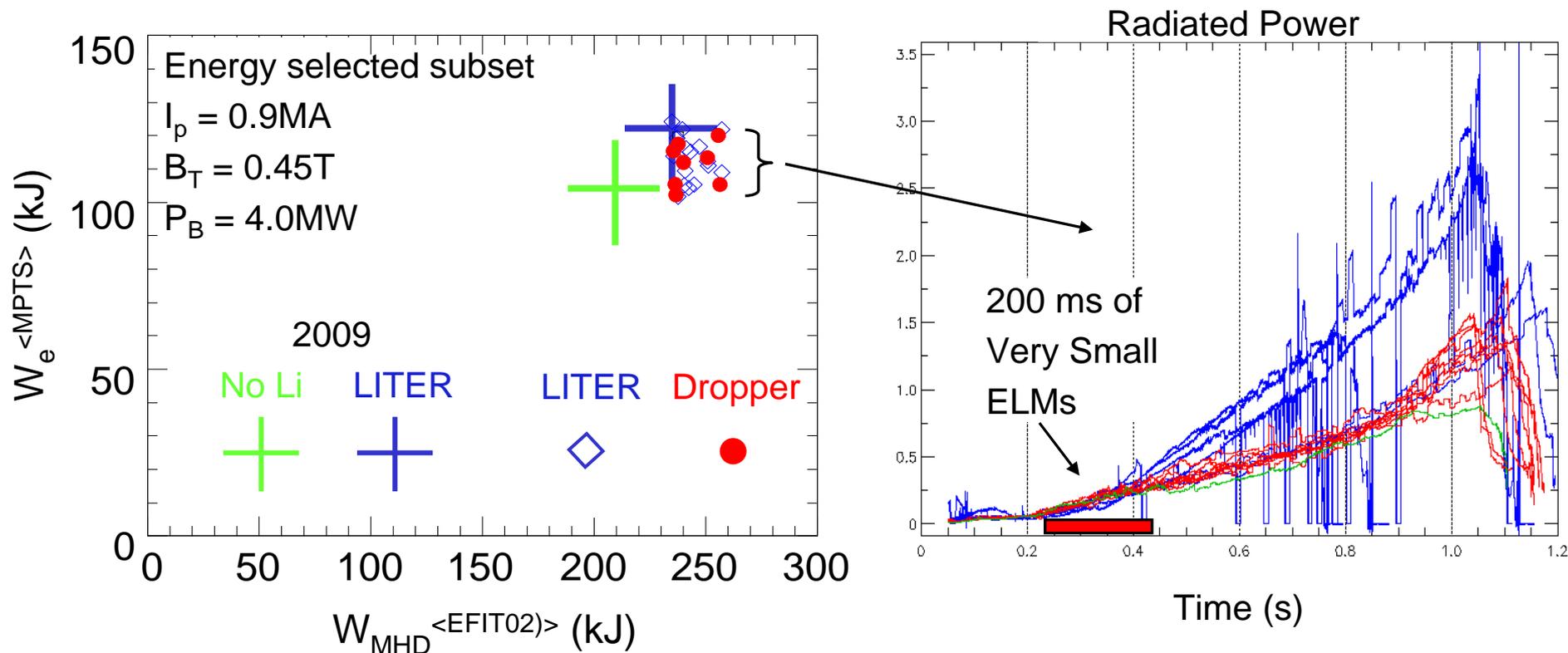


Understanding / Eliminating High-Z Accumulation During ELM-Free H-Modes

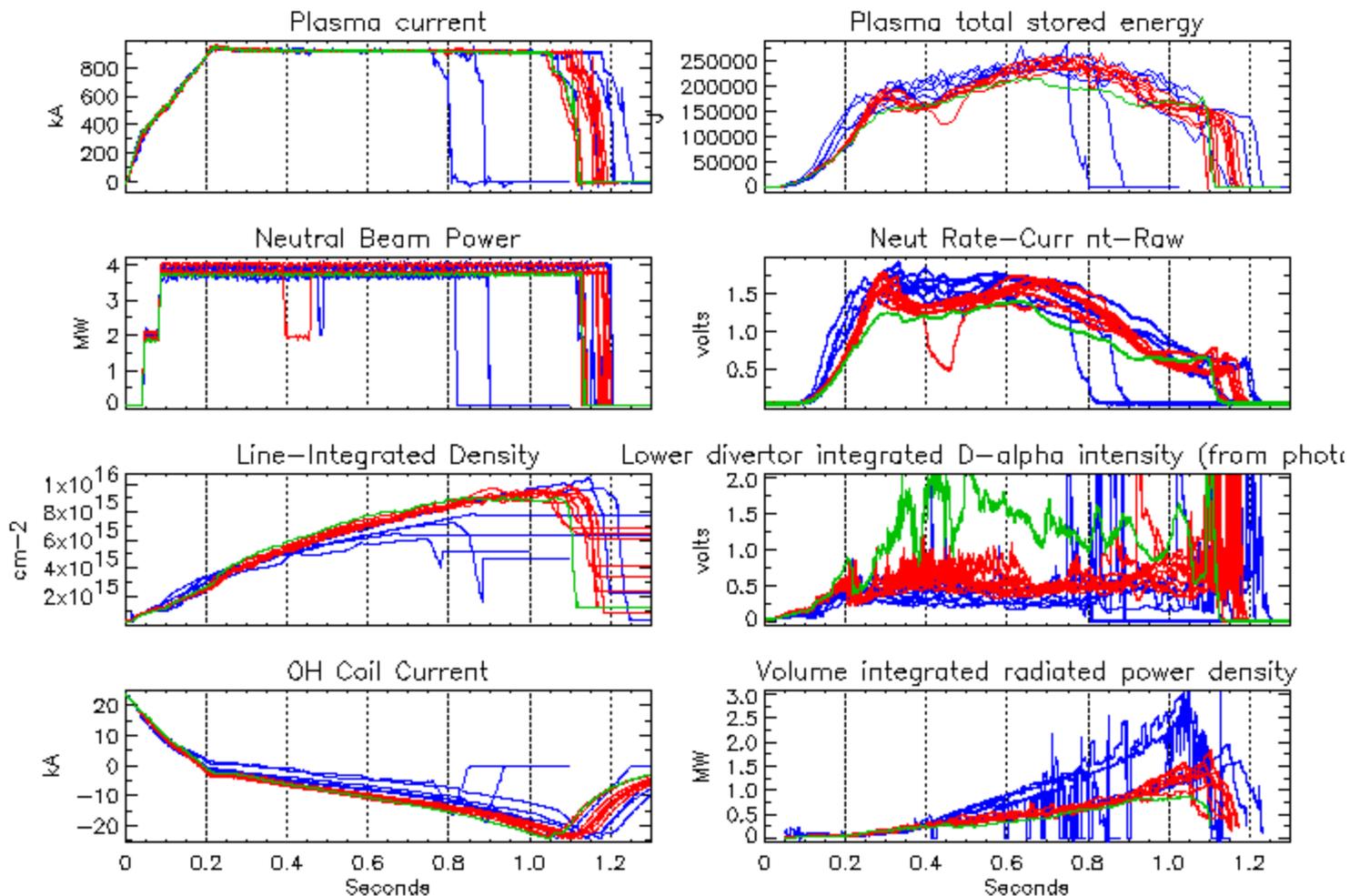
2009 XP-913 Results

- It was easier to get ELM-free conditions with LITER as compared to Dropper
- However,
- ELM-free Dropper shots had less radiated power than their LITER counterparts and only slightly more radiated power than No-Li shots



Understanding / Eliminating High-Z Accumulation During ELM-Free H-Modes

Aerosol
LITER
No Li



Understanding / Eliminating High-Z Accumulation During ELM-Free H-Modes

Proposal: Use Li aerosol to compliment LITER in order to:

- (a) Understand the source of High-Z impurities
- (b) Optimize low-radiation ELM-free discharges (w/wo LLD)

Hypothesis (1): Aerosol droplets in the SOL somehow impede the influx of high-Z impurities. Need Mechanism. (1) Li target for bad beam ions (2) other

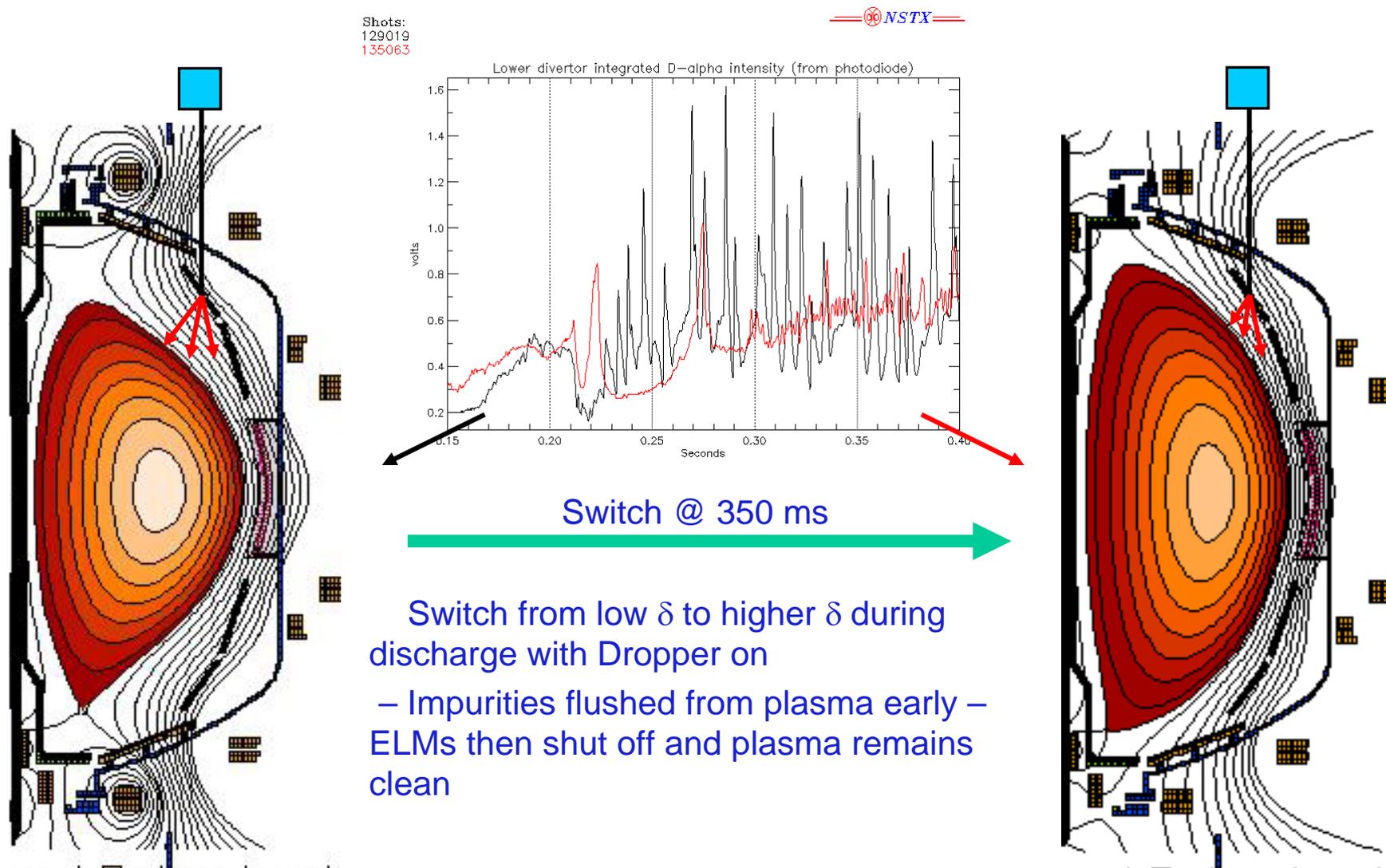
Hypothesis (2): Just a few, early, very small ELMs are needed to purge high-Z impurities that enter before H-mode.

Run plan:

- (1) LITER to eliminate ELMs – standard fiducial configuration
- (2) Start aerosol injection Bays I & C - watch for reduced Prad
If Prad reduced – use only Bay I
repeat with only Bay C
- (3) If no reduced Prad, trigger high-freq ELMs, 250-450 ms – watch Prad
If no reduced Prad, try aerosol as well as early ELMs

Run time: 1 Day

Can Impurities be Purged from the Core by Allowing Early Elms with Shaping and Eliminating Later ELMs with Aerosol ?



Can Impurities be Purged from the Core by Allowing Early Elms with Shaping and Eliminating Later ELMs with Aerosol ?

Proposal: Run low δ plasma on bull nose tiles with LLD cold and Dropper on. This should result in large ELMs – thus purging the plasma of impurities. At 350 ms, switch to higher δ operation. This could result in smaller disappearing ELMs and possibly to a high confinement ELM-free plasma with low radiated power.

Conjecture: A few Large ELMs early in the discharge will be enough to purge the core of high-Z impurities and the aerosol droplets in the SOL will allow the plasma to remain clean.

Run Plan:

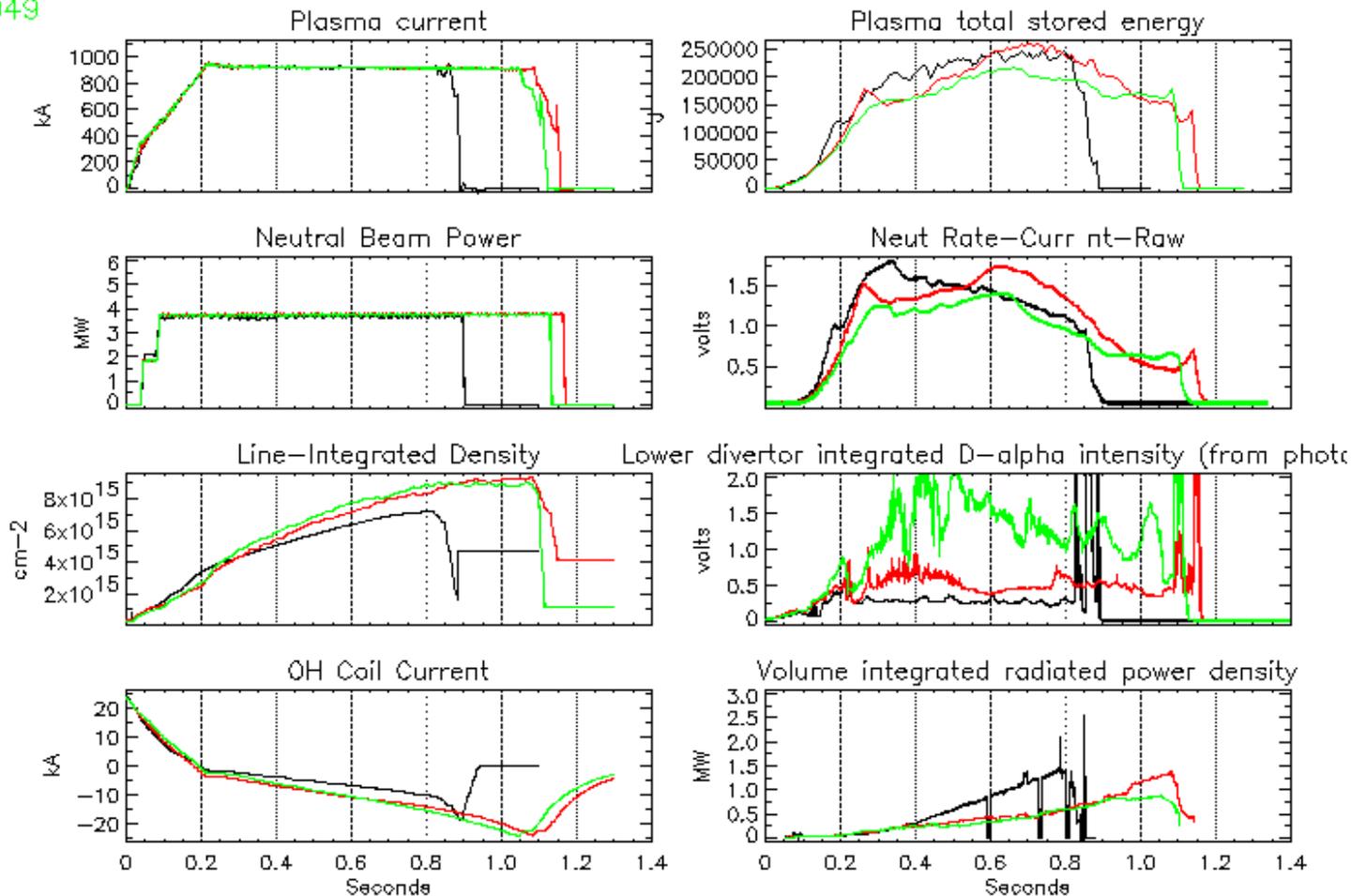
- (1) Make ELMing discharges on bull nose tile – LLD cold, no active lithium
- (2) Switch to standard fiducial at 350 ms
- (3) Repeat with Dropper on (Bays I & C) – watch Prad

Run Time: 1 Day

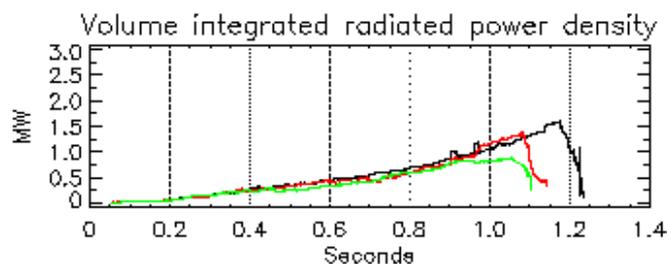
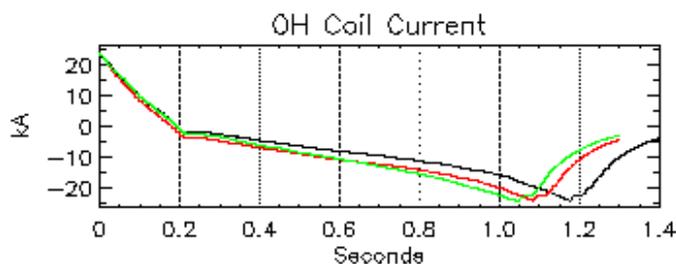
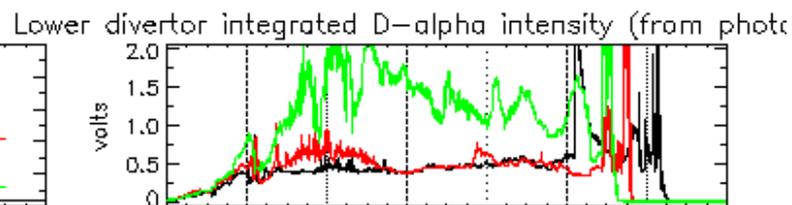
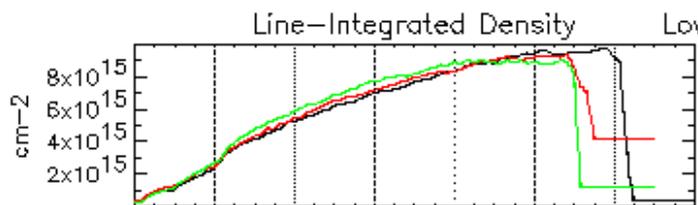
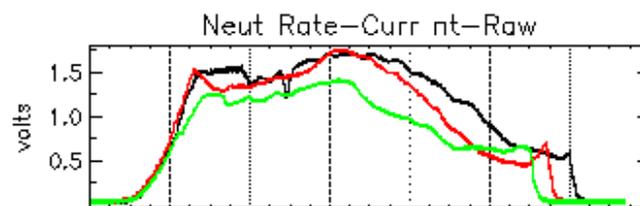
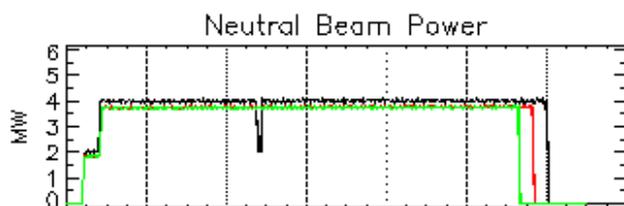
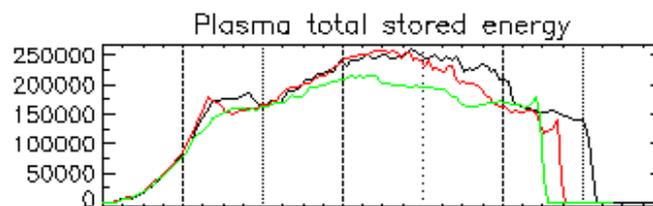
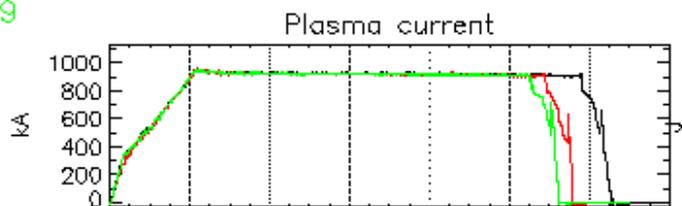
EXTRA SLIDES

Can/Should ELMs be Eliminated Slowly?

Shots:
129263
135063
135049



Shots:
 134085
 135063
 135049

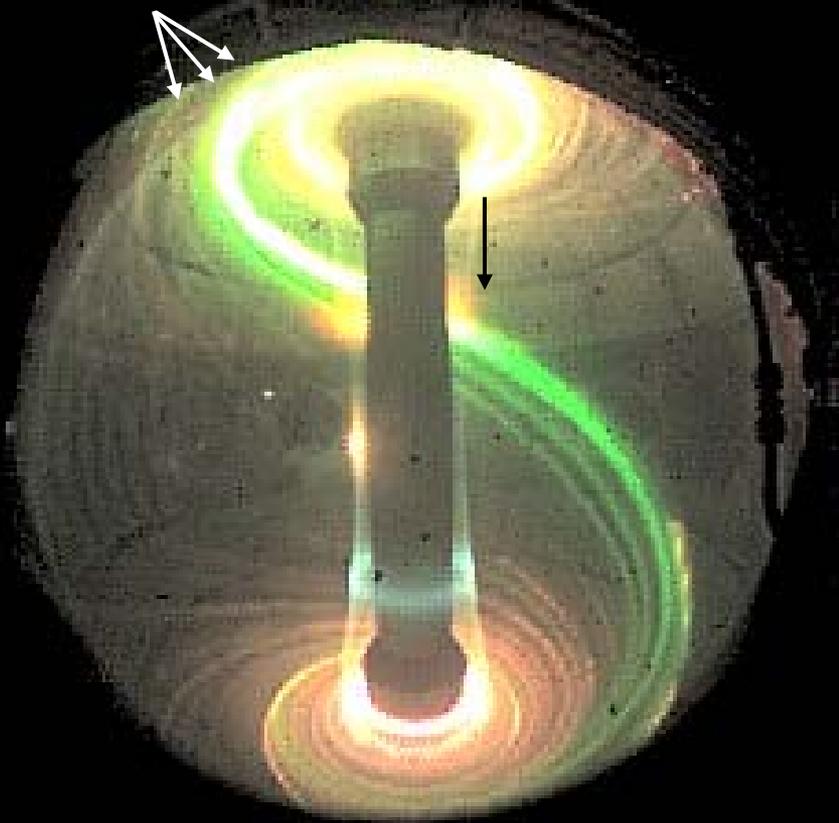


Shot 135063: Enhanced Confinement, No Elms, Low P_{rad}

- A Few Small Elms Early Seems to Purge the Core Sufficiently
- Drop in Carbon Radiation from Center Stack – Transition?

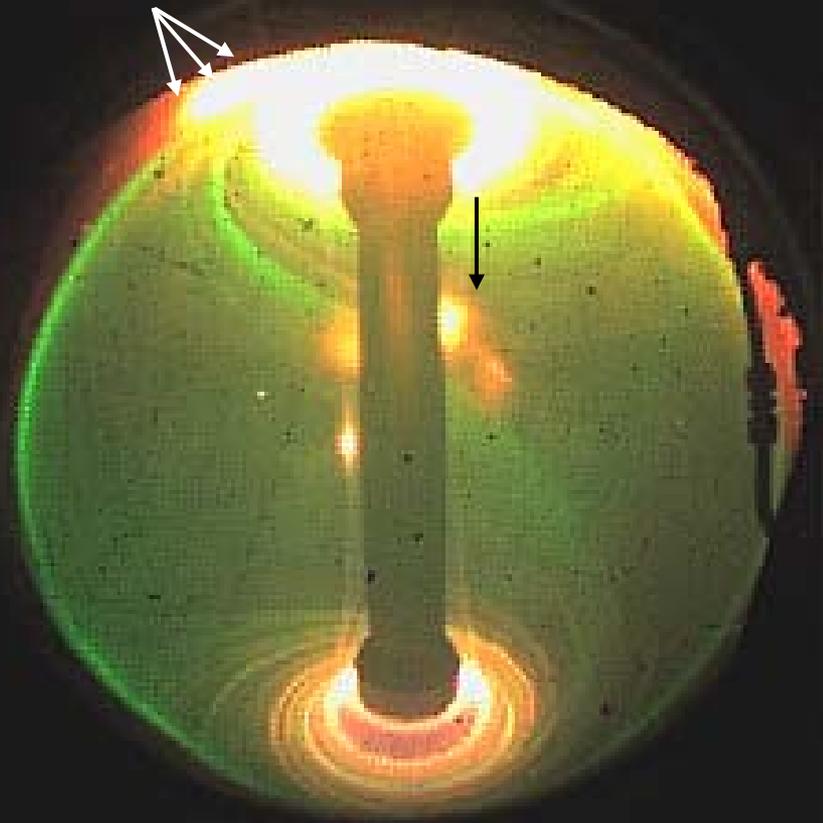
Shot 135063 $t = 369$ ms

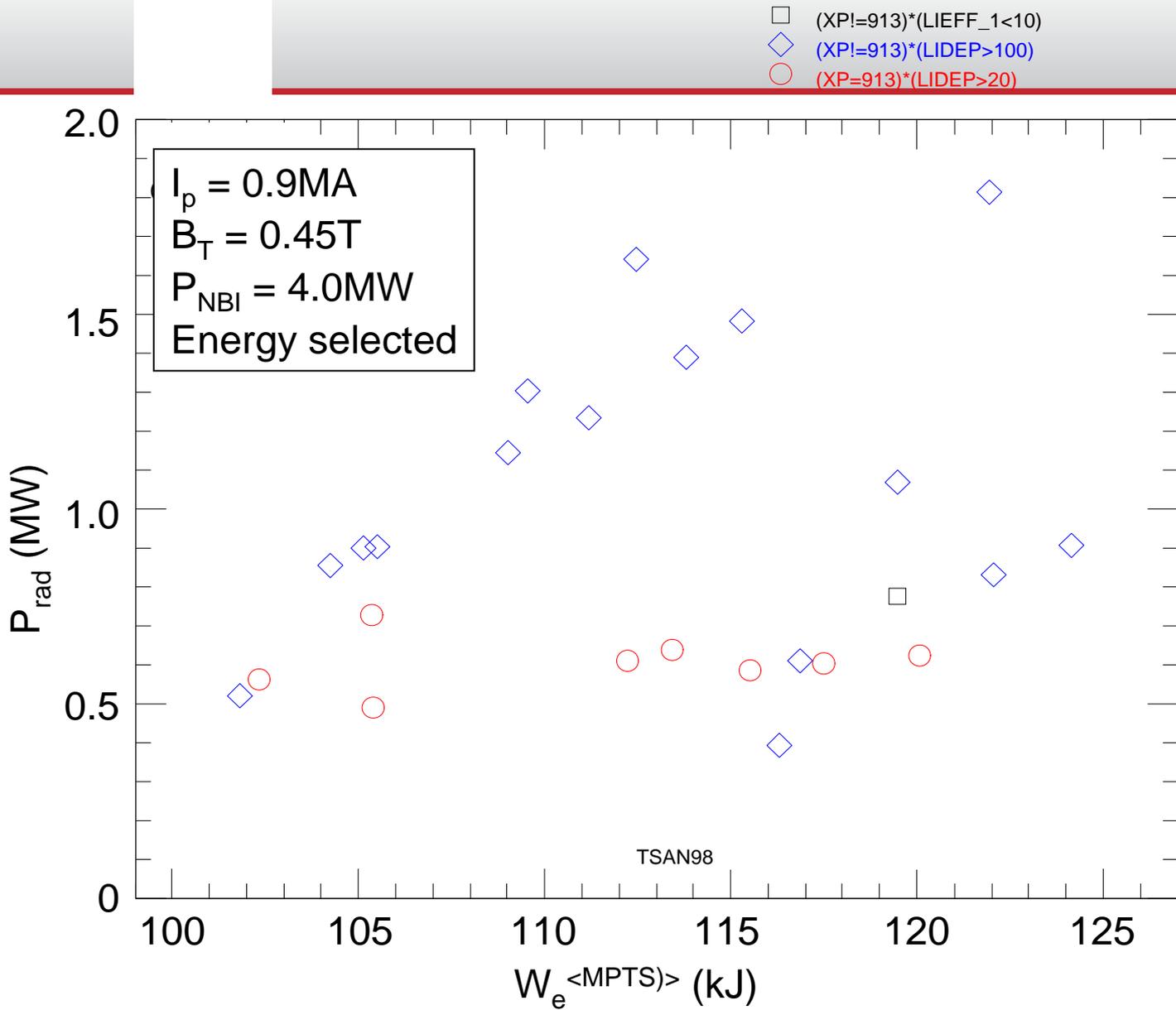
(Above Camera) Bay C Bay I (Behind CS)



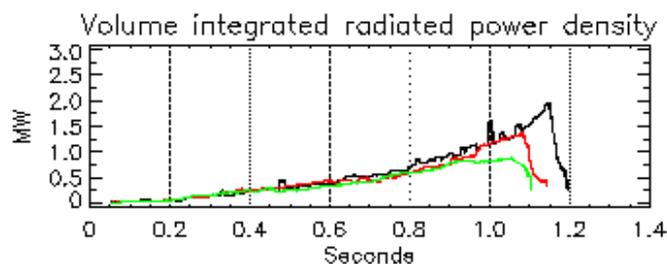
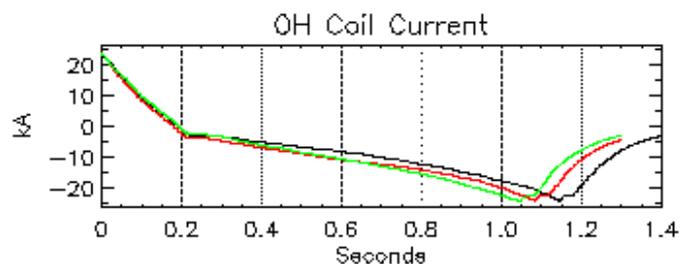
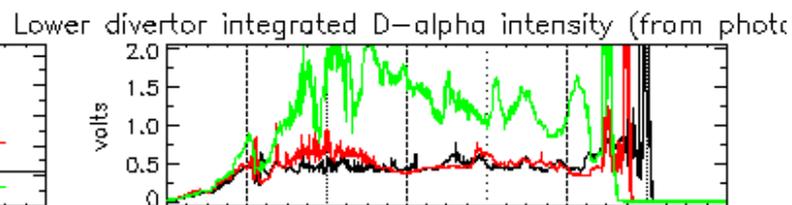
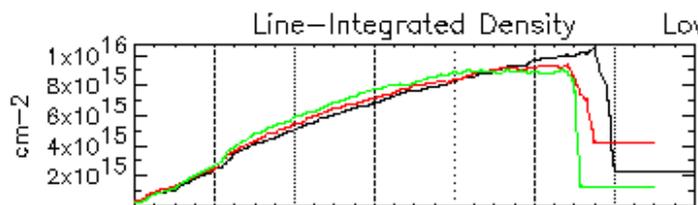
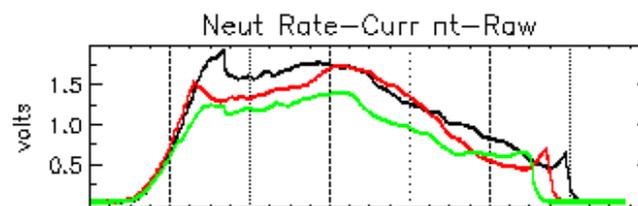
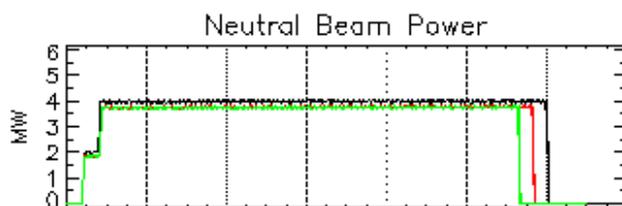
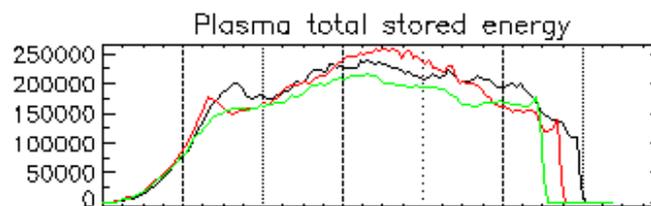
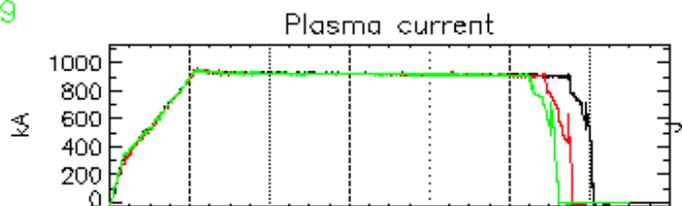
Shot 135063 $t = 655$ ms

(Above Camera) Bay C Bay I (Behind CS)



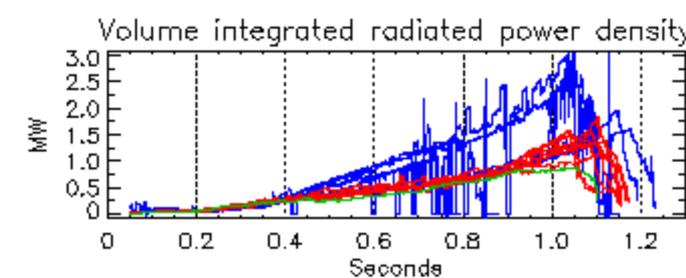
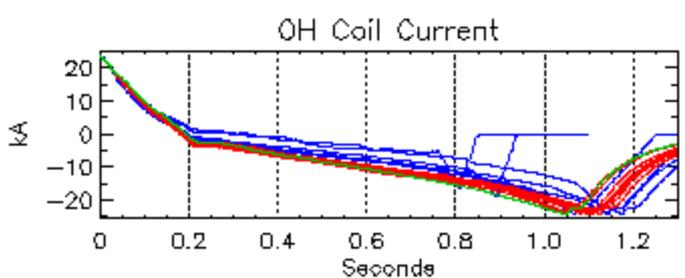
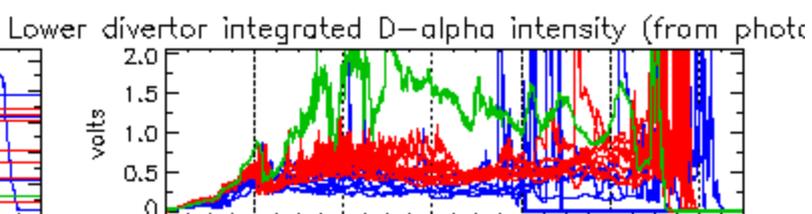
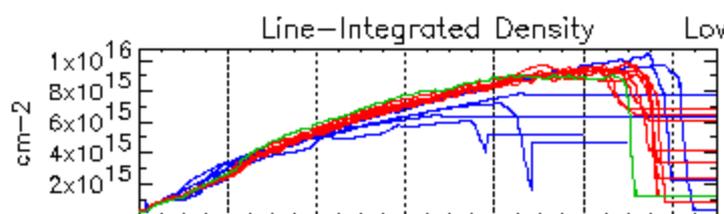
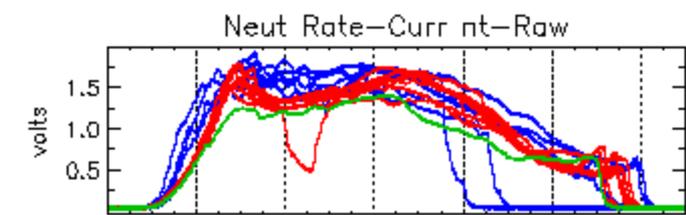
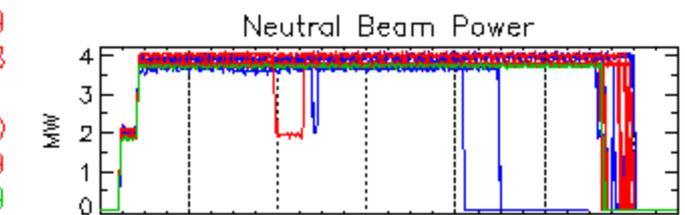
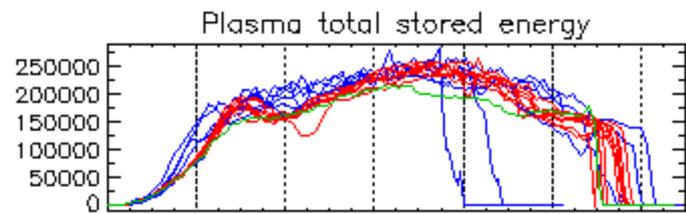
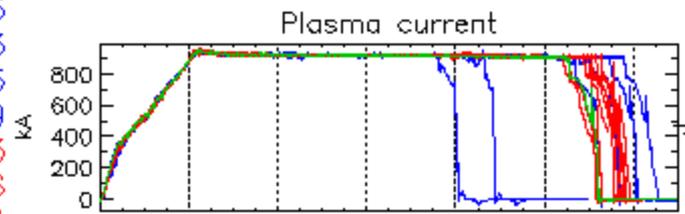


Shots:
134084
135063
135049



Shots:

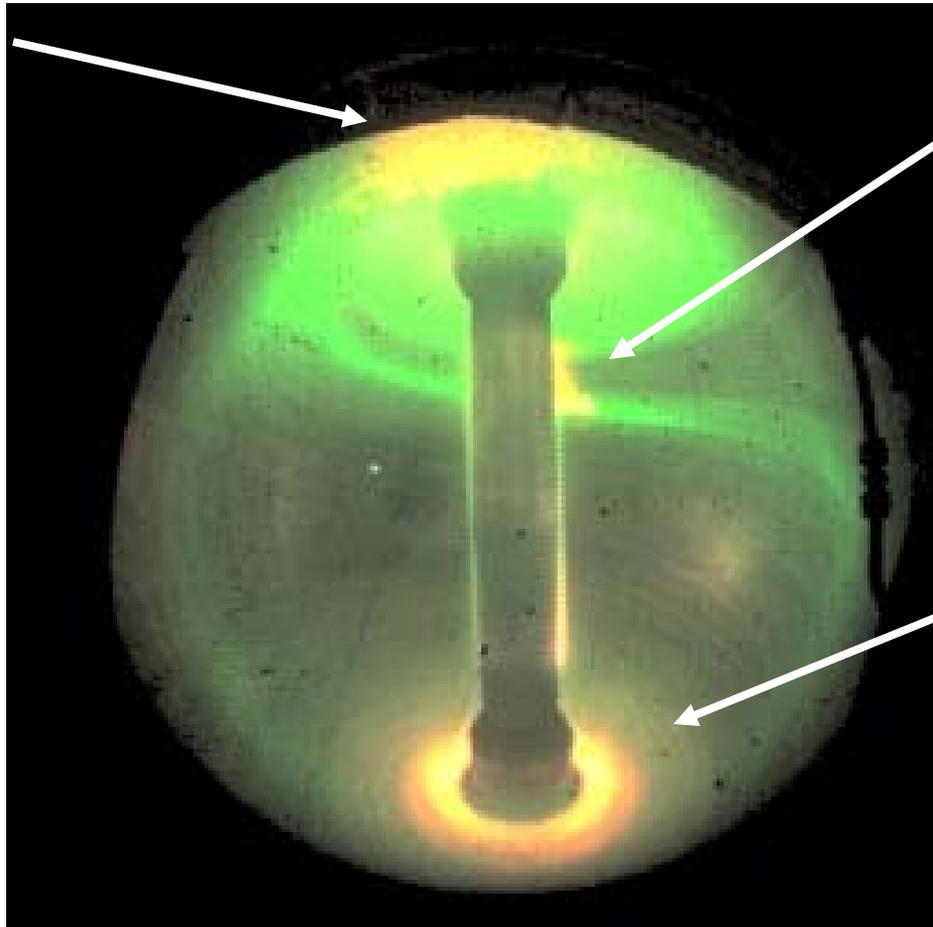
- 134084
- 129946
- 129245
- 129263
- 134085
- 129269
- 135063
- 135056
- 135064
- 135059
- 135058
- 135361
- 135360
- 135069
- 135049



Three Sources of Li from Droppers

Bay C
Li Particles

Shot 135063 @ 79 ms



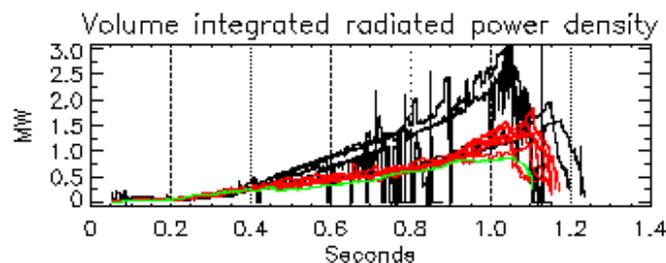
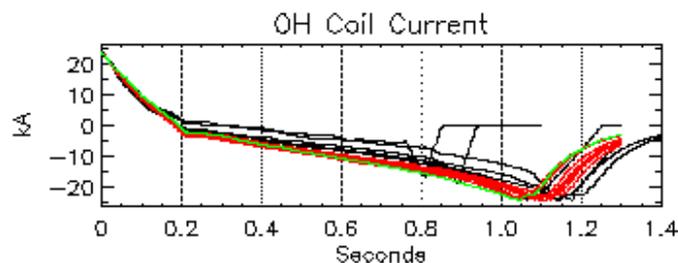
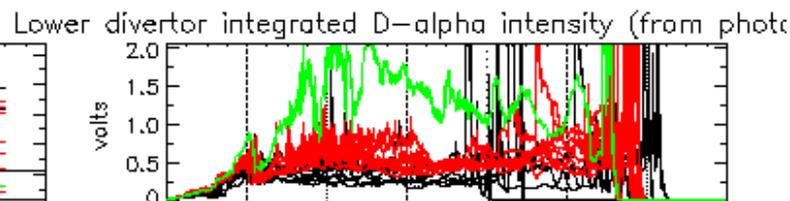
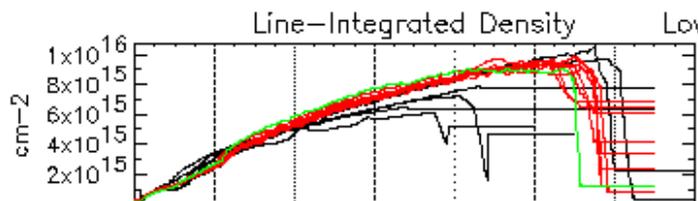
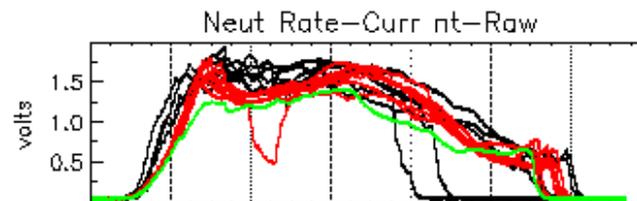
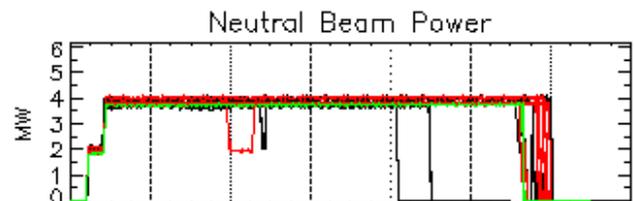
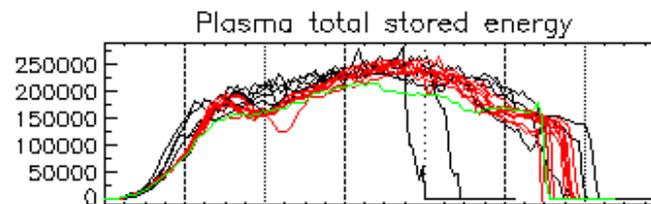
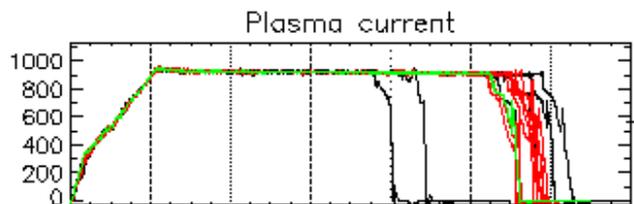
Bay I
Li Particles

Pre-Positioned
Li Particles

Can/Should Elms be Eliminated Slowly?

Shots:

- 134084
- 129946
- 129245
- 129263
- 134085
- 129269
- 135063
- 135056
- 135064
- 135059
- 135058
- 135361
- 135360
- 135069
- 135049



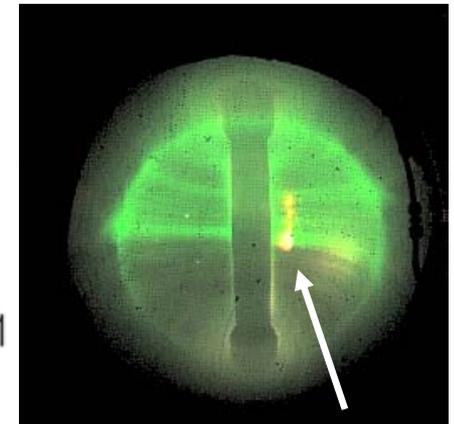
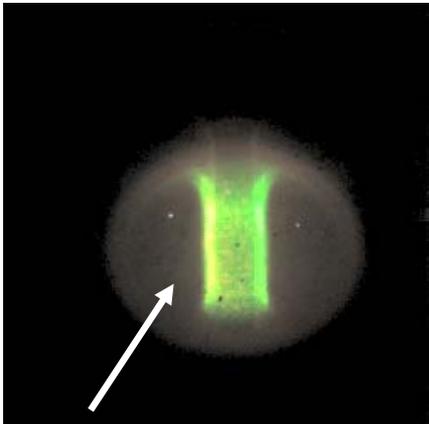
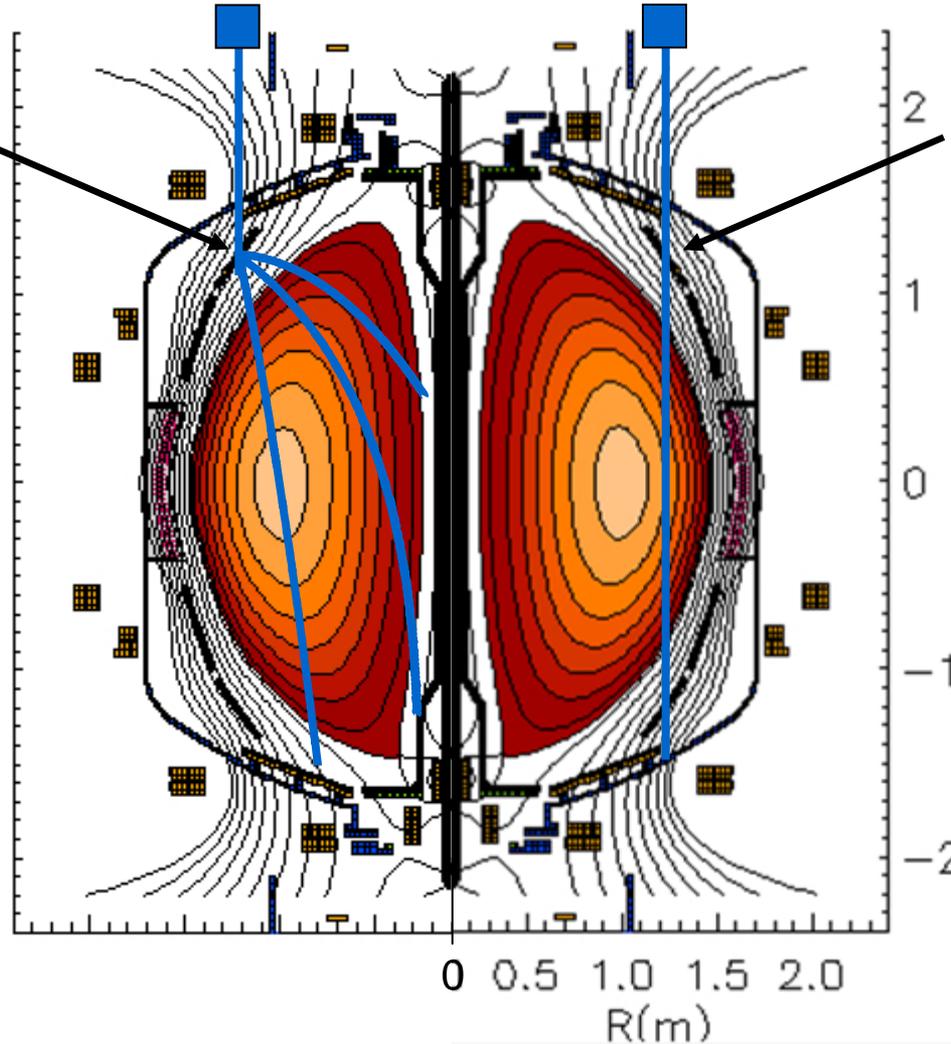
Li Dropper Locations and Trajectories on NSTX Allow a Variety of Injection Scenarios

Bay C Dropper

Bay I Dropper

Particles Scatter
off Splash Plate
(45 degree)

Particles Drop
Straight Down
Into SOL



Li Droplets on
NSTX Center Stack
at Breakdown
Using Bay C Unit

Li Droplets Into
Plasma SOL
at $t = 25$ ms
Using Bay I Unit