§25. Improvements of Dispersion Interferometer

Akiyama, T., Kawahata, K., Okajima, S., Nakayama, K. (Chubu Univ.)

One of advantage of a dispersion interferometer is that it is free from phase errors due to mechanical vibrations. So far, a vibration isolation system and/or a massive flame are equipped with interferometers to reduce the phase errors. However, suppression of the vibration will be difficult on future large fusion devices. The wavelength of the light source is determined to have a larger phase shift than that due to the vibrations for conventional interferometers. In the case of the dispersion interferometer, the restriction is not necessary because of the immunity to the vibration. Hence a short wavelength whose phase shift is smaller than $2\pi$ can be used. Then, the phase is determined without ambiguity. This means that this interferometer is free from fringe jump errors. From these advantages, the dispersion interferometer is suitable to future large and high density fusion devices such as high density operations of LHD and ITER.

The bench-testing of the CO$_2$ laser dispersion interferometer has been made at the diagnostic laboratory$^{1)}$. In the previous annual report, successes of the new phase extraction method and effects of return beam to the laser were reported. Since the previous optical setup was back-and-forth configuration in the object to be measured, the small fraction of the back beam goes back to the laser (back-talk). The back beam made the laser oscillation unstable and the phase resolution and long-time stability was deteriorated. Figure 1 shows the modified optical setup to solve the back-talk$^{2)}$. The probe beam takes only one way in the object.

For simulation of a plasma, a ZnSe plate with a wedge angle $\tan \theta$ of 0.25 deg. was put at the optical path and was scanned by $\delta l$ vertically to change the thickness. The measured phase is given by following expression.

$$\Phi = \frac{A}{\lambda} \frac{4\pi (\delta l) \tan \theta}{(n_{2\omega} - n_{\omega})}$$  \hspace{1cm} (1)