Princeton Plasma Physics Laboratory

NSTX Experimental Proposal

Title: HHFW Heating into Reversed-shear Plasmas		
OP-XP-538	**Revision: 1.0**	Effective Date: *(Ref. OP-AD-97)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

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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

Title: HHFW Heating into Reversed-shear Plasmas **OP-XP-538**

1. Overview of planned experiment

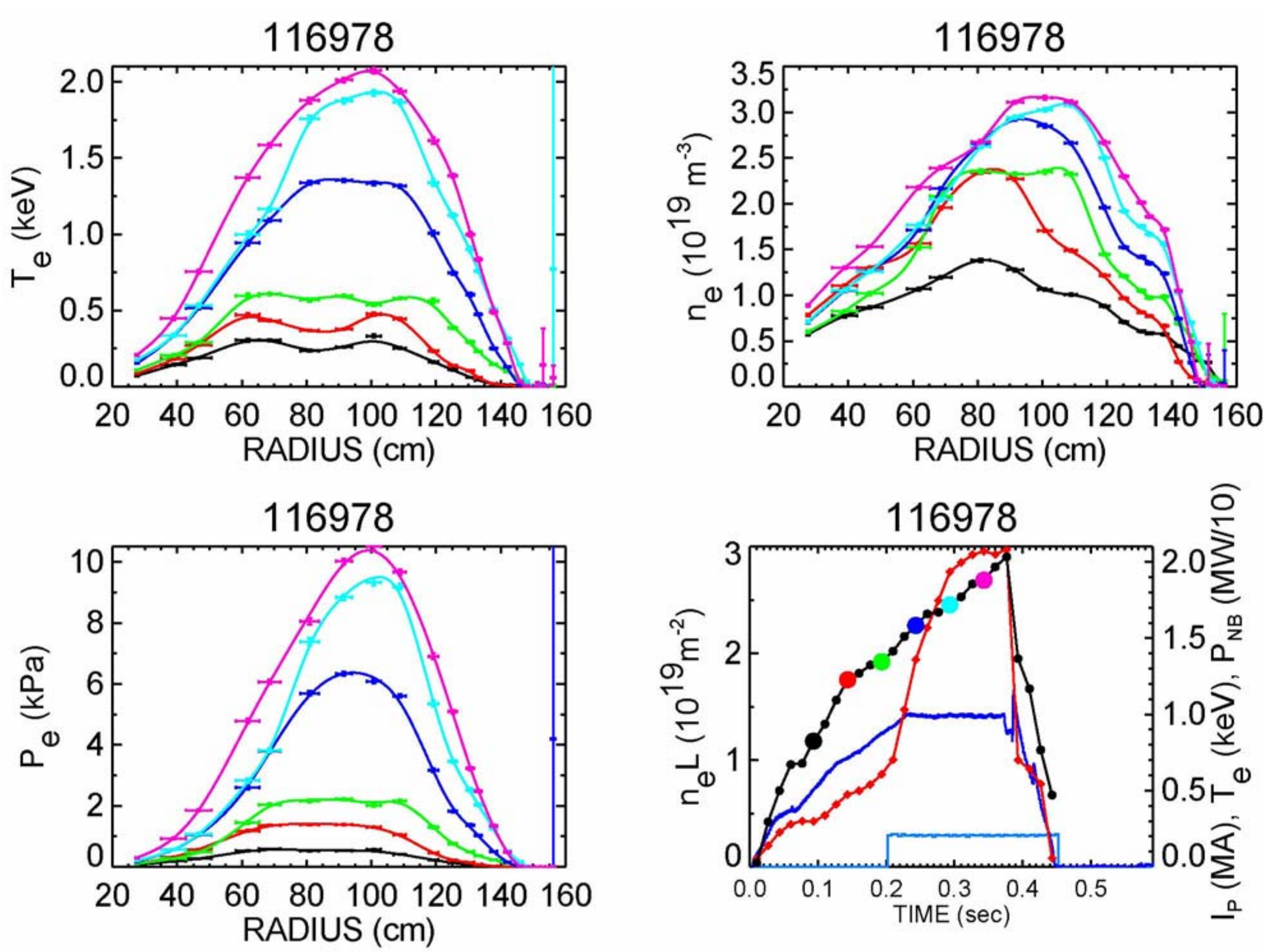
The goal of this experiment is to apply HHFW electron heating to reversed-shear (RS) L-mode plasmas.

2. Theoretical/ empirical justification

The justification of this exercise resides in the experimental observation and theoretical expectation of better electron thermal confinement in RS plasmas. For example, analysis of HHFW heated plasma with very high T_e (*i.e.* 4 keV) suggested that *q(R)* was reversed. Also last year's work by Stutman indicated that RS improved electron thermal confinement.

3. Experimental run plan

(a) Utilize RS scenario developed by Stutman and Levinton to establish a plasma target suitable for HHFW operation.



(b) Probably need to reduce I_p to 0.9 MA to get plasma to last up to 0.5 s.

(c) Keep outer gap as close as possible to original value, but gap should be ≤ 6 cm. Reduce gap is RF loading is too weak.

(d) Change antenna phasing to (0,0,π,π,0,0), $k_{//}$ = 7 m^{-1}, if off-axis is observed with $k_{//}$ = 14 m^{-1}.

(e) May have to reduce HHFW power if discharge runs in β limit.

Shot Id	Description	NBI A(90 kV)	HHFW (≥ 2 MW)	N
Apply HHFW in presence of fast-ion population				
0	Target	0.2-0.5 s	No	1
1	Add HHFW	0.2-0.5 s	0.2-0.5 s, k = 14 m^{-1}	1
Switch NBI with HHFW at 0.3 s				
2	Short NB, HHFW	0.2-0.3 s, 0.4-0.5 s	0.3-0.5 s, k = 14 m^{-1}	1
Apply HFFW in "absence" of fast ions, i.e. wait 50 ms after NBI turnoff				
3	Short NB, delayed HHFW	0.2-0.3 s, 0.4-0.5 s	0.35-0.5 s, k = 14 m^{-1}	1
See what happens when NBI stops at 0.3 s				
4	NB stops at 0.3 s	0.2-0.3, 0.4-0.5 s	No	1

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

This XP will need NBI and RF system.
See attached Physics Operations Request and Diagnostic Checklist pages for details.

5. Planned analysis

EFIT, TRANSP, and specialized RF codes.

6. Planned publication of results

The data will analyzed by the lead author and depending on experimental success, publication will be made to PRL or POP, or equivalent.

PHYSICS OPERATIONS REQUEST

Title: HHFW Heating into Reversed-shear Plasmas **OP-XP-538**

Machine conditions (specify ranges as appropriate)

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

I_P (MA): ___**1.0**___ Flattop start/stop (s): _____/_____

Configuration: **Double Null**

Outer gap (m): **0.04 m**, Inner gap (m): _____

Elongation κ: _____, Triangularity δ: _____

Z position (m): **0.00**

Gas Species: **D** , Injector: **Midplane / Inner wall / Lower Dome**

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

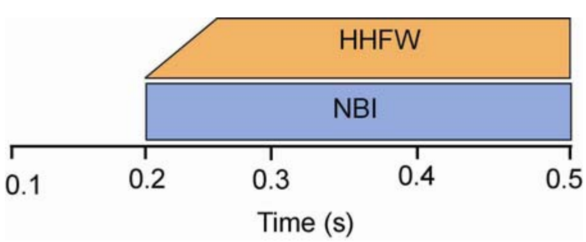
ICRF – Power (MW): > **2.0**, Phasing: **Heating / CD**, Duration (s): _____

CHI: **Off**

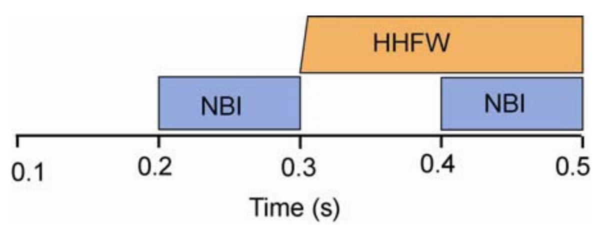
Either: List previous shot numbers for setup: **116978** <<<<<<<<<<<<<<<<<<<

Desired Heating patterns

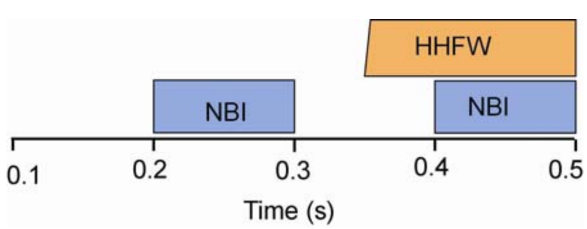
Shot 1



Shot 2



Shot 3



DIAGNOSTIC CHECKLIST

Title: HHFW Heating into Reversed-shear Plasmas **OP-XP-538**

Diagnostic	Need	Desire	Instructions
Bolometer - tangential array		✓	
Bolometer array - divertor			
CHERS	✓		
Divertor fast camera			
Dust detector			
EBW radiometers			
Edge deposition monitor			
Edge pressure gauges			
Edge rotation spectroscopy	✓		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			
Mirnov coils – toroidal array			
MSE	✓		
Neutral particle analyzer	✓		
Neutron Rate (2 fission, 4 scint)	✓		
Neutron collimator			
Plasma TV			
Reciprocating probe			
Reflectometer - FM/CW			
Reflectometer - fixed frequency homodyne			
Reflectometer - homodyne correlation			
Reflectometer - HHFW/SOL			
RF antenna camera	✓		
RF antenna probe			
Solid State NPA			
SPRED			
Thomson scattering - 20 channel	✓		
Thomson scattering - 30 channel			
Ultrasoft X-ray arrays			
Ultrasoft X-ray arrays - 2 color			
Visible bremsstrahlung det.			
Visible spectrometers (VIPS)			
X-ray crystal spectrometer - H			
X-ray crystal spectrometer - V			
X-ray pinhole camera			