Princeton Plasma Physics Laboratory

NSTX Experimental Proposal

Title: Plasma re-fueling with Supersonic Gas Jet

OP-XP-626	**Revision:**	Effective Date: *(Ref. OP-AD-97)* Expiration Date: *(2 yrs. unless otherwise stipulated)*

PROPOSAL APPROVALS

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MINOR MODIFICATIONS (Approved by Experimental Research Operations)

NSTX EXPERIMENTAL PROPOSAL

Plasma re-fueling with Supersonic Gas Jet OP-XP-626

1 Overview of planned experiment

The goal of the experiment is to complete the evaluation of fueling properties of the supersonic gas injector (SGI) - essentially to complete XP 516 started last year. In FY05 progress has been made in parts 3.1 and 3.2 of XP 516 (attached for reference). This experiment will address and slightly expand on tasks from pars 3.2 and 3.3 from XP 516, as described below. Discharge and diagnostic setup will be similar to XP 516.

2 Experimental run plan

The experiment is comprised of four parts which can be executed separately and on different dates. Part one addresses the SGI fueling efficiency in the flat-top phase and compares it directly to low field side conventional gas injectors in L- and H-mode phases of a plasma discharge. H-mode access with SGI is studied in part two. The third part addresses the SGI fueling efficiency in the plasma start-up phase. Finally, sensitivity of SGI fueling characteristics to plasma configurations (inner wall limited, single null, double null) will be studied in part four. Required diagnostics are the MPTS and FIReTIP. Desired diagnostics include fast cameras with a view of the supersonic gas jet at Bay I.

2.1 SGI fueling efficiency in the flat-top phase in L- and H-mode plasmas (up to 7 shots)

- Use a suitable 1-3 source NBI LSN target plasma. Use the LFS Injector # 2 or 3 for conventional gas puffing. Run a sequence of three shots: a reference shot, a shot with a gas puff from the LFS injector, a shot with a gas puff from the SGI. The gas pulses will be added in the flat-top phase.
- Gas pulse parameters are: duration 50-200 ms, rate 60-70 Torr l / s, start time - 200-400 ms.
- The SGI will be parked at R=156.0-158.0 cm - the closest possible to LCFS major radius - in all shots.
- SGI setup: plenum pressure P_0=2000-2500 Torr.
- Repeat in L-mode and H-mode shots. Prefer an ELM-free or large infrequent (Type I or III) ELM H-mode shot.

2.2 H-mode access with SGI (up to 10 shots)

- Use a suitable 1-3 source NBI LSN target plasma with HFS fueling. Assure good wall conditioning and reproducible H-mode access. Obtain a reference H-mode discharge using HFS injector. Replace the HFS injector gas with an SGI gas pulse.

- Repeat a pair of the reference discharge followed by an SGI fueled discharge for three SGI rates: 30, 50, 70 Torr l /s.
- The SGI position will be R=156.0-158.0 cm.
- The SGI pulse start time is 0.100 - 0.150 s, duration 0.400 s
- In one or two long H-mode shots, turn off SGI early in the flat-top (0.300-0.400 s) to see if density rate of rise changes

2.3 Use of SGI in discharge front-end (up to 5 shots)

- Use a suitable 1-3 source NBI LSN target plasma. Use LFS Injector # 1, 2 or 3 for initial density ramp-up (front-end) for a reference case. Replace the LFS injector with an identical or as similar as possible SGI pulse. Note the density ramp rate.
- The SGI will be parked at R=156.0-158.0 cm in in all shots.
- SGI setup: plenum pressure P_0=2000-2500 Torr.
- Adjust SGI pulse duration or pressure as needed

2.4 SGI fueling efficiency vs plasma configuration

- Based on SGI database collected to date run a missing plasma configuration target plasma. Run a sequence of shot as in 2.1 for a missing configuration.
- The missing configuration is likely to be the inner-wall limited plasmas, and possibly the double-null plasmas.
- The SGI will be parked at R=156.0-158.0 cm.
- SGI setup: plenum pressure P_0=2000-2500 Torr.

3 Required machine, NBI, RF, CHI and diagnostic capabilities

Completed Physics Operations Request and Diagnostic Checklist are attached in XP 516.

Prerequisite conditions:

- Supersonic gas injector is commissioned for operation
- MPTS and/or FIReTIP are operational, Fast camera (Canadian Photonics, Kodak or Phantom) is available and mounted on Bay L port window
- NBI and H-mode access conditions are needed for parts 2.1-2.4 of the experiment.

4 Planned analysis

We plan to use DEGAS 2, UEDGE and TRANSP for fueling efficiency and jet penetration analysis.

5 Planned publication of results

Results will be presented at the EPS 2006 conference and / or published in a refereed journal as appropriate.