Stark line shapes in a constant magnetic field and a periodic electric field

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Periodic electric fields can change the radiative properties of plasmas, e.g. with changes in the line shape. Such fields may be generated by an external source, as 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 line shape changes due to the generated waves [1]. 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 [2-3]. We study here 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 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 computer simulation coupled to a numerical integration of the Schrödinger equation for the emitter evolution operator. We show here some calculations of line shape obtained by a simulation code for hydrogen emitters in a static magnetic field, a plasma microfield, and an oscillating electric field.

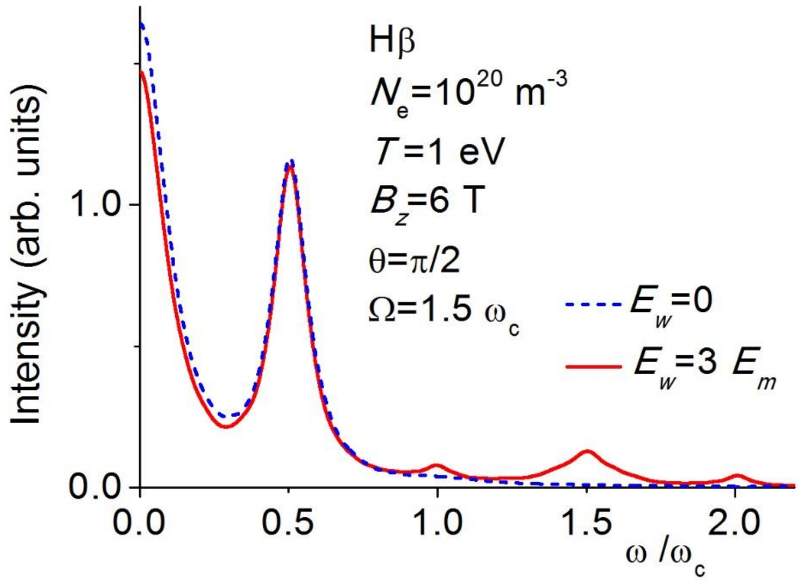

Figure 1. Hβ line observed perpendicular to the magnetic field, for a wave magnitude equal to three time the average plasma microfield and an oscillation frequency equal to 1.5 the cyclotronic frequency.

References

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