Abstract

The MIT Thomson scattering diagnostic has operated with near constant high-repetition rate laser, demonstrating 25 pulses at a repetition rate of 90 kHz with 100 ns pulse length and 700 mJ energy. The 1064 nm laser current is monitored using an optical chopper and 1064 nm Nd:YAG, master oscillator, four 1064 nm Nd:YAG amplifiers, and a Nd:glass amplifier. The frequency demodulation of the full laser system is described, including the addition of a second Nd:glass amplifier, is expected to produce bursts of 2 pulses at a repetition rate of one laser to 25 kHz. The new laser integrator with the same collection optics and detectors as used by the present MIT Thomson scattering system. 21 spatial points across the MIT laser output with sensitivity over a 10 Hz–5 kHz range. Initial results will be presented from application of this diagnostic to plasma-shear Alfvenic wave diagnostics. The evolution of energy confinement during spontaneous enhanced confinement periods, and non-Maxwellian electron distributions.

MST Thomson Scattering

Below Right:

- MIT Thomson scattering has 21 viewing channels along the minor inlets (top to bottom).
- Power dipole laser to polychromator with after it 8 filtered channel masks, recorded at arrival of O Tamborini's channel.

Below Left:

- Lasers are located >30 m away from MST vacuum vessel.
- A complete control and monitor maintenance aligning equipment by a laser.

Integrated Data Analysis - Thomson Scattering & FIR Intercomber

- MST data has tuned on 340–1554 mJ pulses with 15 cm energy density bursts.
- Density measurements can constrain TS measurements to independently.
- Event within equilibrium density only is shown to explain density constrained improved TS measurements.

PCCD T Scaling

- Signal-based model of entire MST data, for TS 2013 to 2015 data points, each combination with Ts > 1.3 J.
- High time resolution laser intensity, Rmin, and each shot has alignment factor Amin.
- FIR observed time averaged TS.
- Parts from early preliminary analysis of 340–1554 mJ pulses.
- Below left: event 2013 using TS data only.
- Below right: a comparison of beta measurements for the last two time periods, showing event energies consistently in a range of 1.3 T–1.5 T.

Analysis Code Development

- Current Bayesian analysis code does grid search and optimization and fits probably distribute of temperatures, densities for each time and chord. All analysis is done in Python, with the Code for this analysis being used in general purpose graphics programs (gplot) code.
- Up to a factor of 30 speed-increase seen on specific functions calls for calculating speeds and probabilities, using low-level level computer graphics card.

Conclusions

- The new MIT Thomson scattering laser system has demonstrated 1.5–2.3 pulses at an 18 kHz, 95 J pulse burst operation, and has operated at 90 kHz to 15 kHz.
- Additional operating modes have been demonstrated, including uniform double and triple 1.5 kHz pulses for 18 kHz.
- A scaling has been found between electron temperature and density with FIR data.
- Early non-Maxwellian Thomson scattering modeling suggests single-shot similarity to non-Maxwellian electrons.
- TS analysis code speed has been improved by use of GPU programming.

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