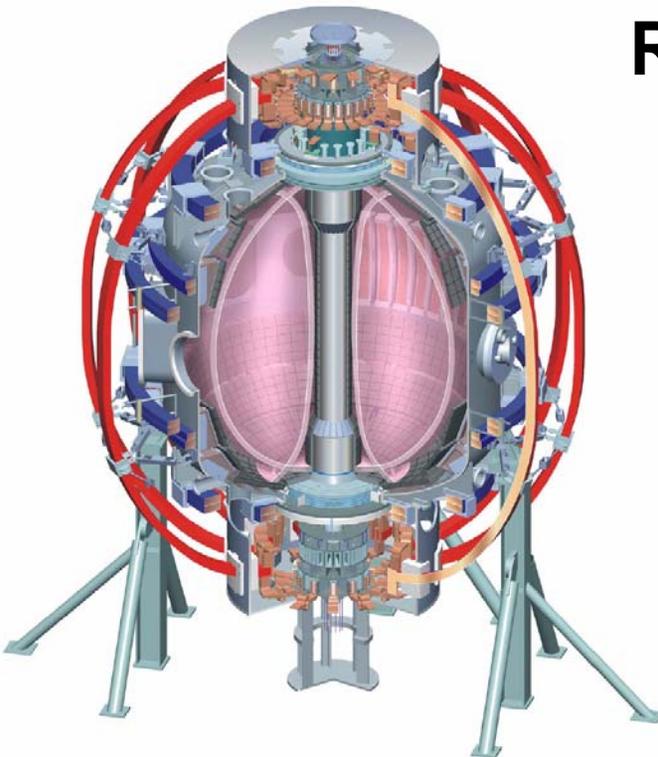


Very early divertor and H-mode development for long pulse

J. Menard, D. Gates (PPPL)
R. Maingi, M. Wade (ORNL)

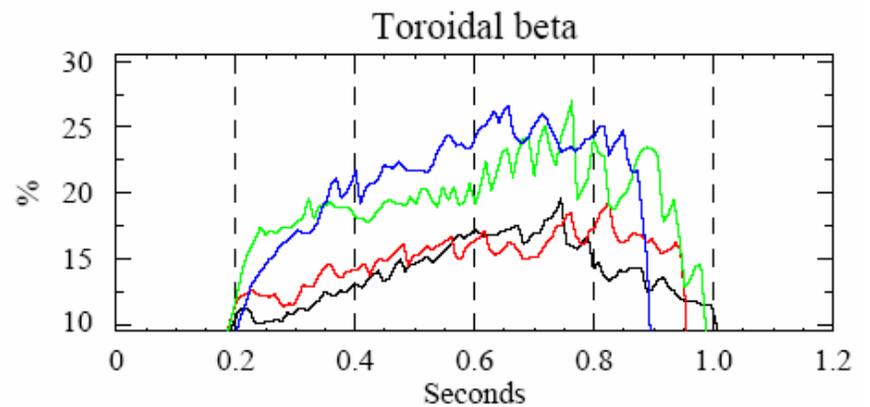
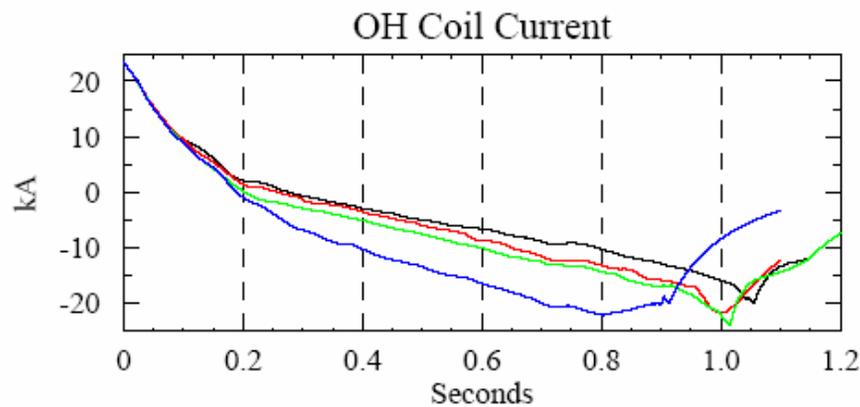
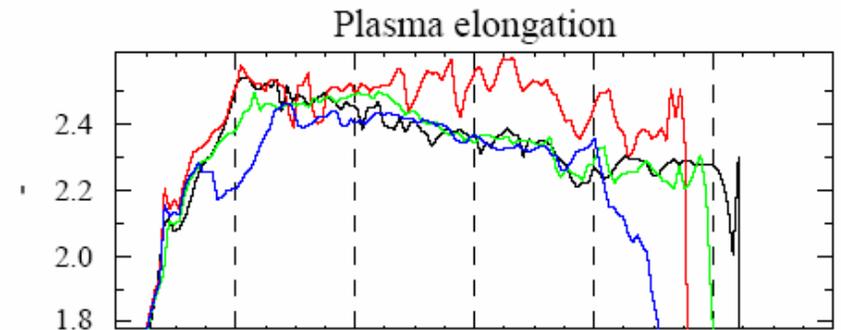
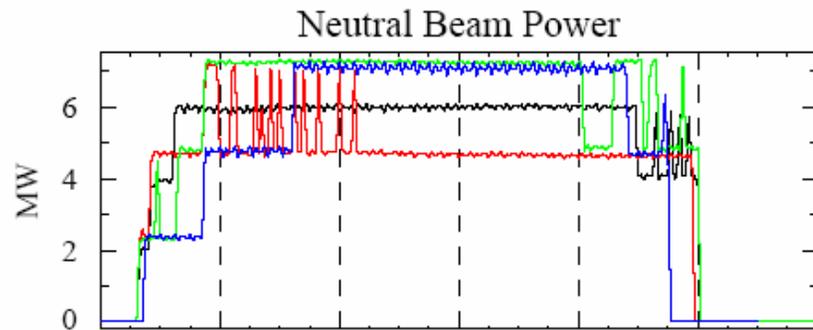
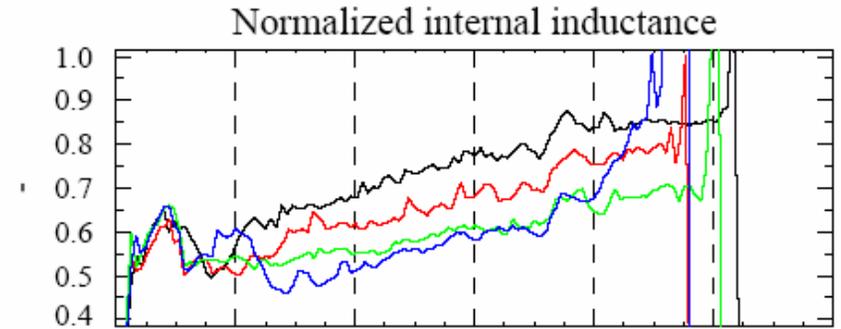
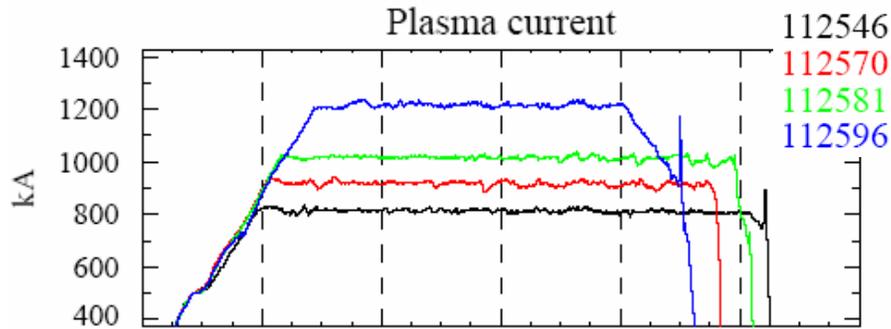


NSTX Research Forum

**Princeton Plasma Physics Laboratory
Princeton, NJ
September 23, 2004**

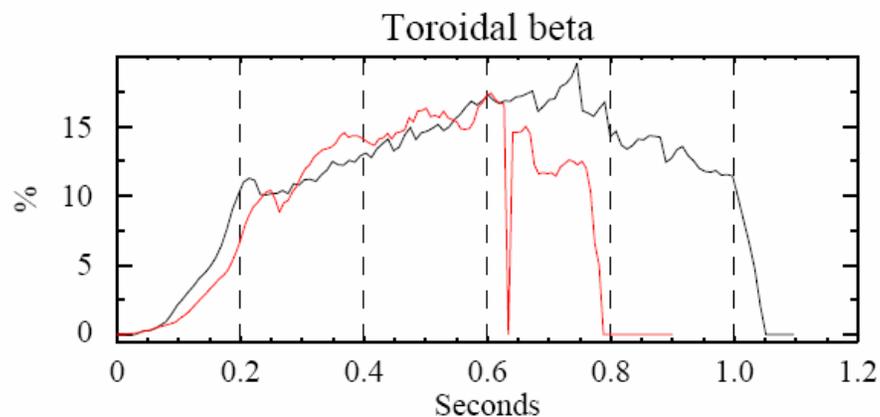
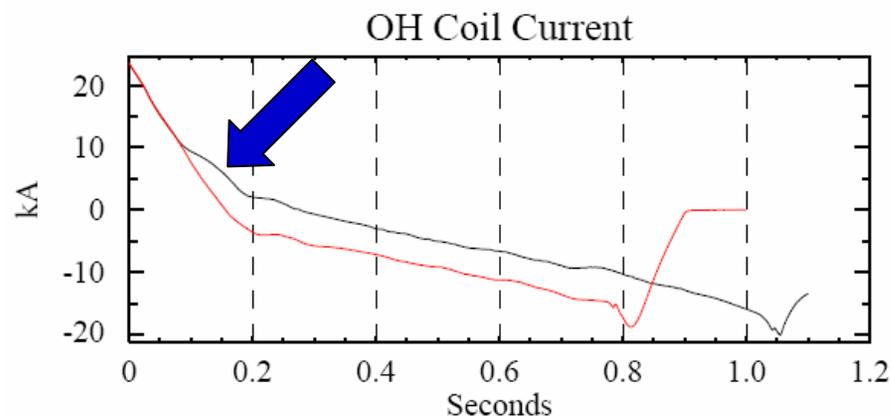
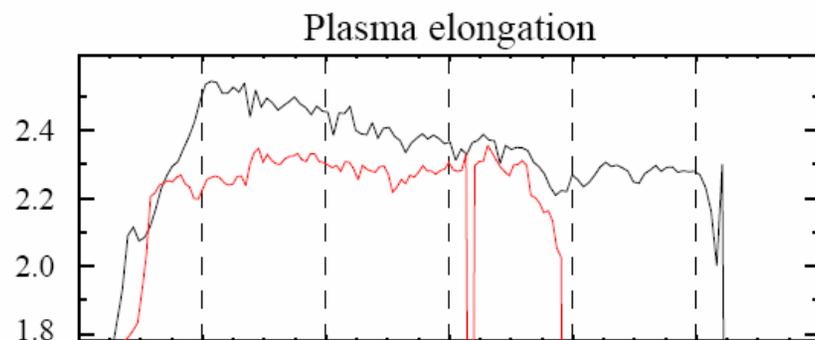
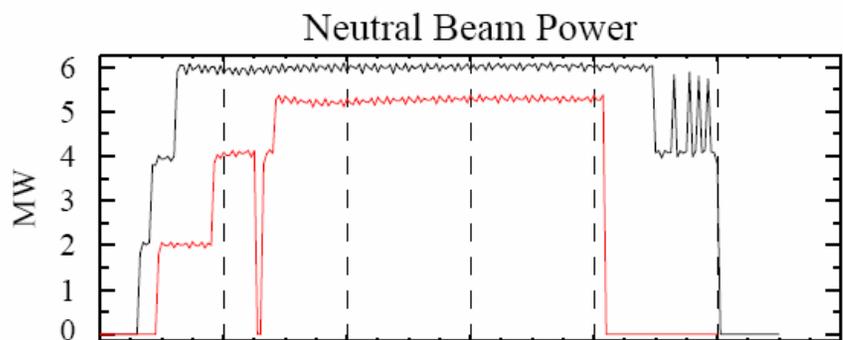
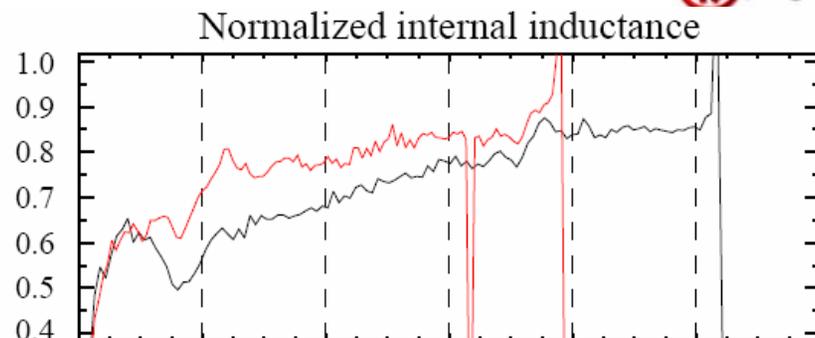
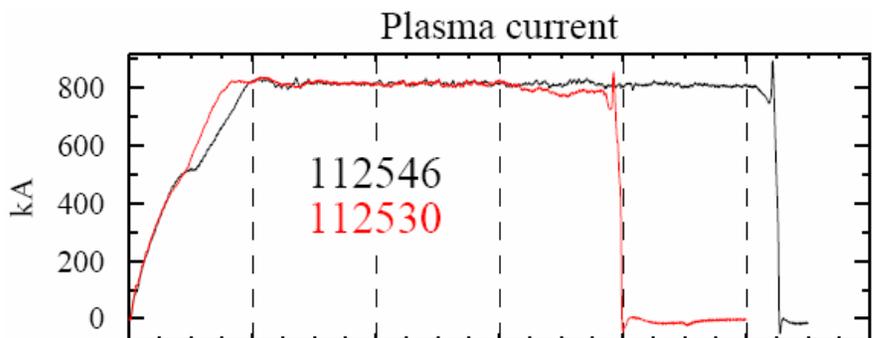
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CEA, Cadarache
IPP, Jülich
IPP, Garching
U Quebec

Early H-mode + high κ produced long pulse-lengths



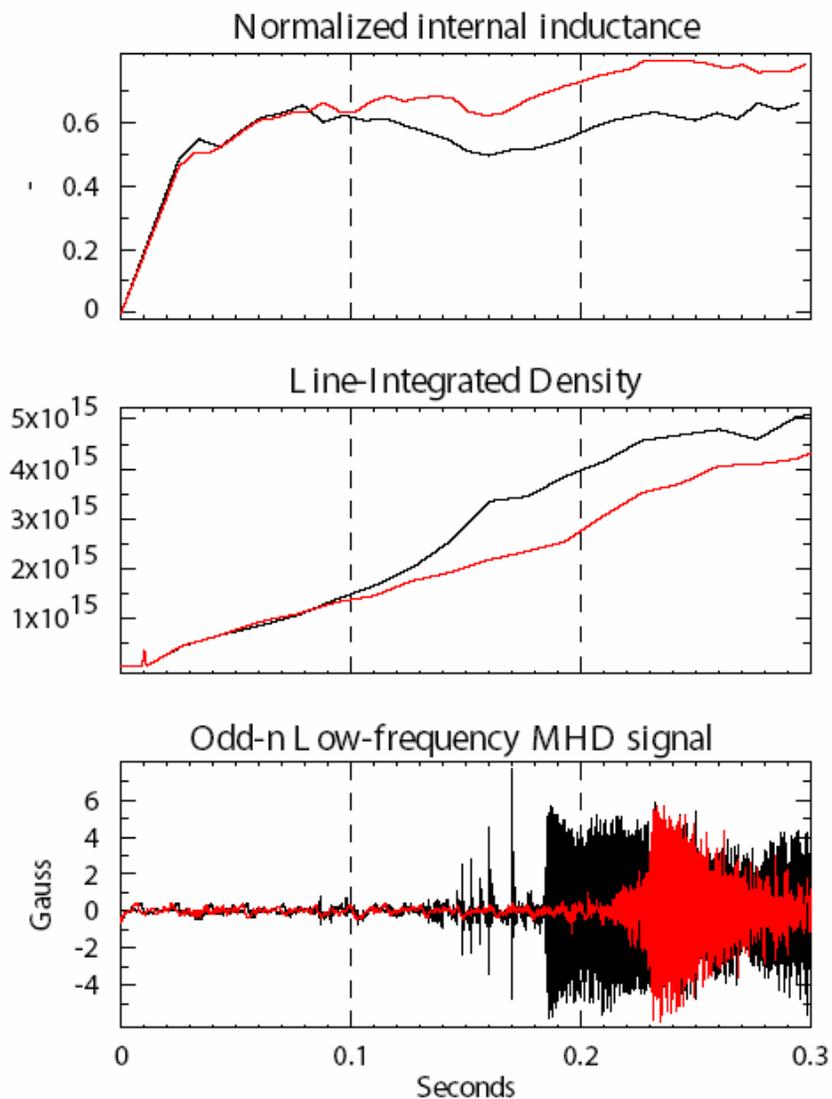
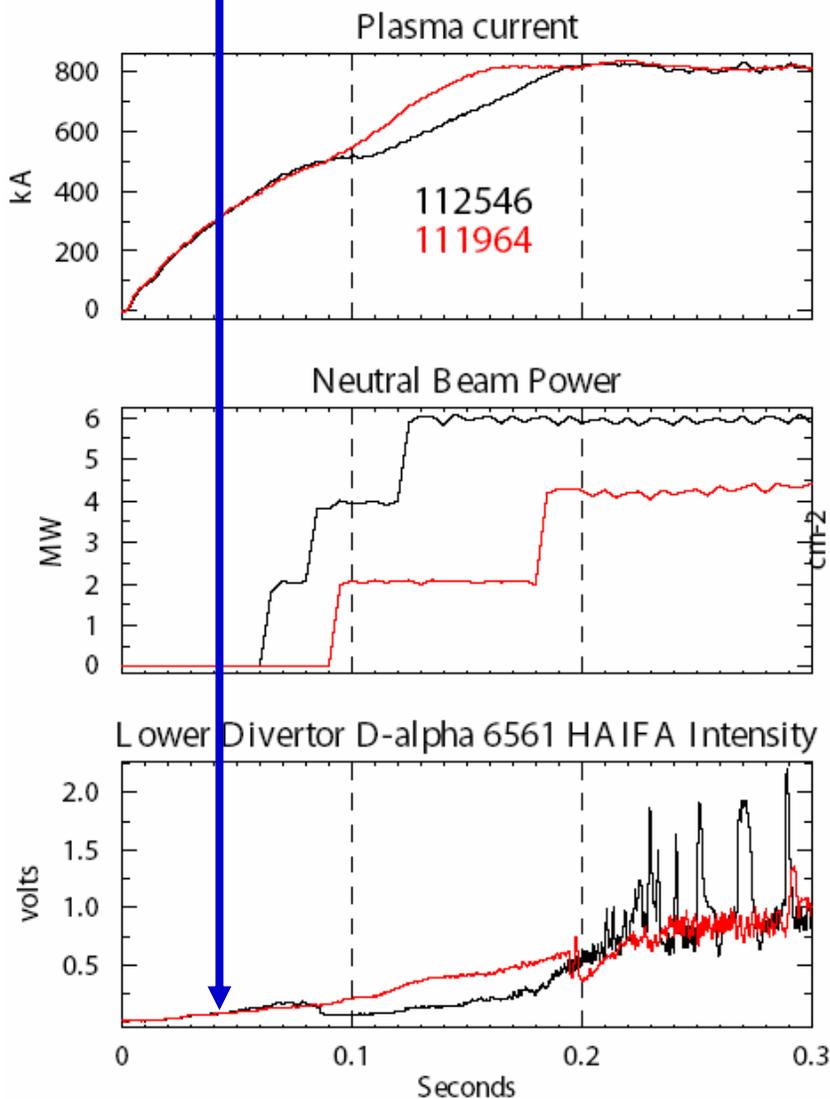
Early H-mode reduces early flux consumption...

Is earlier H-mode possible? Is it better?



Try to move transition earlier to t=40-50ms

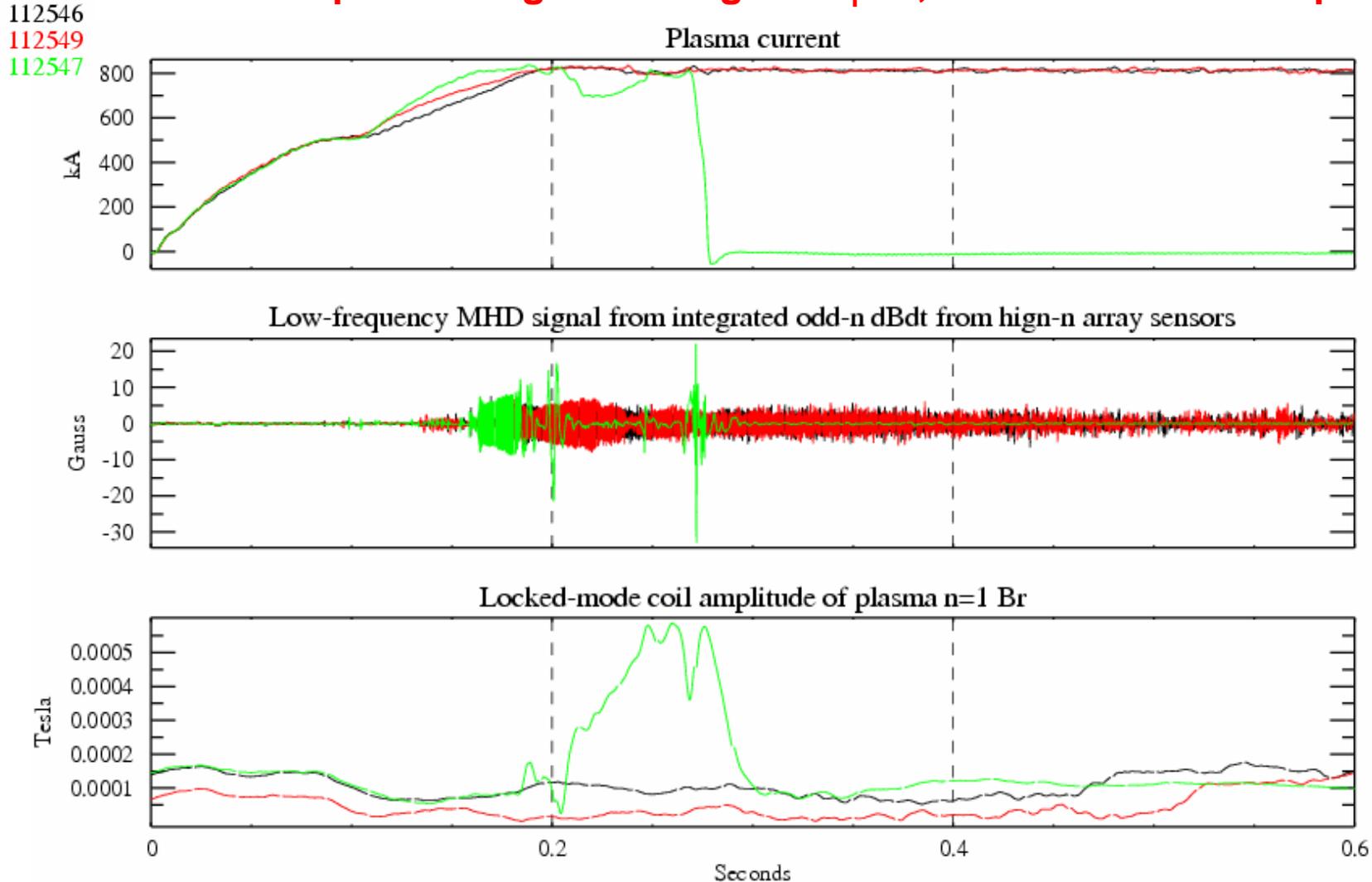
- H-mode now triggered @ t=80-90ms by $P_{\text{NBI}} = 2-4\text{MW}$
- Will need faster I_p ramp for higher I_p to absorb beam...



Persistent TM unwanted side-effect of early H-mode



n=1 rotating mode excited @ t=160-180ms in most early H-mode shots
Mode amplitude larger with higher di_p/dt , mode locks \rightarrow disruption



Goal and Plan (2+ days)



- **GOAL: Further raise q_{\min} and lengthen pulse in long-pulse discharges**

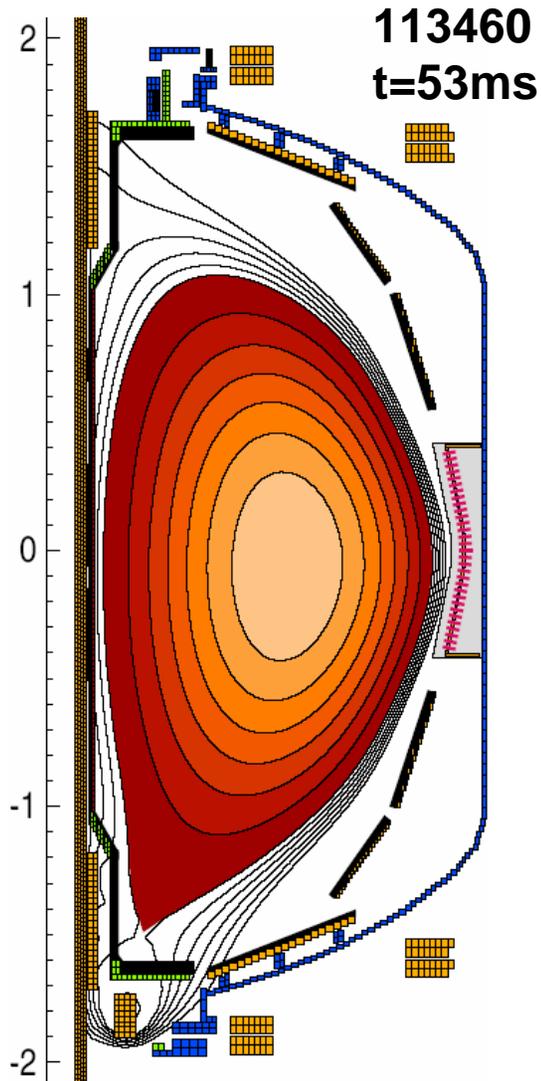
PLAN:

- Measure early q profile with MSE – should be very important guide
- Find fastest sustainable early current ramp
 - Get to $I_p = 0.5\text{MA}$ by 40-50ms (10-12MA/s) to help absorb beam
 - 20MA/s observed to be possible in OH “ramp-down” shots after fizzle
 - Worked up to about 0.8-0.9MA
- Modify early ramp to divert ASAP in PF1B LSN for easiest H-mode access
 - Scan current pause duration, early gas, and NBI power to induce transition
- Work on stabilizing TM that is often excited post-transition
 - Scan I_p ramp-rate after transition to avoid locking of TM
 - Scan κ (and δ ?) to try to avoid mode completely
- Scan flat-top I_p to document pulse-length changes from early H-mode
- Scan B_T to find optimum condition with highest β at long pulse-length
 - Can also effect TM onset through changes in q profile

XP451 started shape development last year



LSN development for very early HHFW heating and H-mode



- Difficulty with early vertical control – increasing Z_{POS} derivative gain helped
- Then focused on moving plasma out toward antenna
- Had difficulty getting consistent match
- This year - focus on earlier H-mode transition instead.