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LHDにおけるECHのための
入射ミリ波パワー/偏波実時間計測モニターの開発

Development of real-time power/ polarization monitor of millimeter wave for ECH on LHD

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For optimization of electron cyclotron heating (ECH), it is important to measure power and polarization status of injected millimeter-waves in real-time. An arbitrary polarization state of millimeter-waves is realized by two grating mirror polarizers set at miter bends in the corrugated waveguide transmission system in the Large Helical Device (LHD). The polarization state of injected millimeter-wave determines the mode excitation purity, and therefore the power absorption efficiency in plasmas. The real-time power/polarization monitor of the injected power and polarization state is required for optimization and/or feedback control of ECH.

The real-time power/polarization monitor is under development to be installed on a miter-bend, which is part of transmission line of millimeter-waves and bend millimeter-waves to 90 degrees, as shown in Fig. 1. The power/polarization is measured in real-time by the monitor composed of bi-linear polarization directional coupler and heterodyne detectors that enables to deduce the power and the phase difference of two orthogonal polarizations. The heterodyne interferometer is composed of harmonic mixers, tunable local oscillator, and so on. The bi-linear polarization directional coupler has several small holes at a miter-bend mirror to pick-up waves to the sub-waveguide with square cross section. The coupled wave is separated into two orthogonal polarizations by orthomode tranducer. The two waves are down converted by harmonic mixers with a voltage controlled local oscillator. The power and polarization state of millimeter-waves can be evaluated from phases and amplitudes of two orthogonal polarizations. The phases and amplitudes of E-polarization and H-polarization are reduced by FPGA (Field Programmable Gate Array) with fast ADC which has sampling rate of 800 MHz in real-time. Flexible analysis in wide frequency range and therefore multi-channel application is also possible by using FPGA. The use of FPGA can be lead to a real-time feedback control of a millimeter-wave polarization in the future.

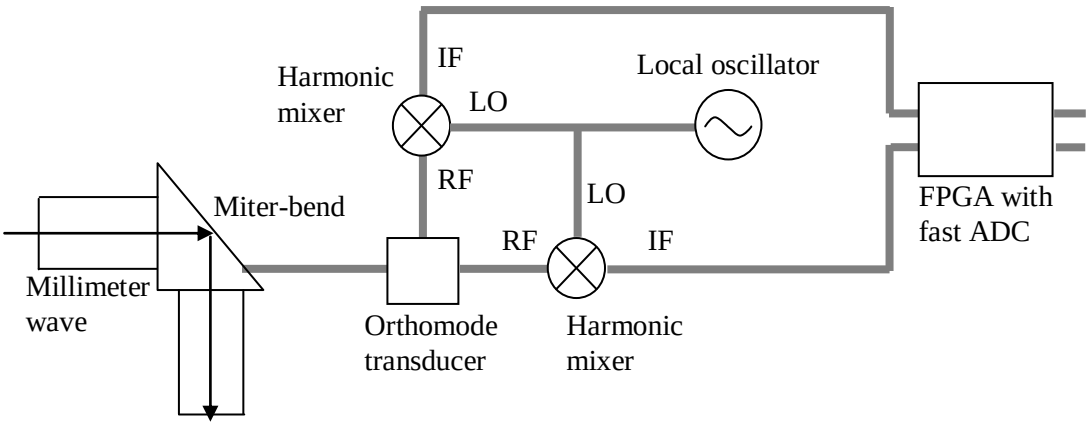

Fig. 1. The real-time power/polarization monitor system for millimeter waves.