§1. The Final Test of the FIR Laser Interferometer for the LHD in the Plasma Diagnostic Laboratories

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A multi-channel FIR laser interferometer system has been developed for the measurement of the spatial and temporal behaviors of the electron density on the LHD. Last two years we have carried out the performance test and optimization of the optical system. And finally we have moved the interferometer system in the LHD exp. building.

The configuration of the multichannel interferometer[1] is of the Michelson interferometer type with 13 vertical chords.The FIR lasers are installed in the laser room 30 m apart from the LHD, and propagate about 40 m through a couple of the waveguides to reach the optical bench of the interferometer. The optical housing is mounted on a massive frame which encircles the plasma vacuum vessel and floats on three pneumatic vibration isolation mounts. The isolation stand is 18.4 meters tall and weights about 30 tons. The diameter of the main supports is 712 mm. The upper shelf of the stand supports thirteen stainless steel corner cube reflectors which are located immediately above the vacuum windows, while the interferometer housing(3900 x 1500 x 4500 mm^3) is supported by the lower shelf which is located below the floor of the Large Helical Device. The optical housing is air tight and filled with dry air, in order to reduce absorption of the CH_3OH laser radiation by atmospheric water vapor. Before the installation of the interferometer system into the LHD torus hall we have been adjusting and testing the system for the preparation in order to estimate the performance of the total system and capability of the long running operation suitable for LHD plasma diagnostics. Figure 1 shows interferometer system under testing in the Plasma Diagnostic Laboratories. In order to simulate the LHD plasma diagnostics the total length of the probing beam path is set to be same as the real one but with 2 additional bending mirrors. The measured signal to noise ratio is 40-50dB and phase noise is about 1/100 fringes which is mainly caused by the blow from the air-conditioner installed in the laboratories. The interferometer system has continuously operated without any problems over than 3 days (Fig.2).

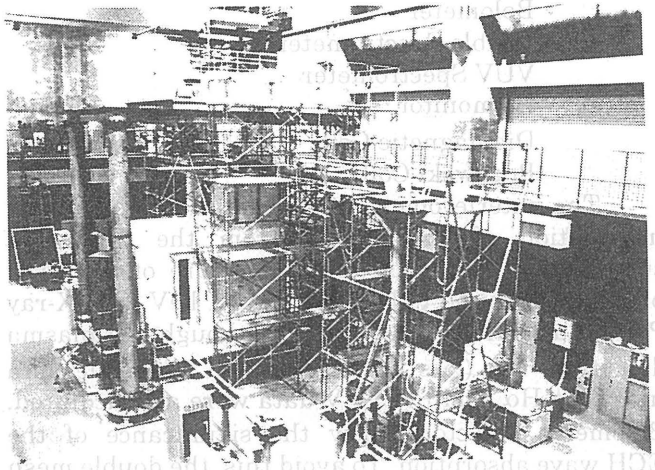

Fig.1 The LHD FIR laser interferometer system under development in the diag. laboratories.

Reference
1) Kawahata, K. et al., Ann. Rev. NIFS,1994-1995 (1995)95.

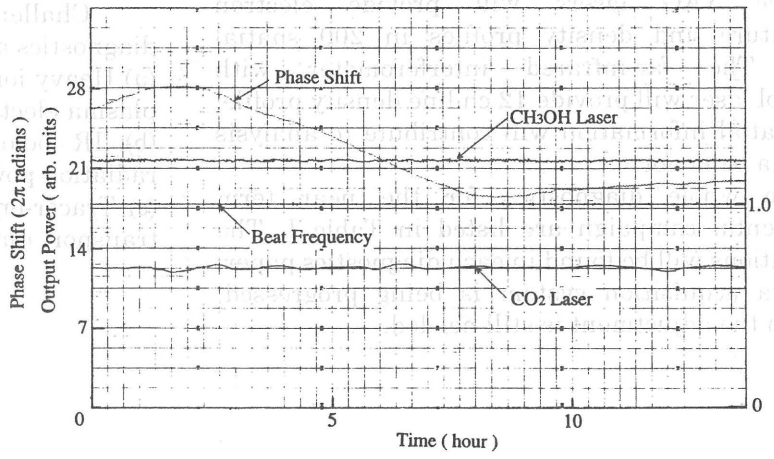

Fig.2
Time behaviors of the CO_2 laser power, FIR laser power and beat frequency of the twin laser, and the phase shift of the interferometer. The interferometer signal shows a drift due to the change of the room temperature.