NSTX

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Measurements of disruptions with the LLD and extended diagnostic capabilities, XP1021

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A. McLean, S. P. Gerhardt, J-W. Ahn, M. Jaworski, J. Kallman, L. Roquemore, F. Scotti, V. Soukhanovskii, K. Tritz

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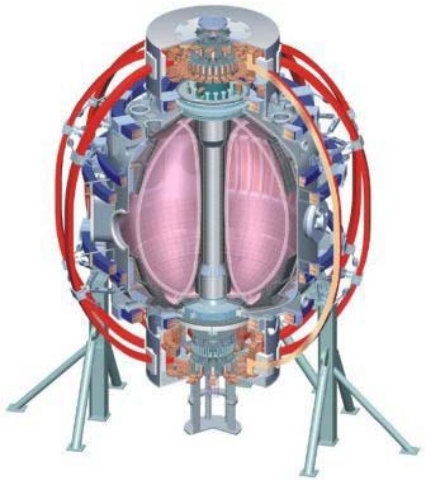
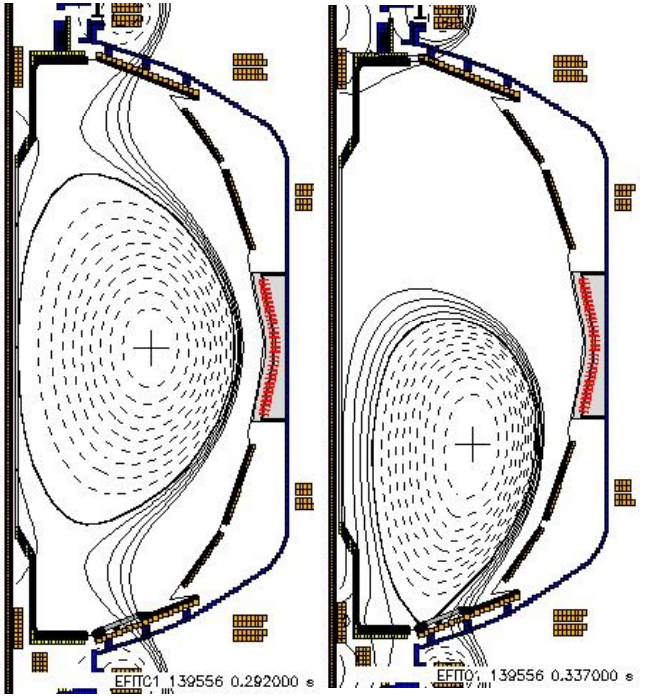
NSTX Results Review 2010/2011
December 1st, 2010

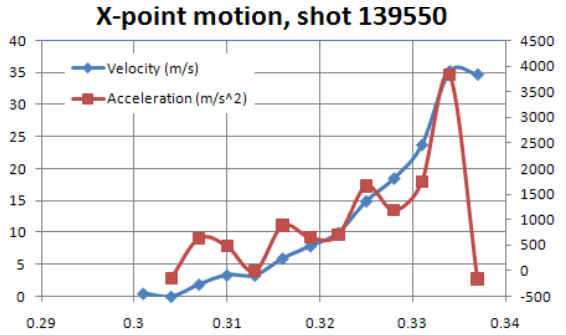


XP1021 accomplishments in 2010

- 8/4/2010, shots 139529-139557, and
- 8/27/2010, shots 140438-140461 – lots of data
- Developed 2 MW inner-wall limited L-mode shot with reliably triggered VDE using an 80 V downward bias on PF3
- Performed scans of $600<I_p<800$ kA and $0.35<B_t<0.55$ T ($0.45<I_p^2/B_t<1.83$)
- Injected power/stored energy scan: P_{NBI} at 0.0, 0.3, 1.0, 2.0, 3.0, and 4.0 MW
- Repeat cases identical to previous years to test Li effect on halo currents, compare to 2009
- In support of ITPA TG DSOL-24 – Disruption heat loads
  - Aim: Accounting of power balance during thermal quench and current quench
  - Desirable output: Heat load footprint size, location, duration, and scans of parameters affecting TQ duration, SOL broadening, energy dissipation, and impurity sputtering. Comparison of VDE, density limit, and beta limit disruptions

- ***139556, t=0.292 sec. 139556, t=0.337 se***



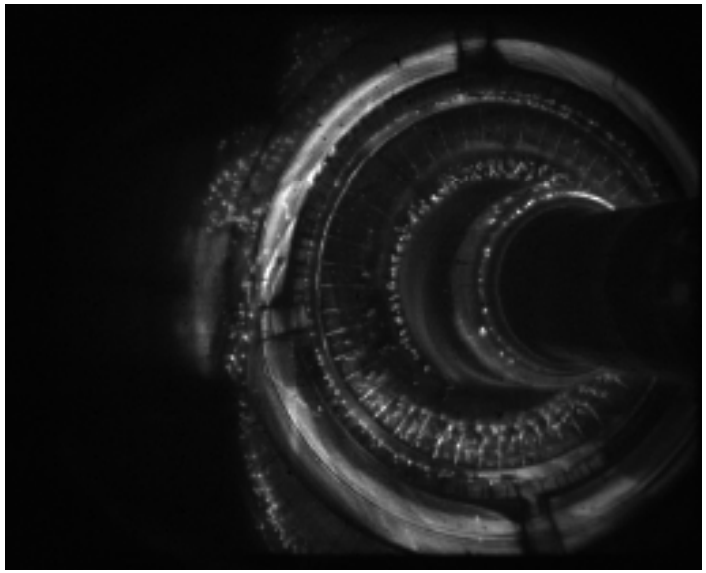


Halo current/disruption study results to date suggests significant role of lithium

- Found halo current magnitude to be significantly less than found in previous conditions of XP833 (~1/2), possibly due to presence of Li.
- Linear trend in HC magnitude vs. B_t/I_p^2 but offset from 2009
- High surface heat fluxes through disruption with dual-band fast IR camera (1.6 KHz, 10-75 us integration time, 0.621 ms frame-to-frame time) (Ahn/McLean)
- Structure observed in I_{sat} of high density Langmuir probe array during disruptions, ripe for T_e measurements (Jaworski)
- Full fast camera view of lower divertor will allow estimation of Li and C fluxes from the floor through disruption (Scotti/Roquemore)

Fast visible cameras, LiI and LiII (F. Scotti)

•*Bay E Top View*



•*Shot 139550*

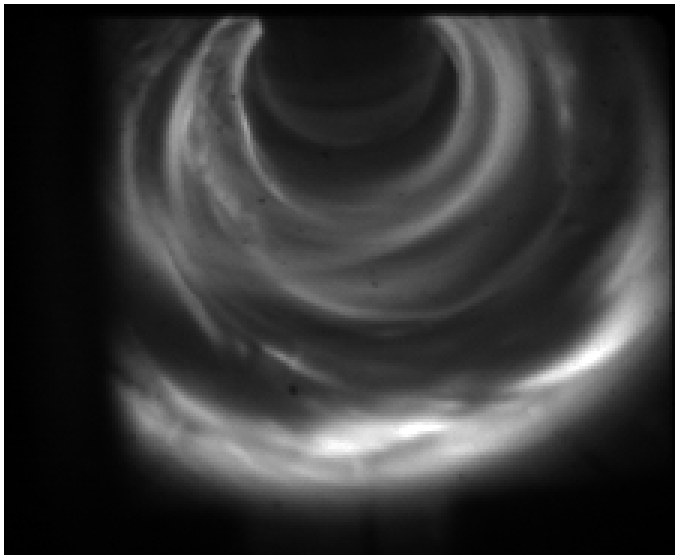
←*Li I (670 nm)*

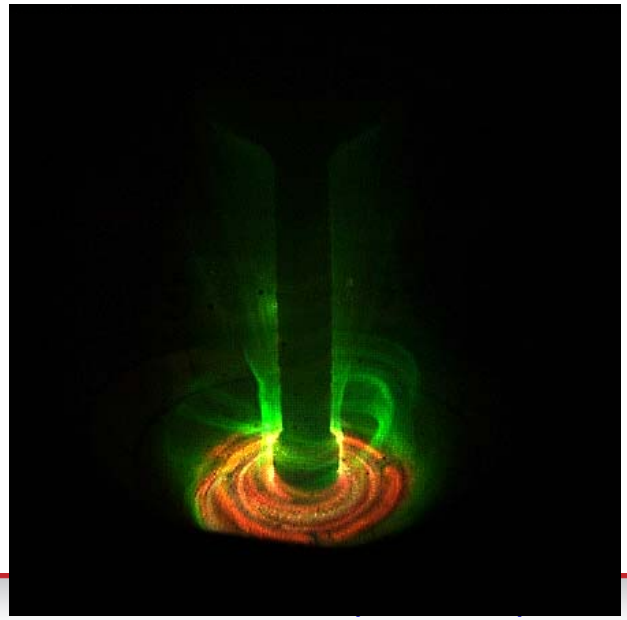
- *1 microsec.*

•*Li II (548.5 nm)* →

•*2 microsec.*

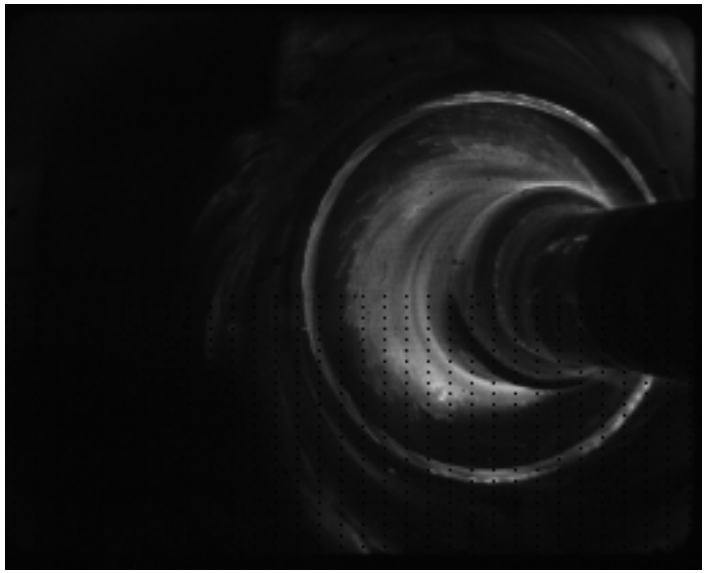
•*Bay J Top View*





Fast visible cameras, CII and CIII (F. Scotti)

•*Bay E Top View*

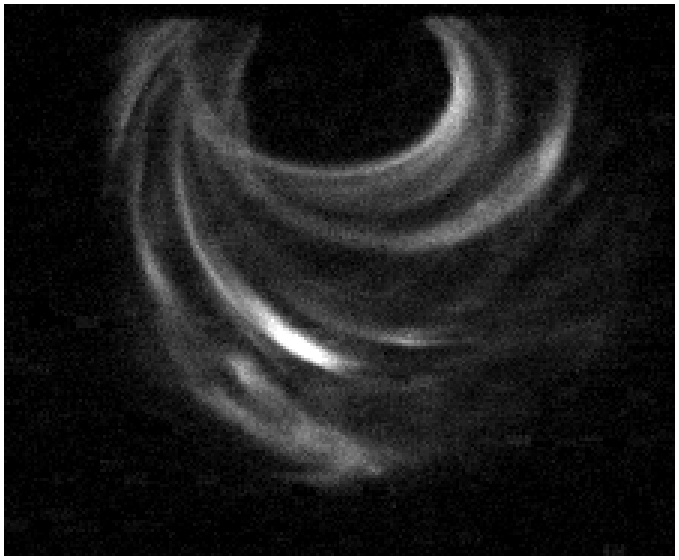


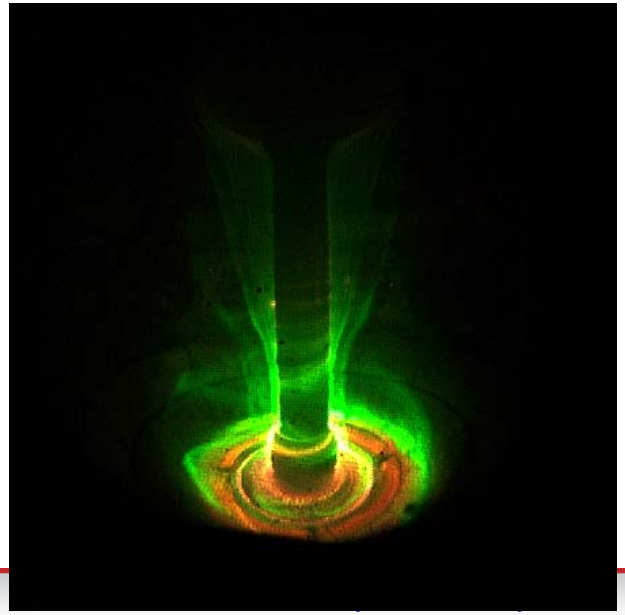
•*Shot 139551*

← *C II (426.8 nm)*
•*3 microsec.*

•*C III (465.0 nm)* →
•*2 microsec.*
•*(image enhanced)*

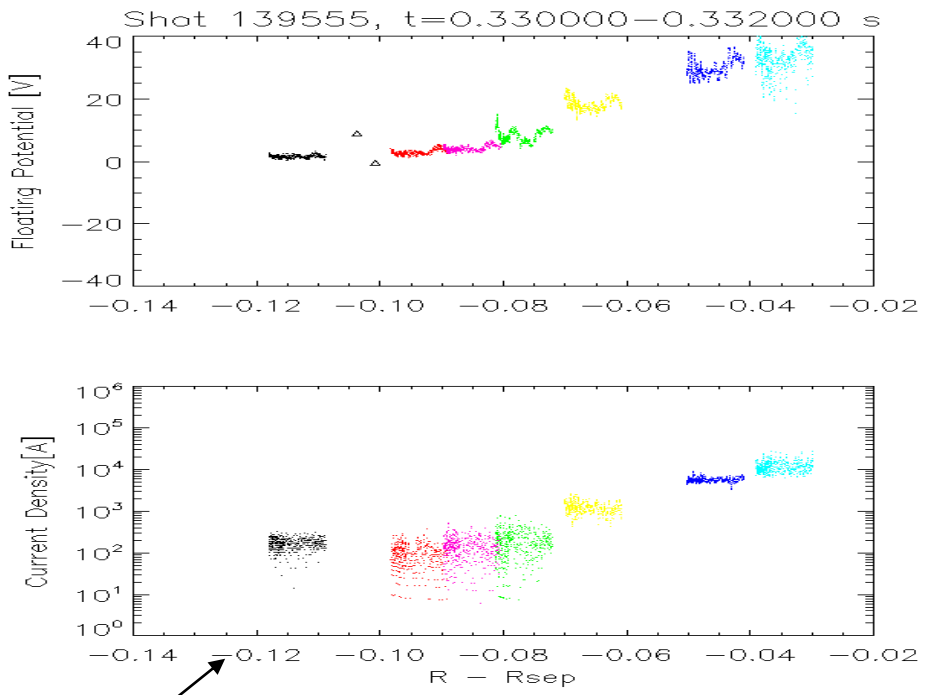
•*Bay J Top View*

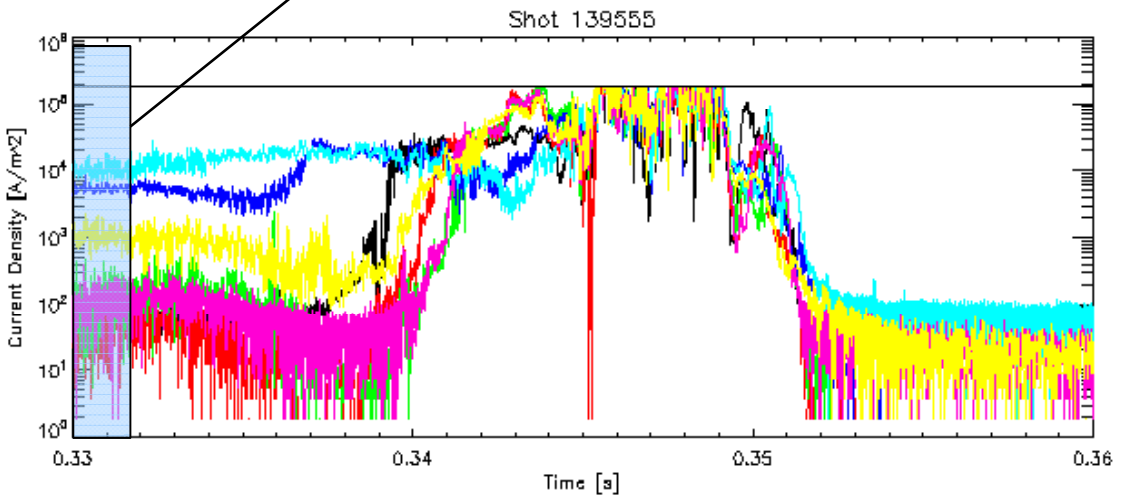




Triple probe acquisition (M. Jaworski)

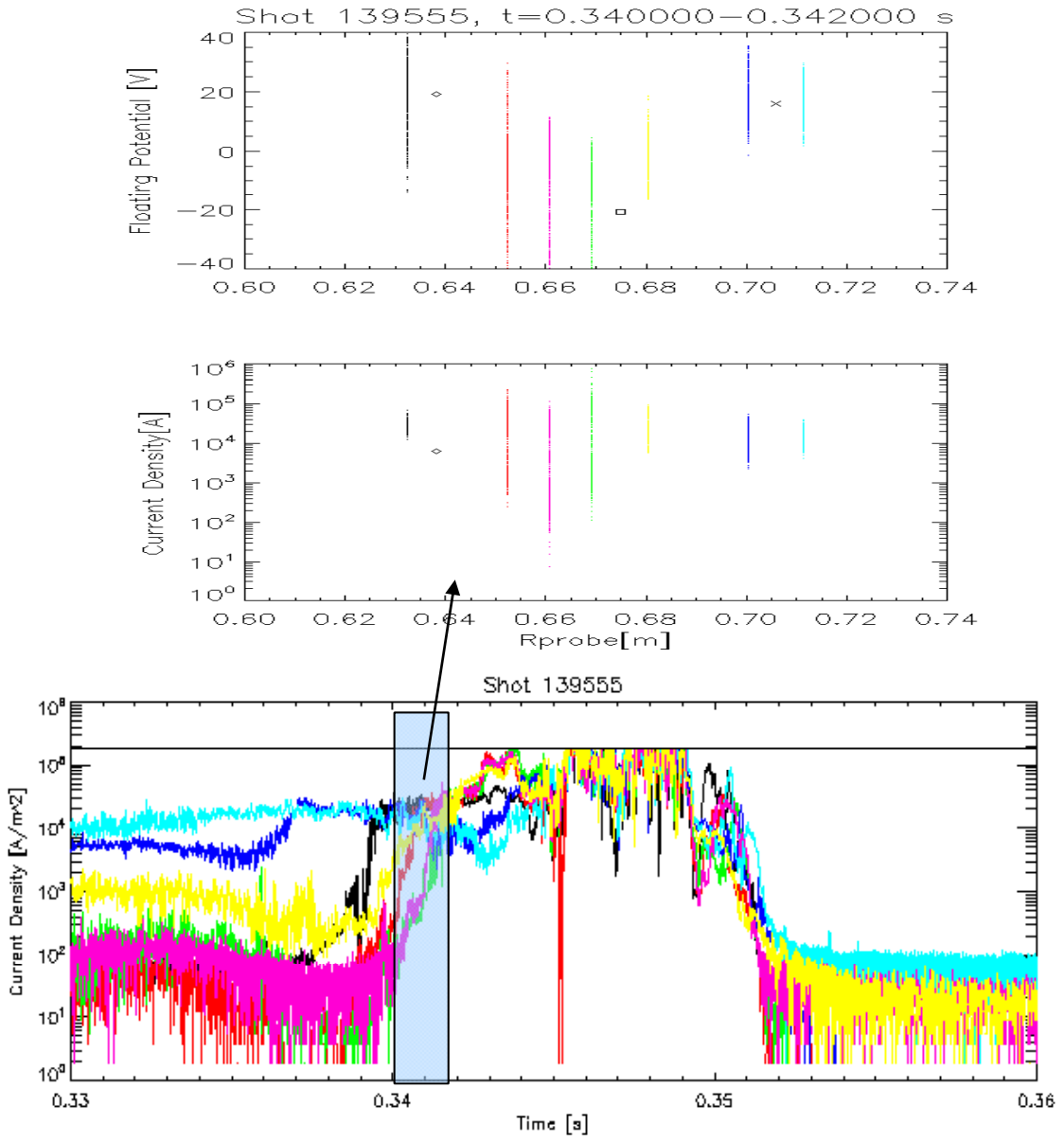
- Super-tile acquisition system operating during XP1021
- Large current transients observed during disruptions (log scale)
- Strike-point well beyond probe array – small signals on inboard probes initially
- Current density from nominal probe head area





Triple probe acquisition (M. Jaworski)

- Structure observed during disruption, particularly in floating potential
- Disruptions prone to saturating signals (indicated by horizontal line in time trace)
- Still analyzing signals for T_e estimation...



Fast Infrared (A. McLean, J-W. Ahn)

- 2-D surface temperature shows significant turbulence
- T, q in t shows interesting pre-collapse signature
- Peak q using THEODOR (α=10,000) shows much (~5-10X) lower value than 1-D C&J
- Fast cooling of the surface shows that incorporation of surface layer physics is essential