

# Effect of divertor electrode biasing on local SOL transport (XP1051)

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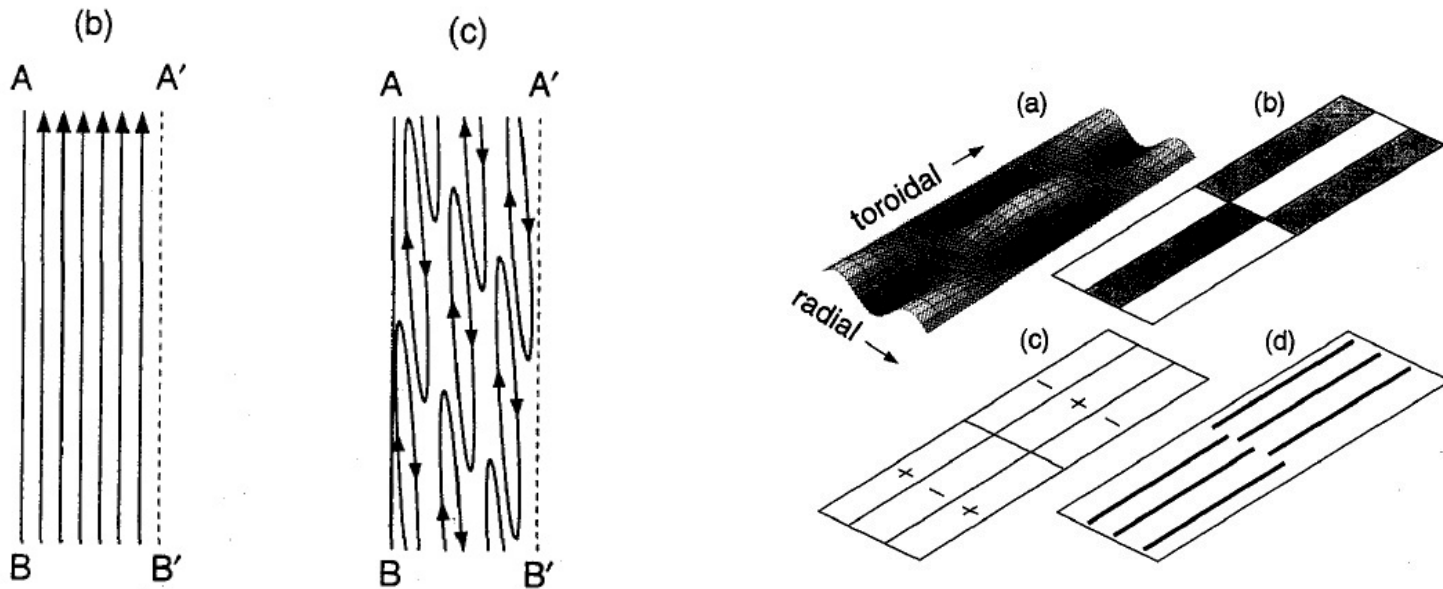
Boundary Group Review 8/18/10

Motivation: learn whether the divertor plate particle flux can be controlled by local electrode biasing

Goal of XP: bias electrodes in Bays E and K and measure effects on local probes and visible emission

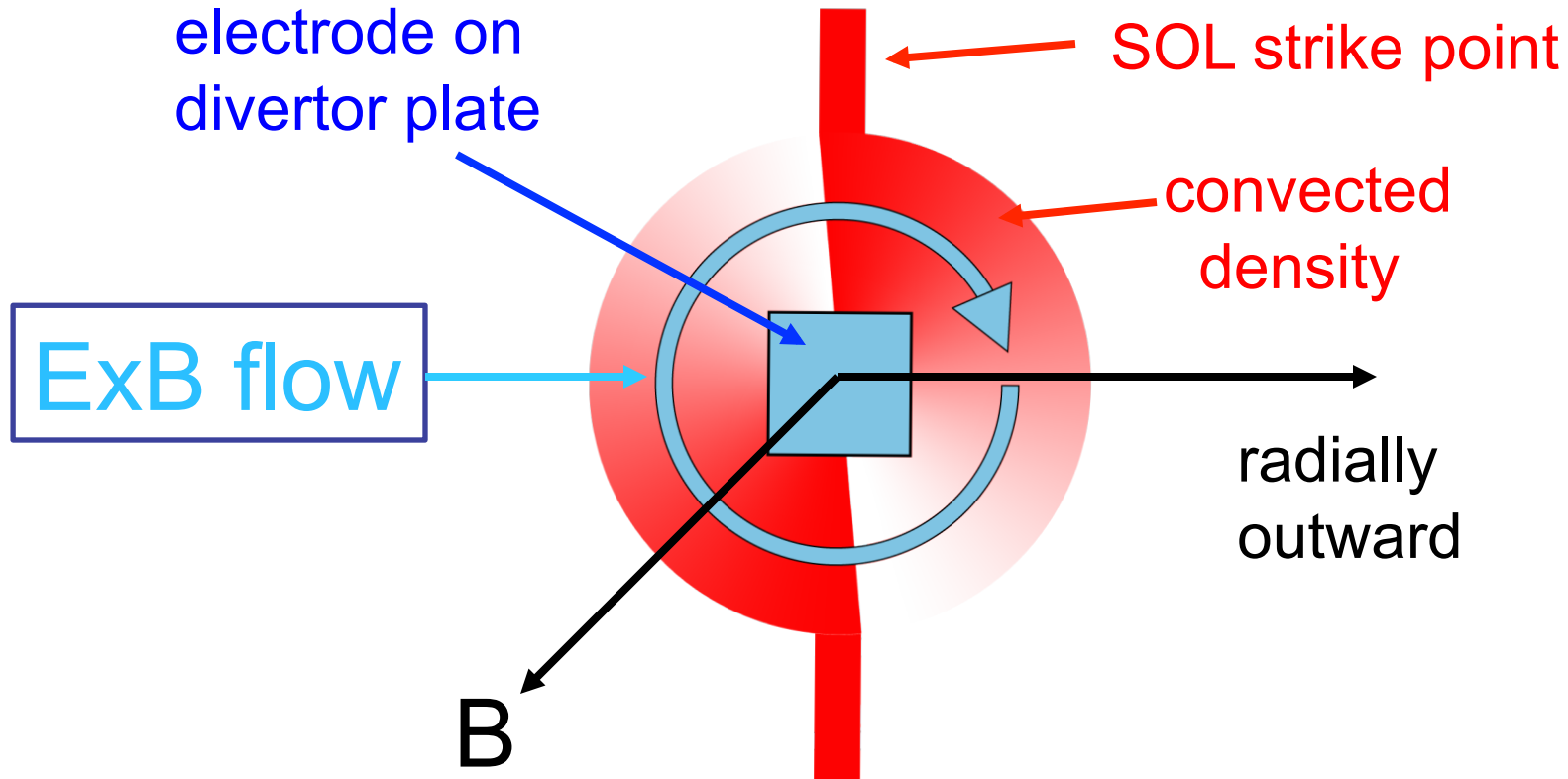
# Idea of Divertor Plate Biasing

- Generate convective cells in SOL to increase transport
- Create convective cells by biasing divertor plates



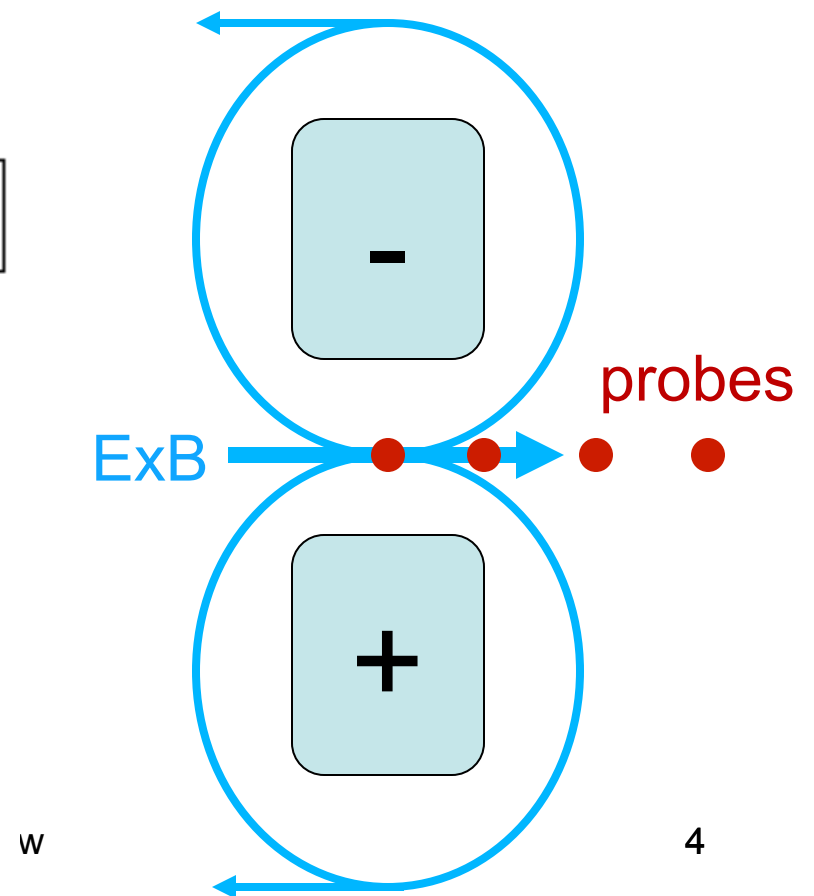
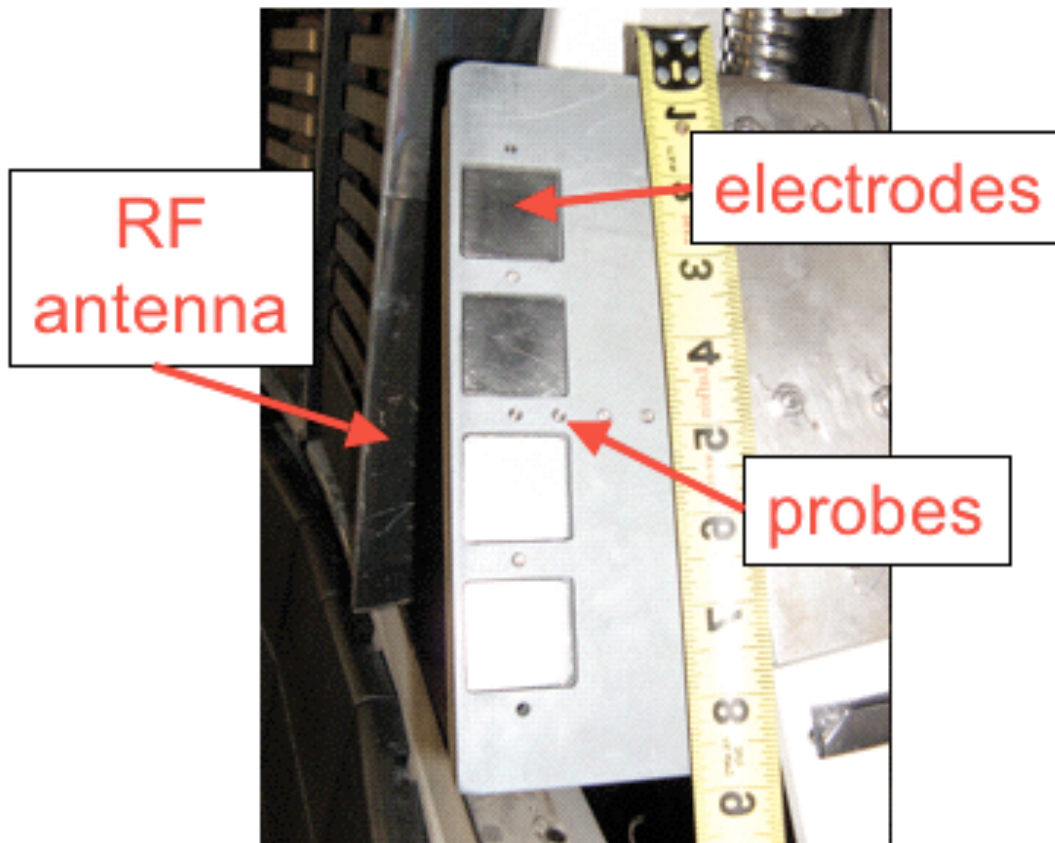
# Convective Cell Near Strike Point

- Goal is to broaden heat / particle SOL width at divertor plate by creating local convective cells [Cohen/Rytuvov '97]



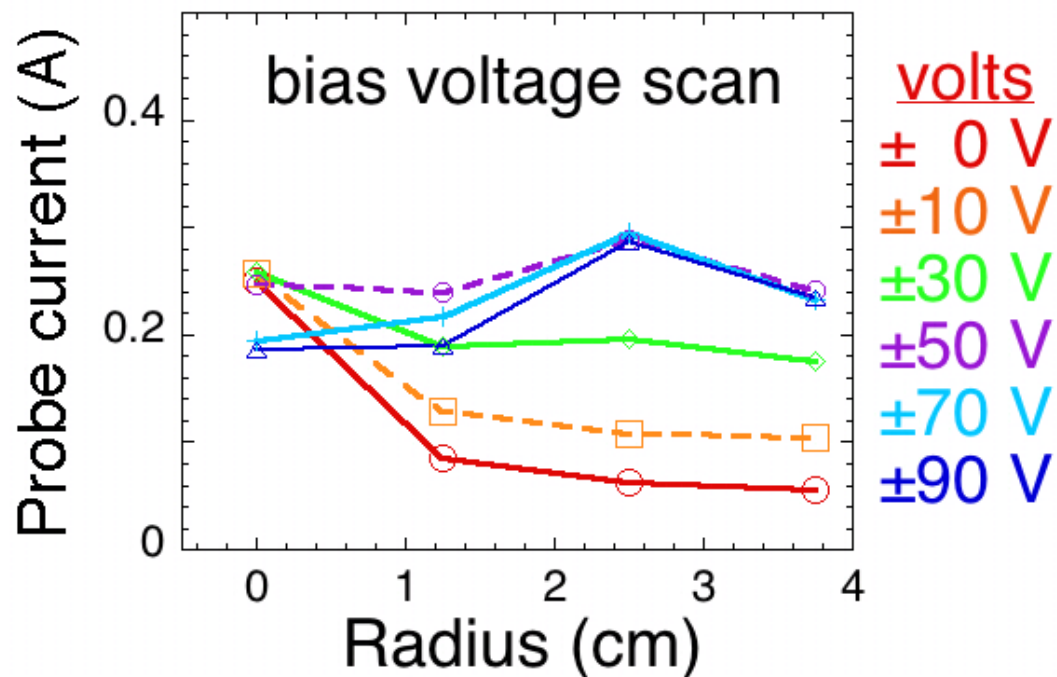
# NSTX Electrodes and Probes

- Electrodes and probes located just below outer midplane
- Electrodes biased up to  $\pm 90$  V with respect to vessel



# Midplane Electrode Bias Scan

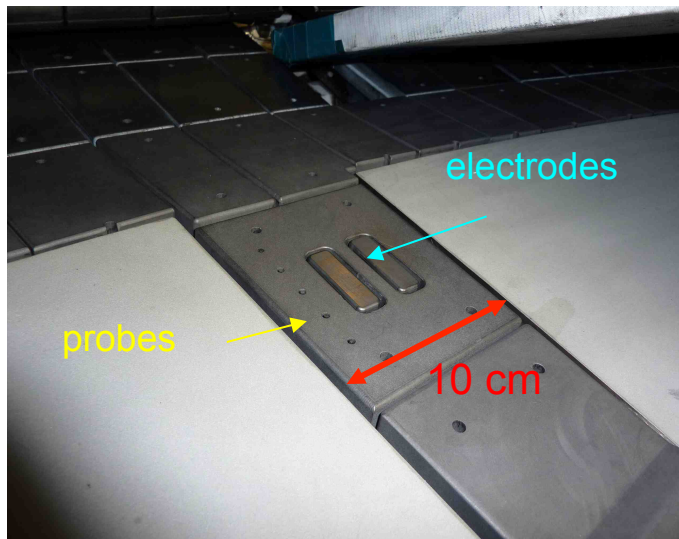
- Effects on density profile vary with biasing voltage
- Increase with bias consistent with expected ExB



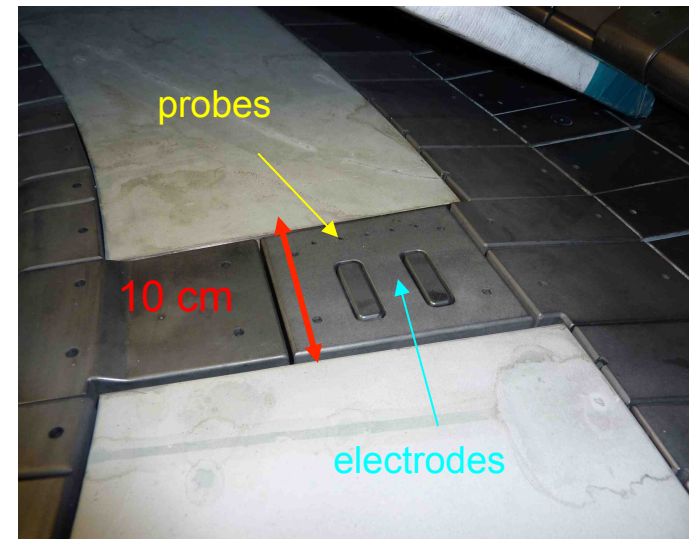
# Electrodes in LLD Diagnostic Tiles

- LLD electrodes 4 cm x 1.5 cm radial or toroidal @ R=78 cm
- Five probes adjacent to each electrode pair @ R=75-82 cm
- LLD cameras view electrodes in Li I or  $D_\alpha$  (close-up @ Bay E)

Bay K

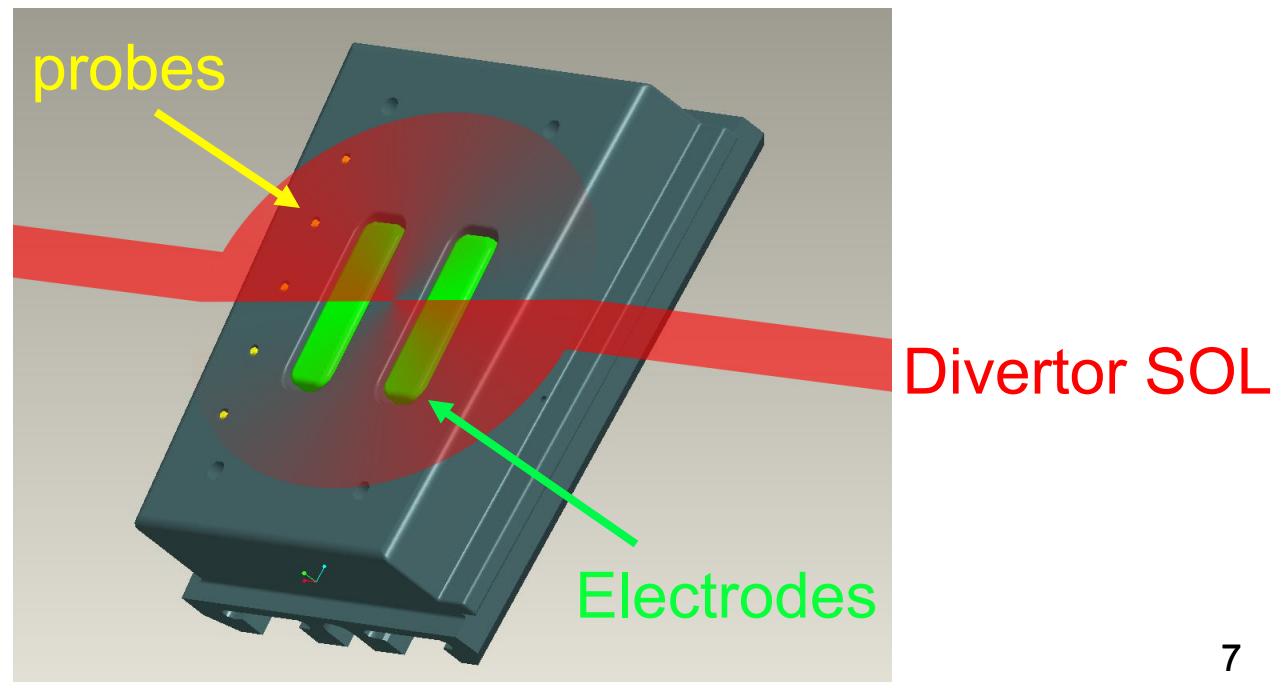


Bay E



# Expected Effect of Biasing

- Biasing should deflect density locally around electrodes
- Will measure effects  $\parallel$  and  $\perp$  B with camera + probes



# XP#1051 Run Plan Steps

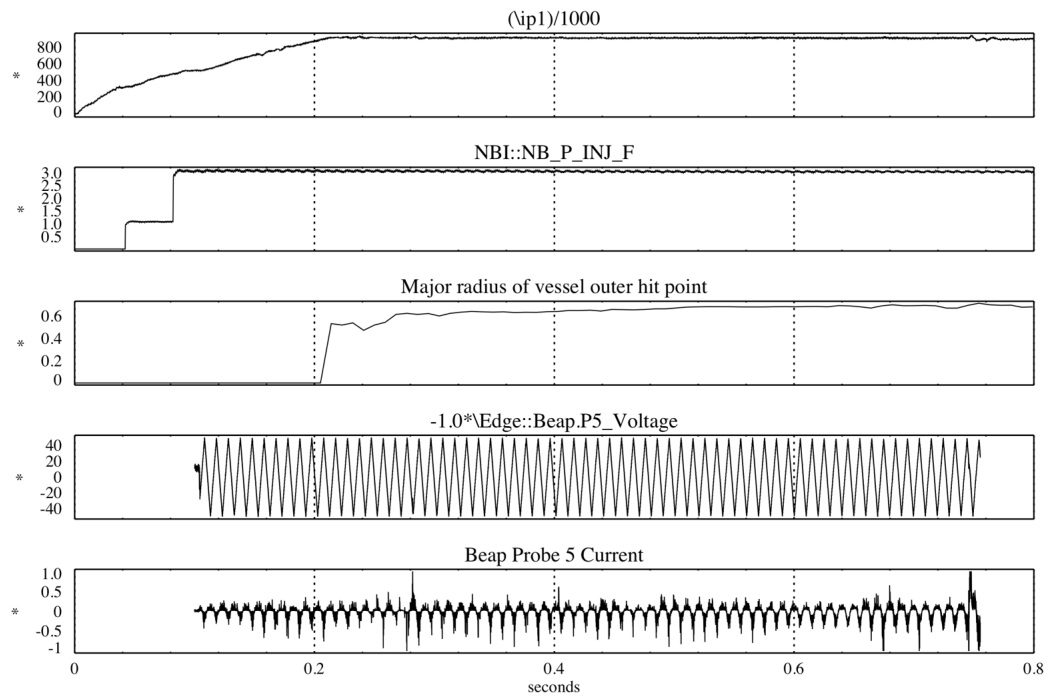
- 1) set up template LLD discharge w/OSP sweep R=60-68 cm
- 2) raise bias on Bay E probes from  $\pm 10$  Volts to  $\pm 90$  Volts
- 3) repeat at  $\pm 90$  Volts with varying filters and probe sweeps
- 4) add Bay K bias to maximize effect on plasma (e.g. ELMs)
- 5) increase OSP to R=74-76 cm with Bay E bias only
- 6) *controlled access to switch probes from Bay E to Bay K*
- 7) bias Bay K probes  $\pm 90$  Volts and vary filters and sweeps



# Template LLD Discharges



Shots:  
139654



<u>SHOT</u>	<u>OSP R</u>
139654	60-68 cm
139395	76 cm
130393	74 cm
139402	75 cm

# Shot List XP1051

Bay E bias scan + variations  
Bay E + Bay K bias together

Shot #	OSP R (cm)	E1 volts	E2 volts	K3 volts	K4 volts	Camera filters	Probe bias	Comment
1	60-68	+10	-10	0	0	E,K - Li I	+50 VDC	E bias voltage scan
2	60-68	+50	-50	0	0	E,K - Li I	+50 VDC	E bias voltage scan
3	60-68	+90	-90	0	0	E,K - Li I	+50 VDC	E bias voltage scan
4	60-68	+90	-90	0	0	E,K - Li I	+50 VDC	repeat shot
5	60-68	+90	-90	0	0	E,K - Dα	sweep	repeat shot
6	60-68	+90	0	0	0	E,K - Dα	+50 VDC	zero negative voltage
7	60-68	+90						contingency repeat
8	60-68	+90						contingency repeat
9	60-68	+90	-90	+90	-90	E,K - Li I	+50 VDC	add K bias to E bias
10	60-68	+90	-90	+90	-90	E,K - Li I	+50 VDC	add K bias to E bias

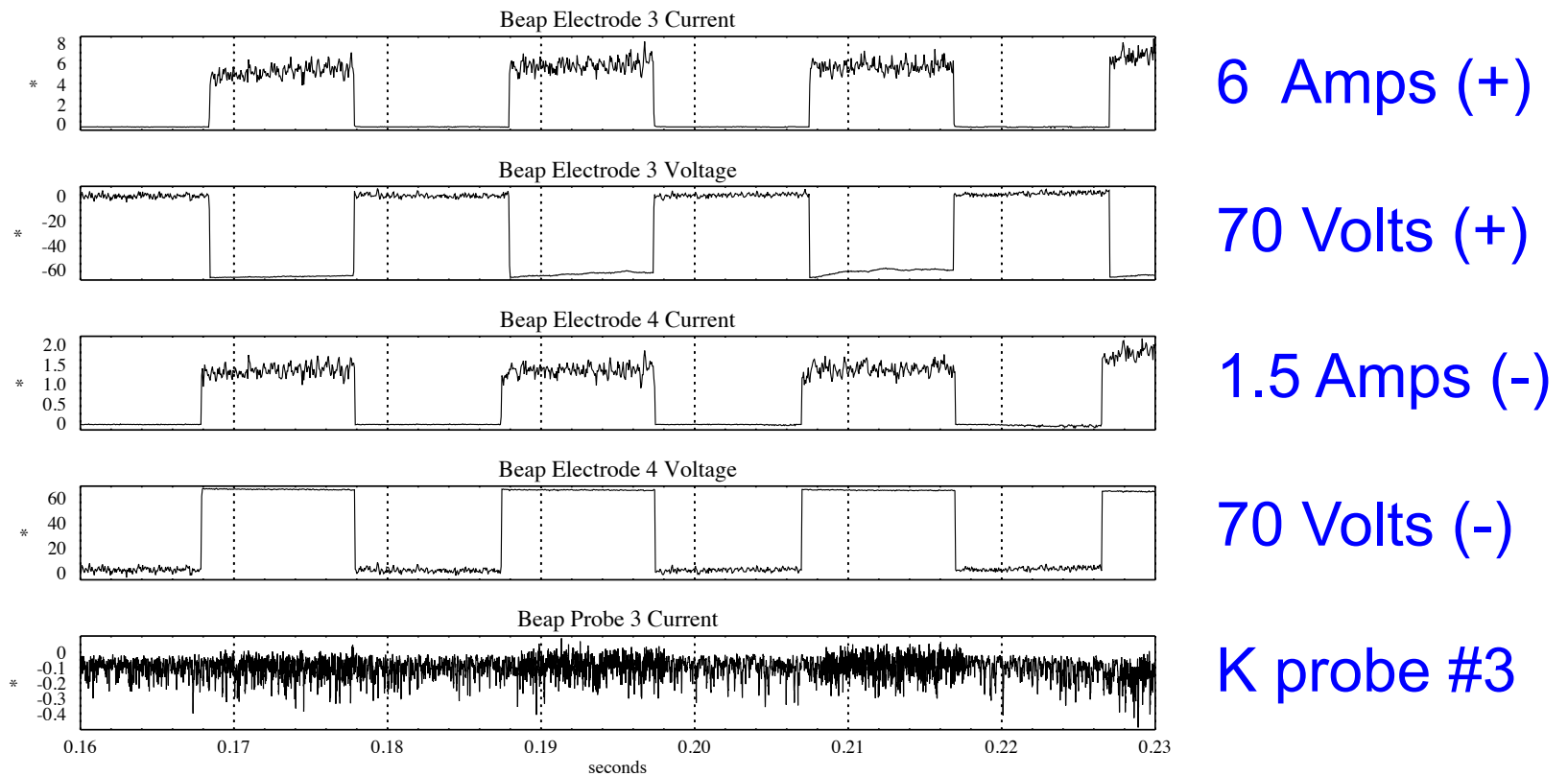
Bay E increased OSP radius  
Bay K bias with Bay K probes

11	74-76	+90	-90	0	0	E,K - Li I	+50 VDC	increase OSP radius
12	74-76	+90	-90	0	0	E,K - Li I	+50 VDC	repeat shot
13	74-76	+90	-90	0	0	E,K - Dα	sweep	w/ Dα + sweep
14	74-76	+90						contingency repeat
switch probes from Bay E to Bay K (controlled access needed)								
15	60-68	0	0	+90	-90	E,K - Li I	+50 VDC	K bias w/K probes
16	60-68	0	0	+90	-90	E,K - Li I	+50 VDC	K bias w/K probes
17	60-68	0	0	+90	-90	E,K - Li I	+50 VDC	K bias w/K probes
18	60-68	0	0	+90	-90	E,K - Dα	sweep	w/ Dα + sweep
19	60-68	0	0	+90	-90	E,K - Li I	+50 VDC	increase OSP radius
20	60-68	0	0	+90				contingency repeat

# Preliminary Results – Probes

- Bay K bias so far makes no clear effect on K probes
- Electrode currents level can still be increased by x 5

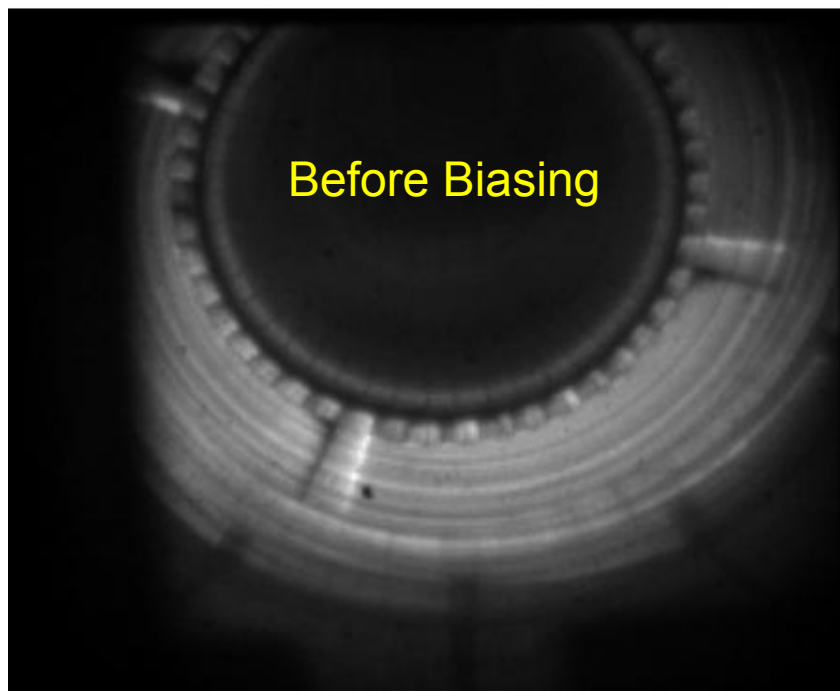
Shots:  
138675



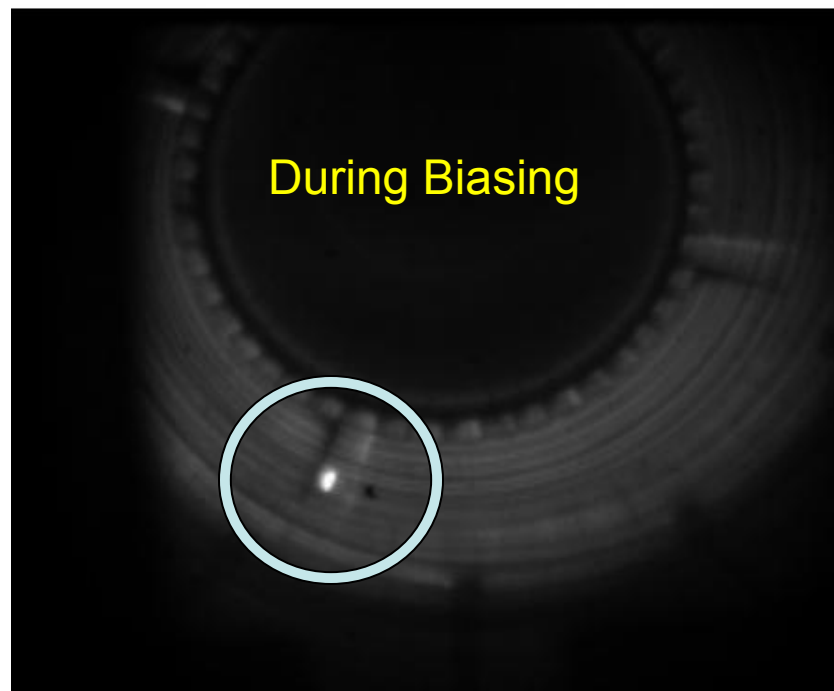
# Preliminary Results – Camera

- Electrode at Bay K glows in Li I during and after biasing
- No clear effect on local Li I emission in vicinity of electrode

...tom73-6663/2010/nstx\_3\_138675.cin at 187.137 ms



...tom73-6663/2010/nstx\_3\_138675.cin at 197.437 ms



## Caveats on XP#1051 run plan

- Do not continue in condition where electrodes are obviously overheating (i.e. glowing well after shot is over)
- Do not continue in condition where impurity level or radiated power obviously increases due to biasing
- Do not continue in condition where electrodes show local arcing behavior (e.g. due to Lithium deposits)