Preliminary Simulation Study for Microwave Imaging Reflectometry

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Microwave imaging reflectometry (MIR) is expected to be a hopeful diagnostic tool to make it possible the visualization of density fluctuations of turbulent plasmas. In reflectometers, microwaves launched from a horn antenna are reflected at equi-density cutoff surface, the reflected waves are received by the same or another horn antenna. In this case, it is of importance how precisely the phase fluctuations of reflected waves can express the density fluctuations on cutoff surface or not. In the previous works, it is shown that cross correlation of the density fluctuation and reflected-wave phase fluctuation becomes worse when the distance between the cutoff surface and horn-antenna location increases for conventional reflectometers, whereas good cross correlation still holds even if the distance increases for the MIR system. This is a merit of MIR system.

In this paper, we perform preliminary simulations on the conventional reflectometers and MIR system. The simulations solve Maxwell equations with use of finite difference time domain (FDTD) method in two dimensions (x, z). We here use a corrugated metal target to simulate fluctuating cutoff density surface. We measure numerically the phase fluctuations of reflected wave from the metal target using a quadrature detection method, and investigate the correlation with the metal-target corrugation for different probing-beam widths and configurations.