§2. Development of Digital Based Millimeterwave Interferometer and Application to Electron Density Imaging at the Potential Barrier Region on GAMMA10

Kogi, Y., Matsukawa, S., Mukunoki, H. (Dept. of Information Electronics, Fukuoka Inst. Tech.), Yoshikawa, M., Kohagura, J., Yamada, T., Akita, D., Shima, Y. (Plasma Research Center, Univ. Tsukuba), Mase, A. (ASTEC, Kyushu Univ.), Nagayama, Y., Kawahata, K.

Profile measurement is important in plasma-confinement research. To control and sustain a high-performance plasma, plasma-profile diagnostics with high temporal and spatial resolution are necessary. We have proposed a new interferometer, which has tens of measurement chord, and a relatively simple measurement system compared to a conventional multi-channel interferometer.

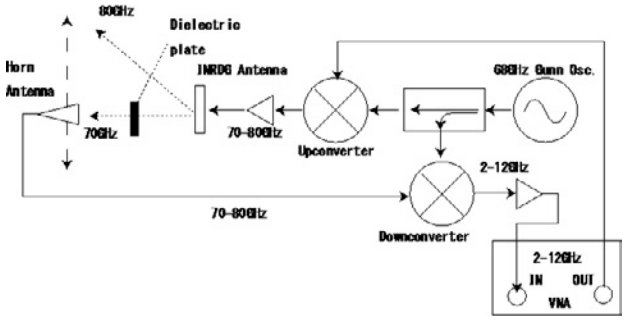

Fig. 1 Block diagram of interferometer for validity confirmation experiment

Fig. 1 shows a block diagram of the interferometer. This experimental setup is utilized for evaluating the principle of this method. An experimental setup, which can be applied to the plasma, was described the other articles[1,2], however, this system can still measure the profile of the stable objects. An image non-radiative dielectric guide (INRDG) antenna can transmit probe beams to the various directions by various frequency input to the antenna. The transmission angle of the beam is a function of the input frequency. The horn antenna receives the probe beam. Here, the receiver antenna is mounted on a movable stage, and can be received the probe beam with different measurement path by the appropriate receiver alignment. The vector network analyzer measures phase at each frequency. In this experiment, we prepare the frequency component from 70-80GHz by upconverting the output of the VNA (2-12GHz) with Gunn output (68GHz). To evaluate our system, we have applied this system to the Teflon plate with width of 28mm, and thickness of 3mm.

Fig. 2 shows experimental results of the profile measurement. We measure the profile of the dielectric plate twice by changing the plate position indicated in upper area of Fig. 2.

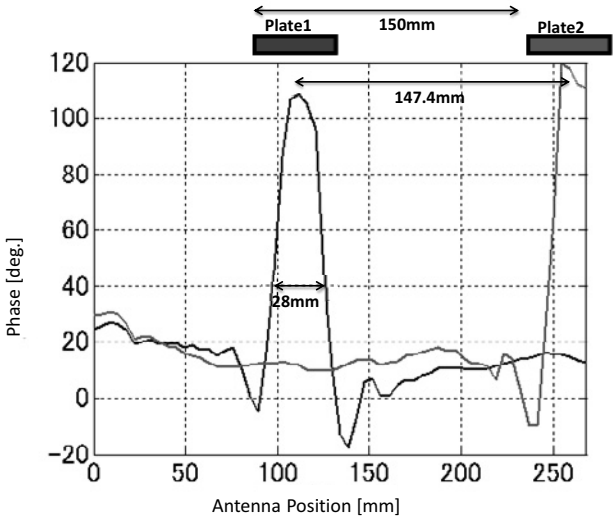

Fig. 2 Measured profile of the dielectric plate located in different position

The receiver antenna is adjusted to the proper position at each frequency in order to receive the highest amplitude of the probe beams at each position. The clear phase increment from 0 degree is recognized around two antenna positions. These positions are good agreement with plate position. These profiles do not become rectangular shape, because the beam spot size is comparable to the width of the plate.

The phase increment at plate position is about 110 degree. Theoretically, phase increment of 3mm thickness plate is estimated to be 120 degree. This measurement error corresponds to the line density error of 2×10^{12} [cm^{-2}] in GAMMA10 plasma.

From this experiment, we can demonstrate the new interferometer for profile measurement. It is confirmed that the dielectric plate profile can be measured properly.

We are now designing the quasi-optical mirror for focusing the probe beam to increase signal to noise ratio. After the fabrication of the mirror, we schedule to apply this interferometer to the GAMMA10 plasma.

1) Kogi, Y. et al.: Transactions of Fusion Science and Technology in print (2013).
2) Kogi, Y. et al.: Review of Scientific Instruments **83** (2012) 10E347.