High-Repetition-Rate Laser for Thomson Scattering on the MST Reversed-Field Pinch

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Work Funded by DOE and CMSO
MST Thomson Demonstrates >1.5 J Laser Pulsing at Up to 75 kHz

• Introduce MST Thomson and existing laser
• Describe new laser and early results
• Discuss simmer current optimization
Both Existing Laser and New Laser Use Same Beamline and Detectors: Needs >1.5 J Pulses

- Computer controlled beamline
- 21 Spatial points across minor radius
- Polychromators: 6+ filters => 10 eV to 5 keV
- APD detectors
- Flashlamp power supplies also shared
Modified Commercial Lasers Run in 2 Modes:
2 kHz Uniform Pulsing, or
25 kHz Pulse-Burst
High Repetition Laser Uses a Master Oscillator and Power Amplifier Architecture

<table>
<thead>
<tr>
<th>Stage</th>
<th>Material</th>
<th>Rod Dia. (mm)</th>
<th>Lamp Count</th>
<th>Lamp Dia. X Length</th>
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</thead>
<tbody>
<tr>
<td>M.O.</td>
<td>Nd:YVO₄</td>
<td>4</td>
<td>Diode pumped</td>
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<td>Nd:YAG</td>
<td>6.4</td>
<td>1/2 *</td>
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<td>2</td>
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<td>Amp 5</td>
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<td>16</td>
<td>6</td>
<td>8x250</td>
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<tr>
<td>Amp 6</td>
<td>Nd:glass</td>
<td>16</td>
<td>6</td>
<td>8x250</td>
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</table>
Laser operates in Uniform Pulsing at 5 kHz for 5+ ms

Droop can be reduced by switching power supply from series to parallel wiring: should extend 5 kHz to 8-9 ms.
Laser operates in Uniform Pulsing at 10 kHz for 4 ms

Limiting flashlamps to 20% of explosion energy gives 4 ms time limit here.
Laser operates in Pulse-Burst mode at 75 kHz, 15 pulses per burst, 5+ bursts

75 kHz Pulse-Burst Energies

Laser Pulse Energy (J)

Extra ~0 J pulses at end of burst in place of dead time between bursts
Flashlamp and laser energy drops on 2nd-4th pulse

Pulse Energy Variation at 500 Hz

- Laser Pulse Energy
- Flashlamp Energy
- Laser Energy, 0.2A Simmer
Pulse-to-pulse energy consistency improved with increased simmer current.
Summary

• New laser operates at 5-10 kHz in uniform pulsing mode for 4+ ms.
• Laser also operates up to 75 kHz in pulse-burst mode, with >1.5 J per pulse.
• Pulse energy consistency improved by optimizing simmer current.

• Visits to laser setup can be arranged