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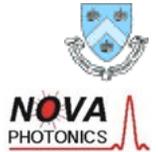


FY03- 04 Facility Plan and Budget

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NSTX PAC- 12



Los Alamos
NATIONAL LABORATORY



Talk Outline



- I. FY 03 - 04 Incremental Proposal
 - Full Facility Utilization
 - Associated Facility Upgrades
 - Associated Diagnostic Upgrades

- III. Budget

Incremental Funding For FY 03 - 04 Can Greatly Enhance NSTX Science Output



- Accelerate research program schedule and enhance quality of science through
 - Additional 12 run weeks per year (\approx 90% increase) can be accommodated in cost effective fashion
 - Strengthening science team (Collaboration + PPPL)
 - Add key research tools to maintain appropriate level of research output with enhanced run (Collaboration + PPPL)
- Improve facility reliability and increase availability
- Prepare for longer term facility capability: Decision point at the end of FY 03
 - Start EBW/ECH non-inductive start-up / NTM stabilization system design/construction - or -
 - Start Second Center Stack design - or -
 - Start Power & Particle handling upgrade design.

Cost Effective Facility Utilization



- For the base case of only 13 run weeks, the NSTX facility is underutilized. The NSTX facility can accommodate 25 run weeks (nearly double the base case) in a cost-effective fashion.
 - Facility operational cost is about \$ 200 k / additional run week including some spare parts and maintenance.
 - Add appropriate level of research support the enhanced operations in priority order:
 - Restore 1.4 FTE research staff reduction from FY 02
 - Add one or two post doc
 - Add half FTE each of research and computational staff
 - Add \$ 250 k for collaboration to support the enhanced runs.
- With appropriate research tool additions, the experimental research program will be able to make significant progress.

Incremental Facility Upgrades to Support Enhanced Research Program



- 1) **CHI absorber null field coil power supply** (in addition to new insulator): Enhances system capability to permit operation over wider parameter range. (PPPL: \$100k, Collaboration: \$20k)
- 2) **EBW emission receiver and measurements**: Enables assessment of technique to enhance EBW coupling efficiency, allowing fast T_e measurements for transport & stability studies and establishing basis for future $j(r)$ control. (PPPL: \$250k, Collaboration: \$50k)
- 3) **Dynamic error field sensors and control**: Accelerates implementation of diagnosis and control of error fields, "Phase-I" system. Permits initial understanding and control of RWM's, for high beta. (PPPL: \$300k, Collaboration: \$80k)
- 4) **Pellet injector in "suitcase"**: Permits fueling control for improved confinement and $p(r)$ control, which can be effectively explored with additional run time. (PPPL: \$350k, Collaboration: \$250*)

* Cost reduced if existing unit supported under enabling technology is available.

PPPL TOTAL: \$ 1,000 K, COLLABORATION TOTAL: \$ 400 k.

Incremental Diagnostic Upgrades to Support Enhanced Research Program



- 1) **Fast IR camera:** Heat flux measurements for fast events. (PPPL: \$50k, Collaboration: \$50k)
- 2) **Dynamo head for scanning probe:** Obtains critical helicity transport data in CHI plasmas from additional CHI run time. (Collaboration: \$ 50 k)
- 3) **Enhanced fluctuation diagnostics support:** Provides support for advanced fluctuation diagnostics for high confinement / high β regimes. (PPPL: \$100k, Collaboration: \$100k)
- 4) **Filtered extreme UV array:** An array of absolutely calibrated extreme ultraviolet detectors viewing the divertor region will provide maps of the divertor recycling and the role of hydrogen recombination radiation in the divertor power balance. (PPPL: \$100k, Collaboration: \$50k)
- 5) **Edge He spectroscopy** Measures spatially resolved edge impurity density, temperature, and poloidal flow to study H-mode transition physics, to benefit from additional run time to explore high confinement physics unique to low-A edge of ST. (PPPL: \$200k, Collaboration: \$100k)

**PPPL TOTAL: \$ 450 k, COLLABORATION TOTAL: \$350 k.
And additional \$ 200 k for collaboration diagnostic interface support.**

Non-Inductive CD Systems

Enhancement Opportunity areas are EBW and CHI



	FY 02	FY 03	FY 04
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Plasma Operations
(Weeks)

12

13 12 inc.

13 12 inc.

HHFW

($T_{e0} \approx 3.7$ keV
6 MW injected)

● Pre-programmed CD Phasing
● Plasma Feed-back phase control

Edge Physics, Antenna / system reliability improvements (ORNL-VLT)

◆ - New Decision Point

● -When available (base)

■ -When available (Incremental)

EBW -E / -CD

● EBWE / Edge $n_e(r)$

■ Optimized EBWE Antenna

◆ High Power EBWCD System

CHI

(390 kA Toroidal Current driven with 27 kA Injection)

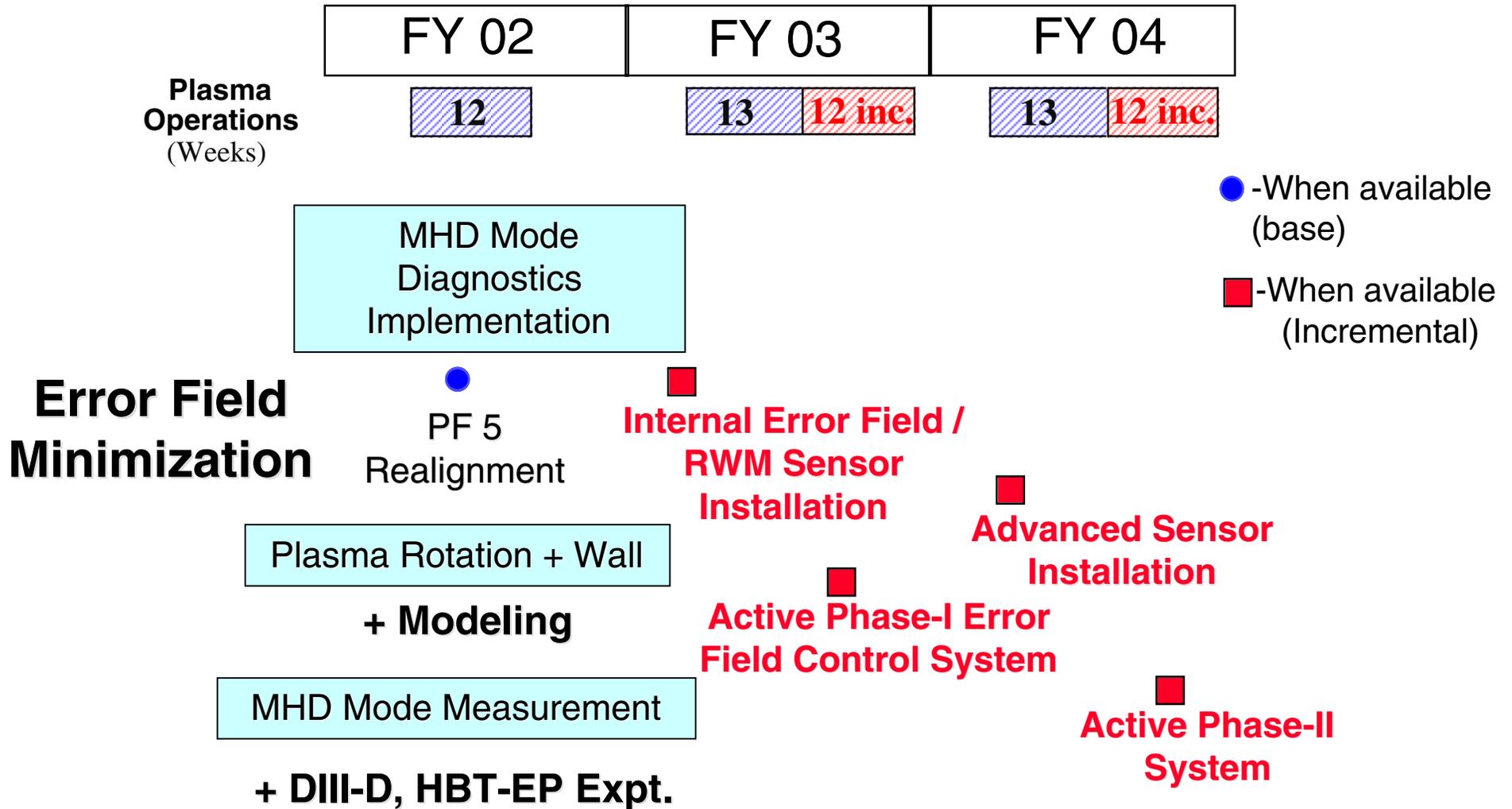
Design & Fabricate New CHI Absorber Insulator

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Install

■ Absorber field null control
◆ CHI in New Center Stack
■ Dynamo-head For helicity transport

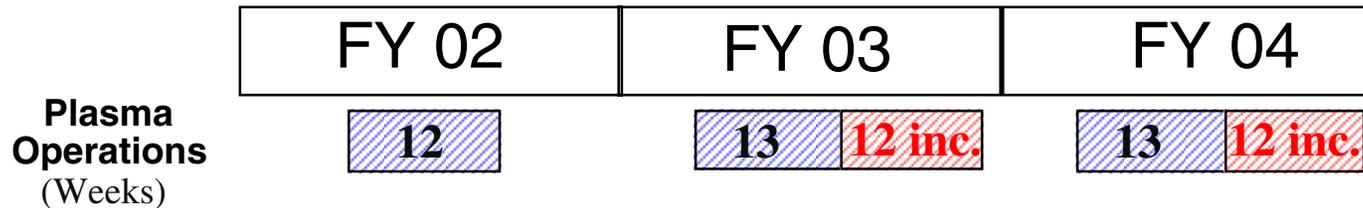
MHD Mode Stabilization

Enhancement Opportunity Areas are Error Field and RWM Controls.



Confinement and Transport

Enhancement to Support Advanced Fluctuation Diagnostics



Many Confinement Diagnostics are now Available for FY 02 Run.

- Manetics for equilibrium reconstruction
- Diamagnetic flux measurement
- Thomson scattering (20 ch., 60 Hz)
- CHERS: T_i and V_f (17 ch.)
- Neutral particle analyzer (scanning)
- Density interferometer (1mm, single chord) [UCLA]
- low k reflectometer [UCLA]
- FReTIP interfr/polarimeter (3 ch.) [UCD]
- VB detector (single chord)
- Midplane tangential bolometer array
- X-ray crystal spectrometer
- X-ray pulse height analyzer
- Electron Bernstein wave radiometer (R&D)

Low - k Turbulence Diagnostics

- Low k: routinely suppressed?

– opportunity for advanced low k imaging to augment reflectometers (proposed)

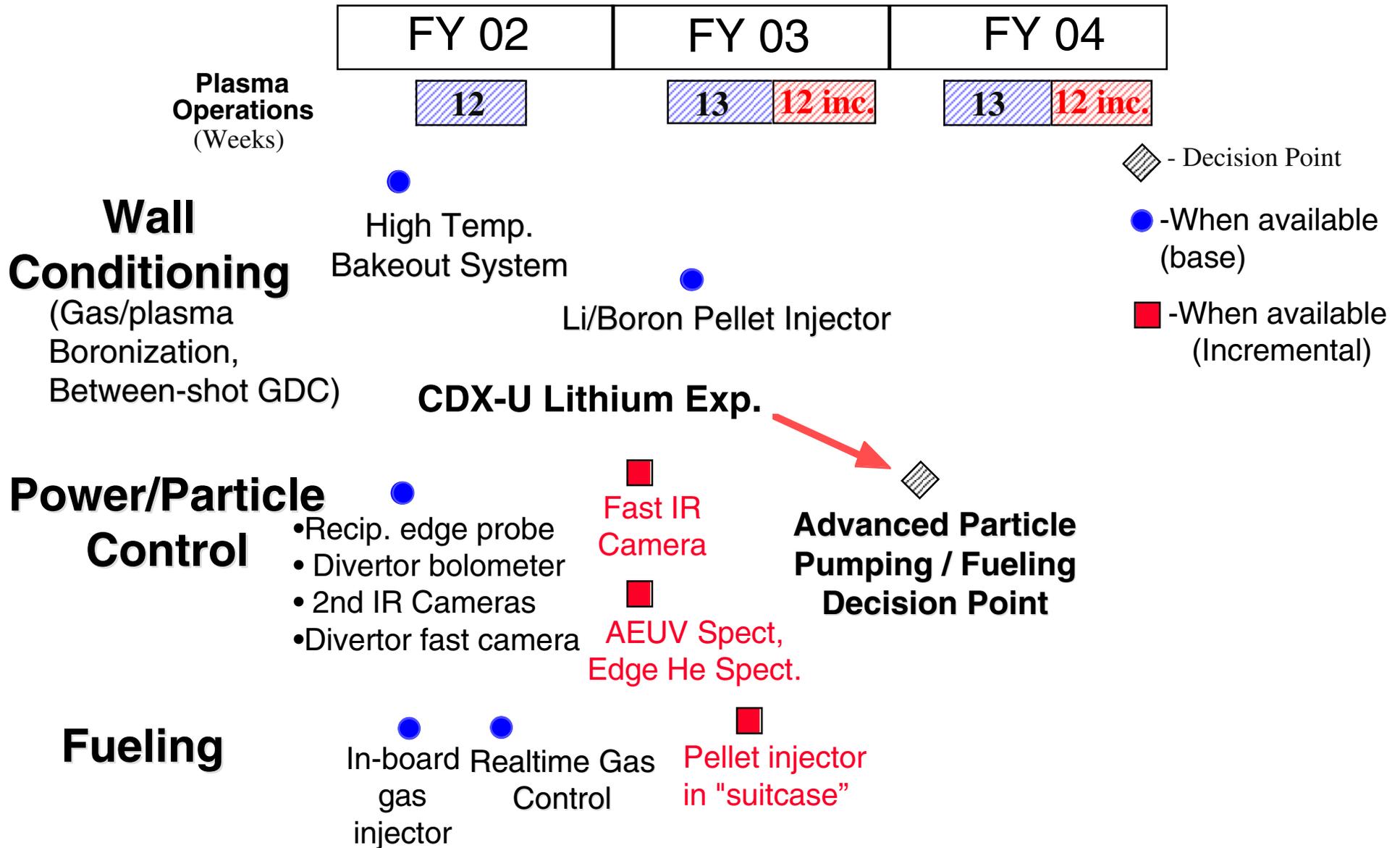
High - k Turbulence Diagnostics

- High k: mode is expected to be larger than in tokamak, easier to detect, can be spatially resolved. Robustly unstable in analysis

– high k milestone for '06 (baseline), '04 (full utilization)

Boundary Physics

Exciting Enhancement Opportunity in Core Fueling and Boundary Physics

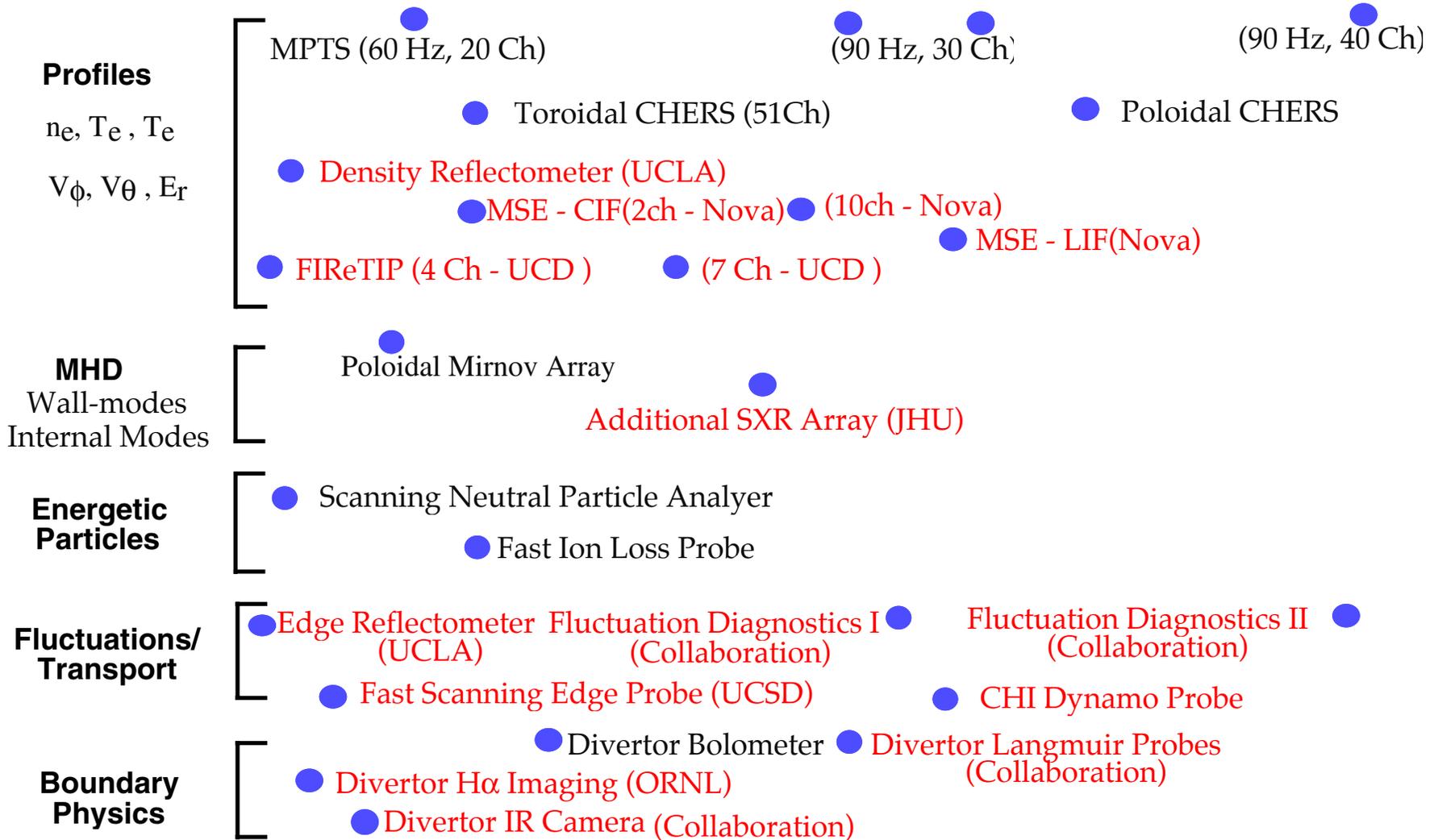


Diagnostics Are Coming Up Rapidly



FY 02	FY 03	FY 04
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● - When installed



Note: Diagnostics with collaboration emphasis are in red.

NSTX Budget Summary (\$M)



	FY 02 Actual	FY 03 #		FY 04	
Facility (Run weeks)	(12)	Base (13)	Incremental (12)	Base** (13)	Incremental (12)
Facility Op.	13.23	14.38	2.48	14.77	2.40
D-site		0.45		0.47	
Wall-mode/ Error Fields.		0.20	0.30	0.30	0.20
CHI Abs.	0.35		0.10	0.10	
EBW-E/-CD			0.25	0.25	1.00
CS Upgrade					
Pellet Inj.			0.35		
Facility Total	13.58	15.03	3.48	15.89	3.60

#Challenging transition year from D&D Completion in FY 02

Science					
PPPL Res.	6.90	6.64*	0.86	7.01	0.90
PPPL Diag.	0.94	1.00	0.45	1.15	0.42
Diag. Interface	0.53	0.63	0.20	0.65	0.20
PPPL Sci.Total	8.37	8.27	1.51	8.81	1.53
Collaboration	4.40	4.40	1.00	4.59	1.00

Grand Total	26.35	27.70	5.99	29.29	6.13
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* 1.4 FTE Reduction from FY 02

** Requirement for 13 run weeks, w/o incremental in FY 03.

Summary



- Exciting FY03-04 Research Program and Associated Facility capabilities are planned.
- FY 03-04 base budget however allows only 13 run weeks (facility underutilized.)
 - FY 03 is particularly challenging due to impact of D&D completion on Lab operations.
- Incremental funding would significantly accelerate research program.
 - Up to 25 run weeks can be accommodated in a cost effective way.
 - Associated facility and diagnostic upgrades are proposed to support the accelerated research program.