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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.