

MEASUREMENT OF TOROIDAL STRUCTURE OF ELECTRON TEMPERATURE WITH ELECTRON CYCLOTRON EMISSION DIAGNOSTIC IN JT-60U

A. Isayama, N. Oyama, H. Urano, and JT-60 team
Japan Atomic Energy Research Institute, Naka, Ibaraki 311-0193, Japan
isayama@naka.jaeri.go.jp

Investigation on magnetohydrodynamic (MHD) instabilities is important not only for clarification of their physics but also for obtaining a stationary high-performance plasma. Among various diagnostics, electron cyclotron emission (ECE) diagnostic has the advantage of being able to measure local electron temperature with good temporal and spatial resolutions.

In JT-60U, three types of ECE diagnostic systems, which are the Fourier transform spectrometer, the grating polychromator, and the heterodyne radiometer, are equipped to measure electron temperature profiles and electron temperature perturbations. Before 2003, ECE passing through one transmission line was divided into three and led to each system. However, as the perturbation study develops, it comes to the surface that input ECE power to the heterodyne radiometer is insufficient for detailed measurements. To improve a signal-to-noise ratio of the ECE signal measured with the heterodyne radiometer, a new transmission line has been installed. The installation also enables ECE measurement at different toroidal location, which also gives a way to analysis of the structure of instabilities in toroidal direction. This paper reports design, installation, calibration, and measurement using the new transmission line.

A new viewing port has been fabricated and installed at one of the horizontal ports. Corrugated waveguides, whose frequency range is 90-220 GHz, and miter bends are used for the new transmission line. To correct the change in the polarity of the transmitted ECE, a polarization rotator was installed. Optimization of the angle of the polarization rotator was done to maximize the detected ECE power. Transmittance measurement shows that input ECE power to the heterodyne radiometer is improved by a factor of ~ 5 .

After the installation, changes in the edge electron temperature during grassy ELMs have been clearly measured for the first time in JT-60U. Such measurement was not possible before the installation due to low intensity of detected ECE. In addition to the improvement of signal intensity, toroidal structure of electron temperature has been investigated by measuring ECE from the new and the existing transmission lines. For example, structure of an $m/n=1/1$ mode has been observed (m and n are poloidal and toroidal mode numbers, respectively.). It has been also found that temporal evolution of ECE signals from these transmission lines is different during a collapse in a reversed shear discharge, suggesting the asymmetry of electron temperature in the toroidal direction.