Princeton Plasma Physics Laboratory **NSTX Experimental Proposal**		
Title: Characterization of GAE modes and their effect on electron thermal transport		
OP-XP-921	Revision: **0**	Effective Date: **8/3/09** *(Approval date unless otherwise stipulated)* Expiration Date: **8/3/11** *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

Responsible Author: Kevin Tritz	Date 8/3/09
ATI – ET Group Leader: Kevin Tritz/Stan Kaye	Date 8/3/09
RLM - Run Coordinator: Roger Raman	Date 8/3/09
Responsible Division: Experimental Research Operations	

Chit Review Board (designated by Run Coordinator)

MINOR MODIFICATIONS (Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

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AUTHORS: Tritz, Stutman, Gorelenkov, et al. — DATE: **4/4/09**

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1. Overview of planned experiment

Fast ion MHD, specifically GAE modes with frequencies ~ 0.6 to >1MHz, have been identified as a possible mechanism explaining the flat electron temperature profiles and apparent rapid electron thermal transport in the center of NSTX plasmas. The goal of this XP is twofold: first, to characterize the spatial structure and amplitude of the GAE modes to compare against numerical calculations predicting their effect on electron thermal transport; second, to change the magnetic fields to try to observe and isolate predicted effects on both the GAE modes and their effect on electron thermal transport.

2. Theoretical/ empirical justification

Correlations between GAE activity and electron transport have been previously observed in past experiments (e.g. Stutman FY08). GAE activity and chi_e both scaled strongly with input NB power, and GAE mode amplitudes were measured in the region where GAEs were predicted to drive electron thermal transport. These predictions were made using the ORBIT code to track particle transport induced by GAE activity, though quantitative comparisons require a more complete characterization of the radial mode structure and mode amplitude.

3. Experimental run plan

This XP has two parts. The first run day for the XP will focus on a detailed analysis of the GAE mode structure and amplitude as a function of NBI power:

Reload conditions from 130335 (0.9MA, 0.45T, 6MW NBI power)
Shot plan: use LITER @ 10mg/min, 10 minute shot cycle

Initial high-k position: 110cm (r/a ~ .25)

Restore reference shot 130335 (6MW preheat, beam step @ 0.45s):
- Ip = 0.9MA, Bt = 0.45T, PNBI = 6MW, gas adjusted for LITER (2)

Scan beam power:
- Repeat shot with no beam step (4MW) (2)
- Repeat shot with step down @ 0.45s (2MW) (1)
- Full power (6 MW) shot with no steps (1)

Scan magnetic field:
- Ip = 1.1MA, Bt = .55T, PNBI = 6MW (2)
- Ip = .8MA, Bt = .4T, PNBI = 6MW (1)

If too much low-f MHD, use 1MA, Bt =.5T	(1)
Sub-total	10 shots, 100min.
Controlled access, move high-k to 115cm (r/a ~ .35)	25min.
Repeat previous scan:	10 shots, 100min.
Controlled access, move high-k to 120cm (r/a ~ .45)	25min.
Repeat previous scan: w/neon injection alternate shots	10 shots, 100min.
Break for Tuesday:	
Controlled access, move high-k to 126cm (r/a ~ .6)	25min.
Repeat previous scan:	10 shots, 100min.
If time left > 75 min.	
Controlled access, move high-k to 132cm (r/a ~ .7)	25min.
Repeat previous scan: w/neon injection alternate shots	10 shots, 100min.
Total:	50 shots, 600min. (10 hours)

Top priority is first 3 positions

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

Machine conditions and diagnostics as specified in attached sheets. Remote high-k radial position capability is a requirement for this XP. Li deposition will be used if it enhances repeatability and low-f MHD free operation. FIReTIP bandwidth upgrade is highly desired, but may not be ready for this XP.

5. Planned analysis

This XP will require EFIT/LRDFit equilibrium reconstructions as well as TRANP runs to calculate the measured electron thermal transport for comparison to numerical predictions. The predictions of GAE induced electron thermal transport will be from the ORBIT code using mode structures and amplitudes as inferred from the high-k radial scans. The shot-to-shot radial scans will be normalized to external magnetic measurements, or FIReTIP if available.

6. Planned publication of results

Any significant results will be in PoP or similar journal.

PHYSICS OPERATIONS REQUEST

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(use additional sheets and attach waveform diagrams if necessary)

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

Low-f MHD quiescence during GAE window (~ 0.45 – 0.6s)

Repeatability

Note: these shots use NBI 6MW preheating and 4MW constant with beam steps (+2MW, +0MW, -2MW) at 450ms to obtain relevant conditions (as per shot 130335)

Previous shot(s) which can be repeated: 130335

Previous shot(s) which can be modified:

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

I_{TF} (kA): 0.4 – 0.55 T   Flattop start/stop (s):

I_P (MA): 0.8 – 1.1   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: **D**   Injector(s):

NBI Species: **D** Voltage (kV) **A: 90**   **B: 90 (60)**   **C:** 90   Duration (s): ~1s

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

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

LITERs: Off / On   Total deposition rate (mg/min): **10-15**

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

DIAGNOSTIC CHECKLIST

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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		