

INHOMOGENEOUS PLASMA PARAMETRIC DECAY INSTABILITY DRIVEN BY STOCHASTICALLY MODULATED PUMP WAVE FREQUENCY

E.Z.Gusakov, B.O.Yakovlev
Ioffe Institute, St.Petersburg, Russia

In the present paper the influence of the pump wave frequency stochastic modulation on the inhomogeneous plasma parametric decay instability (PDI) is studied both theoretically and numerically. The pump wave frequency modulation was discussed as a possible way of PDI suppression since 60th. Following to the results of homogeneous plasma theory [1], it can serve as an effective PDI control method. But the analyses carried out in inhomogeneous plasma model for stochastic pump wave frequency modulation has revealed high stability of convective amplification coefficient, which appeared to be insensitive to the pump wave stochastic frequency modulation [2]. Such stability was recently confirmed in experiment [3] and numerically for absolute PDI [4].

Contrary to this case of very fast (delta-correlated) pump phase modulation [2] slow stochastic pump wave frequency modulation, as well as harmonic or linear pump wave frequency sweep [5], may lead to the PDI resonant enhancement, manifests itself in the form of short giant splashes of decay wave amplitudes as it may be seen on the Fig.1, where the results of numerical modeling are presented for different stochastic phase realizations and the same pump wave frequency correlation time and deviation. The physical reason for that additional amplification is suppression of convective losses due to the drift of the decay point, occurring under the pump frequency modulation [6]. Such suppression should take place when the velocity of the decay point coincides with the group velocity of a decay wave. Recently this effect of convective amplification enhancement due to the pump wave stochastic frequency modulation was also verified experimentally. Dependences of the decay wave amplification coefficient on deviation and correlation time observed in the specially conducted experimental campaign coincide with theoretical and numerical predictions. It allows concluding that the weak influence of the pump frequency modulation on the inhomogeneous plasma PDI level is applicable only to the case of modulation faster than transient time of daughter waves in the decay region. If this condition is violated, the significant PDI enhancement become possible due to the effect of resonant suppression of the convective losses from the moving decay region. This effect can be used for selective and enhanced excitation of Langmuir waves due to the Raman scattering in experiments with ultra short powerful laser pulses, where fast enough pump frequency chirping is possible.

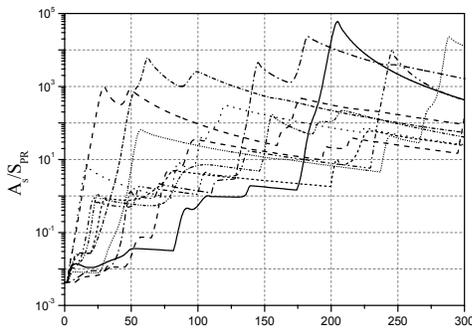


Fig. 1 Decay wave amplitude behavior for different stochastic phase realizations, S_{PR} - convective amplification level

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