Princeton Plasma Physics Laboratory
NSTX Experimental Proposal

Title: HHFW Current Drive with MSE		
OP-XP-537	**Revision:**	Effective Date: *(Ref. OP-AD-97)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS	
Author: J.R. Wilson, S. Bernabei, J.C. Hosea, B. Leblanc, P Ryan, C.K. Phillips, J. Wilgen	Date
ATI – ET Group Leader: J. R. Wilson	Date
RLM - Run Coordinator: J. Menard (S. Sabbagh)	Date
Responsible Division: Experimental Research Operations	

Chit Review Board (designated by Run Coordinator)

MINOR MODIFICATIONS (Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

OP-XP-537

1. Overview of planned experiment

The experiment will document via the MSE diagnostic the amount and location of rf driven current as a function of antenna phasing. A low current (300kA) discharge will be used, both to maximize the current drive effect and to minimize the effect of the 90 kV NBI.

2. Theoretical/ empirical justification

Magnetic measurements have indicated that rf current can be driven in NSTX plasmas under some conditions. These measurements cannot localize the current drive and require very careful matching of paired discharges to yield a quantitative value. Use of the MSE diagnostic should allow both measurement of the current localization (to the extent available from the eight channels) and relax the requirement of exact matching of discharges. MSE requires the use of a 90 kV NBI (source A). This leads to two complications: first, the beam ions will absorb some of the rf power, and second, the beam will heat and drive current in the plasma. By using a low current (300 kA) target plasma the beam absorption will be greatly reduced, lessening the plasma heating/CD effect and hopefully reducing the rf absorption as well. In addition, by using a low current the size of the rf current drive perturbation should be larger and easier to see.

3. Experimental run plan

Establish 300 kA He discharge as in shot 117243. Utilize 90 kV NBI source A for MSE (t_{start} = 0.15 s, t_{stop} = 0.6 s). At least one shot with no rf then rf shots with antennas phased for k_T =-7,and +7 m^{-1} without NBI. Look for evidence of CD on loop voltage. Match Te, ne as close as possible without taking too many shots. Minimum rf power of 2 MW. Power level determined by antenna voltage stand-off. Then do phase scan with full NBI pulse. If MSE indicates an effect between –90 and +90 than proceed to other phases (shots 6,7). If MSE does not show effect than proceed to shots 8-12 where a shorter NBI (100 ms) pulse is scanned thru the rf pulse. If measurement proves successful and conditions (rf pick-up on controls) permit other antenna phases can be applied.

Shot Plan:

Shot no.	Rf phase	nbi
1	No rf	No NBI
2	-90	No NBI
3	+90	No NBI
4	-90	NBI 0.15 - 0.6 s
5	+90	NBI 0.15 - 0.6 s
6	180	NBI 0.15 – 0.6 s
7	±90	NBI 0.15 – 0.6 s
8	-90	NBI 0.2 – 0.3 s
9	+90	NBI 0.2 – 0.3 s
10	-90	NBI 0.25 – 0.35 s
11	+90	NBI 0.25 – 0.35 s
12	-90	NBI 0.3 – 0.4 s
etc		

4. Required machine, NBI, RF, CHI and diagnostic capabilities

Requires MSE, NBI source A at 90 kV. HHFW system, rt-efit discharge control and He discharge

5. Planned analysis

Analysis of the MSE data will be required to obtain the current drive efficiency

6. Planned publication of results

PHYSICS OPERATIONS REQUEST

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Machine conditions (specify ranges as appropriate)

I_{TF} (kA): **4.5 kG** Flattop start/stop (s): _____/_____

I_P (MA): **0.3** Flattop start/stop (s): _____/_____

Configuration: **Double Null**

Outer gap (m): **3 cm**, Inner gap (m): _____

Elongation κ: _____, Triangularity δ: _____

Z position (m): **0.00**

Gas Species: **He**, Injector: **Midplane**

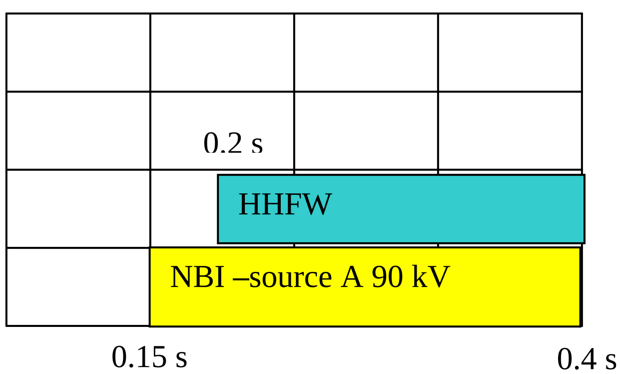
NBI - Species: **D**, Sources:**A**, Voltage (kV): **90**, Duration (s): **.3 s**

ICRF – Power (MW): **>2 MW**, Phasing: **all**, Duration (s): **0.25 s**

CHI: **off**

Either: List previous shot numbers for setup: **117243**

Or: Sketch the desired time profiles, including inner and outer gaps, κ, δ, heating, fuelling, etc. as appropriate. Accurately label the sketch with times and values.



DIAGNOSTIC CHECKLIST

Diagnostic	**Need**	**Desire**	**Instructions**
Bolometer - tangential array			
Bolometer array - divertor			
CHERS		x	
Divertor fast camera			
Dust detector			
EBW radiometers			
Edge deposition monitor			
Edge pressure gauges			
Edge rotation spectroscopy	x		Only available by special request of T. Biewer @ MIT
Fast lost ion probes – IFLIP			
Fast lost ion probes – SFLIP			
Filtered 1D cameras			
Filterscopes			
FIReTIP			
Gas puff imaging			
High-k scattering			
Infrared cameras			
Interferometer – 1 mm			
Langmuir probes - PFC tiles			
Langmuir probes - RF antenna			
Magnetics – Diamagnetism			
Magnetics – Flux loops	✓		
Magnetics – Locked modes			
Magnetics – Pickup coils	✓		
Magnetics - Rogowski coils	✓		
Magnetics - RWM sensors			
Mirnov coils – high frequency			
Mirnov coils – poloidal array		x	
Mirnov coils – toroidal array		x	
MSE	x		
Neutral particle analyzer			
Neutron Rate (2 fission, 4 scint)			
Neutron collimator			
Plasma TV		x	
Reciprocating probe			
Reflectometer - FM/CW			
Reflectometer - fixed frequency homodyne			
Reflectometer - homodyne correlation			
Reflectometer - HHFW/SOL		x	
RF antenna camera		x	
RF antenna probe	x		
Solid State NPA			
SPRED			
Thomson scattering - 20 channel	x		
Thomson scattering - 30 channel		x	
Ultrasoft X-ray arrays			
Ultrasoft X-ray arrays - 2 color		x	
Visible bremsstrahlung det.			
Visible spectrometers (VIPS)			
X-ray crystal spectrometer - H			
X-ray crystal spectrometer - V			
X-ray pinhole camera			