XIV Serbian Conference on Spectral Line Shapes in Astrophysics
Bajina Bašta, Serbia, June 19 - 23, 2023
Book of Abstracts, Eds. Luka Č. Popović, Nataša Bon, Edi Bon and Sylvie Sahal-Bréchot

STRONG DISTORTIONS OF LINE SHAPES IN PERIODIC ELECTRIC FIELDS

R. Stamm[1], I. Hannachi[1,2], J. Rosato[1] and Y. Marandet[1]

[1]*Aix Marseille University, CNRS, PIIM, 13397 Marseille, France*
[2]*University Batna 1, PRIMALAB, Batna, Algeria*

E-mail: roland.stamm@univ-amu.fr

Periodic electric fields are often found in plasmas due to the collective behaviour of the charged particles or the presence of an external source such as a radio frequency generator or a laser. In astrophysical and laboratory plasmas, the typical electrostatic oscillation frequency is the plasma frequency $\omega_p = \sqrt{Ne^2/(m\varepsilon_0)}$, where N, e and m are the density, charge and mass of the charged particle considered, and ε_0 is the permittivity of free space. We focus our interest on oscillations at the electronic plasma frequency since this rather high frequency has a signature on hydrogen line shapes for a large range of plasma conditions. Several decades of measurements and modelling have revealed the formation of structures near to the multiples of the plasma frequency [1,2]. We here assume that nonthermal effects amplify a Langmuir wave, whose electric field magnitude becomes larger than the average plasma microfield. We use a computer simulation of the ions retaining their motion, treat the electrons with an impact approximation, and we integrate the time-dependent Schrödinger equation for the quantum emitter retaining the simultaneous effect of the plasma microfield and the oscillating electric field. Our calculations show strong line shapes distortions as the magnitude of the oscillating field increases. We present results for the first Lyman and Balmer lines and we revisit early experimental Hβ line shapes [3] obtained in the presence of turbulent electric fields in a toroidal chamber.

References

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