

Dependence of Edge Flow on Magnetic Configuration in NSTX

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XP447 successfully executed, with mixed results:

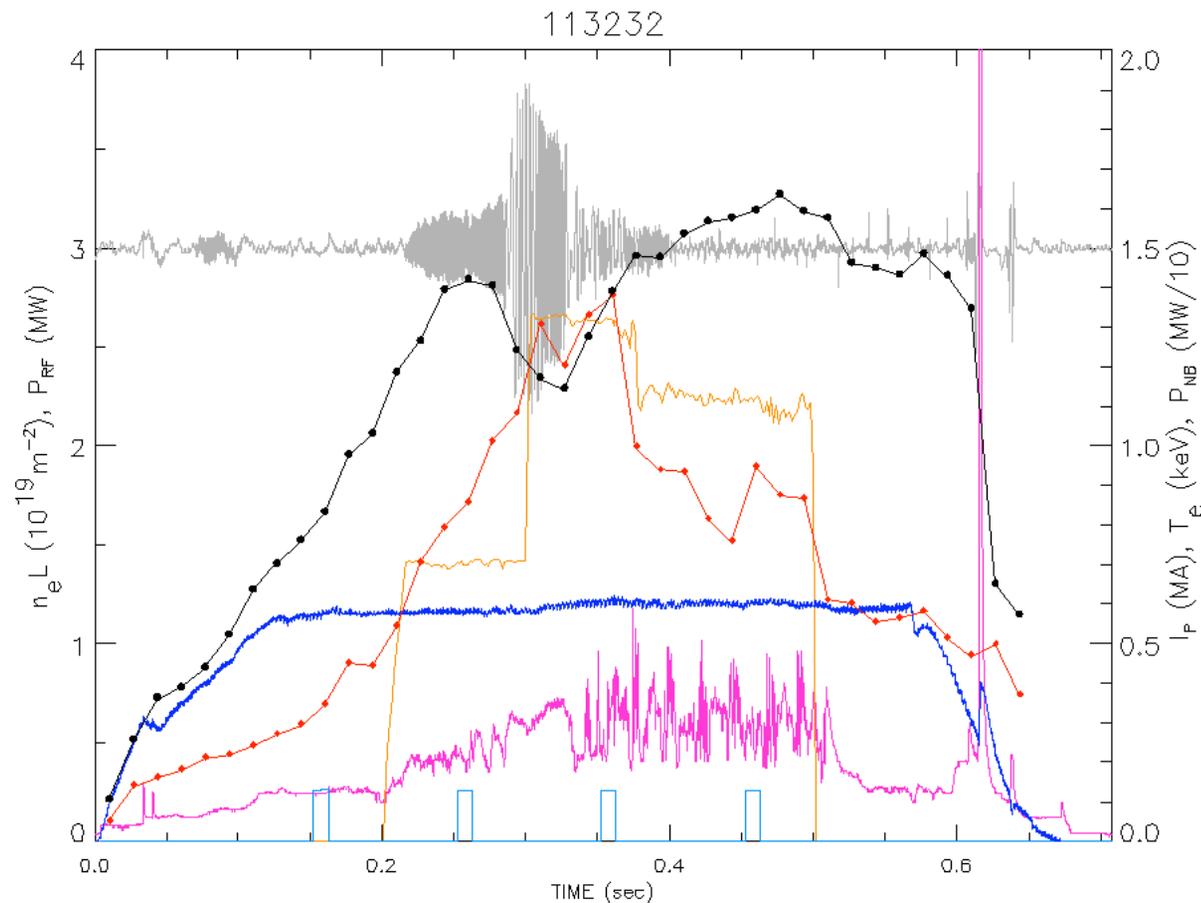
Careful configuration control (dR_{sep}) from rtEFIT.

Edge flow varies with magnetic configuration.

Core & GPI flow data pending.

But, effect on H-mode power threshold undocumented due to failure to achieve H-mode except in DND configuration.

- Recent results from Alcator C-Mod indicate that the plasma flow directions in the SOL changes direction as the magnetic configuration varies from USN to DND to LSN in ICRF heated plasmas.
- Change in the core rotation is also coincident with the SOL flow change.
- Flow directions account for the L-H power threshold difference in USN v. LSN in C-Mod.
- Similar experiments attempted in NSTX (XP447):
 - Use rtEFIT to control the plasma shape as dR_{sep} is smoothly varied in Ohmic and HHFW heated plasmas.
 - The ERD provided poloidal and toroidal measurements of flow in the edge and SOL.
 - CHERS gave profiles of rotation from edge to core.
- H-mode was not accessible in NSTX LSN or USN.



- DND, $dR_{sep}=0$
- D_2 fueled
 - outboard midplane
- rtEFIT controlled
- $I_p \sim 600$ kA
- $B_T \sim 0.42$ T
- $n_e \sim 3 \times 10^{19} \text{ m}^{-3}$
- $gap_{in} \sim 4-6$ cm
- $gap_{out} \sim 4$ cm
- Flattop from $t=100-500$ ms or greater
- at $t=200$ ms apply 2 MW of HHFW at 14 m^{-1}
- 10 ms blip NBI source C (75 kV) every 100 ms for CHERS

USN, $dR_{sep} \sim +2$ cm

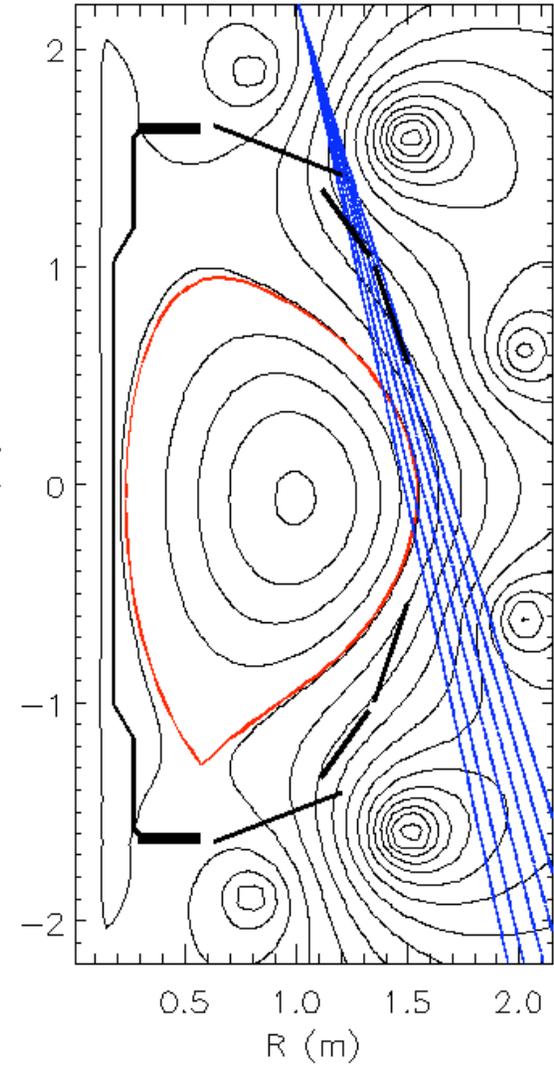
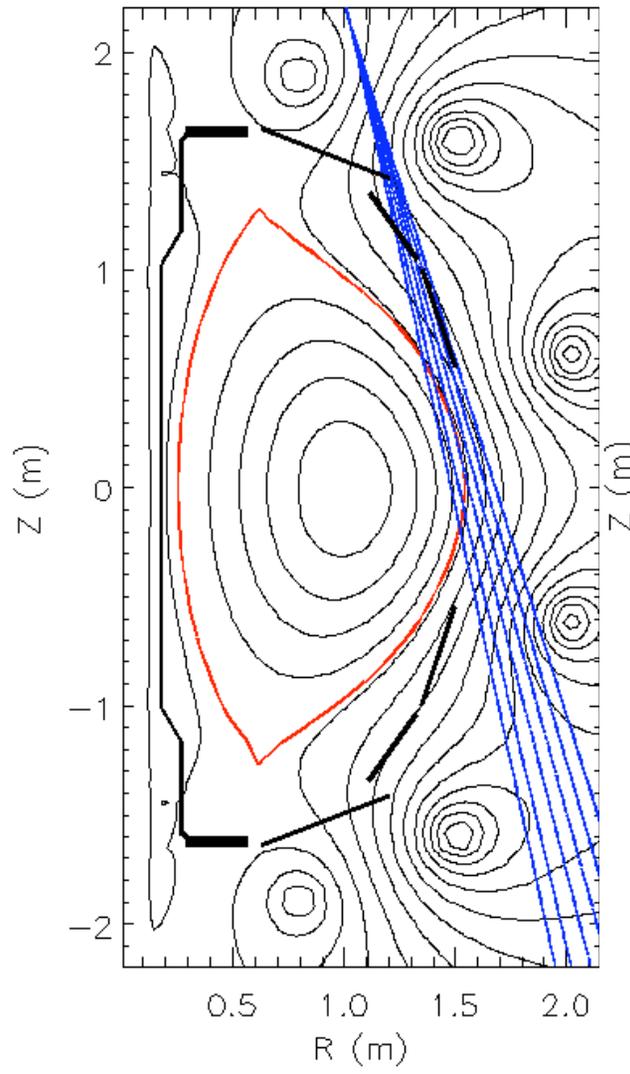
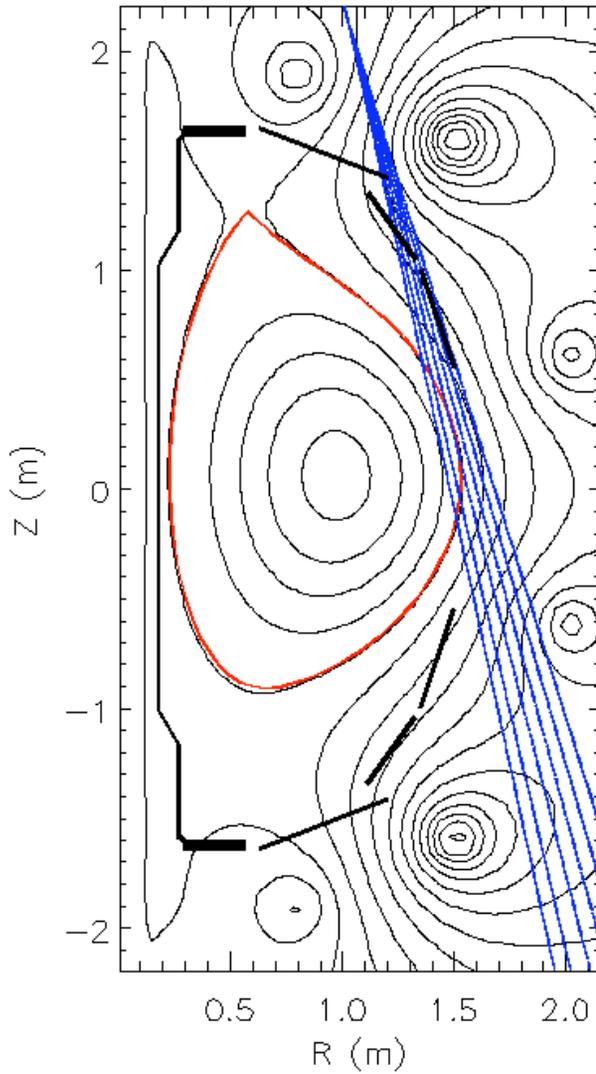
Shot= 113246, time= 0.2500

DND, $dR_{sep} \sim 0$ cm

Shot= 113232, time= 0.247

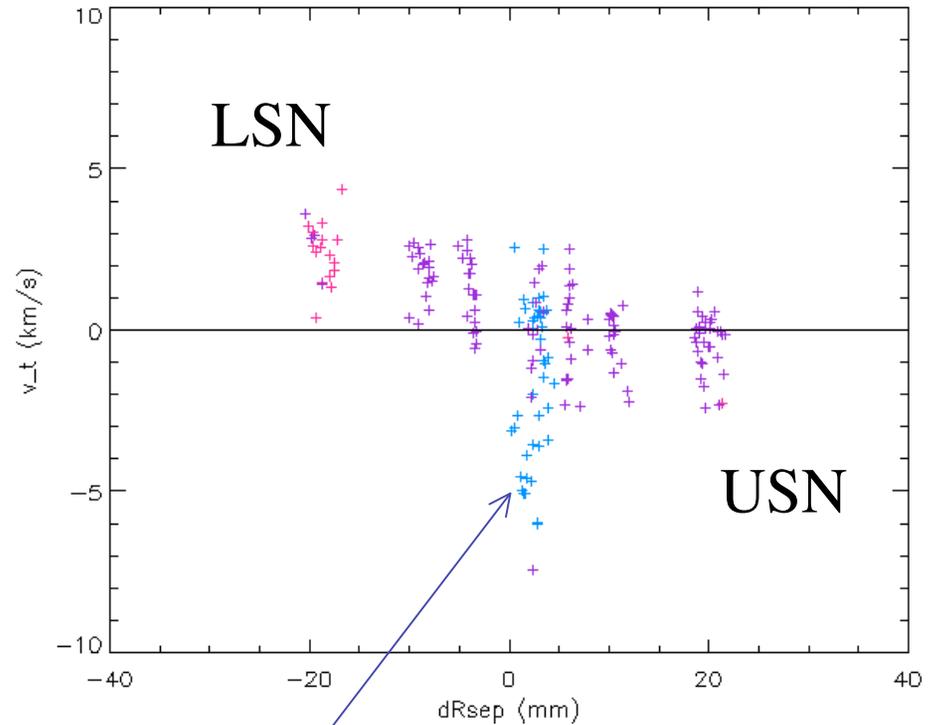
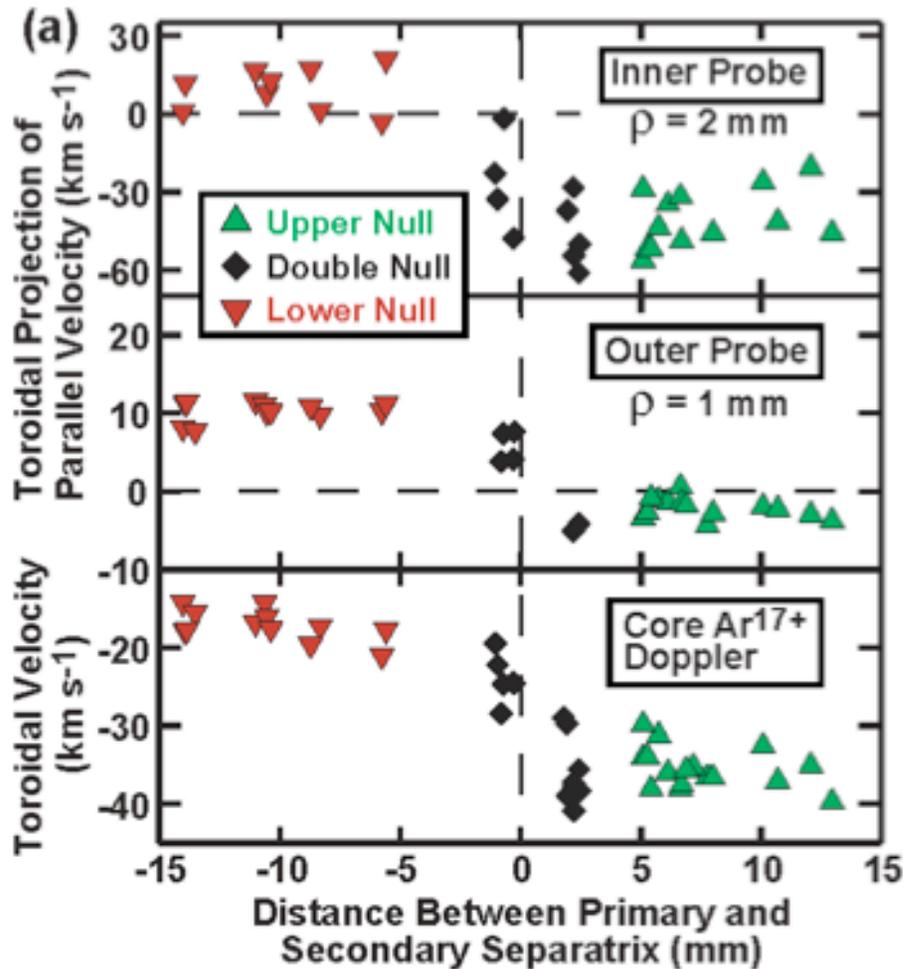
LSN, $dR_{sep} \sim -2$ cm

Shot= 113240, time= 0.250000



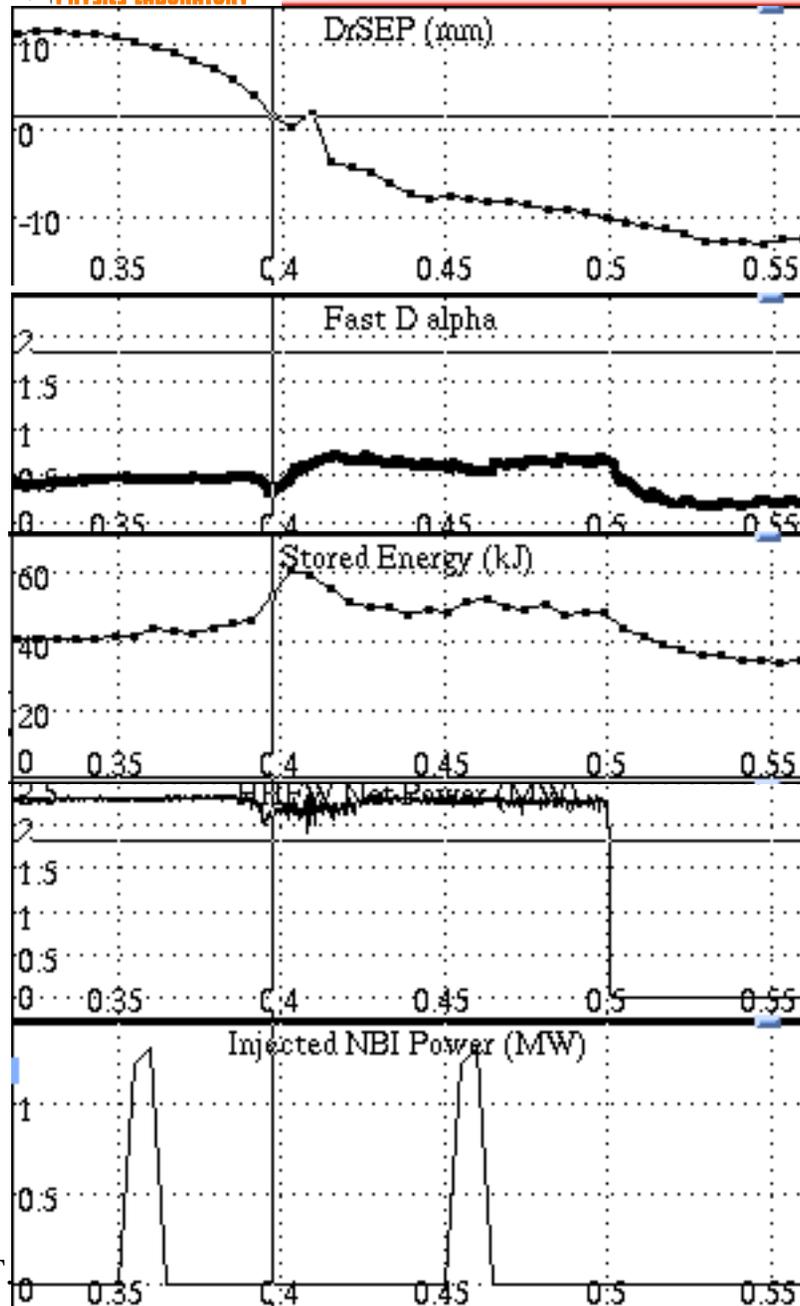
C-Mod results

NSTX results



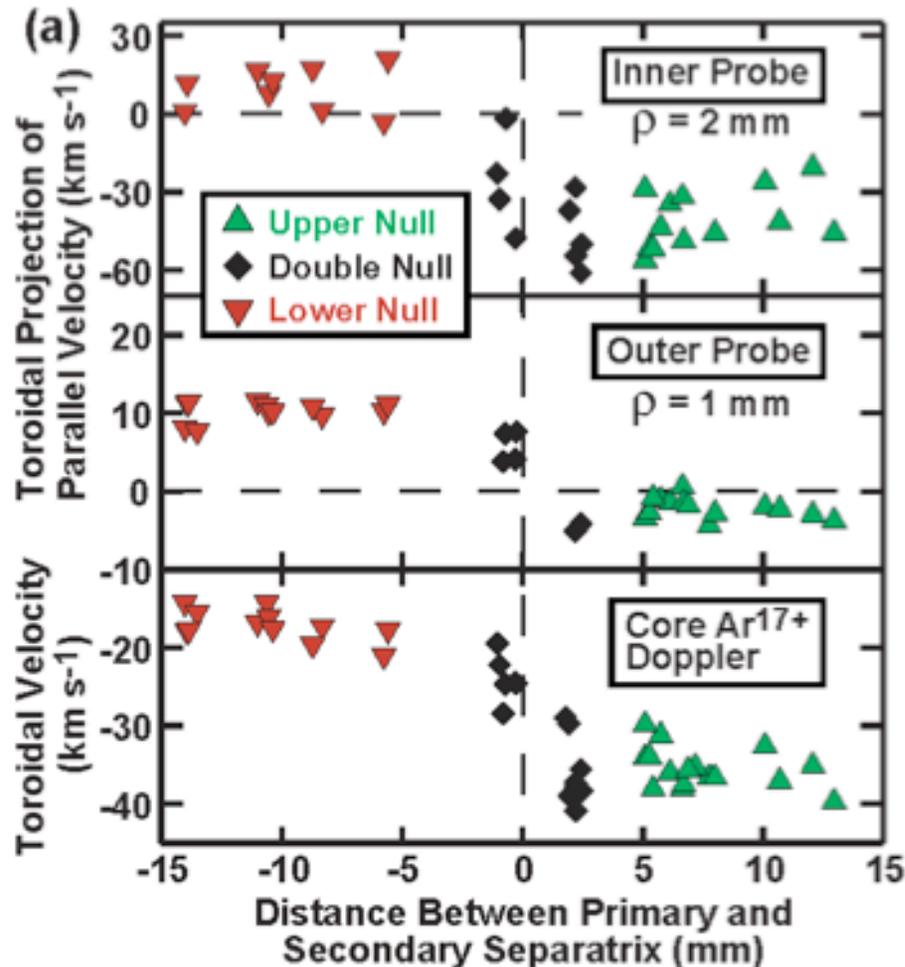
Blue points are during H-mode

LaBombard 2004



- Plasma transitioned into H-mode readily in DND at $P_{RF} \sim 1.5$ MW.
- However transition could not be induced in LSN or USN.
- Scanning dR_{sep} within a shot (thanks to rtEFIT) shows H-mode transition only near $dR_{sep} \sim 0$, i.e. DND.

- rtEFIT has proven to be a very useful tool in plasma shape control.
- Edge flow in NSTX appears to have similar dependence on magnetic configuration as C-Mod.
- Planned Analysis
 - Thorough analysis of ERD measured edge flows.
 - Comparison of CHERS measured core flows.
 - Velocity field calculations of GPI flows.
- Future Work
 - Develop understanding of H-mode access limitations in LSN and USN configurations.
 - Examine L-H power threshold as function of edge/SOL flows (i.e. variation with magnetic configuration).



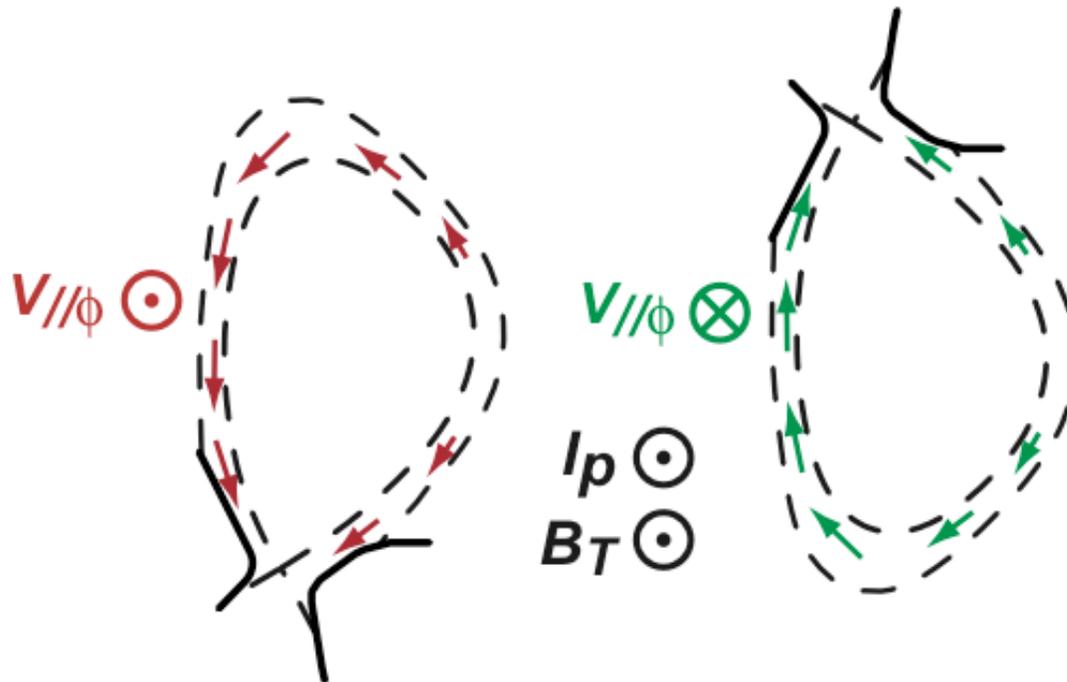
LaBombard 2004

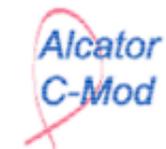
- Change in core flows with topology is in same direction and same magnitude as SOL flows
- Core flows exhibit the same extreme sensitivity to edge topology! – each mm counts
- SOL flows are near sonic on high-field side.

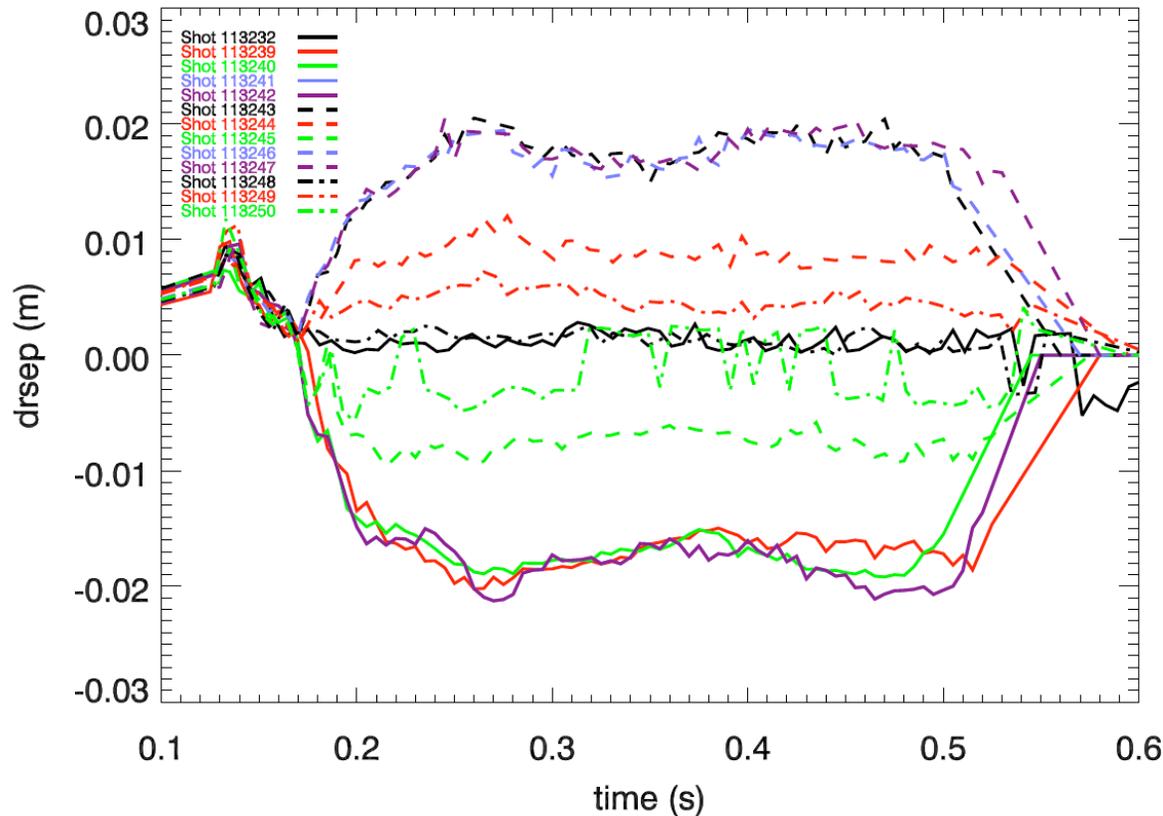


Alcator
C-Mod

⊥ transport-driven parallel SOL flows:




 Alcator
 C-Mod



D. Gates

- Started with a DND plasma.
- Used rtEFIT shape control to transition into USN or LSN.
- Excellent control of the plasma.