

XP-833: Halo Current Dependencies on $I_p/q, \dots$

Force a VDE by freezing vertical control, measure halo current.

- Back in May, 3/4 day
 - Completed I_p & B_T scan in high- δ Ohmic D_2 plasmas.
 - Completed I_p & B_T scan in low- δ Ohmic D_2 plasmas

Measured much larger halo currents than observed in “normal” operations.

- On June 16: 1/2 day \Rightarrow Full Day (PCS Sabotage)
 - Completed I_p & B_T scan in 2MW low- δ D_2 plasmas.
 - Completed P_{inj} scan at low- δ , constant B_T and I_p .
- XP is Finished

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

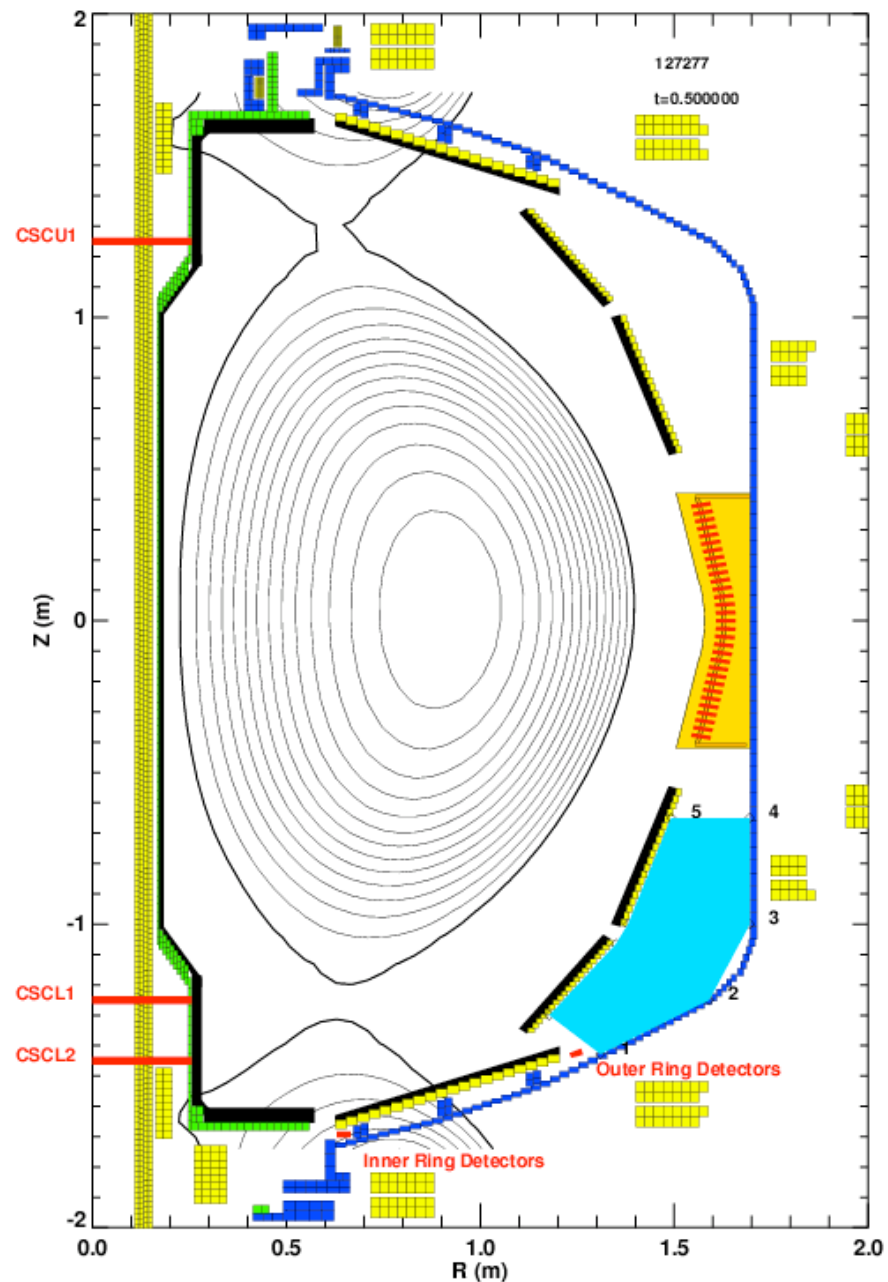
Outer Ring: Just Outside the OBD

Difference Between These: Current into the OBD

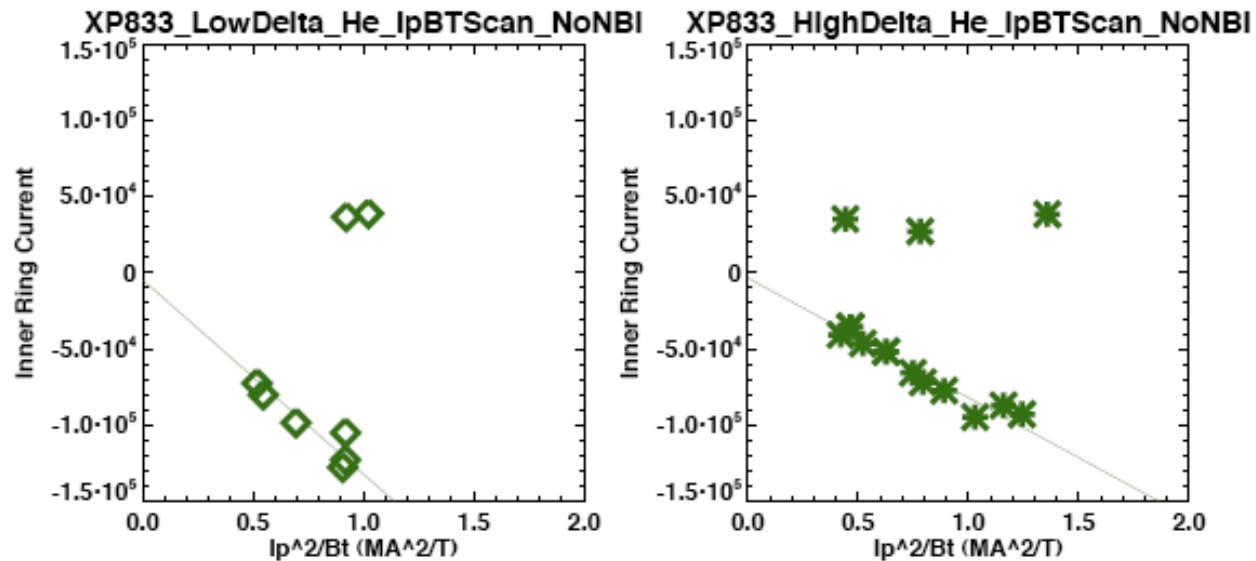
Two Pearson CTs on CHI Bus

Current from inner to outer vessel

NSTX Is Only Device with this Broken Halo Current Path



Current Flowing in the Vessel Bottom (I)

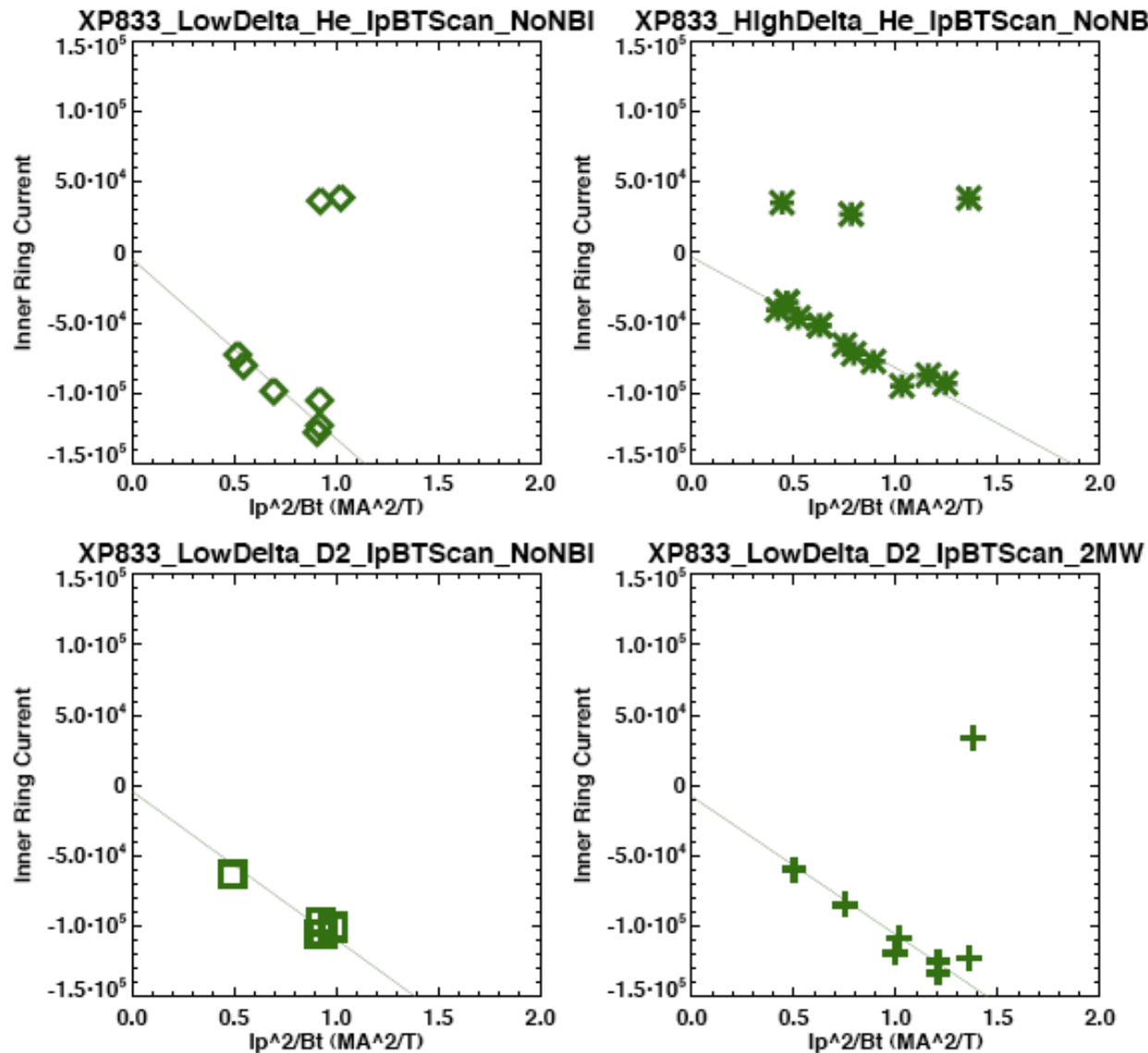


I_p : Halo Currents Increase with I_p

I_p/B_T : Poloidal Halo Currents Increase with Transform

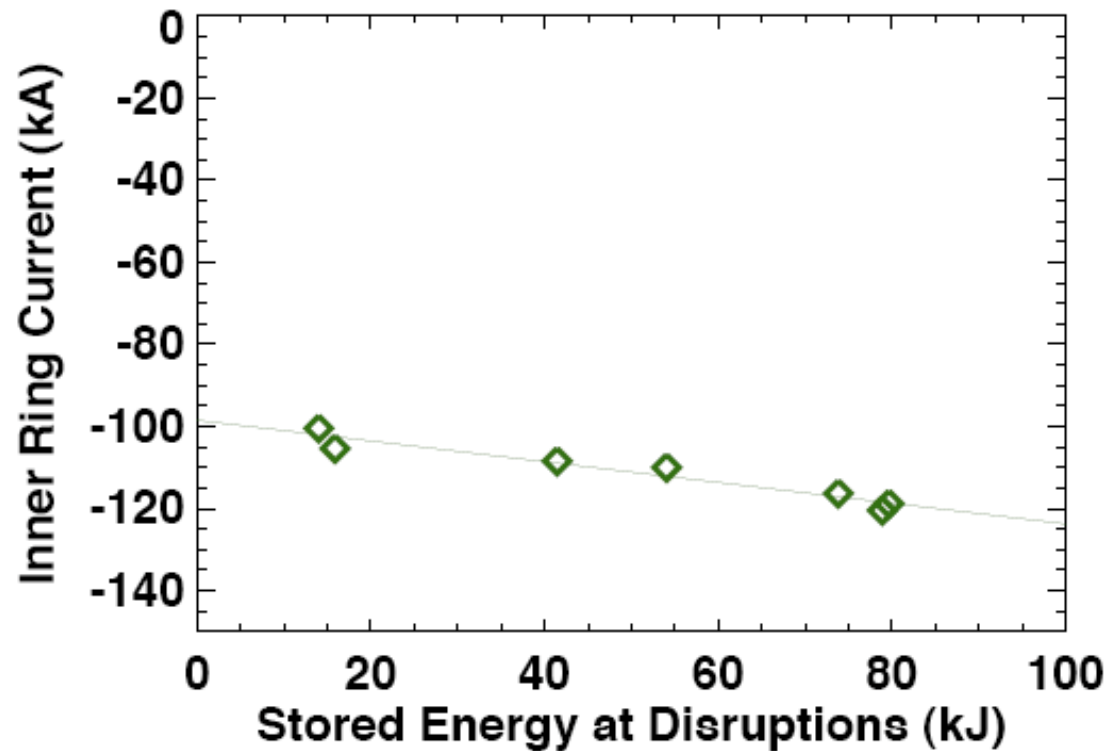
May I_p & B_T scans

Current Flowing in the Vesel Bottom (II)



May + June I_p & B_T scans

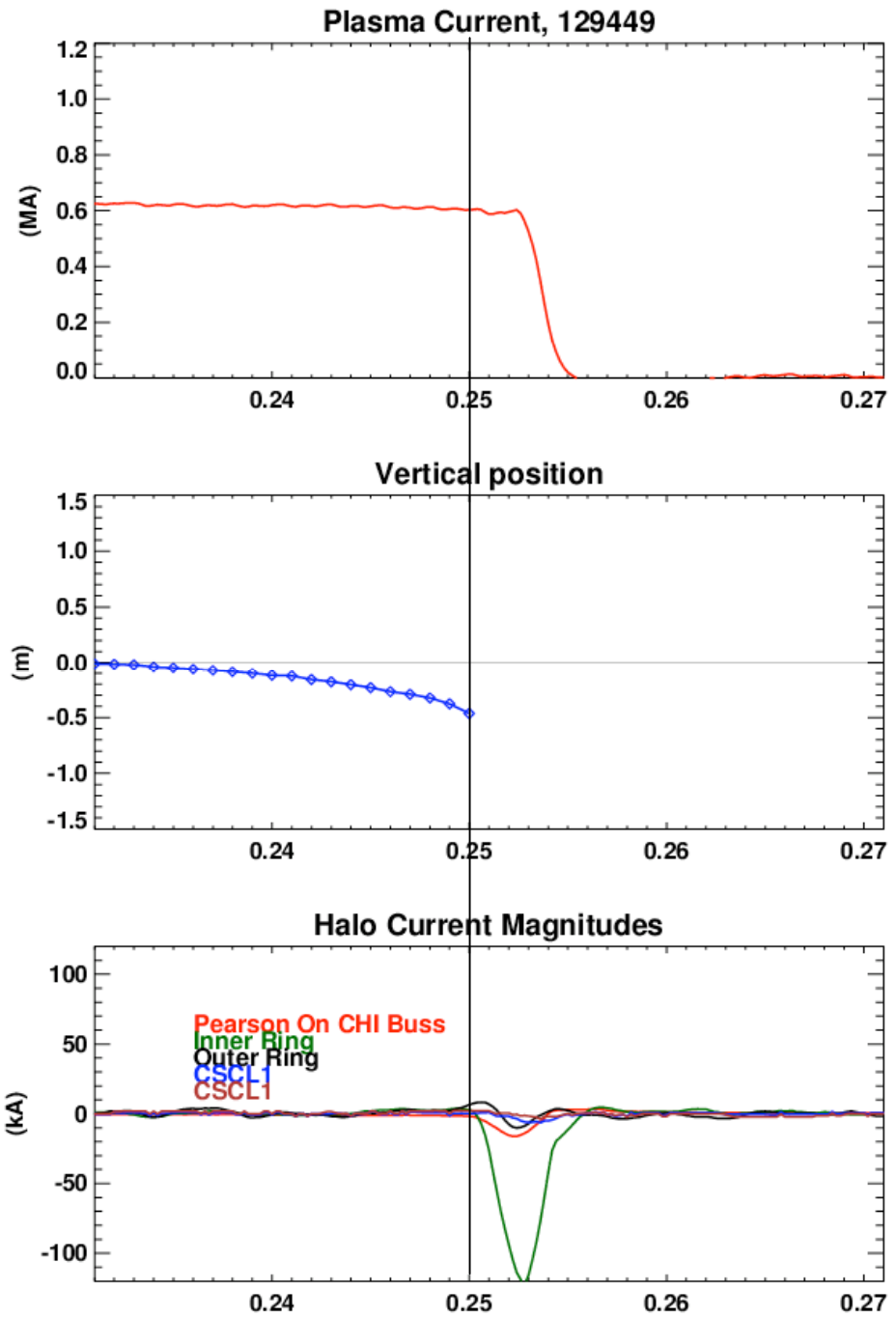
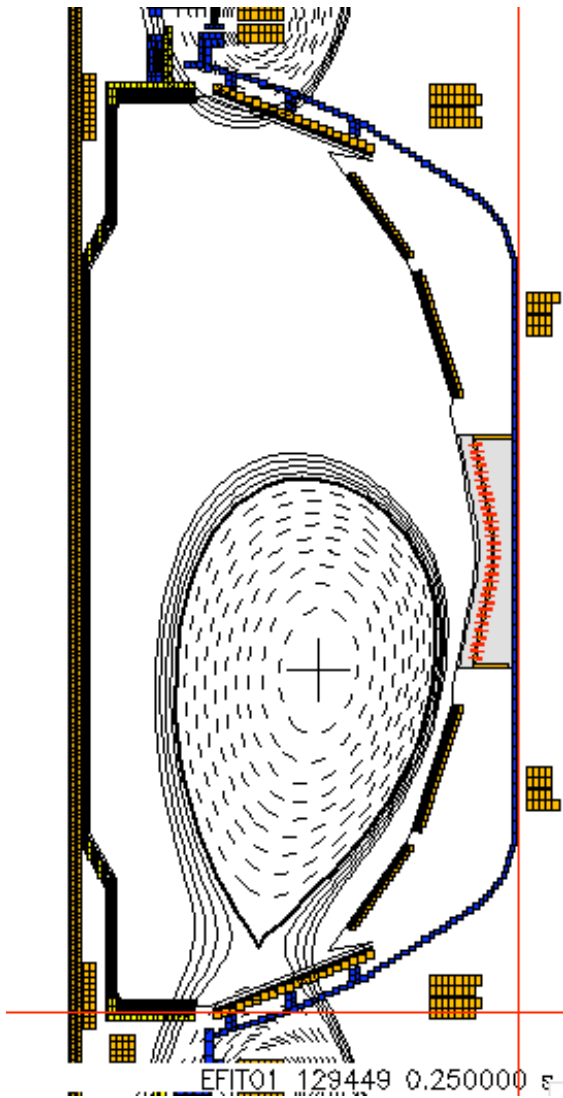
Currents Increase With Stored Energy



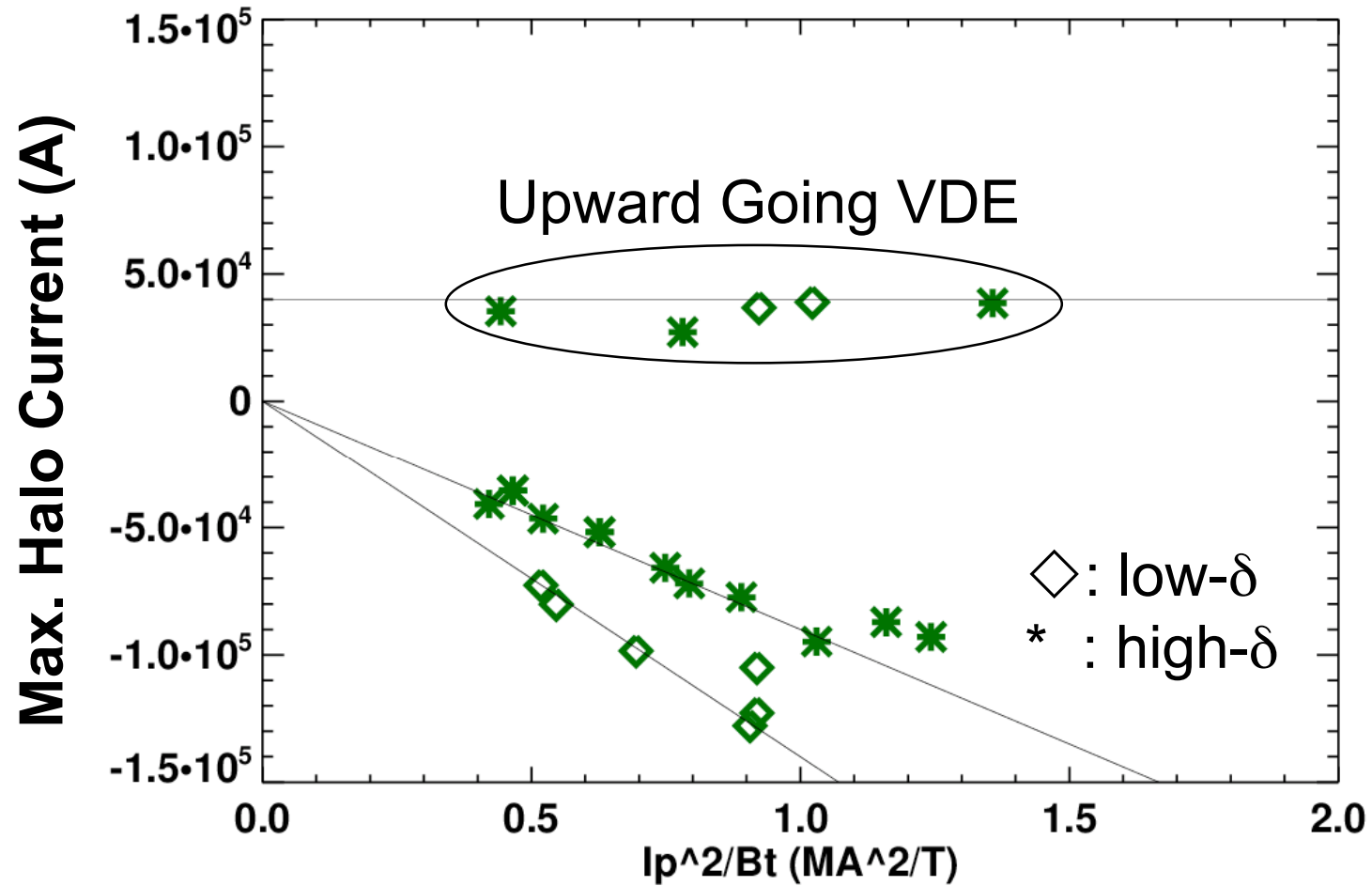
May be related to faster current quenches, and thus larger driving voltages, at higher stored energy.

The Rest is Old

Example

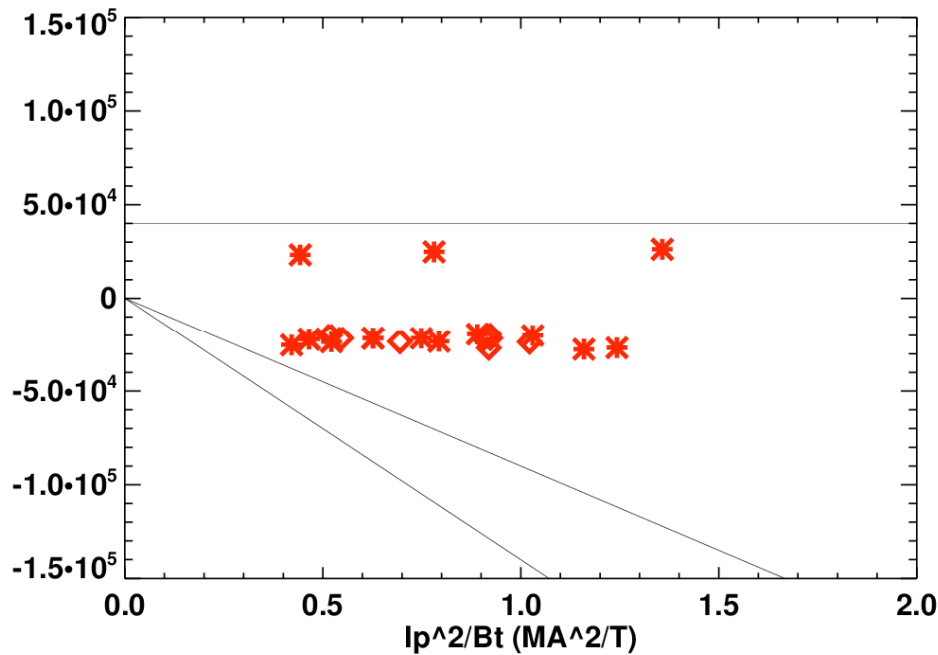


1: Current Linked By Inner Ring

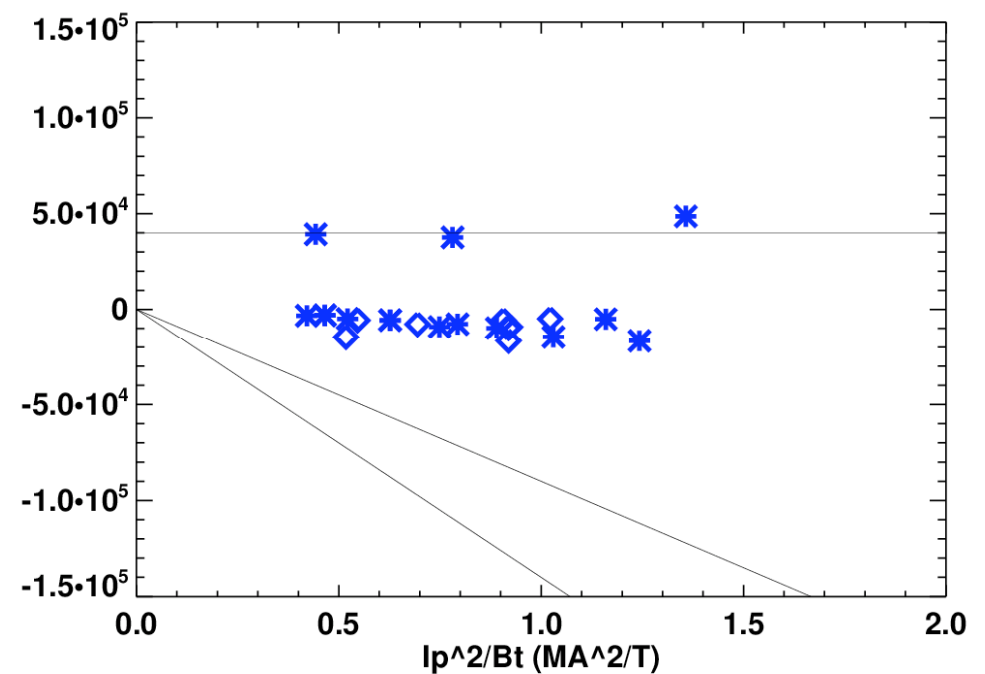


2: Current From Inner to Outer Vessel, PF1A Transition

Inner to Outer Vessel

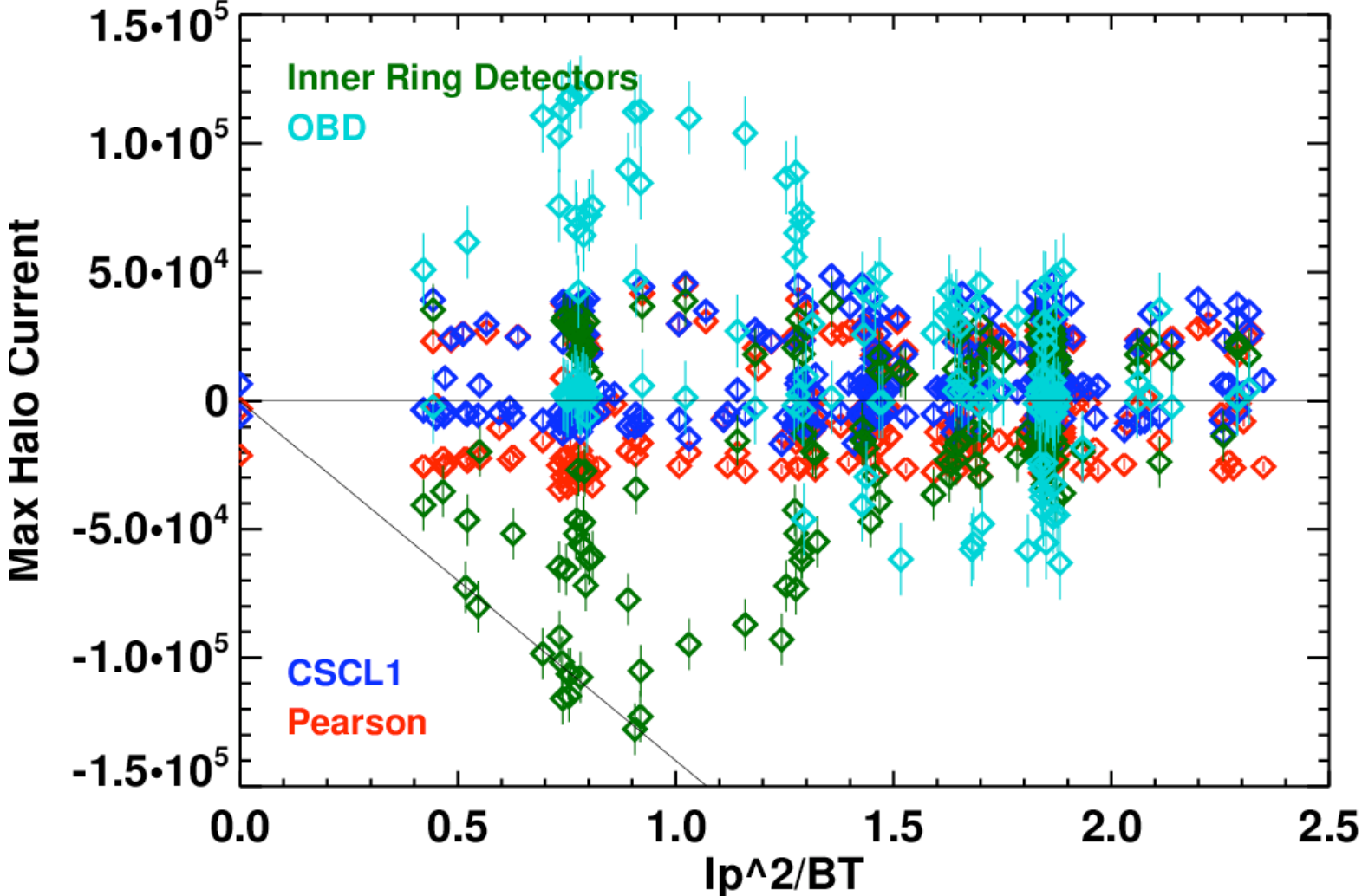


PF1A Transition

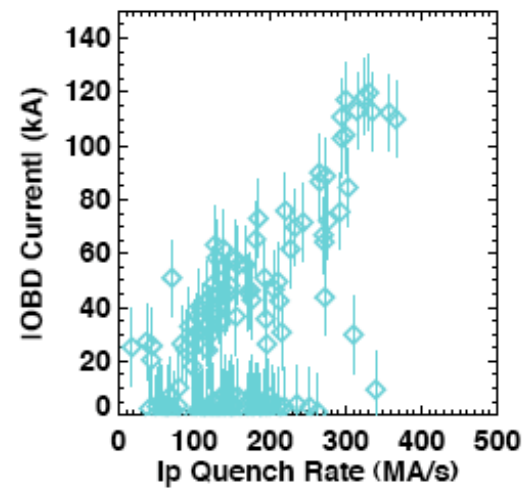
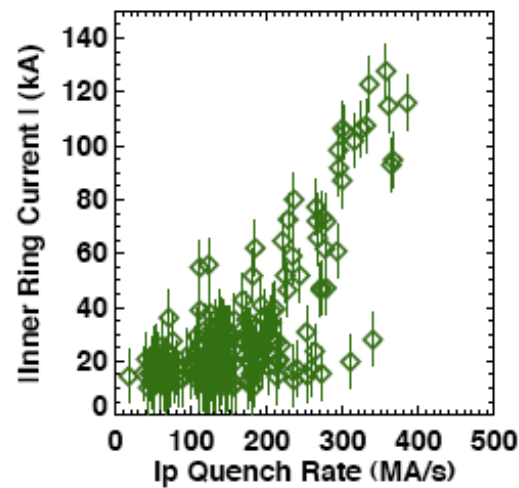
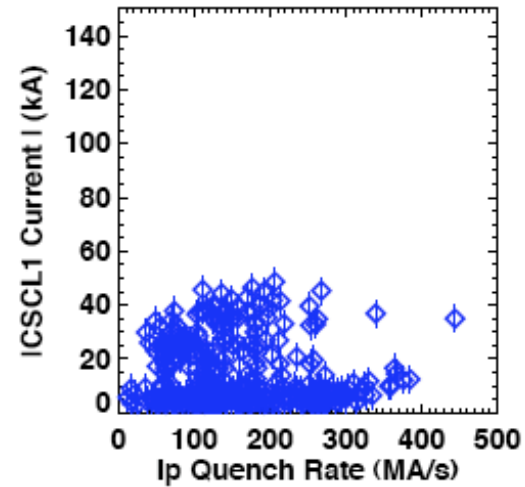
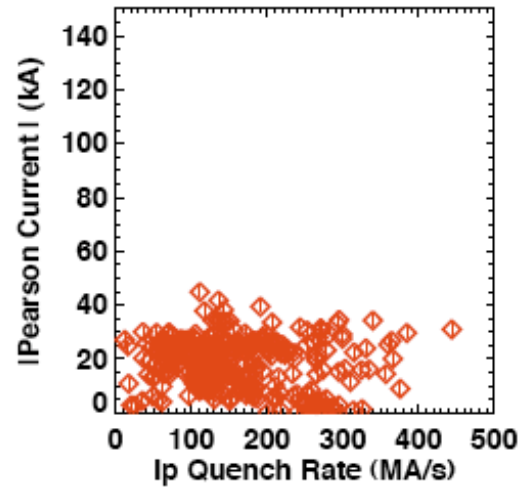


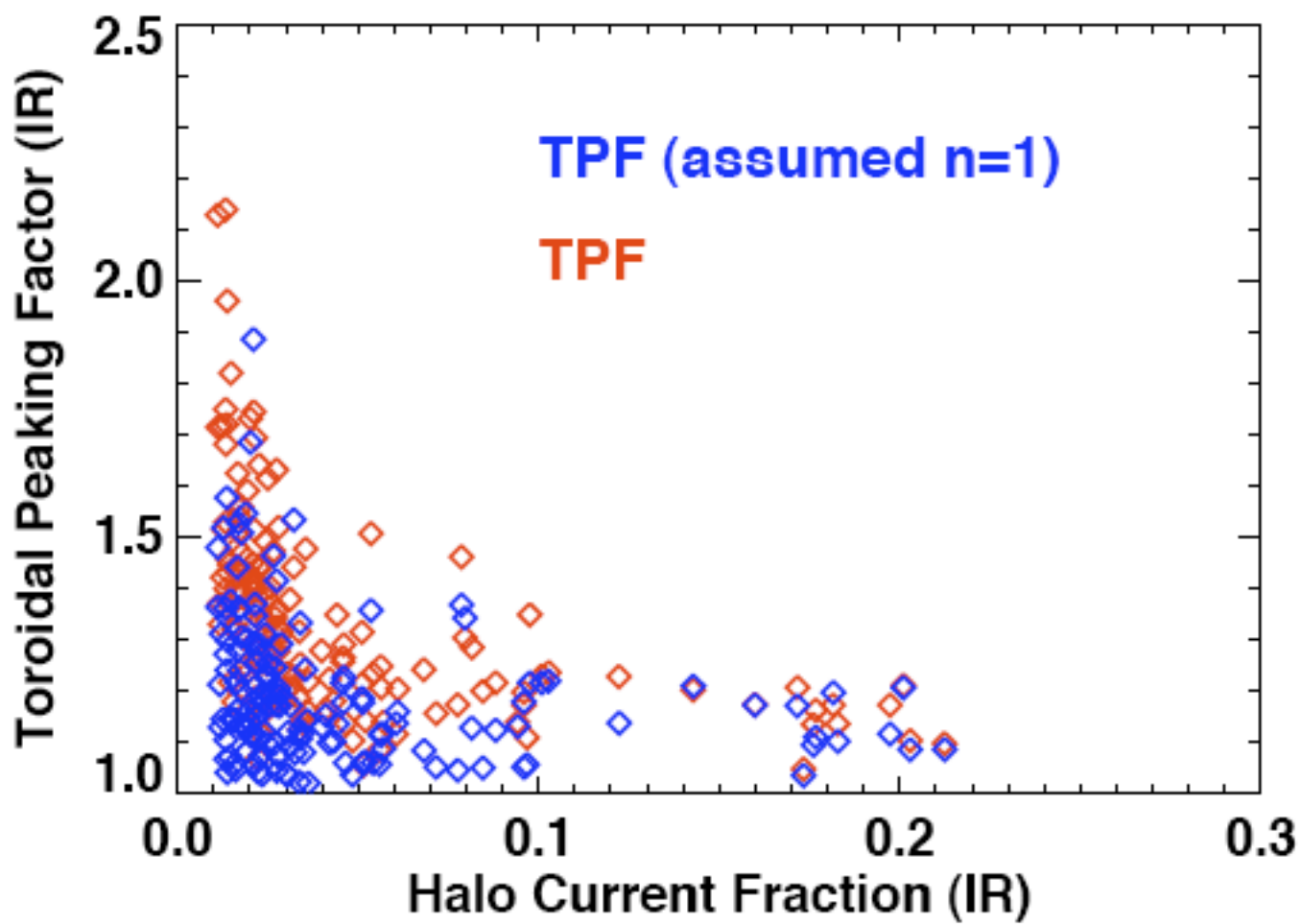
◇ : low- δ
* : high- δ

Compare to All Shots This Year



Halo Currents Scale with Quench Rates





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- What is a halo current?
 - When the plasma loses vertical position control, it can come in contact with PFCs at the top/bottom of the VV.
 - Disruption flux changes create voltages that drive current linking both the plasma and the VV components.
 - The $J \times B$ force on VV components can be a HUGE problem in a larger tokamak.
- Reference: 600 kA, Ohmic, Helium, PF1A ($\delta_l=0.45$).
- Freeze vertical control, give a “kick” to push plasma down, measure currents in lower outboard divertor, CHI gap.
- Scan I_p , B_T , to see scaling of halo currents (12 shots)
- Develop a lower- shape with halo-currents linking the lower SPP and OBD. (14 shots, $\delta_l=0.33$, only partially successful)
- Repeat scan with new halo current path. (4 shots)
- Repeat scan in Deuterium. (1 shot)