Princeton Plasma Physics Laboratory **NSTX Experimental Proposal**		
Title: Development of the Enhanced Pedestal H-mode		
OP-XP-732	**Revision:**	Effective Date: 06/12/07 *(Ref. OP-AD-97)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

Author: R. Maingi, R. Bell	Date
ATI – ET Group Leader: R. Maingi	Date
RLM - Run Coordinator: D. Gates (M. Bell)	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 reproduce the Enhanced Pedestal H-mode in NSTX, from discharges observed in 2005 and 2006. If easily attained, the remainder of the time will go toward optimizing the diagnosis of the pedestal and extending the discharge pulse duration.

2. Theoretical/ empirical justification

In NSTX, the typical edge T_e, T_i and P_e observed extend to 250 eV, 250 eV, and 2 kPa respectively. In 2005 a set of discharges were observed to spontaneously develop a high edge temperature pedestal with values up to 600 eV, leading to pressure pedestals up to 6 kPa. This operational mode was termed the Enhanced Pedestal (EP) H-mode (Fig. 1), and it is characterized by a second transition (following the L-H transition) during which the enhanced pedestals gradually develop (Fig. 2). The discharges were relatively short with a low $\beta_N \sim 4.5$ limit, possibly correlated with a current density hole in the plasma center.

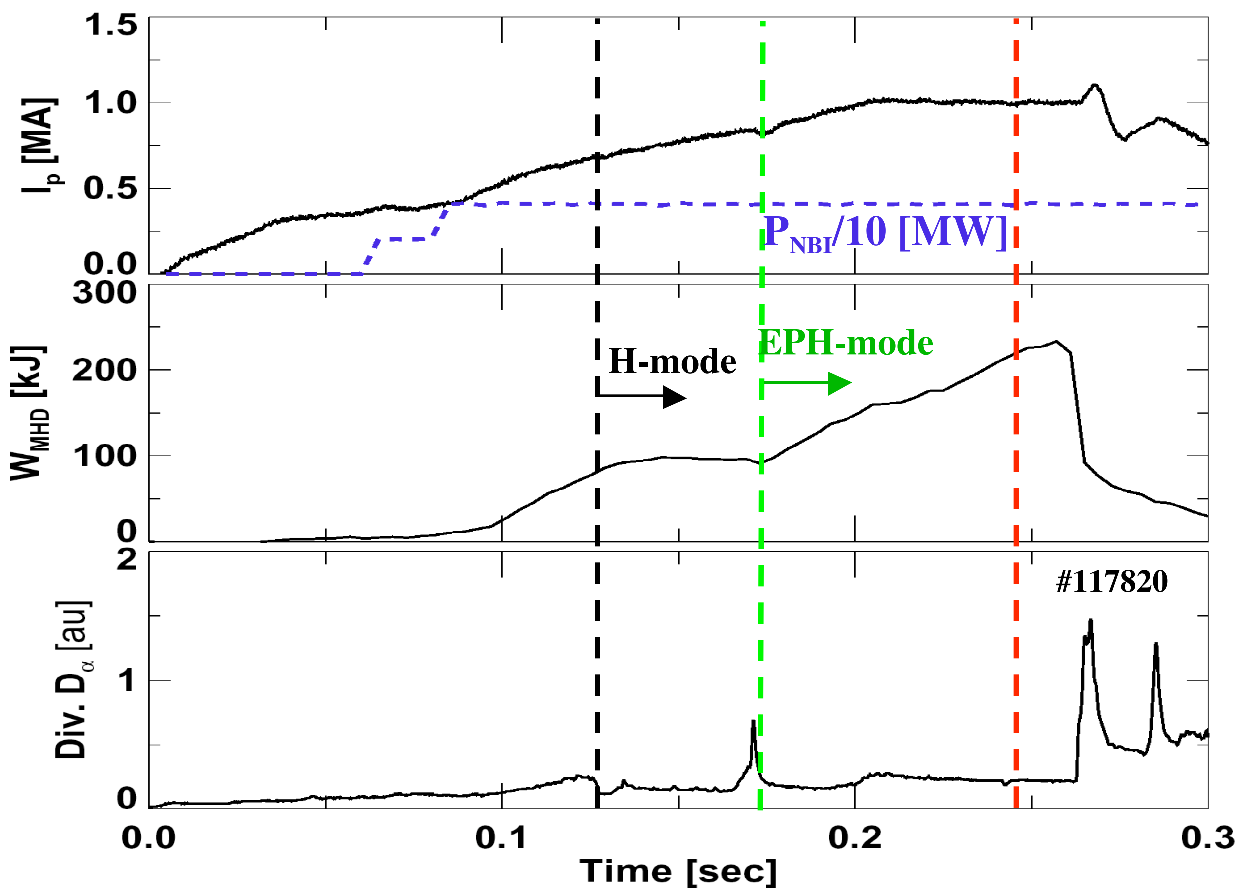

Fig. 1 – temporal evolution of the Enhanced Pedestal H-mode. The colored dashed lines represent the kinetic profile times in Fig. 2.

Data from CHERs indicated that the toroidal rotation component of the radial electric field (from the lowest order radial force balance) was dwarfed by the pressure gradient term, leading to large negative $Er(+v_\theta B_\phi)$ over a large fraction of the edge plasma. As suggested by the last sentence, the role of the poloidal rotation term was unknown, and will be assessed next year when the poloidal rotation diagnostic becomes fully operational. It is also noteworthy that the T_i gradient scale length was approximately one poloidal ion gyro-diameter (Fig. 3), which makes the EP H-mode interesting from a fundamental transport perspective. Generally speaking, EP H-mode bears some similarities to VH-mode from DIII-D, although the details of the structure of the radial electric field appear to be different.

The goal of this XP is to try to reproduce the EP H-mode for full diagnosis with poloidal CHERs next year. If the scenario can be reproduced, then the subsequent goal will be to extend the duration for possible use as a high bootstrap current fraction target.

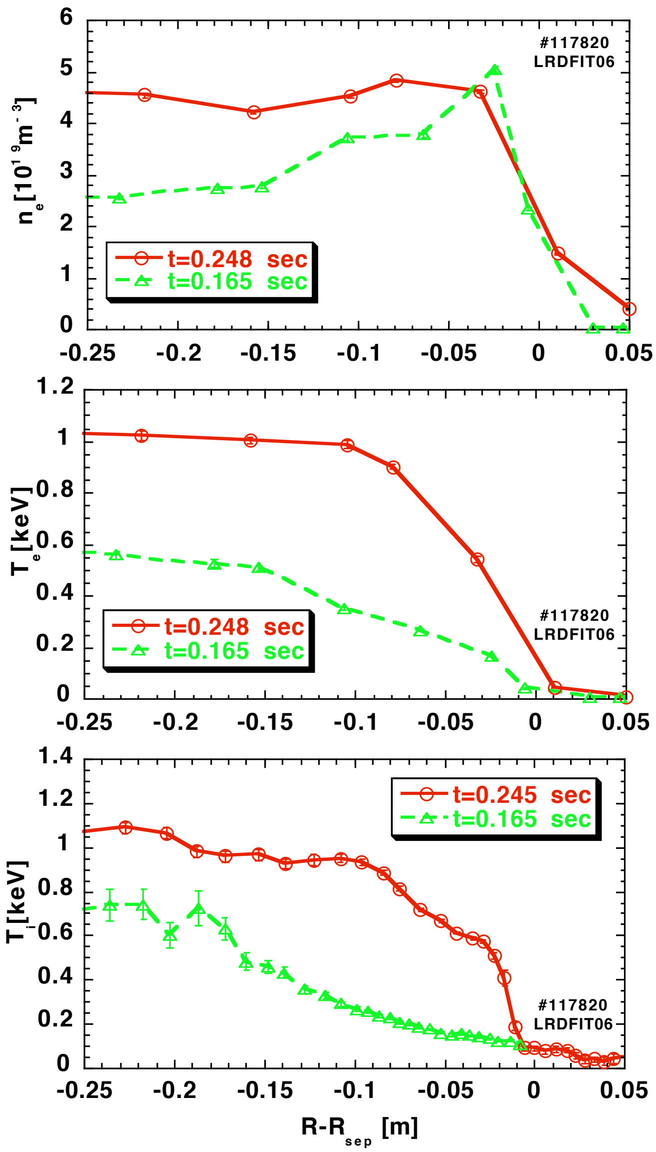

Fig. 2 – Profile comparison during the regular H-mode phase and the Enhanced Pedestal H–mode phase from Fig. 1.

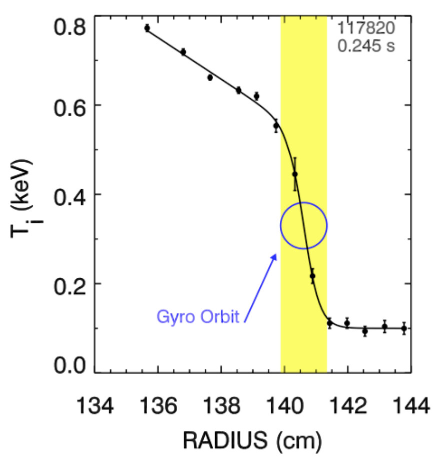

Fig. 3 – comparison of the T_i profile and poloidal ion gyro-diameter.

3. Experimental run plan (1/2 day)

- Reproduce baseline discharge 117820 and/or 119751 (5-15 shots). If difficulty in reproducing EP H-mode, then vary:
  I. Up/down magnetic balance (more toward balanced DN)
  II. Fueling (lower)
  III. Early H-mode transition is necessary – increase NBI power to 6 MW for short phase at 1001-40ms, if needed
  IV. I_p ramp rate (first try slower rate, then try faster rate)
- Adjust outer gap for optimum Thomson and CHERs diagnosis of the pedestal (3 shots)
- Change I_p ramp rate to change current profile and avoid current hole, which may be responsible for low β_N limit (5 shots).

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

This XP requires a fully operational NBI system. We desire HeGDC between shots of ~ 9 minutes for a 15 minute repetition rate.

5. Planned analysis

The Er will be analyzed from the CHERs and ERD data, and the pedestals will be simulated with the XGC code, if warranted.

6. Planned publication of results

Paper to be submitted to PRL or PoP as warranted.

PHYSICS OPERATIONS REQUEST

Scaling of the SOL width in NSTX and extrapolation to NHTX **OP-XP-732**

Machine conditions (specify ranges as appropriate)

I_{TF} (kA): **63** Flattop start/stop (s): _____/_____

I_P (MA): **0.8-1.0** Flattop start/stop (s): **0.15/1.0 (max)**

Configuration: **Double Null**

Outer gap (m): **10 cm** Inner gap (m): **5-10 cm**

Elongation κ: **2.2** Triangularity δ: **0.7**

Z position (m): **0.00**

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

NBI - Species: **D**, Sources: **A/B/C**, Voltage (kV): **90, 90, 90**, Duration (s): **<1 sec**

ICRF – Power (MW): ____, Phasing: , Duration (s): _____

CHI: **Off**

Either: List previous shot numbers for setup: **117820, 119751**

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

Scaling of the SOL width in NSTX and extrapolation to NHTX **OP-XP-732**

Diagnostic	Need	Desire	Instructions
Bolometer - tangential array		✓	
Bolometer array - divertor		✓	
CHERS	✓		
Divertor fast cameras		✓	
Dust detector			
EBW radiometers			
Edge deposition monitor		✓	
Edge pressure gauges		✓	
Edge rotation spectroscopy	✓		
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 PIXCS (GEM) camera			
X-ray pinhole camera			