Princeton Plasma Physics Laboratory

NSTX Experimental Proposal

Title: **H-mode avalanches**		
OP-XP-1011	Revision: **v0**	Effective Date: *(Approval date unless otherwise stipulated)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

Responsible Author: E.D. Fredrickson	Date **Feb. 15, 2010**
ATI – ET Group Leader: G. Taylor	Date
RLM - Run Coordinator: E. Fredrickson	Date
Responsible Division: Experimental Research Operations	

RESTRICTIONS or MINOR MODIFICATIONS

(Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

TITLE: **TAE avalanches in H-modes** No. **OP-XP-1011**
AUTHORS: **E. D. Fredrickson** DATE: **Feb. 15, 2010**

Text in red is instructional: REMOVE IT from your final document

1. Overview of planned experiment

The goal of this experiment is to develop a reliable, reproducible target plasma with TAE avalanches. If such a plasma is found, the remainder of the experimental time will be to explore the range of parameters for which TAE avalanches are still found. A possible starting point would be shots like 135430-135447. Nominally a 700 kA, 4 kG plasma. Of the 16 shots with these parameters attempted, those with density at 0.3 s of about $3x10^{13}/cm^3$ had TAE activity; shots with higher density had no TAE. A similar set of shots at 900 kA showed similar behavior, so target currents of 700 to 900 kA are likely possible. The shots typically had sources A and B at 90kV and source C at 70 kV. It's not clear if the lower voltage source was necessary for the TAE. Unless a more promising target is identified before this XP runs, this will be the target.

2. Theoretical/ empirical justification

Studies of TAE avalanches in L-mode plasmas are becoming mature. Nearly complete data sets on equilibrium parameters, mode amplitudes, internal measurements of mode profiles have been made. In 2010, the new BES diagnostic will allow the extension of the L-mode studies to H-mode plasmas. The density profile is much broader in H-modes, changing the shape of the gap structure and possibly affecting the coupling of poloidal harmonics. This will be the first attempt to explore operational range of H-mode avalanches.

3. Experimental run plan

A small number of H-mode shots with TAE avalanches were identified during the 2008 and 2009 campaigns. These shots are the basis for developing the target plasma. If a more promising target plasma shot is identified before this XP is run, it will, of course, be substituted.

The experiment will begin by trying to reproduce as closely as possible the conditions in shot 135437. Reproducing the conditions should result in similar TAE avalanches. All needed diagnostic data should be acquired in a single shot, so no more than two shots at any condition should be needed (for redundancy). Beyond documenting fast ion transport in an H-mode TAE avalanche, the avalanching dependence on density, plasma current and beam voltage/power could be explored.

Run Plan

1. Reproduce conditions of shot 135437 (3 shots)

2. Small density scan to optimize TAE avalanches (4 shots), down, then up.

3. Drop source C (and condition up to 80 kV) at best density. Then add source C at 80 kV (2-4 shots).

4. Current scan at 'best' density, 0.8MA and 0.9MA, if no avalanches, raise or lower density (4 shots).

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

Describe any prerequisite conditions, development, XPs or XMPs needed.
Attach completed Physics Operations Request and Diagnostic Checklist.

Three beam sources, LITER, SPAs, BES, MSE, FIDA, fast Mirnov. BES set up for full radial coverage, plus 5(?) channels at half radius in poloidal array.

5. Planned analysis

What analysis of the data will be required: EFIT, TRANSP, etc.?

LRDFIT w/MSE, TRANSP, NOVA, ORBIT.

6. Planned publication of results

Results will be published, assuming that good avalanches are produced and full data sets are acquired.

PHYSICS OPERATIONS REQUEST

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(use additional sheets and attach waveform diagrams if necessary)

Brief description of the most important operational plasma conditions required:

Making the density approximately 3.3 x $10^{13}/cm^3$ by 0.3s is probably the most important condition required for this experiment.

Previous shot(s) which can be repeated: 135437

Previous shot(s) which can be modified:

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

I_{TF} (kA): **48** Flattop start/stop (s): **0.0**

I_P (MA): **0.7 to 0.9** Flattop start/stop (s): **0.0**

Configuration: **DN (whatever 135437 used)**

Equilibrium Control: **Isoflux** (rtEFIT) (whatever 135437 used)

Outer gap (m): **0.13** Inner gap (m): **0.06** Z position (m): **0**

Elongation: **2.4** Triangularity (U/L): **0.5/0.8** OSP radius (m):

Gas Species: **D** Injector(s):

NBI Species: **D** Voltage (kV) **A: 90** **B: 90** **C:** 70-80 Duration (s): **0.7**

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

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

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

LLD: Temperature (°C):

EFC coils: On Configuration: **Odd** *(attach detailed sheet)*

DIAGNOSTIC CHECKLIST

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Note special diagnostic requirements in Sec. 4

Diagnostic	**Need**	**Want**
Beam Emission Spectroscopy	√	
Bolometer – divertor		
Bolometer – midplane array		
CHERS – poloidal		
CHERS – toroidal	√	
Dust detector		
Edge deposition monitors		
Edge neutral density diag.		
Edge pressure gauges		
Edge rotation diagnostic		
Fast cameras – divertor/LLD		
Fast ion D_alpha - FIDA	√	
Fast lost ion probes - IFLIP	√	
Fast lost ion probes - SFLIP	√	
Filterscopes		
FIReTIP	√	
Gas puff imaging – divertor		
Gas puff imaging – midplane		
Hα camera - 1D		
High-k scattering		√
Infrared cameras		
Interferometer - 1 mm	√	
Langmuir probes – divertor		
Langmuir probes – LLD		
Langmuir probes – bias tile		
Langmuir probes – RF ant.		
Magnetics – B coils	√	
Magnetics – Diamagnetism		
Magnetics – Flux loops	√	
Magnetics – Locked modes		√
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 detectors	√	
Plasma TV		
Reflectometer – 65GHz		√
Reflectometer – correlation		
Reflectometer – FM/CW		
Reflectometer – fixed f		√
Reflectometer – SOL		
RF edge probes		
Spectrometer – divertor		
Spectrometer – SPRED		
Spectrometer – VIPS		
Spectrometer – LOWEUS		
Spectrometer – XEUS		
SWIFT – 2D flow		
Thomson scattering	√	
Ultrasoft X-ray – pol. 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 tang. pinhole camera		