

**Princeton Plasma Physics Laboratory  
NSTX Experimental Proposal**

**Title:** Shear profile effects on core high-k fluctuations

**OP-XP-620**

**Revision:**  
*2006*

Effective Date:  
*(Ref. OP-AD-97)*  
Expiration Date:  
*(2 yrs. unless otherwise stipulated)*

**PROPOSAL APPROVALS**

**Authors:** D. Smith, H. Park, E. Mazzucato, M. Bell,  
L. Delgado-Aparicio, F. Levinton, J. Menard,  
D. Stutman, K. Tritz, and H. Yuh

Date

**ATI – ET Group Leader:** M. Bell and K. Tritz

Date

**RLM - Run Coordinator:** R. Raman

Date

**Responsible Division:** Experimental Research Operations

**Chit Review Board** (designated by Run Coordinator)

**MINOR MODIFICATIONS** (Approved by Experimental Research Operations)

# NSTX EXPERIMENTAL PROPOSAL

Shear profile effects on core high-k fluctuations

OP-XP-620

## 1. Overview of planned experiment

Utilize the high-k scattering system to measure  $\rho_e$ -scale fluctuations in reverse shear (RS) and conventional shear (CS) discharges. Measure fluctuations both inside and outside the location of the “Te knee”.

## 2. Theoretical/ empirical justification

Recent publications (Stutman, to be published in PoP; LeBlanc, NF 2004; and Bourdelle, PoP 2003) have explored the connection between ETG turbulence, electron thermal transport, and reverse shear profiles on NSTX. Reverse shear discharges exhibit improved core electron confinement and more peaked Te profiles compared to conventional shear discharges. The improved electron confinement may be related to reduced electron gyroscale fluctuations and ETG turbulence suppression.

The high-k scattering system can measure electron gyroscale fluctuations ( $k_{\perp}\rho_e \leq 1$ ) with spatial and k-space resolution at several discrete values of  $k_{\perp}$ . With steerable optics, the scattering volume can be positioned throughout the plasma minor radius.

A prerequisite of this XP is the development of reproducible RS and CS discharges at the same plasma current, similar density profiles, and quiescent MHD. This is the objective of XP-610 (F. Levinton).

Scattering system alignment in real-space and k-space should take into account the results of XMP-44.

### 3. Experimental run plan

The plan is to position the scattering region at three tangency radii (107, 115, and 122 cm) and take two shots each for three discharge scenarios (CS, mild RS, and RS) for **18 shots total**. Controlled accesses will be required to reposition the scattering system.

	CS	mild RS	RS
$R_{\text{tan}} = 107 \text{ cm}$	×2	×2	×2
$R_{\text{tan}} = 115 \text{ cm}$	×2	×2	×2
$R_{\text{tan}} = 122 \text{ cm}$	×2	×2	×2

The target plasmas are **121034 (CS)**, **121030 (mild RS)**, and **121040 (RS)**

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

Thomson, CHERS, NBI, reflectometer, FIRETIP, all x-ray diagnostics, all magnetics, XP610, XMP44

### 5. Planned analysis

TRANSP, LRDFIT, GS2

### 6. Planned publication of results

PoP or maybe even PRL

# PHYSICS OPERATIONS REQUEST

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Machine conditions (specify ranges as appropriate)

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

$I_P$  (MA): **900** Flattop start/stop (s): \_\_\_\_/\_\_\_\_

Configuration:

Outer gap (m): \_\_\_\_\_, Inner gap (m): \_\_\_\_\_

Elongation  $\kappa$ : \_\_\_\_\_, Triangularity  $\delta$ : \_\_\_\_\_

Z position (m): \_\_\_\_\_

Gas Species: **D**, Injector: \_\_\_\_\_

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

ICRF – Power (MW): \_\_\_\_\_, Phasing: \_\_\_\_\_, Duration (s): \_\_\_\_\_

CHI: **Off**

*Either:* List previous shot numbers for setup: **121040, 121034, 121030**

*Or:* Sketch the desired time profiles, including inner and outer gaps,  $\kappa$ ,  $\delta$ , heating, fuelling, etc. as appropriate. Accurately label the sketch with times and values.





## DIAGNOSTIC CHECKLIST

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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			
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 PIXCS (GEM) camera		✓	
X-ray pinhole camera		✓	
X-ray TG spectrometer		✓	