XP 1514: Correlation of SOL Turbulence with Heat Flux Width

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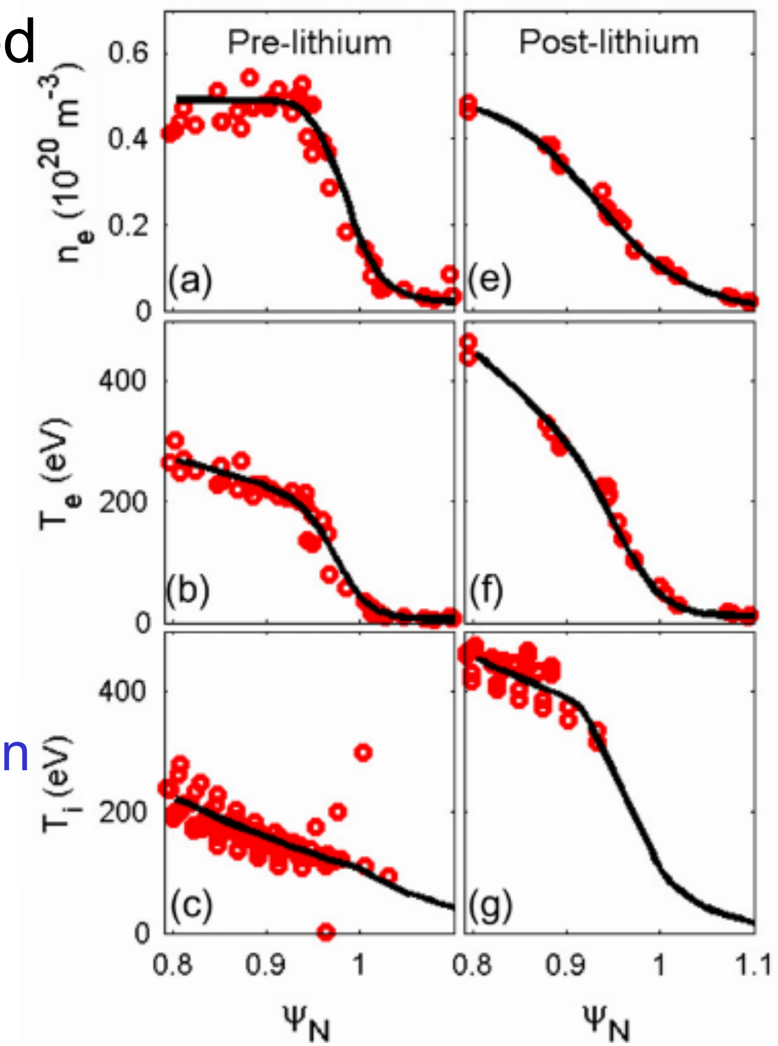
Overview and Goals

- Confirm that the reduction in λ_q measured in NSTX
- Assumed that I_p Scaling data for NSTX-U will be obtained in "piggy-back" during XP 1520 and 1512
- Correlate turbulence measurements at midplane (GPI, BES, reflectometry) with divertor turbulence measurements (perpendicular and tangential visible imaging and probes) and comparison with measured λ_q
- Experimental inputs and constraints for modeling
  - SOLT
  - XGC1
  - SOLPS
- Quantify effects on SOL transport via modeling

Theoretical Justification

- Measurements on NSTX showed the contraction of the small ELM-averaged λ_q with the addition of evaporative Li coatings
- Modeling with the SOLT code suggests this is due to relaxation of pedestal ∇n_e and subsequent reduction in interchange turbulence
- However, it was comparing 2 shots with different P_{NBI}
  - P_{NBI} was reduced with high Li evaporation amounts due to β_N limits
- Still open questions of the role between neoclassical physics vs. turbulence in setting λ_q



Diagnostic Needs

- GPI interferes with CHERS background view
  - Dedicated shots with midplane GPI puffs
  - Both SOLT and XGC1 need T_i and n_C profiles
- Turbulence Diagnostics
  - Reflectometers
    - UCLA fixed frequency system not available until later in the run
  - BES
    - View optimized for SOL
  - GPI
    - Requires I_p [MA] / B_T [T] = 2 for optimal viewing angle
  - Fast Framing Visible Cameras
    - Tangential/X-point and divertor viewing
  - Divertor Langmuir Probes
    - Shots with GPI: Constant bias voltage into i_{sat} to obtain turbulence data
    - Shots without GPI: Swept bias voltage for divertor n_e and T_e
- Fast Dual-band Infrared Divertor camera

Discharge Characteristics with optimal GPI view

I_p (MA)	B_T (T)
0.9	0.45
1.1	0.55
1.3	0.65
1.5	0.75

Proposed Shot Plan — Part 1

1. Establish low P_{NBI} discharge with little to no pre-discharge Li evaporation (10 – 50 mg) and the following discharge characteristics (1 shot):
   a. $I_p = 0.9$ MA, $B_T = 0.45$ T
   b. I_p and B_t may be altered according to Table 2 if machine and administrative limits allow at the time of the experiment.
   c. No Midplane GPI puffing
2. Repeat this low power, low Li discharge for repeatability and to obtain GPI data (1 shot).
   a. Midplane GPI puffing at t = TBD
3. Increase beam power to the pre-defined medium power with low Li evaporation and take 2 shots at these conditions (2 shots)
   a. Maintain GPI puffing on the 2^{nd} shot and follow the same timing as step 2 and follow for all subsequent shots.
4. Increase beam power to the pre-defined high power with low Li evaporation and take 2 shots at these conditions (2 shots)
5. Increase beam power to the pre-defined highest power with low Li evaporation and take 2 shots at these conditions (2 shots)

Proposed Shot Matrix

	mg Li evaporation	
P_{NBI} (MW)	**Low**	**High**
Low Power	2	2 - 4*
Medium Power	2	2
High Power	2	2
Highest Power	2	2?

* Adjust Centerstack fueling as needed

Proposed Shot Plan — Part 2

6. Repeats steps 1 – 4 with a large amount (~ 300 mg) of pre-discharge Li evaporation (8 – 10 shots)
    a. Allow 2 – 4 shots to adjust centerstack fueling when the Li evaporation is first increased
    b. At the highest beam powers, disruptions due to β_N limits are likely and should be reserved for the end of the day or contingency

Summary of Diagnostic Status during each part of the experiment

Shot	PNBI	CHERS	GPI	SOL Refl.	Probes
1	Low	X		Swept	Swept
2	Low		X	Fixed Freq.	i_{sat}
3	Medium	X		Swept	Swept
4	Medium		X	Fixed Freq.	i_{sat}
5	High	X		Swept	Swept
6	High		X	Fixed Freq.	i_{sat}
7	Highest	X		Swept	Swept
8	Highest		X	Fixed Freq.	i_{sat}