

Wave-Particle Interactions Research Summary for FY11-FY12 NSTX Run

Gary Taylor

Group Leader

Mario Podestà

Deputy Group Leader

Nikolai Gorelenkov

Theory & Modeling

FY2011-12 NSTX Research Forum
March 18, 2011

Run Time Allocation, Milestones & ITER/ITPA Issues for NSTX WPI TSG Experiments in 2011-2012

Guidance for Time Allocation: 10 days (FY11 + FY12)

- 3 (+1) days 1st (+2nd) priority for FY11
- 4.5 (+1.5) days 1st (+2nd) priority for FY12
- *28 XP's proposals, 26.75 days total requested (17.3 days minimum useful)*

Research Priorities:

- Utilize HHFW heating and current drive to assist non-inductive plasma current ramp-up and sustainment (R12-2) [with SFSU TSG]
- Characterize and optimize high-harmonic fast wave coupling in deuterium H-mode plasmas
- Assess predictive capability of mode-induced fast-ion transport (IR12-2)
- Extend TAE/EPM studies to H-mode plasma

ITPA Participation:

- TC-9 Scaling of intrinsic plasma rotation with no external momentum input
- TC-14 RF rotation drive
- IOS-5.2 Maintaining ICRH coupling in expected ITER regime
- EP-2 Fast-ion loss and redistribution from localized *AEs
- EP-4 Effect of dynamical friction (drag) at resonance on nonlinear *AE evolution
- EP-6 Fast ion losses, associated heat load from 3D fields

Run Time Allocation, Milestones & ITER/ITPA Issues for NSTX WPI TSG Experiments in 2011-2012

- 2 1/2 hours for presentations, 1 hour discussion & planning
- Presentations included discussions/proposals on needs for RF, EP modeling and code validation
- Proposed ideas combined/prioritized

- 14 (combined) XP's received run time
 - 9 first-priority XP's, contributing to R12-2, IR12-2, ITPA/ITER
 - 5 second-priority XP's, contributing to ITPA/ITER, modeling
 - *Strong synergy between experiments and theory/code validation*

- 2 [3] XMP's
 - HHFW plasma commissioning, 4 days
 - tFIDA commissioning, 1 day
 - [TAE antenna commissioning]

- **Request for 1 day from Cross-cutting/Development for scenarios requiring HHFW (WPI and other TSG's)**

HHFW Experiments

Title	Priority 1 FY11 Run Time	Priority 2 FY11 Run Time	Priority 1 FY12 Run Time	Priority 2 FY12 Run Time	Notes	Related Milestone	ITPA Task NSTX-U
Low Plasma Current Fully Non-Inductive HHFW H-Mode	0.50				XP1009/10 With SFSU TSG (FY12: 1 day) & ASC TSG	R12-2	IOS-5.2
HHFW Ramp Up of Inductively Initiated Plasma from 250 to 400 kA			0.50		With SFSU TSG (FY11: 0.5 days) & ASC TSG	R12-2	IOS-5.2
HHFW Heating of CHI-initiated Plasma			0.50		With SFSU TSG (FY11: 0.5 days, FY12: 0.5 days) & ASC TSG	R12-2	
Study HHFW Power Coupling Versus ELM Activity, Edge Losses	0.50		1.00		XP1016/17; Support RF modeling Need 1 day in FY11 as Cross-cutting to support other TSG's (S. Sabbagh)		IOS-5.2
HHFW Absorption in NBI-Heated Plasmas	1.00		0.50		XP-1012; Support RF modeling		IOS-5.2
Measure HHFW Wavefield		0.50			HHFW amplitude modulation @10kHz		
HHFW Plasma Conditioning to High RF Power	4				XMP		
	2	0.5	2.5		(Not including XMP's and 1 day for Cross-cutting/Development)		

EP Experiments

Title	Priority 1 FY11 Run Time	Priority 2 FY11 Run Time	Priority 1 FY12 Run Time	Priority 2 FY12 Run Time	Notes	Related Milestone	ITPA Task NSTX-U
TAE Dynamics vs. Plasma Rotation			0.50		Complement data from XP-1015 for IR12-2	IR12-2	EP-2
Document of High Frequency CAE			0.50		Target plasma from XP1011		EP-2
Documentation of Angelfish				0.50	XP1014, Requires B _t ~ 2.5 kG; possible piggyback on ASC-TSG experiments		EP-2, EP-4
H-mode TAE Avalanches	1.00		0.50		XP1011, Extend IR12-2 to H-mode	IR12-2	EP-2, EP-4
Effect of Induced 3D Fields on Fast-Ion Distribution	0.50	0.50			Modeling with SPIRAL, NUBEAM, and FIDASIM		EP-6, ITER
High Energy Feature Study with NPA and NBI Scans				0.50	Modeling with SPIRAL		EP-2
Effect of *AEs on NBI CD efficiency				0.50		IR12-2	
t-FIDA Commissioning	1.00				XMP		
TAE Antenna Commissioning			0.5		XMP - May try with 2 HHFW antenna straps		
	1.5	0.5	1.5	1.5	(Not including XMP's)		
Total HHFW+EP	3.5	1	4	1.5	(Not including XMP's, Cross-cutting/Development)		

Backup slides

WPI TSG Run Time Request & Guidance

- 28 XP ideas requesting 26.75 run days, 17.3 minimum run days needed:
 - 10 XP's address NSTX research milestones
 - 21 XP's address ITPA tasks
 - 3 XP's are preparation for NSTX-U
- 3 XMPs; HHFW conditioning (4 days), tFIDA (1 day), TAE antenna (1 day)
- WPI TSG guidance:
 - FY11: 1st priority = 3 days + 2nd priority = 1 day
 - FY12: 1st priority = 4.5 days + 2nd priority = 1.5 days
- Requesting 1 day from CC/E for HHFW coupling to H-mode plasmas
- Requesting some run time for low I_p HHFW from SFSU TSG

WPI TSG Meeting Agenda

Time	Presenter	Title	WPI#	Requested Time	Minimum Time
9:00	G. Taylor	FY11-12 WPI TSG Resaerch Planning			
		Low Plasma Current Fully Non-Inductive HHFW H-Mode	1	1.5	1
		HHFW Ramp Up of Inductively Initiated Plasma from 250 to 400 kA	2	1	1
		HHFW Heating of CHI-initiated Plasma	3	1.5	1
		Assess HHFW+NBI H-Mode Operation with Pnbi ~ 6 MW	4	2	1
9:15	J. Hosea	Study HHFW Power Coupling Versus ELM Activity	5	2	1
		RF Heating at Divertor/SOL Regions	6	2	1
		Turbulence Characteristics for HHFW Saturated Stored Energy versus RF Power	7	1	0.5
9:30	M. Podesta	HHFW Absorption in NBI-Heated Plasmas	8	1	1
		Dependence of TAE Dynamics on Plasma Rotation	9	1	0.5
		Clamping of Edge Rotation by HHFW	10	0.5	0.5
9:45	E. Fredrickson	Documentation of GAE Avalanches	11	1	0.5
		Document of High Frequency CAE	12	0.5	0.5
		Documentation of Angelfish	13	1	0.5
		H-mode TAE Avalanches	14	1	1
		TAE Antenna Commissioning	15	1	0.5
10:05	M. Bell	HHFW Heating to Increase Non-Inductive Current Fraction in NBI H-modes	16	1.25	0.5
10:10	N. Crocker	Investigation TAE Radial Phase Variation	17	0.5	0.25
		Reflectometer Array			
10:20	D. Smith	Measure HHFW Wavefield	18	0.5	0.25
10:25	D. Green	Benchmark Predictive Capability of Advanced Quasi-linear RF Simulation Codes.	24	0	0
10:30	R. Maingi	Comparison of H-mode Pedestal Characteristics with RF and NBI	20	1	0.5
10:35	A. Loarte	Assessment of effects of 3-D fields on fast particle losses in ITER	27	2	1
10:40	A. Bortolon	Effect of Low Frequency MHD on Fast-Ion Confinement	21	1	1
		Effect of Induced 3D Fields on Fast-Ion Distribution	22	1.5	1
		t-FIDA Commissioning	28	1	0.5
		Effect of High Frequency Bursting Modes on NBI Current Drive Efficiency	26	0.5	0.5
11:00	A. Diallo	Plasma Current Scaling of the Pedestal Structure in RF Heated ELMy H-mode	25	0	0
11:05	S. Medley	High Energy Feature Study with NPA and NBI Scans	23	0.5	0.3
11:10	S. Kaye	Assessment of Fast Ion Loss by Microturbulence	19	1	1
11:15	G. Taylor & M. Podesta	Discussion, Consolidation & Prioritization of XPs (until about noon)			
			Run Days	26.75	17.3
			Run Time Guidance Days	10	10
			XMP Days (excluding HHFW)	2	
			XMP Days (including HHFW)	6	

Considerations for XP Prioritization

(in approximate priority order)

- Viability of proposal given available NSTX capabilities
- Joint Research Milestones
- NSTX Research Milestones:
 - Annual milestones + other ST high priority research
 - NSTX-Upgrade design needs
- ITPA , especially where NSTX is lead/prominent experiment
- Experiments leading to high-profile publications/presentations:
 - PRL, Science, Nature / Invited talks: IAEA, APS, EPS
- Career development: PhD thesis, post-doctoral research
- Any good idea generated during run