densities in the range 10^{19} and 10^{23} m^{-3}, and temperatures between 1 and 10 eV.

References

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