Princeton Plasma Physics Laboratory **NSTX Experimental Proposal**		
Title: **Dependence of TAE dynamic on plasma rotation**		
OP-XP-10XX	Revision: **0**	Effective Date: *(Approval date unless otherwise stipulated)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS	
Responsible Author: M. Podestà	Date
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: Dependence of TAE dynamic on plasma rotation No. **OP-XP-10XX**
AUTHORS: M. Podestà et al. DATE: **10/05/2010**

1. Overview of planned experiment

The goal of this experiment is to obtain a systematic scan of (toroidal) plasma rotation in plasmas with unstable TAE modes and characterize the change in mode's dynamic as the rotation is varied. Rotation will be varied through n=3 non-resonant magnetic braking. This data will complement the existing dataset on TAE dynamic in L-mode Deuterium plasmas on NSTX, which is being used to validate the M3D-K code against experiments. If possible, the experiment will then be extended to H-mode plasmas.

The experiment will start from either shot no.135388 (from 2009 Run) or from the "best case scenario" achieved in XP-1015 to study toroidicity-induced Alfvén eigenmodes (TAEs) in L-mode plasmas.

2. Theoretical/ empirical justification

In the past years, experiments on TAEs in NSTX have mainly focused on L-mode plasmas. Detailed scans have been performed to characterize TAE modes as a function of the main operational parameters, such as plasma density, temperature, NB power threshold and effects of rotation shear. The proposed experiment is aimed at complementing data from XP-1015, from which a complete dataset will be collected in order to perform a detailed comparison between the experiments and the predictions of the M3D-K code. We plan to perform a systematic study of the dependence of TAE dynamic (including scenarios with TAE avalanches) in L-mode plasmas upon plasma rotation and its radial shear. Plasma rotation affects the radial structure of the TAE gap, thus determining the structure of the modes and the amount of damping caused by the interaction with the TAE *continuum*. These effects are expected to be especially relevant in a spherical torus, because of the large rotation frequency (often comparable with the TAE frequency in the plasma frame) and the "global" nature of TAE modes, which extend over a good fraction of the minor radius. The main knob to affect rotation will be n=3 non-resonant magnetic braking, which is now a well-established technique on NSTX.

In addition to experiments in L-mode plasmas, TAE studies have been extended to H-mode plasmas in 2010 with XP-1011. A suitable scenario has been identified during the first ½ day of XP-1011 for further investigations. If time permits, the proposed experiment will be extended to H-mode plasmas.

3. Experimental run plan

- Re-establish target scenario from shot no. 135388. Backup: best case from XP-1015 *[2 shots]*

- Optimize density, NB power to maximize the duration of weakly chirping TAEs *[6 shots]*

- Perform n=3 braking scan. Ramp-up coils' current as early as possible (200 ms?).

- Start with 200 A current for n=3 braking. Increase current in steps of 200 A up to 1200 A, or until discharge duration deteriorates during the time of interest because of locking, etc. *[6 shots]*

- Repeat at increased NB power to focus on “avalanching” phase *[6 shots]*

- If time permits, revisit H-mode scenario (from XP-1011) and perform rotation scan *[>4 shots]*

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

Must run after XP-1015.

Two NB source at de-rated voltage (70 kV).

NO LITER evaporation foreseen, as both BES views (130cm and 140cm) are required.

BES set up with maximum radial coverage for mode structure measurements.

5. Planned analysis

Analysis will include EFIT/LRDFIT reconstruction of equilibrium and q-profile; NOVA-K analysis of TAE gap structure and mode structure; M3D-K simulations and comparison with experiments.

6. Planned publication of results

Results will be published in plasma physics journal (Nuclear Fusion, Plasma Physics and Controlled Fusion or Physics of Plasmas). Depending on the short-term progress of the analysis, preliminary results might be already discussed in M. Podestà’s APS-2010 poster on the effects of rotation shear on TAE dynamic.

PHYSICS OPERATIONS REQUEST

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Brief description of the most important operational plasma conditions required:

LITER off.

NB source C at 70 kV voltage.

Both BES views operational.

Previous shot(s) which can be repeated: 135388 or best case from XP-1015

Previous shot(s) which can be modified:

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

I_{TF} (kA): **(.55 T)**   Flattop start/stop (s): **0,0.7 s**

I_P (MA): **0.9 MA**   Flattop start/stop (s): **0.2,0.6 s**

Configuration: **limited on center-stack**

Equilibrium Control: **Outer gap / Isoflux** (rtEFIT) **/ Strike-point control** (rtEFIT)

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

Elongation: Triangularity (U/L):   OSP radius (m):

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

NBI Species: **D** Voltage (kV) **A: 90** **B: 70-90** **C:** 70-90 Duration (s): **0.5**

ICRF Power (MW): **none**   Phase between straps (°):   Duration (s):

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

LITERs: Off   Total deposition rate (mg/min): **---**

LLD: none   Temperature (°C):

EFC coils: On   Configuration: **n=3 braking**

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		