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NSTX

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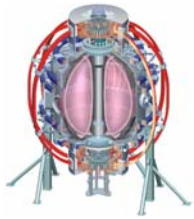
NSTX Run Plan for 2006

NSTX PAC-19 Meeting
PPPL, Princeton, NJ,
15-17 February, 2006



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Outline

- 2006 Research goals
- Research program organized by Experimental Task groups (ETs)
  - MHD (Jon Menard, Aaron Sontag)
  - Wave Particles (Gary Taylor, Phil Ryan)
  - Transport and Turbulence (Michael Bell, Kevin Tritz)
  - Solenoid-free Plasma Startup (Dennis Mueller, Brian Nelson)
  - Boundary (Rajesh Maingi, Vlad Soukhanovskii)
  - Integrated Scenario Development (David Gates, Stanley Kaye)
- Research plan schedule

Program Planning Steps

- NSTX Results Review (Dec 12-13, 05)
- NSTX Research Forum (Dec 14-16, 05)
  - NSTX *milestones* &
  - NSTX *ITPA contributions* used to guide research plan
  - 116 proposals
- 11 Run Weeks in 2006
  - Expect to execute 30-35 proposals

Run Plan breakdown by Experimental Task Groups (based on 41 scheduled days)

Boundary Physics	8 days
Transport and Turbulence	6.5 days
MHD Physics	8 days
Wave Particle Physics	4.5 days
Integrated Scenario Development	5 days
Solenoid-free plasma startup	4 days
Enabling activities	5 days
Contingency	14 days: To be determined at mid-run assessment

Run Plan addresses FY 06 Milestones

ITER/ST Physics

- Boundary physics
  - **Characterize effects of Li wall coatings on recycling [OFES 'tracked' milestone]**
- Transport and Turbulence
  - Measure local high-k turbulence magnitude
- Macroscopic stability
  - Characterize effectiveness of closed-loop Error Field (EF) control using ITER-like control coils

ST/CTF Physics

- Solenoid-free plasma startup
  - Assess requirement for CHI creation of closed magnetic flux

15 ITPA contributions during 2006

- CDB-2: Confinement scaling in ELMy H-modes: β degradation
- CDB-6: Improving the condition of global ELMy H-mode and pedestal databases: Low A
- CDB-9: Density profiles at low collisionality
- PEP-9: NSTX/MAST/DIII-D pedestal similarity
- PEP-16: C-Mod/NSTX/MAST small ELM regime comparison
- DSOL-15: Inter-machine comparison of blob characteristics
- DSOL-18: NSTX/AUG/JET impurity migration and deposition study
- MDC-2: Joint experiments on resistive wall mode physics
- MDC-6: Low beta error field experiments
- MDC-9: Fast ion redistribution by beam driven Alfvén modes and excitation threshold for Alfvén cascades
- SSO-2.1: Complete mapping of hybrid scenario
- SSO-2.2: MHD effects on q-profile and confinement for hybrid scenarios
- SSO-2.3: ρ^* dependence on confinement transport and stability in hybrid scenarios
- DIAG-2: Environmental test on diagnostic fast mirrors (DIAG $\rightarrow$*Diagnostics*)
- DIAG-1: Assessment of the effect of noise on vertical velocity measurement

Possible execution of additional 6 ITPA/ITER contributions during 2006 (TBD after mid-run assessment)

- MDC-5: Comparison of sawtooth control methods for neoclassical tearing modes
- CDB-8: ρ^* scaling along an ITER relevant path at both high and low beta
- TP-6.3: NBI driven momentum transport study
- TP-9: H-mode aspect ratio comparison
- PEP-10: The radial efflux at the mid-plane and the structure of ELMs
- MDC-4: Neoclassical tearing mode physics – aspect ratio comparison

FY 06 Early run emphasizes NSTX Milestones, beginning with Lithium development

- Early run (weeks 1 – 4)
  - Impact of Lithium on plasma operations
  - Measurements of local high-k turbulence
- Mid run (weeks 5 – 8)
  - Closed loop operation of Error - Field Correction Coils
  - CHI closed flux assessment

  Run assessment at 6 weeks:
  - Progress towards Milestone Achievement
  - Progress towards ITPA commitments
  - Opportunities for further scientific advances
  - Decision point on counter injection (requires 2 weeks)

- Late run (weeks 9 - 11)
  - Content determined at mid-run assessment

Boundary Physics (8 days)
Emphasis on Recycling Control

- Milestone (3.5 days + 2 days in ISD group)
  - Recycling control with Li
  - Development of LSN discharges
    - ISD group will develop double null discharges
    - Low density locked modes
  - Supersonic gas injector for fueling
- ITPA contributions (3 days)
  - NSTX/MAST/DIII-D Joint Pedestal parameter dependence on aspect ratio
  - C-MOD/NSTX/MAST small ELM regime comparison
  - Density scaling, erosion measurements, blob characterization in C-MOD/NSTX
- Capability and opportunities (1.5 days + 0.5 days in ISD group)
  - Divertor heat load and detachment
  - Movable glow probe development
  - Divertor Langmuir probe commissioning

Transport and Turbulence (6.5 days)
Emphasis on Electron Transport

- Milestone (5.5 days)
  - High-k diagnostic validation
  - Scaling of perturbed electron transport with collisionality, heat flux and current
  - TESPEL pellet injection
  - Transport in reversed shear discharges
  - Z scaling of impurity transport in beam heated H-mode discharges (Thesis work)

- ITPA contributions (1 day)
  - B_T and β scaling of confinement

MHD (8 days)
Emphasis on Error Field / RWM Control

- Milestone (8 days)
  - Algorithm development and implementation
  - High toroidal beta vs shaping

» Also ITPA contributions (6 days)

  - Dynamic Error Field correction
  - Optimize Error Field vs rotation and low density locked mode
  - Active stabilization of RWM near Omega-critical
  - Active stabilization of low rotation targets
  - RWM dissipation – comparison to theory

Solenoid-free Plasma Startup (4 days)
Emphasis is Closed Flux Assessment

- Milestone (ST specific) (3 days)
  - Transient CHI startup
  - Heating of CHI discharges using HHFW

- ST specific (1 day)
  - Edge current drive by CHI
  - Non-inductive current ramp-up using HHFW (in ISD group)

Wave Particle Interactions (4.5 days)
Emphasis is Fast Ion Interactions with Waves

- ITPA contributions (2 days)
  - Fast ion transport by fishbone and TAE instabilities
  - Characterize Neutral Beam driven current evolution

- ST specific (1.5 days)
  - Thermal EBW emission and oblique O-mode coupling efficiency in L and H-mode plasmas (Thesis)
  - Effect of Li on RF antenna

- Capability and opportunities (1)
  - Measurements of RF power losses and magnetic field magnitude effect on HHFW coupling

Integrated Scenario Development (5 days)
Emphasis is Density Control in Long Pulse H-modes

- ITPA contributions (3.5 days)
  - Long pulse low density target development using EF correction coil [**Boundary milestone**]
  - Long pulse DN target development using rtEFIT [**Boundary milestone**]
  - ELM severity and confinement on boundary shape
  - rtEFIT development
- ST specific (1 day)
  - Non-inductive current ramp up using HHFW
- Capability and opportunities (0.5 day + 0.5 day in Boundary)
  - Divertor detachment by shaping

Breakdown of 55 Run days

	days	% of 41 scheduled days
Milestones	20	**49%**
ITPA 2006 goals	15.5	**38%**
Uniquely ST driven	10.5	**26%**
Additional tokamak	10	**24%**
Enabling tokamak-relevant	5	**12%**
Contingency	14 days	Determined at mid-run assessment

Small aspect ratio in NSTX allows unique and important contributions to ITER, while developing the ST Concept

- Lithium may be a back-up to Be / C / W
- Unique capability for high-spatial-resolution high-k turbulence
- EF/RWM system close in configuration to US proposal for ITER
- $V_{beam} > V_{alfven}$ with full MSE q(r,t)
- Unique ST science:
  - EBW, HHFW, CHI