

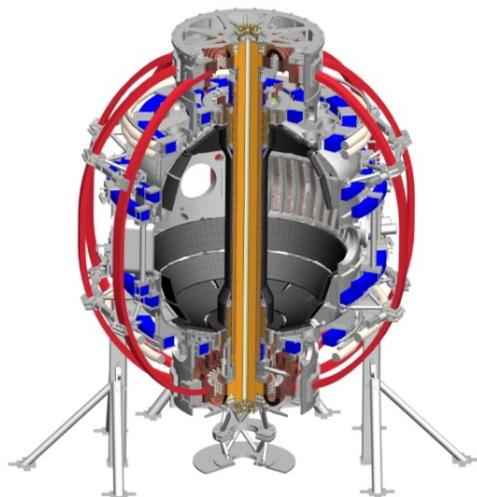
NSTX-U Program Update

J. Menard

For the NSTX-U Research Team

**NSTX-U Team Meeting
PPPL LSB B318
April 25, 2014**

*Coll of Wm & Mary
Columbia U
CompX
General Atomics
FIU
INL
Johns Hopkins U
LANL
LLNL
Lodestar
MIT
Lehigh U
Nova Photonics
Old Dominion
ORNL
PPPL
Princeton U
Purdue U
SNL
Think Tank, Inc.
UC Davis
UC Irvine
UCLA
UCSD
U Colorado
U Illinois
U Maryland
U Rochester
U Tennessee
U Tulsa
U Washington
U Wisconsin
X Science LLC*



*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
Inst for Nucl Res, Kiev
Ioffe Inst
TRINITI
Chonbuk Natl U
NFRI
KAIST
POSTECH
Seoul Natl U
ASIPP
CIEMAT
FOM Inst DIFFER
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep*

Outline

- BPM / research milestones for FY15 / FY16
- Collaborator presentations
- PAC-35
- FESAC strategic planning

Proposed FWP **baseline** and **incremental** NSTX-U research milestones through FY2016

	FY2014	FY2015	FY2016
Expt. Run Weeks:	0	18 20	16 20
Macroscopic Stability	R14-1 Assess access to reduced density and v^* in high-performance scenarios (with ASC, BP TSGs)		IR16-1 Assess τ_E and local transport and turbulence at low v^* with full range of B_T , I_p , and NBI power
Transport and Turbulence		R15-1 Assess H-mode τ_E , pedestal, SOL characteristics at higher B_T , I_p , P_{NBI} (with BP, M&P, ASC, WEP TSGs)	
Boundary Physics		IR15-1 Develop snowflake configuration, study edge and divertor properties (with ASC, TT, MP)	R16-1 Assess heat-flux mitigation and PFC response using advanced divertor configurations at high power density (Joint BP and MP)
Materials & PFCs			
Waves+Energetic Particles	R14-2 Assess reduced models for *AE mode-induced fast-ion transport	R15-2 Assess effects of NBI injection on fast-ion $f(v)$ and NBI-CD profile (with SFSU, MS, ASC TSGs)	R16-2 Assess fast-wave SOL losses and core thermal and fast ion interactions at increased B_T , I_p
Solenoid-free Start-up/ramp-up			R16-3 Develop high-non-inductive fraction NBI H-modes for ramp-up & sustainment (Joint ASC+SFSU)
Adv. Scenarios and Control	R14-3 Assess advanced control techniques for sustained high performance (with MS, BP TSGs)	R15-3 Develop physics+operational tools for high-performance discharges (with CC, ASC, MS, BP, M&P TSGs)	
ITER Needs + Cross-cutting			
Joint Research Target	Quantify plasma response to non-axisymmetric (3D) magnetic fields in tokamaks	Quantify impact of broadened current and pressure profiles on tokamak confinement and stability	Assess disruption mitigation and warning / prediction techniques (+ additional theory contribution?)

Motivation for facility enhancements in support of assessing ST physics and performance in support of FNSF and ITER

	2015	2016	2017	2018	2019	2020
Max B_T [T], I_p [MA]	0.8, 1.6	1, 2				
Structural force and coil heating limit fractions	0.5, 0.5	1.0, 0.75		1.0, 1.0		
Nominal τ_{pulse} [s]	1 – 2	2 – 4		4 – 5		
Sustained β_N	3 – 5	4 – 6	NCC	5 – 6		
v^* / v^* (NSTX)	0.6	0.4	Cryo	0.3 – 0.2	0.2 – 0.1	
Non-inductive fraction ($\Delta t \geq \tau_{\text{CR}}$)	70 – 90%	80 – 110%		90 – 120%	100 – 140%	
NBI+BS I_p ramp-up: initial \rightarrow final [MA]		0.6 \rightarrow 0.8	ECH / EBW	0.5 \rightarrow 0.9	0.4 \rightarrow 1.0	
CHI closed-flux current [MA]	0.15 – 0.2	0.2 – 0.3		0.3 – 0.5	0.4 – 0.6	
P_{heat} [MW] with $q_{\text{peak}} < 10\text{MW/m}^2$	8	10		15	20	
Snowflake and radiative divertor exhaust location	Lower	Lower or Upper		Divertor heat-flux control		
				Lower + Upper		

Inform choice of FNSF
aspect ratio and divertor

Cryo: access lowest v^* , compare to Li **ECH / EBW:** bridge T_e gap from start-up to ramp-up
Off-midplane non-axisymmetric control coils (**NCC**): rotation profile control (NTV), sustain high β_N

Presently gathering input from NSTX-U collaborators funded by FES 3-4 year grants

- Covers 3 groups of grantees: University and industry (diagnostic, non-diagnostic) + National labs

Information we are requesting:

1. Research plans and needs for this year (FY2014) in preparation for NSTX-U operations in FY2015
2. Research Plans for FY2015 beyond
 - The years covered will depend on the duration of present grant
3. Ideas to enhance participation in NSTX-U research and/or program by U.S. Universities, early-career researchers, and students
 - Developing plan to enhance University/ECR/student participation in NSTX-U is FES “Notable Outcome” for PPPL for FY2014
4. Highest-priority incremental measurement capability
 - Applicable to diagnostic solicitation grantees funded for 2012-2015

Agenda (1)

- Thursday, April 24
 - Jon Menard – Introduction – 2:00-2:05PM Eastern
 - Rob La Haye 2:05-2:20PM
 - William Heidbrink 2:20-2:50PM
 - Todd Evans 2:50-3:05PM
 - Werner Boeglin 3:05-3:20PM
 - Fred Levinton 3:20-3:45PM
- Friday, April 25
 - Tony Peebles 3:30-3:50PM Eastern
 - Neal Crocker 3:50-4:10PM
 - Neville Luhman 4:10-4:30PM

Agenda (2)

- Monday, May 5

- Steve Sabbagh 12:30-1:00PM Eastern
- Dan Stutman 1:00-1:20PM
- George McKee 1:20-1:40PM
- J.P. Allain 1:40-2:10PM
- B.D. Wirth 2:10-2:30PM
- Jim Myra 2:30-2:45PM
- Ricardo Maqueda 2:45-3:00PM
- Vlad Soukanovskii 3:00-3:20PM
- A. Ram+P. Bonoli 3:20-3:35PM
- Bob Harvey 3:35-3:50PM
- John Canik/ORNL 3:50-4:15PM
- Bick Hooper 4:15-4:30PM
- R. Raman 4:30-5:00PM
- R. Fonck/A. Redd 5:00-5:20PM

NSTX-U PAC-35

- Will be held June 11-13th, 2014 at PPPL
- Tentative/possible charge topics:
 - Comment on recent research results
 - NSTX/NSTX-U + for/through collaboration on other facilities
 - Research plan for first 1-2 years of NSTX-U operation
 - Advise on ways to increase participation by universities, early career researchers, students in NSTX-U program
- Dry runs will be held weeks of May 19, 26, June 2
 - Likely presenters (you know who you are), please stay available as best as possible during these weeks

FESAC – Developing a 10 year strategic plan

- The FY 2014 Omnibus Appropriations Act requires the Department to submit a strategic plan for the FES program by January 2015 with the following guidance:
 - "The ten-year plan should assume U.S. participation in ITER and assess priorities for the domestic fusion program based on three funding scenarios with the fiscal year 2014 enacted level. Funding baseline: (1) modest growth, (2) budget growth based only on a cost-of-living-adjusted fiscal year 2014 budget, and (3) flat funding...."
- Possible/tentative weeks for public comment/input:
 - Weeks of June 2, July 7
- **We may be asking for your help on developing input**
- Final report due to DOE by October 1(!)

Specific charge to FESAC points to new organizing principles/categories for FES science program

- “We ask FESAC to assess the priorities among continuing and potential new FES program investments required to ensure that the U.S. is in a position to exert long term leadership roles within and among each of the following areas:
 - Burning Plasma Science: Foundations- the science of prediction and control of burning plasmas ranging from the strongly driven to the self-heated state;
 - Burning Plasma Science: Long Pulse -the science of fusion plasmas and materials approaching and beyond ITER-relevant heat fluxes, neutron fluences, and pulse lengths;
 - Discovery Plasma Science: the study of laboratory plasmas and the high energy density state relevant to astrophysical phenomena, the development of advanced measurement for validation, and the science of plasma control important to industrial applications.”