Kinetic full wave analysis of resonant absorption of electromagnetic waves in inhomogeneous plasmas*

Shabbir A. Khan and Atsushi Fukuyama
Graduate School of Engineering, Kyoto University, Kyoto 615-8540 Japan

Integrated modeling of kinetic wave-plasma interaction is a vital tool for prediction of the performance of burning plasmas. The integral form of the dielectric tensor has wide applicability to various kinetic full wave analyses in inhomogeneous fusion plasmas. In order to describe the resonant absorption of laser waves in a hot plasma, kinetic full wave analysis in an unmagnetized plasma has been developed and power absorption of electromagnetic waves obliquely incident on an inhomogeneous plasma is evaluated numerically. For this purpose, an integral form of the dielectric tensor in an inhomogeneous plasma was derived based on unperturbed particle orbits in the presence of static electric field sustaining the pressure gradient. With this kinetic dielectric tensor, integro-differential full wave analysis was carried out by the TASK/WI code using the finite element method. In the presence of density gradient, the plane-polarized electromagnetic wave penetrates into an evanescent overdense plasma region and excites an electrostatic wave as a Langmuir wave which decays by the Landau damping. The power absorption profiles and the parameter dependence of the absorption rate are compared with those using a conventional fluid model including finite collisions. It is found that the power absorption profile considerably differs from the fluid mode, while the incident angle dependence of the absorption rate is similar. The generation of fast electrons will also be discussed with an integral form of the quasi-linear velocity diffusion coefficients.

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