NSTX

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Overview of the 2008 Experimental Campaign

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Run Coordinator

NSTX Results Review

Princeton Plasma Physics Laboratory

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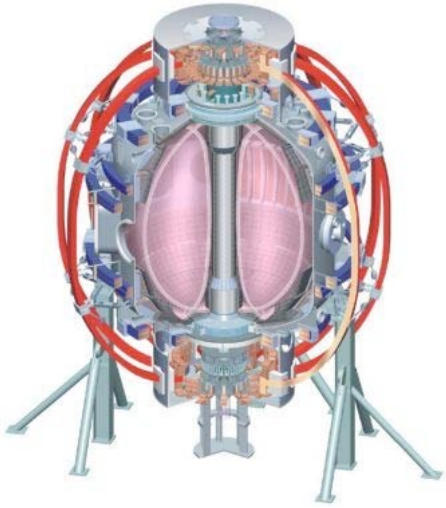

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2008 Run Addressed Four Research Milestones

- **Joule milestone: Evaluate the generation of plasma rotation and momentum transport, and assess the impact of plasma rotation on stability and confinement**
- **R(08-1): Measure poloidal rotation at low A and compare with theory**
- **R(08-2): Couple inductive ramp-up to CHI plasmas**
- **R(08-3): Study variation and control of heat flux in SOL**

- Also included NSTX contributions to resolving high priority issues for ITER
  - **ELM control and suppression by externally applied fields**
  - **RWM control with coils similar to ITER port-plug coil design**
  - **Vertical control requirements, VDE avoidance**
- Investigated two lithium coating techniques: dual LITERs, powder dropper

NSTX Scientific Leadership for 2008

	Coordinator	Deputy	
Run coordination	Michael Bell	Roger Raman (U. Washington)	
Topical Science Group	**Leader**	**Deputy**	**Theory Liason**
Macroscopic Stability	Steve Sabbagh (Columbia U.)	Stefan Gerhardt	Josh Breslau
Transport and Turbulence	Stan Kaye	Kevin Tritz (Johns Hopkins U.)	Taik-Soo Hahm
Boundary Physics	Vlad Soukhanovskii (LLNL)	Rajesh Maingi (ORNL)	Darren Stotler
Wave-Particle Interactions	Gary Taylor	Eric Fredrickson	Nikolai Gorelenkov
Advanced Scenarios and Control	David Gates	Jon Menard	Chuck Kessel
Solenoid-free Start-up and Ramp-up	Roger Raman (U. Washington)	Dennis Mueller	Steve Jardin

In 2008, 43 Experimental Proposals Were Performed

- Run planning started with Research Forum at PPPL 11/27-29
  - TSG leaders defined 2 highest priority themes for each topical area
  - Started under a cloud after "2-years to live" announcement by DOE
  - NSTX Program Head provided initial guidance on runtime allocation
    - Runtime was then uncertain: 12 – 18 weeks
    - Reserved 15% for "cross-cutting" activities, 20% for later allocation
    - 3 days were initially allocated for specific ITER support
    - Distributed balance *per stirpes* to TSGs, adjusting for contributions to milestones, exploiting new capabilities, and ITPA, BPO interests
  - TSGs reviewed proposals, identified gaps, overlaps
- 39 new XPs developed; 4 existing XPs updated
- 12 XMPs (9 new) were also performed
- Achieved 16.6 run weeks, exceeding milestone target of 15
  - Run lasted from Feb 18 through July 14 (21 calendar weeks)

Final Allocation of Run Time Matched Target Reasonably Well

TSG	XPs, XMPs	Initially allocated rundays	Rundays used	Allocation with scaled reserve	Fraction of runtime used (%)
ASC	5	6.5	5.9	8.2	8
BP	11	9	14.4	11.3	19
MS	8	9	12.3	11.3	16
SFS	1	7.5	8.3	9.4	11
TT	10	9	12.7	11.3	17
WPI	6	7	7.2	8.8	9
XC	12	10	9.1	12.5	12
ITER	2	3	6.8	3.8	9
Reserve		14			
Totals	**55**	**75**	**76.5**	**76.5**	**100**

- BP, MS, SFS, TT SFGs included 2008 Milestone experiments
- Routine LITER operation developed by BP benefitted all TSGs
- All XMPs were counted as “cross-cutting and enabling”
- Daily “fiducial” shots were not included in totals (total ~2 rundays)

Number of Experiments Performed Limited by Run Time Available

TSG	2008#				2007*				2006			
	Proposals		Rundays		Proposals		Rundays		Proposals		Rundays	
	Submitted	Executed	Requested	Used	Submitted	Executed	Requested	Used	Submitted	Executed	Requested	Used
ASC (ISD)	14	5	12	6	14	4	24.5	7	16	2	14	4.5
BP	22	11	25.5	14.5	36	12	34	10.5	34	9	32.5	15
MS (MHD)	16	8	17.5	12.5	32	15	20.5	17	7	4	8	8.5
SFS	6	1	11	8.5	7	2	18	4.5	6	3	16	6.5
TT	19	10	20	12.5	25	9	11.5	13	24	7	27	9
WPI	26	6	24	7	9	3	14.5	5.5	13	4	15.5	5.5
Cross-cutting		14		16		3		6		8		8.5
Total	**103**	**55**	**110**	**77**	**123**	**48**	**123**	**63.5**	**100**	**37**	**113**	**57.5**

In 2008, "Cross-cutting" included 2 ITER ELM XPs for 7 rundays

* in 2007 only, MHD TSG included fast-ion MHD otherwise in WPI

"Cross-cutting" includes XMPs for startup plasmas, HHFW conditioning, hardware & diagnostic commissioning & calibration

Week	Monday	Tuesday	Wednesday	Thursday	Friday
Jun 07 – Jan 18 08	Outage				
Jan 21 – 25	ISTP-1 Coil tests	ISTP-1 Coil tests	MP-48 First plasmas Boronization 64	MP-48 Startup plasmas	MP-48 Startup plasmas
Jan 28 – Feb 1	MP-48 Startup plasmas	MP-48 Startup plasmas	Boronization 65 MP-48 Startup plasmas	MP-48 Startup plasmas	MP-48 Startup plasmas XP-806 BEaP
Feb 4 – 8	MP-48 Startup plasmas	MP-48 Startup plasmas	MP-48 Startup plasmas	MP-33 MSE calibration	Bakeout preparation
Feb 11 – 15	Bakeout			Boronization 66 (hot)	Bakeout recovery
Feb 18 – 22	MP-48 Assess conditions	XP-801 2/1 NTM self-stabilization	XP-810 2/1 NTM thresh-hold with EFC	MP-54 FIDA checkout XP-806 BEaP	XP-811 Vertical stability XP-818 ELM suppression
Feb 25 – 29	XP-812 Rot'n & conf't	MP-26 HHFW cond.	XP-812 Rot'n & conf't XP-820 Core momentum Boronization 67	XP-609 ELMs vs drsep	XP-721 Small ELMs XP-809 ELM destabilize
Mar 3 – 7	XP-818 ELM suppression	XP-805 n=2 EFC	MP-26 HHFW cond.	XP-804 NTV with n=2	XP-818 ELM suppression
Mar 10 – 14	XP-817 CHI + induction	XP-817 CHI + induction Boronization 68	XP-817 CHI + induction	XP-813 Momentum transp.	XP-820 Core momentum
Mar 17 – 21	Maintenance 1 (LITER Bay K installation)				
Mar 24 – 28	Boronization 69 XP-818 ELM suppression	XP-822 B-scaling of e-tran	XP-814 Divertor detach't	XP-816 Edge charact'n	XP-823 EFC + long pulse
Mar 31 – Apr 4	Boronization 70 XP-817 CHI + induction	MP-26 HHFW cond.	XP-821 High-k with HHFW	XP-825 HHFW-CD in D L-mode	XP-819 Fast ion transp. (control problem)
Apr 7 – 11	XP-819 Fast ion transp. (control problem)	XP-815 SOL & divert flux Boronization 71	XP-817 CHI + induction	XP-819 Fast ion transp.	XP-802 RWM optimize
Apr 14 – 18	Maintenance 2 (LITER Bay F installation, LITER controls)				

Week	Monday	Tuesday	Wednesday	Thursday	Friday
Apr 21 – 25	XP-807 NPA vert scan XP-831 Fast-ion transport	XP-529 Pedestal A dep. XP-816 Edge character'n	XP-825 HHFW L-mode XP-814 Divertor detach't	XP-830 RWM physics	XP-832 HHFW accel NBI XP-826 X-point limiter
Apr 28 – May 2	XP-815 SOL & divert flux XP-814 Divertor detach't Boronization 72	XP-831 Fast-ion transport XP-829 Shear & transport	XP-805 n=2 EFC & RWM XP-804 n=2 NTV	XP-823 Long pulse with EFC	XP-807 NPA vert scan XP-826 X-point limiter XP-824 Gas balance
May 5 – 9	XP-821 High-k with HHFW heating	XP-827 Dual LITER	XP-827 Dual LITER	XP-827 Dual LITER XP-823 Long pulse with EFC	MP-26 HHFW condition XP-829 Shear & transport
May 12 – 16	Maintenance 3 (LITER reload)				
May 19 – 23	XP-827 Dual LITER	XP-818 ELM suppression XP-836 High κ	XP-821 High-k with HHFW heating	XP-829 Shear & transport XP-529 Pedestal A dep. NB bellows leak XP-806 BEaP	XP-833 Halo currents
May 26 – 30	Holiday	MP-55 MPTS align XP-806 BEaP XP-833 Halo currents	NB bellows repair		
Jun 2 – 6	XP-817 CHI + induction	XP-817 CHI + induction	MP-26 HHFW condition XP-825 HHFW L-mode	XP-506 OH H-mode XP-824 Gas balance	NB bellows repair
Jun 9 – 13	NB bellows repair and reconditioning				

LITER operation

Week	Monday	Tuesday	Wednesday	Thursday	Friday
Jun 16 – 20	XP-833 Halo currents XP-826 X-point limiter	XP-836 High κ MP-56 SWIFT	XP-812 Rot'n & conf't XP-813 Momentum transp.	XP-813 Momentum transp. XP-820 Core momentum XP-836 High κ	XP-829 Shear & transport XP-821 High-k with HHFW heating
Jun 23 – 27	XP-809 ELM destabilize XP-529 Pedestal A dep.	XP-819 Alfvén avalanches MP-58 TGS commission	XP-808 Alfvén cascades	XP-801 2/1 NTM self-stabilization XP-810 2/1 NTM thresh-hold with EFC	XP-830 RWM physics XP-802 RWM optimize
Jun 30 – Jul 4	XP-834 3/2 NTM	XP-839 Edge turbulence XP-840 GAEs & e-transp	XP-840 GAEs & e-transp XP-828 Li powder	XP-838 Density red'n for long pulses	Holiday
Jul 7 – 11	XP-817 CHI + induction	XP-817 CHI + induction	MP-33 MSE calibration MP-59 NB species mix	XP-835 HHFW H-mode XP-802 RWM optimize	MP-60 NB control XP-809 ELM destabilize XP-841 L-H vs rotation XP-814 Divertor detach't
Jul 14 – 18	XP-841 L-H vs rotation XP-819 Fast ion transp. XP-804 n=2 NTV MP-57 Li-CHERS	**Diagnostic calibrations**			
Jul 21 –	**Outage**				

LITER operation

Thanks to All the Team for a Productive 2008 Experimental Campaign

- We addressed all our milestones diligently
  - With analysis now underway we should be in a position to claim success
- ITER support experiments produced some very interesting results
  - Different from initial expectations but potentially important
- Lithium evaporation with dual LITER system became a reliable, routine tool benefitting a range of experiments
  - >100g deposited on PFCs through run
  - Reloaded evaporators 3 times
  - Use of LITER accelerated shot rate by eliminating between-shot HeGDC
- Chronic problem with underestimating time needed for experiments
  - 5 XPs did not receive their original requests: none completed
  - Remainder met or exceeded their requests: not all completed
    - Overran by up to factor 6 (logbook entries) or 5 (analyzable shots), geometric mean 1.8
  - HHFW conditioning (XMP-26) took 4 days: twice original request
  - Sometimes the experiment involves pushing the boundaries, *but*
  - We should be able to do better
    - Consider this at the Run Assessment on Friday