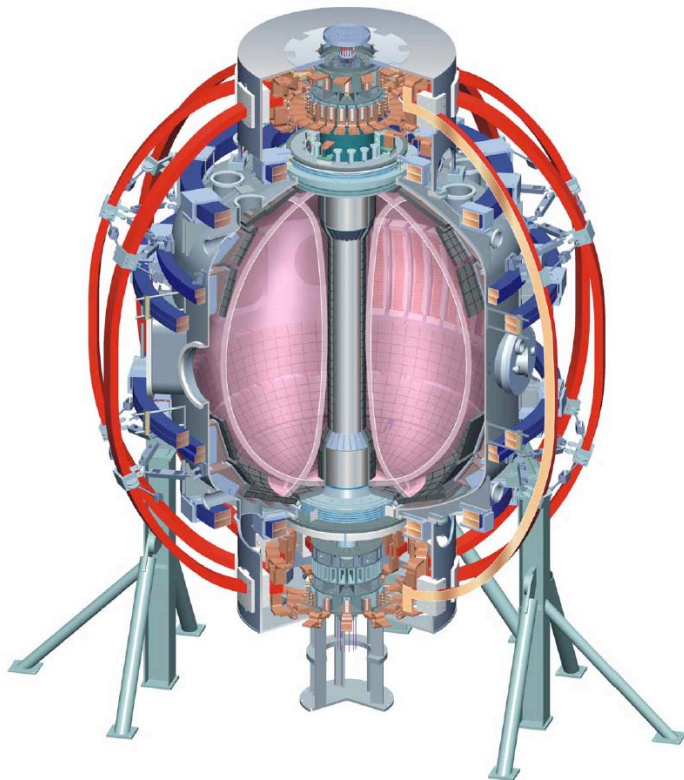


Supported by



NSTX Facility and Diagnostics Update and Plan for FY 05 - 07



Masayuki Ono
For the NSTX Team

Jan. 20-21, 2004

17th NSTX PAC Meeting

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Many exciting new capabilities came on line in FY 04



- **New facility capabilities:**

- Operated 21.1 weeks exceeding the programmatic goal of 20 weeks
- Faster plasma control system extended κ from ~ 2 to 2.5
- Installed first pair of EFC/RWM coils and performed experiments
 - » Remaining EFC/RWM coils readied for installation
- Lithium pellet injector / supersonic gas injector tested
- Performed first experiments with new CHI capacitor bank
- PF-only start-up experiments initiated

- **New diagnostics:**

- MSE successfully commissioned - took data with 8 channels
- Fast X-ray camera commissioned and took data
- High-k scattering system in-vessel components readied for installation
- Edge/Divertor diagnostic capability (e.g. GPI, divertor fast camera, fast probe) greatly enhanced

FY 05 Outage / Plasma Start-Up Schedule



- o Continuing resolution impacted outage schedule
- o Center-stack casing installed in the vessel in mid-Dec.
- o Completed NB armor, Diagnostic calibrations, clean/photo/close, install NB Duct shortly after
- o Vacuum pump-down began on Dec. 22
- o Bake-out completed on Jan. 19, 2005
- o PF1A coil fabrication completed on Jan. 18, 2005
- o TF flag epoxy refill activities on going
- o Install TF and OH, Flex bus, and machine connections in February
- o Complete machine scrubs in 1st week in March followed by ISTP
- o Commence plasma operation in mid-March and run until the 17 run week goal is met

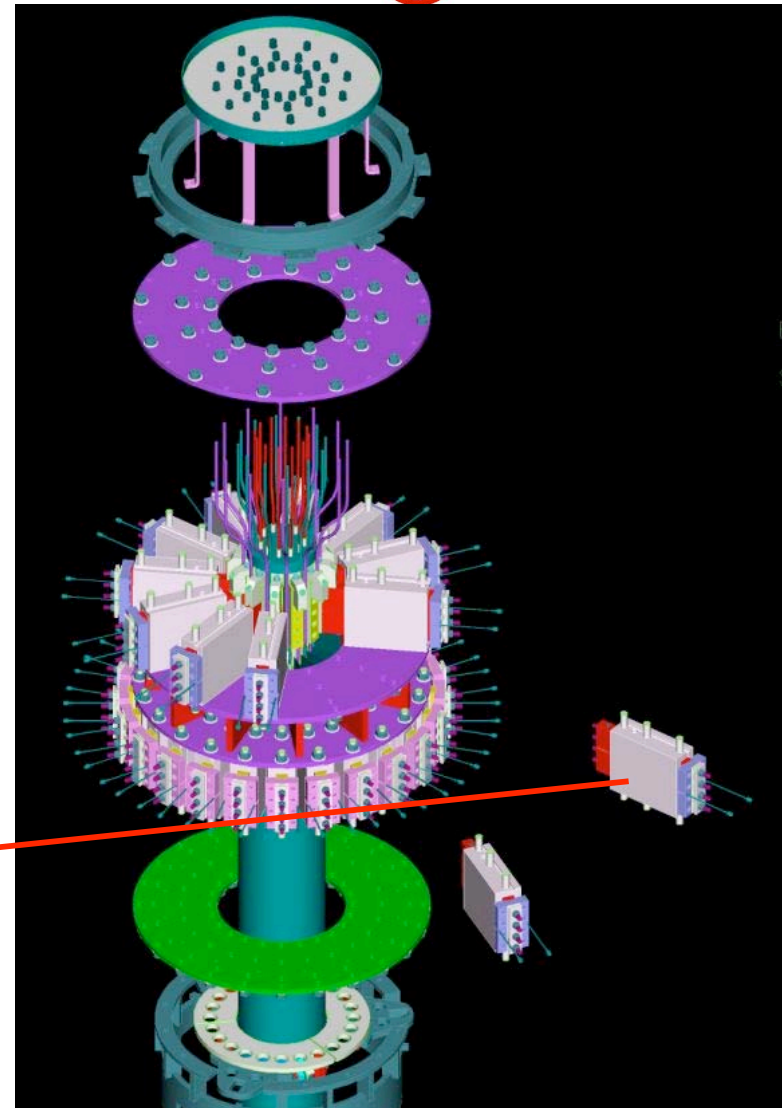
TF-Joints issues resolved



- Out-of-spec flag movement traced to not-fully-penetrated epoxy fill
- A reliable full-penetration epoxy-fill technique developed
- The new potting fully met engineering requirements and preparation for new improved epoxy fill on-going
- An overall design review to define the TF operational limits to be conducted in early February



Transparent box for potting



TF work to be completed in Feb 2005

Motor Generator Weld Repairs



Issue:

- Small cracks detected on some load bearing welds in rotor of MG#1
- Cracks appeared to worsen during the last run
- Subsequent inspections of MG#2 (not currently used) revealed similar but less severe cracking.

Pursuing two parallel paths to support the run:

- Load bearing welds in MG#1 will be repaired:
 - Manufacturer (GE Canada) completed extensive engineering analysis
 - Negotiating contract to have GE make repairs
 - PPPL developing procedure to lift (unload) the rotor to allow the repair
 - Estimated to take ~ 4 weeks, then rebalance the set
- Meanwhile, MG#2 will be readied to support NSTX operations if needed
 - Work to be completed in January.

NSTX Operating Plan for FY 05



The 17 week run to be completed by September 2005.

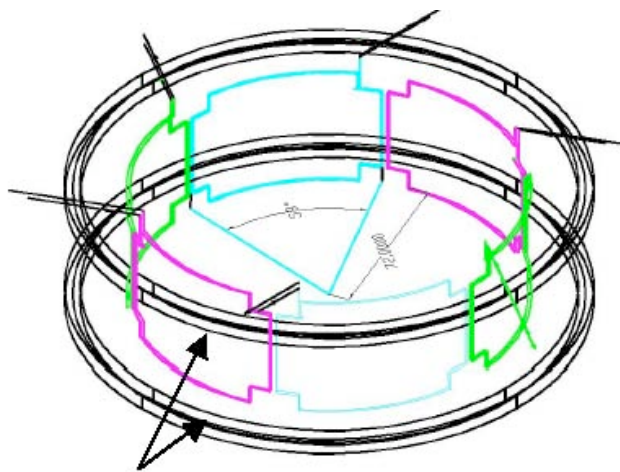
- Start plasma operations in mid-March
- Aim to complete the run by mid-August
- September is a contingency month
- Next expected outage period: October 2005 ~ February 2006 for 17 run weeks in FY 06

Implement ER/RWM Coil System

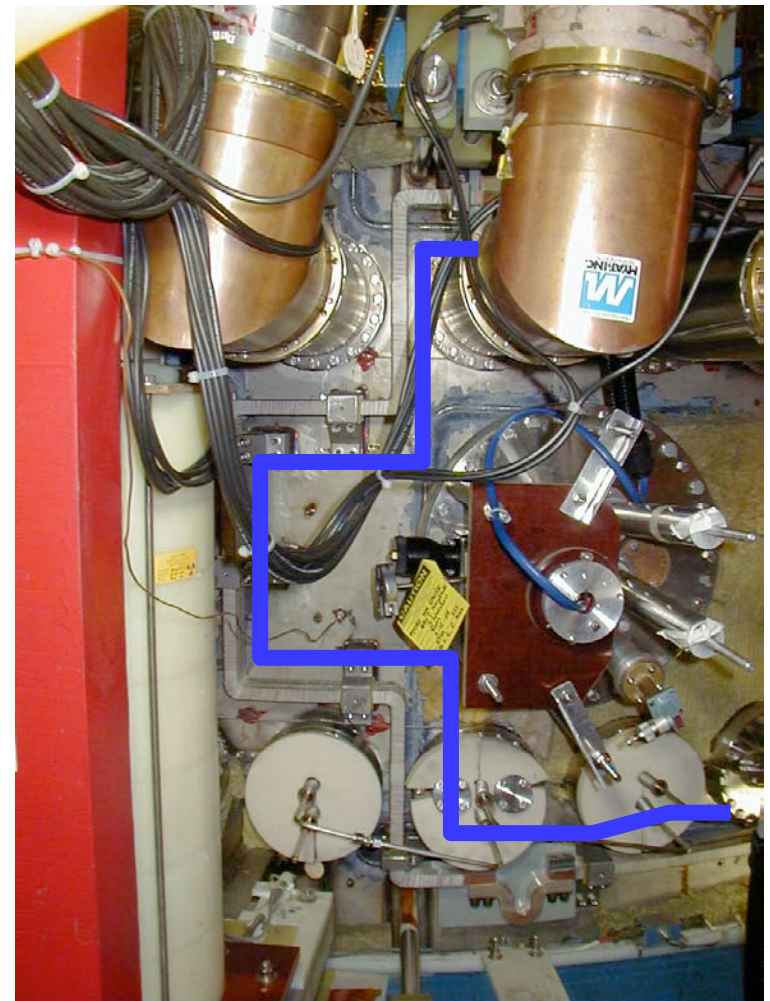


Good progress toward operation

- All six ex-vessel coils installed
- Installed cables between EF/RWM coils and Switching Power Amplifier (SPA)
- Disconnect switches installed in Jan.
- SPA dummy load tests in Feb.
- Real time plasma control system interfaced to control SPA in Feb.
- Aiming to complete ISTP in March to support experiments



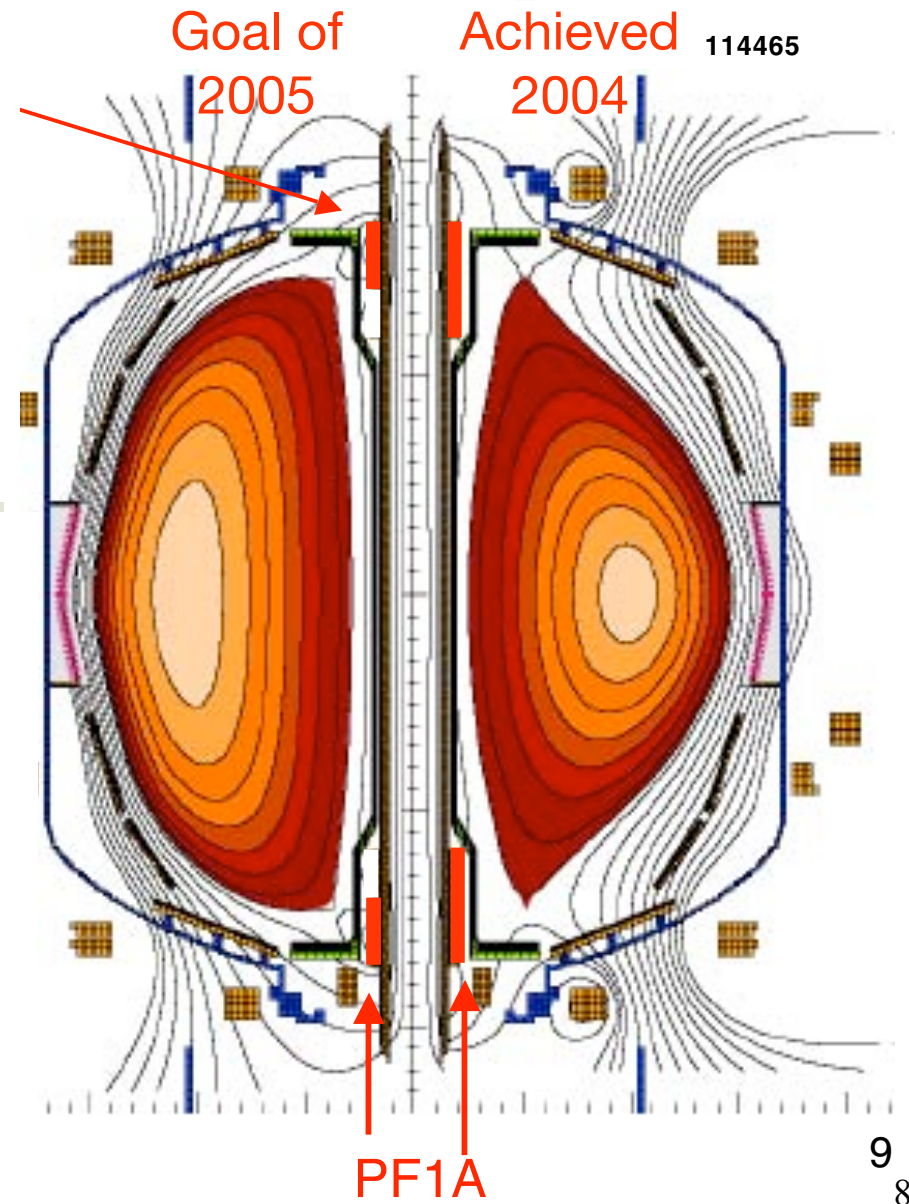
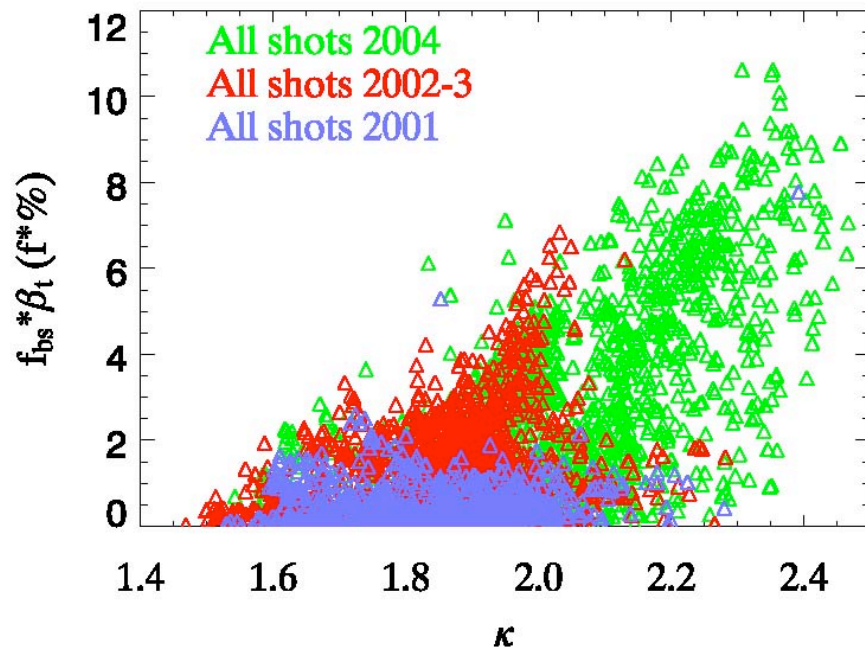
PF5 coils (main vertical field)



New PF 1A Coils to improve plasma shaping



- NSTX Five Year Plan identified critical need for new PF 1A coils to improve plasma shaping control ($\kappa = 2.5$ and $\delta = 0.8$)
- Due to the success of high κ operation in FY 04, installation of new PF 1A coils was accelerated to FY 05 from FY 06
- New PF 1A coil installation fitted well with the TF flag box epoxy repair activities



Commission a new pair of PF1A poloidal-field coils to produce high-triangularity, high-elongation plasma equilibria

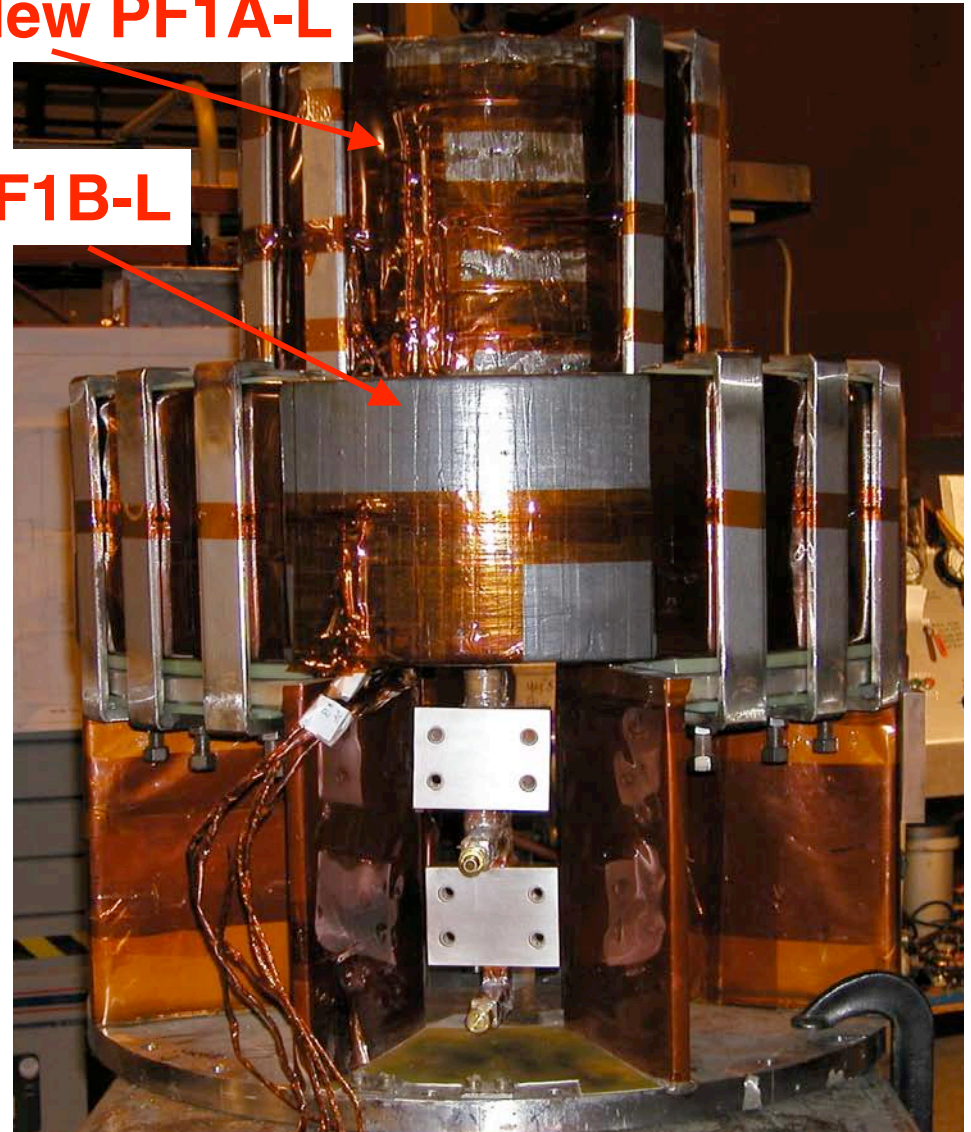


- To insure high quality, PF1A coils wound in the NCSX Coil Facility
- Fabrication completed this week
- Coils will be available for FY 05 run a year ahead of schedule



New PF1A-L

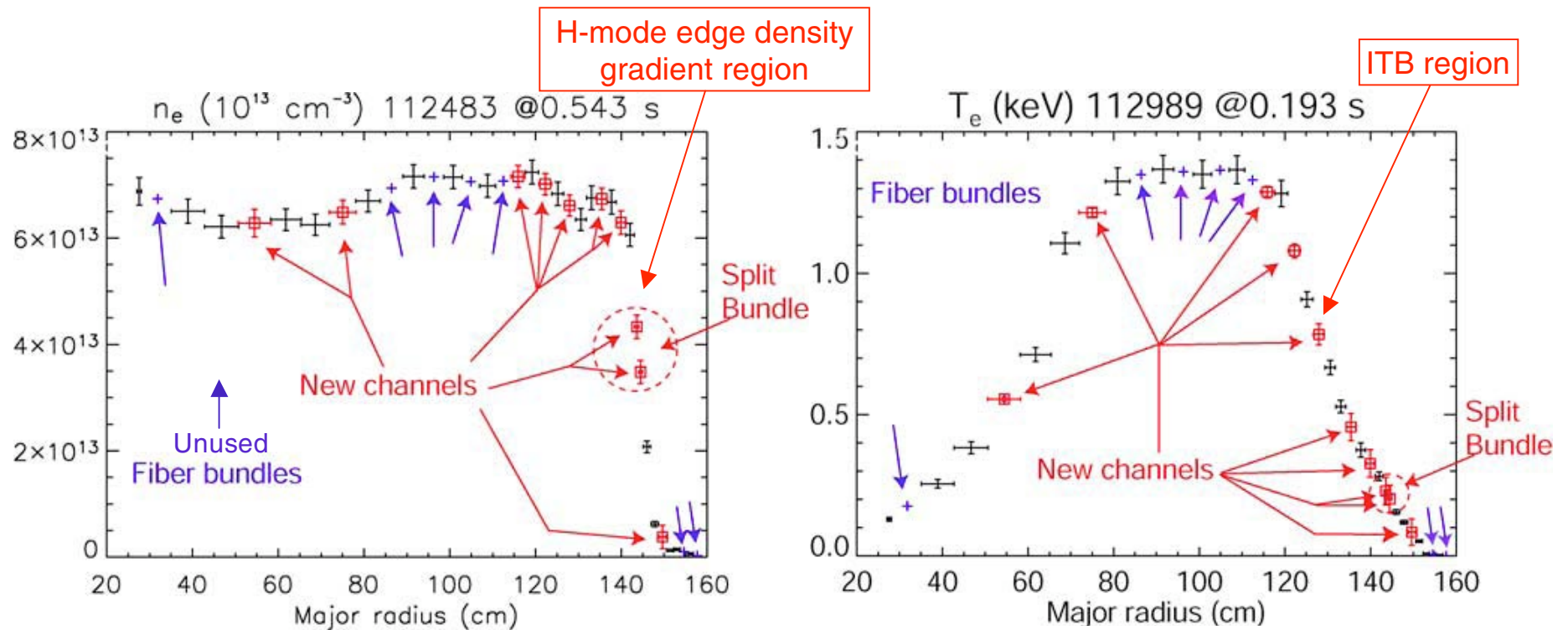
PF1B-L



Installing Additional 10 Channels for Multi-Pulse Thomson Scattering System

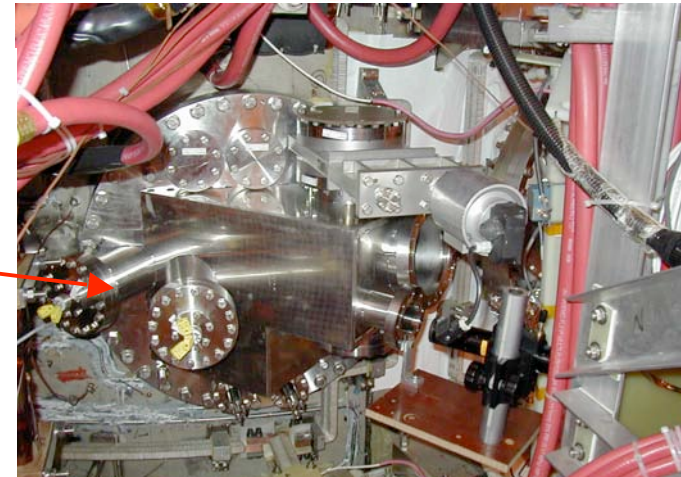
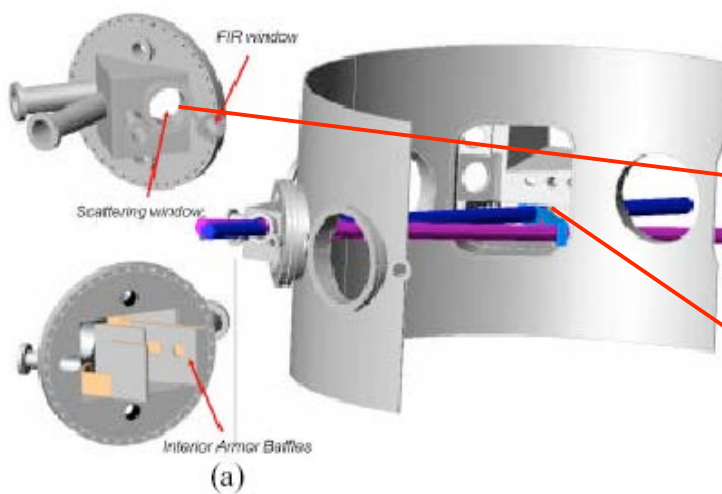


- Locations chosen to improve resolution in the H-mode edge gradient and eITB regions

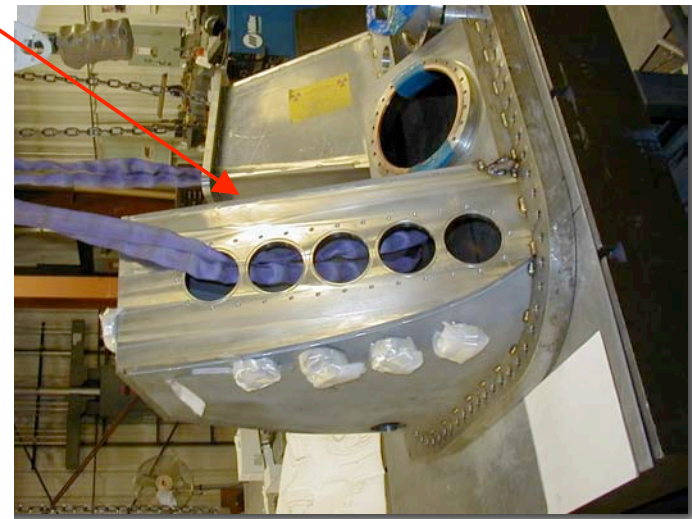


- Start run with existing 20 channels
- Additional 10 channels should become available in May

Installing diagnostic to measure short-wavelength plasma turbulence by scattering from the plasma density fluctuations

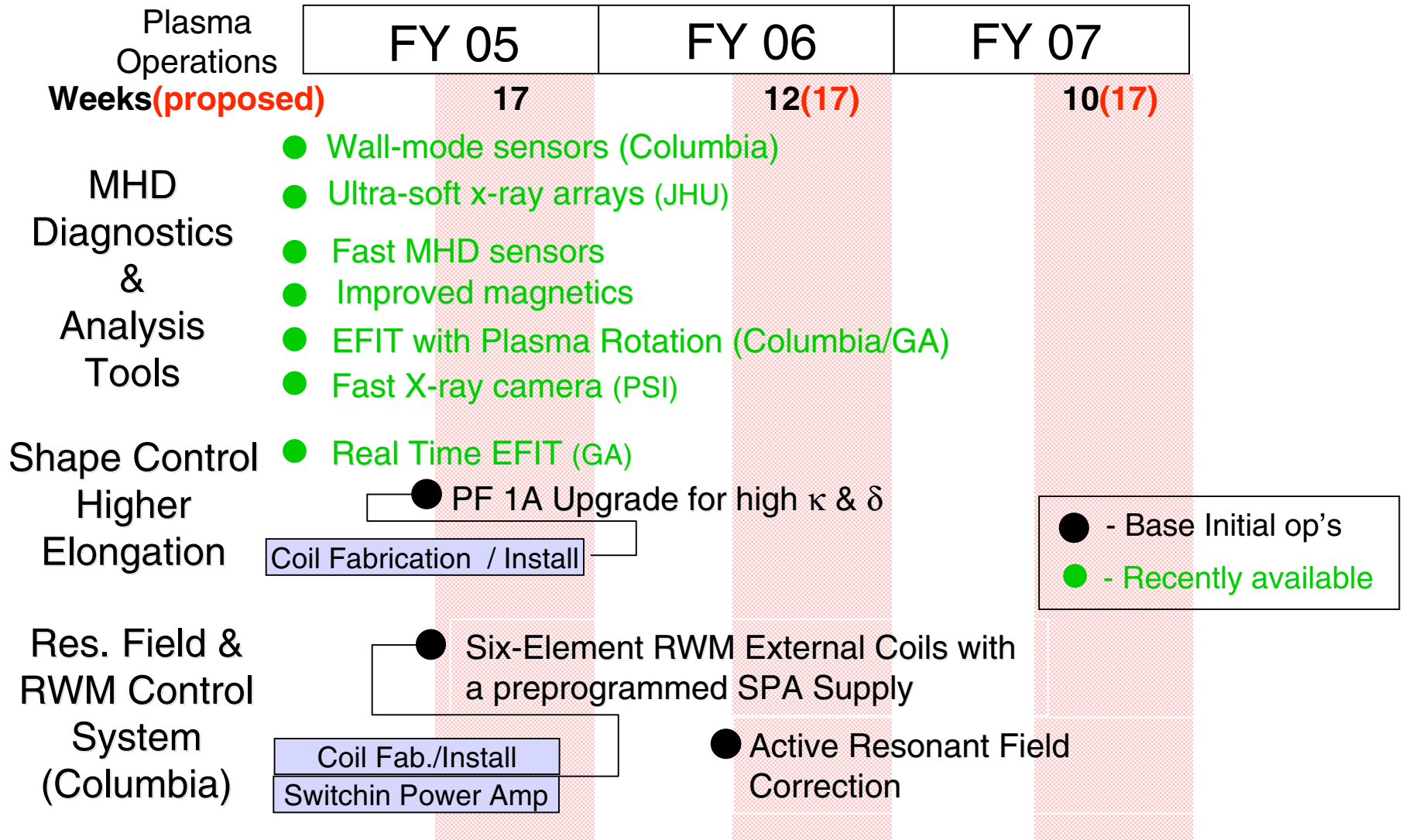


- In-vessel components installed and alignment confirmed
- Ex-vessel components now being installed to prepare for commissioning



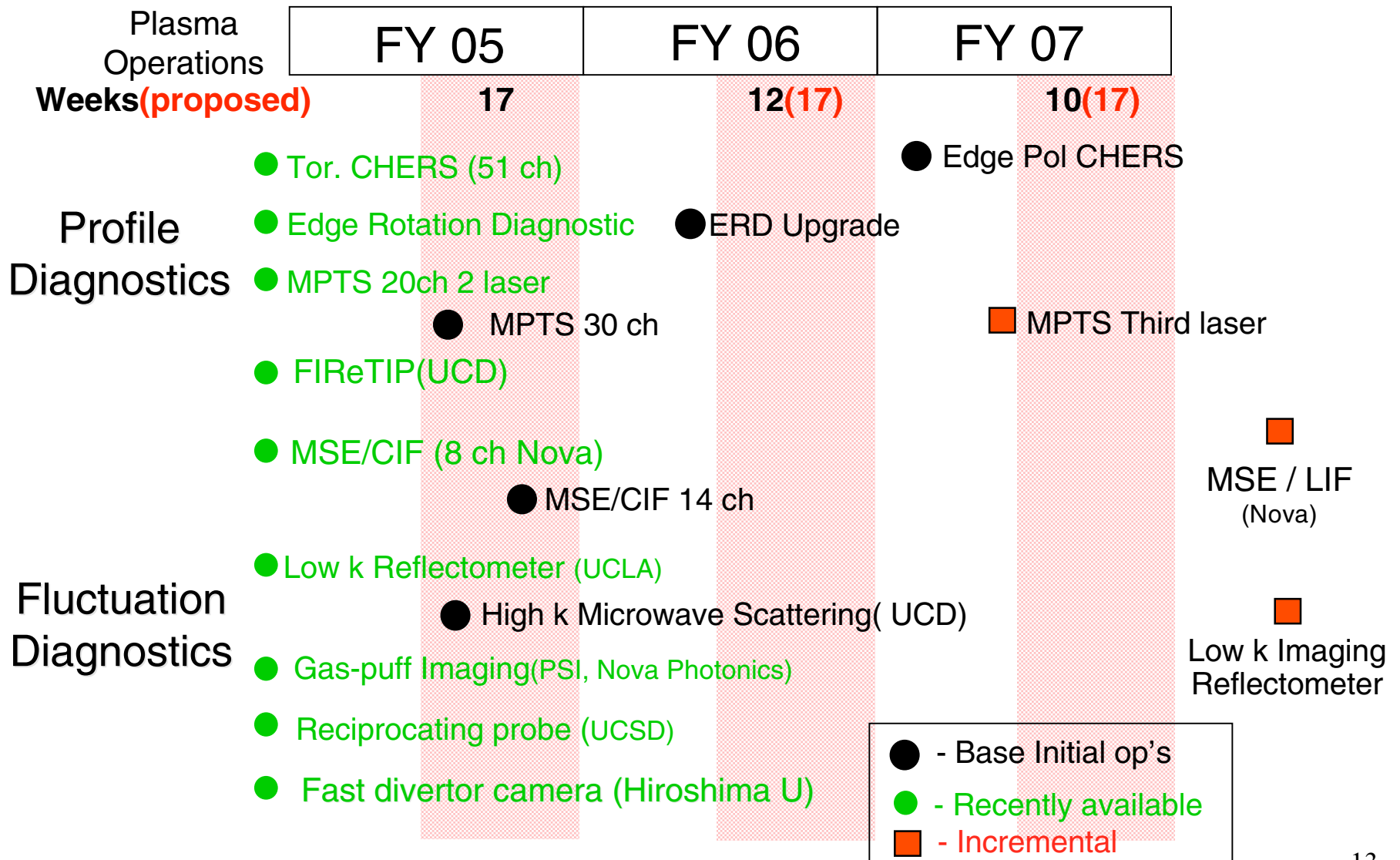
MHD

Opportunity Areas are Shaping and RWM Controls.



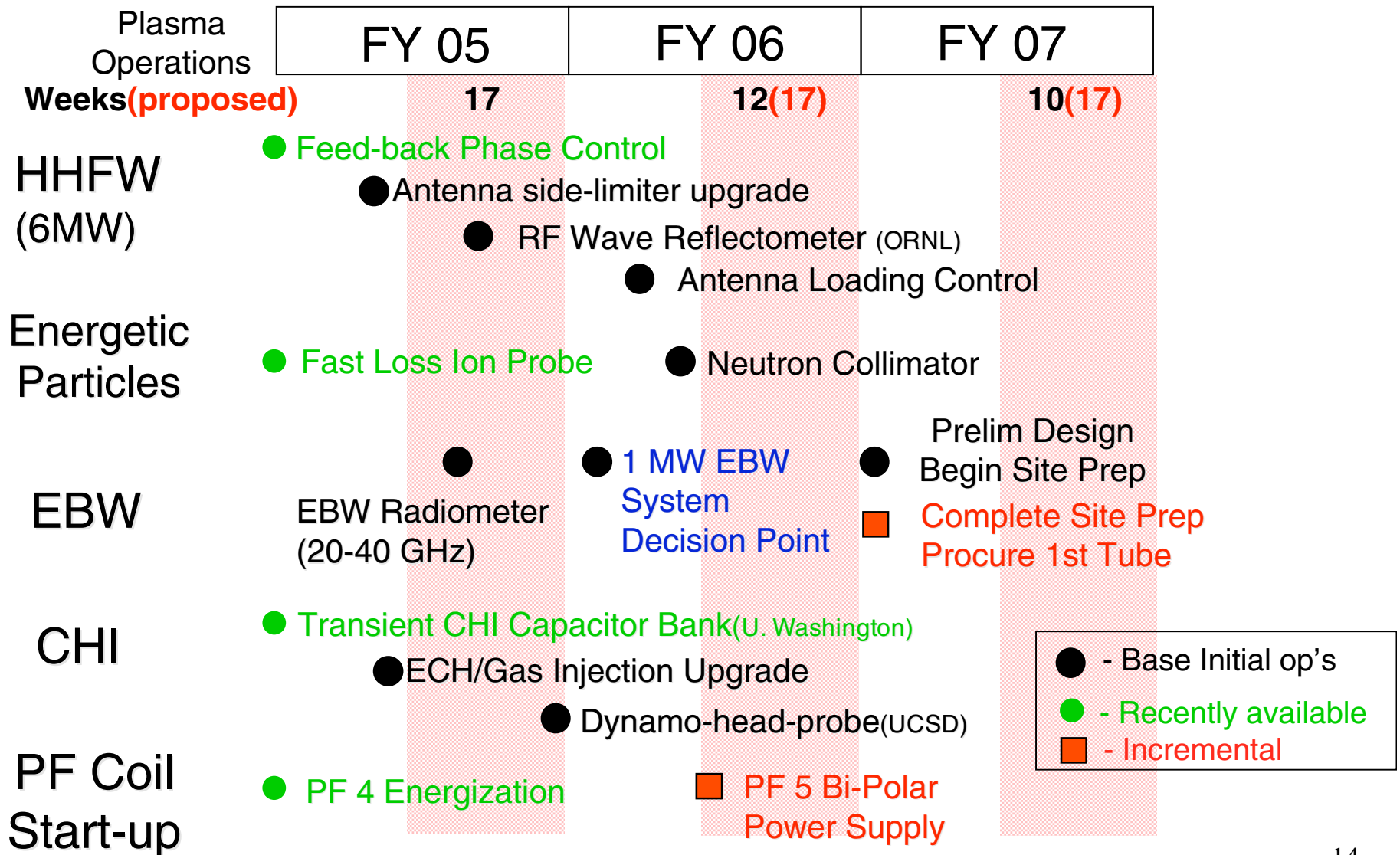
Confinement and Transport

Exciting Opportunities For Advanced Fluctuation Diagnostics



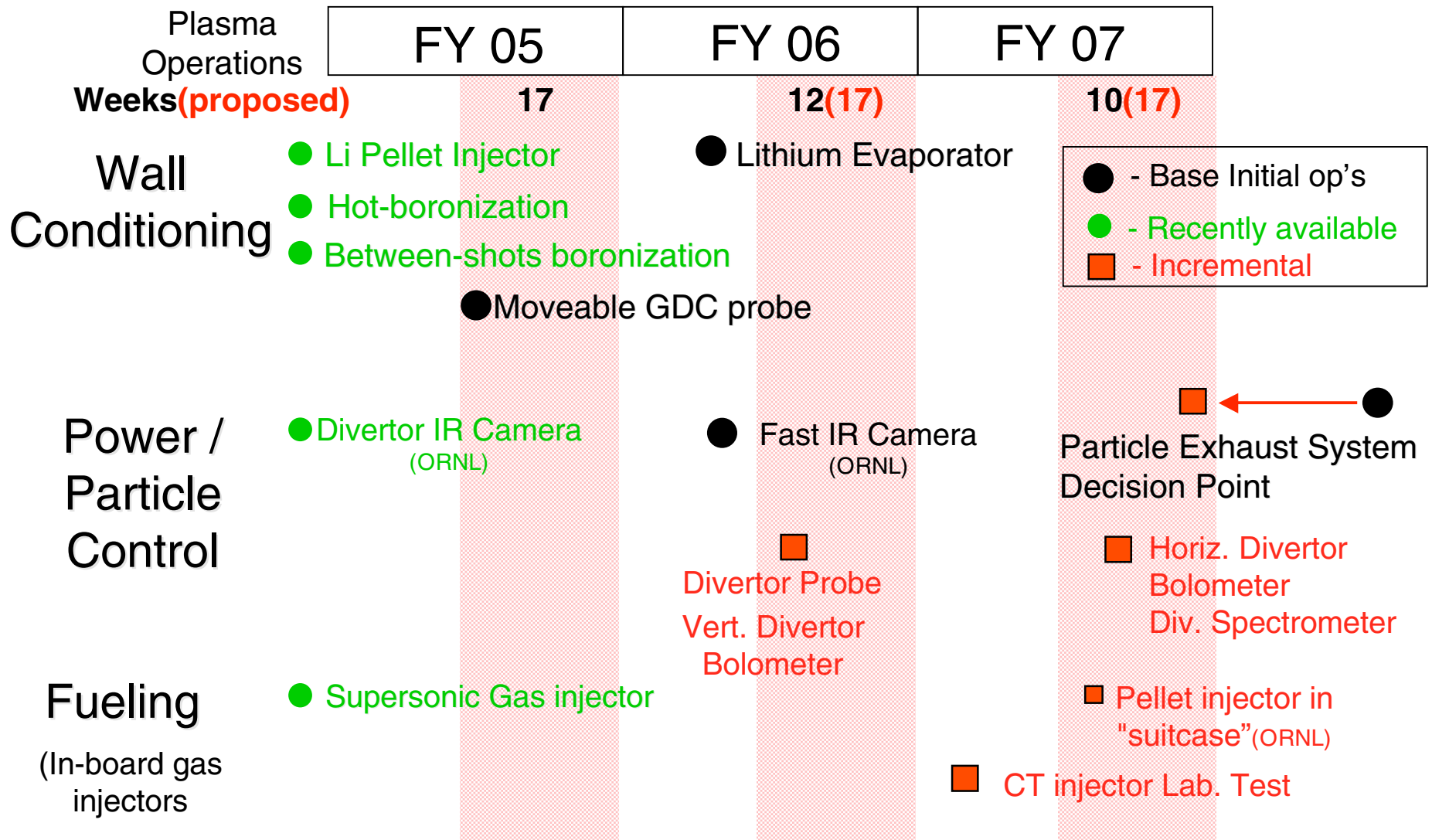
Wave-Particle Interactions

Enhancement Opportunity areas are EBW and Solenoid-free Start-up



Boundary Physics

Exciting Enhancement Opportunity in Core Fueling and Boundary Physics



NSTX Budget Summary (\$M)

(No budget guidance presently available for FY 06 - 07)



	FY 05	FY 06		FY07	
Budget Cases	Base	Base	Request	Base	Request
Run Weeks	17	12	17	10	17
Facility Ops	17.34	16.6	17.7	16.8	18.4
Facility Upgrades	1.17	0.7	2	0.7	2.0
Facility Total	18.51	17.3	19.7	17.5	20.4
PPPL Research	9.69	9.8	10.0	9.8	10.4
Diag Upgrades	0.78	0.7	1.2	0.5	1.1
Coll Diag Interf	0.48	0.5	0.6	0.5	0.7
Collaborations	4.77	4.8	5.2	4.8	5.2
Science Total	15.72	15.8	17.3	15.6	17.4
NSTX Total	34.23	33.1	37.0	33.2	37.8

- Facility budget for FY06 Base reduced by \$1.1M and kept constant in FY06 resulting in fewer run weeks: 12 in FY06 and 10 in FY07
- Additional \$1M / year effective budget reduction due to inflation
- FY 06-07 requested budget assume a constant level of effort from FY 05 and some key facility and diagnostic upgrades

Requested Incremental Funding will Greatly Enhance NSTX Science Output



- **Significantly increase Facility Utilization:**
 - 17 run weeks in FY 06 and FY07 (~ 50 - 70 % increase)
- **Improve Facility/Diagnostic Capabilities:**
 - Start construction of EBW 1MW System (FY 06 - 08)
 - Implement Deuterium Pellet Injector (FY 06 & FY07)
 - Outer PF Start-up System (FY 06)
 - Implement Critical Boundary Physics Diagnostics (FY 06 - 07)
 - Third laser for MPTS to improve time resolution
- **Improve Facility Reliability and Availability**
 - Spare OH solenoid (FY06 & FY07)
 - Preventative Maintenance and critical spare parts

Facility and Budget Summary



- Very successful FY04 research operation of 21 run weeks:
 - Faster plasma control system allowed higher elongation
 - Many new capabilities introduced during the run time
- Exciting FY05 run with many new capabilities:
 - 17 run weeks to start in mid-March
 - New PF 1A, RWM Coils powered by SPA, and increased spatial resolution for MPTS, MSE
 - High k scattering system to be commissioned
- FY06 and FY07 base budget very tight: \$1.1 M cut + inflationary reduction of ~ \$ 1 M per year
 - Facility not fully utilized; 12 and 10 run weeks in FY06 and 07
 - Only allows modest upgrades of ~ 4.5% of budget
 - Requested budget to help restore the research program toward the 5 Year Research Plan