Dispersion interferometer for the measurements of laser produced plasma

K. Tanaka[1,2], N. Yoshihara[2], C. Suzuki[1]

[1]*National Institute for Fusion Science, Toki, Gifu, Japan*

[2]*Kyushu University, Interdisciplinary Graduate School of Engineering Sciences, Plasma and Quantum Science and Engineering, Kasuga, Fukuoka, Japan*

We report the first result of the temporal evolution measurements of laser produced plasma (LPP) electron density by using a dispersion interferometer (DI). The purpose of the measurement is the simple and reliable electron density monitor of LPP for the extreme-ultra-violet light source. We developed a homodyne DI using 1064 nm YAG laser with temporal resolution about 2 ns. Figure 1 shows the principle of DI. A 1064 nm laser light is injected to the second harmonics generator (SHG) and generates 532 nm. After passing through the plasma, the lights are injected to the second SHG and interference between the first second harmonic and the second one gives phase shifts due to the electron density of LPP. The phase shift due to mechanical vibration and neutral particles are self-compensated. The system is simple and does not require the external reference path outside of plasma. The change of the phase shift due to the mechanical vibration is negligible during plasma production, because its characteristics time is around order of milli-second and is much longer than duration of laser produced plasma, which is around 1μsec. However, for the repetitive measurements of which repetition rate is order of Hz, phase shift due to mechanical vibration is not negligible. Consequently, DI has a strong advantage for the stable density monitor. We tested the DI for the tungsten LPP produced by 532nm pulsed YAG laser. Figure 2 (a) shows a calibration curve scanning a wedge plate. Figure 2 (b) and (c) show measured DI signals with different initial phases (phase1 and 2). The initial phase can be tuned by moving wedge plate. The ablation laser was injected at 500ns. The stray radiation due to the mirror appeared at 500 – 580 ns. Then, signal increased (decreased) and decreased (increased) at the initial phase 1 (2). The opposite signal change with around half period difference of initial phase confirms signal is interferometric. The phase shifts at initial phase 1 and 2 correspond to the line integrated density of 2.4 x 10^{20}m^{-2} and 3.6 x 10^{20}m^{-2} respectively.

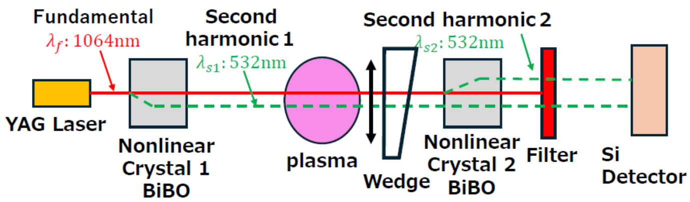

Fig.1 Principle of DI

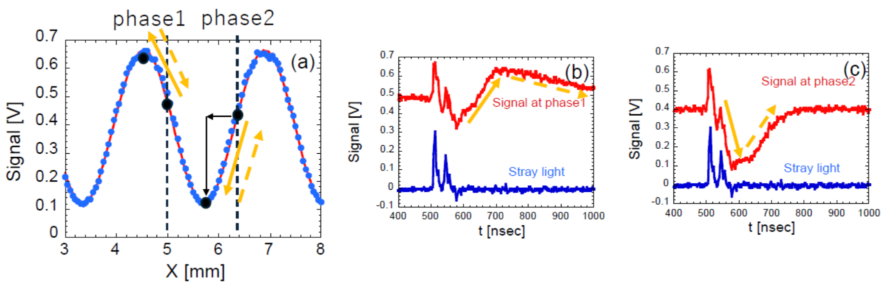

Fig.2 (a) Calibration curve, DI signal at initial (b) phase 1 and (c) phase 2