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P3.001 Quasi-optical polarizer system for ECH/ECCD experiments in the QUEST spherical tokamak

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A transmission line has been newly developed in QUEST spherical tokamak (ST) for the highly efficient electron cyclotron heating and current drive (ECHCD) experiments with a 28 GHz gyrotron. Waves in plasmas can be described in terms of two eigenmodes, so-called extra-ordinary/ordinary modes, coming from anisotropic property of the electron motion on the magnetic-field direction. The modes have different polarization states, so they can be excited through the incident polarization control. The ECHCD effect depends on the incident mode or the polarization state of the propagating beam. All elliptical polarization states can be controlled in combination with two corrugated directions of the plates with respect to incident planes of the waves. The two corrugated groove depths are one-quarter and one-eighth wavelength, respectively. The two corrugated-plates were designed, and then were fabricated with careful attention to reduce Ohmic losses by means of high-precision milling. Arcing events were frequently detected at the polarizer section when the high-power millimeter-wave were transmitted. A new quasi-optical (QO) concept for the polarizer system is proposed to avoid the arcing here. In the QO polarizers, a coupling phase-inversion mirror was designed with the based on the Kirchhoff integral. The new QO polarizer has three components (two corrugated-plates and one coupling phase-inversion mirror). To check the polarizer performance, a low-power test system on heterodyne detection has been prepared. The amplitude ratio and the phase difference between horizontal- and vertical-fields of intermediate frequency at the heterodyne detection were measured with a network analyzer, and then were used to evaluate the polarization states. The evaluated polarization states are comparing with those calculated by the numerical code. The QO system with the two corrugated-plates and one coupling phase-inversion mirror will be introduced, and the evaluated and calculated polarization states will be discussed.

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