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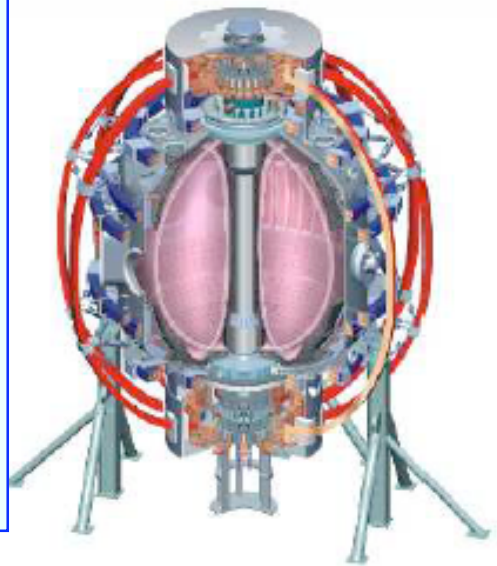
Office of Science

NSTX

NSTX Team Meeting

March 21, 2008

College W&M
Colorado Sch Mines
Columbia U
Comp-X
General Atomics
INEL
Johns Hopkins U
LANL
LLNL
Lodestar
MIT
Nova Photonics
New York U
Old Dominion U
ORNL
PPPL
PSI
Princeton U
SNL
Think Tank, Inc.
UC Davis
UC Irvine
UCLA
UCSD
U Colorado
U Maryland
U Rochester
U Washington
U Wisconsin



Culham Sci Ctr
U St. Andrews
York U
Chubu U
Fukui U
Hiroshima U
Hyogo U
Kyoto U
Kyushu U
Kyushu Tokai U
NIFS
Niigata U
U Tokyo
JAERI
Hebrew U
Ioffe Inst
RRC Kurchatov Inst
TRINITI
KBSI
KAIST
ASIPP
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep

NSTX Team Meeting Agenda

Time: 1:30 ~ 3:00, Place LSB-318, March 21, 2008

- **General Items (15 minutes)**
- **Plasma Operations Updates (30 minutes)**
- **BP Meeting (30 minutes)**
- **Program Plan (15 minutes)**

Safely, Safely, Safely

NSTX

- **ES&H Issues (J. Levine)**

- **Heath/Safety is the foundation of what we do! NSTX team continue to be vigilant on safety related issues both personal and facility"**
  - **Please keep mentally/physically alert on safety**
  - **Please follow safety rules and procedures**
  - **If in doubt, please ask!**
  - **Please keep yourself safe and healthy (do best you can!)**

- **Please make sure everyone understand the NSTX Test Cell Access Rules: The rule can change with the radiation level in the NTC - Please be alert!**
  - **With NTC access permit and your own radiation badge, you can access yourself not others**
  - **People without NTC access permit would require the Health Physics issued radiation badge and proper paper work**
  - **Removal of exposed material from NTC requires Health Physics radiation survey**
  - **Only items brought in during the non-operating day can be brought out without the radiation survey.**

NSTX Safety Information Tree

For PPPL and on-site collaborators

Directors' Office

M. Ono	
J. Menard	J-K Park (S)
	P.Norgaard (S)
	M. Peng
S. Kaye	
T. Egebo	
J. Savino	

Engineering Op Div

Al VonHall
Engineering Branches

Physics Analysis Division

S. Kaye	
	E. Fredrickson
	F. Kelly
	KL Wong
	S. Sabbagh
	J. Bialek
	O. Katsuro-Hopkins
	J. Berkery

Research Op Division

M. Bell		
	H. Kugel	D. Mansfield
		C. Skinner
		R. Maingi
		V. Soukhanovskii
		S. Paul
		J W Ahn
		S. Zweben
	D. Mueller	D. Gates
		P. Ross (S)
		E. Kolemen
		S. Gerhardt
		R. Raman
	B. Stratton	F. Levinton
		E. J. Foley
		H. Yuh
		Nova-personnel
		M. Bitter
		K. Hill
	R. Kaita	Josh Kallman (S)
		D. Darrow
		K-C Lee
		S. Kubota
		E. Mazzucato
		D. Smith (S)
		W-C Lee
		K. Tritz
		R. Bell
		B. LeBlanc
		S. Medley
		M. Podesta
	J. Hosea	G. Taylor
		S. Diem (S)

NSTX Collaboration Safety Information Tree
For part time on-site personnel

PPPL Host	On-site Rep	non-on-site Collaborators			
M. Bitter		P. Beiersdorfer	other LLNL personnel		
D. Darrow	M. Podesta	W. Heidbrink	D. Liu		
D. Gates		T. Evans	other GA personnel		
D. Gates		J. Ferron	D. Humphreys		
D. Gates		R. La Haye			
D, Gates		E. Schuster	other LHU personnel		
J. Hosea		P. Ryan	J. Wilgen	T. Bigelow	other ORNL RF personnel
R. Kaita	S. Kubota	N. Crocker	other UCLA personnel		
R. Kaita	K.C. Lee	other UCD personnel			
R. Kaita		N. Nishino			
R. Kaita	K Tritz	L. Delgado-Aparicio	D. Stutman	other JHU personnel	
H. Kugel		J.P. Allain	A. Hassanein	other Purdue University personnel	
H. Kugel		D. Ruzic	other Univ. Illinois personnel		
H. Kugel		R. Nygren	other SNL personnel		
H. Kugel		N. Tamura	other NIFS personnel		
R. Maingi	J.W. Ahn	Boedo	other UCSD personnel		
R. Maingi		C. Bush			
D. Mueller	R. Raman	B. Nelson	T. Jarboe		
B. Stratton		G. McKee	other U Wisconsin personnel		
S. Zweben		R. Maqueda			

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NSTX Project

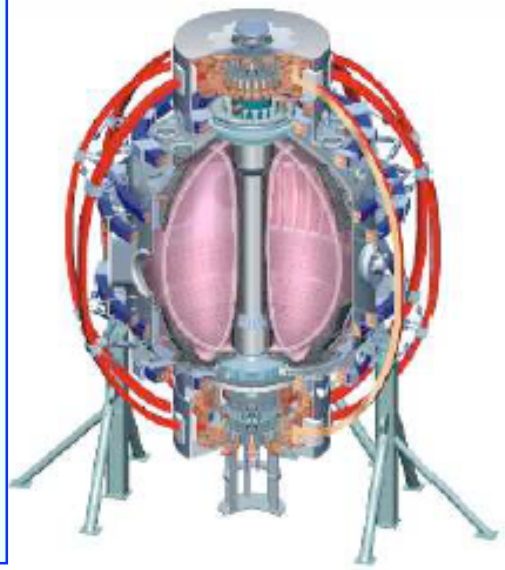
Facility Operations, Upgrades and Budget Plans

College W&M
Colorado Sch Mines
Columbia U
Comp-X
FIU
General Atomics
INL
Johns Hopkins U
Lehigh U
LANL
LLNL
Lodestar
MIT
Nova Photonics
New York U
Old Dominion U
ORNL
PPPL
PSI
Princeton U
SNL
Think Tank, Inc.
UC Davis
UC Irvine
UCLA
UCSD
U Colorado
U Maryland
U Rochester
U Washington
U Wisconsin

Masayuki Ono
for the NSTX Team

Culham Sci Ctr
York U
Chubu U
Fukui U
Hiroshima U
Hyogo U
Kyoto U
Kyushu U
Kyushu Tokai U
NIFS
Niigata U
U Tokyo
JAEA
Ioffe Inst
RRC Kurchatov Inst
TRINITI
KBSI
KAIST
POSTECH
ASIPP
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
IPP AS CR

FY 2010 Budget Planning Meeting
March 11-12, 2008



NSTX Budget Summary ($M)

NSTX

	FY 2008	FY 2009			FY 2010		
Budget cases	**Base**	**Base**	**Increm**	**Full Util**	**Base**	**Increm**	**Full Util**
Run Weeks	**15**	**11**	**15**	**25**	**11**	**15**	**25**
Facility Operations	19.7	19.1	20.0	21.8	19.4	20.3	22.2
Facility Upgrades	0.9	0.2	0.7	1.9	0.2	0.5	0.9
Diag. Upgrades	1.5	0.1	0.4	0.8	0.1	0.3	0.7
Facility Total	**22.1**	**19.4**	**21.1**	**24.5**	**19.7**	**21.1**	**23.8**
PPPL Research	10.3	10.0	10.2	10.4	10.4	10.5	10.7
Collab Diag Interf.	0.5	0.3	0.5	0.5	0.2	0.5	0.7
Collaborations	5.9	5.6	5.8	6.1	5.7	6.1	6.3
Science Total	**16.7**	**15.9**	**16.5**	**17.0**	**16.3**	**17.1**	**17.7**
NSTX Total	**38.8**	**35.3**	**37.6**	**41.5**	**36.0**	**38.2**	**41.5**

- 11 run week base cases in FY 09 and 10 assumes very minimal upgrades.
- Requested ~ 17% budget increase to allow full facility utilization (25 run weeks) and acceleration of high priority facility and diagnostic upgrades.

Transport and Turbulence

Increase and Understand H-mode Confinement at Lower n_e, ν^*

NSTX

FY 08	FY 09	FY 10

○ Increment
⬣ Full Utilz

Run Weeks
Base / Increment

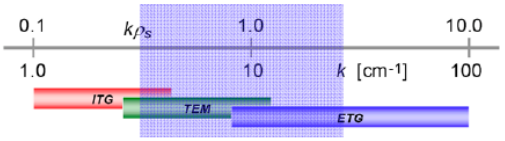
15 | 11 | 4 | 10 | 11 | 4 | 10

Profile Diagnostics

- ● P-CHERS(70 ch)
- ⬣ MPTS High Spatial Resolution
- ● MSE/CIF (16 ch)
- ● MSE/LIF (4 ch)
- ● MSE/LIF (12 ch) — Nova Photonics
- ● Multi-Color-T_e(r) — JHU

MSE-LIF w/o heating beam
- **Direct reconstruction of total plasma pressure**
- **Radial electric field profiles**

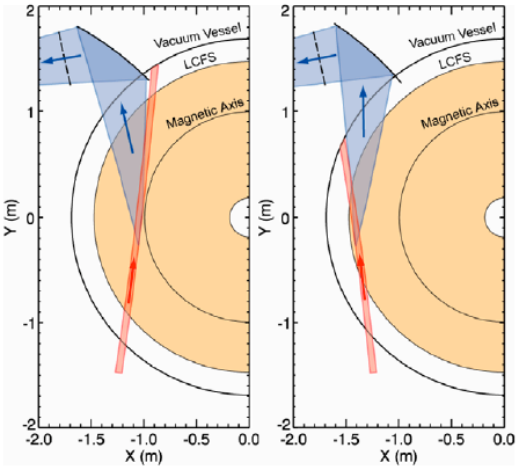
Tangential High-k Scattering (3 MHz)



Turbulence Diagnostics

- ● Corr. Reflect (low-k) — UCLA
- ○ High-k Scattering k-θ
- ● Improved High-k Scattering
- ● BES — U. Wisconsin

BES - Localized low-k turbulence structures to complement high-k → full turbulence k-spectrum



UC Davis
(Ph.D. thesis)

To enable extrapolation to next-step STs

Macrostability

Sustain β_N and Understand MHD Near and Above No-Wall Limit

NSTX

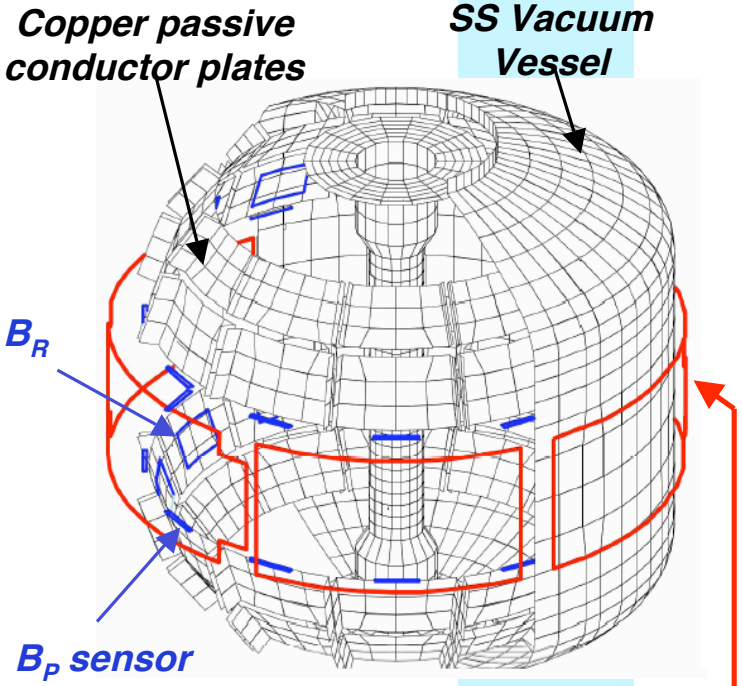
FY 08	FY 09	FY 10

Full Utilz

Run Weeks
Base / Increment

15 | 11 4 10 | 11 4 10

- Control system upgrade
- NBI Feedback
- Control Coil (n=1,2,&3)
- Non-magnetic RWM-ID — JHU



Columbia U — *VALEN Model of NSTX (Columbia Univ.)*

6 ex-vessel midplane control coils

ITER design issue related activities:

- **Vertical control**
  - PF configuration similar to ITER
- **ELM suppression** — GA
  - Attractive single row of coils test for improved RMP understanding (n=1,2,&3)
- **RWM control – impact of missing control coils on feedback performance**

To provide basis to extrapolate high-beta operation to next-step STs

(Ph.D. thesis)

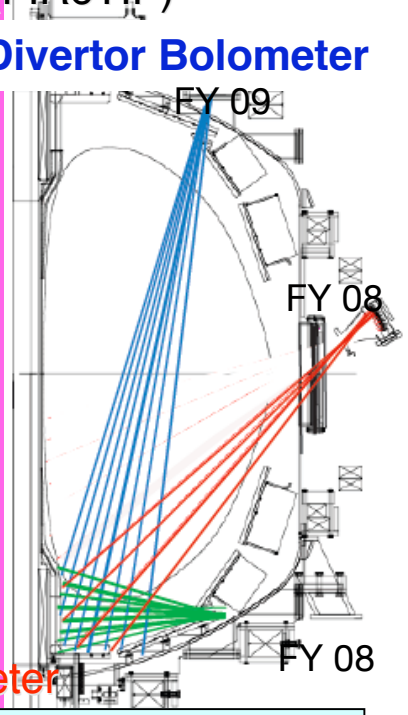
Boundary Physics

Unique Facility Capability for Divertor Particle Control Using Lithium

NSTX

	FY 08	FY 09	FY 10
Run Weeks Base / Increment	15	11 4 10	11 4 10
Lithium Systems	Second LITER	LLD-I (plates) SNL	LLD-II (Mesh under R&D)
	SGI Upgrade LLNL	rt-SGI	rt-ne-bar (FIReTIP)
Edge Tools	Edge Biasing Probes		Divertor Bolometer
Divertor/Edge Diagnostics	Lithium CHERS	Surface analysis probe	
		Divertor Bolometer (12 ch)	
		Divertor Bolometer (20 ch)	
	Divertor Rogowski Coils		
	Penning Gauge Upgrade	U Washington	
	Fast IR Camera ORNL	Ion Flow Measurement Hiroshima U	Divertor Spectrometer

Increment



To Support Beam Current Drive, H-mode Confinement, and MHD

HHFW and EBW

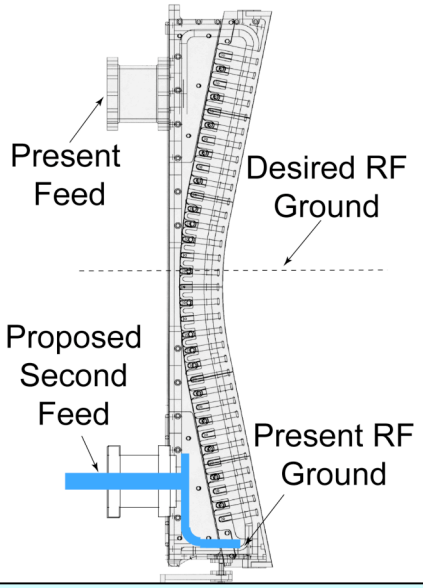
Demonstrate and Understand Non-Inductive Start-up and Ramp-up

NSTX

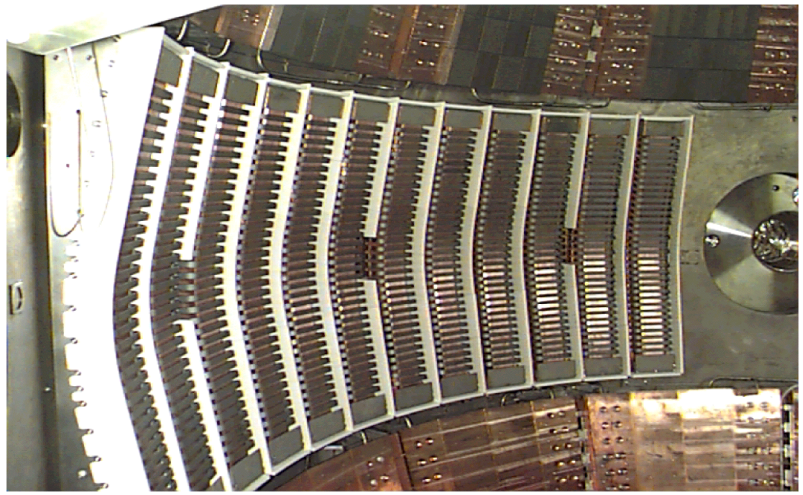
	FY 08	FY 09	FY 10
Run Weeks Base / Increment	15	11 4 10	11 4 10
HHFW		● HHFW Antenna Upgrade	● HHFW ELM Resilience ORNL
EBW	● Improved EBW Radiometer *(Ph.D. thesis)*		⬣ 350 kW EBW/ECH (start-up) ORNL

⬣ Full Utilz

Double Feed Upgrade to Double Power



HHFW Antenna Upgrade - FY 09



HHFW/ICRF and EBW can provide heating and CD for next-step STs

Energetic Particles

Increase and Understand Beam-Driven Current at Lower n_e, ν^*

NSTX

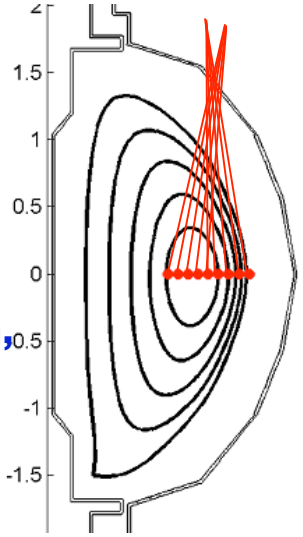
	FY 08	FY 09			FY 10		
Run Weeks Base / Increment	15	11	4	10	11	4	10
Energetic Particles ● Fast Ion Dα Camera		UCI					
● Fast SFLIP							
● Fast IR Camera							
Energetic Particle Mode ● FIReTIP (3 MHz)		UCD					

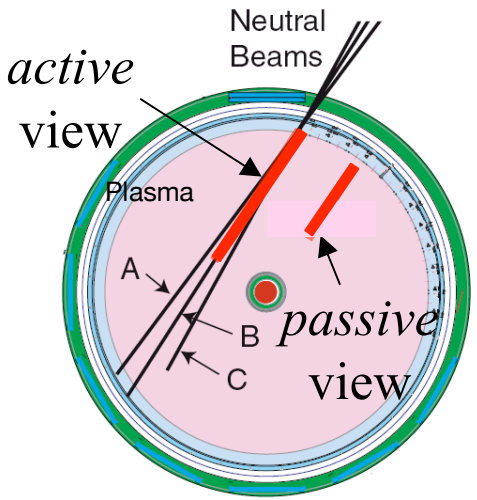
Other EP Diagnostics:
- **Scanning NPA, SS-NPA**
- **MSE-LIF, Neutron detector**

Other EP Mode Diagnostics:
- **High-k scattering, μ– Reflectometer**
- **BES, Magnetic Sensors**

FY 08 FIDA
2x16 channels

- **Resolution:**
- **10keV, 5cm, >5ms**





(Ph.D. thesis)

To provide basis for modeling energetic particles in next-step STs

Solenoid-free Start-up

Demonstrate and Understand Non-Inductive Start-up

NSTX

	FY 08	FY 09			FY 10		
Run Weeks							
Base / Increment	15	11	4	10	11	4	10
CHI							
● Staged bank firing							
● Absorber control coils							
● CHI + PF-Only							
○ PEGASUS/MST-like plasma guns (under discussion)							
⬢ 350 kW EBW/ECH preionization							

○ Increment
⬢ Full Utilz

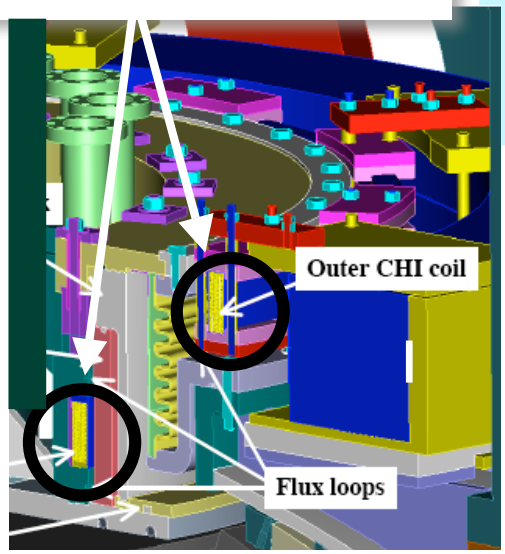
U Washington

U Wisconsin

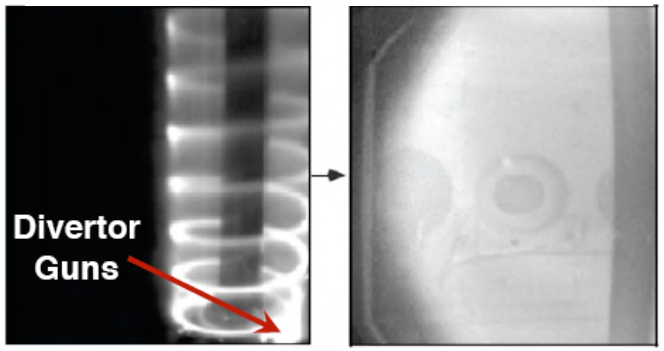
ORNL

PF-Only Start-Up

Absorber control coils



PEGASUS Gun Start-up



Ip ~ 30 kA achieved with one gun

May allow elimination of even slender iron core in ST-CTF

Modest Budget Enhancement
Significantly Increases Science Output

NSTX

Incremental: + ~ 7%

- Increase operations from 11 to 15 run weeks
- Accelerate key facility/diagnostic upgrades:
  - Plasma gun for start-up in FY 10
  - Divertor Spectrometer to support LLD in FY 09-10
  - High k-θ scattering for improve tubulence measurement in FY 10

Full Utilization : + ~ 17%

- Increase operations from 11 to 25 run weeks
- Accelerate additional key facility/diagnostic upgrades:
  - Non-Magnetic RWM-ID for long-pulse ST-CTF/ITER in FY 10
  - MPTS higher spatial resolution in FY 10
  - Install ECH/EBW System 350 kW for start-up and EBW study in FY10
- Improve facility reliability / availability to achieve full utilization
  - Critical spare parts on hand

10% Budget Cut Case (FY10)

NSTX

The 10% budget cut case is particularly difficult for NSTX since the base budget is already reduced to provide very little upgrades:

- 50% reduction in runtime (from 11 to 6 weeks)
- NSTX staff reduction of 14 FTE (15 %) relative to the base case
- Further reduce facility and diagnostic upgrades procurement ~50%
  - Eliminate HHFW ELM resilience hardware
  - Cut preventive maintenance (increase risk)
- Research progress slowed by ~ 50%
  - Focused on transport studies with BES and exploiting liquid lithium divertor.
  - Eliminate studies of non-inductive startup and high power RF.