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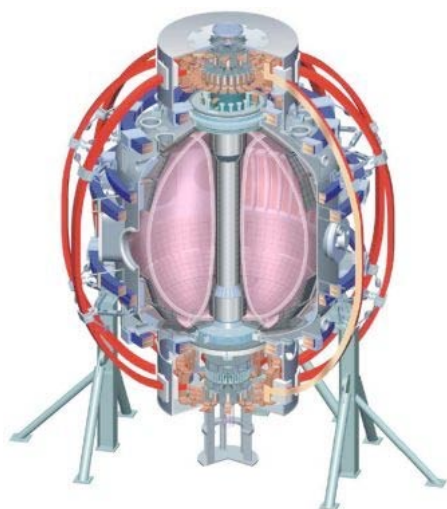
Office of
Science



NSTX Program Governance, Research Support and Facility Operation

M.G. Bell, PPPL
for the NSTX Research Team

NSTX 5 Year Plan Review for 2009-13
Princeton Plasma Physics Laboratory
July 28-30, 2008



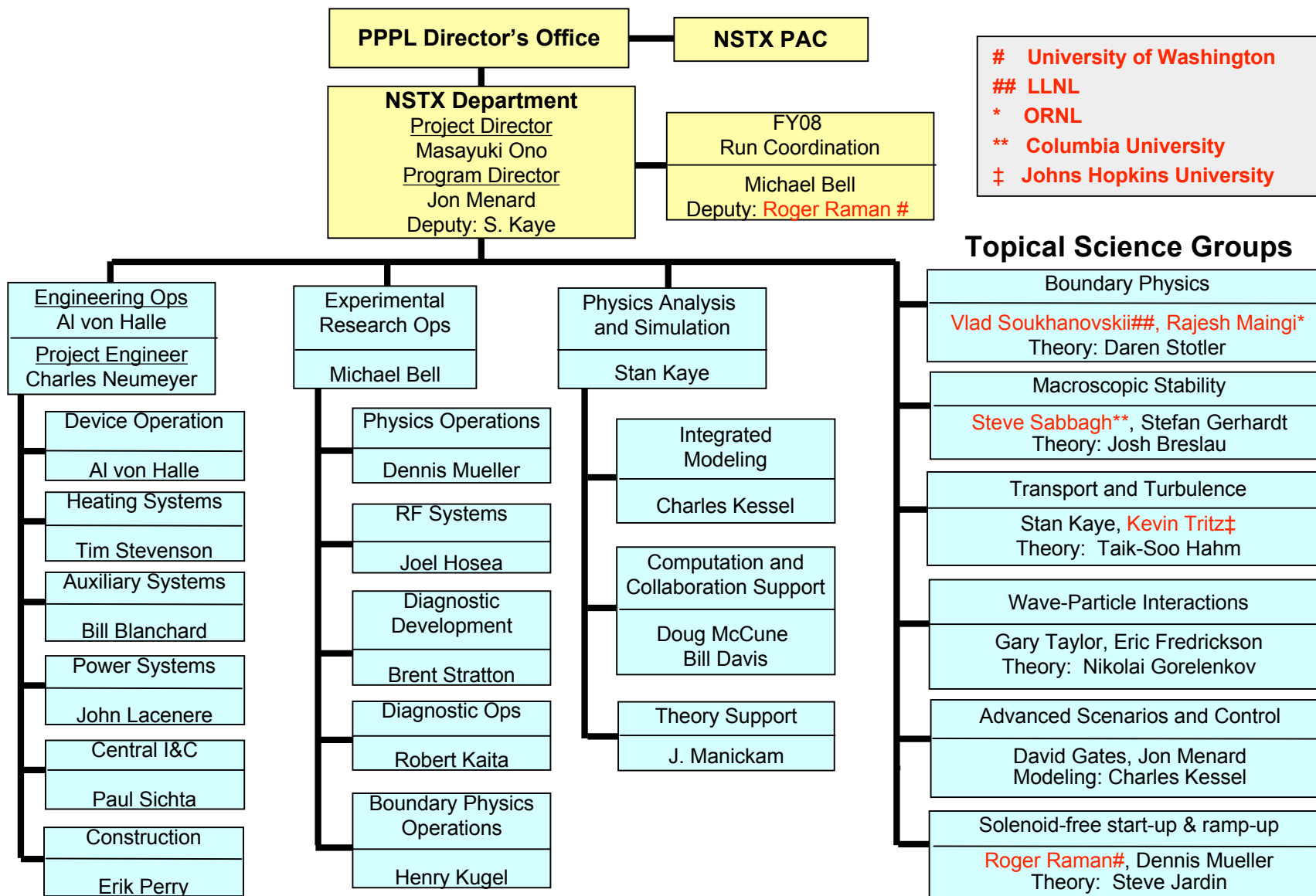
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Topics and Relationship to Review Charge



NSTX Organization Within PPPL



NSTX Draws on and Benefits from the Resources, Infrastructure and Staff at PPPL

Research environment and resources

- NSTX Test Cell and associated diagnostic laboratories
- Pulse power systems: *flywheel MG sets, rectifiers*
- Auxiliary plasma heating equipment and expertise: *NBI, ICRF*
- Machine shops: *diagnostics, lithium technology*
- Coil winding facilities: *new PF1A coils*
- Computing facilities and networks: *data management and access*

Experienced, well-qualified staff

- Research staff (including 41 APS Fellows of DPP, 3 PU faculty)
- Graduate students & post-doc (from PU)
- Engineering expertise: *design, electrical, I&C, mechanical, software*
- Procurement and quality assurance organizations
- ES&H organization

For additional details, see presentation by A. vonHalle at Facility Review

Since Its Inception, NSTX has Involved Collaborators Extensively

- Collaborations involve a broad group of domestic and international users
 - Collaborators were involved in originally proposing, designing NSTX
 - Many diagnostic systems are built and operated by collaborators
- Of 189 researchers (including students & post-docs) associated with NSTX:
 - 59 are from PPPL and PU,
 - 87 are from 22 US institutions (~60% personnel, ~40% FTE of US effort)
 - 18 of these are located at PPPL long-term (≥ 1 year)
 - 43 are from institutions in other countries
- DOE annually solicits proposals for collaboration with NSTX
 - Both new proposals and renewal of existing collaborations
 - Collaborations are competitively peer-reviewed on a three-year cycle
- Collaborators participate fully in the research program
 - Meetings of research team to plan upgrades and research
 - Proposing, developing and executing experiments
 - Reviewing, analyzing and discussing results
 - Publishing and presenting the results of their work

NSTX Collaborations are Governed by Formal Arrangements

- Record of Discussion
 - Results of discussions between prospective collaborators and an NSTX Research Contact in support of proposals submitted to DOE
 - Includes goals of research, describes on- and off- site components of work involved and estimates of support required from NSTX
- Record of Agreement
 - Describes agreed commitments of resources, equipment and facilities by a collaborating institution and NSTX
- Data Usage Agreement
 - Governs access to and publication of data
 - Provides for project and peer review of external publications
 - Policies for access to, use and publication of NSTX data are the same for PPPL staff and collaborators

Leadership of NSTX Topical Science Groups Plays a Major Role in Governing the Research Program

- Determine and address highest priority scientific issues within a topical area through discussion and consensus at open meetings
- Organize the NSTX Research Forum sessions for the TSG
- Draft scientific milestones utilizing expertise of the TSG
- Propose and execute experiments to achieve milestones and address priorities
- Define facility and theory resources to achieve research goals
- Aid dissemination of results with Physics Analysis & Simulation Division
 - Journal publications, invited talks, seminars, colloquia, conferences, ITPA, BPO
- Provide summaries of scientific progress at NSTX monthly team meetings and other venues to promote discussion
- Assist and report to the NSTX Program and Project directors

NSTX Scientific Leadership for 2008 Run

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

- Forms an integrated research team to take advantage of unique facilities

Developing the NSTX Research Program

- Guided by NSTX mission
 - Provide the physics basis for future ST-based devices
 - Broaden the basis for ITER, participating in ITPA and USBPO
 - Advance the understanding of toroidal magnetic confinement and evolving device and diagnostic capabilities
- Research Milestones and plans for upgrades are
 - developed by NSTX leadership in discussion with NSTX Topical Science Group leaders
 - reviewed by the NSTX Program Advisory Committee and
 - agreed with DOE as part of the FWP process
 - complemented by Facility and Diagnostic Milestones

Annual NSTX Research Forum Provides Team Members the Opportunity to Propose Experiments

- Held at PPPL over 2¹/₂ days ~2 months before start of experiments
 - Involves wide participation, both on-site and by teleconference
- ***Follows an open invitation to submit ideas for experiments***
 - Provided guidance from TSG Leaders on 2 highest priority themes for each topical area
- In opening plenary session, NSTX Program Head provides initial guidance on runtime allocation
 - Based on Milestones, facility development, and ITPA, BPO interests
- Include presentations from other facilities (e.g. DIII-D, C-Mod, MAST)
- Proposals for experiments discussed and prioritized by TSGs in breakout sessions (3 serial, 2 parallel, accessible by teleconference)
 - TSGs asked to identify gaps, overlaps and combine if appropriate
- Final plenary session reviews recommended prioritized experiments from TSGs and plans for developing Experimental Proposals (XPs)

NSTX Experimental Proposals Guide Operation During Experimental Operation

- Experimental Proposals (XPs) are documents describing
 - justification for the experiment and that it is well suited to NSTX
 - the plan for executing the required shots and scans efficiently
 - the required machine and diagnostic capabilities
 - plans for analysis, reporting and publication of the results
- XPs are discussed in TSG meetings and recommended for review by the research team led by the Run Coordinator
 - All meetings are open and accessible by teleconference from off-site
 - Review “chits” may be submitted, pointing out deficiencies and/or recommending changes to improve the experiment
- Final version is approved, posted on the Web and a formal “run copy” is prepared when the experiment is scheduled
- NSTX also provides Experimental Machine Proposals (XMPs) which are used to commission new systems or capabilities
 - Reviewed and approved by Experimental Research Operations

In 2008, the NSTX Team Performed 43 Experimental Proposals

- 12 Experimental Machine Proposals were also performed
- Run lasted from Feb 18 through July 14 (21 calendar weeks)
- Included 4 scheduled maintenance weeks, 4 days unscheduled maintenance time and 2 holidays
 - Scheduled maintenance to avoid running during major meetings
- Achieved 16.6 run weeks, exceeding milestone target of 15
- Schedule for experiments in the next 1 - 2 weeks is developed at a weekly Program/Operations meeting chaired by Run Coordinator
 - Adapt schedule to evolving status and availability of facility, heating systems, diagnostics, collaborator travel *etc.*
 - Meeting is accessible by teleconference, schedule is posted on Web and updated as conditions change
 - Schedule up to 4 experiments (XPs and/or XMPs) on each run day
- Daily plan discussed at “8:30am Meeting” and summarized in an email distributed widely

Final Allocation of Run Time Matched Target Reasonably Well in 2008

- At outset of run, ~20% of runtime was held in reserve and ~15% allocated to “cross-cutting and enabling” activities
 - Most of the XMPs were counted as “cross-cutting and enabling”
- For the 2008 run, 3 days were initially provided for specific ITER support

Topic	Experiments performed	Run time guidance (%)	Run time used (%)
Advanced scenarios	5	9	8
Boundary physics	11	12	18
Macro-stability	8	12	16
Solenoid-free startup	1	10	11
Transport & Turbulence	10	12	16
Wave-Particle Interactions	7	9	10
Cross-cutting & enabling	12	13	12
ITER support	2	4	9
Reserve		19	

Results and Analysis of Experiments Presented to and Discussed by the Whole Team

- 5:00pm “end of runday” meeting
 - Progress on performing the plan and highlights of data
- Weekly Physics Meeting
 - Preliminary analysis
- Mid-run Assessment
 - Progress towards meeting milestones
 - Needs for additional runtime to complete experiments
 - Need for experiments not foreseen at Research Forum
- Annual Results Review
 - Progress towards comprehensive analysis and conclusions
 - Plan for publication
- Annual Run Assessment
 - Discussion of successes and difficulties encountered
 - Improving planning and execution of experiments and communication

All meetings are accessible by teleconference

NSTX Facility Operation Efficiency has Steadily Improved Over Last 5 Years

	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008
Run weeks planned / achieved	20 / 21	17 / 18	11 / 12.7	12 / 12.6	15 / 16.6
Hours of operation planned / achieved	800 / 844	680 / 720	440 / 508	480 / 504	600 / 664
Total plasma shots	2460	2221	1617	1879	2571
Plasma shots per run week	117	123	128	149	155

- Facility operations have exceeded all the facility operations milestones for the last Five Year Plan period.
- Plasma shots per week increased by 33% over the period
 - Benefits of improvements learned through Run Assessments
 - Upgrades to real-time plasma control system
 - Lithium evaporator obviates need for between-shots HeGDC

In Last 5 Years, NSTX Consistently Achieved Its Research, Facility and Diagnostic Milestones

- In 2005 – 2007, all 19 Research Milestones were met on time
 - Included 1 Joule milestone for NSTX research in 2007
- Research Milestones for 2008 are on track for completion by September
 - Includes 1 Joule milestone for research on NSTX, DIII-D, C-Mod
- 7 Facility Milestones in 2005 – 2008 (separate from operation targets) were met or are on track for completion on time
- All FEA Diagnostic Milestones in 2005 – 2008 were completed on or before schedule

Maintenance, Repair and Upgrade Activities are Carefully Planned and Managed

- PPPL Work Planning system used to approve and track progress on major activities and upgrades
- Work Permits used to maintain configuration control and proper work practices in NSTX Test Cell
 - Requirements for procedures and permits (e.g. RWP)
 - Provides record for checks of area before resuming operation
- Specific training required for both PPPL and collaborator staff to work in the NSTX Test Cell
 - General Employee Training
 - Radiation Safety Training
 - Lockout/Tagout (Control of Energy Sources)
 - Basic Electric Safety
 - Knowledge of applicable Administrative Procedures
- Periodic Preventive Maintenance is performed on critical systems
 - On-Line Management System is being implemented

Attention to Environment, Safety and Health Central to NSTX Planning, Maintenance and Operation

- DOE Integrated Safety Management is used throughout PPPL to integrate safety into all work planning and execution
- ES&H is a line management responsibility
 - e.g. performing regular safety walkthroughs & work observations
- A Safety Assessment Document is maintained for NSTX
 - Identifies hazards of systems and components
 - Addresses design features & administrative controls to mitigate hazards
 - Provides detailed FMEA of NSTX systems
- Work on NSTX performed using Job Hazard Analyses (JHAs).
- Targeted safety inspections conducted by NSTX Activity Certification Committee for new/modified installations with safety implications
- Safety issues are presented and discussed all Team Meetings
- NSTX received a special NJ State award in March 2008 for working 7 consecutive years (1/1/01-12/31/07) without an away-from-work case

NSTX Provides an Open, Productive and Safe Research Environment for All Team Members

- Drawing on highly qualified staff from PPPL and a broad group of domestic and international collaborators, NSTX has created a well integrated research team to exploit its unique facilities
- Governance practices are designed to promote collaborative research
 - Open access to meetings, data, presentations and documents
 - Allocation of experimental runtime is through an open process
- Topical Science Groups provide scientific leadership for NSTX research
 - About half of the TSG leaders are collaborators
 - About half of invited talks and publications are led by collaborators
- PPPL provides resources and support to promote NSTX research
- Detailed planning and control are applied to ensure that operation is efficient and that commitments are met
- NSTX has consistently achieved its operational goals and its milestones for science, facility upgrades & diagnostic development
- Processes have been established to promote continuous improvement
- There is a strong focus on safety, well supported by PPPL management