Princeton Plasma Physics Laboratory
NSTX Experimental Proposal

Title: **Extending reversed shear scenarios**

OP-XP-939	Revision:	Effective Date: *(Approval date unless otherwise stipulated)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

Responsible Author: H. Yuh	Date
ATI – ET Group Leader: K. Tritz	Date
RLM - Run Coordinator: D. Gates	Date

Responsible Division: Experimental Research Operations

Chit Review Board (designated by Run Coordinator)

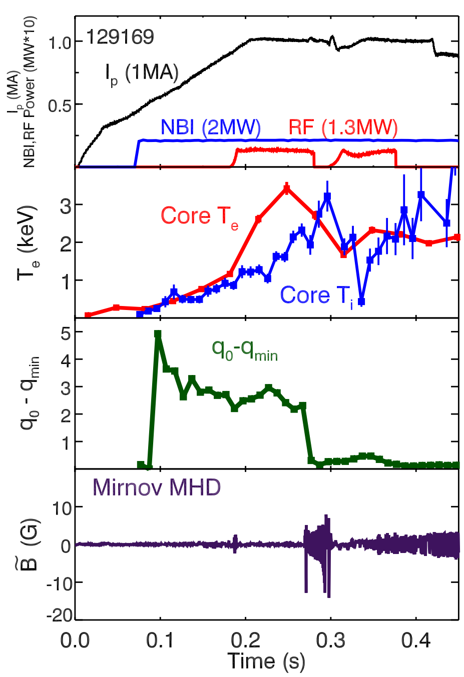
MINOR MODIFICATIONS (Approved by Experimental Research Operations)

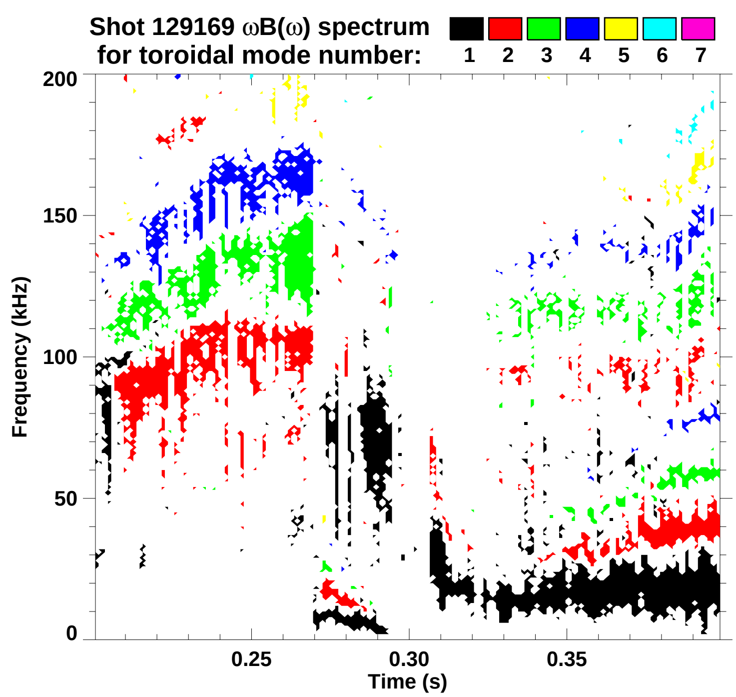
1. Overview of planned experiment

This experiment seeks to extend the L-mode reversed shear discharges to a full current relaxation time by investigating and avoiding the MHD induced current redistribution observed on all reversed shear discharges made so far. The XP further seeks to transition into H-mode while maintaining a reversed shear q-profile.

2. Theoretical/ empirical justification

Although high confinement ITBs have been observed in previous XPs, using NBI, NBI+RF (XP829), or RF only (XP821), a rapid influx of current to the core as fast or faster than the MSE time resolution (10ms) is routinely observed (see q_0-q_{min} in third panel). This rapid change in q-profile ends the period of improved internal transport. While the primary goals of the XP in the past campaigns have been to document the q-profile and turbulence behavior during the RS phase, this XP will focus on two phases



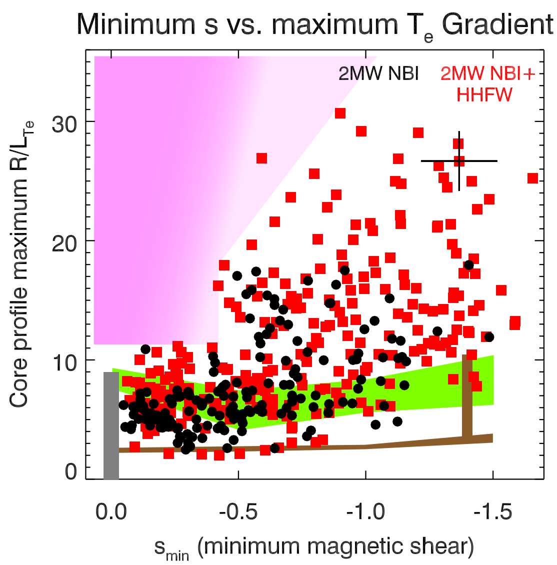


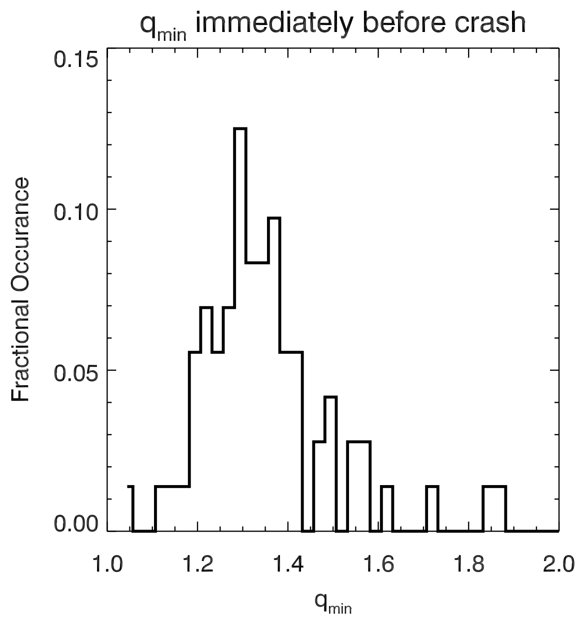
1. T&T - Avoiding the rapid redistribution of current to the core and characterizing turbulence through a current relaxation time. This could provide direct observations of ETG onset. Apply additional power during intermediate RS profiles to assess maximum accessible gradient.
2. ASC – Maintaining the RS q-profile with the ITB through an H-mode transition has been discussed for years. It will be attempted in earnest in this XP.

3. Experimental run plan

The XP will focus on developing a RS scenario that does not result in a transition to a monotonic q-profile via MHD.

1. NBI and RF power, including Src A, and their timing will be scanned to observe their effect on the reversed shear discharge evolution, this includes turning off all auxiliary heating after establishing a high confinement reversed shear ITB. Turning the power back on above the H-mode threshold





may create a RS H-mode.

   a. This may result in a clearly observable onset of ETG via the high-k.

   b. By raising the power, we might be able to probe the intermediate shear region.

2. We may also attempt to use the RWM coils to attempt to circumvent the MHD.
3. Density has been observed to affect the early current density evolution, we had previously attempted to optimize deeply reversed shear shots.
4. Change the plasma current / current ramp rate to change the current profile evolution
5. Lithium has been shown to have a positive effect on the performance of these discharges and will be used at a low to moderate evaporation rates.
6. The effect of RF current drive will be examined by using heating, co and counter current phasing.

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

The RF XMP must have been completed RF will be required.

Lithium evaporation required at a moderate rate 5-15mg/min.

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NBI Src A,B and C at 90 and 65kV will be required.

MSE and high-k diagnostics required.

Attach completed Physics Operations Request and Diagnostic Checklist.

5. Planned analysis

LRDFIT with MSE, TRANSP, gyrokinetic codes GS2 and/or GYRO, MHD stability codes will be used.

6. Planned publication of results

If results are of publication quality, they will be published in the appropriate journals.

PHYSICS OPERATIONS REQUEST

TITLE: No. **OP-XP-**
AUTHORS: DATE:

(use additional sheets and attach waveform diagrams if necessary)

Describe briefly the most important plasma conditions required for the experiment:

Start with model 129169

Previous shot(s) which can be repeated:

Previous shot(s) which can be modified:

Machine conditions *(specify ranges as appropriate, strike out inapplicable cases)*

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

I_P (MA): Flattop start/stop (s):

Configuration: **Limiter / DN / LSN / USN**

Equilibrium Control: **Outer gap / Isoflux** (rtEFIT)

Outer gap (m): Inner gap (m): Z position (m):

Elongation κ: Upper/lower triangularity δ:

Gas Species: Injector(s):

NBI Species: **D** Voltage (kV) **A:** **B:** **C:** Duration (s):

ICRF Power (MW): Phase between straps (°): Duration (s):

CHI: **Off / On** Bank capacitance (mF):

LITERs: Off / On Total deposition rate (mg/min):

EFC coils: Off/On Configuration: **Odd / Even / Other** *(attach detailed sheet*

DIAGNOSTIC CHECKLIST

TITLE: No. **OP-XP-**

AUTHORS: DATE:

Note special diagnostic requirements in Sec. 4

Diagnostic	**Need**	**Want**
Bolometer – tangential array		
Bolometer – divertor		
CHERS – toroidal	√	
CHERS – poloidal	√	
Divertor fast camera		
Dust detector		
EBW radiometers		
Edge deposition monitors		
Edge neutral density diag.		
Edge pressure gauges		
Edge rotation diagnostic		
Fast ion D_alpha - FIDA		
Fast lost ion probes - IFLIP		
Fast lost ion probes - SFLIP		
Filterscopes		
FIReTIP	√	
Gas puff imaging		
Hα camera - 1D		
High-k scattering	√	
Infrared cameras		
Interferometer - 1 mm		
Langmuir probes – divertor		
Langmuir probes – BEaP		
Langmuir probes – RF ant.		
Magnetics – Diamagnetism		
Magnetics – Flux loops	√	
Magnetics – Locked modes		
Magnetics – Pickup coils	√	
Magnetics – Rogowski coils	√	
Magnetics – Halo currents		
Magnetics – RWM sensors	√	
Mirnov coils – high f.	√	
Mirnov coils – poloidal array	√	
Mirnov coils – toroidal array	√	
Mirnov coils – 3-axis proto.		

Note special diagnostic requirements in Sec. 4

Diagnostic	**Need**	**Want**
MSE	√	
NPA – E||B scanning		
NPA – solid state		
Neutron measurements	√	
Plasma TV		
Reciprocating probe		
Reflectometer – 65GHz	√	
Reflectometer – correlation	√	
Reflectometer – FM/CW		
Reflectometer – fixed f		
Reflectometer – SOL		
RF edge probes		
Spectrometer – SPRED		
Spectrometer – VIPS		
SWIFT – 2D flow		
Thomson scattering	√	
Ultrasoft X-ray arrays	√	
Ultrasoft X-rays – bicolor	√	
Ultrasoft X-rays – TG spectr.	√	
Visible bremsstrahlung det.		
X-ray crystal spectrom. - H		
X-ray crystal spectrom. - V		
X-ray fast pinhole camera		
X-ray spectrometer - XEUS		