

HTPD 2018



Contribution ID : 311

Type : not specified

14.53 Nd:YAG laser Thomson scattering diagnostics for laboratory magnetosphere

Thursday, 19 April 2018 10:31 (120)

Stable confinement of high-beta (local electron $\beta \sim 1$) is demonstrated with high-energy electrons ($T_e > 10$ keV) by an X-ray measurement in the RT-1 magnetospheric plasmas. A new Nd:YAG laser Thomson scattering (TS) system has been developed to investigate the mechanism of the high-beta plasma formation in the RT-1. The designed parameters for the TS system is $10 \text{ eV} < T_e < 50 \text{ keV}$ and $n_e > 1.0 \times 10^{17} \text{ m}^{-3}$. In order to obtain the sufficient amount of scattered light for the low-density plasmas, we adopted the long scattered length (60 mm) and a bright optical system with both large collection window ($\Phi=260 \text{ mm}$) and large collection lens ($\Phi=300 \text{ mm}$). The system employs a Nd:YAG laser of 1.2 J (oscillation frequency: 10 Hz) with a scattering length of 60 mm (scattering angle: 90 degrees). Scattered light is collected by one set of lens ($f/2.0$, $NA = 0.145$) with a solid angle of $\sim 68 \text{ mstr}$ and guided to an interference filter polychromator through an optical fiber bundle. As a test measurement and calibration, the Raman scattering signals were successfully obtained in N_2 gas. We found that the collection optics realizes a sufficient signal-to-noise ratio above $n_e \sim 10^{17} \text{ m}^{-3}$. We also observed that the spectrum of TS light changes with the RT-1 plasma parameters.

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Session Classification : Session #14. Thursday Morning Poster Session