

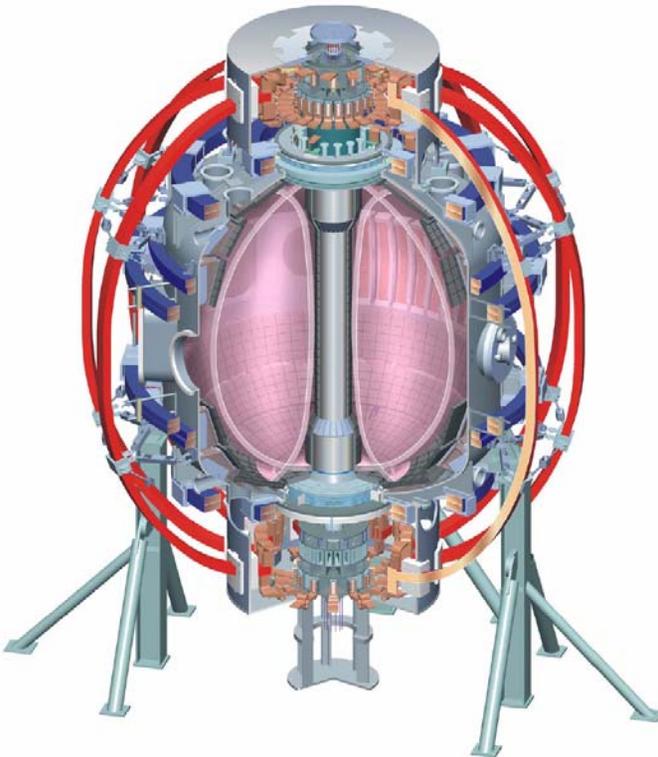
Discussion of XP 507: Very early divertor and H-mode development for long pulse

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NSTX ISD Group Meeting

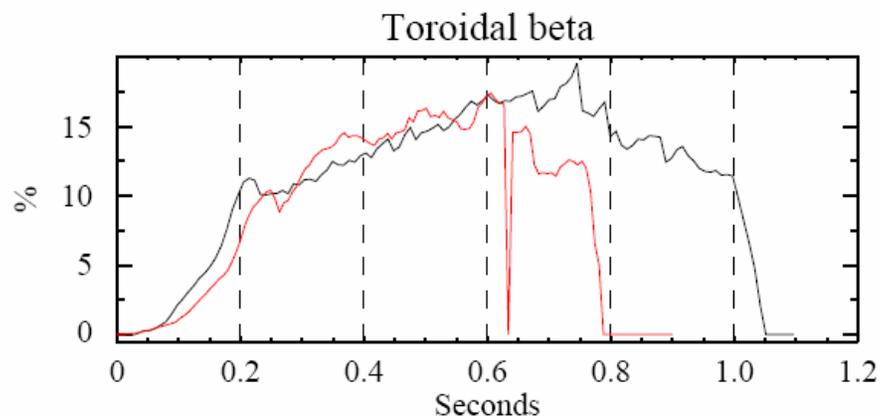
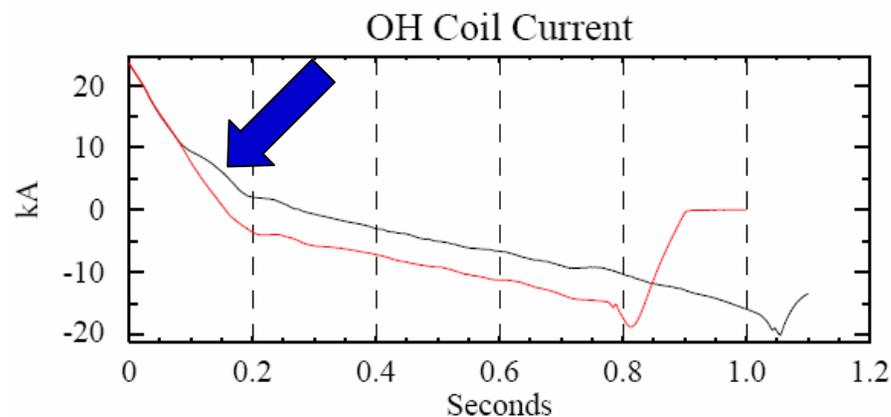
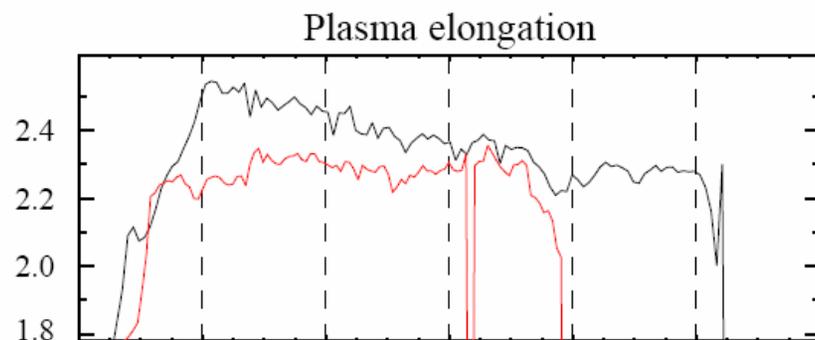
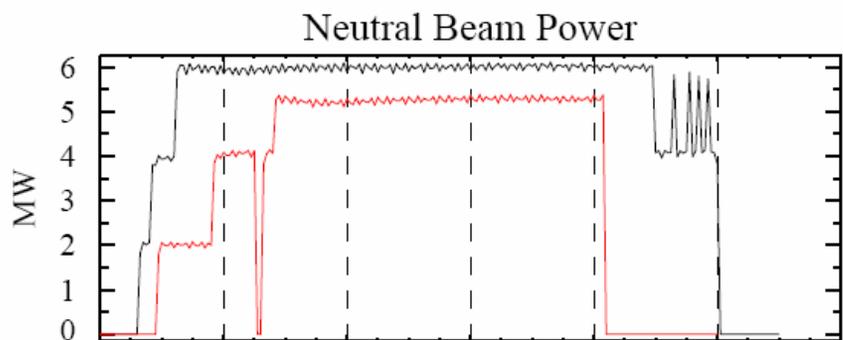
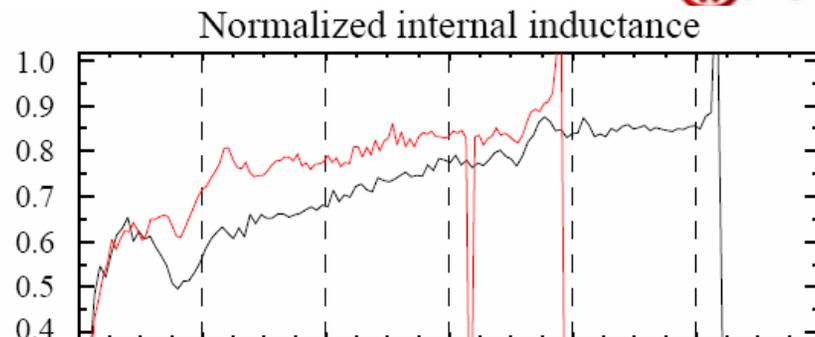
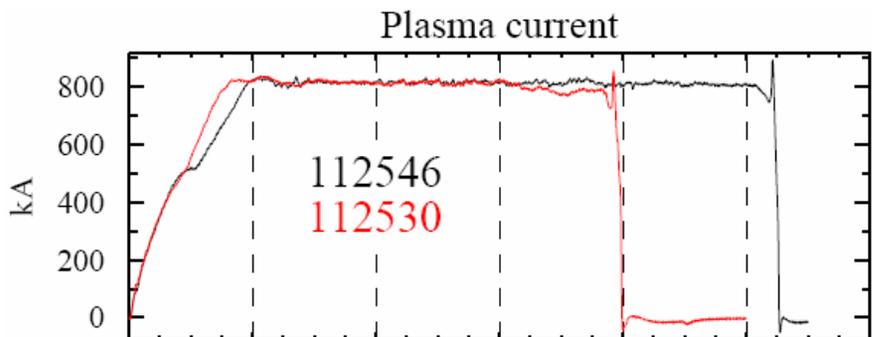
**Princeton Plasma Physics Laboratory
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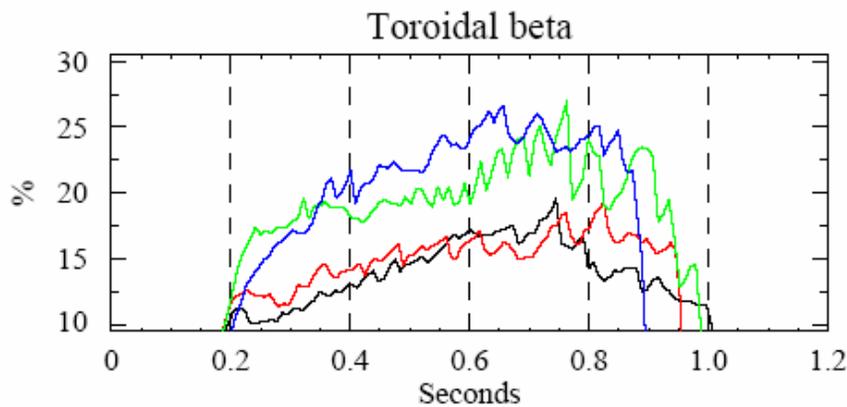
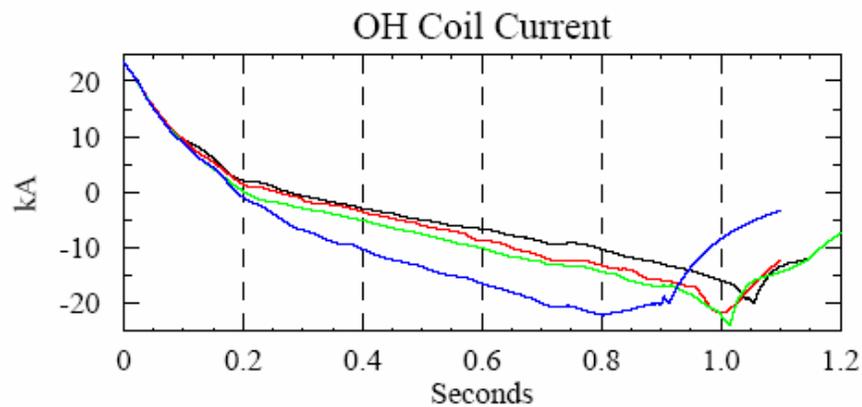
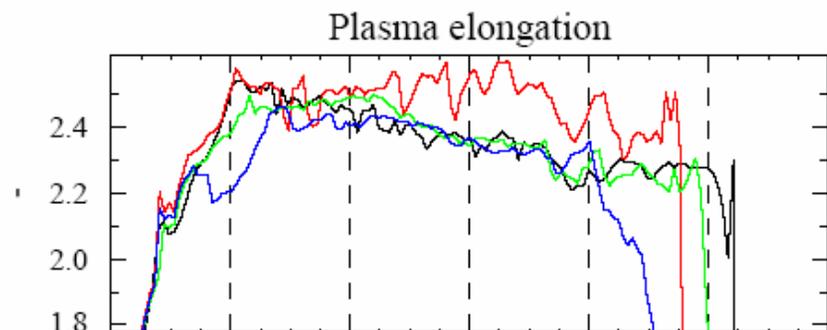
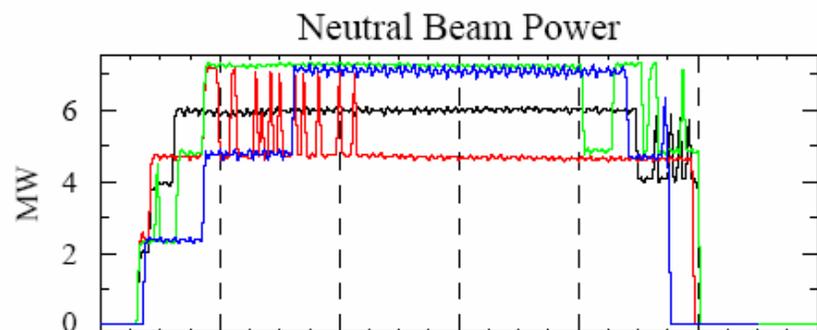
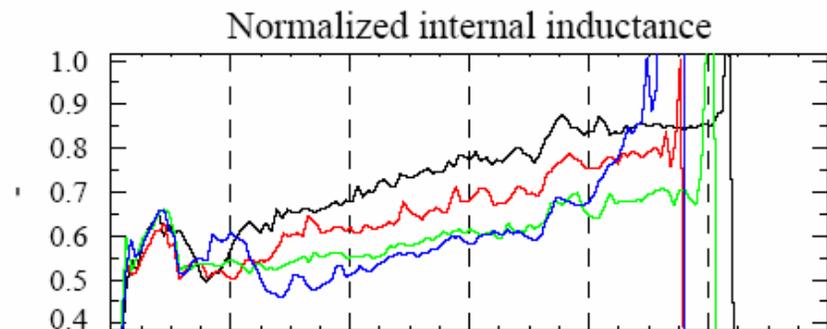
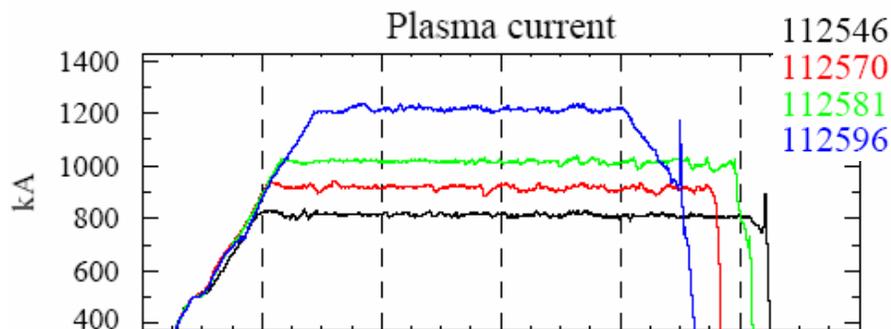


Early H-mode reduces early flux consumption...

Is earlier H-mode possible? Is it better?

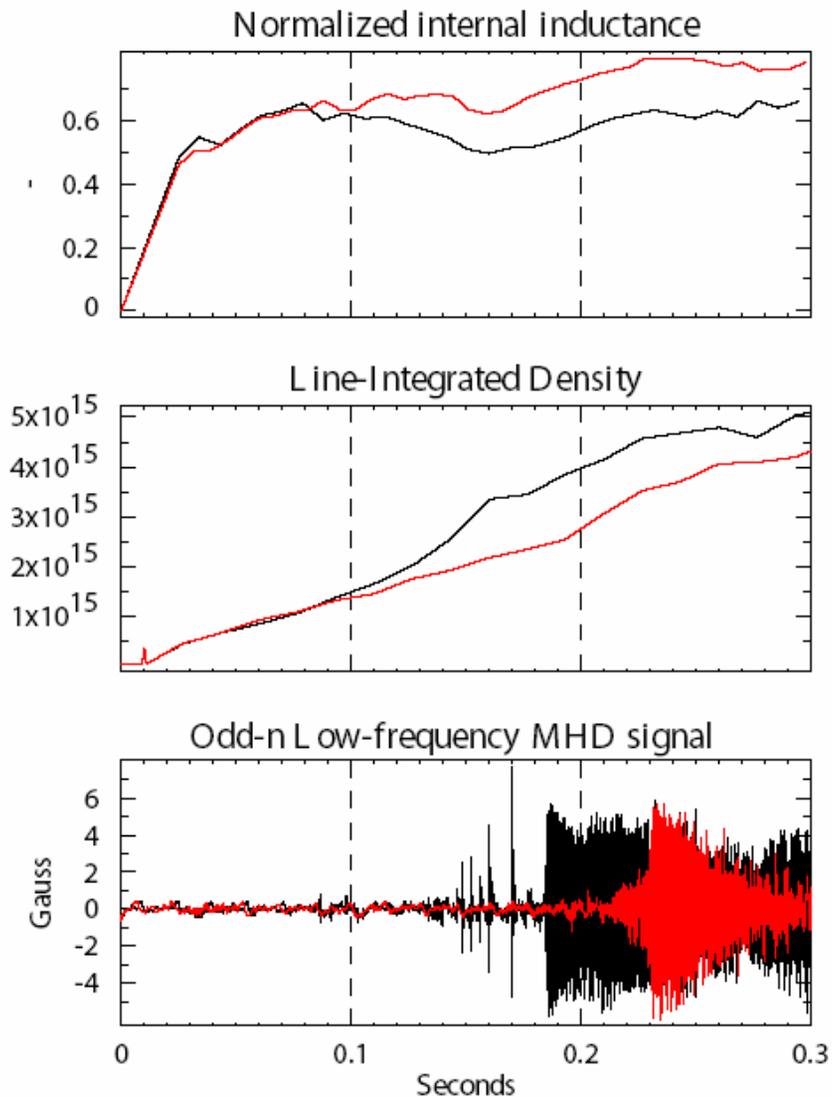
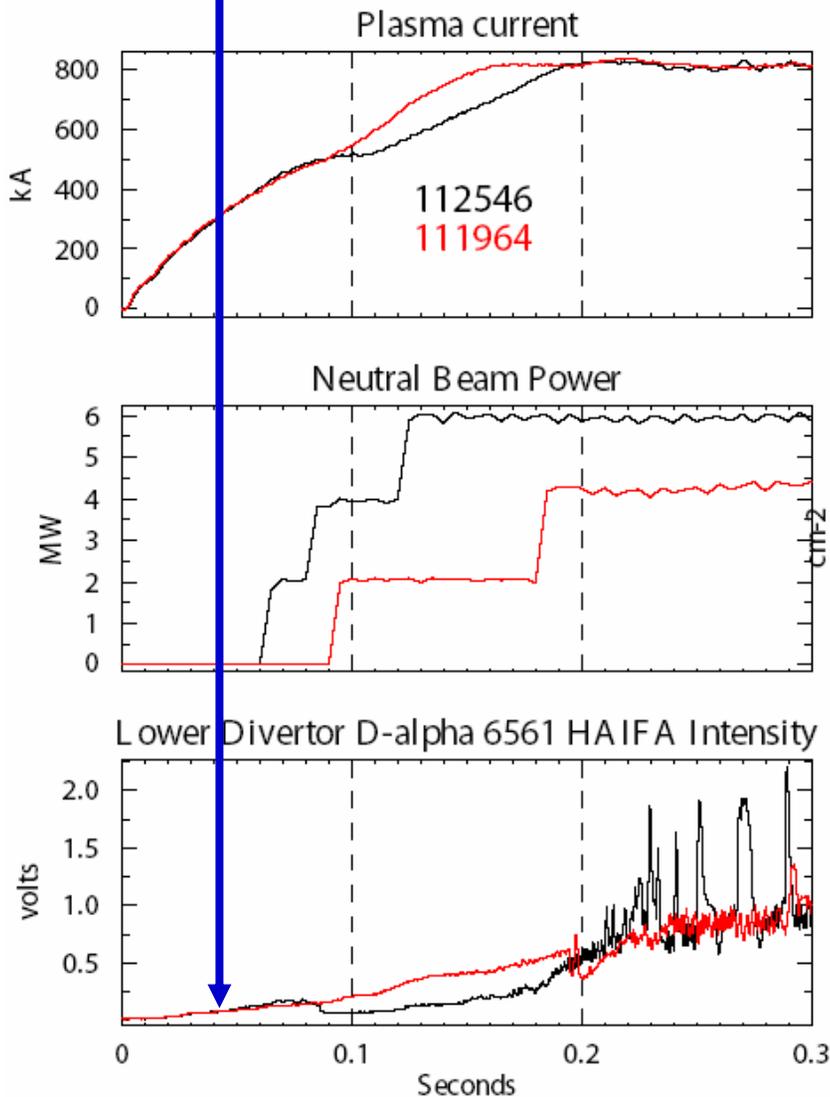


Early H-mode + high κ produced long pulse-lengths



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

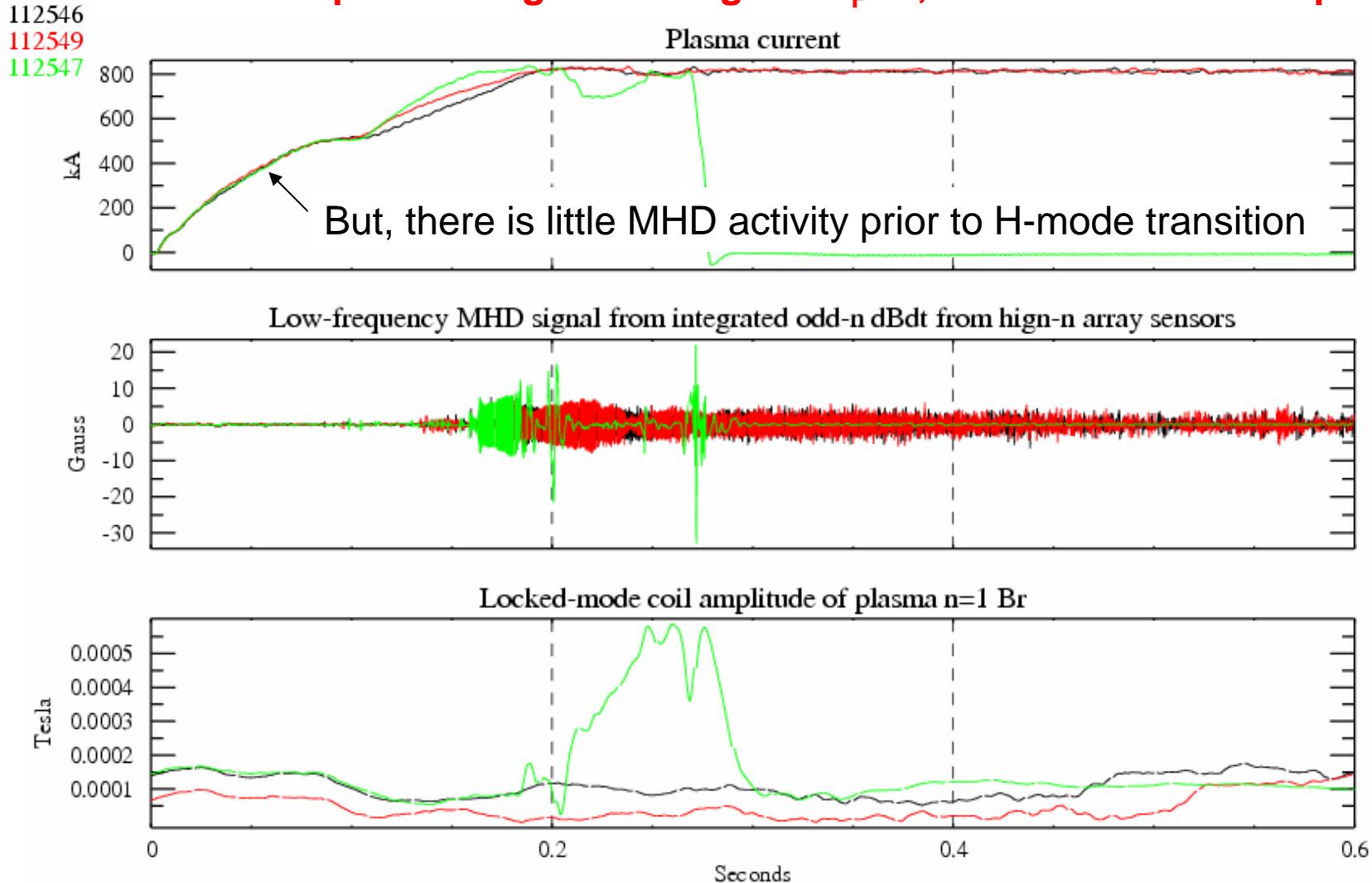
- H-mode now triggered @ t=80-90ms by $P_{\text{NBI}} = 2-4\text{MW}$
- Will need faster I_p ramp for higher I_p to absorb beam...



Persistent T M 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



Goals and Plans (Day 1)



1. Re-obtain FY04 long-pulse discharges at 4.5kG (10 shots)
 - Try to reproduce best 0.8, 0.9, 1.0 and 1.2 MA shots
 - Document $q(\psi, t)$ of existing early H-mode scenarios
 - Are we close to a “hybrid scenario” in any of these discharges?

2. Find fastest sustainable early ramp to 0.5MA (10 shots)
 - 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
 - Measure early q profile with MSE – should be very important guide
 - Open question - is error field correction useful/needed for this ?

3. Modify early evolution to divert ASAP (10 shots)
 - Attempt in PF1B + new PF1AL – use DND if vertical control problematic
 - X-point major radius and height off floor and likely critical elements

Elements 2 and 3 also useful for high- β and DND long-pulse + some overlap with early-HHFw heating scenario development

Goals and Plans (Day 2)



Assuming faster ramp and earlier diverted plasma successful...

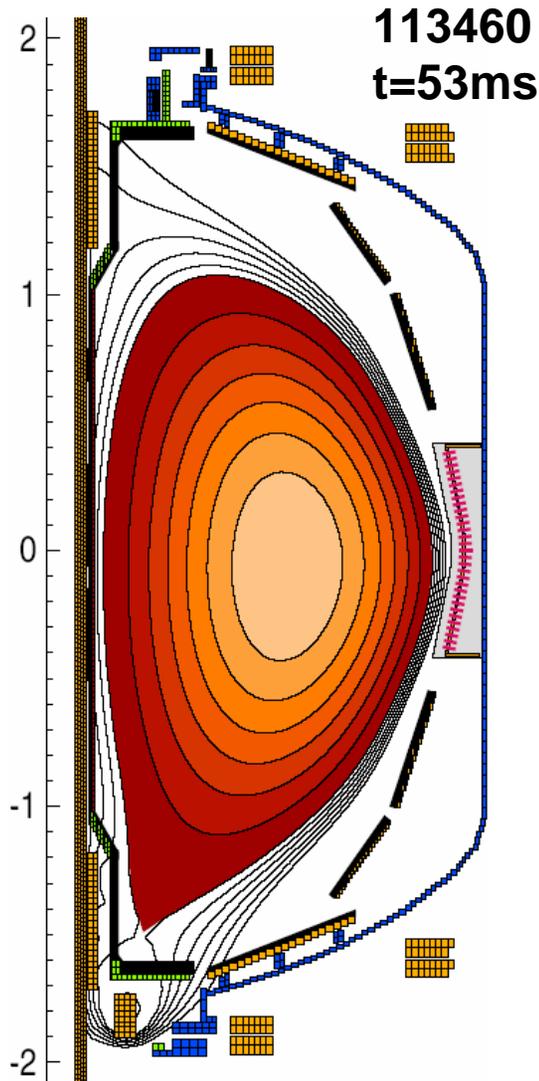
4. Attempt to induce H-mode by $t=50\text{ms}$ (10 shots)
 - Scan current pause duration, early gas, and NBI power

5. Minimize post-transition TM and locking activity (10 shots)
 - Scan I_p ramp-rate after transition to avoid locking of TM
 - Optimize lower δ and squareness to avoid mode completely?

6. Maximize plasma flat-top duration (10 shots)
 - Goal is **$\Delta t > 1\text{s flat-top}$** at or above 800kA - as quiescent as possible
 - Need to lower B_T to $< 4.5\text{kG}$ due to TF coil heating limit...
 - Is pulse length limit set by MHD, TF heating limit, or OH?
 - Perform “fine-scale” I_p and B_T scans to optimize
 - Expect $B_T = 0.375\text{-}0.425\text{T}$ and $I_p = 0.8\text{-}1.0\text{MA}$ to be optimal
 - Increase I_p to 1.2MA to document OH and/or MHD limits

Earlier plasma diversion is possible

LSN development for very early HHFW heating and H-mode – XP451



- **Difficulty with early vertical control – increasing Z_{POS} derivative gain helped**
 - Then focused on moving plasma out toward antenna for HHFW heating
 - Had difficulty getting consistent match
- **Useful as earlier H-mode target?**
 - I_p is only 300kA at t=50ms in this shot
 - Perform I_p ramp-rate scans starting from this