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液晶サーマルシートを用いたビームプロファイル計測の定量評価法の研究

Experimental Study of Quantitative Measurement Method of Beam Profile Using Liquid Crystal Thermal Sheet

真鍋亜佑斗[1)]、辻政裕[2)]、小田靖久[2)]、髙瀬芳貴[1)]、
森映樹[1)]、小紫公也[1)]、南龍太郎[3)]、假家強[3)]
MANABE Ayuto[1)], TSUJI Masahiro[2)], ODA Yasuhisa[2)], TAKASE Yoshiki[1)],
MORI Eiki[1)], KOMURASAKI Kimiya[1)], MINAMI Ryutaro[3)] and KARIYA Tsuyoshi[3)]

1) 東大、2) 摂南大、3) 筑波大
1) Univ. of Tokyo, 2) Setsunan Univ., 3) Univ. of Tsukuba

Abstract

A new method is proposed to determine the intensity distribution of an RF beam with no IR camera. The gaussian output of GAMMA 10 gyrotron is successfully measured by the method., within the accuracy of about 20 %.

1. Introduction

For efficient transmission of RF beam from gyrotron to a launcher, transmission mode measurement is necessary. The conventional beam profile measurement by IR camera[1)], however, is not suitable for some situations, such as the beam duct of the launcher. This is due to the limited optics setup of the IR camera, which makes it difficult to set up measurement systems in tight spaces. In addition, IR cameras are expensive, but there is a risk of damage by an RF incident.

In this study, a thermal liquid crystal (TLC) sheet, whose color tone changes with its temperature[2)], is used to measure the beam profile of GAMMA 10 gyrotron.

2. Experiment

The setup is shown in **Fig.1**. The distance between the output window and the screen, L, is changed from 100 to 400 mm. The RF is 28 GHz and about 200 kW. The pulse width is under 6.0 ms, depending on the screen distance. As a benchmark, an IR measurement is also conducted in a similar setup.

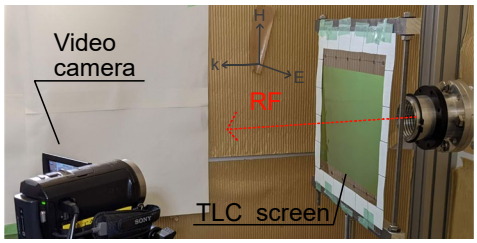

Fig.1 The experimental setup

The normalized cross-sections of each method at $L = 250$ mm are shown in **Fig.2**. The $1/e^2$ radius of the profile at each distance, calculated by gaussian surface fitting, is shown in **Fig.3**.

3. Discussion

From Fig.3, the accuracy of the TLC method against the IR method is within 20 %. The accuracy may be improved by reducing the flicker noise of the video camera. The phase distribution is expected to be reconstructed from the TLC measurement.

References

1) S. Jawla, et al., *IEEE Trans. Plasma Sci.* **37**, 2009.
2) J. L. Hay, D. K. Hollingsworth, *Exp. Therm. Fluid Sci.* **12**, 1996.

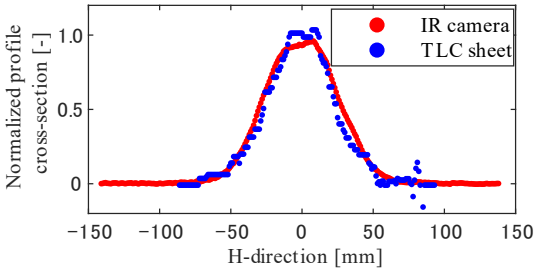

Fig.2 Comparison of cross-sections ($L = 250$ mm).

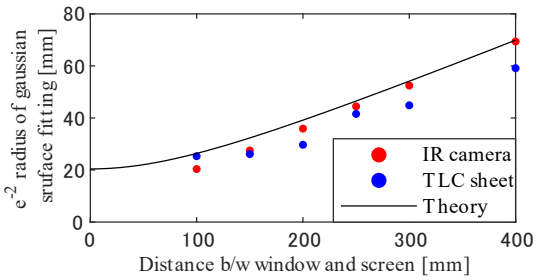

Fig.3 Comparison of gaussian radiuses