



HHFW/EBW Breakout Summary

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Goals for the Breakout Discussion



- Identify key physics issues that need to be addressed in 2003
- Review status of existing XPs and RF modeling
- Identify XMP's needed before the start of experimental campaign
- Determine specific XP topics & possible collaborations with other machines
- Assign primary XP authors and estimate run days needed for XPs
- Prioritize XPs in light of NSTX baseline milestones and other issues

Priorities for 2003 Run Guided by NSTX Milestones



- Measure and analyze effectiveness of a combination of non-inductive techniques to assist startup and to sustain plasma pulse lengths up to 1 s
- Characterize EBW mode-converted emissions to estimate requirements for EBW heating and current drive

Breakout Presentations Divided into Four Topics



- HHFW Heating & Current Drive
 - LeBlanc
 - Swain
 - Bonoli
 - Ryan
 - Mau
- HHFW-Ion Interactions
 - Rosenberg
 - Zweben
- HHFW Reliability & Performance
 - Swain
- EBW Physics
 - Taylor
- Discussion of Run Plan & XP Priorities

HHFW Current Drive



- If RF feedthrough modifications work, run at > 5 MW
- Measure current profile, if MSE is operational
- Increase pulse length to ~ 1 s:
 - run at higher RF power to conserve volt-seconds
 - improve plasma position control to maintain matching
 - avoid MHD by trying different I_p ramps & RF turn-on times
- Study effect of wave phase on heating efficiency
- Previously ran low n_e and β to enhance CD, in 2003 run at $> 5 \times 10^{19} \text{m}^{-3}$ to achieve higher β , and maybe off-axis CD

HHFW Electron Heating



- Limited Success in 2002:
 - did not reproduce $T_e > 3$ keV from 2001
 - limited by HHFW power (≤ 3 MW)
- Study HHFW heating in single and double null:
 - gap scan
- Go to higher densities
- Vary phasing

HHFW & NBI Fast Ion Interaction



- Wait for scintillator fast lost ion probe, if possible (Feb '03)
- Detailed NPA scan (1 run day)
- Scans at $I_p > 1$ MA (1 run day)
- Take advantage of higher HHFW power in 2003, if available
- Determine method to estimate power in tail
- Currently interfacing HPRT ray tracer to METS full wave code:
 - allows better absorption profile comparison between 2-D ray tracer and 1-D full wave code

HHFW Driven H-Mode



- Try to obtain H-Mode at $I_p \sim 800\text{kA}$
 - so far observed at 400kA & 500kA
 - limited by HHFW Power in 2002 ($\leq 3\text{ MW}$)
- Try lower TF, so far tried 3.5 kG & 4 kG
- Look for power threshold & document T_i

Enhancements to Full-Wave TORIC Code for HHFW in FY03



- Version of TORIC presently in TRANSP only valid for $k_{\perp} \lambda_i < 1$, but NSTX has $k_{\perp} \lambda_i \sim 10$:
 - need to reformulate dielectric tensor elements in TORIC using full Bessel function expansion
- Implement TORIC with modified wave equation within TRANSP:
 - routine transport analysis of NSTX HHFW-heated discharges
- Begin HHFW CD studies with modified full-wave module

Plans for CURRAY HHFW CD Modeling in FY03



- Analyze HHFW current drive discharges from 2002
- Complete coupling of CURRAY to TRANSP
- Benchmark CD calculations to CQL3D:
 - is quasilinear effect important for HHFW electron damping in NSTX?
 - is the wave damping and current drive modified by DC electric field and, if so, in what regimes?

EBW Emission Experiments & Modeling in 2003



- Demonstrate > 80% B-X and/or B-X-O conversion:
 - prerequisite for EBW heating and CD on NSTX
- Currently installing two B-X antennas with movable local limiters, local gas feed and O-mode reflectometry
- Hope to modify existing ORNL reflectometer antenna with BN wedge for B-X-O study
- Early in 2003 campaign, EBW emission measurements will piggyback, but some dedicated run time required:
 - B-X conversion emission study (2 days)
 - outer gap scan for B-X-O emission study (0.5 days)
- Complete GENRAY/CQL3D heating & CD scoping study

5.5 Days of HHFW XMPS Needed Early in 2003 Campaign



Operational

Priority	Title	Author	Run Days
1	RF Noise Generation	Swain & Wilson	1
2	Raise RF Power to 6 MW	Wilson	3
3	Antenna Conditioning Between Shots	Hosea	0.5
4	Startuo with Large Plasma for HHFW	Wilson	1
Total Days			5.5

16.5 Days for all XP's, 11.5 Days for Highest Priority (A) XP's



Research

Running

Priority	Title	Author	Run Days	Total
A	HHFW Current Drive	Ryan	3	3
A	X-Mode EBW Emission	Taylor	2	5
A	O-Mode EBW Emission	Taylor	0.5	5.5
A	HHFW + NBI Ion Interaction	Rosenberg	2	7.5
A	Electron Heating with HHFW	Swain	2	9.5
A	HHFW Heating of NBI H-Mode	LeBlanc & Hosea	2	11.5
B	ITB High Te	LeBlanc, Swain & Hosea	2	13.5
C	HHFW H-Mode	LeBlanc	1	14.5
C	Temperature Scan at Constant Density		1	15.5
C	Reverse Ip & TF	Bernabei	1	16.5