On O-X mode conversion in 2D inhomogeneous turbulent plasma

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Heating plasmas by means of microwaves is a widespread tool nowadays. A possibility of energy transfer, which applies for most fusion devices, is the well-known concept of the electron cyclotron resonance heating (ECRH). The problem of the ECR heating and current drive in overdense plasmas of tokamaks and stellarators has been widely discussed recently. Due to high plasma density at comparatively low magnetic field typical for these devices the conventional ECRH and current drive are inefficient. To overcome this difficulty the electron Bernstein wave (EBW) heating can be implemented [1]. In this scheme the EBW is excited in a vicinity of the upper hybrid resonance (UHR) through the O-X-B mode conversion scenario in which an ordinary (O) wave, launching obliquely from the low magnetic field side, transforms to an extraordinary (X) wave. The latter then totally converts to the EBW, propagating inwards without further density cutoff and absorbed at harmonics of the electron cyclotron resonance. The key element of the scheme is the O-X mode conversion, determining its efficiency entirely. Though, the phenomenon of the linear O-X mode conversion has been investigated extensively [2 - 5], the influence of low frequency drift turbulence on the efficiency of the O-X mode coupling still remains an unresolved problem and appeals for further theoretical analysis.

This paper is an attempt to fill this gap, assuming the 2D inhomogeneous plasma model and the long-wave length density fluctuations, whose the correlation length is much larger than the length of the O-X mode conversion layer. We derive the reduced wave equations describing the O-X mode coupling in a vicinity of the plasma cutoff surface and find out their solution after averaging procedure over an ensemble of the density fluctuations. Finally, we obtain the O-X mode conversion coefficients as a function of the amplitude of the density fluctuations.