Invited Lecture

ION DYNAMICS AND EFFECTS OF MICROFIELD ROTATION

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Lineshapes of atomic radiative transitions broadened by plasma is a complex problem lacking a general analytic solution, and several models have been suggested to treat it (Gigosos 2014). Lyman-α is the simplest transition, but paradoxically, calculating plasma broadening of this spectral line ends up in a large spread between results of different models (Stambulchik 2013, Ferri *et al.* 2014).

In this presentation, we discuss influence of the microfield rotations on the Stark lineshape formation. The first quantitative analysis of this phenomenon was performed long ago (Demura *et al.* 1977) and recently became a subject of study again (Demura and Stambulchik 2014, Calisti *et al.* 2014). We show that the Lyman-α broadening changes from the impact regime to another, also dynamical in nature, "rotational" broadening, in which the line width depends only on the typical frequency of the plasma microfield rotation and is independent both of the microfield magnitudes and the atomic properties of the transition. A simple universal expression is suggested interpolating between the two asymptotic regimes, applicable unchanged to broadening due to electrons and ions alike. Comparison to results of accurate computer simulations shows a good agreement over a very large range of plasma parameters.

References

Calisti, A., Demura, A., Gigosos, M. A., González-Herrero, D., Iglesias, C. A., Lisitsa, V. S. and Stambulchik, E.: 2014, Influence of microfield directionality on line shapes, *Atoms*, 2(2):259 276, 2014. doi:10.3390/atoms2020259.

Demura, A. V., Lisitsa, V. S. and Sholin, G. V.: 1977, Effect of reduced mass in Stark broadening of hydrogen lines, *Sov. Phys. J. Exp. Theor. Phys.*, 46:209215.

Demura, A. V. and Stambulchik, E.: 2014, Spectral-kinetic coupling and effect of microfield rotation on Stark broadening in plasmas, *Atoms*, 2(3):334356, 2014. doi:10.3390/ atoms2030334.

Ferri, S., Calisti, A., Mossé, C., Rosato, J., Talin, B., Alexiou, S., Gigosos, M. A., González, M. Á., González-Herrero, D., Lara, N., Gomez, T., Iglesias, C. A., Lorenzen, S., Mancini, R. C. and Stambulchik, E.: 2014, Ion dynamics effect on Stark broadened line shapes: A cross comparison of various models, *Atoms*, 2(2):299318, 2014. doi:10.3390/ atoms2030299.

Gigosos, M. A.: 2014, Stark broadening models for plasma diagnostics, *J. Phys. D: Appl. Phys.*, 47(34):343001, August 2014. doi:10.1088/0022-3727/47/34/343001.

Stambulchik, E.: 2013, Review of the 1st Spectral Line Shapes in Plasmas code comparison workshop, *High Energy Density Phys.*, 9(3):528534, 2013. doi:10.1016/j.hedp.2013.05.003.

Invited Lecture

LINE BROADENING IN PRESENCE OF STRONG LANGMUIR TURBULENCE

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In a linear regime three types of waves are observed in a fully ionized unmagnetized plasma: Langmuir, ion sound and electromagnetic waves. These waves couple in a nonlinear regime, observed as the amplitude of the waves is growing. Many different phenomena may then occur, but the focus in this work will be on strong Langmuir turbulence, first described by the Zakharov equations (V.E. Zakharov, Sov. Phys. JETP 35, 980 (1972)). These equations predict the development in the plasma of both density depressions and electric field maxima. If enough energy is injected into the plasma, many wave packets will form, collapse, dissipate, then reform. This wave packet cycle has been observed in space and laboratory plasmas, and analysed with the Zakharov equations and numerical simulations (P. A. Robinson, Rev. Mod. Phys. 69, 507(1997)). The electric field generated by the wave packet cycle can reach values up to two orders of magnitude larger than the Holtsmark field. The lifetime of a cycle takes values much larger than one in units of the inverse electron plasma frequency. If we consider an emitting atom immersed in such a plasma, its energy levels will be strongly modified by the electric field of the wave packets located in the vicinity. Line shapes of atoms and ions in such a plasma may thus be significantly affected. We propose a stochastic model using probability density functions (PDFs) for the lifetime of a wave packet cycle, and for the values of the electric field in the wave packets. We assume that the Langmuir field applied on an emitter is a sequence of oscillating field with random amplitude and phase, and obtain the emitter dipole correlation function by a numerical integration. Calculations of Lyman alpha profiles will be performed for different plasma and wave packet conditions.