NSTX

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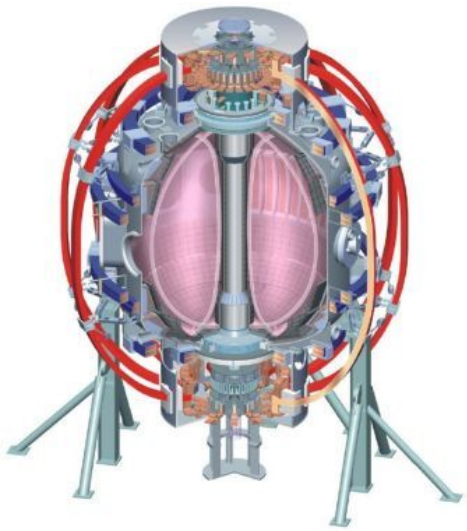
NSTX Program Update

J. Menard, S. Kaye

NSTX Team Meeting
B318, PPPL
June 30, 2009



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Colorado Sch Mines
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NSTX Program Update Topics

- Some highlights from MAST PAC meeting
- Research Needs Workshop (ReNeW) status
- Program letter for laboratory collaborations

MAST PAC-3 held last week
(subsequent slides give a few highlights from talks below)

Agenda

	Monday 22nd June 2009	
9.00	Chairman's Opening Remarks	Chris Schuller
9.30	Outlook for MAST and MAST Upgrade given developments in EU	Steve Cowley
10.30	COFFEE	
10.45	Status of MAST Upgrade 1. Overview of developments 2. Physics evaluation of reduced proposal 3. Project cost and resource overview	Derek Stork
12.00	Super X divertor 1.Introduction 2.CTF divertor issues and developments	TBC Garry Voss
12.30	LUNCH	
13.30	Physics of Super-X divertors Engineering Implementation of Super-X on MAST	Mike Kotschenreuther (Univ Texas) Ioannis Katramados
14:45	Discussion on MAST Upgrade	All
15:30	COFFEE	
15:45	MAST Programme Overview	Brian Lloyd
16:40	Turbulence and Transport in MAST and STs	Colin Roach Walter Guttenfelder (Warwick Univ)
17:20	Closed Session	PAC
18:15	Feedback if necessary	All
19:30	DINNER	PAC + Culham senior members and speakers
	Tuesday 23 June 2009	
08.30	Plasma Wall Interactions in MAST	Greg de Temmerman
09:15	Off-axis neutral beam current drive	Mikhail Turnyanskiy
10.00	COFFEE	
10.15	Closed Session	PAC
12.00	Discussion and Feedback on MAST and MAST Upgrade (In view of Fusion Advisory Board on 9/10 July)	All
12.30	LUNCH	
13.30	Closed Session and Reprot Writing	PAC
	Responses from PAC questions	
	MAST programme	Brian Lloyd
	MAST Upgrade	Hendrik Meyer

MAST-Upgrade Status and Progress

MAST Programme

MAST Upgrade Engineering

Progress in Engineering Design

- Load Assembly – design has progressed on:
  - scheme design for 'central column' elements (solenoid, centre rod, airside coils, centre tube);
  - sliding joint design and analysis and qualification exercises;
  - vertical stability analysis and design;
  - concept design and analysis of divertor coils, target, Expanded divertor (Super-X) and cryopumps;
  - full concept design for all in-vessel components;
  - Cyanate ester test coil tests and Chiller readiness for installation.

a couple of examples herein

Covered by Ioannis Katramados

UKAEA

D Stork – PAC Meeting 22/23 June 09

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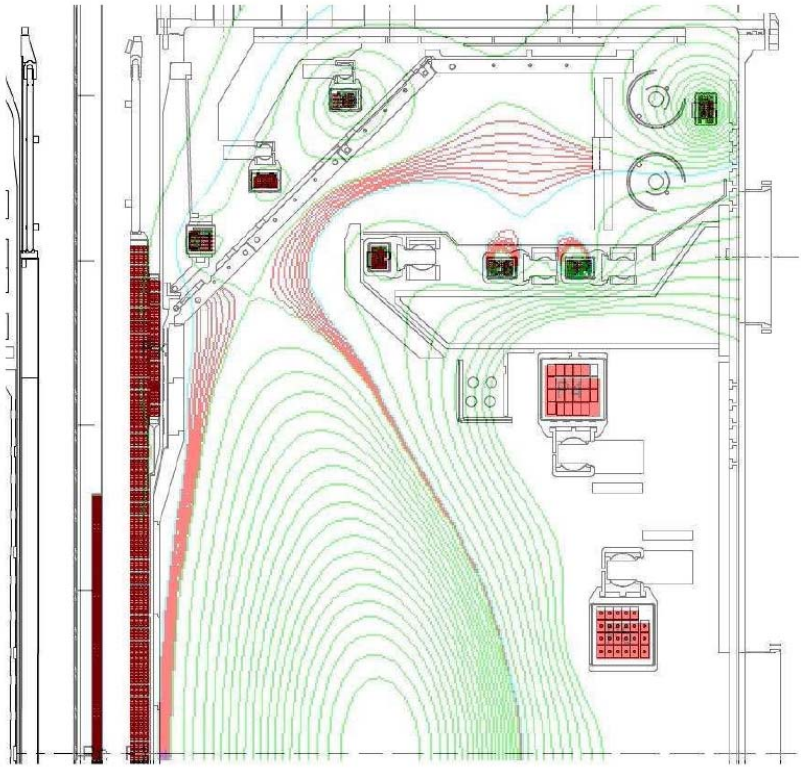
Incorporation of EXD in upgrade is major new element

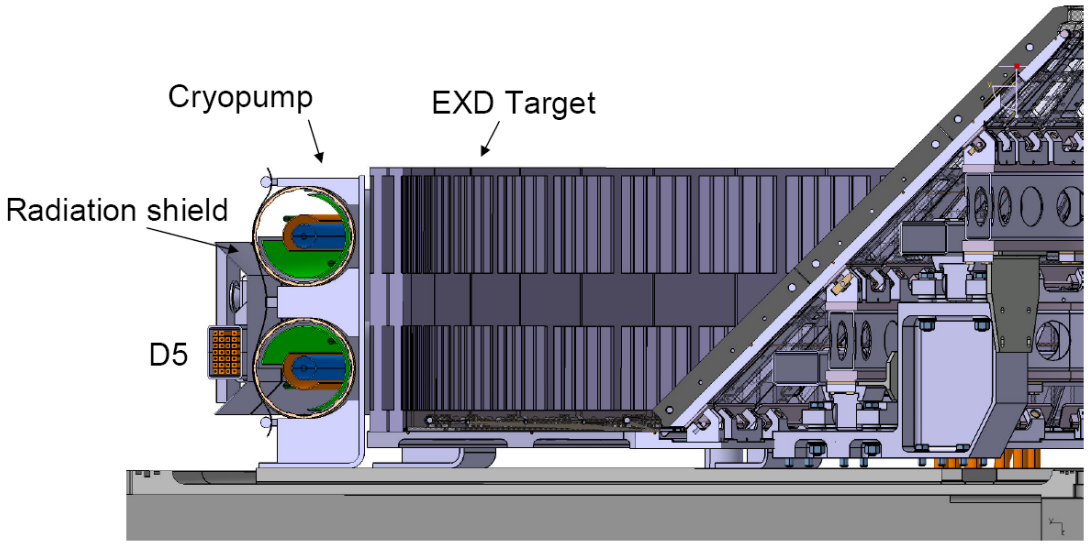
- EXD = “EXpanded Divertor” ≈ “Super-X Divertor” (UT Austin)
- Significant progress on engineering design
- Need additional emphasis on EXD diagnostics
- EXD/SXD important for CTF & Demo - opportunity for collaboration with NSTX researchers?



MAST-U EXpanded Divertor Engineering

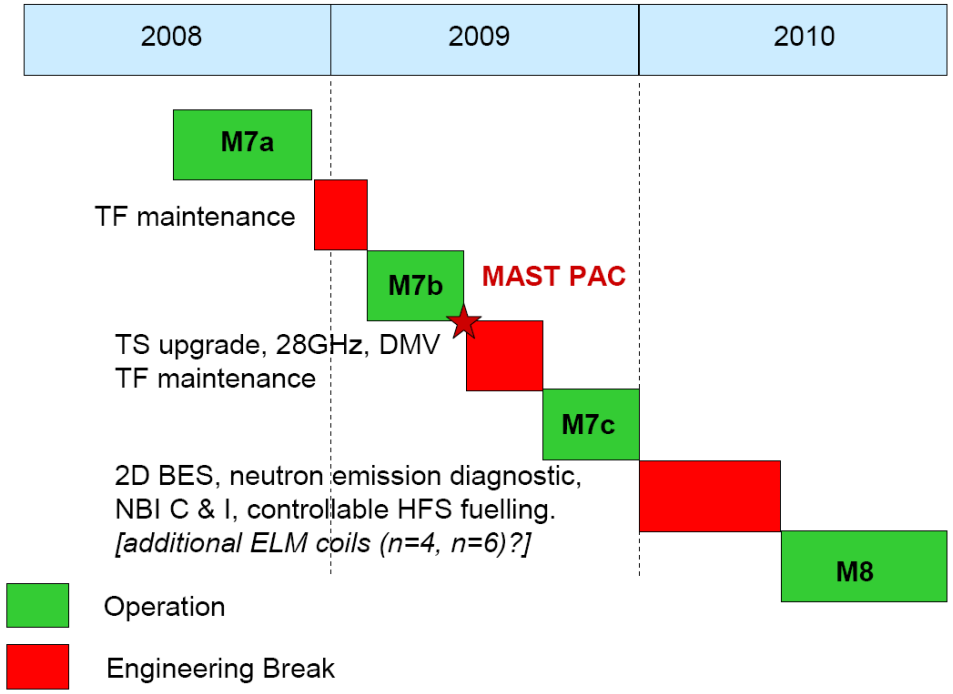
UKAEA Fusion Working in Europe

Armour Tiles

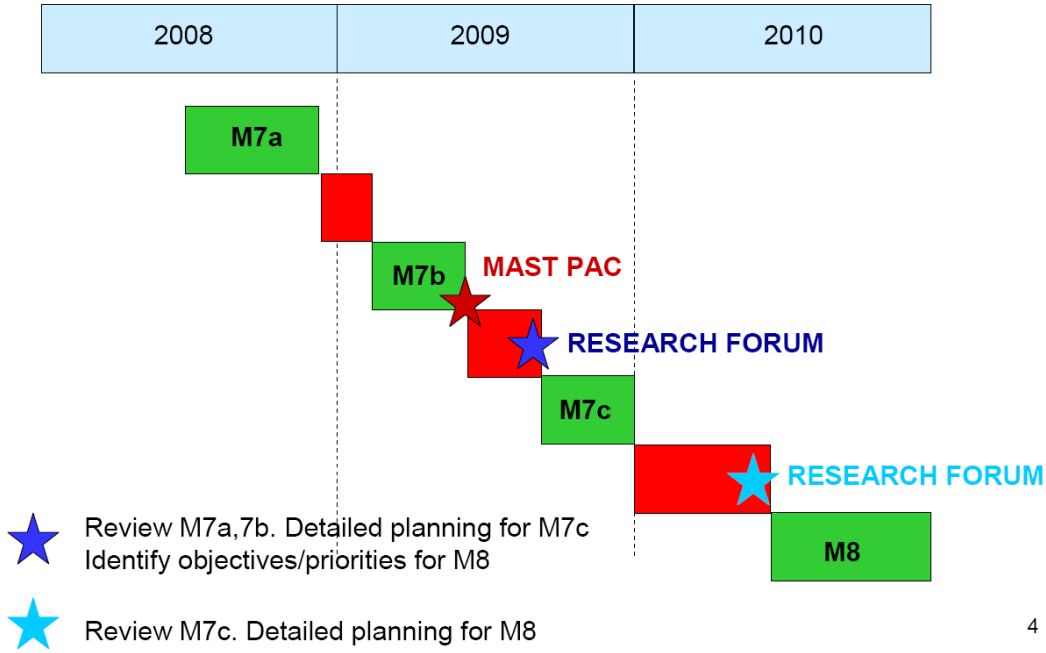


MAST Program Schedule

Operating schedule



Review & planning



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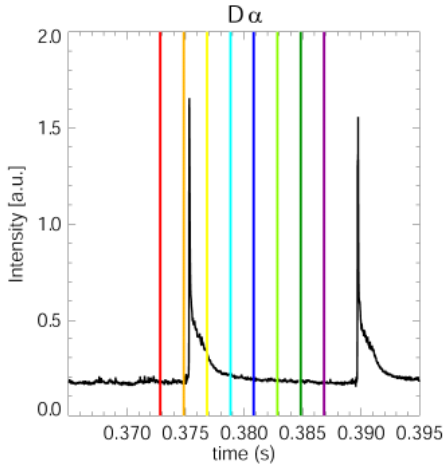
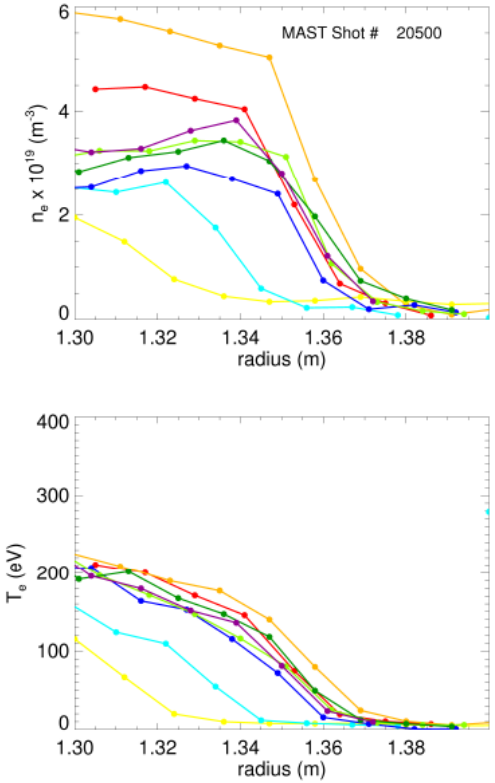
MAST upgraded TS system will enable many physics studies

Nd:YAG TS upgrade

Collaboration with York University. To be fully implemented in 2009.

Stage 1: Replace 4 0.9J, 50Hz lasers by 8 1.5J, 30Hz lasers increasing temporal resolution and enhancing burst mode capability for NTM, ELM, pellet studies etc. COMPLETE



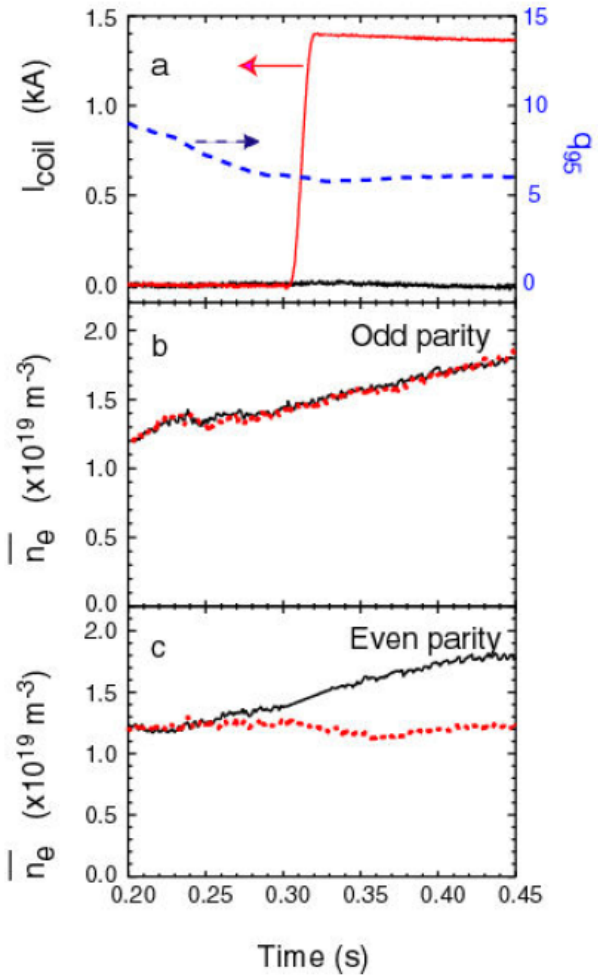


Pedestal changes associated with an ELM

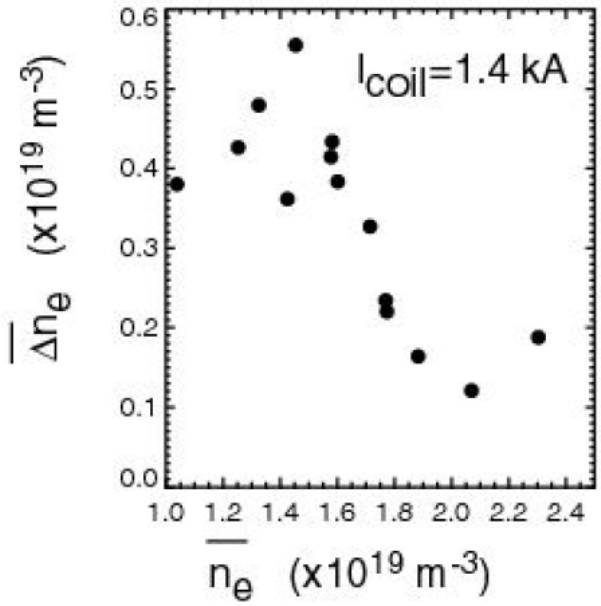
Stage 2: New collection system and spectrometers, 120 spatial points, ~ 10mm resolution (2009). High resolution edge TS and 300pt ruby TS single pulse system will be retained.

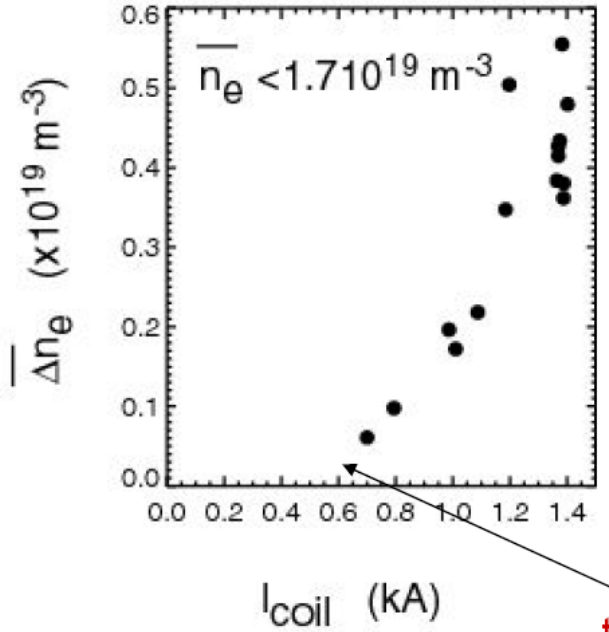
n=3 RMP density pump-out observed in L-mode
but RMP triggers ELMs in ELM-free H-mode, no impact on ELMy H-mode

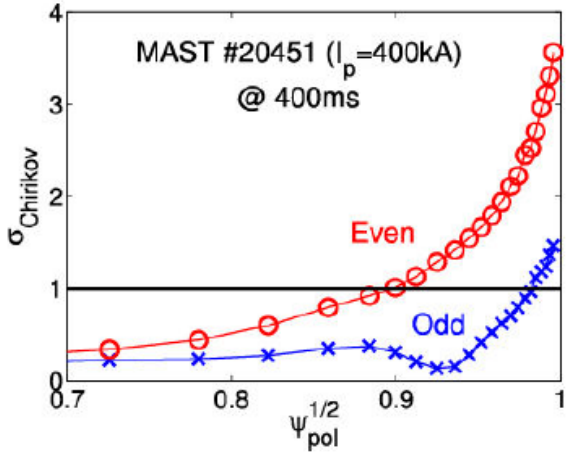
Scenario 1: I_P=400 kA – L-mode – n=3 coils



- Size of the pump out depends on density and coil current







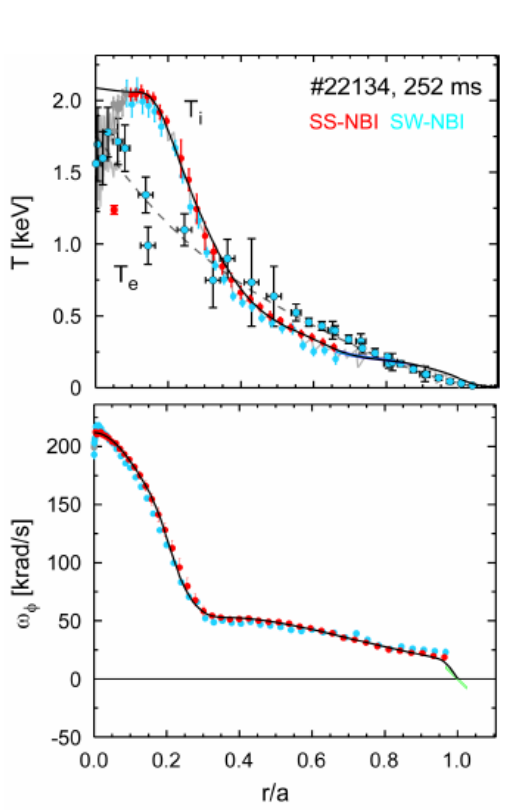
2010 – installation of 6 additional upper coils

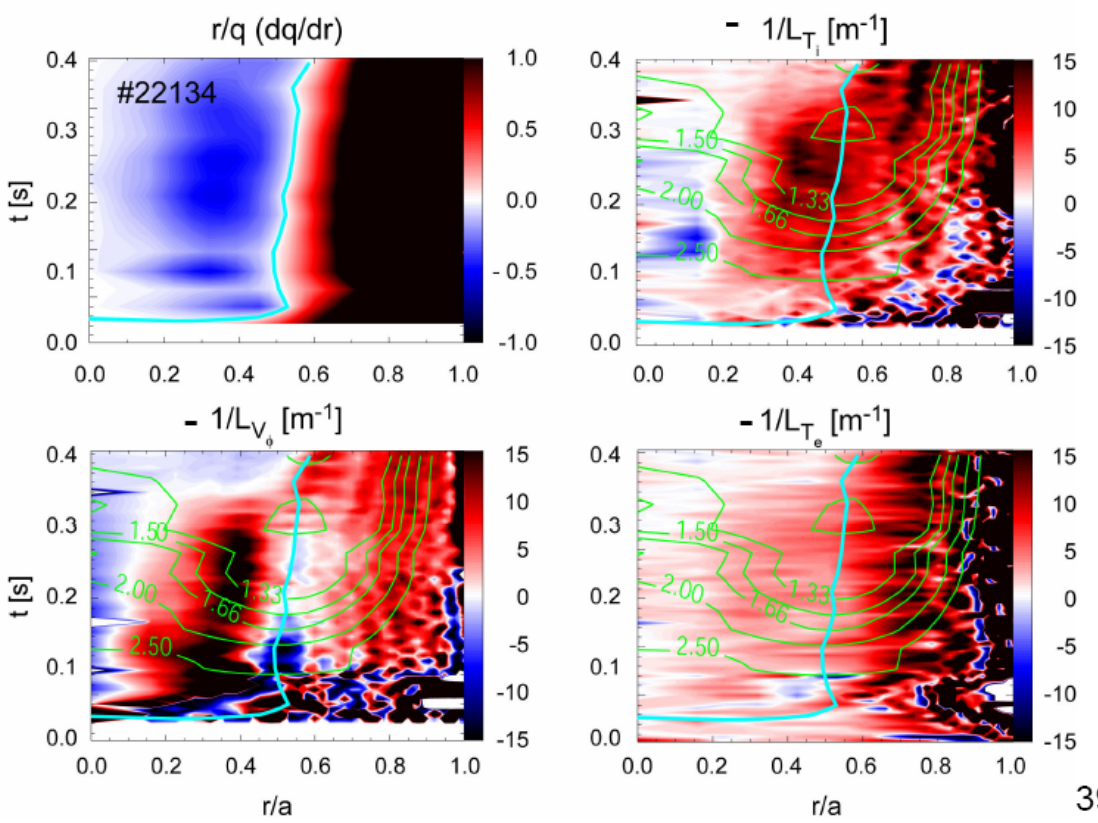
- Under consideration again in view of strong international interest
- Allows n=4 and n=6 configurations as well as better alignment to q_{95}~ 5 discharges

Beginning to use 35 channel MSE to study transport barrier structure as a function of magnetic shear

q-profile effects on transport

- Early NBI heating during current ramp results in reversed (s < 0) magnetic shear
- Reversed shear results in ITB formation in momentum and ion thermal channels
- ITB in V_ϕ forms where shear *most negative* and ion-ITB slightly outboard of this





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ST panel (led by S. Sabbagh) is coordinating completion of "Theme" and "Thrust" chapters

- S. Sabbagh coordinating "Theme" chapter, R. Majeski did "Thrust" chapter
  - Theme = discussion of issues, research needs
  - Thrust = outline of actions to be taken to address issues/needs (6 pager)
  - Both to be finalized in next week or two…
- Thrust 16: "Developing the ST to advance fusion nuclear science"
  - Proposed actions for Thrust 16 (of 18):

1. Exploit and understand magnetic turbulence, electromagnetic waves, and energetic particles for megampere plasma **current formation and ramp-up**
2. Develop innovative magnetic geometries and **first wall solutions** such as liquid metals to accommodate multi-megawatt per square meter heat loads
3. Utilize upgraded facilities to **increase plasma temperature, magnetic field** to test understanding of **ST confinement, stability** at fusion-relevant parameters
4. Implement and understand active and passive control techniques to enable **long-pulse disruption-free operation** in plasmas with very broad current profiles
5. Employ energetic particle beams, plasma waves, particle control, and core fueling techniques to **maintain the current and control the plasma profiles**
6. Develop normally-conducting radiation-tolerant **magnets** for low-A applications
7. Extend **ST to near-burning plasma conditions** in new or further upgraded device

Upcoming NSTX collaboration solicitation for laboratories for FY2010-2012

- Working on draft program letter now
- Will be discussed with OFES week of July 13, reviewed by NSTX PAC-26 week of July 20 (approx)
- Expect final version to be available in early August
- Affected team members + research contacts should begin working on letters of intent, records of discussion, proposals
  - and you are encouraged to discuss any and all of this with NSTX program and project directors at any time…