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Development of the CO2 dispersion interferometer on HL-2M Tokamak

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HL-2M is a new medium-sized tokamak with major radius of 1.78 m, minor radius of 0.65 m, and aspect ratio of 2.8. Designed parameter of HL-2M is: Plasma current Ip=2.5 MA, toroidal magnetic field Bt=2.2 T, average electron density ne=5×10^{20} m^{-3}. Duel to relatively high plasma density, the effect of fringe jump and refraction is more severe. Short-wavelength interferometer suffers much less from fringe jump and refraction, so it is more suitable on high density. Because the phase shift caused by mechanical vibration is inversely proportional to the wavelength, a short-wavelength interferometer is susceptible to mechanical vibration.

To meet the requirement of electron density measurement on HL-2M, a single channel CO_2 dispersion interferometer based on second harmonic generation technology has been developed[1,2] and commissioned on HL-2M Tokamak. The short wavelength system can avoid fringe jump and refraction and has a large measuring range to meet the designed density parameter on HL-2M. The dispersion system uses fundamental wave and second harmonic to generate the interfere signal. The optic system is compact and stable because of two second harmonics are naturally coaxial. Optic layout is simplified and more compact due to absence of beam combiners in traditional interferometer. In addition, disruption caused by mechanical vibration is eliminated by dispersion measurement, thus this kind of interferometer is suitable for future plasma devices with high density. Dispersion interferometer is already been tested on devices such as LHD and is planned to be commissioned on ITER.

A data acquisition/ analyze/uploading system based on phase-modulation technology is developed for the dispersion system. Density curve measured by CO_2 dispersion interferometer was agree with the curve measured by microwave interferometer. Density resolution of the system is about $2\times10^{17}/m^3$, and the measuring range is up to $10^{21}/m^3$.

References

[1] H.X. Wang, Y. Zhou, Y. Li, *et al*, Review of scientific instruments, **88**, 103502(2017)

[2] T. Akiyama, K. Kawahata, S. Okajima, Review of scientific instruments, **81**, 10D501(2010)

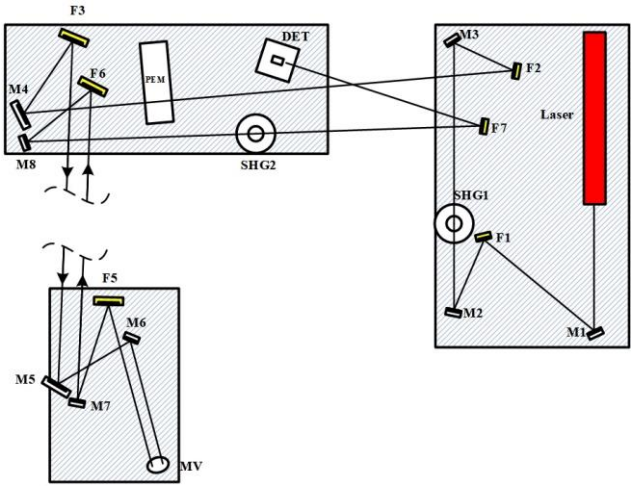

Figure 1. Optic layout of dispersion interferometer

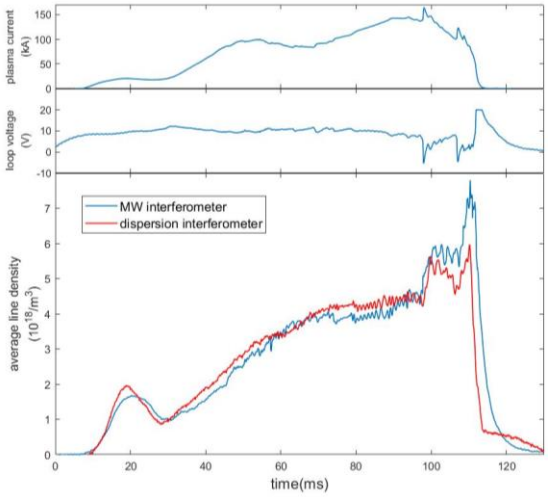

Figure 2. Electron density measuring result in shot #446