



Supported by



U.S. DEPARTMENT OF
ENERGY

Office of
Science

Draft FY2014-18 NSTX Research Goals for Waves and Energetic Particles

Gary Taylor
Mario Podesta
Nikolai Gorelenkov

NSTX WEP TSG Meeting
September 1, 2011

Introduction

- Need draft WEP TSG research goals for 2014-18 plan by September 23 in order to impact the diagnostic solicitation decisions
- At this (and probably a subsequent meeting) we will discuss, review and modify the draft WEP TSG goals provided by Jon Menard
- Goals modified assuming upgrade outage starts in fall and ends mid FY2014 ("Plan B"), run "FY2011/12" experiments in FY2014/15

Plan B

FY2011	FY2012	FY2013	FY2014	FY2015
	Upgrade Outage (30 months)		NSTX-U Operations	

- Identify key diagnostics needed to support WEP TSG draft plan goals from the recent NSTX-U diagnostic brainstorming meetings

Long-term WEP TSG Research Goal for 2014-18: Study the effect of multiple, high-frequency, MHD modes and RF heating on NBI-generated fast-ion confinement and test whether RF heating and current drive can generate fully non-inductive NBI+RF H-mode plasmas in NSTX-U

Draft Goals for FY2014-18 EP Research

FY11/12 Goals Moved to FY14/15:

- ✧ Measure fast-ion redistribution with tangential FIDA & *AE eigenfunctions with BES
- ✧ Characterize distribution function modifications induced by *AE modes with tangential & perpendicular FIDA

Draft Goals for FY14-18:

- ✧ Measure *AE activity driven by more tangential 2nd NBI - compare to existing more perpendicular NBI
- ✧ Implement prototype *AE antenna, then design & install upgrade
- ✧ Simulate *AE activity driven by more tangential NBI, extend non-linear models to Upgrade plasmas with 2nd NBI, compare simulations to new data
- ✧ Utilize *AE predictive capability to optimize/minimize *AE activity during non-inductive current ramp-up with 2nd NBI. Compare simulations to experimental results
- ✧ Extend simulations of *AE avalanches to FNSF/Pilot current ramp-up phase & assess implications for NBI geometry & expected NBCD

Draft Goals for FY2014-18 HHFW Research

FY11/12 Goals Moved to FY14/15:

- ✧ Heat CHI start-up plasma coupled to induction, sustain low I_p plasma 100% non-inductively
- ✧ Improve coupling to NBI-heated H-modes & quantify RF edge power loss mechanisms & effect of ELMs

Draft Goals for FY14-18:

- ✧ Assess HHFW performance at higher magnetic field and higher plasma density - especially compatibility with high-power NBI operations
- ✧ Utilize HHFW to assist start-up plasma formation - compare to short-pulse ECH
- ✧ Assess impact of HHFW electron heating on NBI current ramp-up
- ✧ Modify HHFW antenna to have reduced straps & utilize to optimize plasma start-up, ramp-up, and NBI sustainment
- ✧ Design EHO antenna using HHFW straps, or some other location
- ✧ Test EHO antenna for impact on density/particle control

Draft Goals for FY2014-18 ECH/EBW Research

- ✧ Implement short-pulse, high-power ECH system for plasma start-up support (0.5-1MW, 10-50ms)
- ✧ Test short-pulse, high-power ECH system for plasma start-up support
- ✧ Assess impact of ECH on close-flux current achieved, pulse-length extension, non-inductive fraction
- ✧ Upgrade ECH system power and pulse-length for EBW heating studies (1MW, 0.2-0.5s)
- ✧ Project EBW CD performance to FNSF/CTF

Proposed Diagnostics Upgrades that Support WEP Research Goals

Diagnostic Upgrades Supporting FY11/12 Goals Moved to FY14/15:

- ✧ Fusion source profile via charged D-D fusion products
- ✧ Fixed sightline NPA
- ✧ 10-40 GHz edge reflectometer for HHFW

Diagnostic Upgrades Supporting FY14-18 Goals:

- ✧ Neutron collimator
- ✧ Upgraded ssNPA
- ✧ FIDA & BES Imaging
- ✧ FReTIP-II upgrade with 4 MHz bandwidth
- ✧ Profile reflectometry with increased Δf
- ✧ Improved ERD spatial & temporal resolution
- ✧ VB imaging of AE* modes
- ✧ Outboard Langmuir probe array
- ✧ BES expansion & increased resolution
- ✧ BES passive FIDA view
- ✧ Radial polarimetry
- ✧ PCI
- ✧ 2-D wavenumber spectra via high-k scattering
- ✧ Toroidally-displaced in-vessel multi-energy DXR arrays
- ✧ Dual-energy, ultra-fast SXR arrays