Upgrades to the MST Thomson Scattering Diagnostic

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Abstract
The Thomson scattering diagnostic on MST records both equilibrium and fluctuating electron temperature with a range capability of 10 eV to 5 keV. Standard operation with two modified commercial Nd:YAG lasers allows measurements at rates of 1-25 kHz. A new laser system is being commissioned to enable measurements up to 250 kHz. Subsystems of the diagnostic are also being improved. The power supply for the avalanche photodiode detectors (APDs) that record the scattered light are being updated to improve safety, reliability, and maintainability. Each of the 144 APDs will have an individual rack mounted switched supply, with bias voltage adjustable to improve safety, reliability, and maintainability. A supercontinuum pulsed white light source is being implemented to improve Maxwellian distributions and to enable electron velocity measurement. A new filter: 1140 nm center, 80 nm bandwidth has an individual rack mounted switched supply, with bias voltage adjustable to improve safety, reliability, and maintainability.

Thomson Scattering (TS) Process Provides n_e and T_e Measurement
- photon E-field accelerates e^-
- e^- absorbs and reemits photon at same wavelength.
- e^- thermal velocity => Doppler broadening => T_e
- total signal => N_e

MST TS Diagnostic has High Temporal, Spatial Resolution
- Two Operating Modes: Resolution
  - Standard: Two modified commercial Nd:YAG lasers
    - measurements at rates of 1-25 kHz.
    - 21 radial points, 1°cm resolution
  - Fast Thomson
    - enable measurements up to 250 kHz
    - see W. Young poster (poster 54)

APD - Digitizers / Power Supply (PS) Interface
- Overall Objective: improve safety, reliability, and usability
- Eliminate BNC to BNC panel connection for signal feedthrough: signals should go directly from APD module to digitizer input
- Eliminate possibility of HV connection to anything but HV APD input

Dedicated PS for each APD for improved gain control
- Two PSs per PCB
- Each PS has
  - +8V, -8V on BNC connections
  - adjustable high voltage (HV) bias (270V-410V) on SMA connection
  - improved gain control
  - lights out coupling to small integrating sphere

Long-Wavelength Filter Addition to Polychromators
- Motivation: to improve capability to resolve non-Maxwellian distributions
to gain capability to detect directed electron flow via a shift in the Maxwellian fit
- New filter: 1140 nm center, 80 nm bandwidth

Supercontinuum White Light Source for Spectral Calibration
- SNR produced by tungsten-halon light source previously employed was insufficient
- Attempt to use optical parametric oscillator (OPO) failed
  - large pulse-to-pulse variation reduced accuracy
  - difficult to use, unreliable
- SC white light source meets calibration requirements
  - sufficient brightness
  - ns pulses
  - sufficient spectral range
  - reliable

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