

Advanced Scenarios and Control TSG Scientific Goals for FY15

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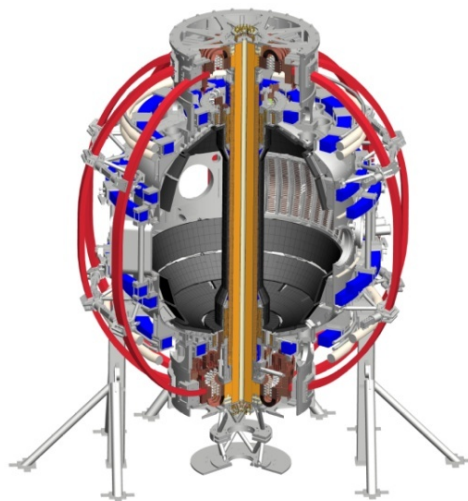
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and the ASC Team

PPPL

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Goals of meeting:

- Review proposed ASC activities for FY15 campaign
 - Establish main scientific goals for FY15 in order to motivate XPs
 - Identify tasks that can be completed or started in first month of FY15
 - Conclusions will be presented at January 29 pre-forum meeting
- Answer Stefan's request for run-time guidance

Run schedule assumptions

FY15			Early FY16	
Run Weeks 1-4	Run Weeks 5-8	Run Weeks 9-12	Run Weeks 13-16	17-18
Commissioning	Science	Science	Science	

Mid-run assessment

Scope of pre-forum meeting #2 - see next page for additional details

Scope of Research Forum

- Pre-forum meeting #2 should emphasize XMP/XP title, goal, author identification to cover first 2 run months (Weeks 1-8)
- Forum should emphasize prioritization of XPs for weeks 3-18, but also document commissioning XMP/XP goals + run-time
- Mid-run (re-)assessment after first 6-8 Science run-weeks

Assumptions for first 2 run-months to use in identifying XMP/XP titles/goals/authors for Jan 29th pre-forum meeting #2

- Machine Commissioning...assume 1 month (run weeks 1-4)
 - Develop basic breakdown, current ramp, shape/position control, diverted plasmas, H-mode access, basic fuelling optimizations.
 - Goal: 1 MA, 0.5 T, NBI-heated H-mode (i.e. ~NSTX fiducial levels)
 - Diagnostic commissioning
 - Boronized PFCs
 - Mostly XMPs
 - **What science (aka XPs) can be done during this phase?**
- 1st Month of Science Campaign (run weeks 5-8)
 - Boronized PFCs, possibly begin lithium coatings
 - Operations and basic profile diagnostics, neutron rate,...
 - Operation up to 1.4 MA and 0.65 T, 2 seconds
 - 6 beam sources up to 90 kV
 - HHFW available for commissioning
 - **What critical XPs can/should be done during this phase?**

Four ASC Research Thrusts Identified in 5 Year Plan

- Scenario development and optimization
 - Demonstrate 100% non-inductive operating points
 - Develop stationary high-current partially-inductive scenarios
- Axisymmetric control development
 - Advance control capabilities (divertor heat flux, profiles, etc.)
- Controlled termination of high- β_N ST discharges
 - Disruption detection and intervention
- Examine critical issues for next-step STs
 - Regimes of classical beam current drive
 - Transport modeling verification and validation

Proposed FY15 Scientific Goals To Motivate and Organize XPs at Forum

- Identify mechanisms limiting vertical stability and what additional capabilities are required for achieving vertical stability at high κ
 - ELMs, li evolution, latency, actuator saturation, measurement noise, ...
- Evaluate access and scalability of three scenario goals:
 - High non-inductive fraction ($I_p \sim 0.7\text{MA}$, $B_T = 0.75\text{T}$)
 - High current ($I_p \sim 1.5\text{MA}$, $B_T = 0.75\text{T}$, 1s)
 - Long pulse ($I_p \sim 1\text{MA}$, $B_T = 0.75\text{T}$, 5s)
- Advance capabilities of tokamak control and disruption avoidance
- Achieve scenarios that advance the verification and validation of transport and confinement modeling and predictive tools
 - Coordinate with Core Science Group
- Evaluate access to low-density startup with minimal LFS fueling
 - Coordinate with Particle Control Task Force

Proposed FY15 Activities Toward Thrust 1 (Scenario Development)

- Develop very high non-inductive fraction discharges at $600 < I_p$ [kA] < 800 at $B_T = 0.75T$ for a few τ_e
 - Connect to NSTX database ($B_T = 0.5T$) at new A, beam tangency
- Current ramp-up with reduced fueling, including required error field reduction studies
- Develop short $B_T = 0.75T$, $I_p < 1.5MA$ discharges for studying confinement and divertor physics
- Achieve 5s pulse duration at $B_T = 0.75T$, $I_p \sim 1.1MA$ with boron and lithium PFC coating

RED: Progress can be made early in run

Proposed FY15 Activities Toward Thrust 2 (Control)

- Retune PD vertical control algorithm and assess limitations on vertical stability at larger A
- Restore SISO boundary and strike point control capabilities
- Begin implementation of rtEFIT improvements
 - Higher resolution (65 x 65), real-time MSE constraints
- Implement real-time X-point tracking and dual X-point control
- Perform initial validation of q_{\min} control via changes in the beam sources in partially inductive scenarios
- Minimize high field side fueling, use SGI as a tool

Proposed Activities (XMP/XP) for Initial Operations in FY15 (priority order)

- Retune PD vertical control algorithm and assess limitations on vertical stability at larger A
- Restore existing NSTX control capabilities
 - Beam control, X-point control, etc...
- Current ramp-up with reduced fueling, including required error field reduction studies
 - Optimize HFS fueling
- Connect to NSTX high-inductive fraction database at new A, beam tangency
 - Perform initial validation of q_{\min} control via changes in the beam sources in partially inductive scenarios

For discussion ...

- Identify authors for initial XMP/XPs suitable for first run period
- Establish run time guidance for Science Group leader
 - How much XP time is needed for each FY15 scientific goal in order to generate a publication or make significant progress?