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ヘリオトロンJにおける
高時間分解能Nd:YAGトムソン散乱計測システムの構築
Construction of high time resolution Nd:YAG Thomson scattering system in Heliotron J

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Time evolution of plasma profiles is indispensable to clarify the physics of transport barrier formation relating to so-called improved confinement modes in magnetically confined plasmas. In a helical-axis heliotron device, Heliotron J, spontaneous transition to improved confinement mode, which is similar to H-mode, has been observed experimentally [1]. However, the existence of transport barrier in this transition has not been confirmed yet for the lack of detailed electron density and temperature profiles. A Nd:YAG Thomson scattering system has been developed to obtain such profile data with high time and spatial resolutions in Heliotron J. The system has 25 measurement points with spatial resolution of ~10 mm. Two Nd:YAG lasers of 500 mJ have been selected to obtain adequate signal intensity for the profile measurement by considering typical electron densities of Heliotron J plasmas (n_e = 0.5-3×10^{19} m^{-3}). Polychrometors with a set of interference filter are used to analyse the scattered light spectra. The data acquisition system is a VME based one that is operated under the Time Invariant Method (TIM) with real-time operation capability [2].

Since transport barriers are usually formed transiently during several hundreds of microseconds, the laser oscillation timing has to be controlled with accuracy sufficient for tracing the barrier formation. For this purpose, a timing controller using a PIC micro-controller has been developed. By using two lasers (> 500 mJ@50 Hz) and this control system, we can widely control the effective time interval. Figure 1 shows Q-switch signals and power signals of each laser. The excitation timing of these two lasers is well controlled in the interval of 80 ns. Moreover, an interrupt process of the PIC makes it possible to control the laser timing precisely with scattering of only several dozens of ns. In addition, this timing controller can be used to increase the laser power gradually for slow start-up by the precise timing control between the Q-switch and the flash lamp, which is useful to protect optical components from unstable initial laser oscillations.

We have already completed the construction of high time resolution system of laser controller and confirmed its design performance. In the future, by this system, the formation of transport barrier will be demonstrated and the system will contribute to the clarification of the relevant physics.

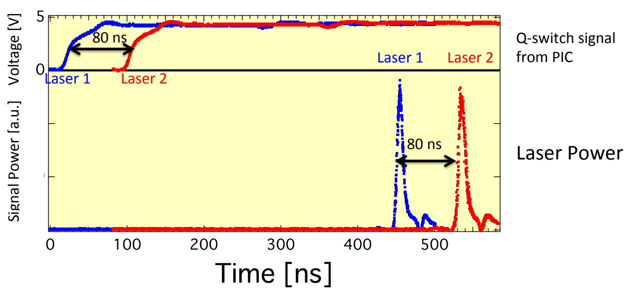

Figure 1. Signals from controller and Power of oscillated lasers.

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