NSTX

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# Development and characterization of an intermediate triangularity discharge with lithium PFC coatings


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**Josh Kallman**

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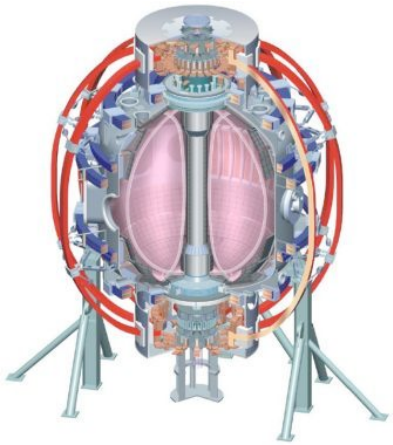
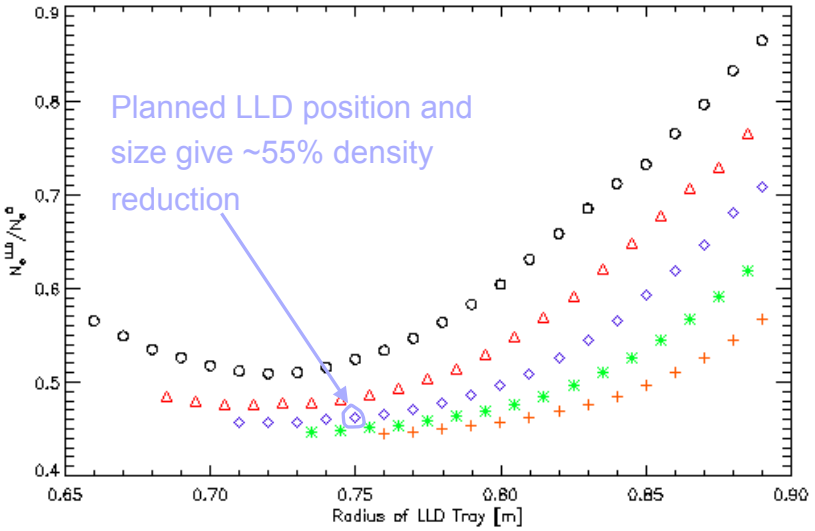
**NSTX Results Review**
**September 16, 2009**



# FY09 Run Goals

- For planned LLD operation, it was desired to develop a discharge that balanced the performance benefits of high-δ plasma shapes with the higher expected pumping rates of low-δ shapes



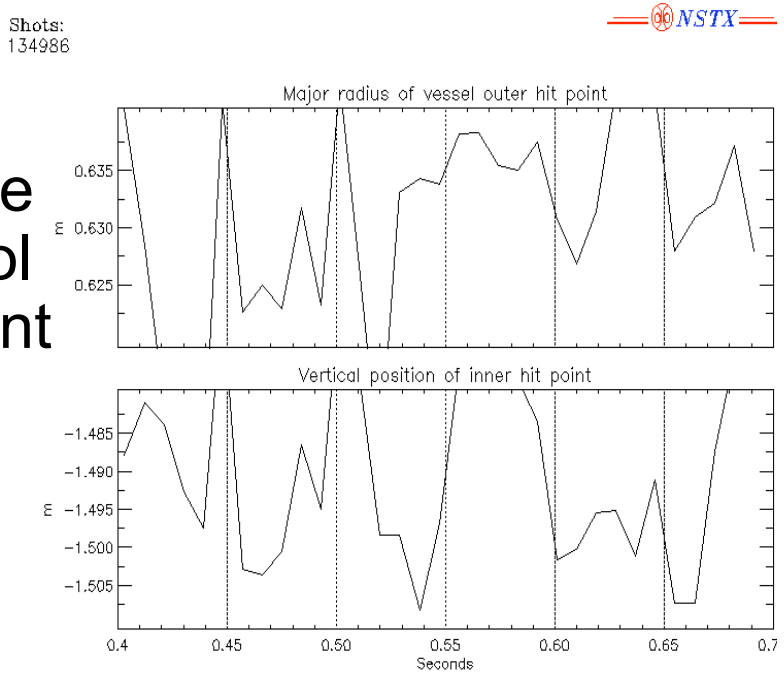

***R. Maingi***

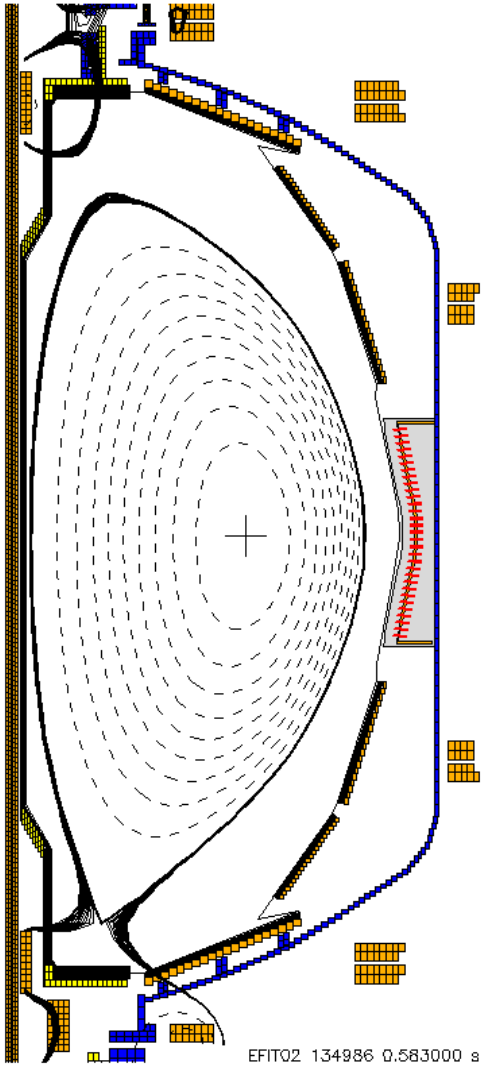
- To achieve this shape, it was necessary to control the outer strike point location to place the strike point on the bull-nose tile (R~0.63 m) between the CHI gap and the LLD
- Basic profiles ($T_e$, $n_e$, $P_{rad}$, equilibria) and impurity and heat flux data would be obtained for use in elucidating heat and particle deposition on the divertor in this discharge shape and to guide operation in the presence of the LLD

# Discharge shape was developed and 38 plasmas were run over ~1.25 days

- Outer and inner strike point control algorithms were developed by E. Kolemen and utilized to produce stable discharges of the desired LLD shape

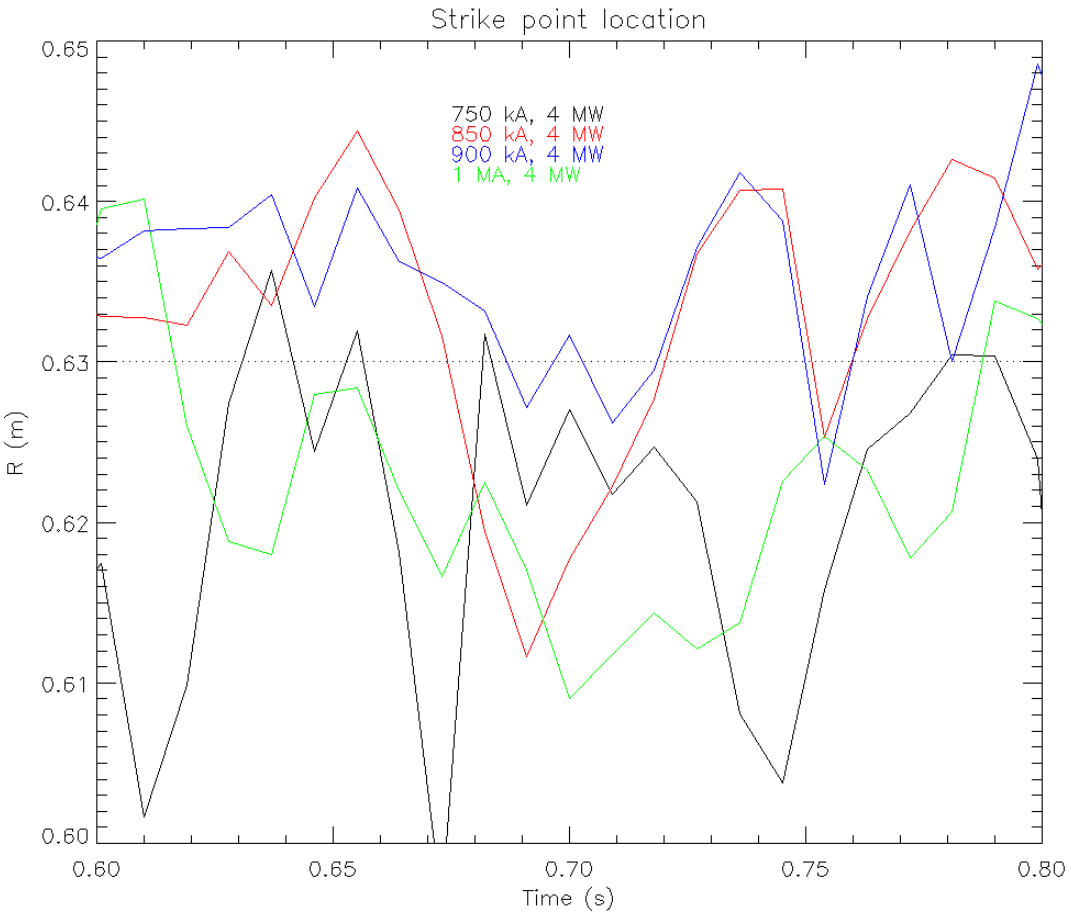
- The algorithms provided precise (+/-1 cm) control of the strike point for extended periods during shots



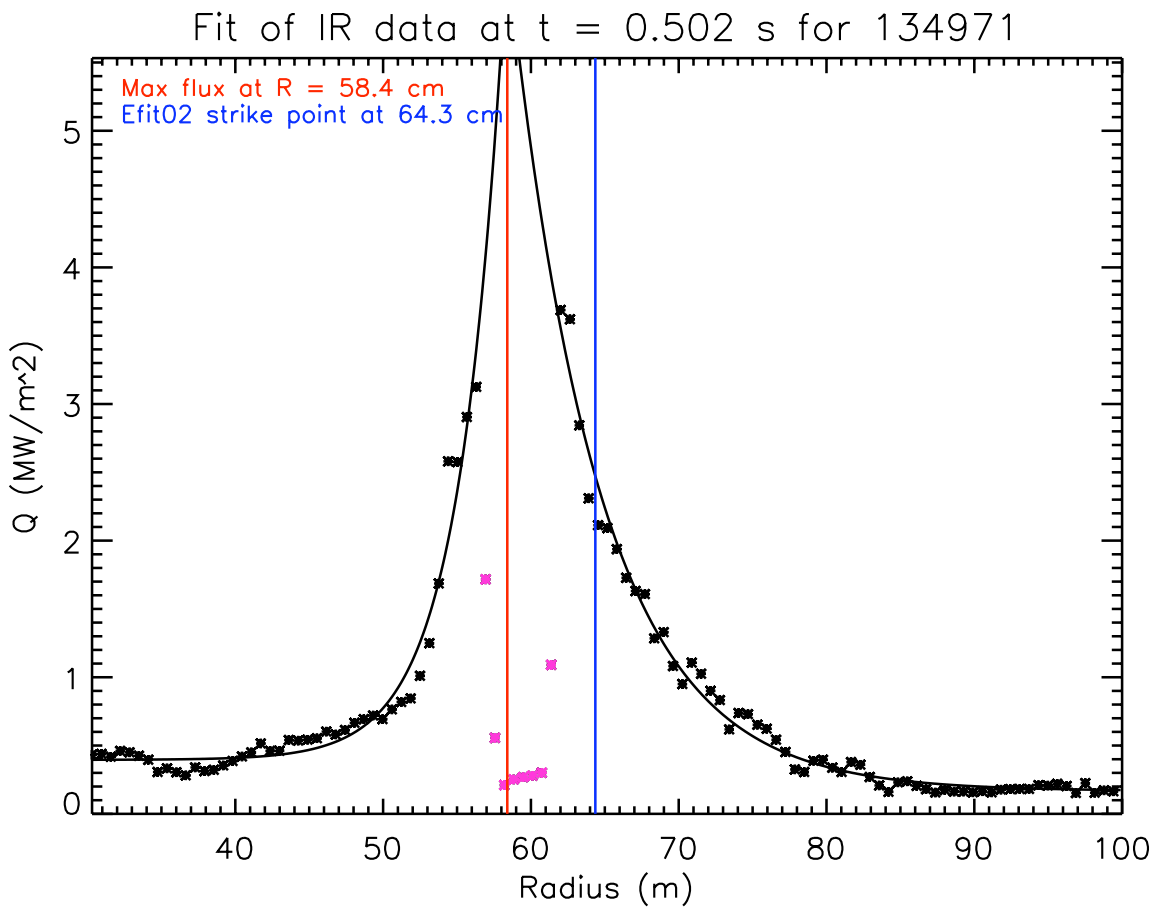



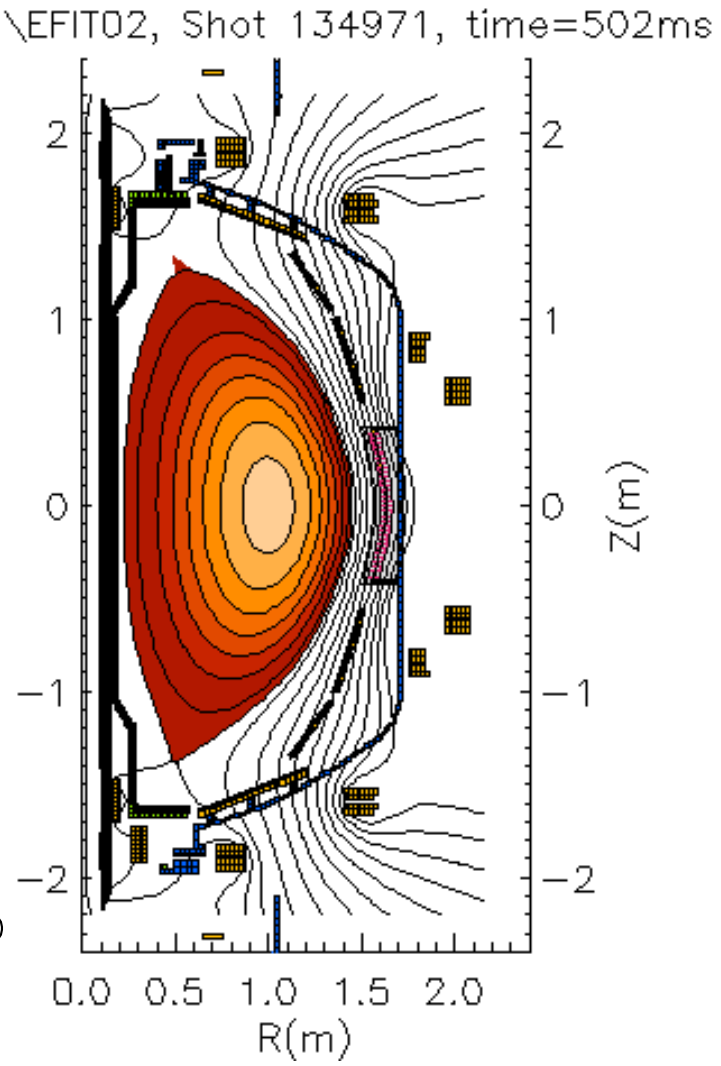
# Power scan was performed to study robustness of the strike point control under varying current and input power conditions

- Shots were performed at varying plasma currents and powers
  - 750 kA – 2, 3, 4, 6 MW
  - 850 kA – 2, 3, 4, 5 MW
  - 900 kA – 4 MW
  - 1 MA – 2, 3, 4, 5 MW
- Outer strike point stayed within a ~2 cm range for macroscopic time intervals
- Gains on strike point control algorithms were further calibrated for use with other XPs



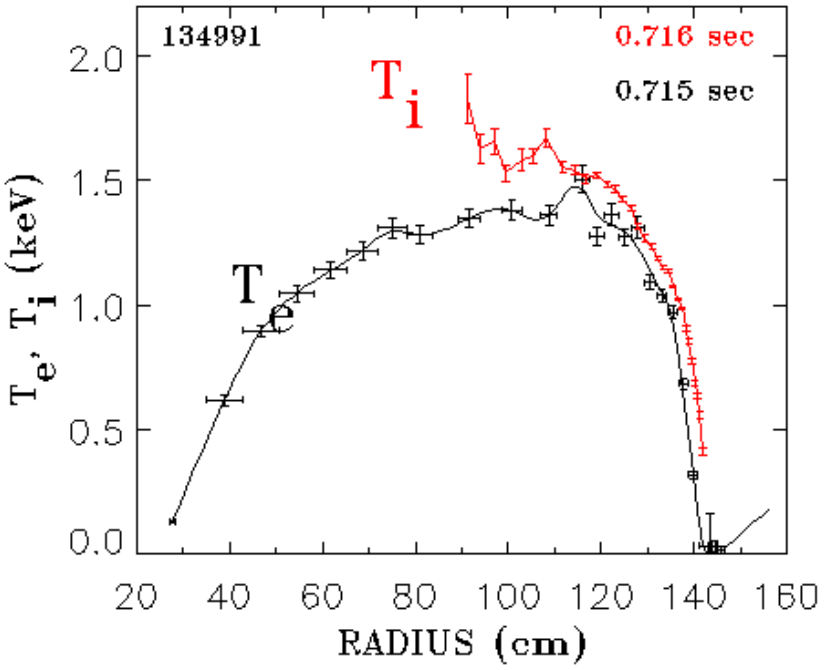
# But divertor strike point did not coincide with peak heat flux from IR camera data

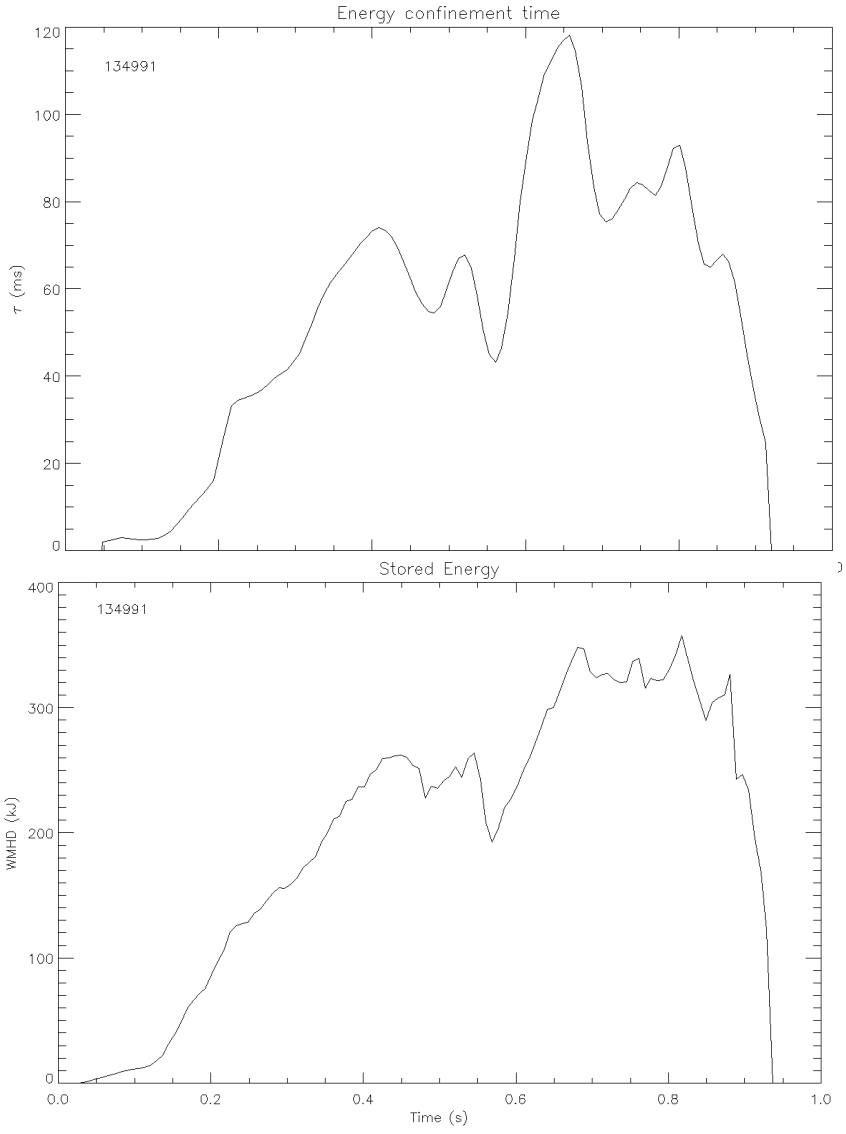


# Discharges showed good performance with high levels of Li evaporation

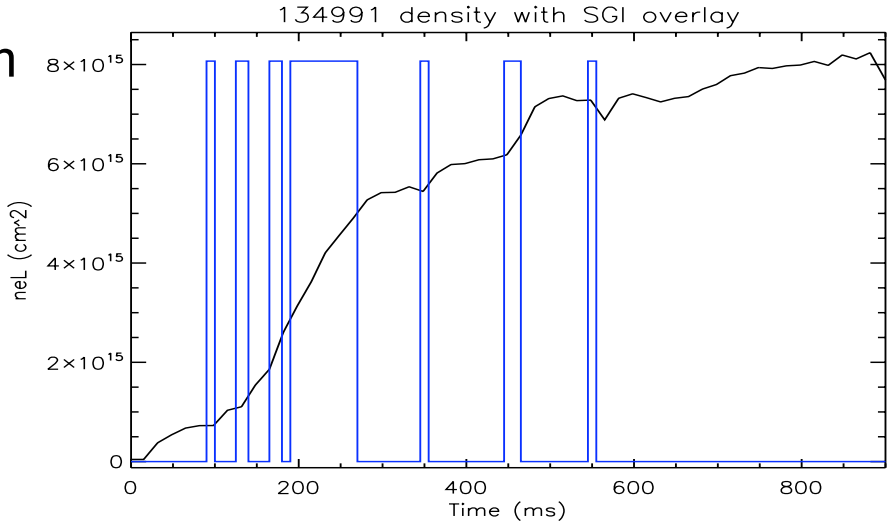
- Using 400 mg of Li deposition, 4 MW of beam power, strike point control, and SGI fueling (see next slide), the intermediate-δ shape was optimized for LLD operation beginning in FY10
- BetaN of ~6.8 achieved

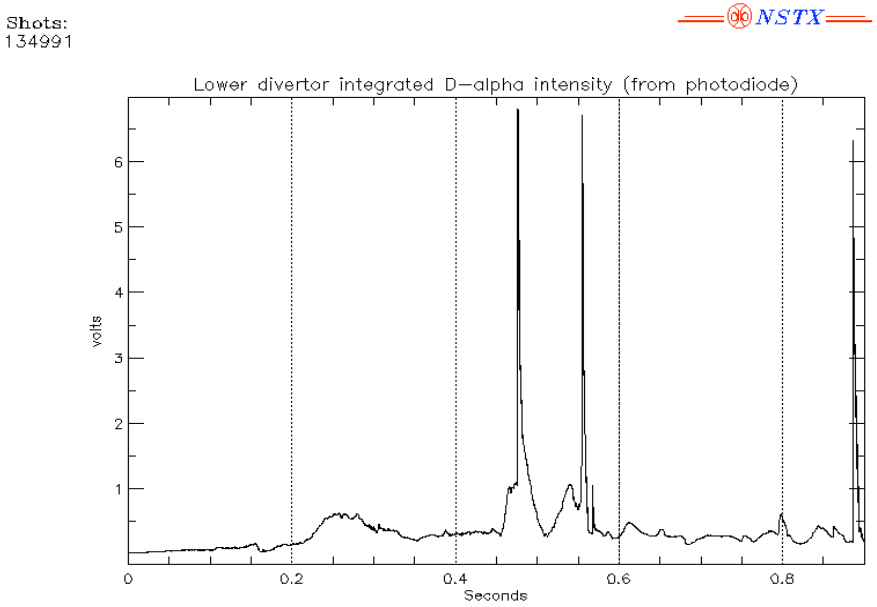


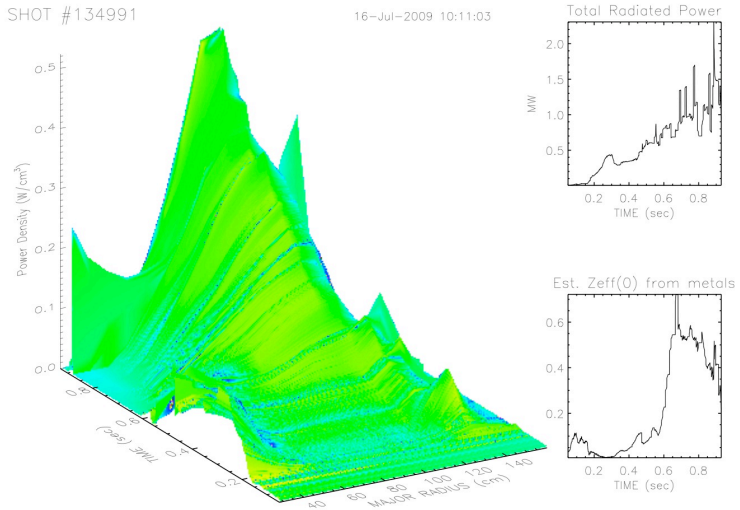



# SGI successfully used to fuel discharge

- SGI run at 5000 Torr using waveform from 133102
- CS gas reduced to 940 TL
- Sustained H-mode with nearly steady-state density was produced with significant Li evaporation
- Rise in radiated power still observed



# Conclusion and future plans

Summary

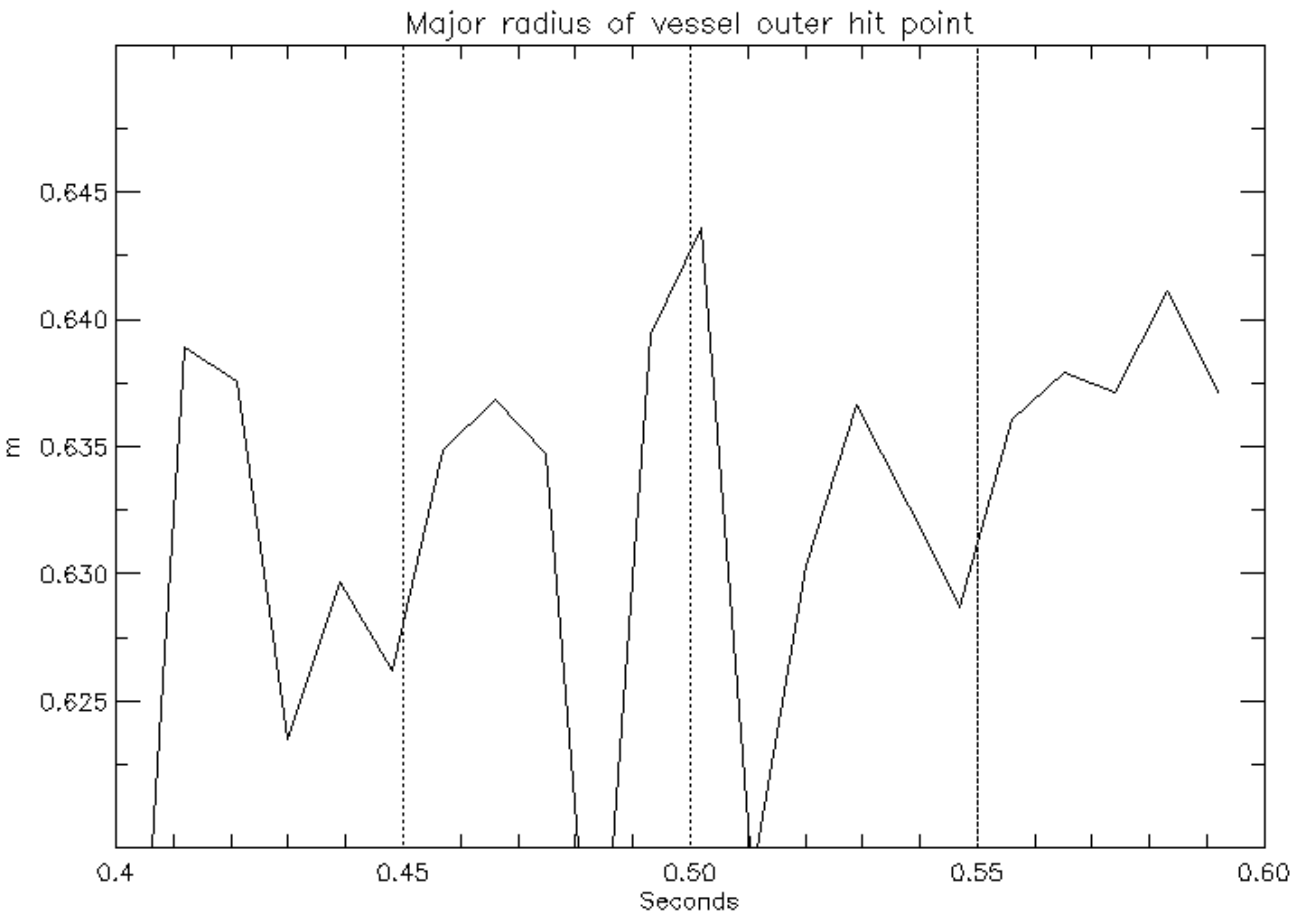
- FY09 goals of developing strike point control and using it to create an intermediate-$\delta$ discharge were achieved
  - EFIT data show strike points come within ~1 cm of request
- Profile and equilibrium data were obtained for new discharge shape
  - favorable results for ion temperature, WMHD, and beta observed
- Progress was made in fueling discharge with SGI

Future Plans

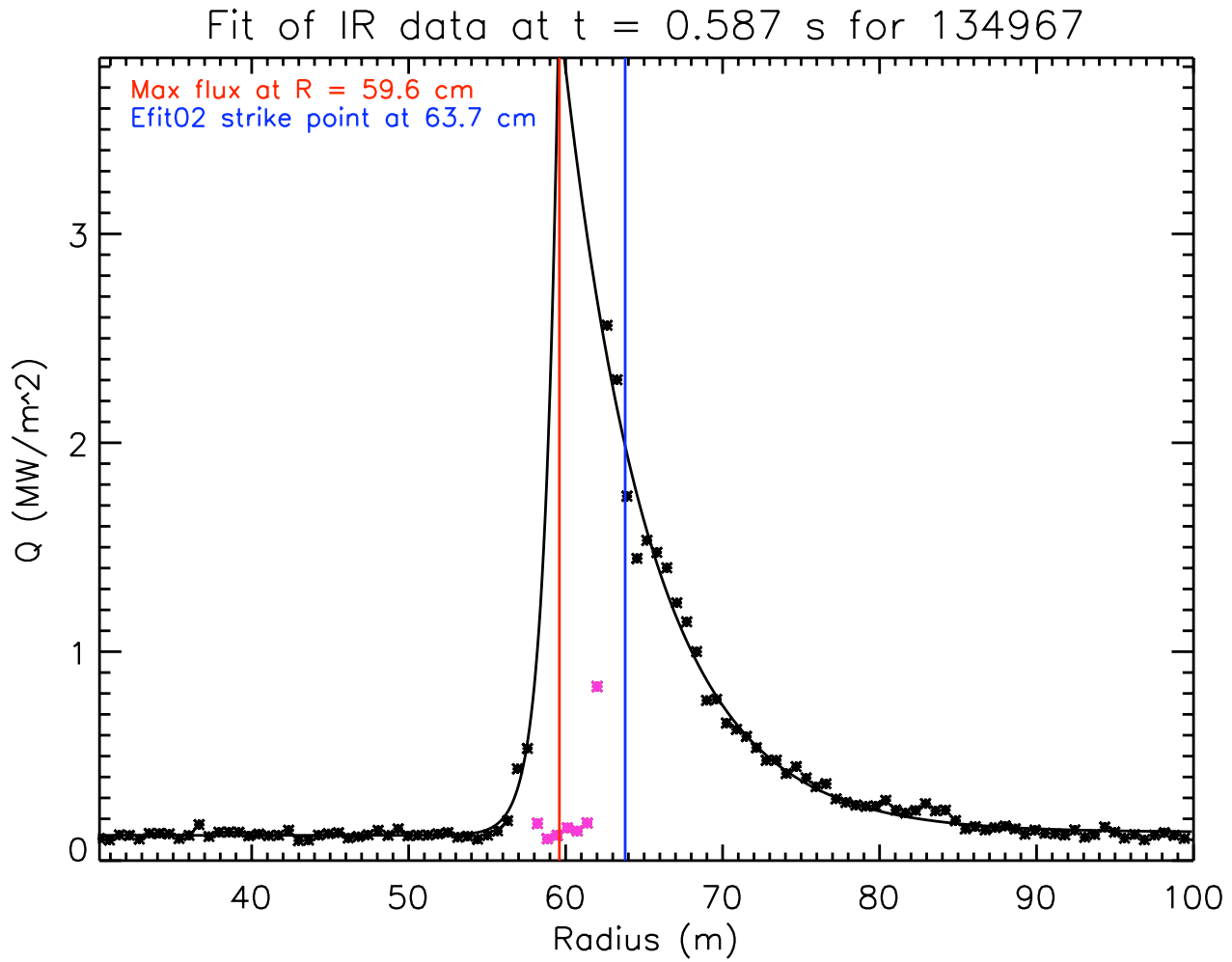
- Examine equilibria and resolve discrepancy between peak heat flux and strike point locations using LRDFIT, TRANSP, etc
- Analyze data with UEDGE to determine recycling and pumping behavior
- Utilize new diagnostics (LP array, LLD camera system, 2-color IR cameras, Lyman-$\alpha$ array, thickness diagnostics) to characterize discharge under LLD conditions in FY10

# Backup

Shots:
134971



# Backup2


Fit of IR data at t = 0.587 s for 134967
Max flux at R = 59.6 cm
Efit02 strike point at 63.7 cm
Q (MW/m^2)
0
1
2
3
40
50
60
70
80
90
100
Radius (m)