



U.S. DEPARTMENT OF
ENERGY

Office of
Science



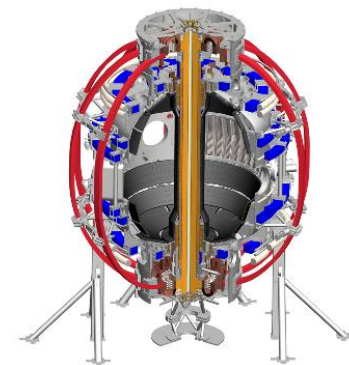
Thomson Scattering on NSTX-U

NP10.00048

B.P. LeBlanc and A. Diallo

58th Annual Meeting of the APS Division of Plasma Physics
San Jose, California

October 31 - November 4, 2016 •

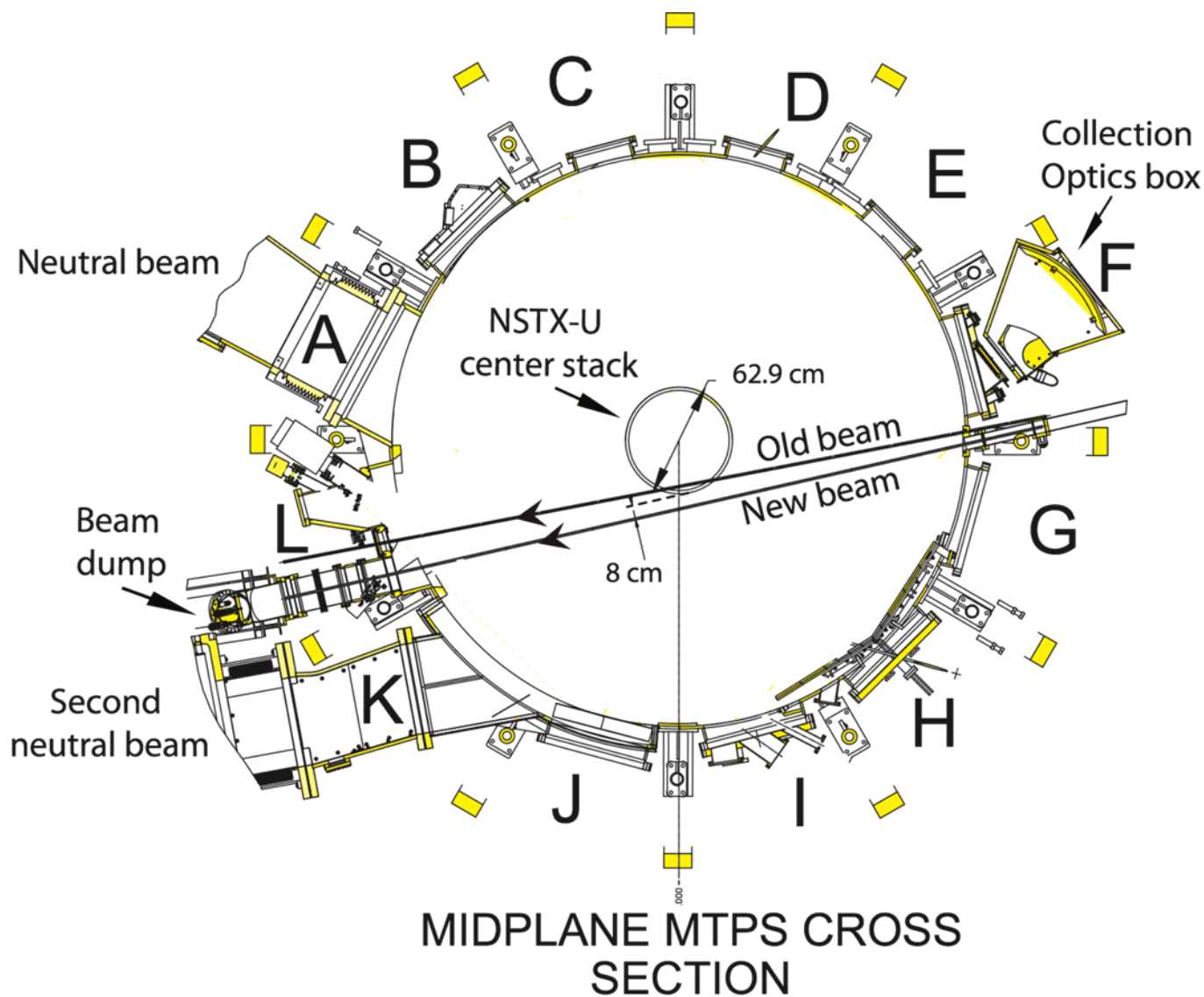


Outline: MPTS Upgrades for NSTX-U

- **New laser beam path and delivery**
 - Re-aimed laser beam path to accommodate larger CS
 - Beam delivery optics and hardware with increased aperture
 - Increased path to beam dump to delay stray laser light
 - New laser enclosure for last steering mirror on input path
- **Reconfigured collection optics**
 - Use same fiber-optics bundle assembly (FOA) and spherical mirror
 - New FOA manipulator
 - Improvement for dust reduction
- **Scattered light measurement**
 - 42 radial positions up from 30 previously
 - Ten polychromators reconfigured for better Rayleigh light immunity
- **Plans for the Pulse Bursting Laser System (PBLs)**

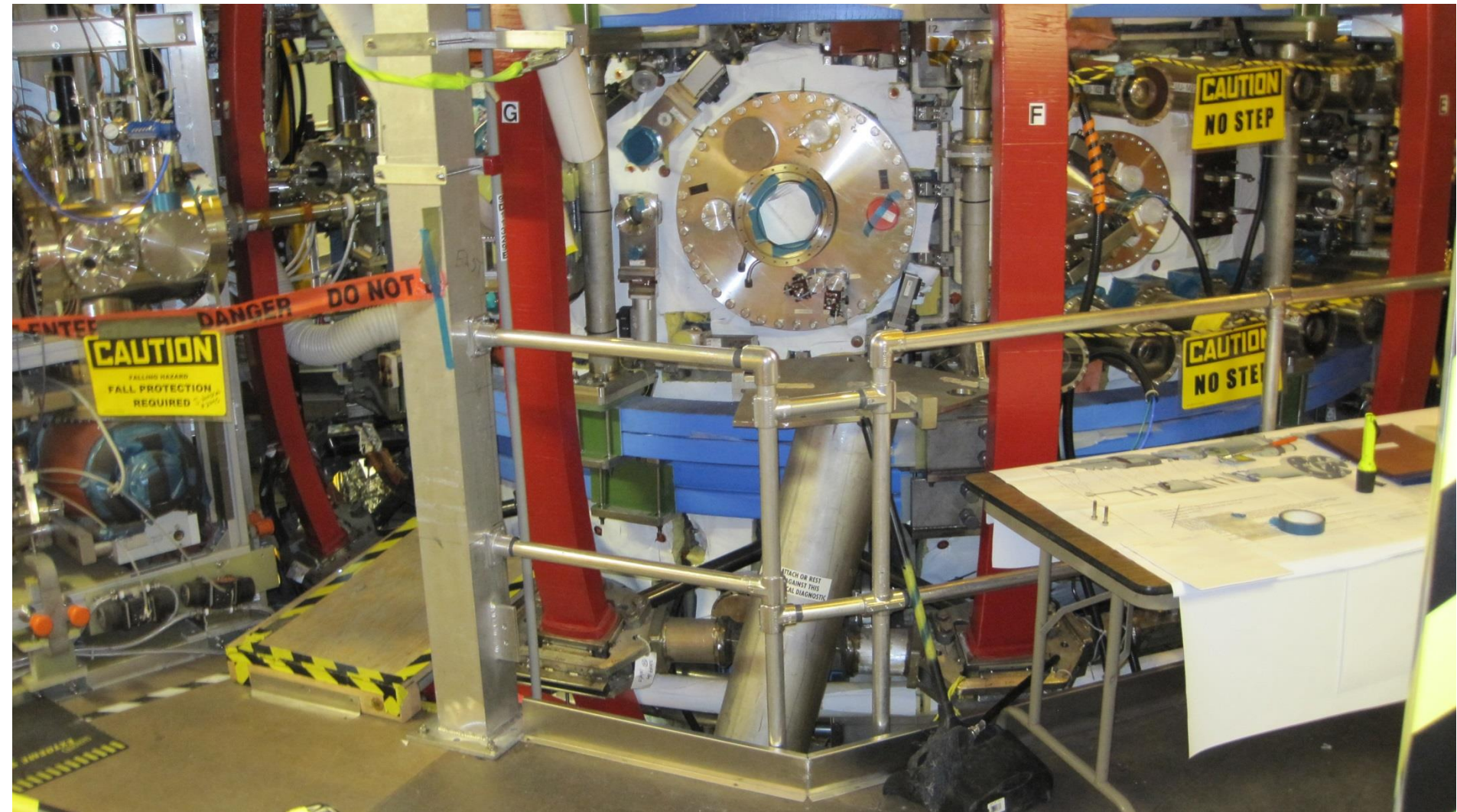
Beam Path closer to Center Stack

8 cm for NSTX-U vs. 10 cm for NSTX



Bay F during NSTX-U Upgrade Construction

MPTS equipment removed



Bringing back Collection Optics Box to NTSX-U

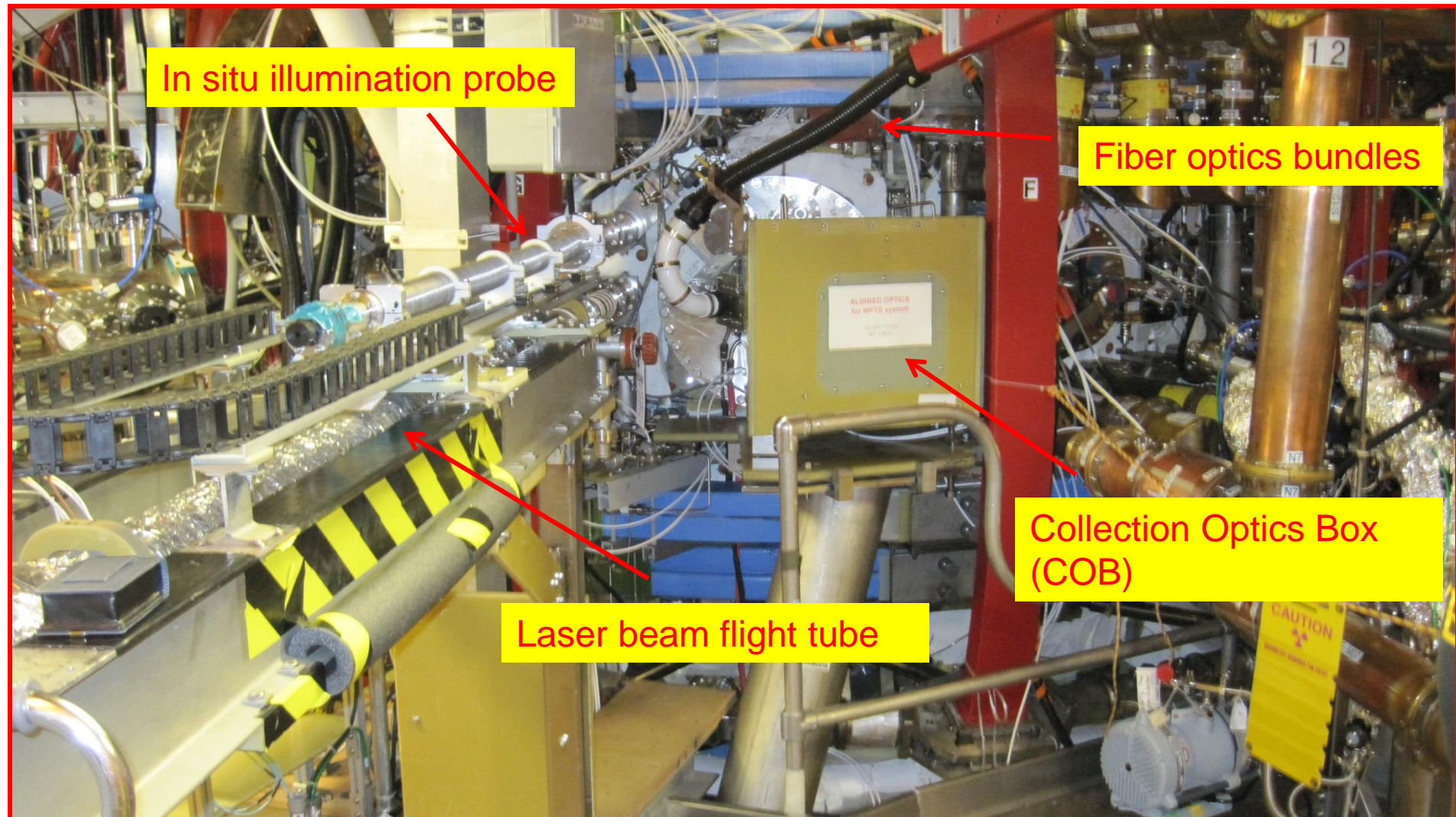
COB above south radiation wall



COB landed on platform near bay F



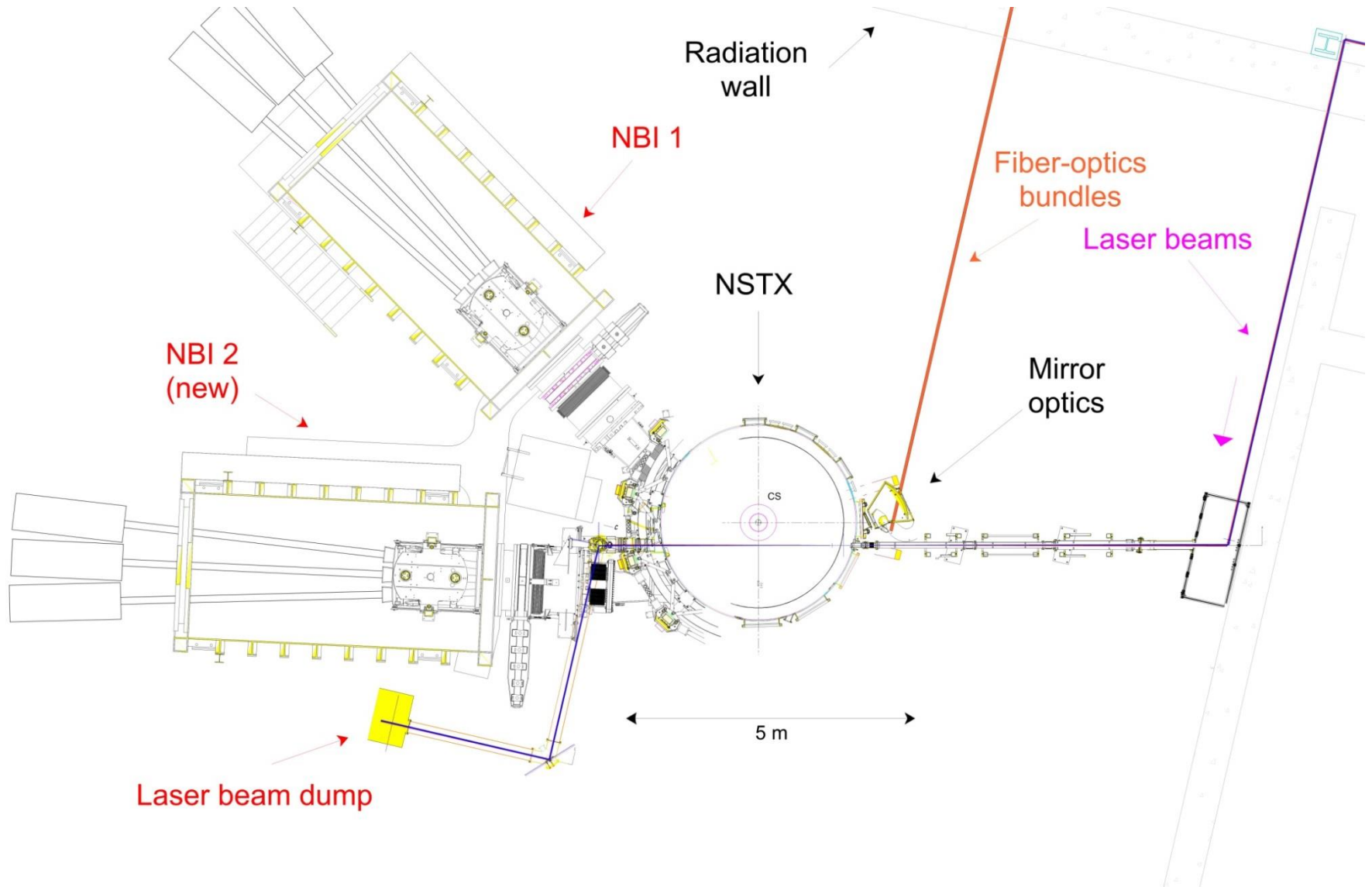
Bay F after MPTS Deployment



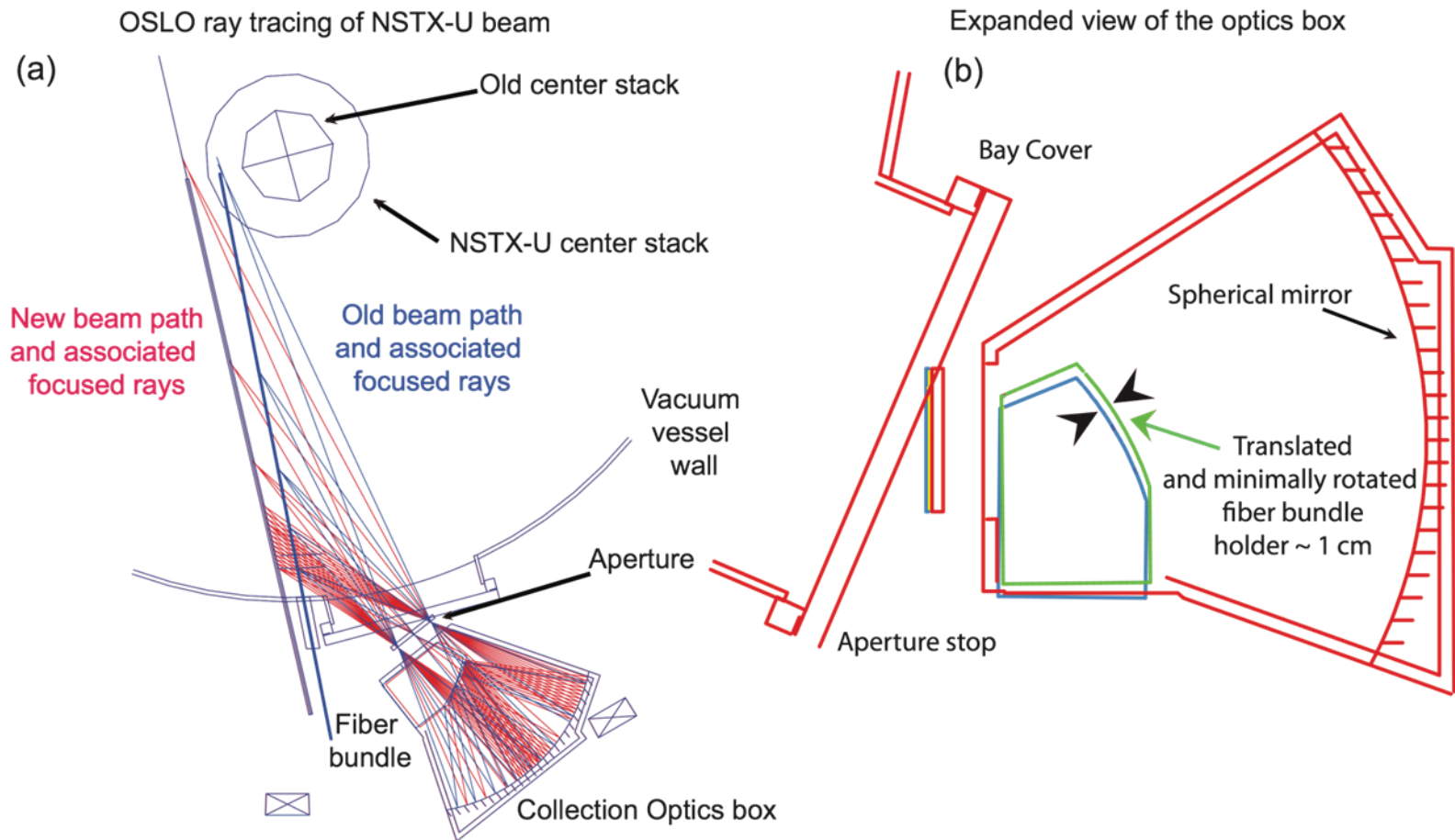
New Laser Optics Enclosure in Test Cell



Top View of Arrangement in Test Cell



Fiber Optics Assembly adjustment for imaging along new laser beam path



Images of Split Fiber Bundles: Separation made at output end

Whole bundle
Back illuminated input end



Split bundles
Back illuminated input end



Light output end



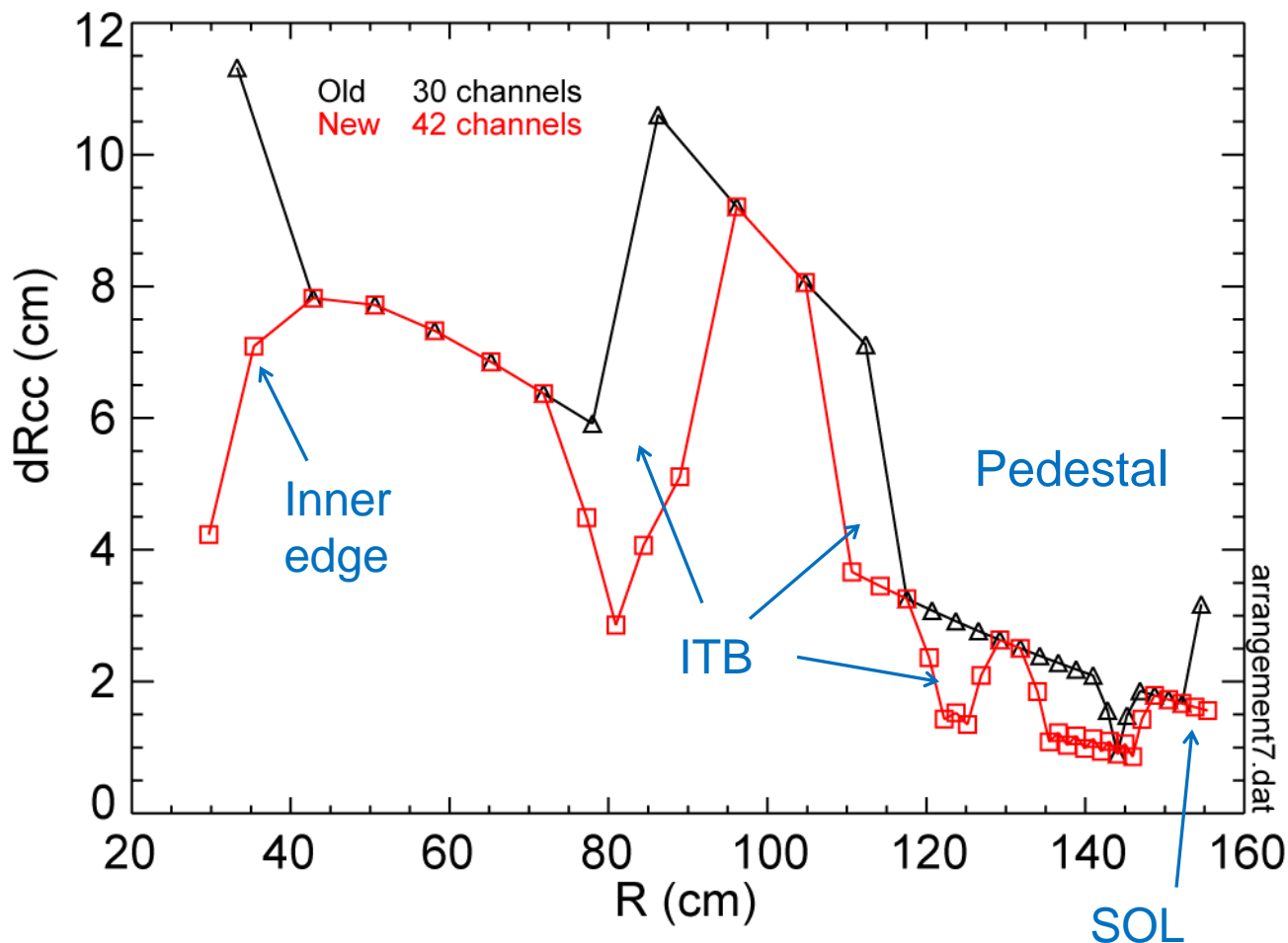
Light output end



Improved Spatial Resolution

Reduced radial array spacing

NSTX radial array shown below. Similar improvement obtained on NSTX-U



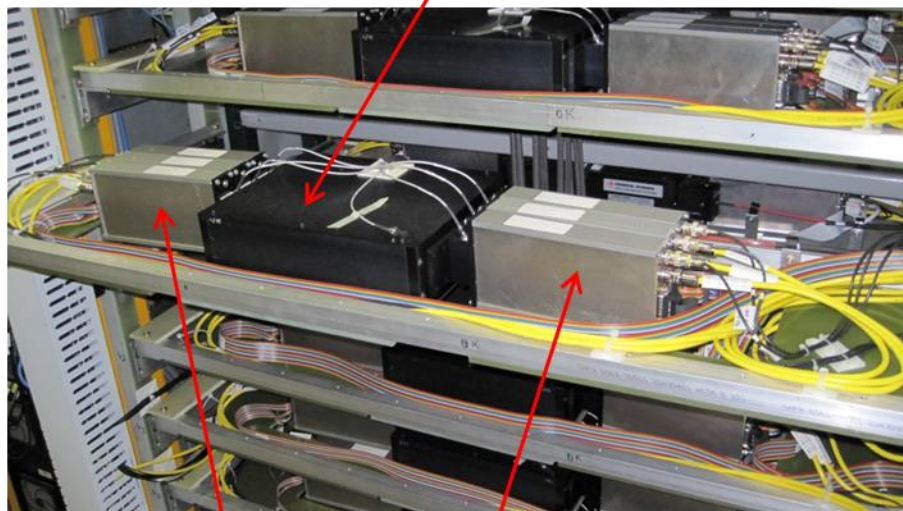
MPTS has a total of 42 radial channels

First Light for 12 New Channels Obtained on NSTX-U



New 12-high polychromator tower

6-filter polychromator

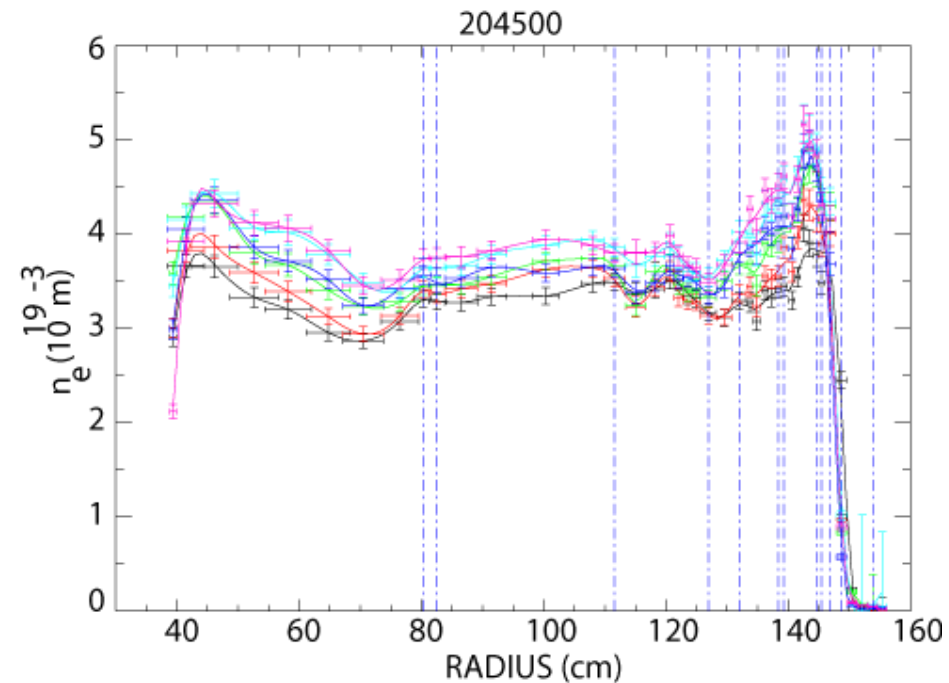
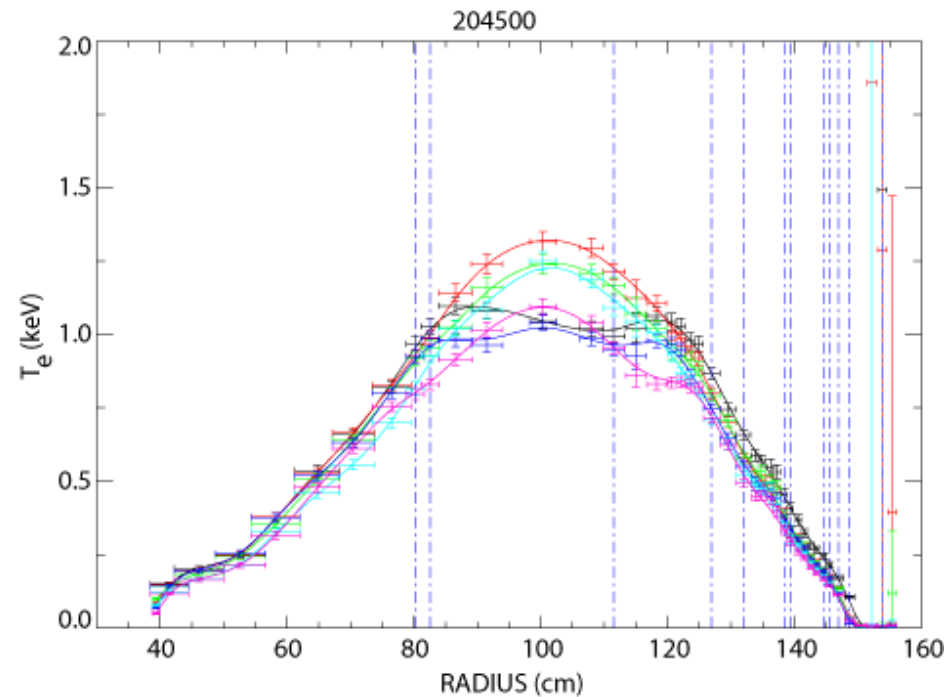


PPPL "low readout noise"
preamplifiers

42-Radial Position Profiles

Twelve new polychromators marked with dotted line

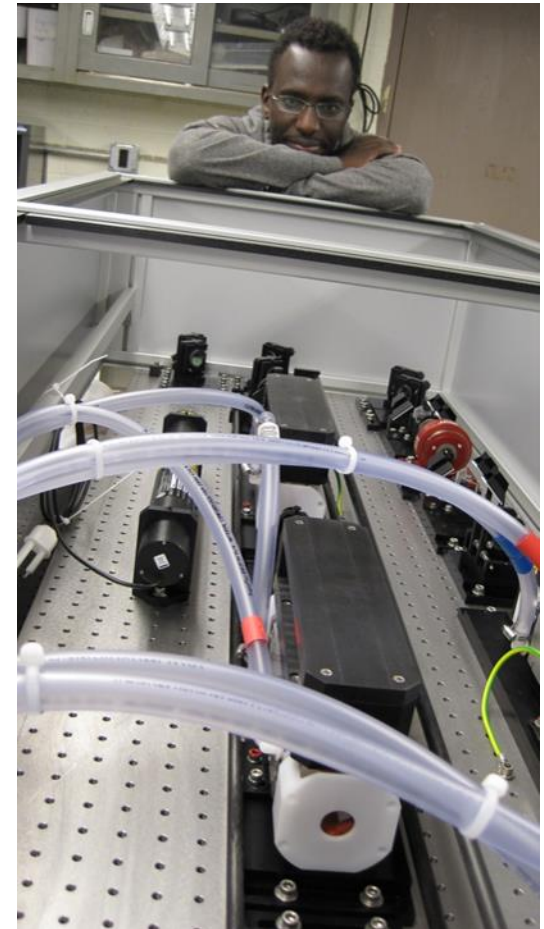
NSTXU shot 104500



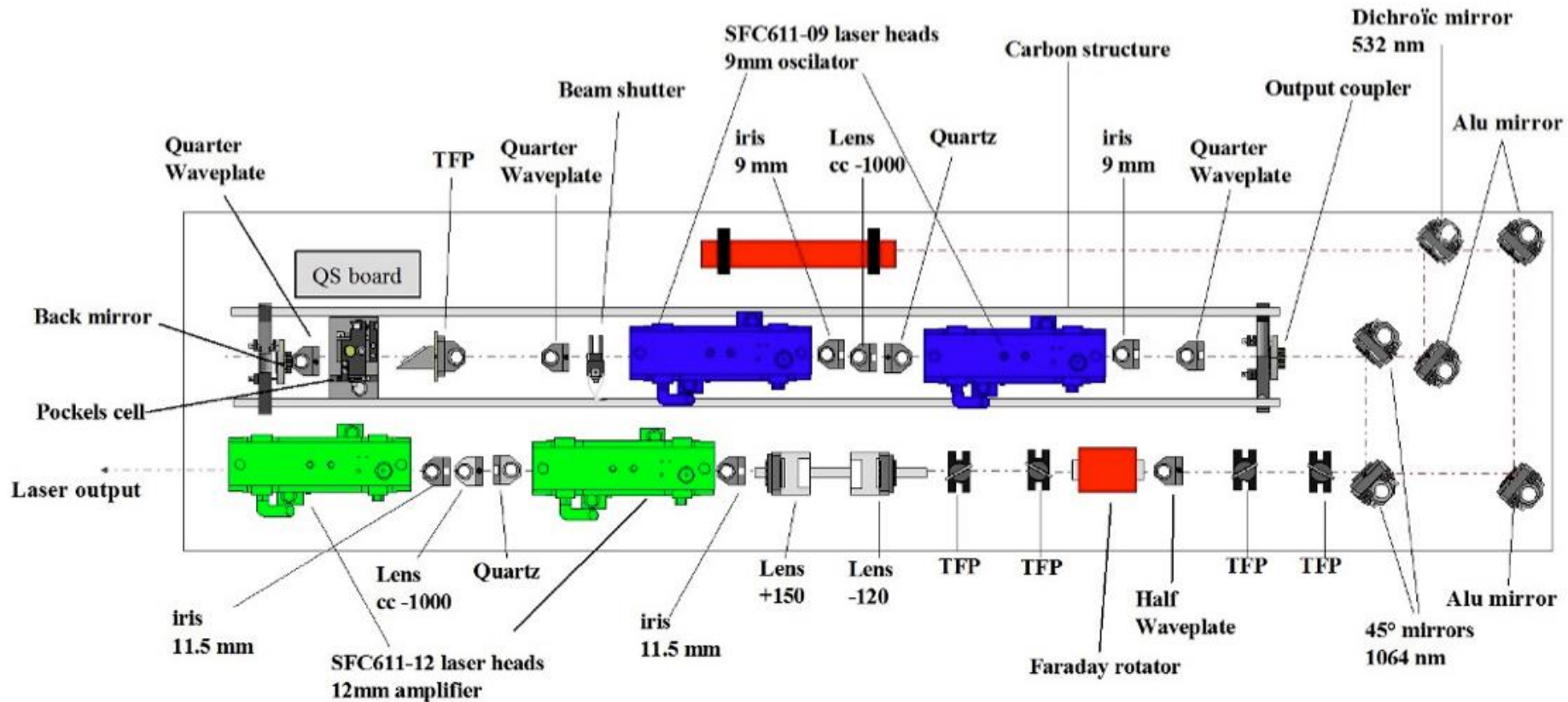
Pulsed Bursting Laser System

- A laser operating on a base line of 30 Hz, but capable of two burst modes
 - Slow burst: 50 pulses at 1 KHz
 - Fast burst: 50 pulses at 10 kHz
- PBLS made possible by Ahmed Diallo winning DOE Early Career Research Program
 - Work done in collaboration with D. Den Hartog of UW and PSL
 - PBLS will supplement two existing 30-Hz lasers

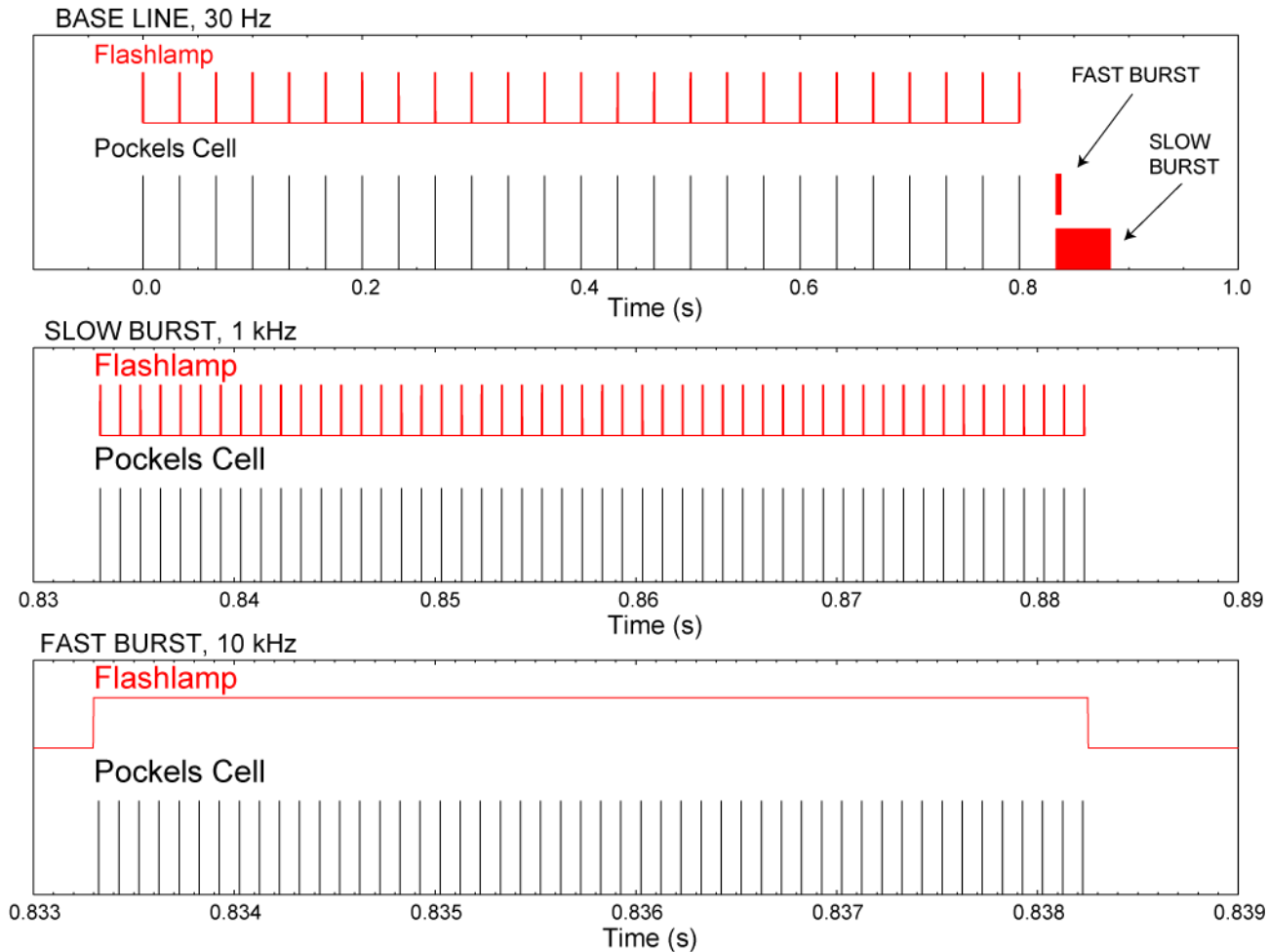
Laser Head



Quantel Laser Head used on PBLS

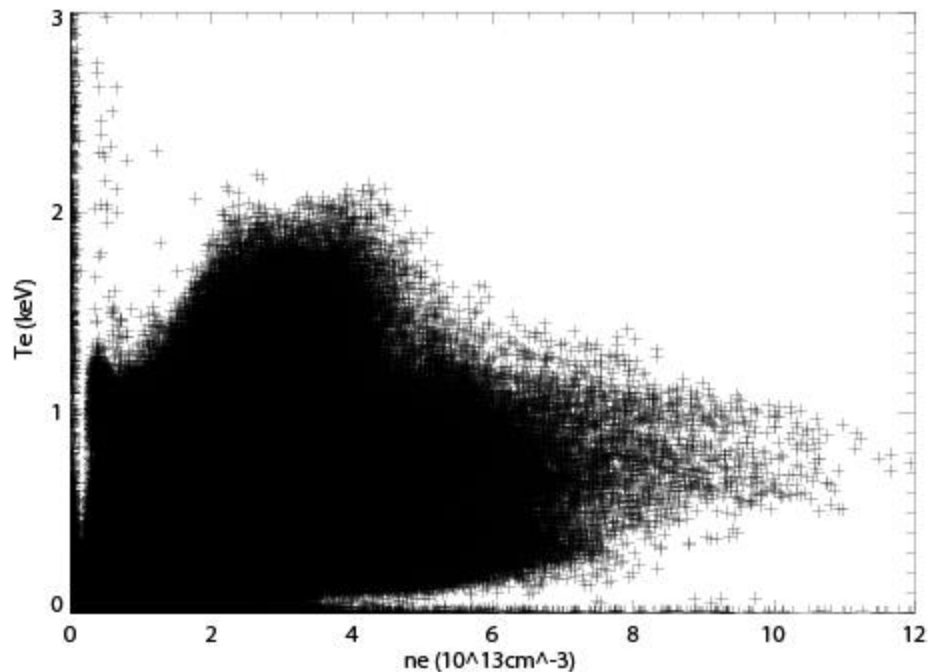


PBLS Time Patterns



Scatter Plot T_e vs. n_e for last Run

1025 NSTX-U shots, 1861350 data points



MPTS availability > 96% during last run

Future Plans

- Complete installation of illumination probe
- Proceed with modification of the laser system
 - Combine the 2 existing Nd:YAG lasers on a single beam line
 - Install the PBLS
 - Power supply to be located below the floor of the laser room
 - PBLS – Quantel – laser head to be installed on existing cradle in the laser room
 - The 3 lasers Nd:YAG lasers should provide
 - A 90-Hz base line combined with capability for
 - Slow burst: 50 pulses at 1 kHz, or
 - Fast burst: 50 pulses at 10 kHz.
- Align and calibrate for NSTX-U next run