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Draft 2014-18 NSTX Research Goals for Waves and Energetic Particles

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Introduction

- The following viewgraphs show draft WEP TSG research goals for 2014-18 based on research goals provided by Jon Menard, and modified assuming the Upgrade outage starts in the fall of 2011 (see "Plan B" below). It assumes that "FY11/12" experiments are run in FY14/15.
- This plan will be used as a "strawman" for discussions.

Plan B

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

- *NOTE: Text shown in green italics in the following viewgraphs are modeling and hardware related goals that could be brought forward to FY2012-13*

Draft Research Goals for 2014 WEP Research

Energetic Particles:

- ✧ Measure fast-ion redistribution with tangential FIDA, *AE eigenfunctions with BES (FY2011 goal)
- ✧ *Extend simulations of fast ion transport to later in avalanche evolution*
- ✧ *Develop reduced model of fast-ion transport rates during avalanche burst, and impact on fast ion profiles*
- ✧ Implement prototype *AE antenna
- ✧ Begin design of upgraded *AE antenna

RF-HHFW:

- ✧ Heat low I_p plasma, achieve high non-inductive current fraction, improve coupling to NBI-heated H-mode plasmas (FY2011 goal)
- ✧ *Modify HHFW antenna limiter as needed for Upgrade operations*
- ✧ *Model performance with reduced number of antenna straps*
- ✧ Develop physics basis for particle transport induced by EHO excitation

RF-ECH:

- ✧ Update design of ECH system plasma start-up support

Draft Research Goals for 2015 WEP Research

Energetic Particles:

- ✧ Use tangential + perpendicular FIDA to characterize distribution function modifications induced by *AE modes (FY2012 goal)
- ✧ Measure *AE activity observed to be driven by more tangential 2nd NBI - compare to existing more perpendicular NBI
- ✧ Finalize design of upgraded *AE antenna

RF-HHFW:

- ✧ Heat CHI start-up plasma coupled to induction, sustain low I_p plasma 100% non-inductively, improve coupling to NBI-heated H-modes (FY2012 goal)
- ✧ Assess HHFW performance at higher magnetic field and higher plasma density - especially compatibility with high-power NBI operations.
- ✧ Design EHO antenna using HHFW straps, or some other location

RF-ECH:

- ✧ Implement short-pulse, high-power ECH system for plasma start-up support (0.5-1MW, 10-50ms)

Draft Research Goals for 2016 WEP Research

Energetic Particles:

- ✧ Simulate *AE activity observed to be driven by more tangential NBI, extend non-linear models to Upgrade plasmas with 2nd NBI, compare simulations to new data
- ✧ Implement upgraded *AE antenna
- ✧ Extend simulations of avalanches to FNSF/Pilot sustainment phase

RF-HHFW:

- ✧ Utilize HHFW to assist start-up plasma formation - compare to short-pulse ECH
- ✧ Assess impact of HHFW electron heating on NBI current ramp-up
- ✧ Simulate/mock-up performance using reduced number of straps
- ✧ Implement EHO antenna compatible with HHFW requirements

RF-ECH:

- ✧ Test short-pulse, high-power ECH system for plasma start-up support and assess impact on close-flux current achieved, pulse-length extension, non-inductive fraction

Draft Research Goals for 2017 WEP Research

Energetic Particles:

- ✧ Utilize *AE predictive capability to optimize/minimize *AE activity during non-inductive current ramp-up with 2nd NBI. Compare simulations to experimental results

RF-HHFW:

- ✧ Modify actual HHFW antenna system to have reduced number of straps
- ✧ Test EHO antenna for impact on density/particle control

RF-ECH:

- ✧ Upgrade ECH system power and pulse-length for EBW heating studies (1MW, 0.2-0.5s)

Draft Research Goals for 2018 WEP Research

Energetic Particles:

- ✧ Extend simulations of *AE avalanches to FNSF/Pilot current ramp-up phase
- ✧ Assess implications for FNSF/Pilot design, in particular NBI injection geometry, expected current drive

RF-HHFW:

- ✧ Utilize modified HHFW system heating and CD to optimize plasma start-up, ramp-up, and NBI sustainment

RF-ECH:

- ✧ Pending successful EBW heating results, further upgrade ECH system power and pulse-length for EBW heating studies (2-4MW, 1-5s),
- ✧ Project EBW CD performance to FNSF/CTF