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Progress Report

EFFECT OF TURBULENCE ON LINE SHAPES IN ASTROPHYSICAL AND FUSION PLASMAS

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

[1]*PRIMALAB,Faculty of Sciences, University of Batna 1, Batna, Algeria*
[2]*PIIM, Aix-Marseille Université-CNRS, centre Saint Jérôme, 13397 Marseille, France*
E-mail: ibtissem.hannachi@univ-amu.fr, ibtissem.hannachi@univ-batna.dz

The problem of plasma turbulence is of interest both from a theoretical point of view and from an experimental one for laboratory, fusion, and astrophysical plasmas. One kind of plasma turbulence suspected to be present in astrophysical and fusion plasma is driven by plasma and electromagnetic waves. We have studied the case of strong Langmuir turbulence, a phenomenon occurring in presence of an external source of energy, and coupling nonlinearly the Langmuir waves with ion sound and electromagnetic waves. Due to this coupling, the density fluctuations associated with ion sound waves refracts the Langmuir waves in regions of low densities. Coherent wave packets localize in such regions, and experience a cycle driven by the ponderomotive force which decreases them to shorter scales and enhances their intensity (wave collapse). In such conditions, numerous wave collapses sites are present in the plasma, and change its radiative properties. We have proposed a model for calculating the change on a line shape of atoms submitted to the electric field of a nearby wave collapse (Hannachi et al. 2016). Our model uses the numerical solution of the emitter Schrödinger equation submitted to an electric field taken as a sequence of envelope solitons oscillating at the plasma frequency. We have used the results of numerical simulations of wave collapse (Robinson 1997) for sampling the lifetime of each soliton, and the probability density function for the magnitude of the electric field. We will present the change expected on a line shape of hydrogen for different plasma conditions of interest in astrophysical and fusion plasmas.

References

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