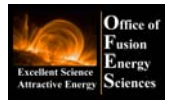
Supported by



Office of Science

NSTX

Jon's MHD and ISD XP status

College W&M
Colorado Sch Mines
Columbia U
Comp-X
General Atomics
INEL
Johns Hopkins U
LANL
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Princeton U
SNL
Think Tank, Inc.
UC Davis
UC Irvine
UCLA
UCSD
U Colorado
U Maryland
U Rochester
U Washington
U Wisconsin

Presented by:

J. Menard, PPPL

(in absentia… and phoning it in…)

FY2007 mid-run assessment

May 18, 2007

Princeton Plasma Physics Laboratory

Culham Sci Ctr
U St. Andrews
York U
Chubu U
Fukui U
Hiroshima U
Hyogo U
Kyoto U
Kyushu U
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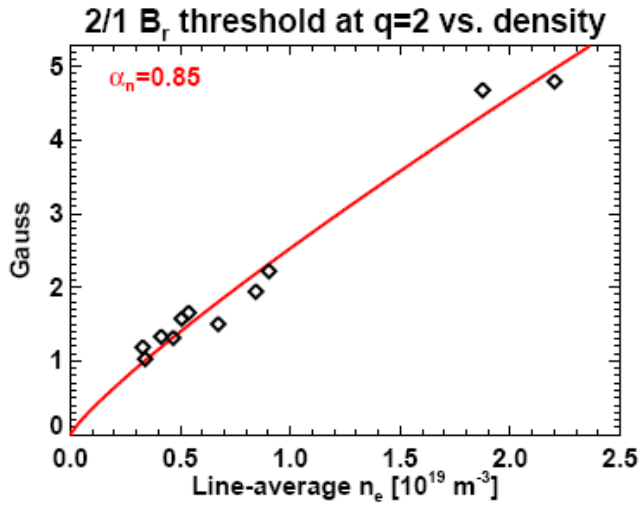
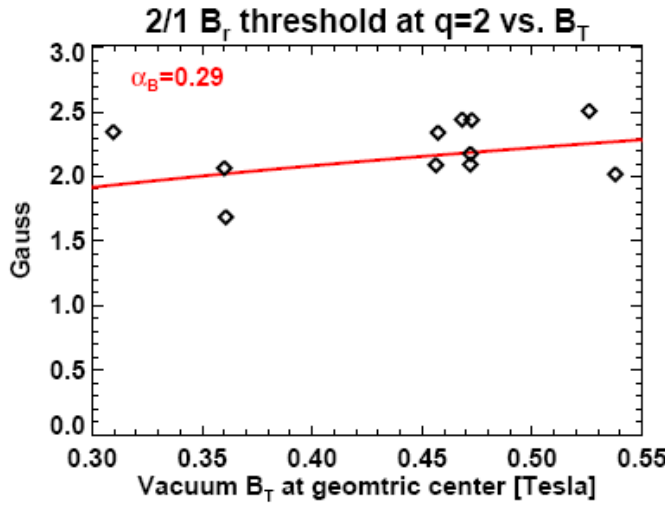
TRINITI
KBSI
KAIST
ENEA, Frascati
CEA, Cadarache
IPP, Jülich
IPP, Garching
ASCR, Czech Rep
U Quebec

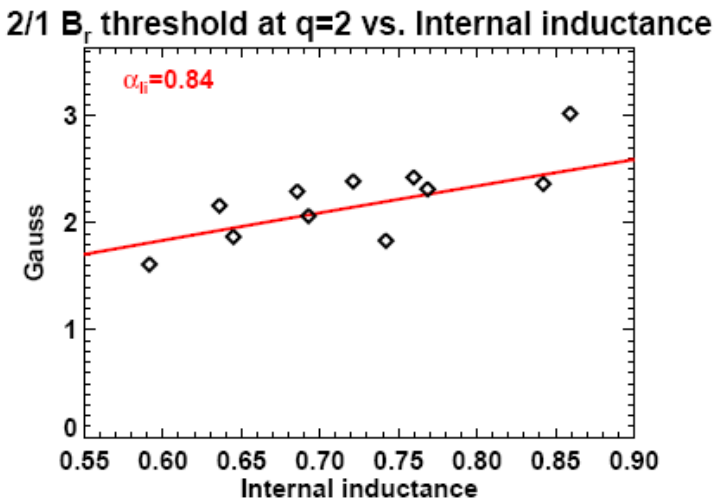
MHD XP-703 - B and q scaling of low-density locked-mode threshold at low-A

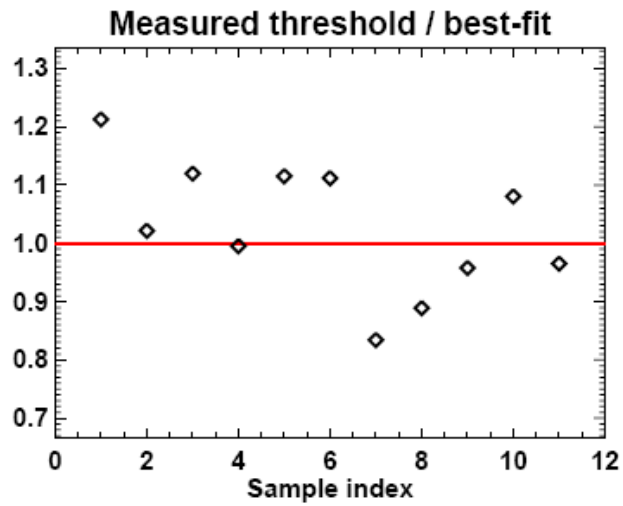
- **XP is complete**
- Intrinsic EF very similar to 2006 for LM ohmic shots
  - Larger difference for long-pulse – to be assessed in other MHD XPs
- Extended density range for threshold – now have factor of 4
- Performed B_T scan from 3kG to 5.5kG
- Obtained MSE data for 4 scenarios of interest
  - Confirmed q=2 surface is in plasma at time of locking
  - Core shear is often weakly reversed
  - No q=1 surface in plasma – different than most other machines
- q_{95} scan difficult because high-q does not have q=2 in plasma
  - Found this out after MSE data was obtained
- Threshold increases with increased edge q-shear (w/o MSE)
  - Similarly - also increases with internal inductance
- Did not have time for shape scan

NSTX Provides ITPA / ITER Locked-Mode Scaling Threshold Data + Productive Benchmarking of 3-D Locked-Mode Code (Ph.D. Thesis)









Assuming size scaling coefficient $\alpha_R = 2\alpha_n + 1.25(\alpha_B - 1)$ → NSTX $\alpha_R = 0.8$ → ITER threshold $B_{21}/B_T > 1\times10^{-4}$ – consistent w/ 0.5-1.5 $\times10^{-4}$ from JET and DIII-D

MHD XP-701 - Assessment of intrinsic error fields after TF centering

- First ½ day was supposed to be devoted to looking for phase dependence of n=1 response, but…
  - Could not reproduce 800kA LSN shots that had previously shown rotation collapse – some signs of collapse late in day
  - Lack of source B and use of Li modified q-profile and β evolution
  - Beta lower in these shots at usual time of collapse – smaller RFA?
  - Only ran ½ day 701+702 due to src B repairs + finishing NTM XPs
- Need to run with 3 sources to test enhancement of RFA
- Still need to do SPA current phase scan
  - Even if rotation doesn't collapse naturally, can look for direction of higher and lower rotation – 2pt beta scan would also be informative
- Still want to try n=3 polarity scan to look for asymmetries in plasma response – is there n=3 error field?
- **Need 1 run day**

MHD XP-702 - Optimization of RFA detection algorithms during dynamic error field correction

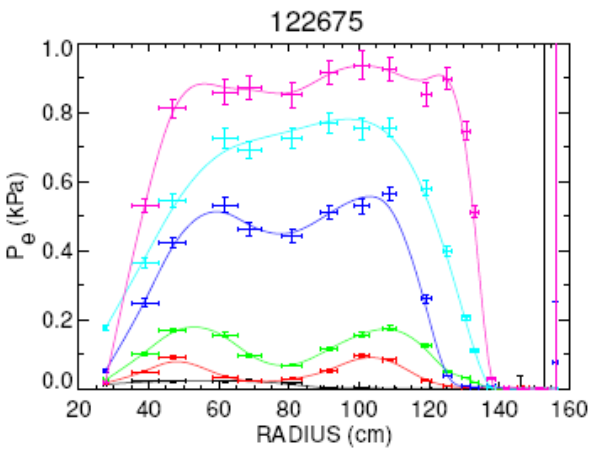
- **Not run yet - need 1 run day**

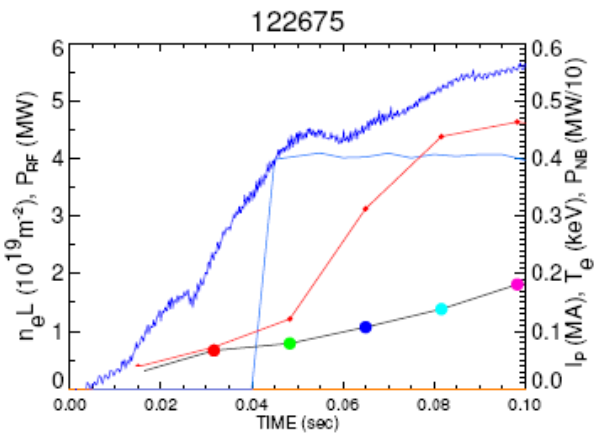
- GOAL:
  - Develop robust mode-ID, DEFC, and RWM feedback by utilizing more RWM/EF sensors in PCS

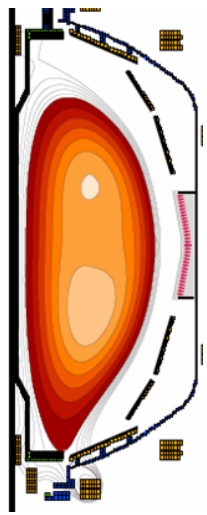
- Methodology:
  - Test up-down averaging of BP sensors – optimize feedback
  - Test BR-sensor-based feedback for first time
  - Test BP and BR sensor combinations

ISD XP-711 - Improved break-down scenario for higher q during I_P ramp

- 80% complete (and successful)
- Found PF2 and PF1A coil currents that can allow stable high elongation and diverted plasma by t=45ms
  - H-mode measured as early at t=65ms for a few shots
  - Very early H-mode was not reproducible because of radial position oscillation from t=40-100ms (no H-mode when inner gap is small)
- **Desire 0.25-0.5 run days** to achieve reproducible outer gap evolution in LSN and very early H-mode – then couple to rt-EFIT (DND or LSN) after transition







122675
t=45ms

ISD XP-7?? - Stability and pulse-length limits with reduced fueling and higher q_{MIN}

- GOAL:
  - Attempt to achieve identified fully non-inductive target scenario utilizing only NBI and BS at 700kA, 5.2kG
- Pre-requisites:
  - Higher q startup (would like to get reproducible very-early H-mode)
  - Higher τ_E from Li
  - Evidence of Li pumping of D
  - SGI readiness
  - **ALL OF THESE HAVE BEEN ACHIEVED THIS YEAR**
- Methodology
  - Replace CS gas fueling with SGI to eliminate late fueling from CS
  - Utilize between-shots Lithium for higher τ_E and pumping
  - Scan flat-top I_P = 0.7MA, 0.8MA, 1MA at B_T = 5.2kG
  - Scan flat-top TF = 4.5kG, 4kG at 0.7MA and 0.8MA
  - Use/adjust EF/RWM feedback as necessary for high β_N operation
- Need 1-1.5 run days