Gas Puff Imaging Measurements with Varying Lithium Coating on NSTX

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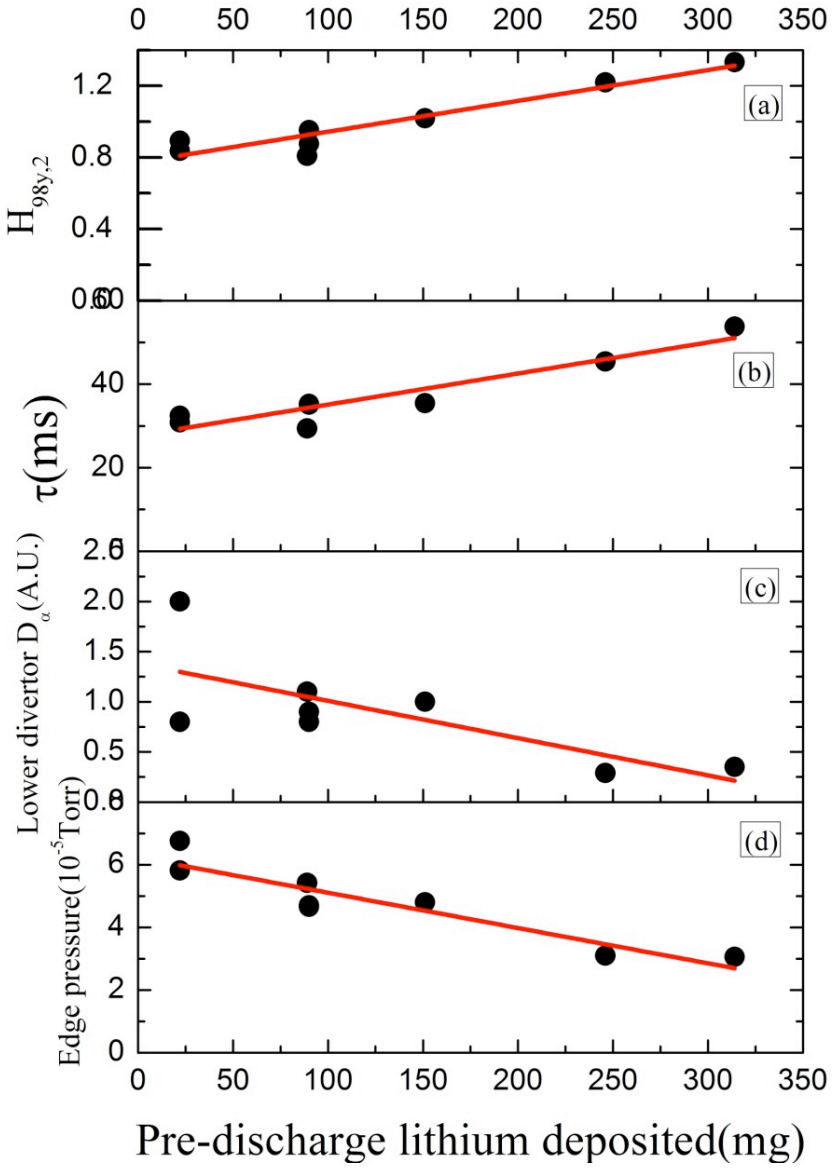
Motive for this research

- (a) shows the empirical scaling coefficient $H_{98y,2}$ increasing with more lithium.
- (b) shows the energy confinement time τ increasing with more lithium.
- (c) shows the divertor D_α light decreased as lithium increased, which means the recycling decreased as more lithium is added.
- (d) shows the edge pressure decrease measured by an ion gauge at vessel wall near outer mid-plane as lithium increased, which means fewer neutral particles in the edge.

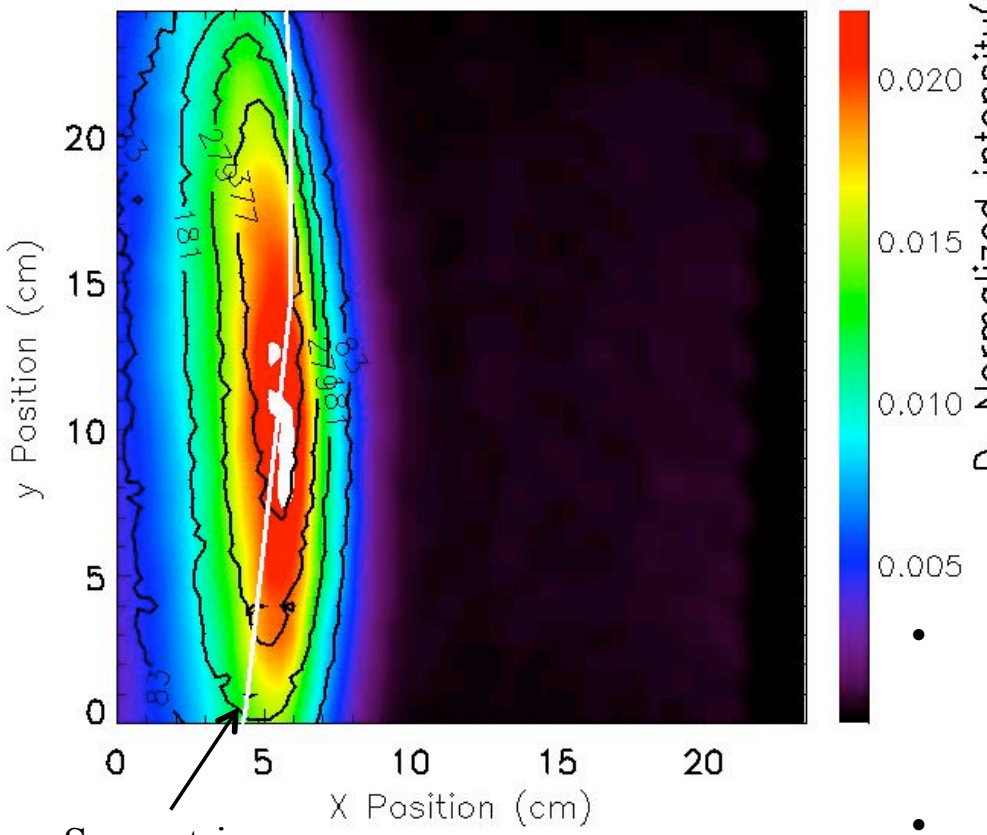


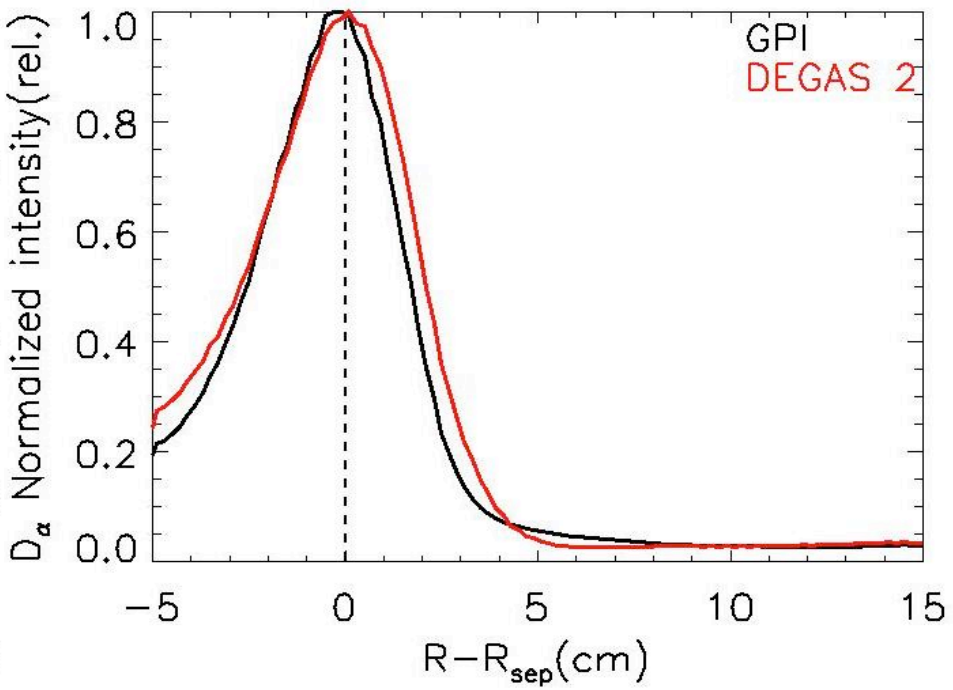
Shot list for database

The shots were all standard NSTX double-null, neutral beam heated, deuterium divertor plasmas taken on Oct. 21, 2010.

shot	Start time (ms)	End time (ms)	P_{NBI} (MW)	W_{MHD} (J)	P_{loss} (MW)	$\tau_{E<MHD>}$ (s)	$H_{98(y,2)}$	n_e (10^{15}cm^{-2})	I_p (KA)	B (kG)	Edge pressure(10^{-5} Torr)	Li dep'n (mg)	Li accum (mg)
141307	480	490	3.8	1.37E+05	4.2	0.032	0.893	7.5	700	4.43	5.82	22	1497
141309	480	490	4.8	1.60E+05	5.2	0.031	0.837	7.8	700	4.43	6.76	22	1540
141319	530	540	3.9	1.42E+05	4.0	0.035	0.877	7.9	650	4.43	4.7	90	2041
141320	530	540	4.0	1.42E+05	4.0	0.035	0.952	8	650	4.43	4.66	90	2131
141321	530	540	3.9	1.41E+05	4.8	0.029	0.809	7	650	4.43	5.42	89	2220
141322	530	540	4.0	1.48E+05	4.2	0.035	1.02	8	650	4.43	4.8	151	2371
141324	530	540	2.9	1.26E+05	2.8	0.045	1.22	6	650	4.43	3.1	246	2845
141326	530	540	2.9	1.57E+05	2.9	0.054	1.33	5.6	650	4.43	3.06	314	3396

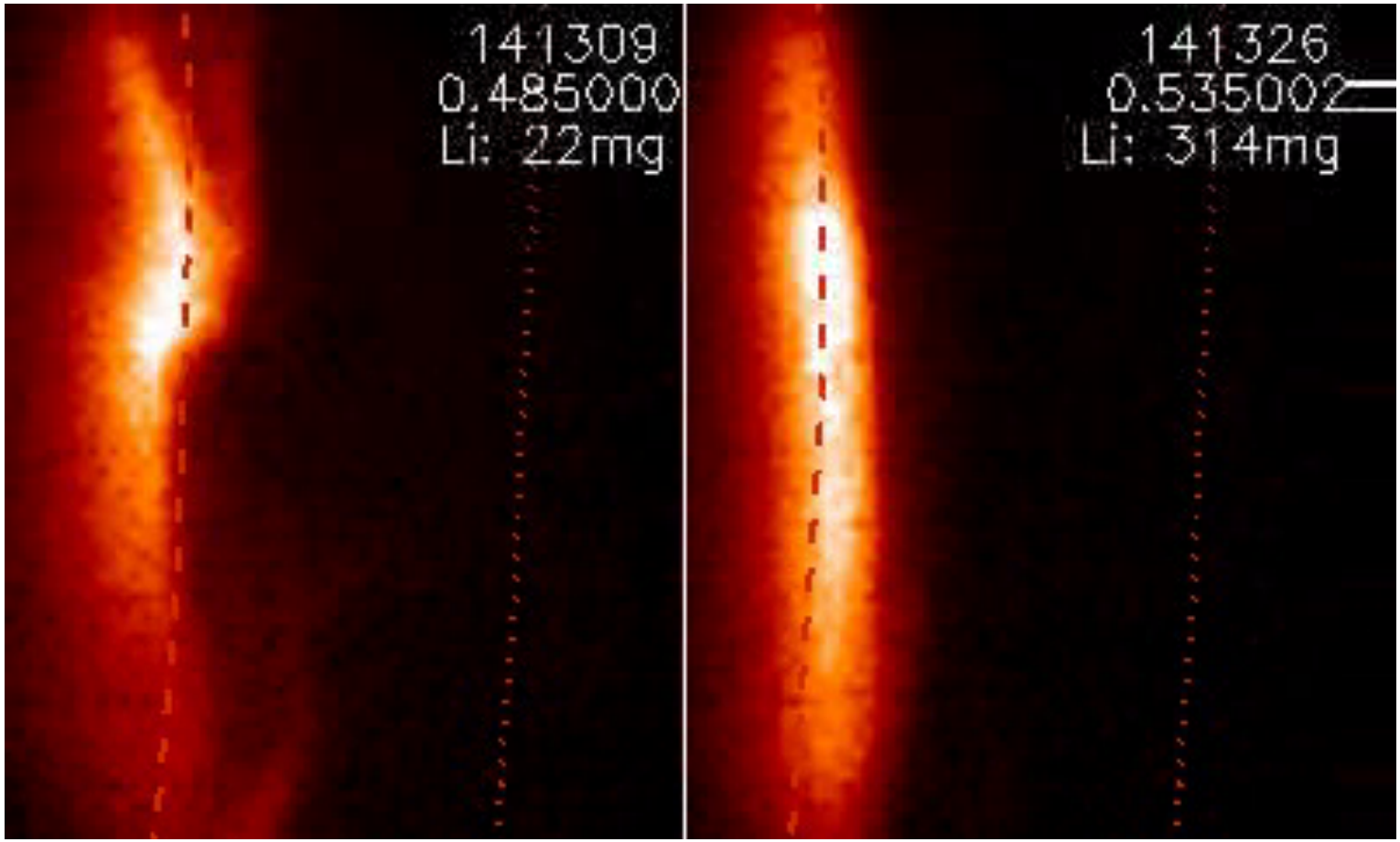
Comparison between DEGAS 2 and GPI



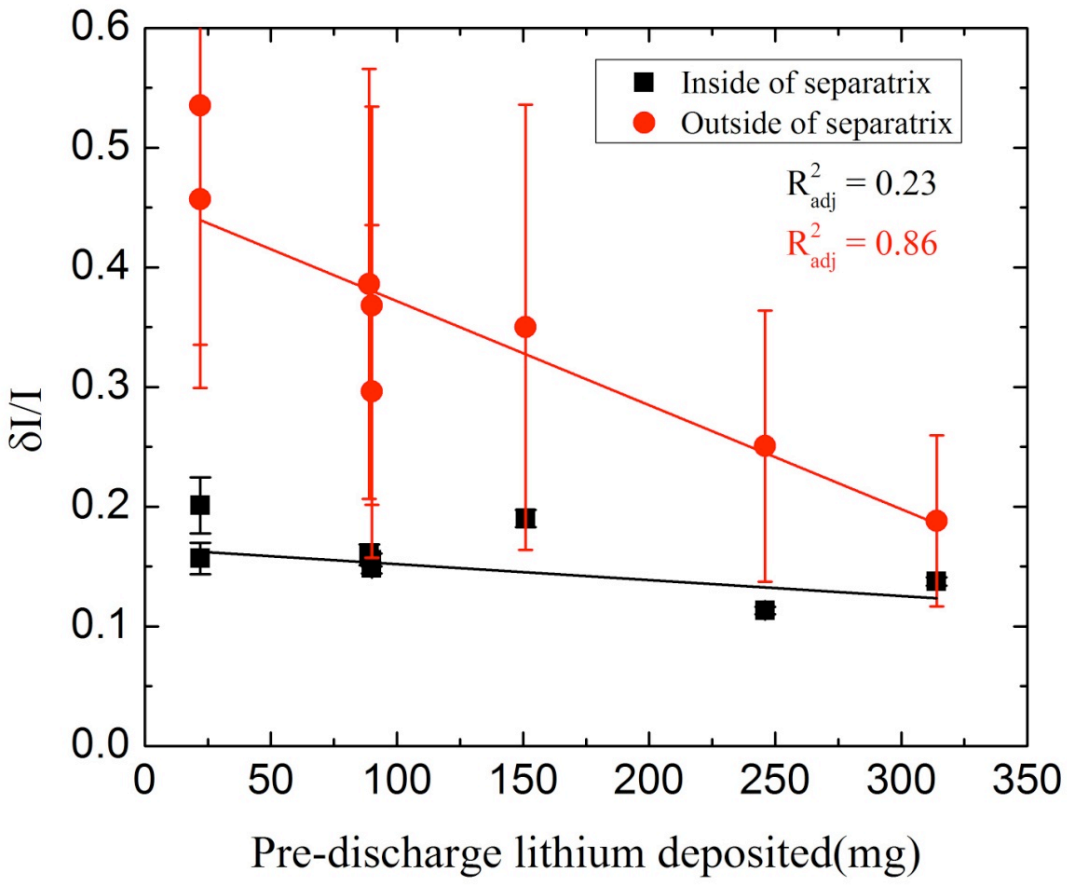


- The color contours are the DEGAS 2 results in units of Watt/(m^{2}ster), the black contours are the GPI results, and the white line is separatrix.
- Radial profile of D_α light from DEGAS 2 and GPI, with all the data mapped to the mid-plane, where the vertical scale is for the DEGAS 2 results and the GPI results are normalized to the peak of the DEGAS 2 results.

The maximum (right) lithium has a higher fluctuation than the minimum (left) lithium



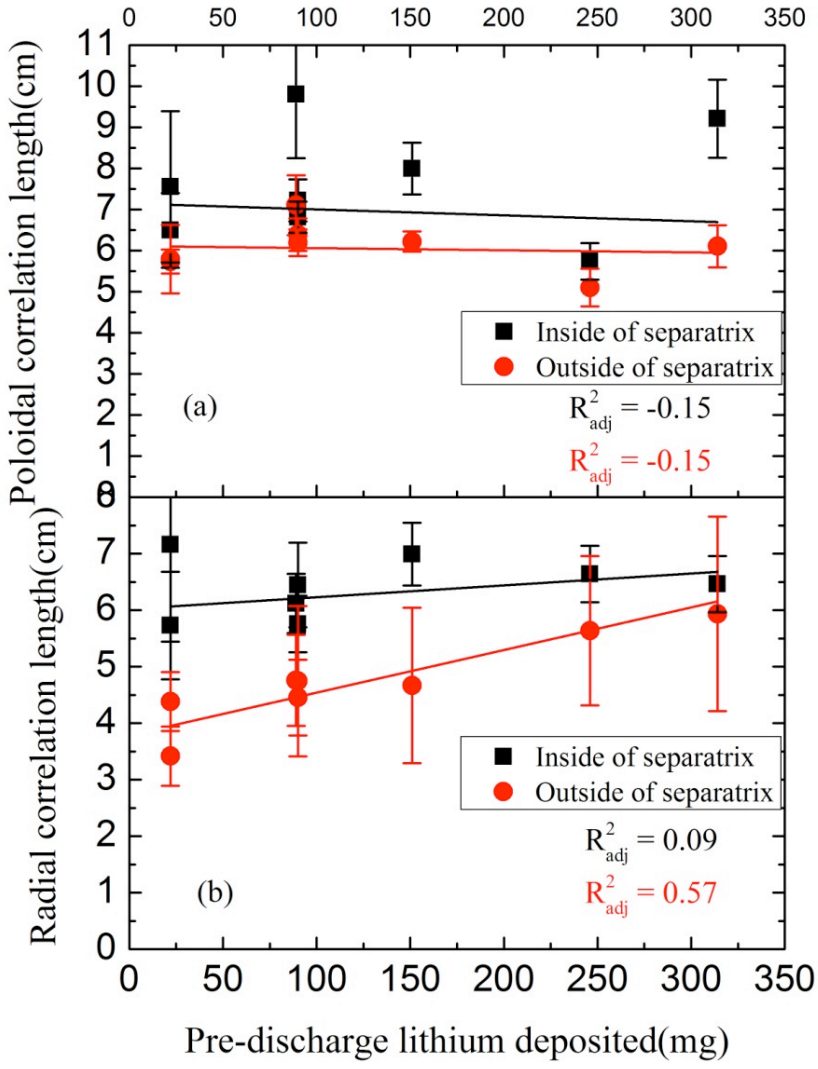
Relative GPI fluctuation decreased lithium



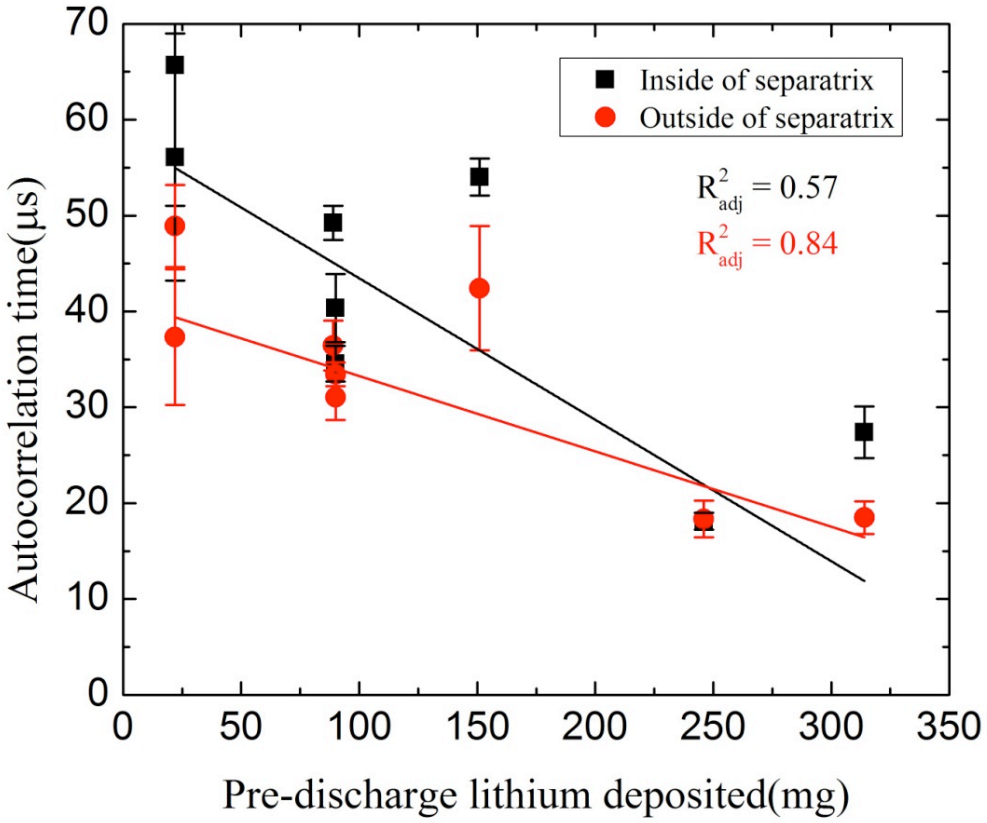
Relative GPI fluctuation level vs. lithium for the regions the inside separatrix (radius from -3 cm to 0 cm) and outside the separatrix (from 0 cm to 3 cm). With increased lithium coating the relative fluctuation level decreased from 0.45 to 0.2 outside the separatrix, but did not change significantly inside the separatrix. The relative fluctuate level is always bigger outside than inside the separatrix. The line is linear fit of these point and the R_{adj}^2 is the adjusted R-square and it defined as R^2_{adj} = 1-MSE/MST.

Inside radial correlation increased with lithium

- (a) Poloidal vs. lithium, there is no clear correlation between the amount of lithium and the poloidal correlation lengths
- (b) radial correlation lengths vs. lithium, inside the separatrix there is no clear correlation between the radial correlation length and the amount of lithium; however, there does seem to be an increase in the radial correlation length outside the separatrix with more lithium.

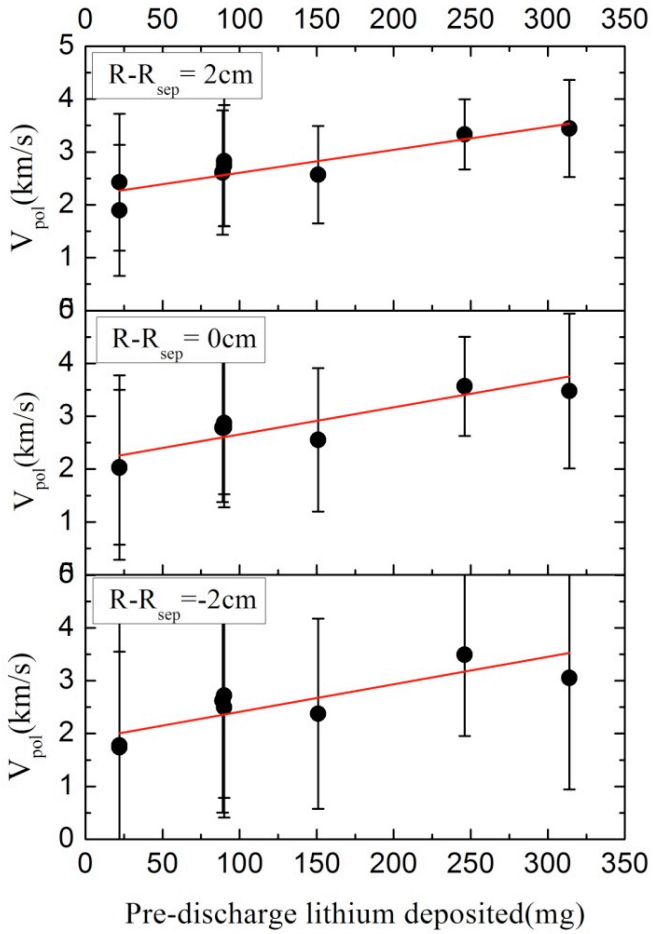


Autocorrelation time decreased with lithium

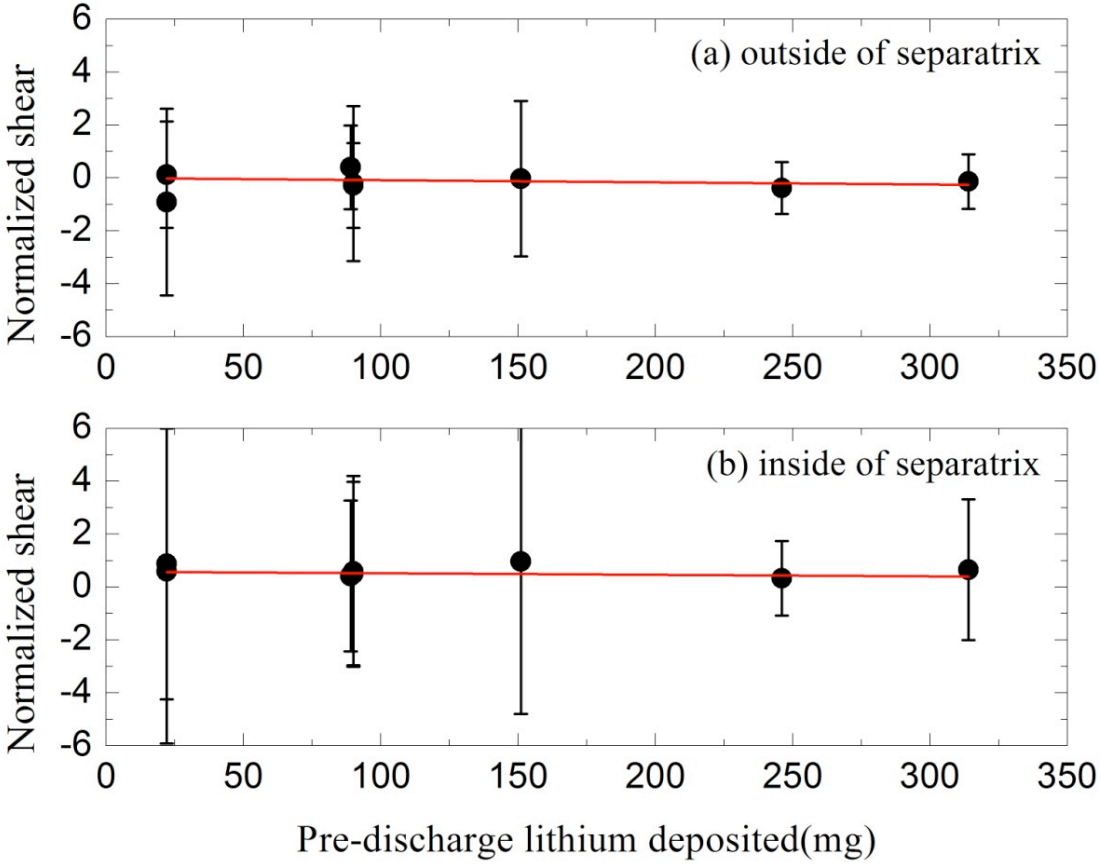


Turbulence autocorrelation time vs. lithium deposition both inside and outside of the separatrix. The autocorrelation times both inside and outside the separatrix decrease as the lithium deposition is increased.

Turbulence flow speed increased with lithium



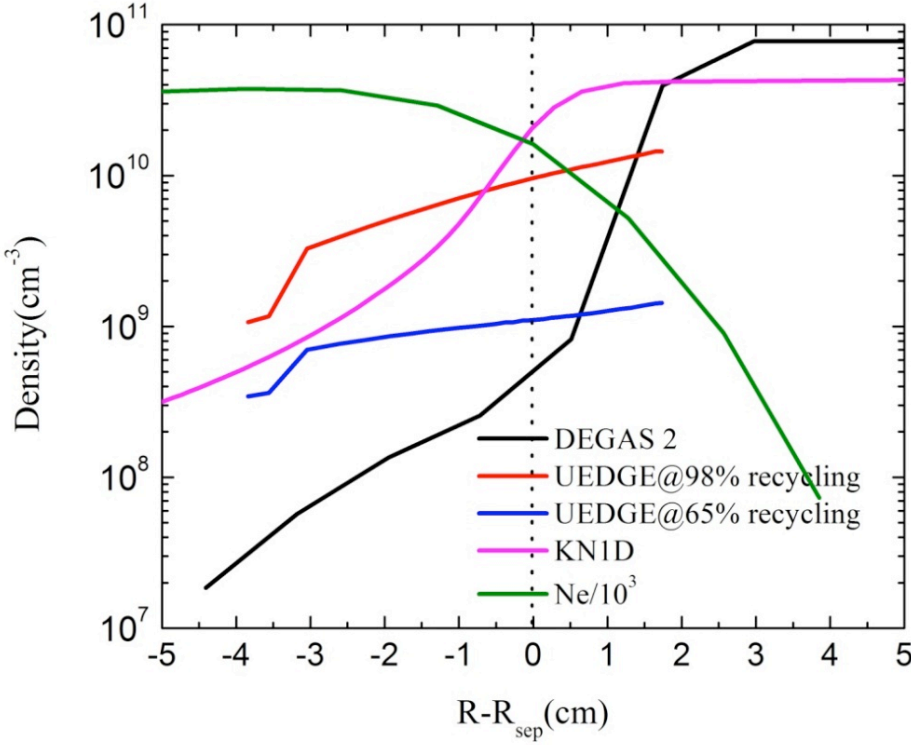
Poloidal turbulence velocities vs. lithium at different radial locations (R-R_{sep} =-2, 0, 2 cm).



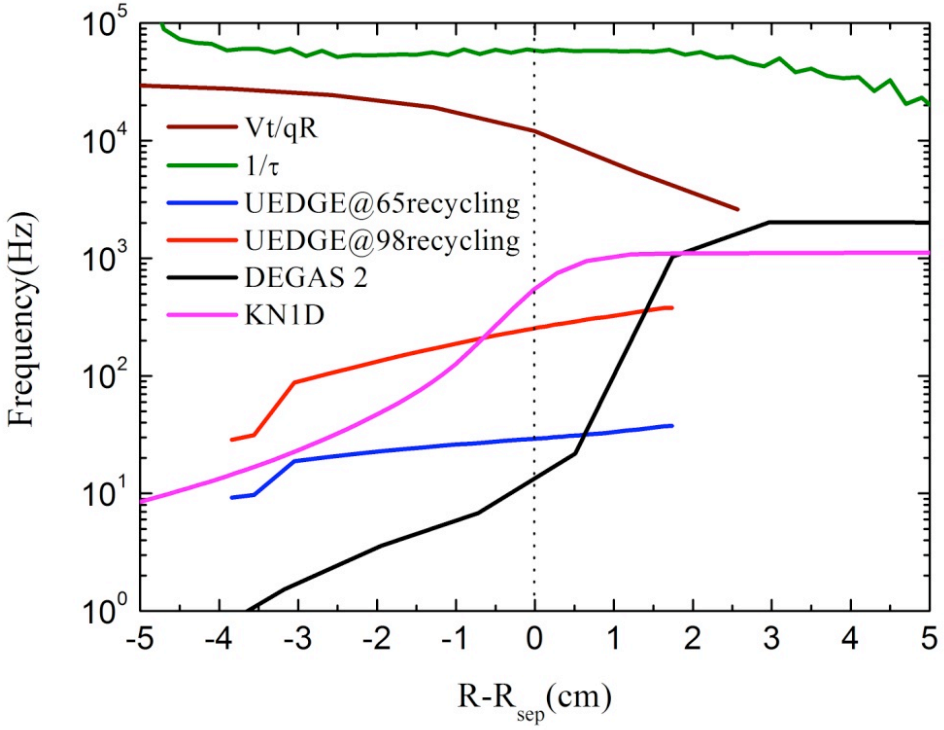
Normalized turbulence flow shear vs. lithium.

$$S=(dV_p/dr)(L_r/L_p)\tau$$

Neutral for shot #141324



Edge neutral density profiles from neutral particle simulation codes



Ion charge exchange collision frequency profiles from neutral particles simulation results

One possible mechanism