

NSTX Run Planning Overview: CY11-FY12

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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
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Princeton U
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Sandia NL
Think Tank, Inc.
UC Davis
UC Irvine
UCLA
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U Colorado
U Maryland
U Rochester
U Washington
U Wisconsin

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NSTX FY2011-12 Research Forum

March 18th, 2011

PPPL

*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
JAEA
Hebrew U
Ioffe Inst
RRC Kurchatov Inst
TRINITI
KBSI
KAIST
POSTECH
ASIPP
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep
U Quebec*

Your hard work has made the 2011-12 research forum a SUCCESS

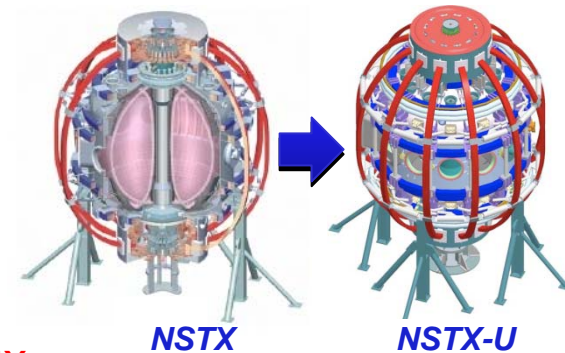
- ❑ Thanks to the hard work of many people
 - ❑ Jon Menard for organizing the meeting
 - ❑ A/V crew – Larry Nixon, Bob Reed, Carl Scimeca
 - ❑ Logistics – Joanne Savino, Carol Ann Austin
 - ❑ Refreshments – Masa Ono and Joanne
 - ❑ Presenters of plenary talks from other labs – Brian Lloyd (MAST), Earl Marmor (C-Mod), Rob La Haye (DIII-D)
 - Especially important guidance for collaboration during outage
 - ❑ TSG leaders and deputies who led the breakout sessions and prepared summaries

- ❑ Record number of proposals submitted
 - ❑ 195 XPs/XMPs were considered, totaling ~ 248 days requested
 - Almost exactly 3 times oversubscribed
 - ❑ TSG leaders have provided their group prioritization – GOOD WORK!

NSTX advances toroidal plasma science, burning plasma physics, and supports attractive near-term fusion options

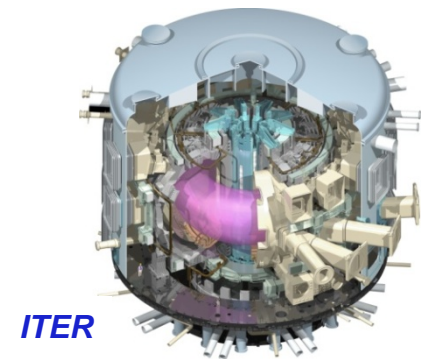
• Understand/exploit unique ST parameters

- High heat flux for novel divertor and PMI studies
- Low A , I_i and high β , κ , v_{fast}/v_A for stability, transport
- Role of NSTX Upgrade:
 - Prototype methods to mitigate very high heat/particle flux
 - Study high beta plasmas at reduced collisionality
 - Access full non-inductive operation for FNSF applications



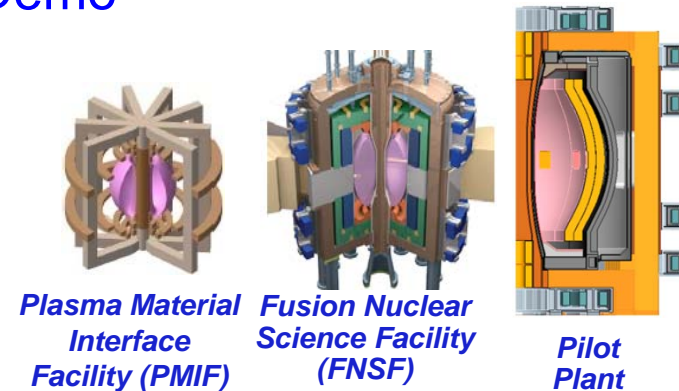
• Extend understanding of tokamak / ITER

- Develop predictive capability for ITER/FNSF/Demo



• Establish attractive ST operation

- Utilize ST to close key gaps to Demo
- Advance ST as fusion power source



Brief summary of NSTX Milestones – key guidance for TSG XP prioritizations – FY2011

- ❑ 2011 OFES Joint Research Milestone (Boundary Physics, Transport & Turbulence)
 - ❑ *Improve understanding of physics mechanisms responsible for pedestal structure, compare with the predictive models.*
 - ❑ *Perform detailed measurements of the height and width of the pedestal, E_r , initial measurements of pedestal region turbulence.*
 - ❑ *Perform focused analytic theory and computational effort, including large-scale simulations, on physics controlling pedestal structure, height. Predictive models will be developed, with key features tested against observations.*
- ❑ R(11-1): Measure fluctuations responsible for turbulent electron, ion and impurity transport
 - ❑ TSGs: Transport & Turbulence
- ❑ R(11-2): Assess ST stability dependence on plasma aspect ratio and boundary shaping
 - ❑ TSGs: Macro-stability, Advanced Scenarios and Control
- ❑ R(11-3): Assess very high flux expansion divertor operation
 - ❑ TSGs: Boundary Physics, Advanced Scenarios and Control
- ❑ R(11-4): H-mode pedestal transport, turbulence, and stability response to 3D fields
 - ❑ TSGs: ITER/CC, Transport & Turbulence, Boundary Physics, Macro-stability

Brief summary of NSTX Milestones – key guidance for TSG XP prioritizations – FY2012

- ❑ 2012 OFES Joint Research Milestone (Transport & Turbulence)
 - ❑ *Improve understanding of core transport and enhanced capability to predict core temperature and density profiles.*
 - ❑ *Assess the level of agreement between theoretical / computational transport models and available experimental measurements of core profiles, fluxes and fluctuations.*
 - ❑ *Emphasize simultaneous comparison of model predictions with experimental energy, particle and impurity transport levels and fluctuations in various regimes, including regimes with significant excitation of electron modes.*
- ❑ R(12-1): Investigate the relationship between lithium-conditioned surface composition and plasma behavior.
 - ❑ TSGs: Lithium research, Boundary Physics, Advanced Scenarios and Control
- ❑ R(12-2): Assess confinement, heating, and ramp-up of CHI start-up plasmas
 - ❑ TSGs: Solenoid-Free Start-up, Wave-particle Interactions, Advanced Scenarios and Control
- ❑ R(12-3): Assess access to reduced density and collisionality in high-performance scenarios
 - ❑ TSGs: Advanced Scenarios and Control, Macro-Stability, Boundary Physics
- ❑ Incremental
 - ❑ IR(12-1): Investigate magnetic braking physics and develop toroidal rotation control at low collisionality ([Macro-stability and Advanced Scenarios and Control](#))
 - ❑ IR(12-2): Assess predictive capability of mode-induced fast-ion transport ([WEP TSG](#))

Run Time Guidance for the FY2011-12 Run

- ❑ FY2011-12 run-time allocation: 24 run weeks (120 run days)
- ❑ 15 days for operational cross-cutting, calibrations, conditioning, etc. → 105 run days
- ❑ 2 days for program reserve → 103 run days
- ❑ Subtract FY11 time used in CY10 → 82 run days
- ❑ Add 4 run days for TSGs that have a JRT
 - ❑ WEP has one less day since milestone is shared
- ❑ FY11/FY12 run days split based on # of milestones in each year
- ❑ 1st priority experiments given 75% of total

Standard disclaimer: TSG's are NOT guaranteed to receive the full allocation indicated; Actual FY12 allocation may be re-evaluated at mid-run assessment.

Run-time guidance for CY2011-FY2012 run was given, so, how did we do?

Run time guidance for experiments and proposal stats (CY2011 & FY2012)

Topical Science Group	Milestones	FY11 1st priority XPs	FY11 2nd priority XPs	FY12 1st priority XPs	FY12 2nd priority XPs	FY11+12 total run days	XPs (+XMPs) submitted	Run days requested	TSG met total run time guidance
Advanced Scenarios and Control	R12-3	3.0	1.0	4.0	1.5	9.5	23	22.0	YES
Boundary Physics	FY11 JRT, R11-3	7.0	2.5	3.0	1.0	13.5	28	35.5	YES
ITER urgent needs & cross-cutting	R11-4	4.0	1.0	2.5	1.0	8.5	44	74.0	YES
Lithium Research	R12-1	3.0	1.0	5.0	1.5	10.5	17	19.0	YES
Macroscopic Stability	R11-2	5.5	1.5	3.5	1.0	11.5	22	23.5	YES
Solenoid-free Start-up & Ramp-up	R12-2	3.0	1.0	4.0	1.5	9.5	8	17.5	YES
Transport and Turbulence	FY12 JRT, R11-1	4.0	1.0	4.0	1.0	10.0	24	29.0	YES
Waves and Energetic Particles	R12-2 (w/ SFSU)	3.0	1.0	4.5	1.5	10.0	29	27.0	+0.5 FY11 P1
Total		32.5	10.0	30.5	10.0	83.0	195	247.5	

- ❑ Record number of proposals
- ❑ Requested run days outpaced available days by factor of 3
- ❑ TSGs were either very close to meeting, or met run time guidance
 - ❑ Slight (up to 0.5 day) mis-alignment of FY12 1st and 2nd priority not an issue – some shuffling may be required at mid-run assessment
 - ❑ WEP TSG is +0.5 days on their FY11 1st priority XPs (but total # days ok)

WELL DONE !! ...but did we break the bank on operational cross-cutting & enabling?....

Operational cross-cutting and enabling time is close to being filled, but we came in just under guidance

Operational Cross Cutting & Enabling (CY2011 & FY2012)

Operational CC & enabling	Guidance	Assigned	
Characterizing incremental Li introduction + possible boronization	2	2.0	Supplement Li introduction time + XMP for Li de-conditioning (LRTSG)
Mo tile performance characterization	2	1.0	Supplement Mo tile performance characterization (LRTSG)
Control system development	3	1.0	t-FIDA commissioning (WEP) (WPI-28 Bortolon)
		1.0	Ramp-down development (ASC)
		0.5	rt-Vphi checkout (ASC)
		0.5	n = 1 feedback check/optimization (ASC)
Calibration: magnetics, MSE, other	2	2.0	locked
HHFW conditioning	4	4.0	Assigned to WEP TSG (WPI-29 Hosea)
Other XMP TBD	2	1.0	Control early MHD (MS) - for low ne startup / low nu (R12-3) milestone*
		1.0	WEP TSG (WPI-5 Hosea) - for HHFW/NBI plasma development*
Total CC & enabling (days)	15.0	14.0	

- ❑ Time allotted closely follows initial guidance from program
- ❑ Program reserve (2 days) was not used
- ❑ One day (of 15) still available (tight!)
 - ❑ Assigned time targeted work enabling the team - open for discussion

“*” refers to enabling work partially addressing a flagged “group task”...

What do we do next in run development? Suggest brief, focused meetings to define plan for certain group tasks

- Tasks identified during research forum that would benefit from further planning (and why)...
 1. Development of low density startup (to reduce collisionality, help fulfill R(12-3) milestone
 - Several proposals of varying scope (from tactical to strategic)
 - Grouped by ASC TSG – suggest that further discussion be had to define combined proposals, including Mueller (main XP lead, now on vacation)
 2. Development of HHFW+NBI operation for group use
 - Supports NSTX physics XPs over the broader group - L-mode, H-mode, with high NBI power (> 2 MW), etc.
 - Several XPs discussed, grouped by WEP TSG, discussion also in ASC, specialized forum session for HHFW + CHI coupling work
 - Should hold a team-wide discussion of the group needs, and a discussion of the run plan including input from the broad research team
 3. Other, similar broader group meeting needs?
 - e.g. LRTSG run plan for Li introduction to CY2011 machine, moly tiles?

Pre-run preparation and considerations

- ❑ Present best guidance for start of run: Plasma ops July 5th
 - ❑ ISTP to be held the week before (**NOTE: which is EPS week**)
 - ❑ *It's really NOT that far away, so start prep soon!*

- ❑ Many new control / diagnostic capabilities
 - ❑ Set schedules to be ready for run, ensure that piggyback tests don't conflict, ensure new/modified capabilities/diagnostics are ready to support your XP.

- ❑ Present plan is to operate with Li immediately
 - ❑ No significant operations phase without Li / no early boronization
 - ❑ Controlled Li introduction XP and planned XP for operation on moly tiles (LRTSG)
 - These XPs need to be reviewed soon
 - If no special meeting is held to discuss XPs, LRTSG reviews should be announced to / attended by broad team to allow expanded discussion

- ❑ Can your XP run early?
 - ❑ Early run plasma performance is uncertain – we need primary XPs and backups

TSGs should start XP reviews right away, when possible

Strawman start-up run plan and considerations

- ❑ Fast shot cycle (10 mins) – session leader needs help!
 - ❑ We request a deputy session leader be identified in XP document – especially important for complex XPs, complicated control needs, etc.
- ❑ Strawman start-up run plan
 - ❑ Pump-down
 - ❑ Bake-out for 3 weeks at 350°C; cool-down
 - ❑ Power testing ISTP vacuum shots, magnetics calibration shots, etc.
 - ❑ First plasma operations right after ISTP, quickly transition into LRTSG experiments
 - Controlled lithium introduction and discharge development (Maingi)
 - Comparison of diverted plasmas on incident lithiated moly (Kugel)
 - ❑ Enabling / commissioning XPs follow, start some JRM XPs if all is ready
 - (ASC) Vertical control improvements (SPG), snowflake control (Kolemen)
 - (WEP) t-FIDA commissioning (Bortolon) – if impurity levels sufficiently low
 - (BP) Start snowflake Xp (Vlad) OR d/Bt effect on pedestal ELM-y H (Diallo)
 - Follow with mix of higher performance enabling XP work, 1st priority mix of TSGs
 - ❑ Piggyback testing of new control for 2nd SPA, checkout of new / expanded diagnostics whenever possible during this time

Did someone say that this run is special? It sure is!!

□ What's so special?

□ It's pre-run preparation for NSTX-U

- Several milestones / XPs focus on prep work for the upgrade
- The upgrade targets a new operational space for the ST which we must demonstrate will perform well (major responsibility)

□ It's our opportunity to solidify the legacy of NSTX

- The device is still **INCREASING** productivity, **INCREASING** diagnostics, **INCREASING** research publications

□ It's the Team

- Look around you. This is the best team that NSTX has ever seen.