

ITER ECランチャーモックアップの高周波伝送特性 Millimeter wave transmission performance of ITER EC launcher mock-up

福成雅史¹、高橋幸司²、小田靖久²、梶原健²、池田幸治²、大島克己²、坪田直明²、坂本慶司²
M. Fukunari¹, K. Takahashi², Y. Oda², K. Kajiware², K. Ikeda², K. Oshima²,
N. Tsubota², K. Sakamoto²

¹東京大学, ²(独) 日本原子力研究開発機構

¹The University of Tokyo, ²Japan Atomic Energy Agency

1. Introduction

The EC launcher is being designed to inject 20MW of millimeter-wave beams into the ITER plasma. High-order modes (HOMs) excited at miter bends, the junction between the waveguide and so on may be radiated from the waveguide and randomly scattered in the launcher. This can cause unexpected heating in the launcher components [1, 2].

In this paper, beam intensity profiles of the ITER EC equatorial launcher mock-up were measured at low power level. In order to investigate effects of HOMs, mode mixed beam was injected into the launcher mock-up. Section 2 describes experimental apparatus and results are mentioned in Section 3.

2. Experimental apparatus

Figure 1 shows the EC launcher mock-up and experimental setup. The mock-up was fabricated at full-scale size and simulates one of three mm-wave transmission sets. Only one of the eight line is an authentic waveguide line. A 170 GHz, HE₁₁ mode generator was used as a beam source. In order to excite HOMs two waveguide couplings with 3 mm and 5 mm offset respectively were used.

3. Result

Figure 2 shows the intensity profile of the radiated beam on x-y plan, x-z plan and z-y plan. Mode contents at the waveguide outlet are 86% of LP₀₁ mode, 2.2% of LP₁₁ (o) mode, 2.8% of LP₁₁ (e) mode and 6.6% of LP₀₂ mode, respectively. As a result almost all of mm-wave beam injects the fixed mirror and the intensity on the mirror-edge was about -35 to -39 dB at each offset. No signal was observed on the

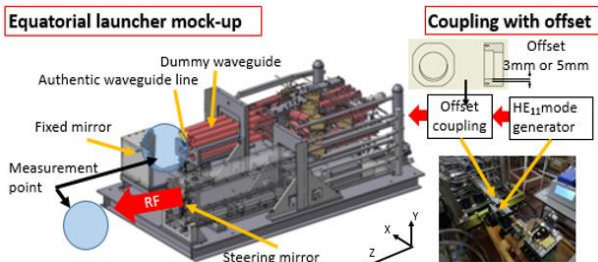


Fig.1 Experimental set up of the EC Equatorial launcher mock-up.

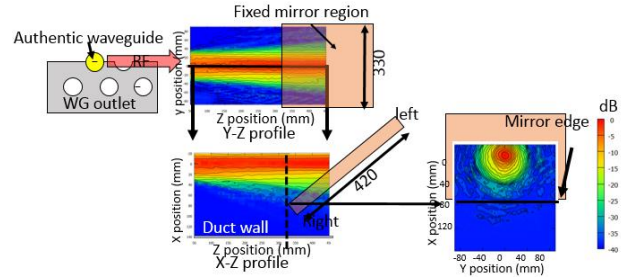


Fig.2 Intensity profile x-y plan, x-z plan and z-y plan. (Mode contents LP₀₁ mode:86%, LP₁₁(o):2.2%, LP₁₁(e) : 2.8%, LP₀₂:6.6%)

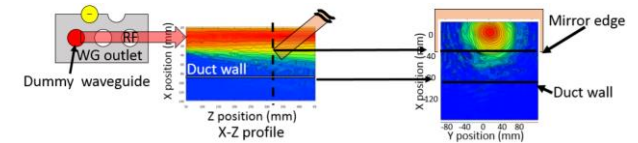


Fig.3 Intensity profile x-y plan and x-z plan the waveguide shown in red. (Mode contents LP₀₁ mode:86%, LP₁₁(o):2.2%, LP₁₁(e):2.8%, LP₀₂:6.6%).

beam-duct wall.

Assuming a radiation from the waveguide nearest to the wall, an intensity profile on the beam-duct wall was evaluated in Fig. 3. Mode contents are 81.5% of LP₀₁ mode, 9% of LP₁₁ (o) mode, 3% of LP₁₁ (e) mode and 4.9% of LP₀₂ mode, respectively. Measured intensity on both mirror edge reached -15 dB and it is changed by the mode contents. The RF which was not able to be caught the fixed mirror can be scattered in the launcher and may hit components. Therefore, strong active cooling structures are necessary for the beam-duct.

References

- [1] K. Takahashi, K.Kajiware, Y. Oda, A. Kasugai, N. Kobayashi, K. Sakamoto, J. Doane, R. Olstad, and M. Henderson "High power millimeter wave experiment of ITER relevant electron cyclotron heating and current drive system," Rev. Sci. Instrum. **82**, 063506 (2011)
- [2] Y. Oda, K. Kajiware, K. Takahashi, A. Kasugai, M. A.Shapiro, R. Temkin, and K. Sakamoto," Measurement of RF Transmission Mode in ITER Relevant EC H&CD Transmission Line", Int. J. Infrared Millim. Waves **31**, 949 (2010).