Princeton Plasma Physics Laboratory

NSTX Experimental Proposal

Title: Neutral Beam Ion Loss During Energetic Particle Mode Bursts

OP-XP-	Revision:	Effective Date: Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

Responsible Author: D. Darrow	Date
ATI – ET Group Leader:	Date
RLM - Run Coordinator:	Date
Responsible Division: Experimental Research Operations	

Chit Review Board (designated by Run Coordinator)

MINOR MODIFICATIONS (Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

TITLE: Neutral Beam Ion Loss During Energetic Particle Mode Bursts

No. **OP-XP-**

AUTHORS: **D. Darrow, N. Crocker, E. Fredrickson, G. Fu, N. Gorelenkov, W. Heidbrink, D. Liu, S. Medley, M. Podestá**

DATE: **1/15/08**

1. Overview of planned experiment

Briefly describe the scientific goals of the experiment. The goal of this experiment is to reproduce bursts of the energetic particle mode (EPM), sometimes called "fishbone" instability in NSTX NBI plasmas in order to measure the beam ion loss resulting from the mode and the mode amplitude profile in the interior of the plasma. The mode amplitude profile would be measured using the soft X-ray arrays, multiple reflectometers, and the FIReTIPS diagnostic. In addition, simultaneous measurement of the confined neutral beam ion parameters is sought from all available fast ion diagnostics, namely the NPA, SSNPA, FIDA, and neutron diagnostics.

2. Theoretical/ empirical justification

Repeated EPM bursts are seen in almost every NSTX shot, especially during the current ramp up phase. The bursts often are comprised of multiple n-number modes existing concurrently, and the beam ion loss during these bursts is spread over a wide range in pitch angle. Previous results from NSTX indicate that the loss occurs only during the time interval when the multiple modes overlap in time. Since the loss is over a broad range of pitch angle and not just one or a few single pitch angles, it is inferred that this loss arises from stochastic transport of the beam ions in phase space, rather than by resonant interaction of a small population of particles with a single mode. Such a fast ion loss process might occur in ITER, if TAEs are driven unstable on adjoining interior flux surfaces, stochastic radial transport of the fast ions could move those particles rapidly to the wall. Consequently, it is important to understand and model the transport mechanisms active in the EPMs.

3. Experimental run plan

Use 125038 as a template shot (1 MA, 3 NBI sources). Confirm modes are present by examining neutrons, sFLIP data, and magnetics. Check whether mode is seen by reflectometers, FIReTIPS and soft X-ray arrays. Puff argon to enhance soft X-ray signals, if needed. Puff gas to increase plasma density for reflectometers, if needed. Scan NPA if time permits and interest dictates.

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

It is preferred that the FIDA commissioning XMP have been completed prior to the start of this XP. This XP requires 3 functional NB sources. No RF or CHI is used. Prefer SPAs to be off if error correction coils are not needed for these shots as SPAs add noise to the SSNPA signals.

5. Planned analysis

EFITs, LRDFITs, and TRANSPs of all shots in the XP are required. Analysis of the reflectometer and SXR array data to produce mode amplitude profiles is required. NOVA-K runs for conditions of each burst of interest are needed. Guiding Center ORBIT code calculations of the neutral beam ion loss due to the observed mode structures is planned. Measured and calculated mode profiles will be compared, along with the measured and calculated beam ion loss characteristics.

6. Planned publication of results

Results will be analyzed and written for publication in Nuclear Fusion, PPCF, or comparable journal within a year of completion of the XP.

PHYSICS OPERATIONS REQUEST

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Machine conditions (specify ranges as appropriate)

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

I_P (MA):1.0 Flattop start/stop (s): 0.2-0.5

Configuration: **LSN**

Outer gap (m): **0.1** Inner gap (m):

Elongation κ: Upper/lower triangularity δ:

Z position (m):

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

NBI Species: **D** Sources: ABC Voltage (kV): 90 Duration (s): per template shot

ICRF Power (MW): 0 Phasing: Duration (s):

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

LITER: If needed

Either: List previous shot numbers for setup: 125038

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.