§42-25 Development of an Advanced Data Analysis Technique for Density Fluctuation Measurements by the Laser Phase Contrast Method

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1. Introduction

We have developed a laser phase contrast (LPC) method with a folded beam to obtain information concerning the spatial distribution of electron density fluctuations in magnetically-confined plasmas. The authors have carried out investigations of a 2-dimensional maximum entropy method (MEM) with polar coordinates as a means of analyzing data that is appropriate for the LPC. The MEM, in particular, is anticipated to provide a high spectral resolution in spite of the low amount of data. On the other hand, for distribution measurement by the LPC system, a 2-dimensinal detector array is required. Then, in CHS, to decrease the load of the data acquisition system, a 1-dimensinal detector array and a 12-shots fixed operation of the CHS were applied. In this study, we develop a measurement system of the LPC that can measure spatial distribution during a single shot, in spite of using a 1-dimensional array detector.

We planned to develop the LPC system by adding image rotation prism (dove prism). In this system, signal images can be obtained by the rotating dove prism, which can be rotated at two times the rotational speed of the prism. By setting it on an LPC system with a 1-dimensional detector array, a 2-dimensional signal image can equivalently be obtained. We have developed a high speed rotation system of the dove prism (unmagnetized system) and the software for the signal.

2. Fast image rotation system

The developed fast-rotation system of the dove prism driven by wind flow is shown in figure 1. A higher rotation speed of 3000 rpm was accomplished using compressed air that was jetted from a nozzle connected to a compressor. We set the system up (dove prism: 42.2×10×10 mm) on a LPC system at the detection region. We then experimentally

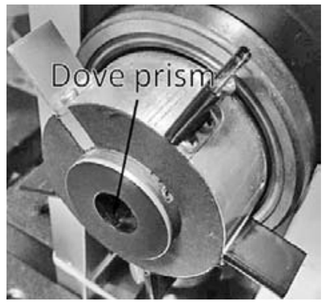

Fig. 1 Fast-rotating system for the dove prism. It is rotated by 4 feathers which shed compressed air.

examined researchable rotating speeds and the stability of the beam axis to maintain alignment. From this, we obtained practical abilities, the rotational velocity is greater than 3000 rpm and the shift of the beam axis is less than 0.1 mm. These result show that the spatial distribution can be obtained every 10 ms at 3000 rpm.[1)]

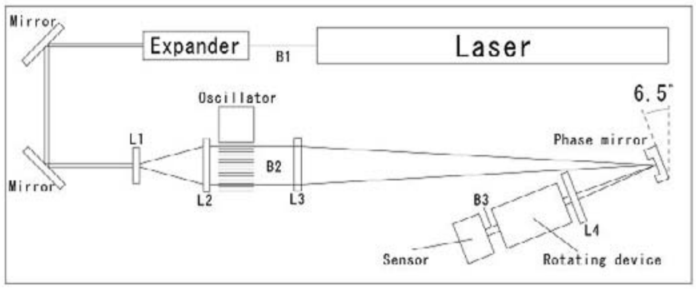

Fig. 2 LPC optical system for applicability evaluation composed with a He-Ne laser. Ultrasonic wave is used instead of electron density fluctuation. The dove prism is set between L4 and optical sensor.

Furthermore, we quantitatively evaluate the experimental error by using YAG laser LPC system for plasma-confinement devices with ultrasonic waves. Then, we will complete the LPC system that can measure the spatial profile of the electron density fluctuations during a single shot, by a combination of the developed rotating system and appropriate analyses.

1)K.Shiozaki,K.Matsuo,H.Iguchi JSPF Kyushu annual meeting 2014.12