1. Purpose of Experiments

The purpose of this mini-proposal is to gather more data on the motion of striational structures that form in the ablation cloud of injected lithium pellets. Increased understanding of these structures, in particular a comparison of their behavior in L-mode and H-mode plasmas during the flat top portions of shots, should provide insight as to whether these striations are related to turbulence-suppressing zonal flows.

2. Background

Striations in ablation clouds were first observed during prior work on the LPI in which the Li pellet ablation cloud was used to determine the local field directions during the plasma ramp down, in L-mode [1,2]. An ultra high speed CCD camera, with integration time of approximately 2 µs, captured images of the ablation cloud that showed the formation of distinct strational structures parallel to the field lines. After formation, these striations move poloidally, with the speed and direction of movement varying with the ablation cloud’s major radial position at the time of formation. Analysis of the images obtained previously (see figure 1) indicates that the spatial scale for this variation is on the order of tens of ion gyro radii. These fluctuations may be consistent with theoretical predictions of the radial variation of Zonal flow amplitudes obtained using gyro kinetic simulations [3], indicating that there may be a connection between the motion of the striations and the existence of zonal flows. Theory predicts that the zonal flows suppress turbulence, allowing the plasmas to enter H-mode, but then are themselves suppressed. Thus if the striations are connected to zonal flows, there should be a qualitative change in their behavior between L and H-mode operation.
3. Approach

In order to observe the differences in striation behavior during L-mode and H-mode operation a pellet would be injected into C-port during the flat top portion shots, comparing inner wall limited (L-mode) and SNL diverted (H-mode) and the same current and similar line average densities (just before pellet injection). The pellet ablation will be observed using the PSI , mounted to C-port without intensifier, while its radial position will be determined using the vertical looking diode array. After checking the exposure of the PSI camera, a radial scan of both L-mode and H-mode plasmas will be conducted using the PSI, by varying the time delay on the image acquisition with respect to the pellet injection time.

4. Resources

4.1 Machine and Plasma Parameters

Give values or range for:

- **Toroidal Field:** 5.4T
- **Plasma Current:** 800 kA
- **Working gas species:** D (H minority)
- **Density:** $n_l04 = 2e20m^{-2}$ for L-Mode inner wall limited; $n_l04 = 1e20m^{-2}$ for L-Mode target, Single Null Lower diverted.

**Equilibrium configuration** (if possible, refer to database equilibria): Compare inner wall limited to SNL diverted; standard 800 kA SNL equilibrium, such as 1030620010, but with toroidal field of 5.4 tesla straight across; limited shot with similar shape but inner gap reduced to 0.

**Pulse length, typical current & density waveforms, etc.** Refer to database or sketch desired waveforms.

4.2 Auxiliary Systems

- **RF Power, pulse length, phasing:** 3 MW, 0.3 seconds, heating phase
- **Pellet Injection (species):** yes(lithium)
- **Impurity blow-off injection:** no
- **Diagnostic Neutral Beam:** Not required
- **Special gas puffing:** none
- **Other:** none
4.3 Diagnostics

List required diagnostics, and any special setup or configuration, e.g. non-standard digitization rate.

All standard core and edge diagnostics desired. Kinetic profile diagnostics, including core and edge Thomson, ECE (GPC and/or FRCECE), visible continuum and bolometer arrays required. Must have PSI fast camera at the same horizontal port as the LPI, configured to look at Li+, without its intensifier.

5. Experimental Plan

Both sections must be filled in.

5.1 Run sequence plan

Specify total number of runs required, and any special requirements, such as consecutive days, no Monday runs, extended run period (10 hours maximum), etc.

This experiment requires 10 dedicated discharges, which should take less than 1/2 of a run day. Piggyback operation, injecting pellets at the end of flat-top, or into the current ramp-down, is also requested for additional studies.

5.2 Shot sequence plan

For each run day, give detailed specification for proposed shot sequence: number of shots at each condition, specific parameters and auxiliary systems requirements, etc. Include contingency plans, if appropriate.

1) 2 shots, inner wall limited, L-mode (with RF. PSI camera exposure will be checked and data will be taken at 2 micro-seconds per frame near R=0.82 m.

2) 5 shots, SNL: scan the PSI data radially, in H-mode, by changing the delay of image acquisition with respect to the pellet time.

3) 3 shots, inner wall limited, to complete a similar L-mode radial scan.

6. Anticipated Results

Discuss possible experimental outcomes and implications. Indicate if the program may be expected to lead to publications, milestone completions, improved operating techniques, etc. Indicate if the experiments are intended to contribute to a joint research effort, or an external database.

Statistics and radial profiles of striation motion will provide data on the poloidal flows for comparison with gyro-kinetic simulations using the GS2 code. This should provide additional data for an APS poster, and will serve as a guide for follow-up experiments. It should also contribute to a PhD thesis.

7. References

Include references both to external and internal literature or communications which bear on this proposal. See Section 2.

