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Development of Two-Dimensional Thomson Scattering Measurement System Using the Time-Of-Flight of Nd:YAG Laser

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We are developing two-dimensional Thomson scattering measurement system using the time-of-flight of Nd:YAG laser. Using time-of-flight, we can cover two-dimensional measurement area by using only one-dimensional number of polychromators, as a new cost-effective measurement system. Because the Nd:YAG laser reflects 14 times inside of the vacuum chamber, a series of back-scattered light enters to polychromator with the time-of-flight interval.

Nd:YAG Thomson scattering measurement system is one of the most reliable methods to measure the temperature and density of electron. It needs a lot of polychromators as the number of measurement points. Each polychromator uses a lot of inference filters to measure the spectrum of the scattered light, indicating high cost of two-dimensional Thomson scattering measurement system.

We are studying the magnetic reconnection, which is expected to be a new heating method for the initial plasma. Due to electrical resistance, two antiparallel magnetic field lines approach and are reconnected. When magnetic reconnection occurs, electron is accelerated by reconnection electric field to the downstream forming a quadrupole type potential structure, which accelerates ions. There is several heating such as Joule heating near the X-point, the magnetic field lines meet, and outflow heating.

We developed a cost-effective polychromator system with two angled filters for Thomson scattering diagnostics [1]. We expect that this polychromator will significantly reduce the number of interference filters required for polychromators. While the previous research focused on simplifying the polychromator itself to reduce costs, our future research focuses on reducing costs by decreasing the number of polychromators required.

To make time-difference, we uses the multiple reflection of Nd:YAG laser. The concave mirrors are spaced at least 3 meters apart. As Figure 1 shows, the measurement points are arranged in parallel. By utilizing the time-of-flight it takes for the Nd:YAG laser to return to these measurement points, we can cover 7 measurement points with a single polychromator. This is the key point of our research.

References

[1] J. Kim *et al.*, Plasma Fusion Res. **18**, 1301015 (2023).

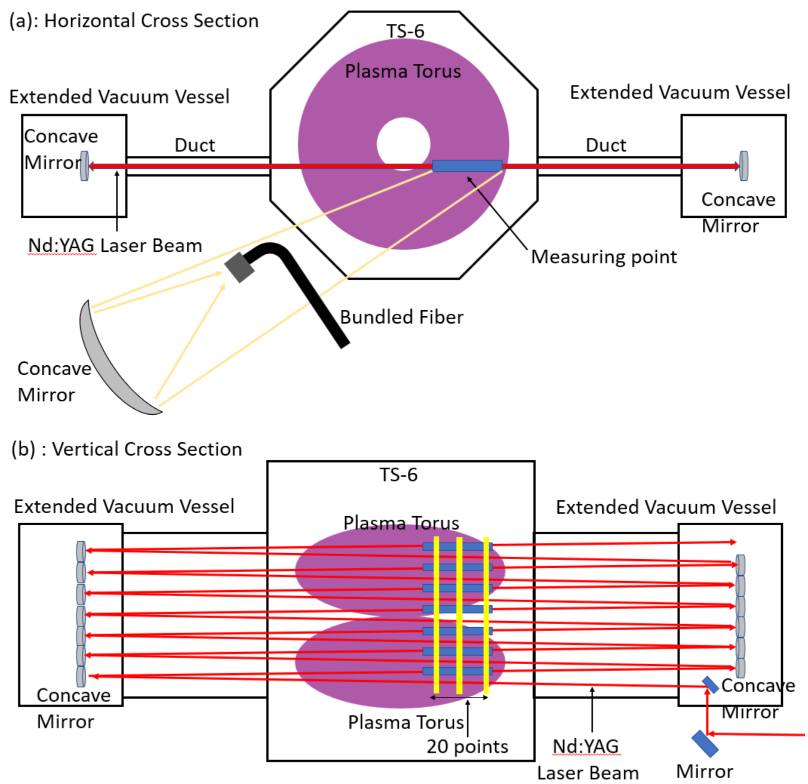

Figure 1. (a) Horizontal Cross Section and (b) Vertical Cross Section of the 2-Dimensional Thomson scattering measurement system using time-of-flight