Recent Disruption Studies in NSTX

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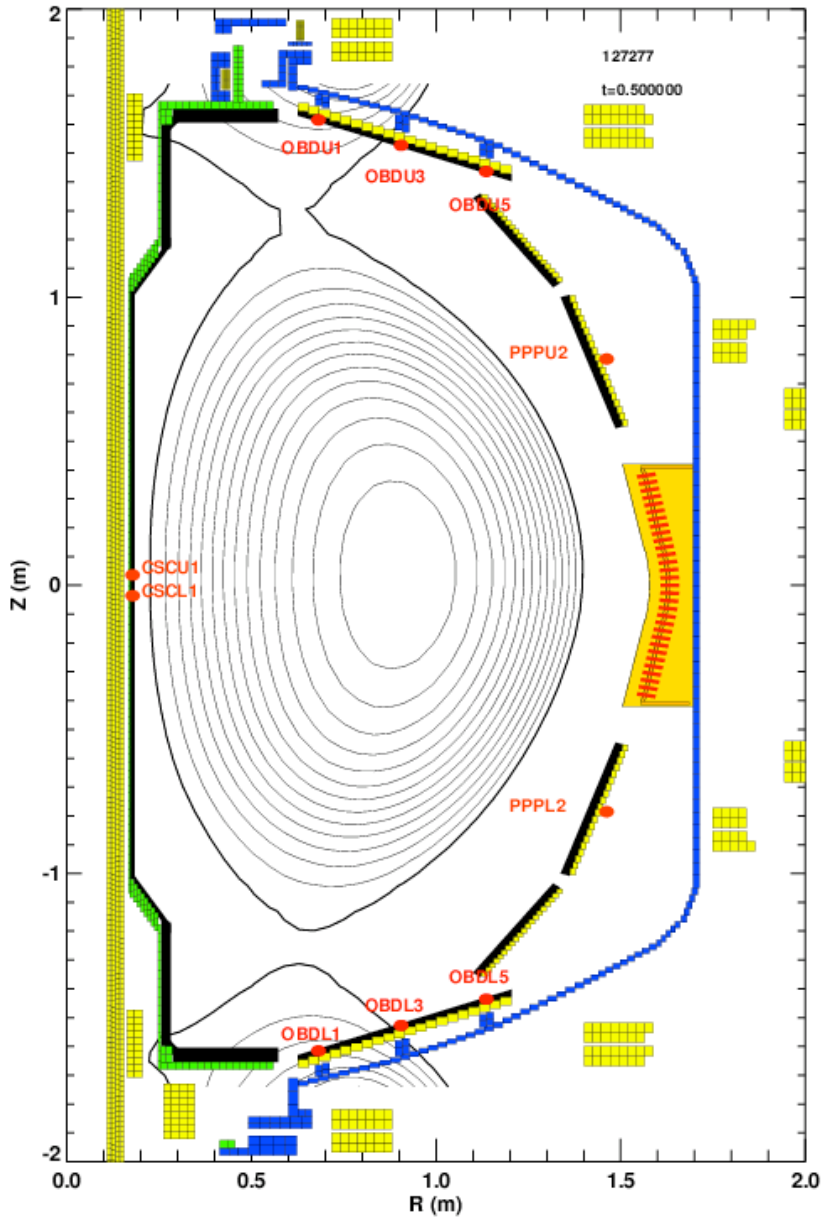
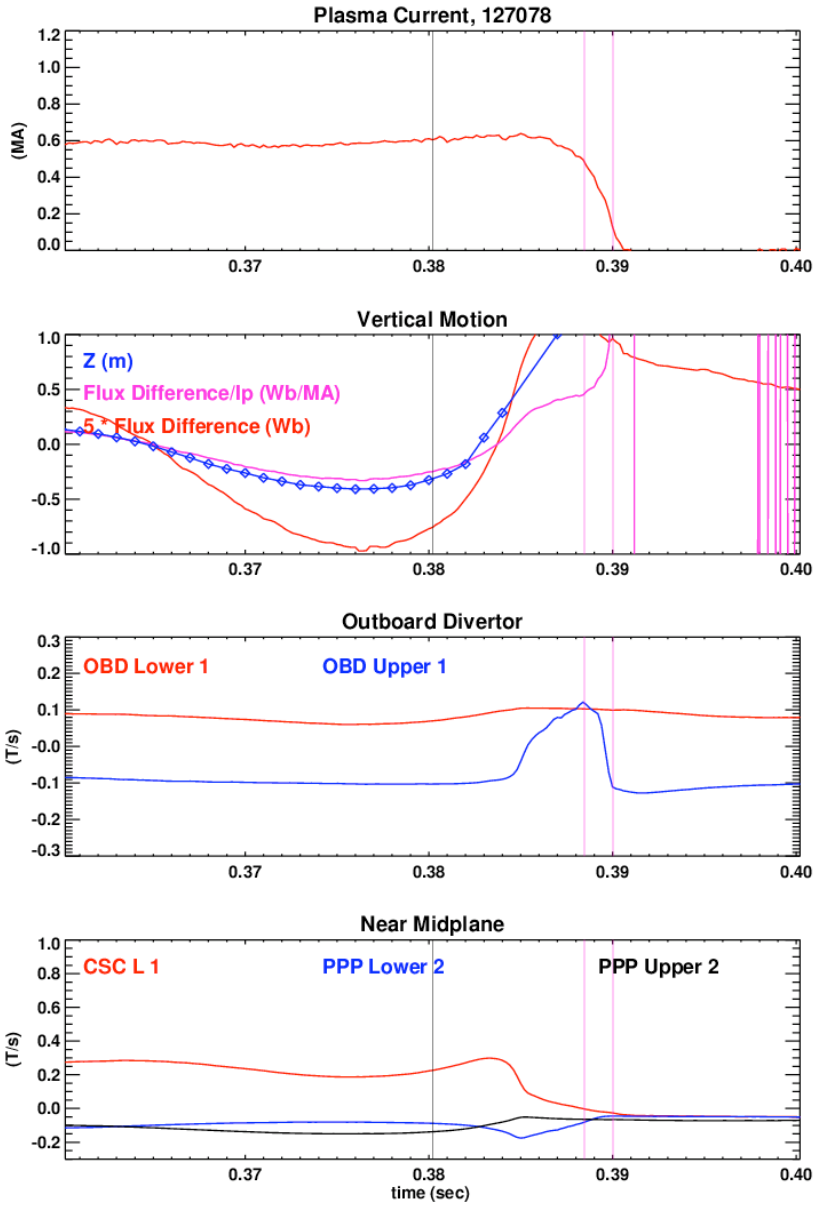
Four Destructive Phenomena Associated With Disruptions

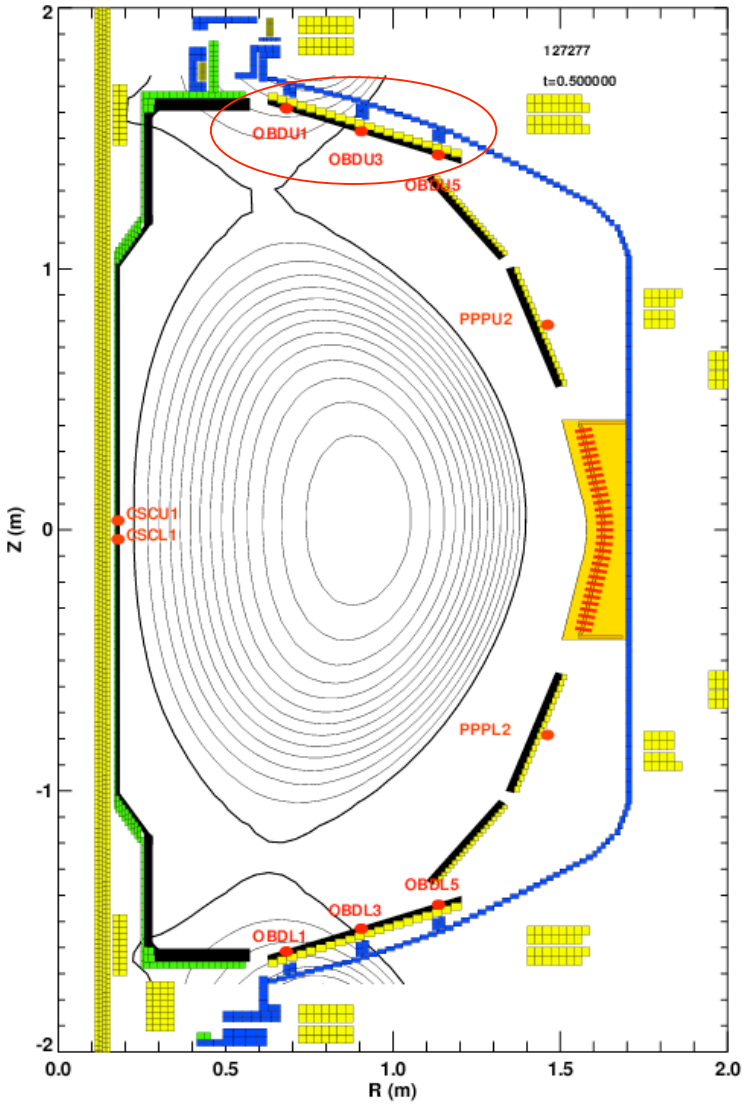
- Thermal Quench
  - Extremely Rapid (<1msec) loss of the plasmas thermal energy.
  - May lead to impulsive loading of PFCs beyond the melting/ablation threshold of materials.
  - Not well diagnosed in NSTX…need fast IR thermography.
- Current Quench
  - Rapid termination of the plasma current.
  - Leads to eddy currents in nearby conductive structures (overturning moments on ITER blanket modules)
  - Much NSTX Data, briefly mentioned here.
- Runaway Electron Generation
- Halo Currents
  - When vertical plasma motion leads-> currents link plasma and PFC.
  - The currents in the PFC X B_T yield large forces.
  - Both new and old diagnostics collect data.

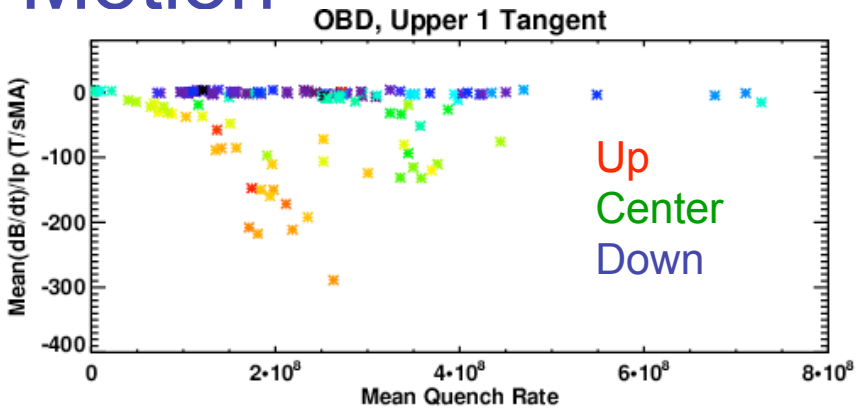
Mirnovs and Rogowski Are Main Diagnostics For Current Quench

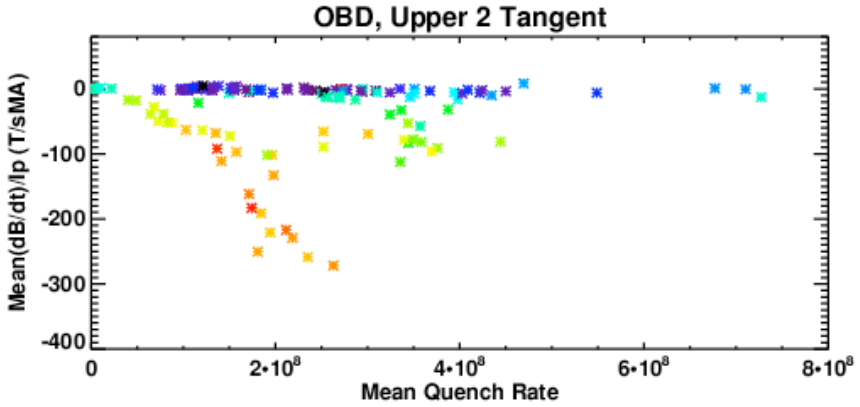


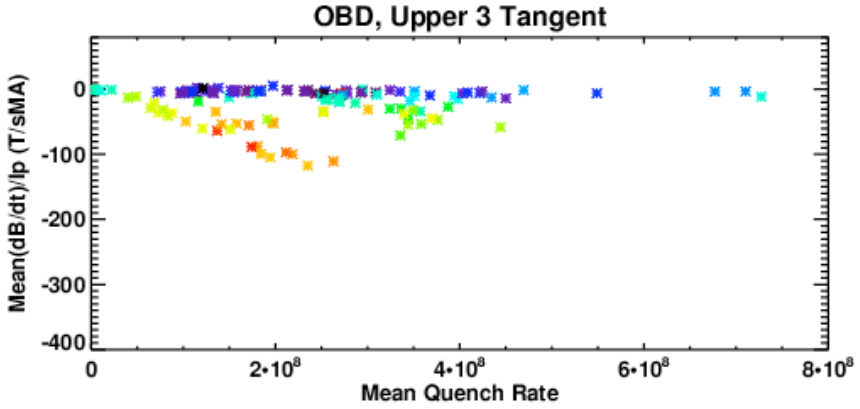


Eddy Current Drive [(dB/dt)/I_P] Depends on Vertical Motion

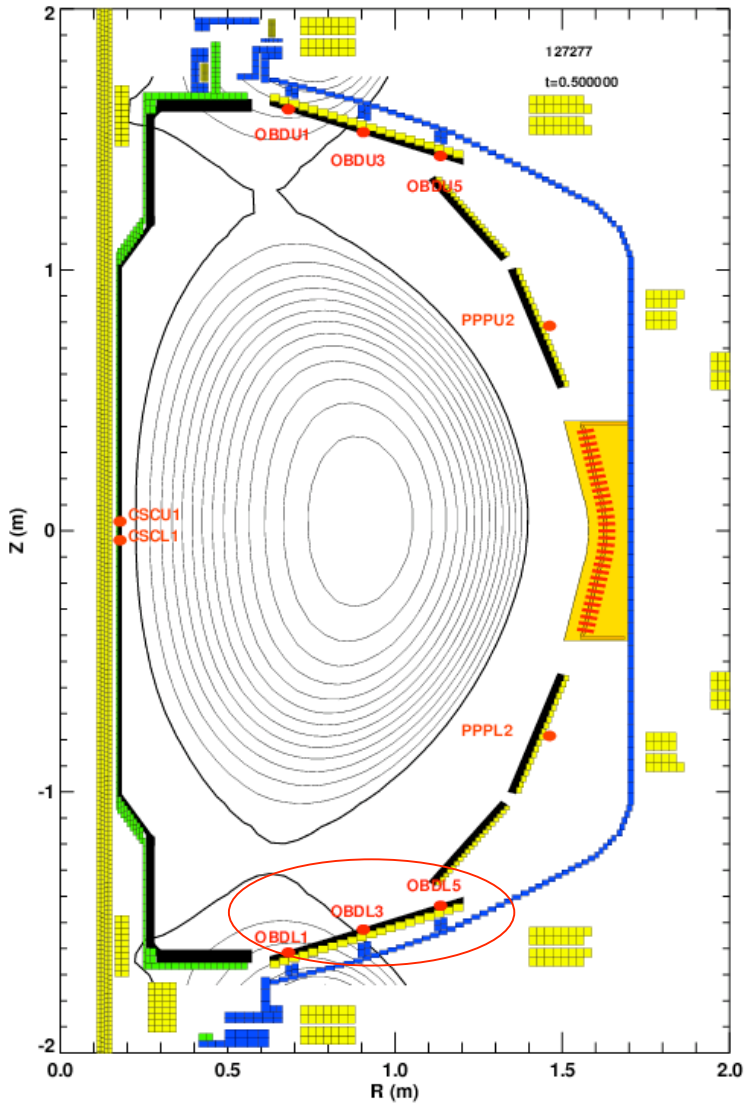


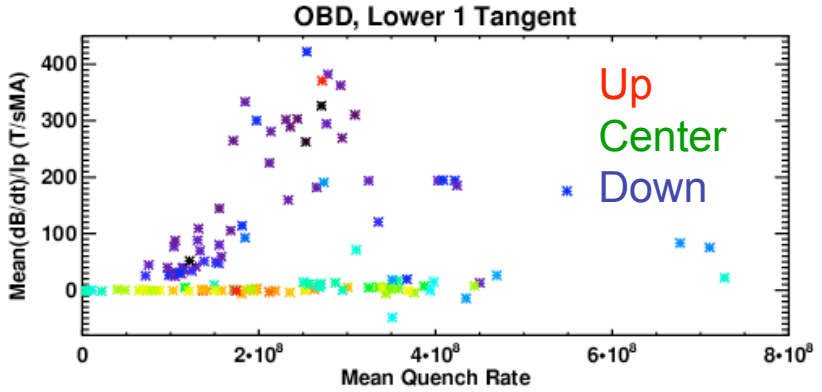


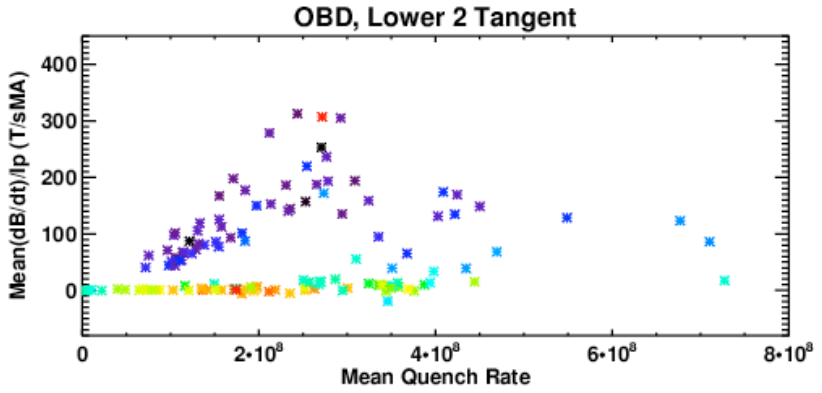


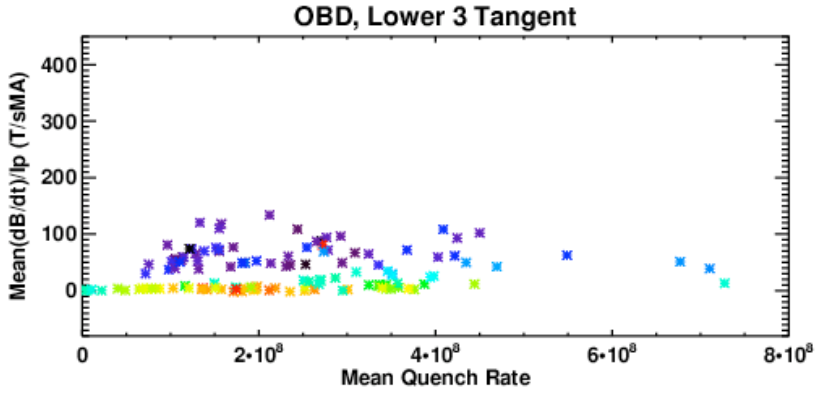


Opposite Trend for Lower OBD









Halo Current Diagnostics For CY08 Run

Rogowskis on the CSC

CSCL1, CSCL2, CSCU1

Two Arrays of 6 B_T coils

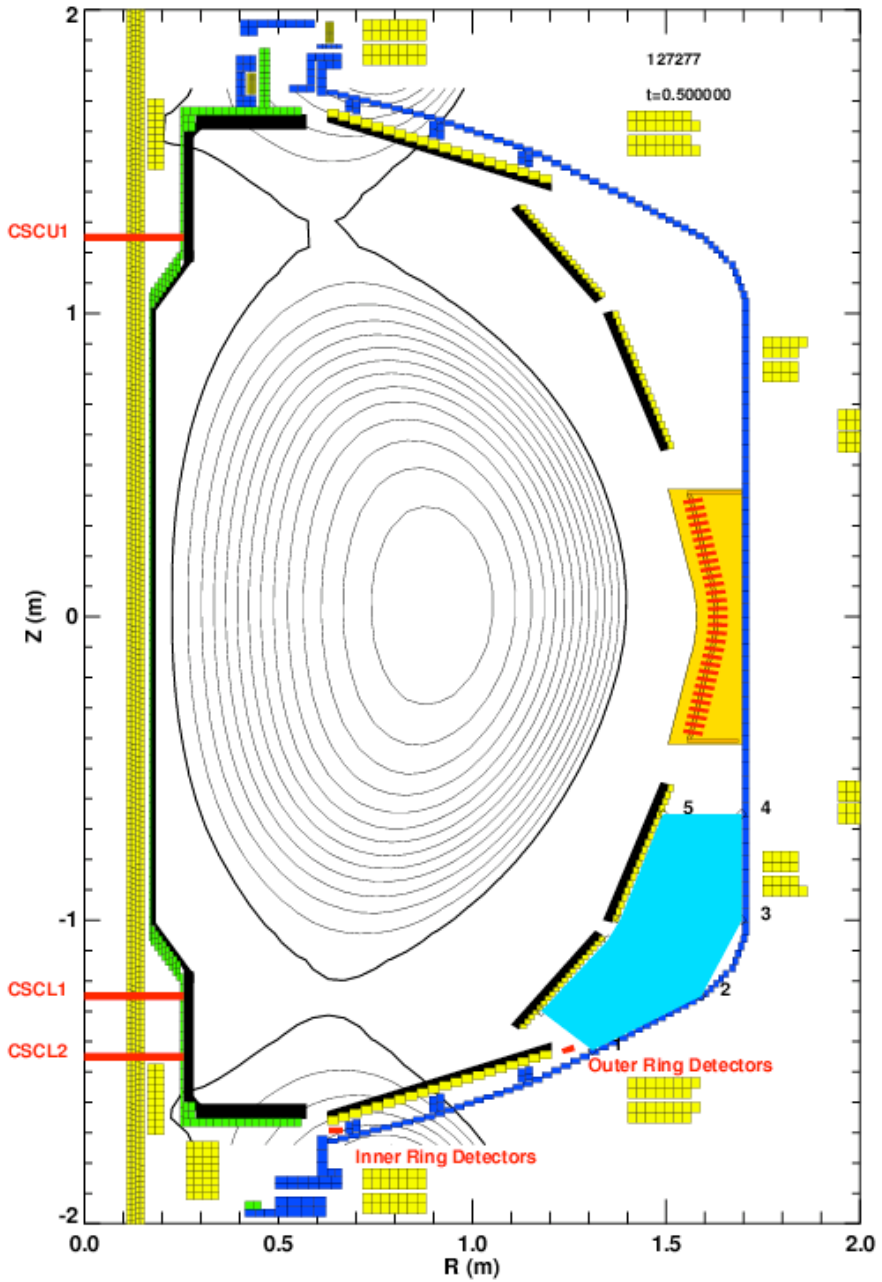
Inner Ring: Just Outside the CHI Gap
Outer Ring: Just Outside the OBD

Difference Between These: Current into the OBD

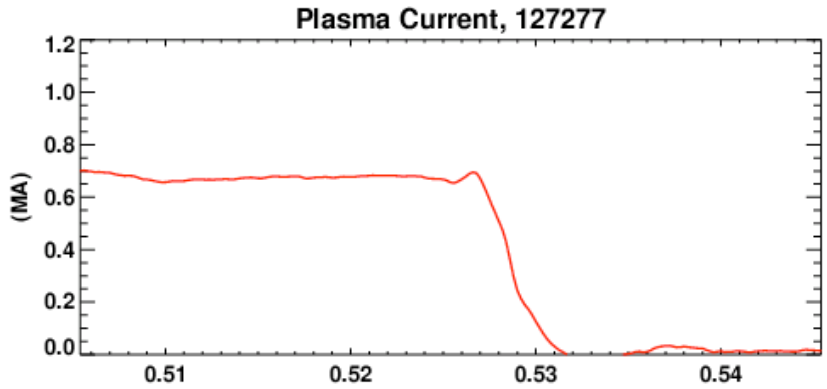
Two Pearson CTs on CHI Bus

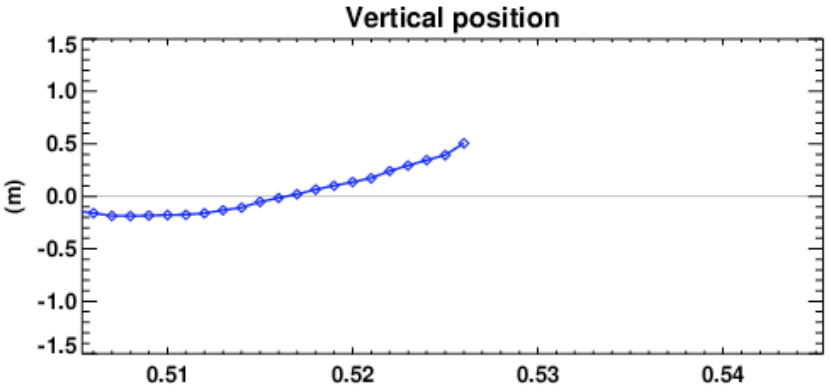
Current from inner to outer vessel

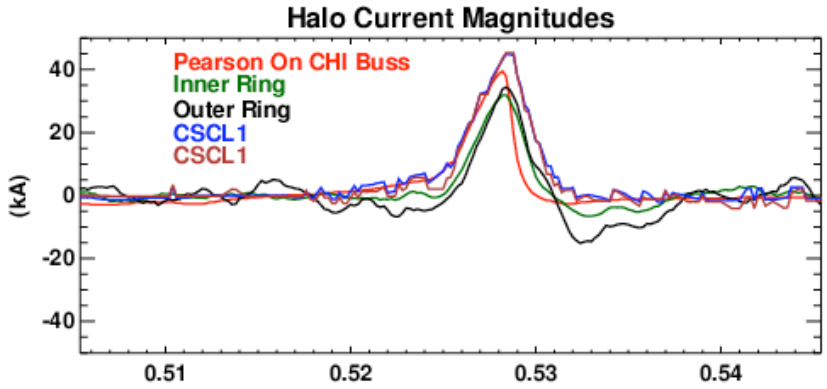
NSTX Is Only Device with this Broken Halo Current Path

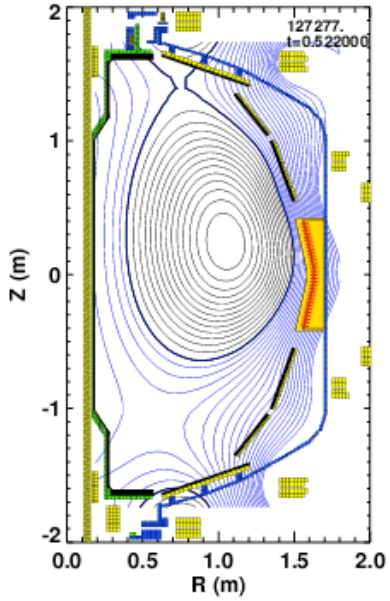


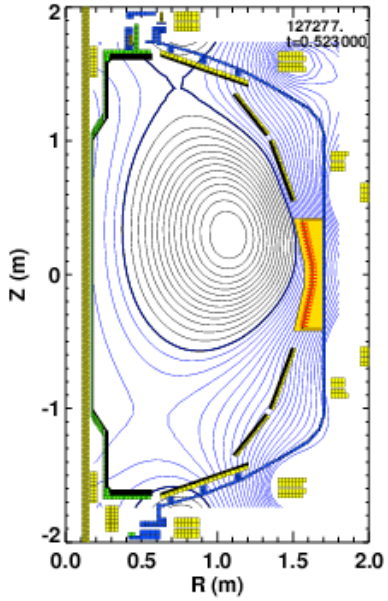
Example 1: Shot 127277, Upward Going VDE

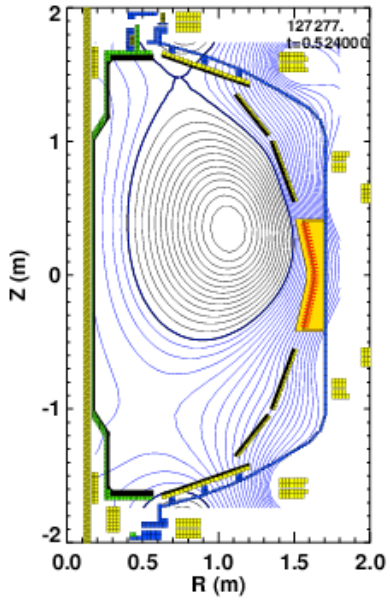


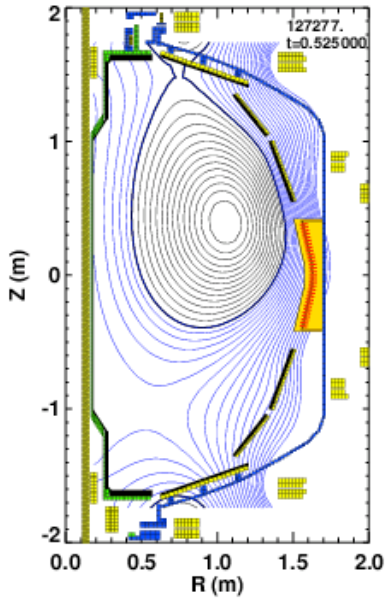




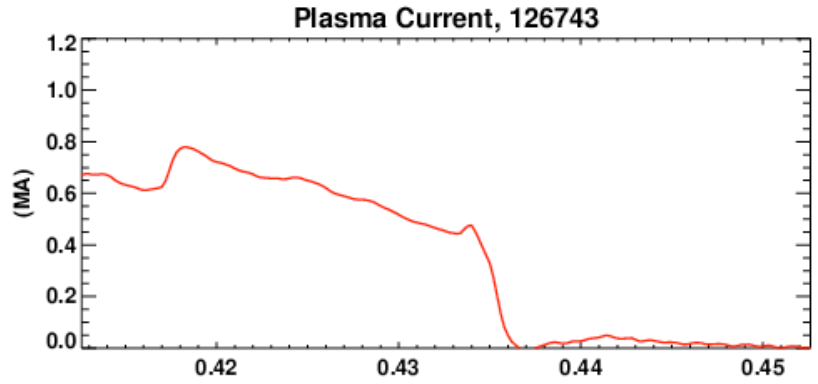


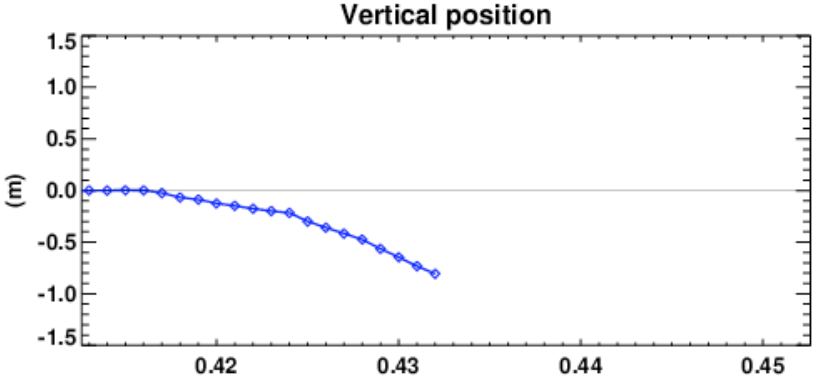


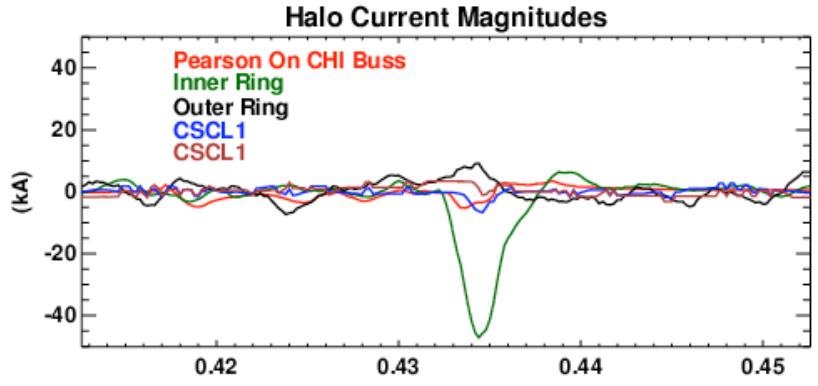


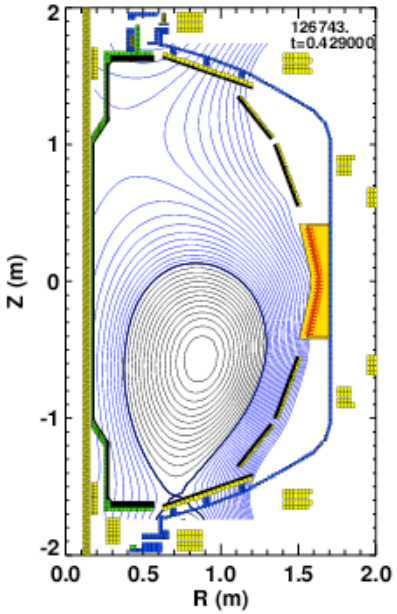


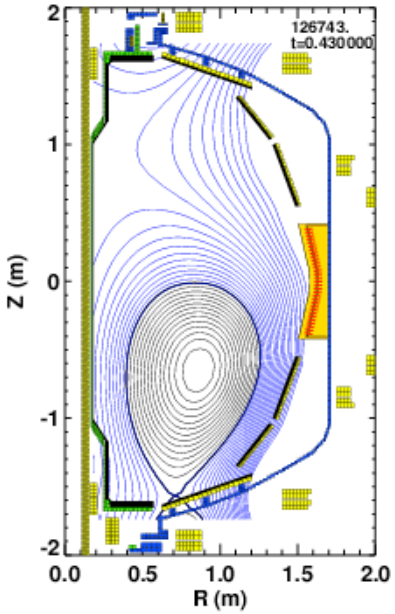
Example 2: Shot 126743, Downward Going VDE

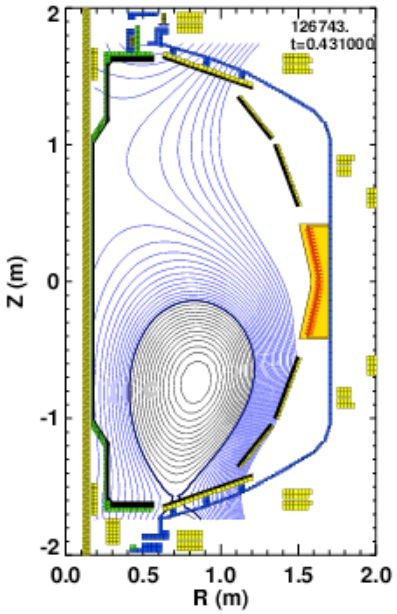


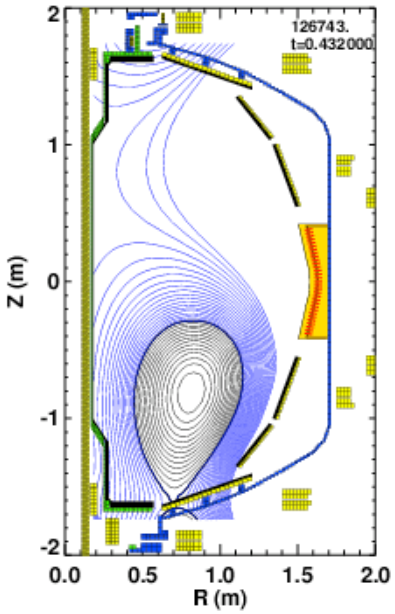




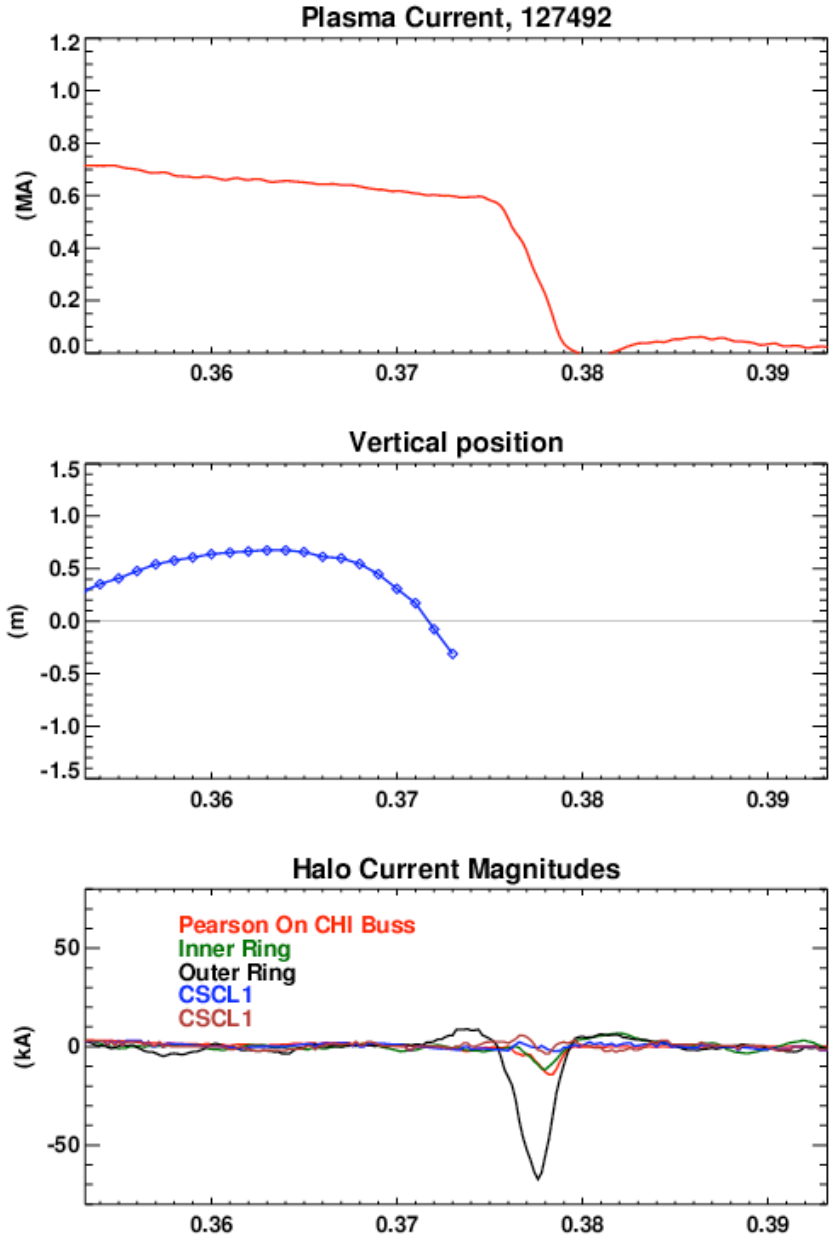


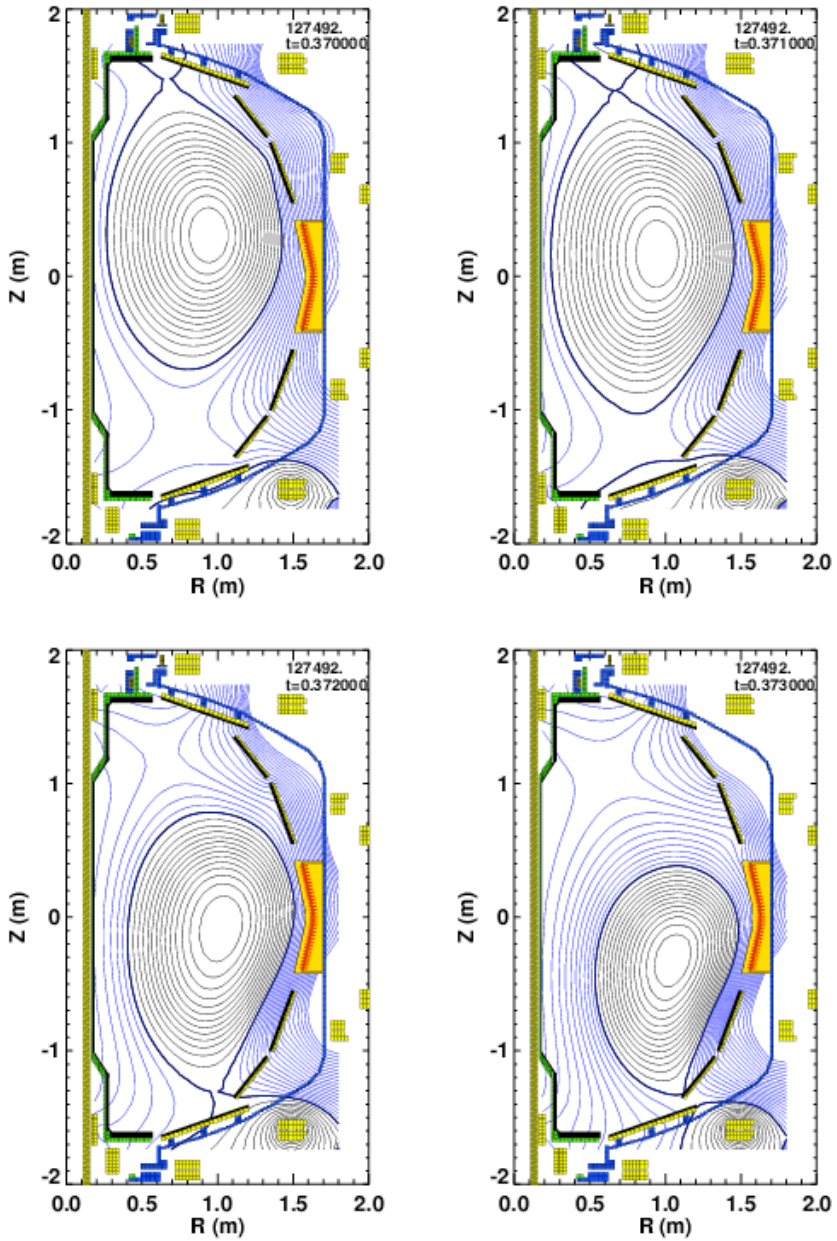




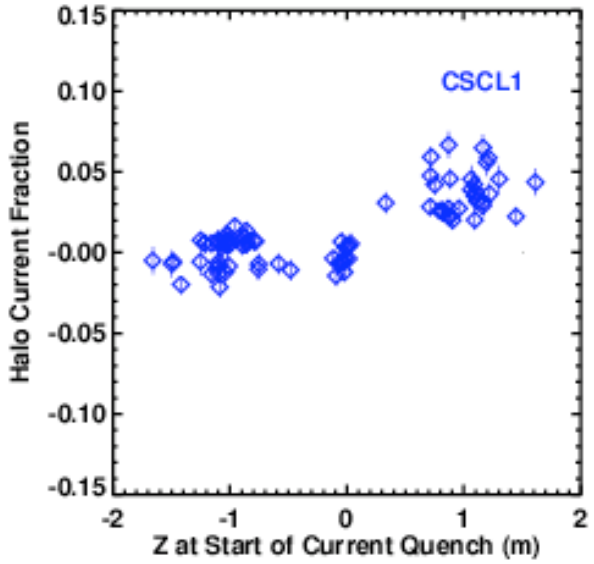


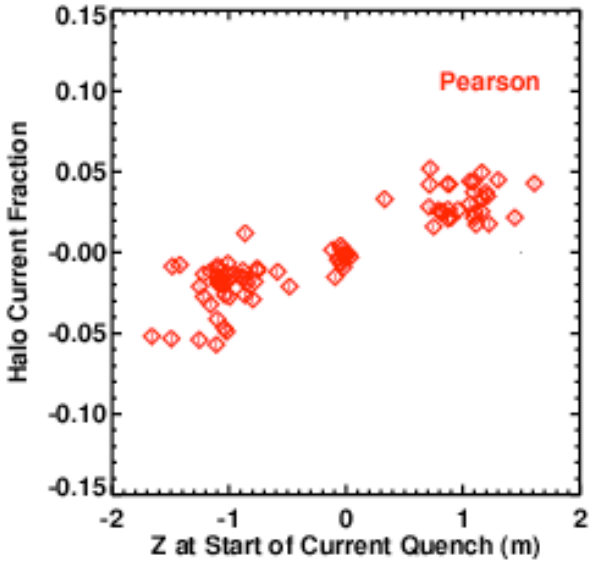
Example 3: Shot 127492, Downward Going VDE

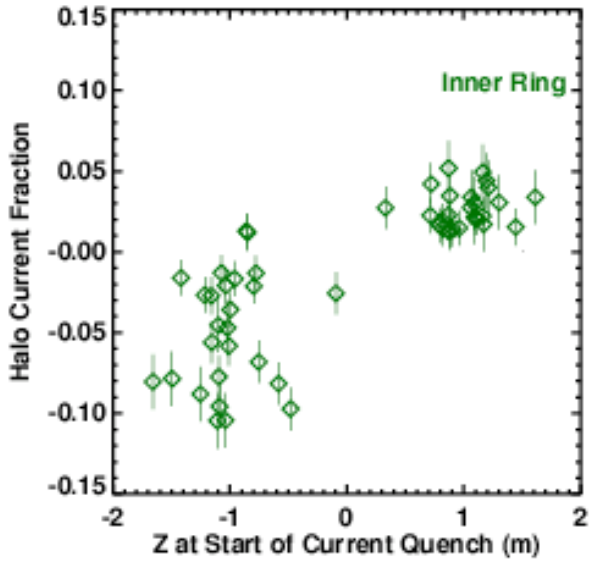


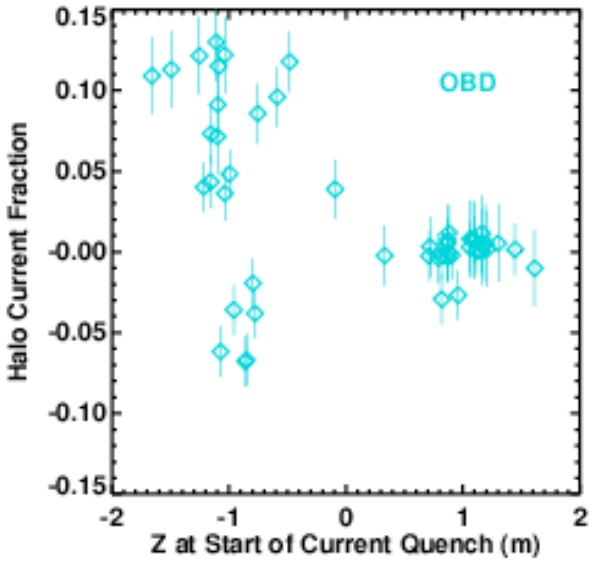


Halo Current Fractions Often Depend on VDE Directions



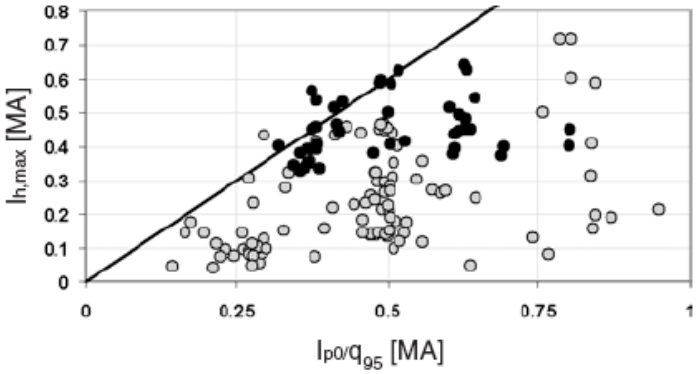




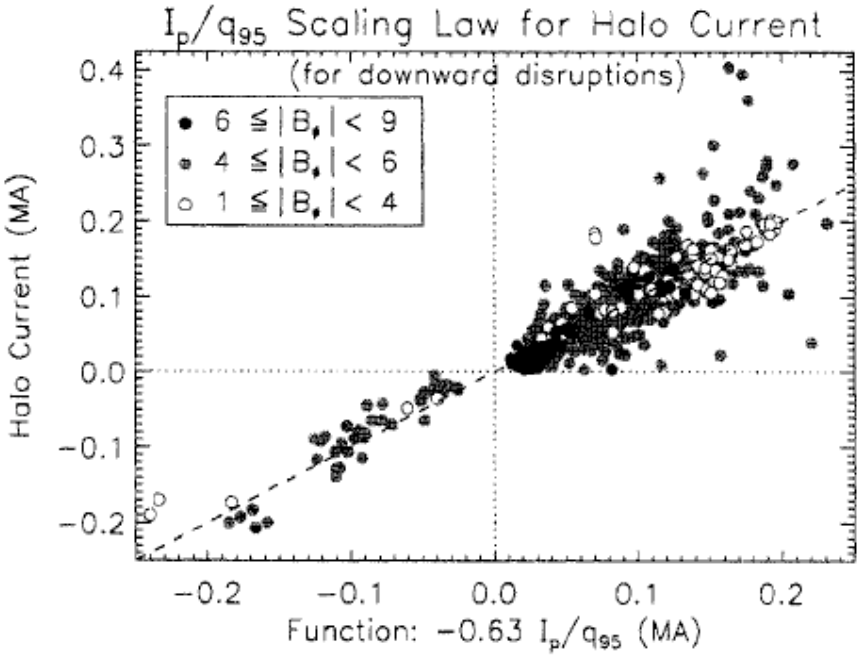


Pearson
CSCL1
Inner Ring
OBD

How Much Halo Current Can We Expect?

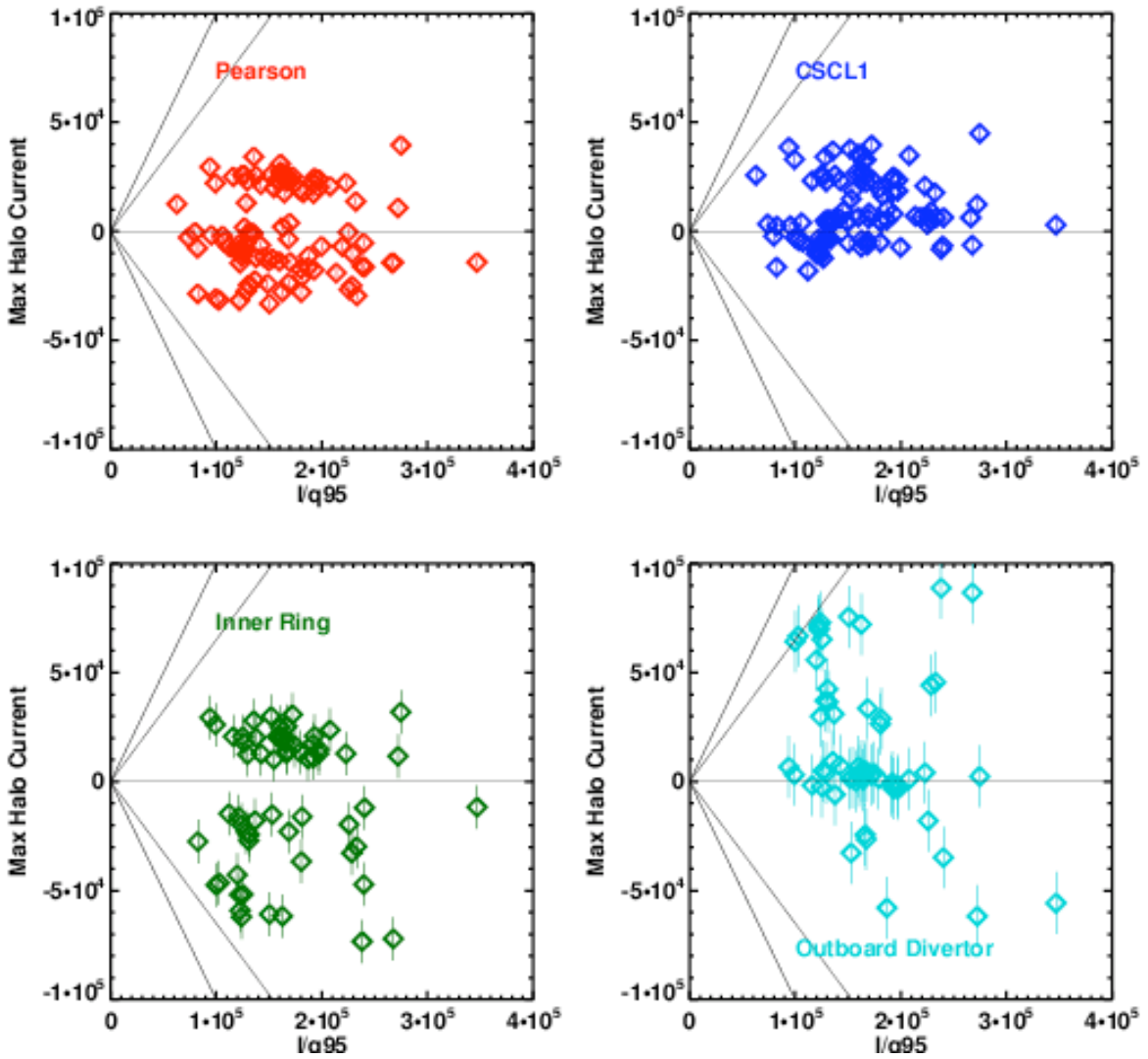


JET Data
Riccardo et al, PPCF, 2004



$I_{p,halo} \sim I_p/q_{95}$

Halo Current Magnitude In Agreement With Scalings From Other Devices



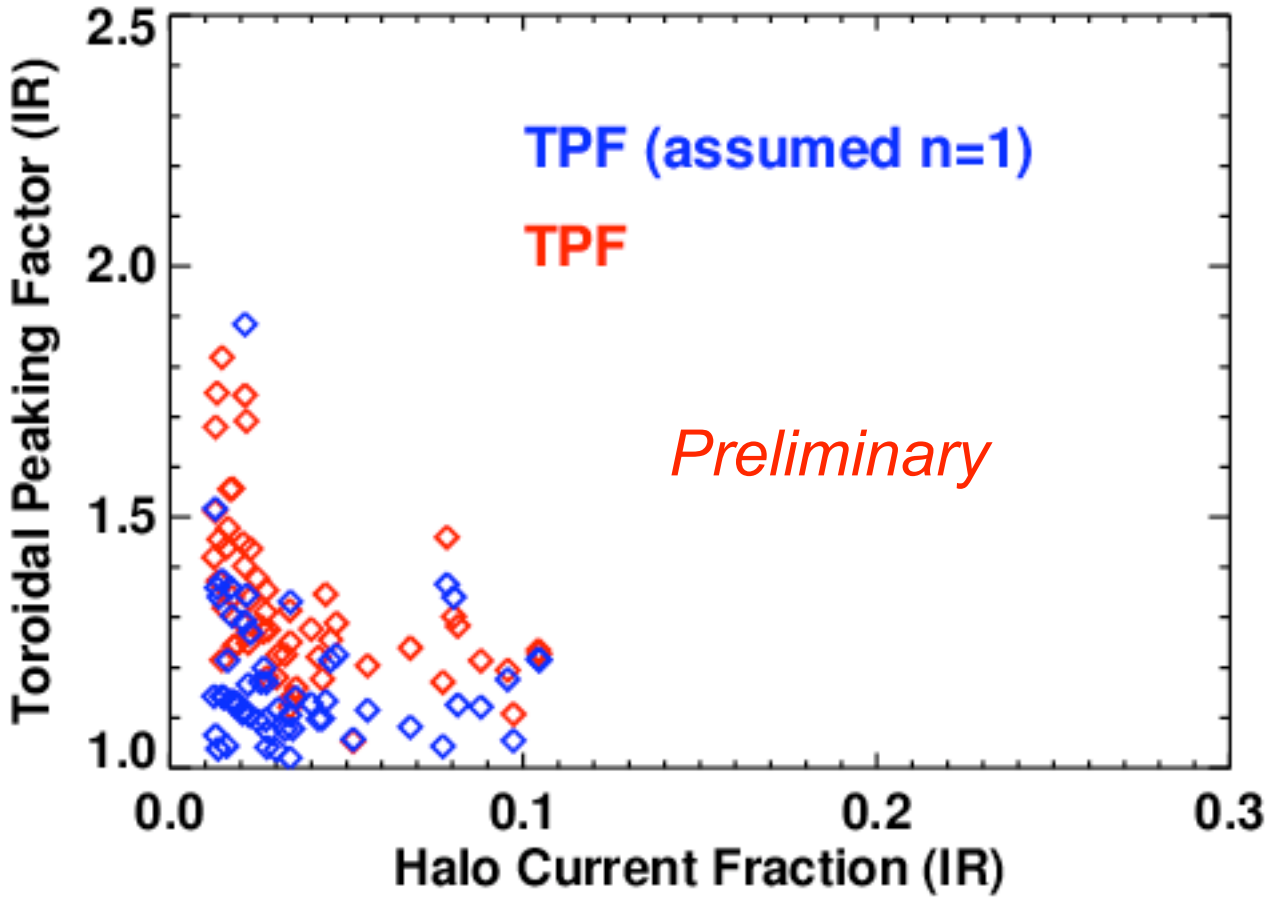
Lines

$I_{p,halo}=I_p/q_{95}$

$I_{p,halo}=0.65\ I_p/q_{95}$

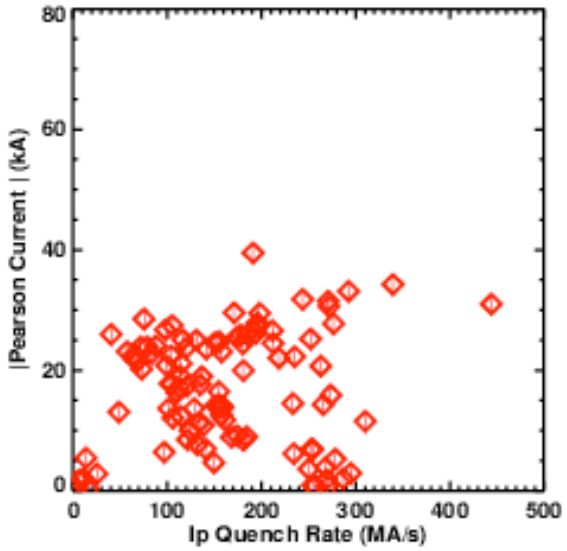
Pearson
CSCL1
Inner Ring
OBD

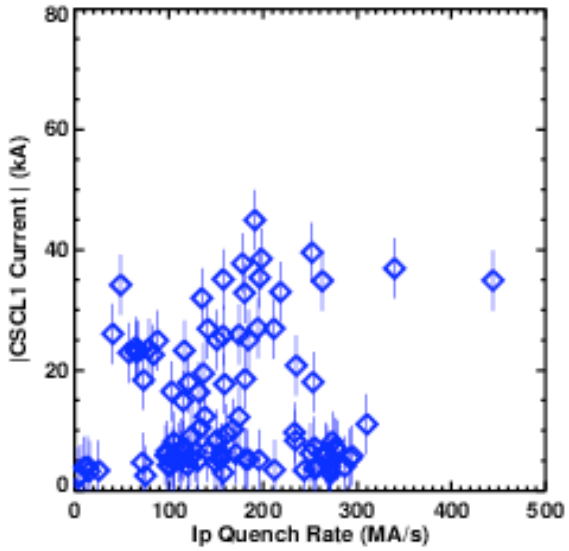
TPF Appears to Decrease with HCF

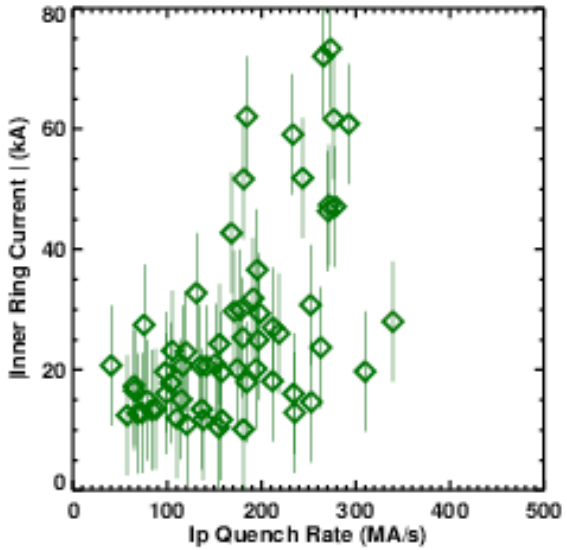


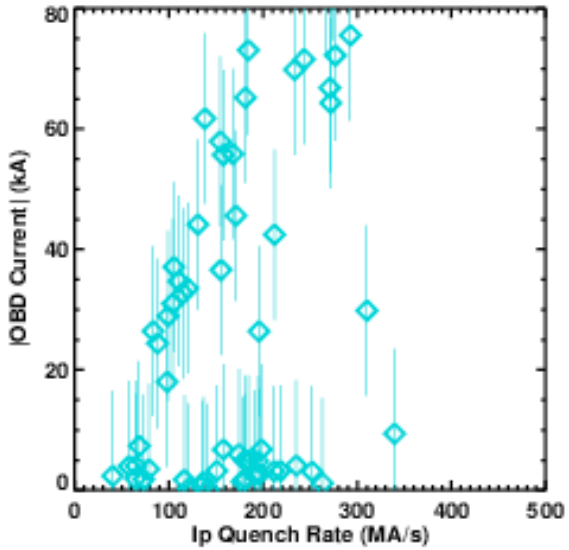
Quench Rate and Halo Currents are Not Anti-Correlated

Pearson
CSCL1
Inner Ring
OBD









Conclusions

- Large Database of Quench Rates and Field Derivative Measurements…plasma motion is very important.
- New Halo Currents Measurements Are Working And Collecting Data
- New Halo Current Paths are Measured
- Have Revised Upward the Halo Current Limits to be in line with expectations.