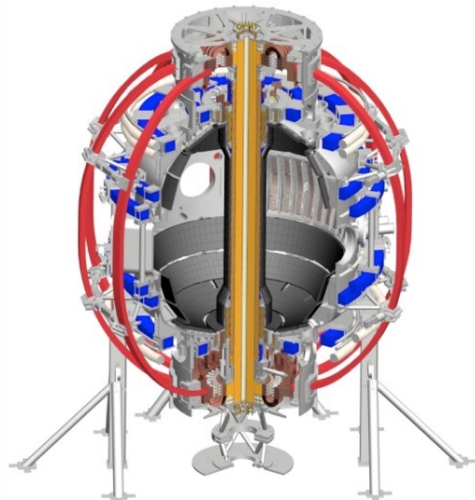


## NSTX-U Pedestal Structure & Control TSG

A. Diallo, R. Maingi, D. Smith

NSTX-U Pedestal NSTX-U Forum  
February 24, 2015

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

## 22 Proposals were submitted in the Pedestal TSG

- Proposals were organized into 4 groups
  - Pedestal stability, turbulence, and impurity effects ( 7 ideas)
  - ELMs and 3D Physics (4 ideas)
  - Pedestal structure and L-H transition (4 ideas)
  - Alternative scenarios and pedestal manipulations (5 ideas)
- After the presentations, we had a good discussion within the TSG to tentatively prioritize

# Highlights of the proposals - Pedestal stability, turbulence, and impurity effects

- **Understanding impurity transport mechanisms in the plasma pedestal** - Loarte
  - Determine the impurities (Ne Ar, Xe) profiles in the pedestal to test neoclassical predictions for ITER
- **Understanding of pedestal anomalous transport reduction/increase from L-mode to Type I ELMy H-mode and back** - Loarte
  - Measure the ETB transport evolution for L to ELMy and back to L mode
- **Effect of neutral particles on upstream and pedestal turbulence** -Chang
  - Validate the XGC1 results on the effects of neutral on the pedestal turbulence
- **Effects of different impurities on pedestal structure** - Osborne
  - Test He, Li, B, N, Ne, Ar effects on pedestal over a range of  $I_p$  , BT , Pnbi : Multi machine XP
- **Pedestal peeling-ballooning mode stability along the ballooning boundary** - Osborne
  - Low triangularity required to reach ballooning limit
- **Investigations of nonlinear ELM dynamics** - Smith
  - Perform kappa scans in ELMy discharges to understand the nonlinear ELM dynamics
- **ELM-induced fueling effects on the pedestal evolution** - Diallo
  - Understand the outgassing effects on the pedestal evolution

# Highlights of the proposals - 3D Physics

- **Resonant ELM frequency behavior as a function of  $q_{95}$  with 3D fields** - Lore
  - Look for resonant behavior in frequency vs  $q_{95}$  with 3D fields on NSTX-U
- **ELM suppression with mid-plane coils** - Ahn
  - Higher aspect ratio in NSTX-U favorable for lower  $q_{95}$
- **Impact of 3-D fields on pedestal profiles under varying wall conditions and collisionality** - Canik
  - Response of profiles to 3D fields with/without lithium will be revisited, extended to low collisionality
- **Interaction of LGI with 3D fields** - Gan
  - Investigate ELM frequency and size with combined LGI and 3D field application

# Highlights of the proposals - Pedestal structure and L-H transition

- **Multi-machine studies of the L-H power threshold dependence on aspect ratio** - Bongard
  - Test ITPA L-H scalings for low aspect ratio - multi - machine experiment with Pegasus
- **Effect of beam tangency radius on H-mode access and quality with XGC simulations** - Churchill
  - Effect on L-H power threshold and H-mode quality and comparison with XGC suites of codes
- **Characterization of the Pedestal Structure as function  $I_p$ , BT, and  $P_{nbi}$**  - Diallo
  - Document the pedestal structure and test EPED model for NSTX-U
- **Effects of B-> Li transition on the pedestal structure** - Maingi
  - Document the transition and impact on the pedestal

# Highlights of the proposals -

## Alternative scenarios and pedestal manipulations

- **Pedestal rotation shear enhancement with high-n NTV braking and 2nd NBI** - Menard
  - Try broad/varied NBI deposition + vary outer gap and NTV (both DC and pulsed)
- **Comparison of H-mode pedestal with RF and NBI** - Maingi
  - Systematic comparison of the pedestal characteristics of RF heated H-modes with NBI heated H-modes
- **Can SOL heating from HHFW improve pedestal stability?** - Smith
  - Explore HHFW mode and frequency scans to provide SOL heating
- **Effect of poloidal variation of gas fueling on H-mode access and sustainment** - Churchill
  - Understand using XGC0 simulations, varying the poloidal fueling location
- **Generating and Characterizing the Edge Harmonic Oscillation via Counter- $I_p$  Torque Injection** - McKee
  - Use the DIII-D prescription to generate EHO on NSTX-U
- **Ideas for Control of Pedestal** - Kolemen
  - Reduce the EHO frequency as low as possible using magnetic braking and control of actuators (e.g, LGI, 3D fields) to enhance the pedestal

# Programmatic considerations for XP prioritization

- ☑ Viability of proposal given available NSTX-U capabilities
- ☑ NSTX-U Research Milestones
- ☑ ITER and ITPA
- ☑ Experiments leading to high-profile publications/ presentations
- ☑ Career development: PhD thesis, post-doctoral research
- ☑ Maximize institutional / researcher breadth of XP leadership

**Priority 1** → **5 days**

**Priority 2** → **3 days**

Title of proposal	Names	Pri.	P1-day	P2-day	B vs Li	Note
Understanding impurity transport mechanisms in the plasma pedestal	Loarte	1	1		either	Spectroscopy technically feasible?
Effect of neutral particles on upstream and pedestal turbulence	Chang					
Effects of different impurities on pedestal structure	Osborne				B	
Multi-machine studies of the L-H power threshold dependence on aspect ratio	Bongard	1	1		B	priority 1 or 2?
Effect of beam tangency radius on H-mode access and quality with XGC simulations	Churchill					
Understanding of ped. anom. transp red/increase L-mode to Type I ELMy H-mode and back	Loarte					
Characterization of the Pedestal Structure as function Ip, BT, and Pnbi	Diallo	1	1		both	
Resonant ELM frequency behavior as a function of q95 with 3D fields	Lore	1	1	0.5	P1: B	cut B or Li part?
Impact of 3-D fields on pedestal profiles under varying wall conditions and collisionality	Canik				P2: Li	
ELM suppression with mid-plane coils	Ahn					
Effects of B-> Li transition on the pedestal structure	Maingi	1	1		both	reduce runtime?
Exploration of I-mode regime on NSTX-U	Hubbard	1	1		Li	postpone to full field? w/ PCTF?
Investigations of nonlinear ELM dynamics	Smith	2		1	B	some overlap with Diallo.
Pedestal peeling-ballooning mode stability along the ballooning boundary	Osborne				req low triangularity	
Pedestal rotation shear enhancement with high-n NTV braking and 2nd NBI	Menard	2		1	Li	EHO initiative? w/ PCTF? P1 or P2?
Generating and Characterizing the EHO via Cnt-Ip Torque Inj.	McKee				EHO initiative? w/ PCTF? P1 or P2?	
Effect of poloidal variation of gas fueling on H-mode access and sustainment	Churchill	2		0.5	either	is absolute neutral density required? w/ ASC
Interaction of LGI with 3D fields	Gan	pb				initial data from PCTF
Comparison of H-mode pedestal with RF and NBI	Maingi	pb				
Can SOL heating from HHFW improve pedestal stability?	Smith	pb				connection to EHO initiative?
ELM-induced fueling effects on the pedestal evolution	Diallo	pb				data from groups 1 & 2