Princeton Plasma Physics Laboratory **NSTX Experimental Proposal**			
Title: Dependence of ELM Severity and Confinement on Boundary Shape			
OP-XP-526	**Revision:**	Effective Date: *(Ref. OP-AD-97)* Expiration Date: *(2 yrs. unless otherwise stipulated)*	
PROPOSAL APPROVALS			
Author: S.M. Kaye, R. Maingi, D. Gates			Date 6/10/05
ATI – ET Group Leader: R. Maingi			Date
RLM - Run Coordinator: J. Menard			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

The goal of this experiment is to examine the severity of ELMs and dependence of energy confinement on plasma shape, most notably elongation and triangularity. Because of the scans involved in this XP, both topics can be addressed. Scans in both triangularity at fixed elongation, and the converse, will be performed. The experiment is planned to complete in 1 run day.

2. Theoretical/ empirical justification

ELM severity has been found to depend on plasma elongation. In experiments conducted in FY04, the plasma elongation and X-point height were varied simultaneously, but then independently, to determine that plasma elongation was the controlling factor, with ELM severity getting worse, and plasma stored energy decreasing, with increasing elongation (Fig. 1). In this set of discharges, neither triangularity or squareness was held fixed. Plasma confinement was also shown to be dependent on plasma boundary shape, with the confinement worsening with increased triangularity (Fig. 2). The source of this is not entirely ELMS, as this trend is observed even in ELM-free discharges, as can be seen in the figure.

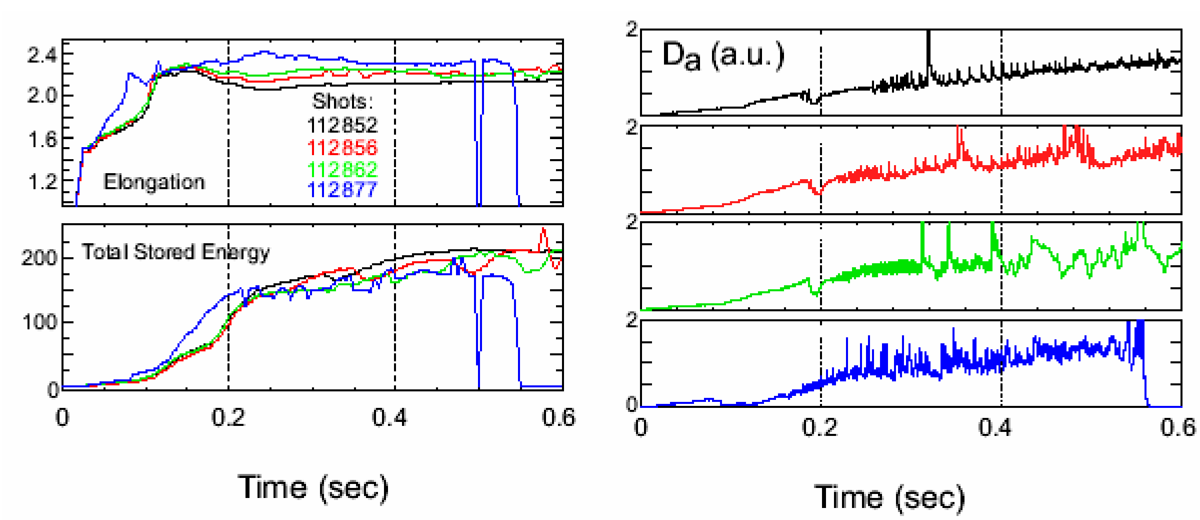


Fig. 1

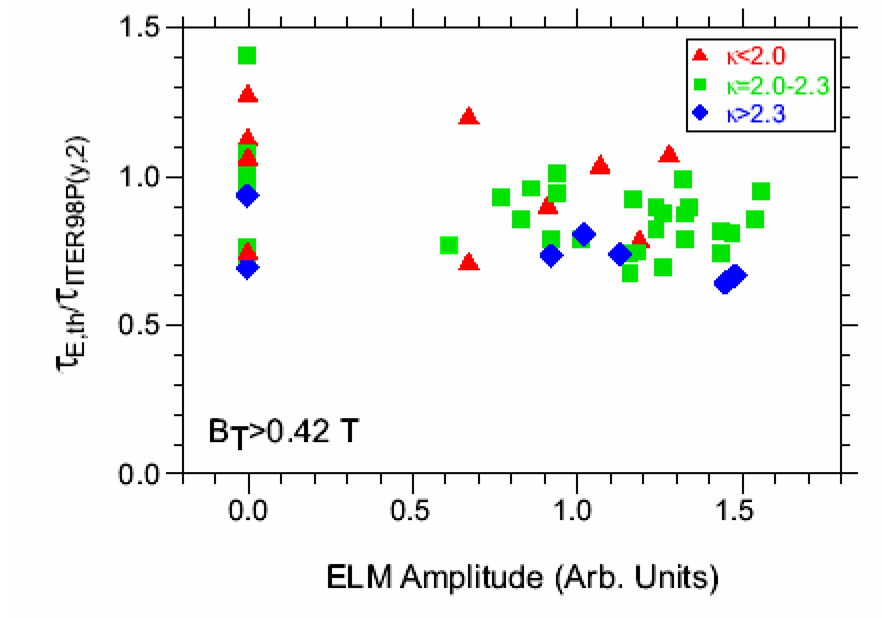


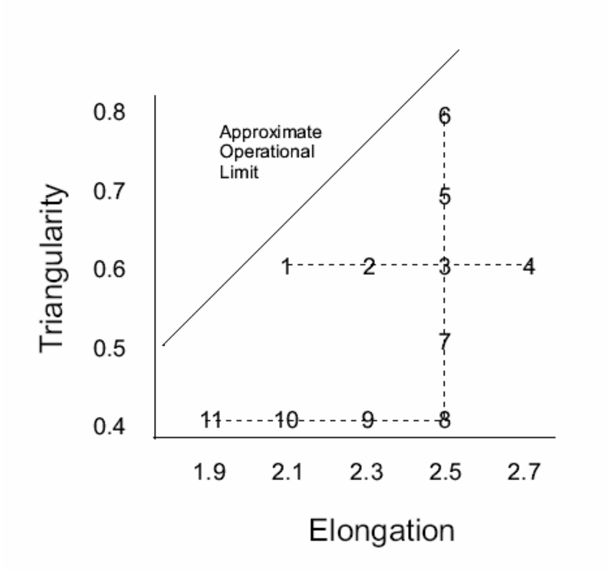
Fig. 2

3. Experimental run plan

In this experiment we will separate the effect of elongation and triangularity to address how ELM severity and plasma confinement varies with these parameters. Several scans at fixed elongation or triangularity are planned. The scan will start with a baseline shot of 115308/310 at an elongation of 2.1 and triangularity of 0.6 (800 kA). The first scan will be to increase kappa to the max (2.7) while keeping delta fixed. Then, delta will be scanned at fixed kappa, and finally, another kappa scan will be performed at lower delta. These scans can be done within the operating limits of the new PF1a coil. The run plan, in tabular form, is given below along with a schematic showing the shots in kappa-delta space. This XP would benefit from using rtEFIT, but after the rtEFIT XMP is completed.

CASE	Kappa	delta
1	2.1	0.6
2	2.3	0.6
3	2.5	0.6
4	2.7	0.6
5	2.5	0.7
6*	2.5	0.8
7	2.5	0.5
8*	2.5	0.4
9	2.3	0.4
10	2.1	0.4
11	1.9	0.4

* Power scan to be performed - First three sources, then 1 source (A or B, whichever is on earlier)



Several shots may need to be taken at given conditions in order to obtain enough data for good stability and transport analysis.

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

No special capabilities are needed. The edge stability analysis to be done in support of this XP would benefit from high resolution MPTS implementation, but it may be more important to get a first cut through the space before going back to diagnose specific conditions with this high resolution/edge capability. To be run after rtEFIT shape control XMP for rtEFIT use.

5. Planned analysis

EFIT, TRANSP, Edge stability (ELITE)

6. Planned publication of results

Presented at meetings, and published in a refereed journal.

PHYSICS OPERATIONS REQUEST

Boundary Shape Dependences **OP-XP-526**

Machine conditions (specify ranges as appropriate)

I_{TF} (kA): **53** Flattop start/stop (s): **usual**

I_P (MA): **0.8** Flattop start/stop (s): **usual**

Configuration: **Double Null**

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

Elongation κ: _____, Triangularity δ: _____

Z position (m): **0.00**

Gas Species: **D**, Injector: **Midplane**

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

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

CHI: **Off**

Either: List previous shot numbers for setup: **115308 with outer gap reduced by 2-3 cm for outer MPTS channels**

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	♫		
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			