Supported by

NSTX Research Plans and Goals for 2005 - 2007

E.J. Synakowski
PPPL

on behalf of the NSTX Team

For the NSTX Program Advisory Committee

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NSTX research for FY '05 - '07 will advance toroidal confinement science and fusion energy development

- Unique properties of NSTX plasmas enable leverage to be applied in theory tests, strengthening all of toroidal confinement science and the basis for ITER.

- Important elements include the deployment of new control tools, development of advanced diagnostics, and execution of joint experiments within the ITPA.

- Integration of these elements is central to the achievement of high beta, solenoid-free operation of the ST

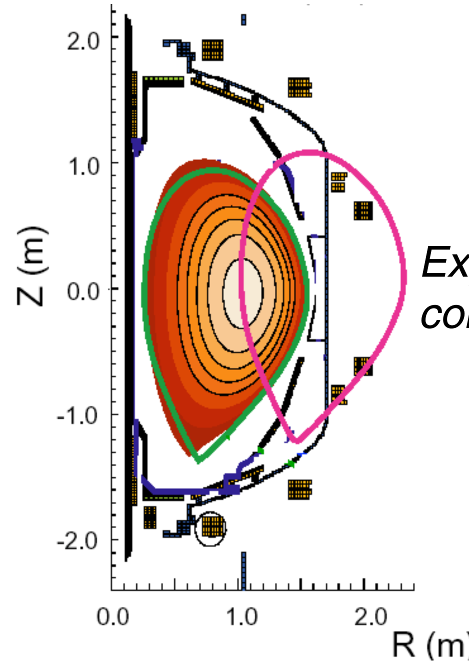
- The scientific opportunities afforded by this program are well aligned with the national program's scientific priorities

Joint experiments, new control tools, novel diagnostics are key for advancing the science

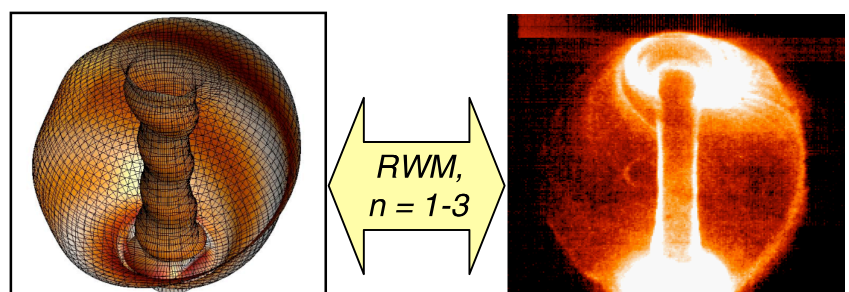
- NSTX is vigorously participating in ITPA activities: obtain “binocular vision” for model & theory validation on issues important to ITER & toroidal confinement

- New control tools will enable tests & validation of theory important for all of toroidal confinement & burning plasmas, and for increasing the ST operating space

- Diagnostics are being developed to enable detailed comparisons with leading theories



Experimental collaboration



Theory-experiment coupling

Strengthen the community’s theory and predictive capability by exploring physics from important new vantage points

NSTX research contributes to toroidal confinement science on a broad front

- *MHD: stability & helicity injection*
- *Core transport and turbulence*
- *Wave/particle interactions*
- *Edge physics and plasma/boundary interfaces*
- *Integration*

Strengthen the scientific basis for fusion energy

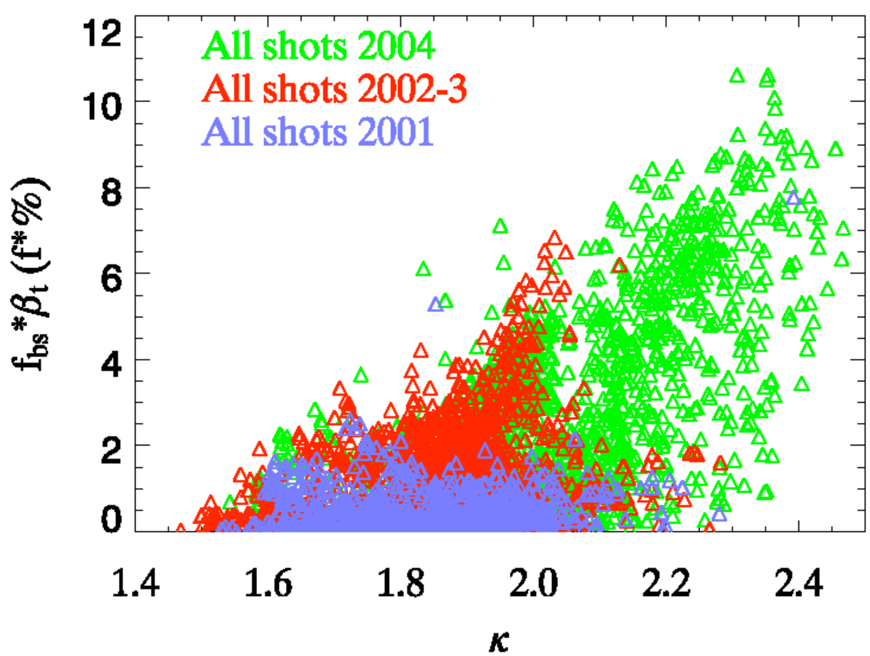
Emphases are well-aligned with national research priorities

The NSTX operating space was expanded in 2004

Reduced latency improved vertical control at high-κ, high-β_T

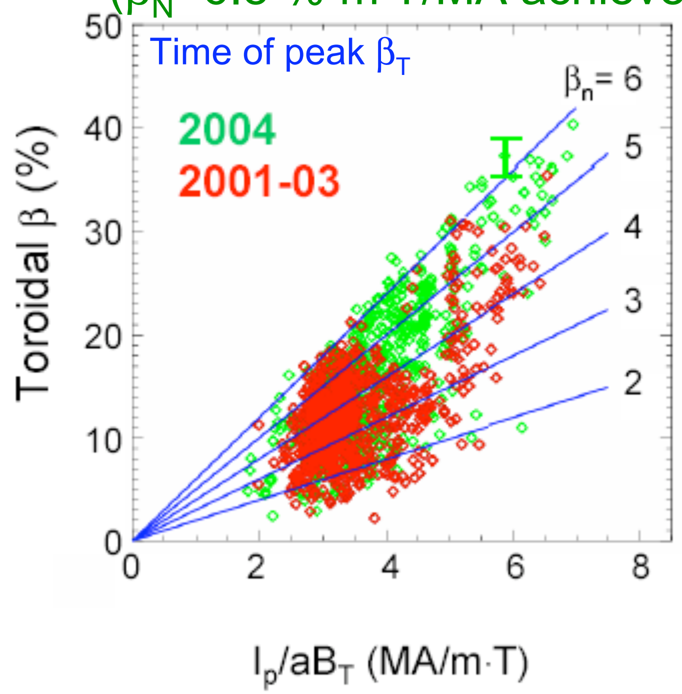
Improved control enabled…

higher β_T and J_{BS} simultaneously with higher kappa



Higher β_T at higher β_N

(β_N=6.8 % ·m·T/MA achieved)



NSTX

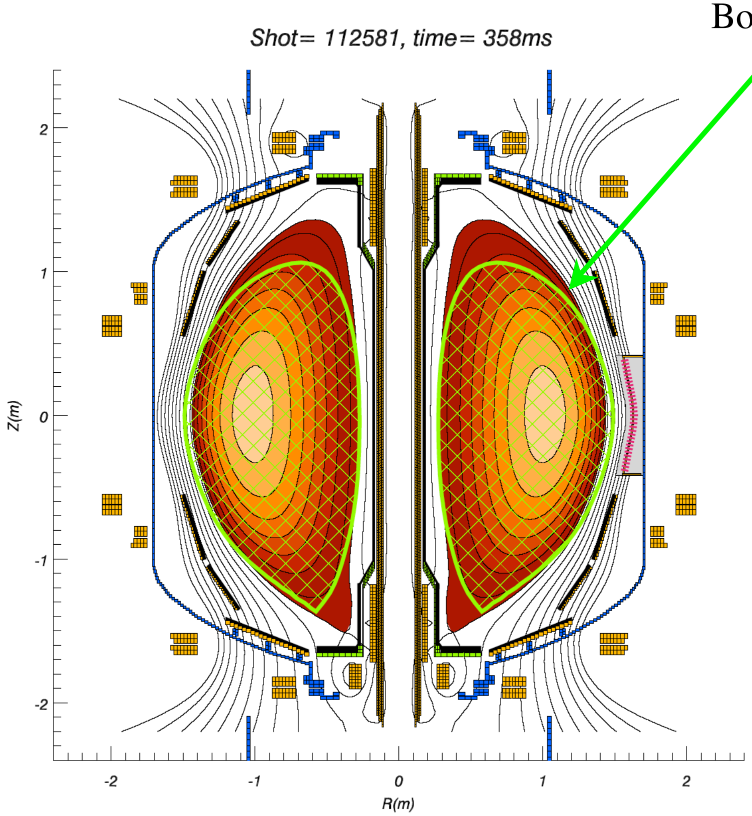
Benefits of improved control also seen in integration of long pulse & high β_T

Higher elongation raised bootstrap current and edge q, yielding a longer pulse length at higher current and lower TF

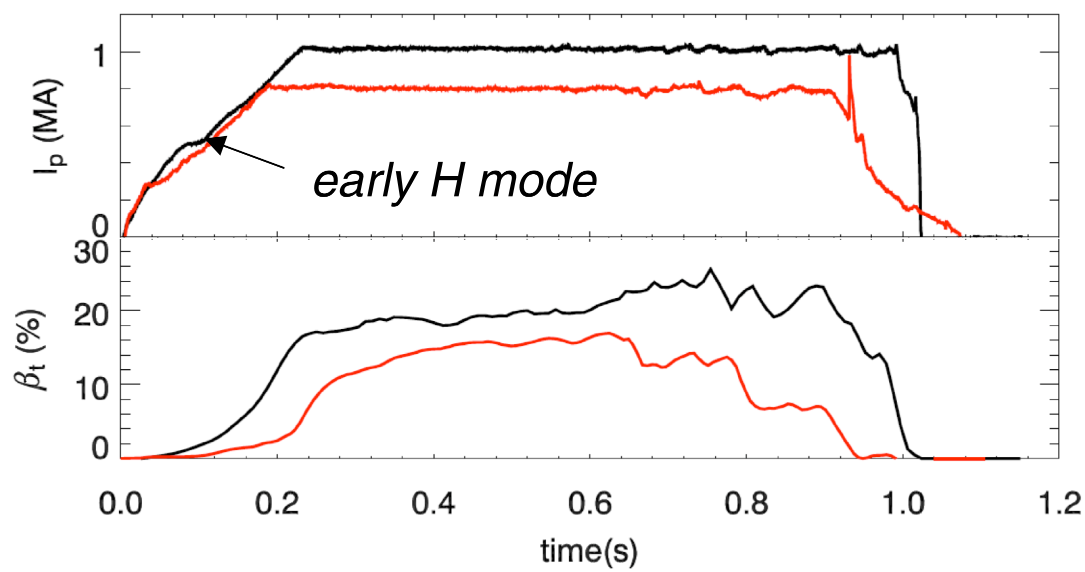
- 25% more I_p, ~5% longer pulse with 10% less toroidal field
- Joint research (ITPA) a key: early H mode(M. Wade, ORNL)

==> Slower J diffusion, better shape control, delayed MHD

Boundary from 109063 overlaid (green)



Shot 112581 (Black) - 2004
Shot 109063 (Red) - 2002



- *MHD: stability & helicity injection*
- *Core transport and turbulence*
- *Wave/particle interactions*
- *Edge physics and plasma/boundary interfaces*
- *Integration*

Opportunities include

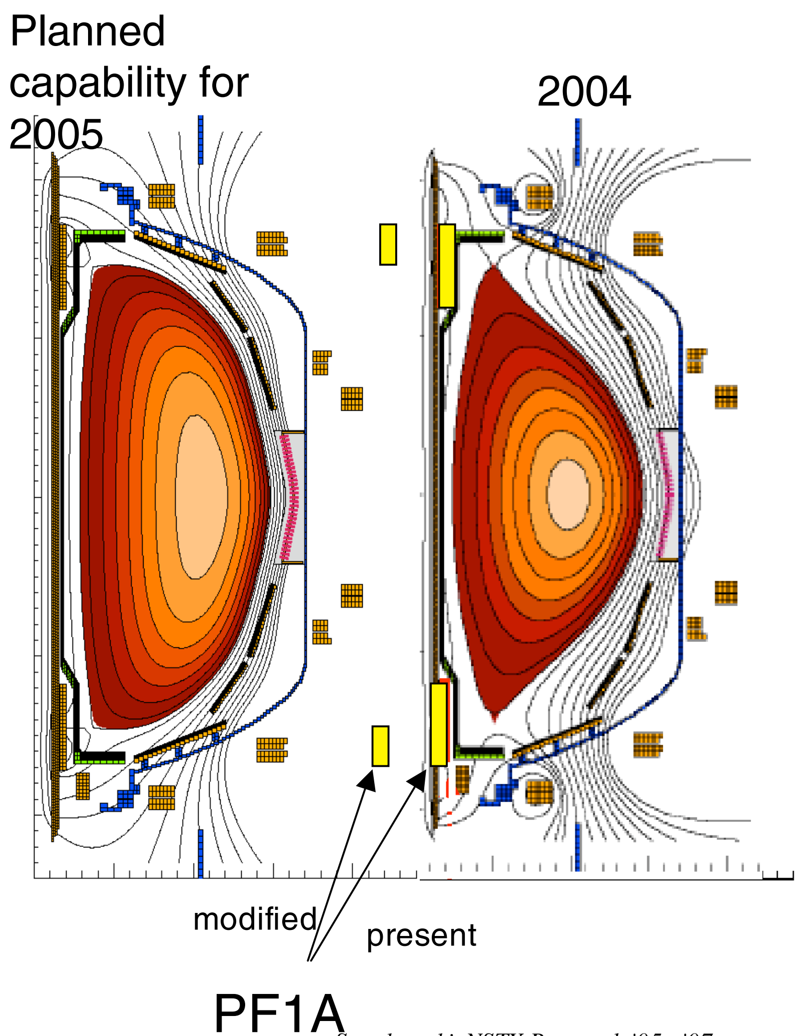
- *Test stability limits with strong shaping*
- *RWM damping & dissipation at high $V_\phi / V_{Alfvén}$ and low A*
- *Increased mode coupling at low A*
- *Flow shear: $V_{flow}/V_A \rightarrow 1$ => $V'_{flow} \sim \gamma^{lin}_{MHD}$*
- *Helicity injection & reconnection*

Even stronger shaping will enable access to higher β_T & β_N regimes

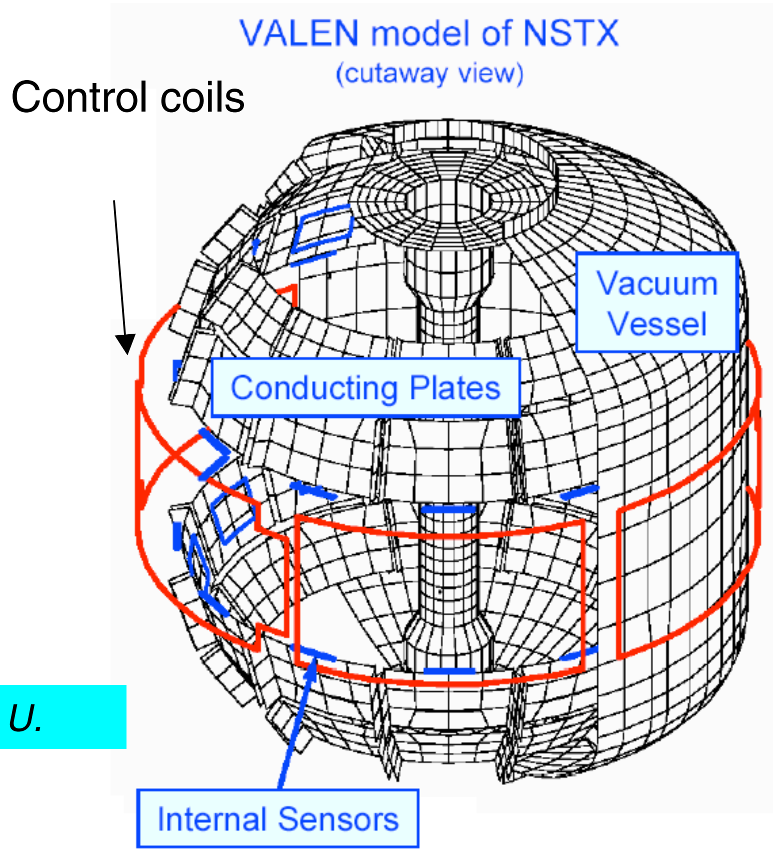
- Should enable higher simultaneous κ (= 2.7) and δ (=0.9). Winding & installation of new PF1A coils completed.

- Extend range of MHD stability studies and further enable routine access to high beta for research throughout the program

- For optimized profiles,
  - no-wall limit increases β_N and β_T by ~ 20% due to shaping alone
  - Ideal with-wall limit increases by ~ 30%



External coils installed to enable operation near the with-wall limit and tests of mode growth & dissipation



Columbia U.

Milestone for FY05: *Study rotating plasmas close to the with-wall stability limits with error field correction*

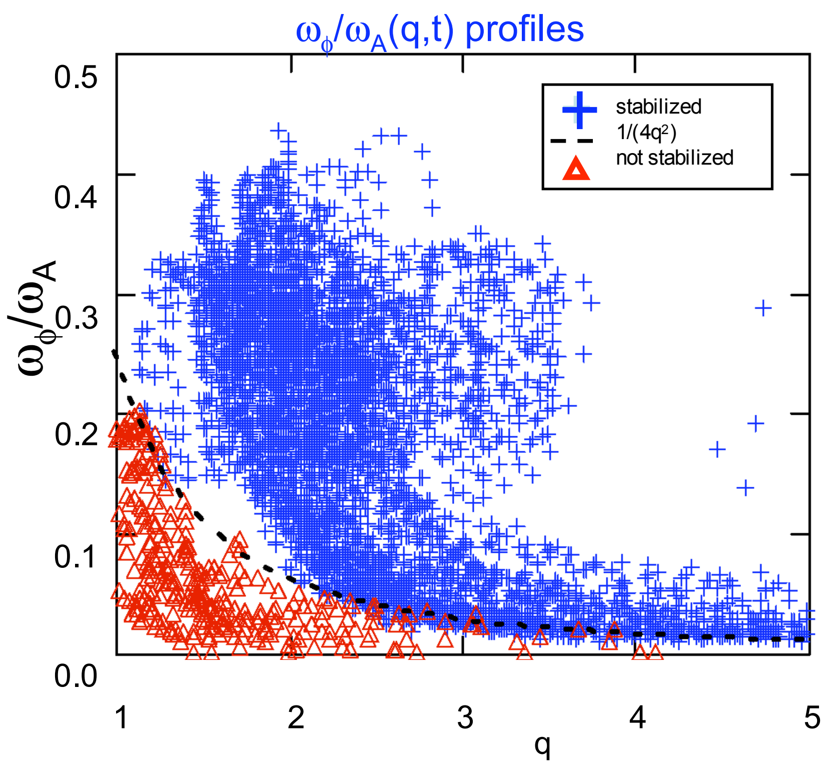
Milestone for 06 *Characterize the effectiveness of closed-loop EF control.*

Milestone for 07 *Characterize the effectiveness of closed-loop RWM control.*

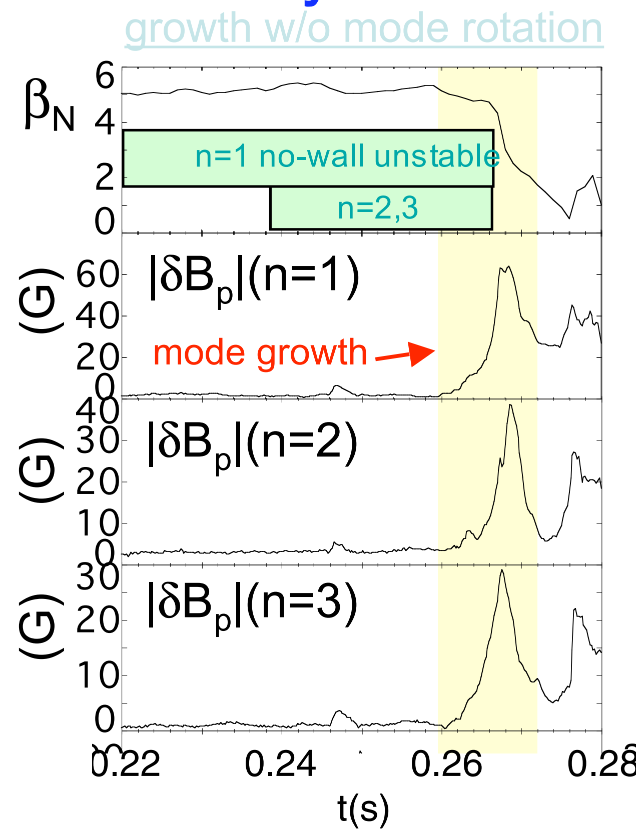
If higher budget, combine closed-loop EF & RWM in ‘06

- Study controlled variations in ‘05, use of feedback on EF and RWM to expand operating space in ‘06 and ‘07
- Studies with two coils in ‘04 already yield a reduction in locked mode density threshold

Low A, high β_N will extend RWM theory tests



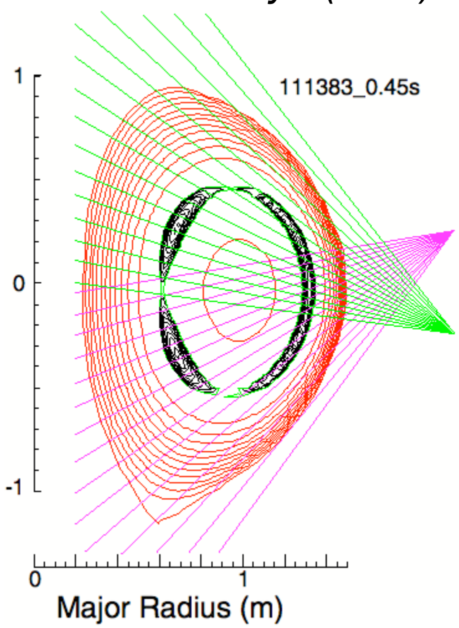
n >1 readily observed, as expected at low A



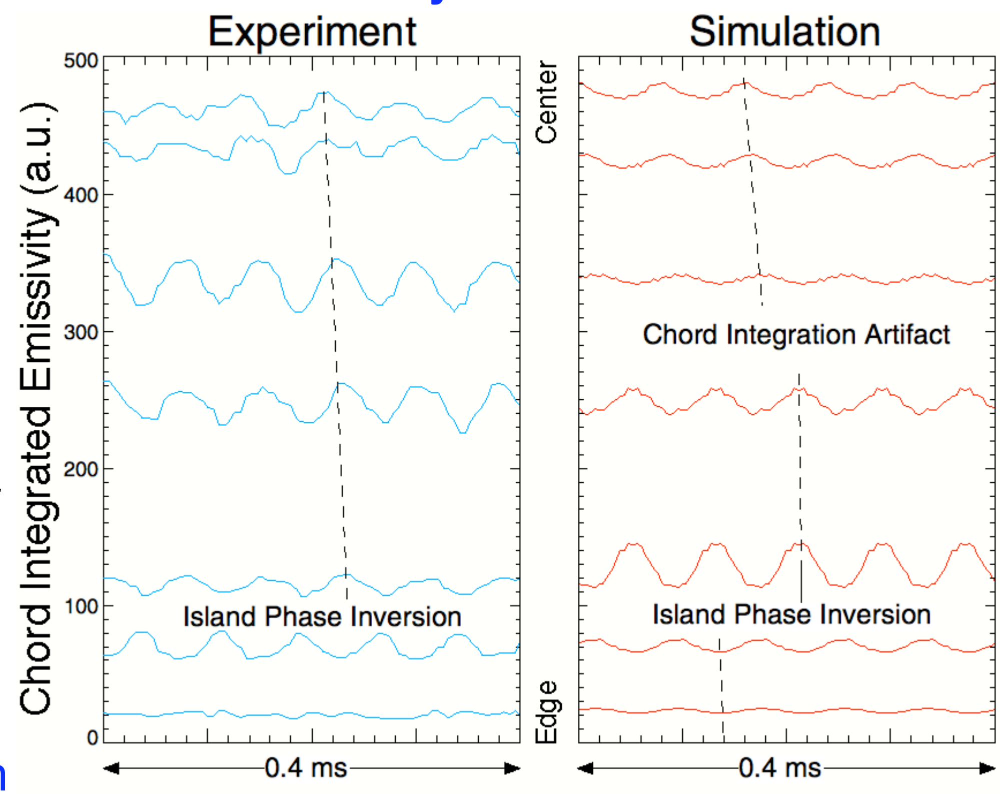
- RWM stabilization considered for ITER: use low A to test the theory, assess the readiness of the investment
- Scaling of critical rotation frequency for RWM stabilization, as well as the spectrum of unstable modes, are both testable features theory
  - $|_{crit} = \omega_A/(4q^2)$ (Bondeson-Chu): agrees so far. Differences at moderate A?
  - Higher mode numbers expected to be accessible at low A: thus far, true

Tearing mode measurements & theory tests will increase in emphasis over the next three years

USXR arrays (JHU)



Emission measurements indicate wide radial extent of coupled internal modes (3/2, 2/2)

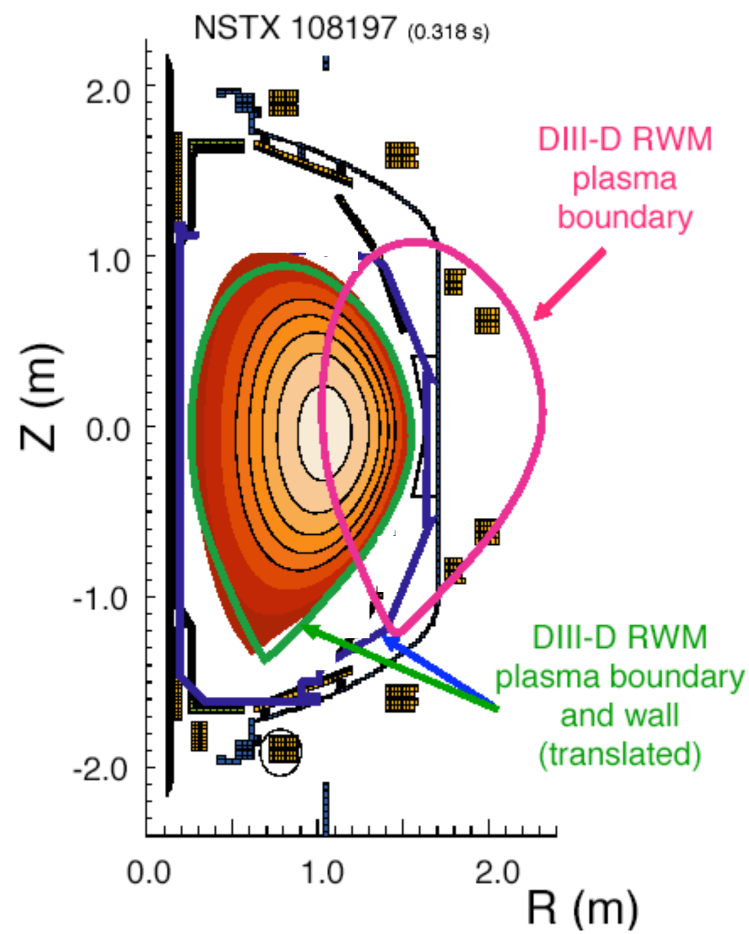


- Challenge theory understanding with
  - Low A geometry expected to *enhance* toroidal mode coupling
    - a path to couple to the fast ion distribution?
  - Large $V_\phi/V_{Alfvén} \rightarrow$ differential rotation can *reduce* coupling
  - Glasser-Greene-Johnson theory: NTMs more stable due to low A
- Does NTM have the same impact at low A as at moderate A?
  - Study importance in high β plasmas with elevated q

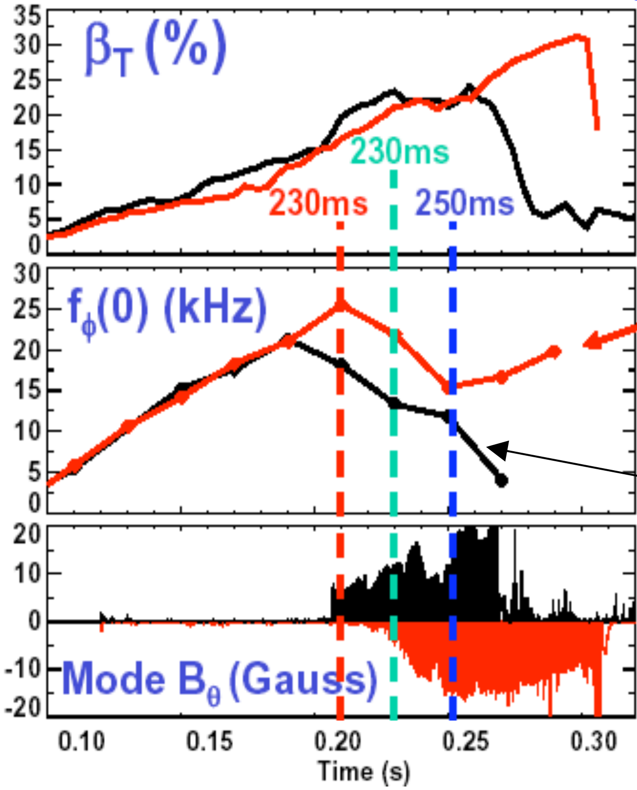
Milestone for FY 07 (if budget increase)
Characterize tearing mode onset conditions and impact

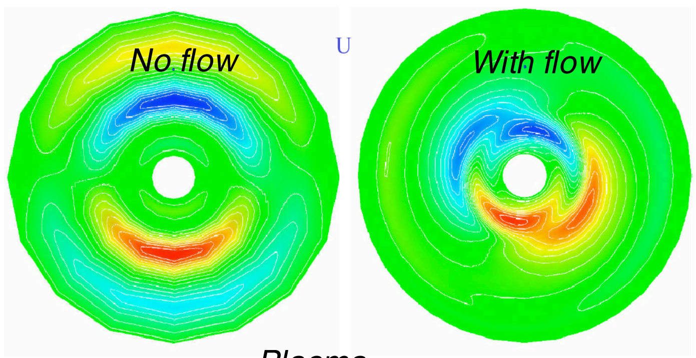
Joint experiments within the ITPA are being executed and are part of the plan for assessing RWM and tearing mode physics

- Researchers working on low and moderate A devices are identifying high leverage joint experiments
  - RWM: Similar V_{sound} & rotation frequency, different $V_{Alfvén}$ → NSTX has joint experiment with DIII-D. This ITPA activity also involves many other programs as well
  - Tearing mode: with DIII-D, MAST, ASDEX-U



Theory development is central to understanding physics of high $V_\phi/V_{Alfvén}$ on MHD stabilization & saturation





Plasma top view

M3D code

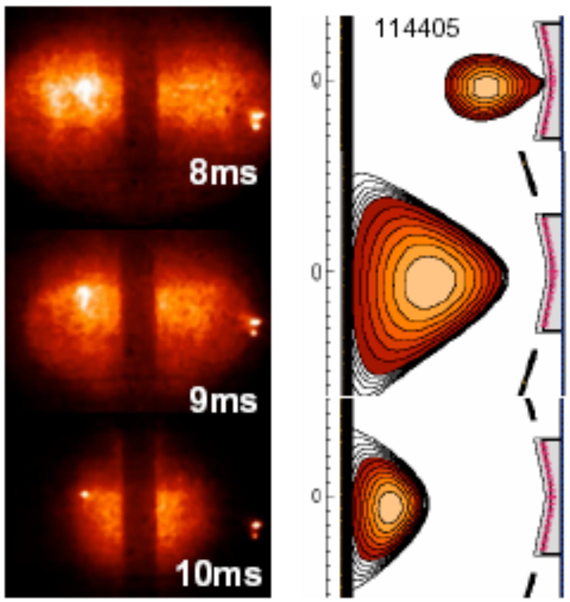
Menard, Park

- A new regime to test MHD theory: with $V_{flow} \sim V_{Alfvén}$, flow can shear apart MHD modes
- **Theory target for '07**: develop fully nonlinear treatment with self-consistent momentum transport ==> can codes reproduce observed saturation of internal modes?

Two major approaches are being pursued for solenoid-free start up and ramp-up to high currents

1) PF-only startup

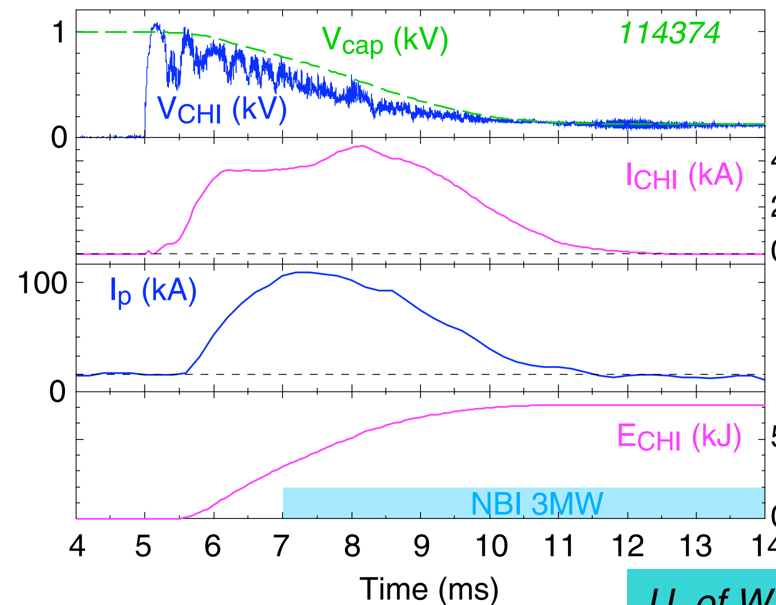
- 20 kA generated



With U. of Tokyo

2) Transient Co-Axial Helicity Injection

- I_p up to 140 kA, $I_p/I_{injector}$ up to 40

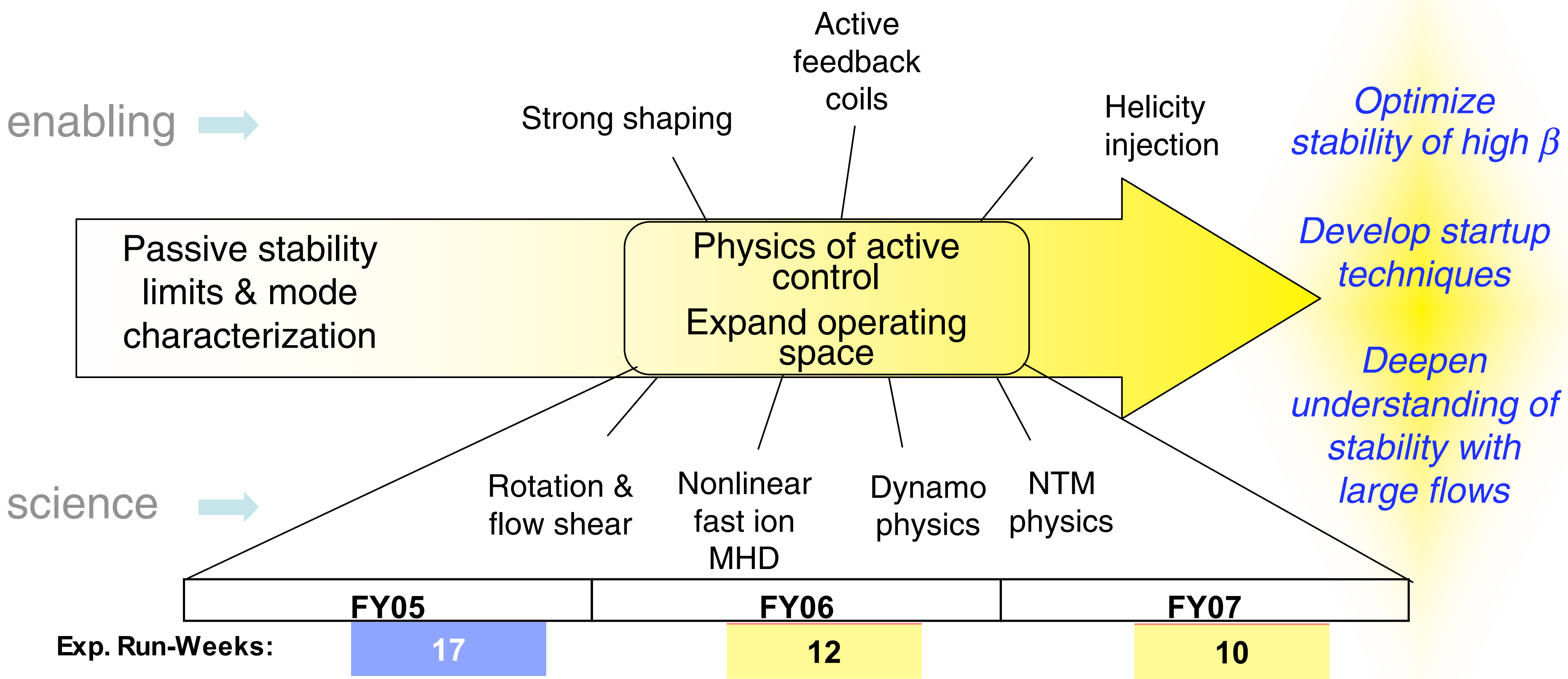


U. of Washington

- Both PF induction and CHI require advances in plasma control during FY ‘05 - ‘07
  - Plans for how to control at the lowest I_p values being developed
- Theory involvement in CHI increasing (NIMROD code Sovinec (U. Wisc), X. Tang (LANL), Schaffer (GA))

Milestone for FY06: *Assess CHI creation of closed magnetic flux*

MHD & helicity injection



Study plasmas ≤ "wall-stabilized" pressure limit

Characterize effectiveness of closed-loop EF control

Characterize effectiveness of closed-loop RWM control

Assess flux closure with CHI

If increased budget (17 run weeks in '06 & 07), combine EF & RWM milestones, add NTM onset & impact milestone to '07

- *MHD: Stability & helicity injection*
- *Core transport and turbulence*
- *Wave/particle interactions*
- *Edge physics and plasma/boundary interfaces*
- *Integration*

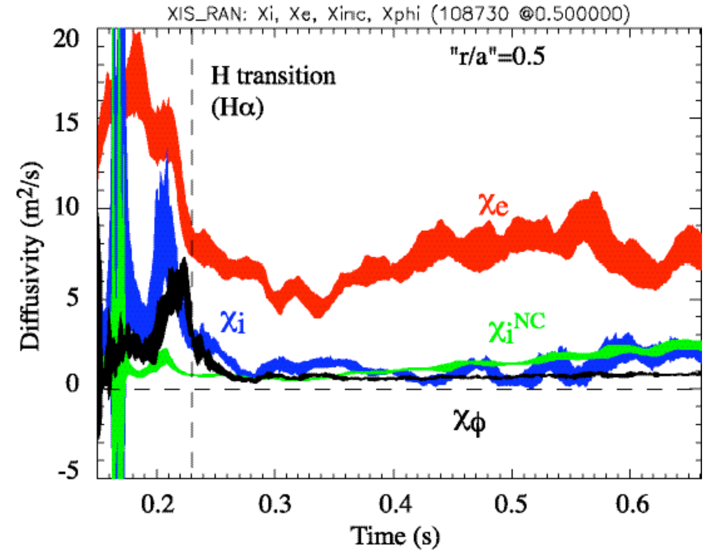
Opportunities include

- *Intrinsically large flow shear at low A, potentially controllable with EF coils*
- *Electron thermal transport: unique opportunity with electron-scale turbulence measurements over a wide range of beta*

emphasized in the following…

Understanding electron thermal transport will be a focus for '05 - '07

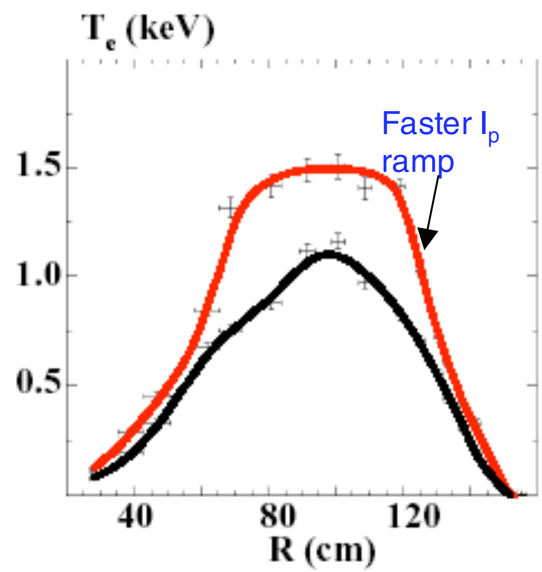
- Ion channel is often within 2x(neoclassical), sometimes below, revealing dominant electron thermal transport

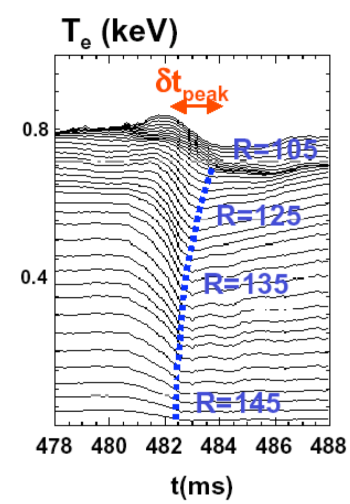


- But χ_e can be manipulated via magnetic shear. Linear analysis revealed many possible modes in high k range. ETG, microtearing…
  - Nonlinear GS2: χ_e ~ 10 m^2/s from ETG

- First step ('05): strengthen these studies through MSE, study dependence of χ_e on q' and T_e'

Milestone for FY05*:*
Characterize q' and Te' effects on electron thermal transport





T_e cold pulse after ELM

Electron thermal transport is a worldwide priority, and the NSTX plan takes advantage of important opportunities

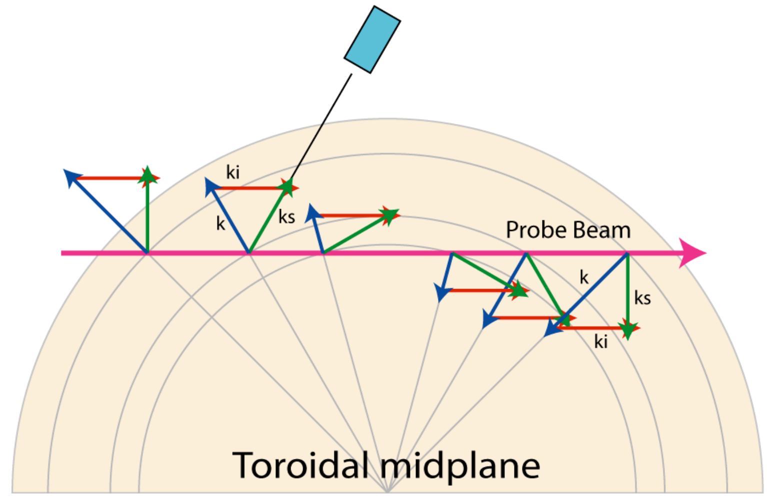
- Ion transport has a generally accepted "standard model," but electron thermal transport does not

- For a burning plasma, α heating will be largely be *on the electrons*. NSTX fast ions predominantly heat electrons as well.

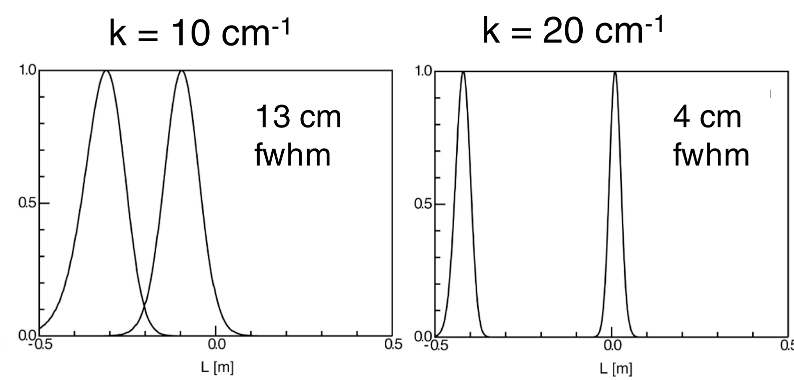
- Electron scale turbulence is a leading hypothesis for much of this transport. On NSTX, opportunities include
  - From low to unity $\beta \Rightarrow$ e-m effects emerge
  - Neoclassical ions in many cases
  - Anisotropic turbulence + strong toroidal curvature + Bragg condition

    $\Rightarrow$ Excellent spatial resolution

  $\Rightarrow$ *Unique opportunity to study electron scale*



Localized scattering volume

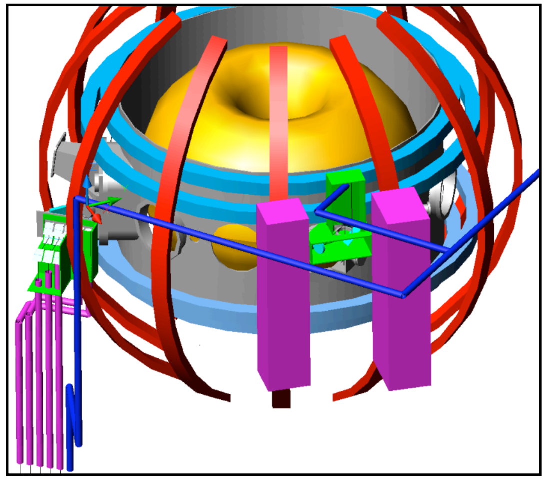


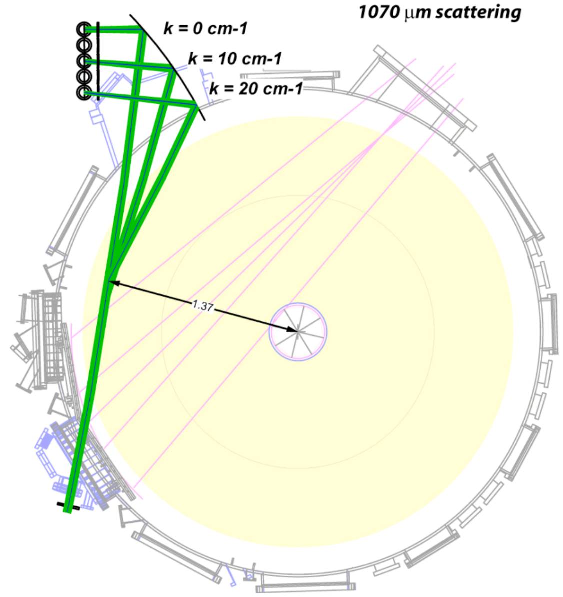
Instrument selectivity, from ray tracing

Synakowski, NSTX Research '05 - '07

First light on high k scattering system this run will mark a new step in electron transport studies

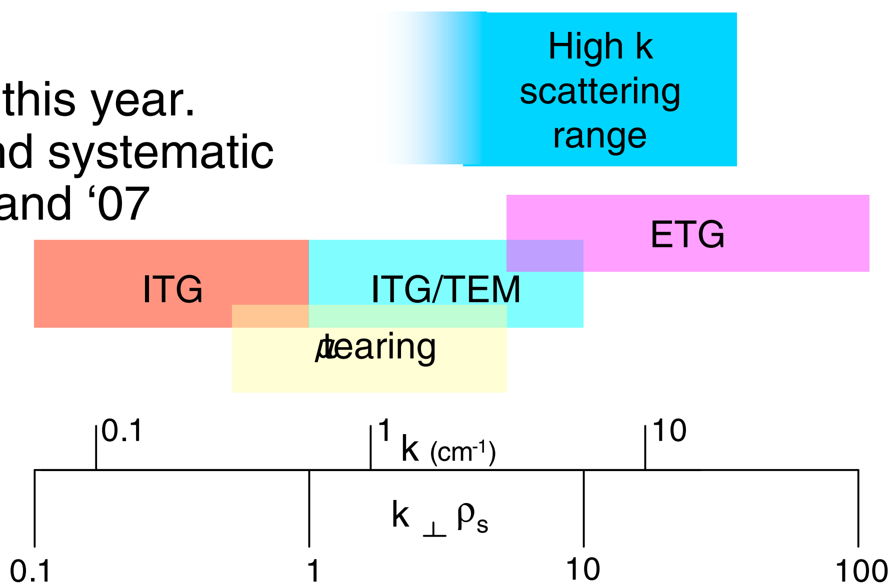
- Access to electron scales
  - k_r-resolved measurements in select locations (~2 - 20 cm^{-1}, $\Delta k_r = 0.5\ cm^{-1}$)
  - good spatial resolution at higher k. $\Delta n/n < 0.01\%$ (ETG $\Delta n/n \sim 0.1\%$)
  - '07: new source (Fukui University) will extend k_r to 25 cm^{-1}, better $\Delta n/n$)





With UC Davis and U. Colorado

- Commission this year. Dedicated and systematic scans in '06 and '07

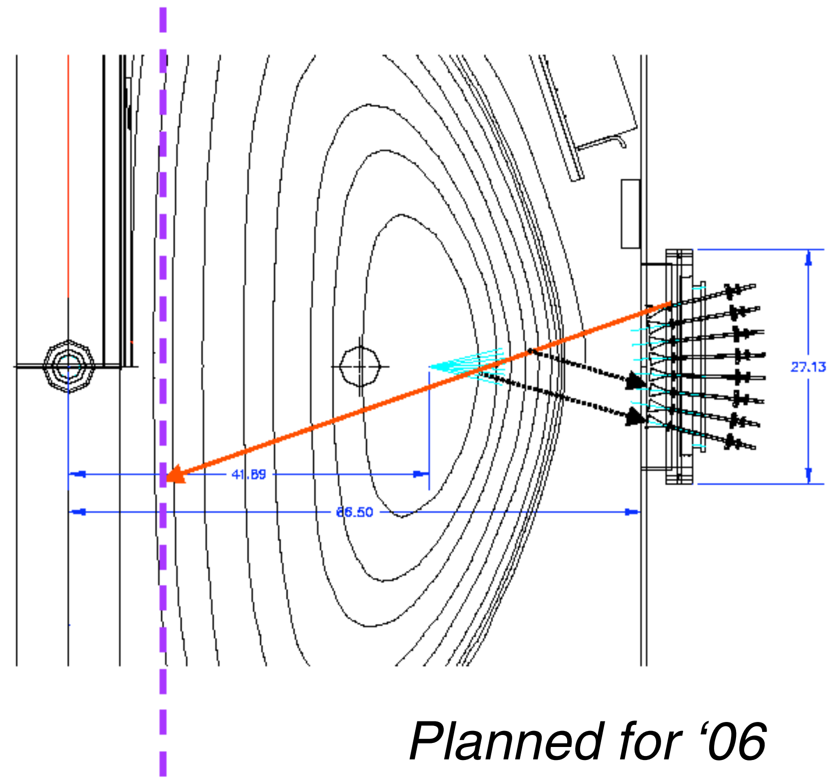


Milestone FY 06-1*:*
Measure high k_r spectra in select conditions

Milestone FY 07-1*:*
Compare measured k_r spectra with heat fluxes and turbulence simulations over a wide range of conditions

Proposed large angle back-scattering will allow probing of high radial wavenumbers

- Launch 100 GHz with waveguide/antenna/lens combination
- Wavenumbers from 35 - 40 cm^{-1} can be studied
- Refraction will not significantly change scattering angle $\rightarrow$ should be good contrast between low and high k

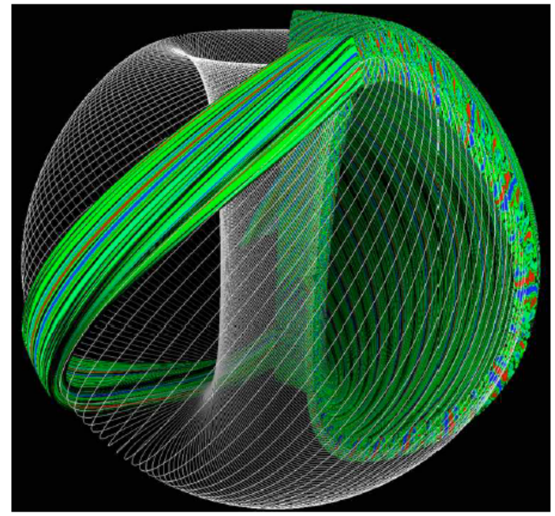


Planned for '06

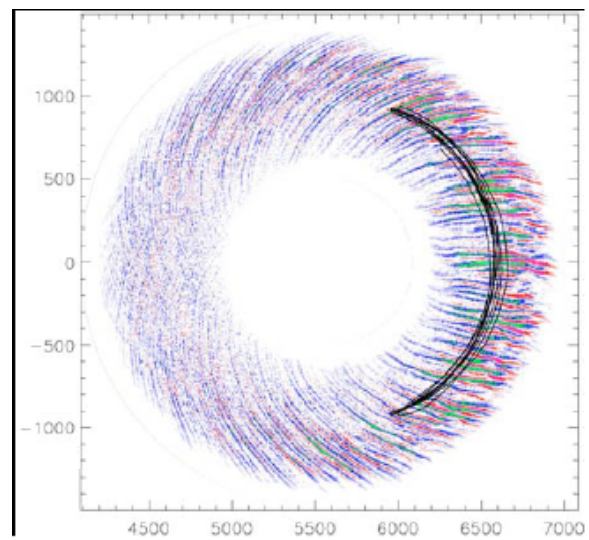
UCLA

New measurements will enable tests of tools in regimes where role of electron dynamics is maximized

- Unity β will drive community towards regimes where electron dynamics are even more important
- Nonlinear GS2 has begun and will increase in effort (U. Maryland).
- Very large ρ*, large ExB flow shear, potentially large profile and nonlocal effects: "…what GYRO was created for" (Waltz - GA)
- GTC: Inclusion of finite β effects mid-plan. Detailed k_r measurements can be compared to detailed predictions in '07 (UC Irvine).



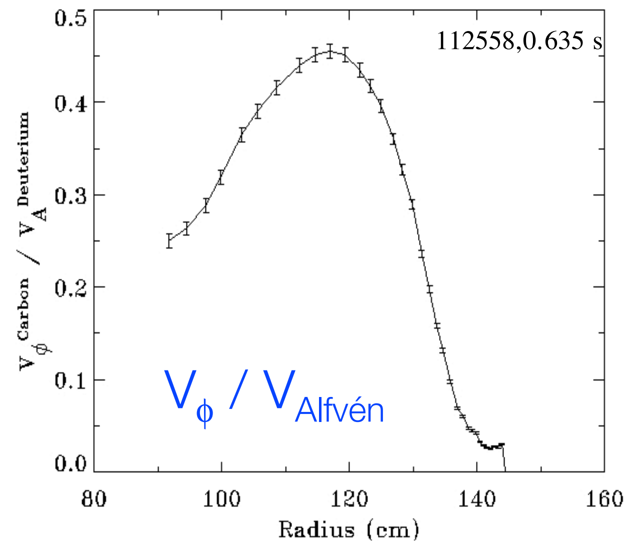
GS2

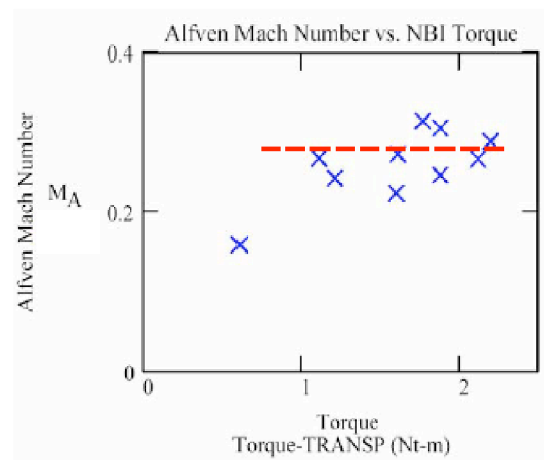


GTC

Transport research priorities are supported by ITPA efforts

- β and ν^* scaling: ITER issue, ITPA activity
- MAST confinement similarity experiment
- Momentum transport: a focus of a joint similarity experiment with MAST
  - Measured $V_\phi/V_{Alfvén}$ saturates with applied torque. First leg of NSTX effort completed
  - Will be able to apply EF coils to modify V_ϕ without changing heat deposition
- Aspect ratio dependence of local transport
  - DIII-D leg one week from today: dimensionless scaling approach
  - MAST joining the effort
- Confinement database contributions to ITPA continue to be made as well

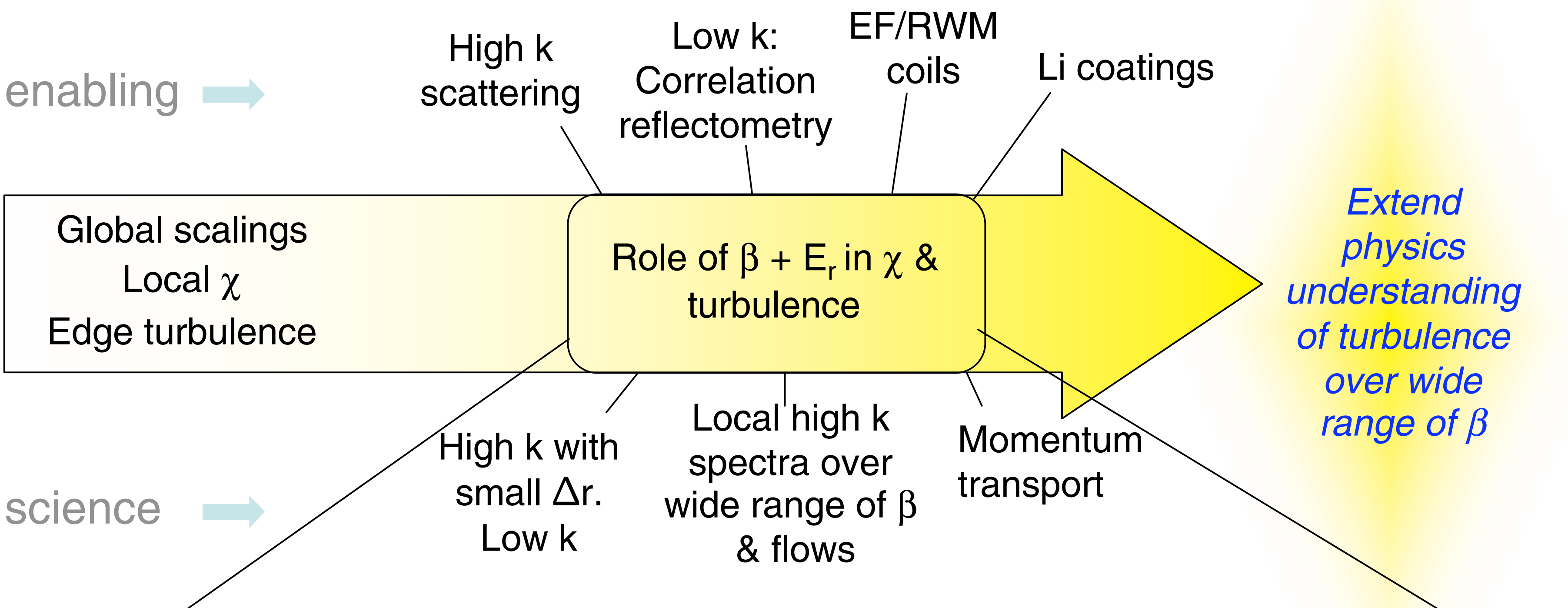




Rotation saturating at large V_ϕ/V_A in ITPA experiment with MAST

Transport & turbulence

Edge/pedestal-related transport issues to be discussed in boundary section



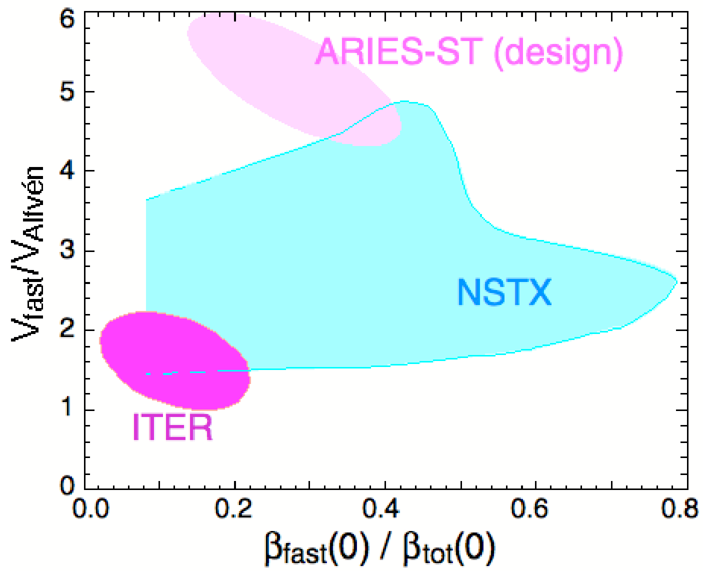
	FY05	FY06	FY07
Exp. Run-Weeks:	**17**	**12**	**10**
	Characterize q' and Te' effects on electron transport	**Measure high-k turbulence**	**Assess high-k spectra & electron transport**

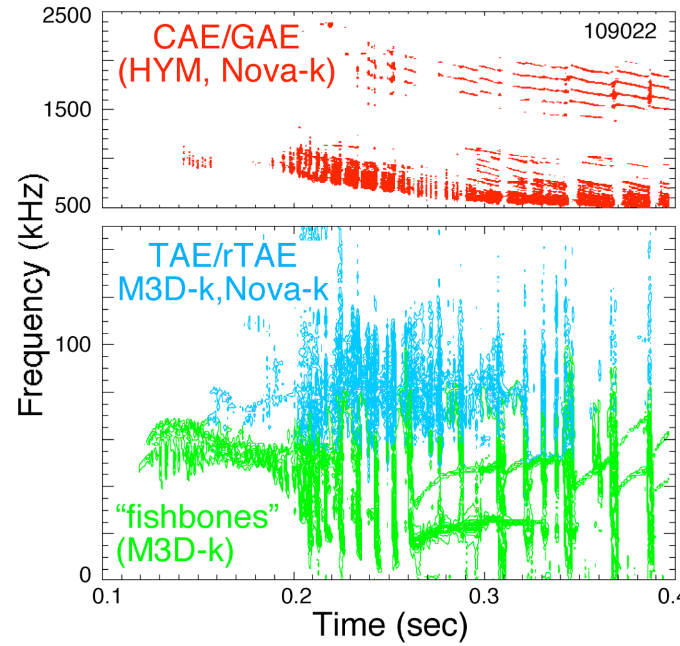
- MHD: Stability & helicity injection
- Core transport and turbulence
- **Wave/particle interactions**
- Edge physics and plasma/boundary interfaces
- Integration

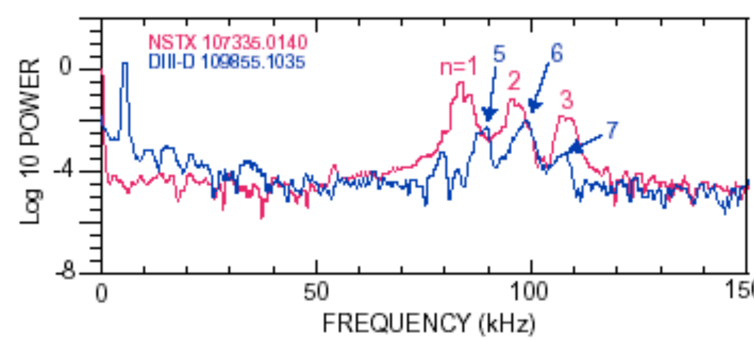
Opportunities include

- *Nonlinear fast-ion MHD with large super-Alfvénic population*
- *Wave physics in overdense plasmas: heating, CD, & startup*
- *Wave/particle interactions with high trapping: EBW*

NSTX includes and goes beyond ITER operating space for fast ion MHD, enabling theory tests



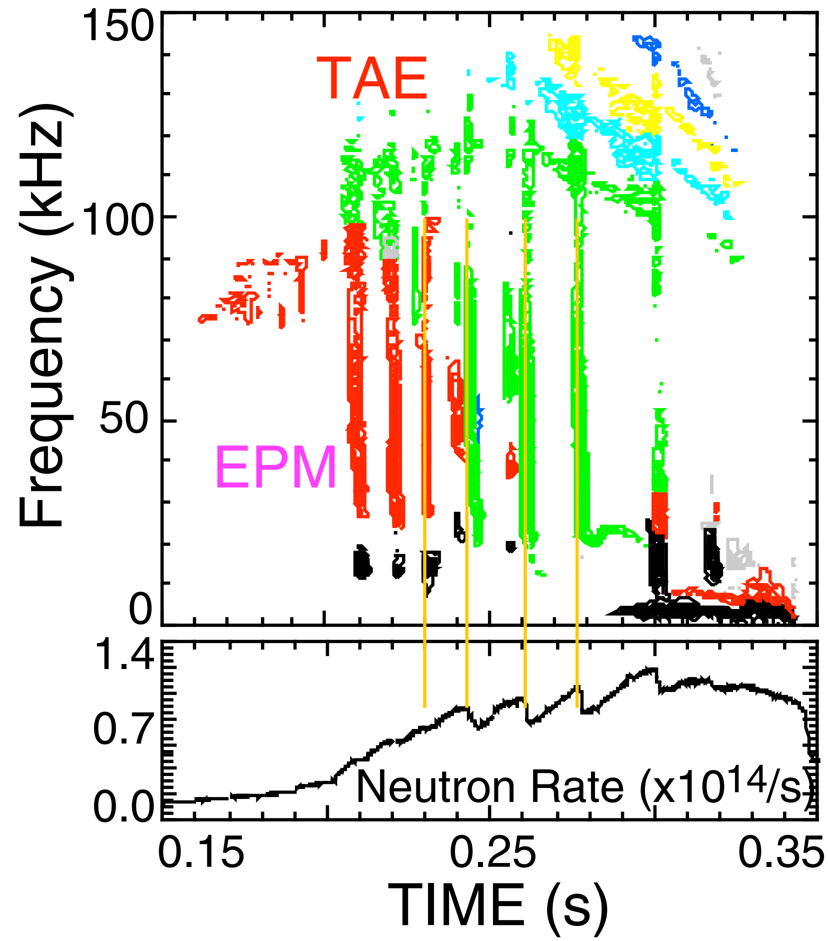




- NSTX includes and goes beyond ITER fast ion parameter space
- Low B, high n_e, high $\beta_{fast\ ion}$ & $V_{fast\ ion}$ □/□ $V_{Alfvén}$
  - ⇒ Strong drive for Alfvénic modes.
- NSTX and moderate A are complementary for benchmarking codes (M3D,HYM,NOVA)
  - ITPA joint experiment with DIII-D

Interplay between waves & fast ions has practical import for burning plasmas and STs

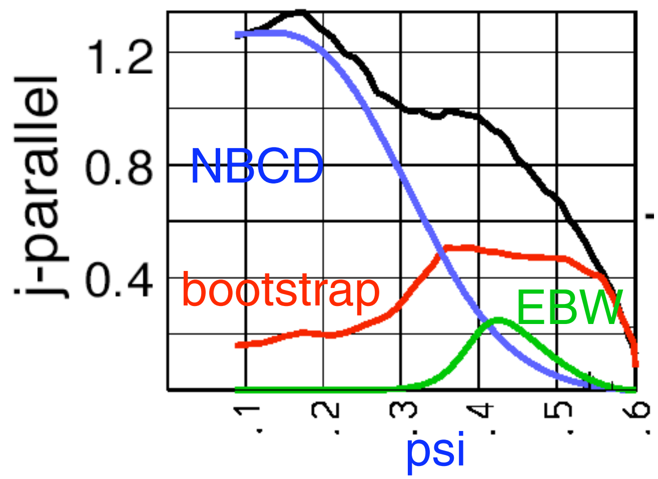
- Theory challenge: fast ion population cannot be treated as a perturbation
- Coupling between fast ion modes, followed by fast ion loss, observed on NSTX
- Fast MHD impact on core current density is a question in community
  - increase NBI CD, yet q(0) does not fall (ASDEX-U, IAEA): *why?*

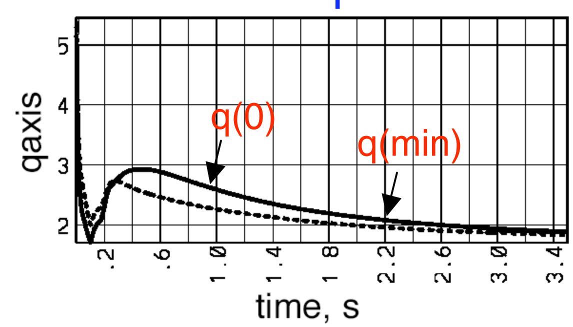


If MHD effects modify the fast ion current profile , there may be a significant effect on integrated long-pulse scenarios on NSTX & elsewhere

- Broadening of J_{NB} by MHD may affect requirements on EBW current drive in the outer region

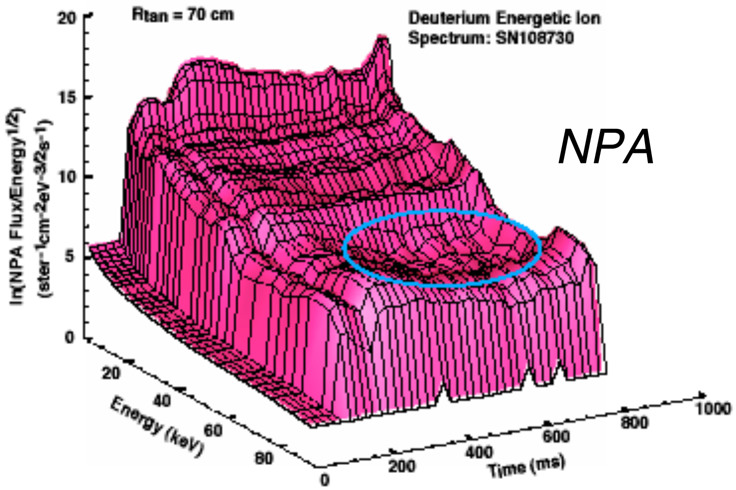
- Beam driven currents on-axis spell the difference between stationary and time-varying q(0) in the V_{loop} = 0 scenarios



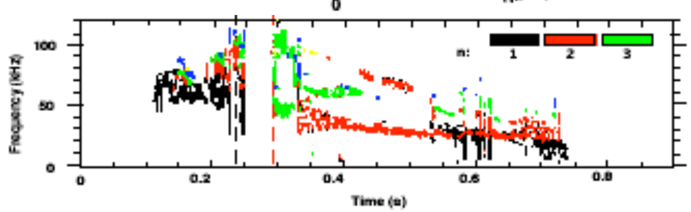


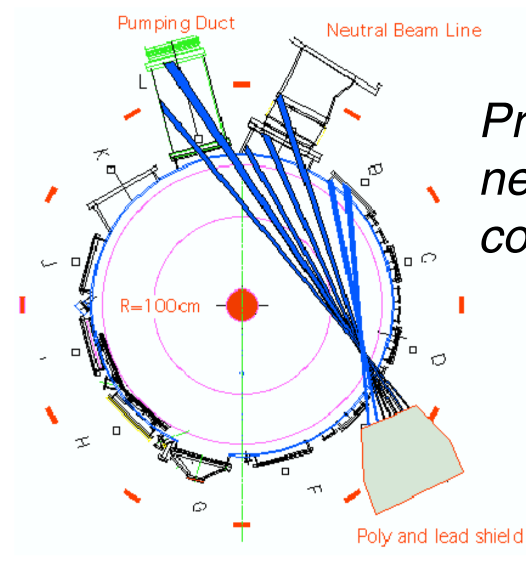
40% β_T, fully non-inductive long pulse scenario (TSC)

Studying fast-ion instability effects on J_{NB} and $n_{fast\ ion}(r,v,t)$ is a program priority for '05 - '07



NPA





Proposed neutron collimator

Layout of the proposed Tangential Profile Monitor

Milestone for FY 05: *Assess effects of beam-driven instability on core J_{NB}*

Milestone FY 07 (if increased budget): *Measure fast-ion transport due to fast-ion driven modes*

- With large $V_{fast\ ion}/V_{Alfvén}$ ==> high ITER relevance
- Major tools are
  - MSE
  - Scanning NPA for changes in distribution function
  - Neutron collimator proposed for radial distribution
  - Fast ion loss probe (this year)

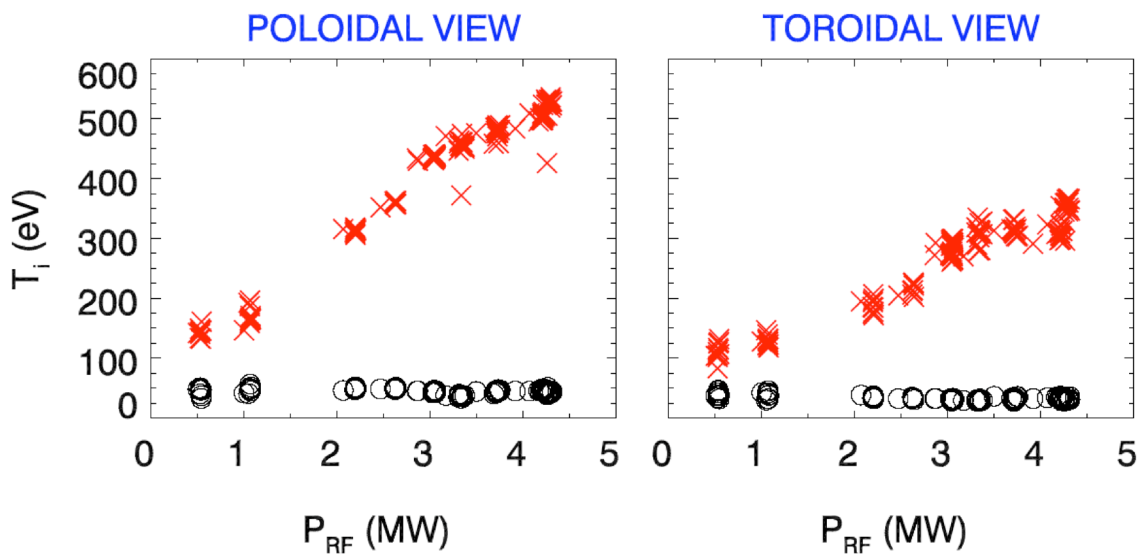
Observed ion absorption is one candidate to explain puzzling HHFW observations

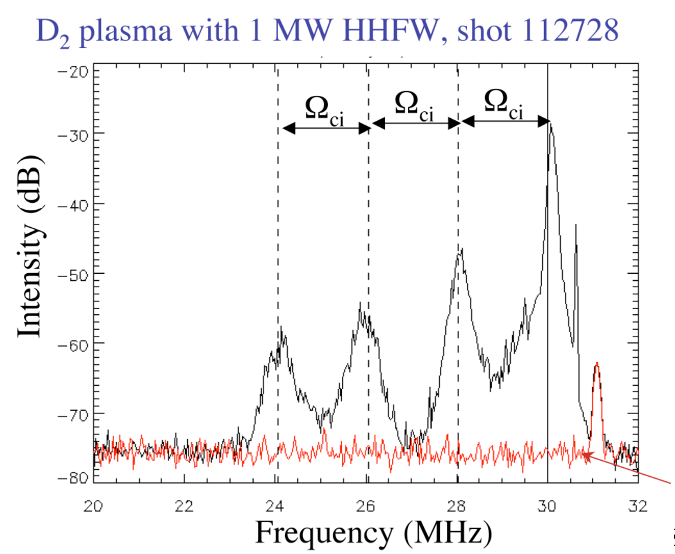
- Recall: strong wavenumber dependence of heating efficiency
  - 14 m^{-1} and 70 - 80% absorption vs. 3.5 m^{-1} and zero absorption

- Anisotropic edge ion heating driven by HHFW from conversion to IBW a leading candidate.

- Plan includes further and new study of
  - Parametric absorption
  - Sheath physics
  - Core wave penetration

Milestone FY 06*:*
Understand & optimize HHFW coupling

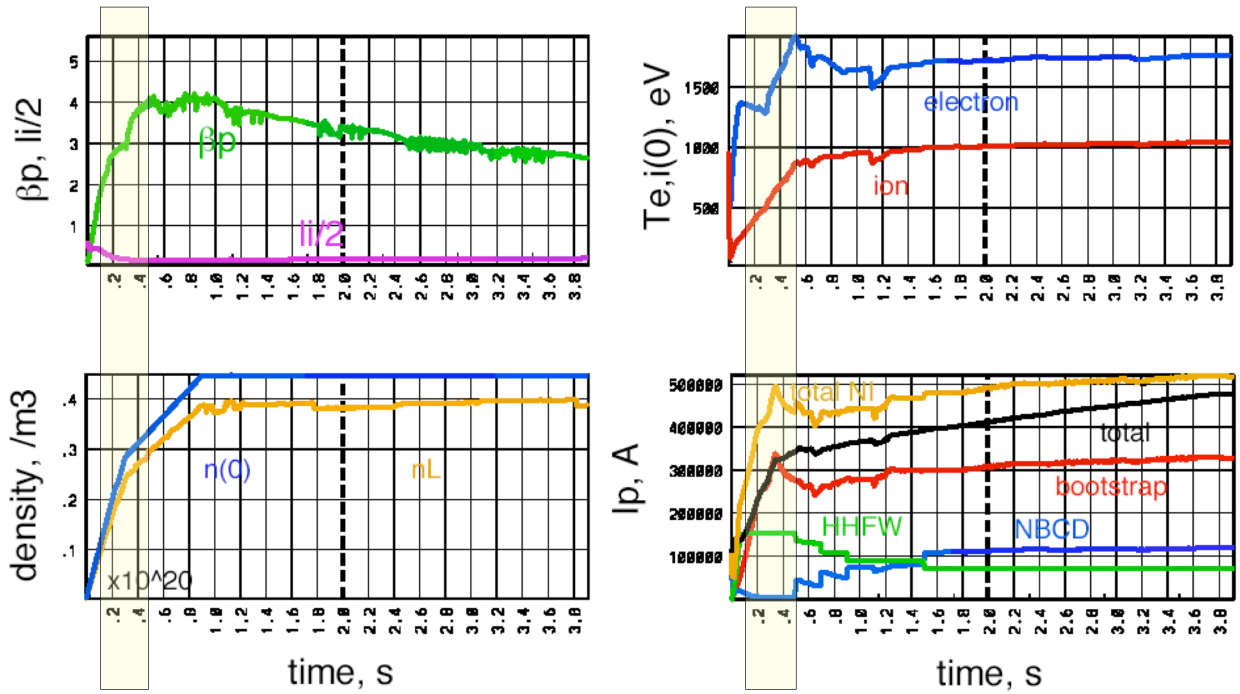




RF Probe measurements during HHFW

A HHFW research priority for FY '05 - '07 is using it to assist in an I_p ramp-up without a solenoid

All tokamak-based reactor scenarios will benefit from this capability



TSC

- Scenario must elevate I_p to level where beam ions can be confined (hundreds of kA)

- Control work will target
  - controlling antenna gap at low I_p
  - optimizing shape for coupling
  - transitions from one CD method to the next

Milestone for FY 07
Test solenoid-free ramp-up to high current.

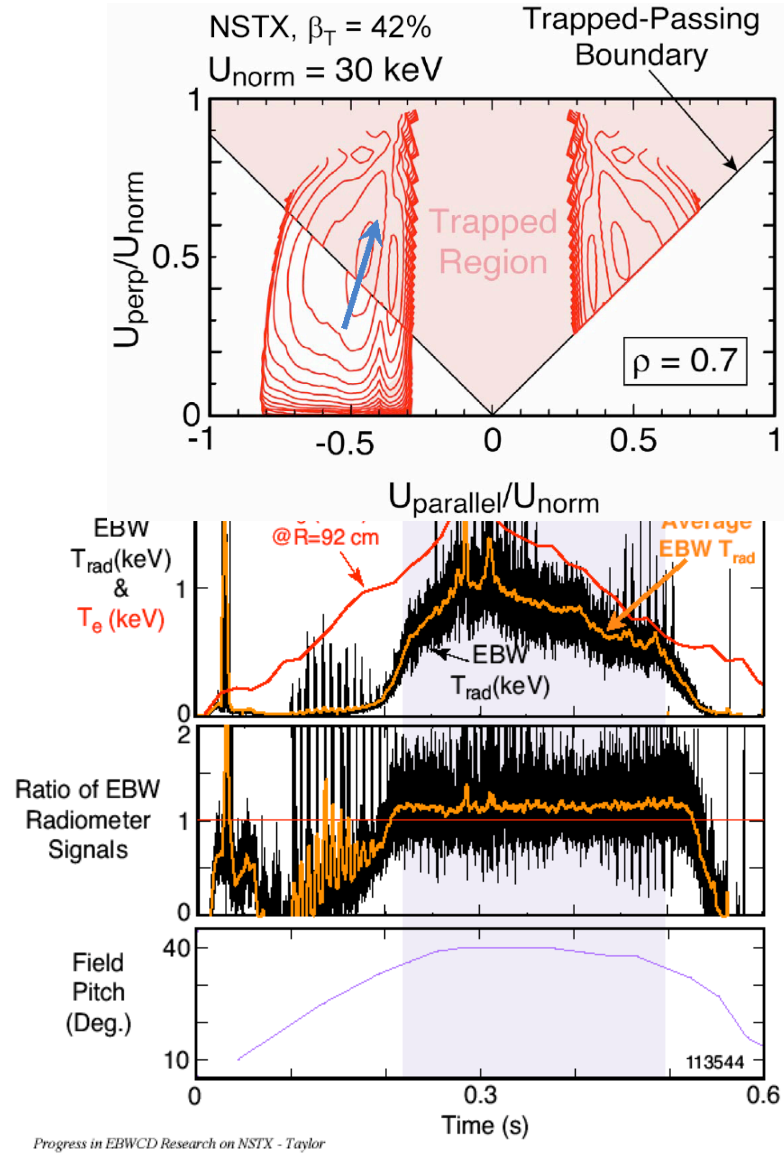
EBW design will draw upon extension of emission studies and collaboration

- Test novel aspect of wave-particle theory by taking advantage of strong ST particle trapping: *phase space diffusion*

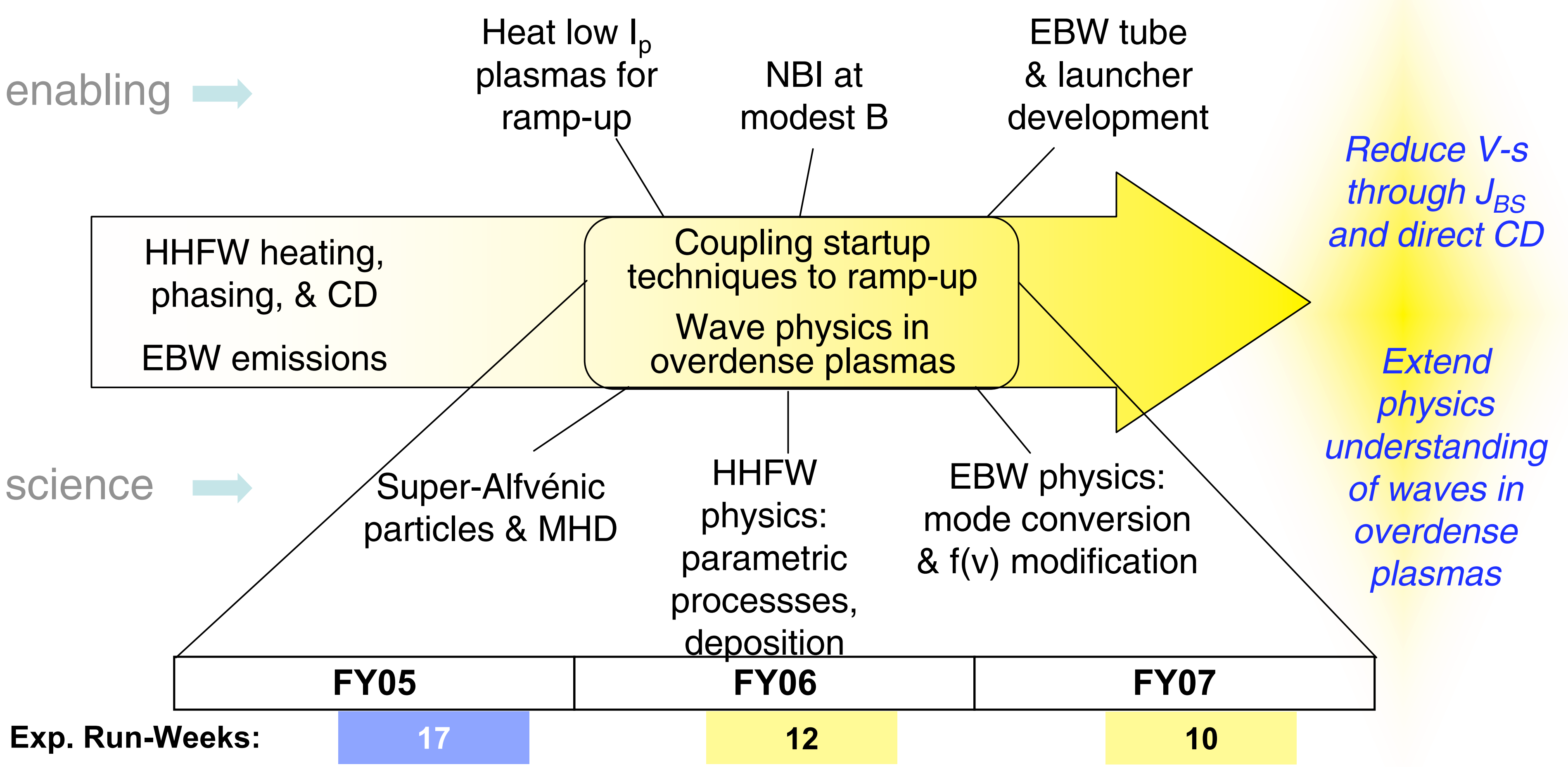
- Experiments in ‘04 show good conversion efficiency of nearly circular emission, in accord with theory

- New view will enable emission & polarization studies at 28 GHz, which is at present the preferred option for NSTX (28 GHz)

- Plan: Decision at end of ‘05, design in ‘06 of 1 MW system.



Waves & energetic particles



Assess effects of beam-driven instabilities on core J_{NB}

Understand & optimize HHFW

Measure fast-ion transport ← due to fast-ion MHD

coupling

Test solenoid-free ramp-up to high current

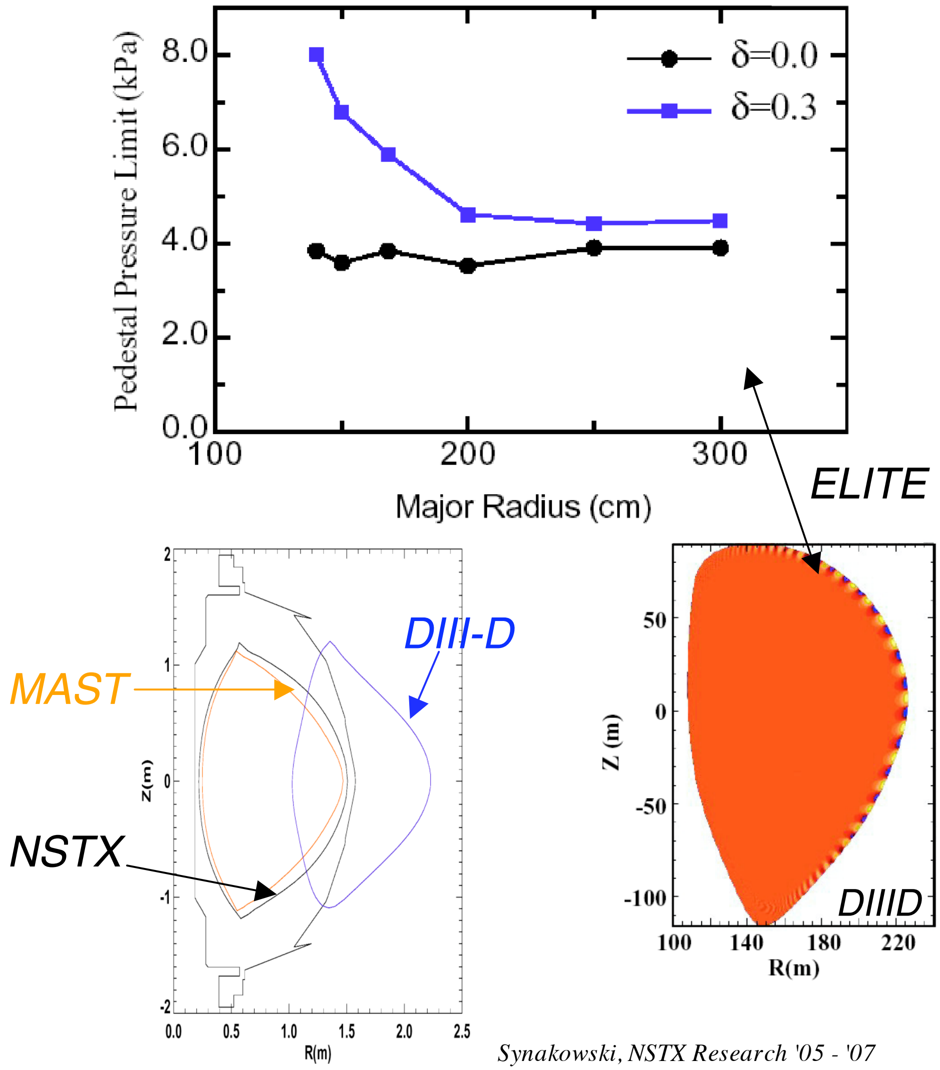
- *MHD: Stability & helicity injection*
- *Core transport and turbulence*
- *Wave/particle interactions*
- *Edge physics and plasma/boundary interfaces*
- *Integration*

Opportunities include

- *Low A and edge stability*
- *Turbulence dynamics: intermittency & shear Alfvénic turbulence*
- *ITER-relevant power densities*
- *Opportunity for new power/particle handling solution*

Low A to be used to test understanding of edge pedestal stability

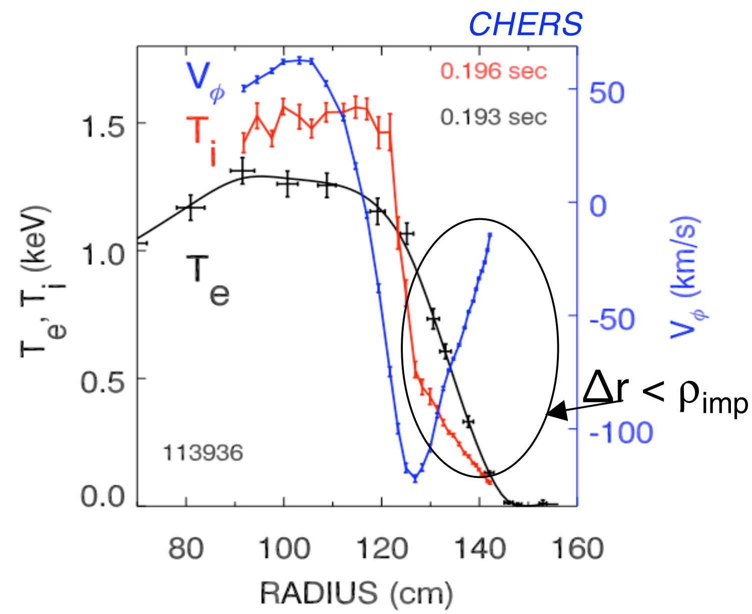
- Developing and testing pedestal models is of high importance to ITER and burning plasmas
- ELITE code predicts easier access to 2nd stability at low A with moderate shaping
- Prediction is the basis of an ITPA experiment with NSTX, MAST, and DIII-D

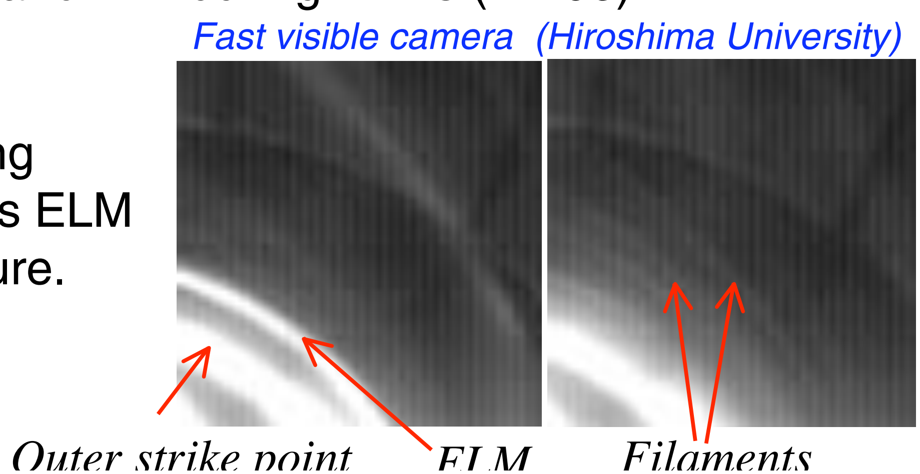


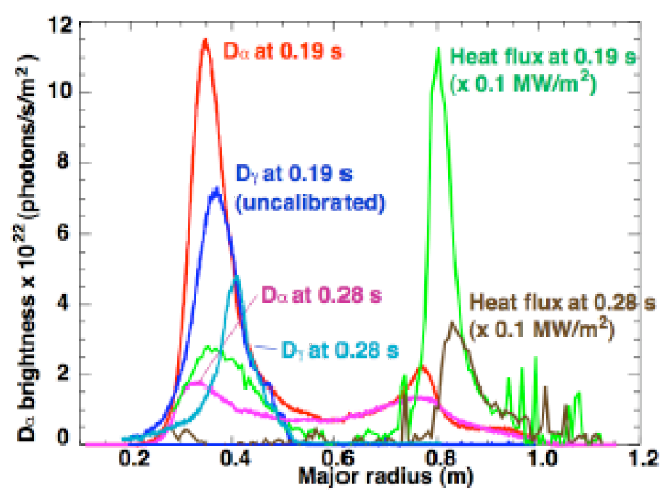
Synakowski, NSTX Research '05 - '07

Edge diagnostic capabilities enable edge pedestal and SOL studies in conditions relevant to ITER and the ST

- Low aspect ratio + heating ==> high P/R, power densities at ITER levels (10 MW/m²).
  - Helps motivate small ELM regime joint experiments (with C-Mod, MAST: ITPA)
- Excellent spatial resolution with CHERS, improved resolution with MPTS
  - Edge reflectometry for finer resolution of edge n_e
  - Edge reciprocating probe: SOL n_e, T_e
  - Also edge poloidal and toroidal flows
- Divertor IR camera & spectroscopy. New fast camera for ΔT during ELMs (FY 06)
- Edge imaging reveals ELM structure.





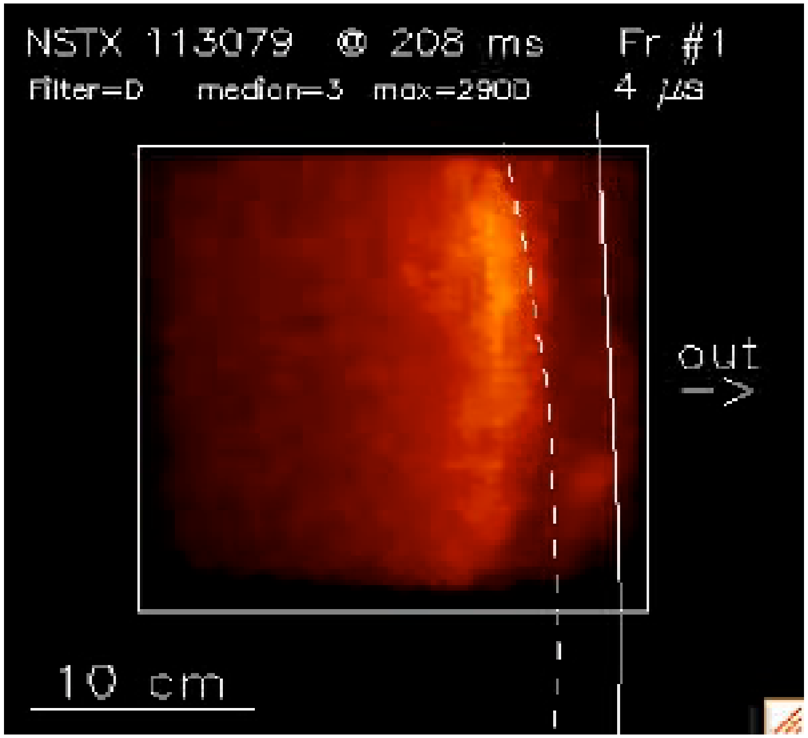


Divertor cameras

A strong collaborative effort in turbulence imaging will continue

- Convective SOL turbulence has large implications for ITER
- NSTX program is a collaboration with C-Mod and is an ITPA activity. A leading effort community-wide.
- NSTX may be revealing new class of turbulence in the edge, as BOUT simulations point to shear Alfvén turbulence
  - large gyroradius challenge the code at new limits (Umansky, LLNL).

L-H transition



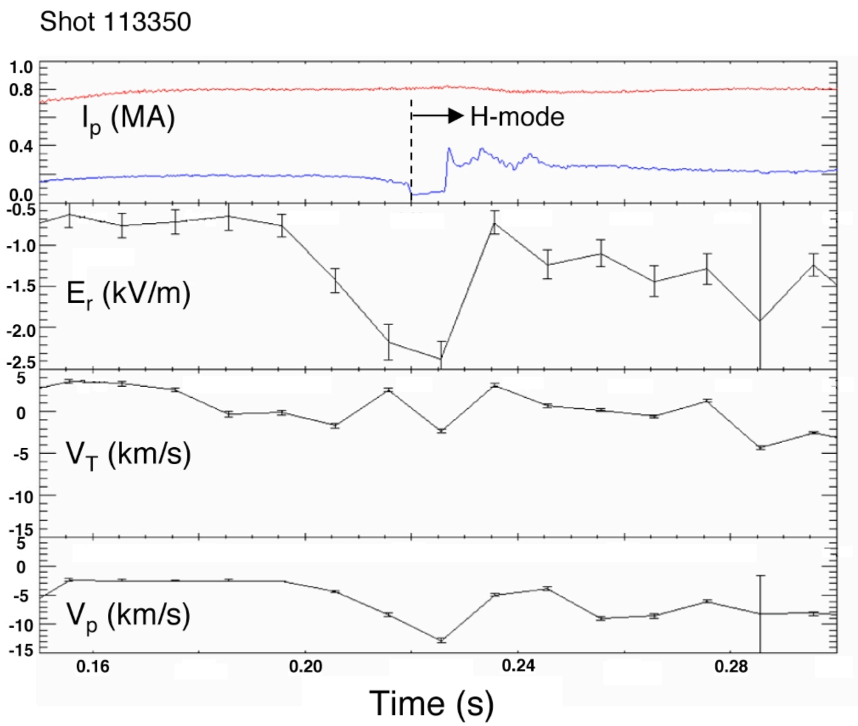
Zweben

The entire edge diagnostic complement will enable:

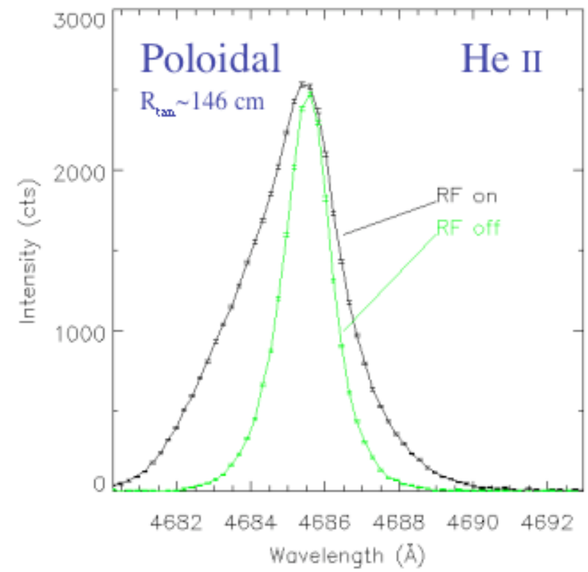
Milestone for FY 05*:* *Characterize pedestal and SOL of low-A, H-mode, high P/R plasmas*

Milestone for FY 07 (if increased budget)*:* *Assess long-pulse heat & particle control requirements of low-A, H-mode, high P/R plasmas*

Recent results from NSTX and from the rest of the community motivate edge flow research

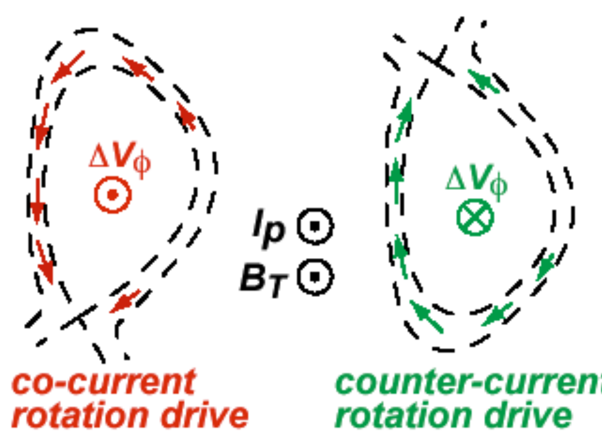


Long-time precursor in V_θ and E_r to ohmic H mode transition



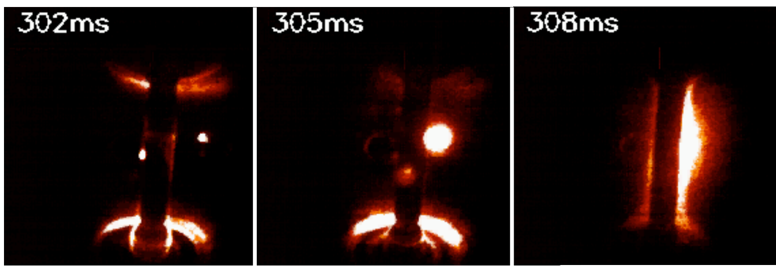
HHFW-induced V_θ

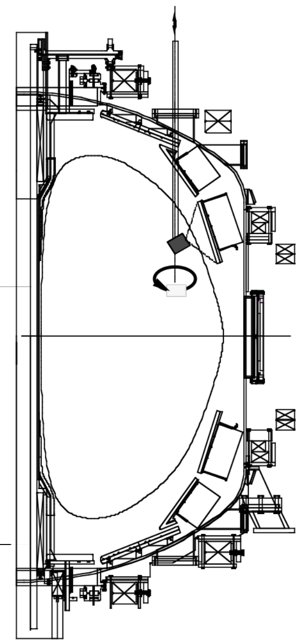
Configuration dependence of edge rotation (with LaBombard, MIT)

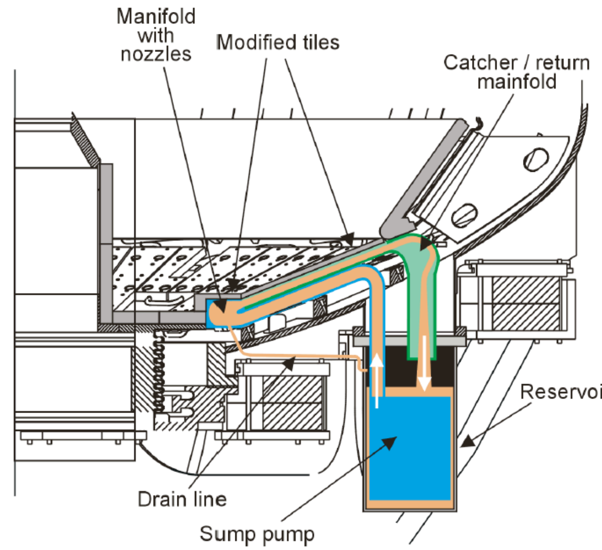


Lithium edge flux control studies start with pellets, and may culminate in a powerful new edge control technique

Milestone for FY 07*:*
Characterize lithium pellet & evaporator coating effectiveness (advance to FY 06 if increased budgets)







Li pellets: injector commissioned in '04

- Develop deposition techniques in '05
- Note opportunity for pellet abalation studies (1/R, high β)

e-beam for Li coatings in '06

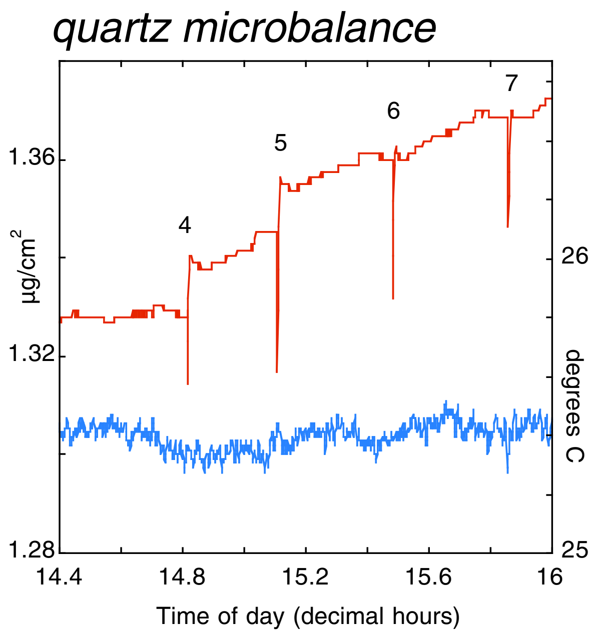
- Li coatings: localized, 1000 Å *before every shot*

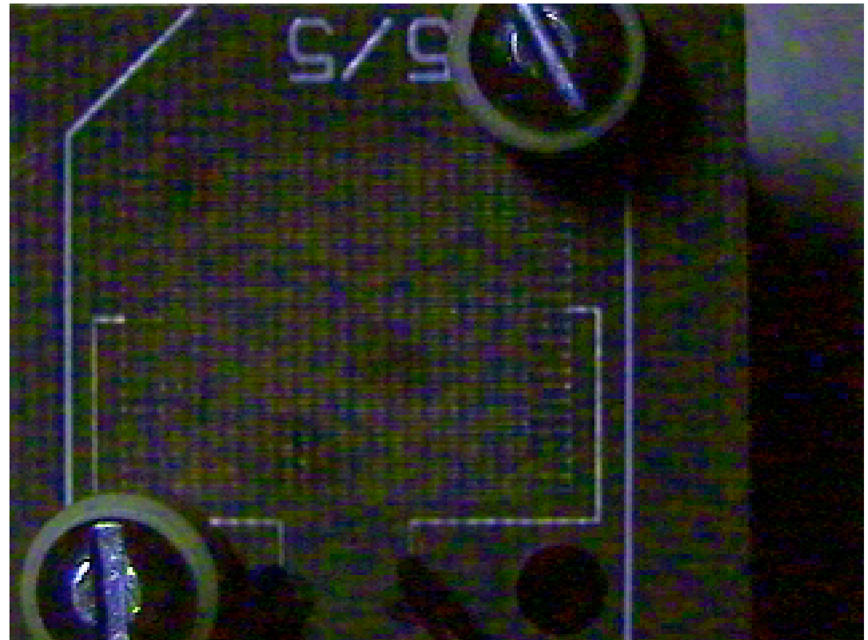
See Kaita's talk, this meeting

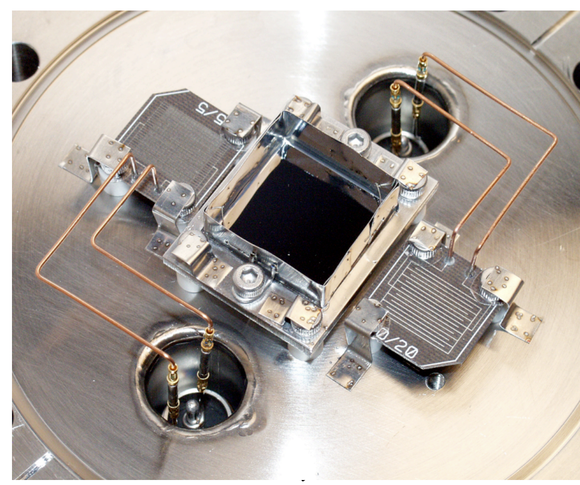
Liquid lithium module: decision following coatings studies

- Under ALIST group of VLT
- Would represent a revolutionary solution for both power and particle handling

NSTX is developing ITER/BP-relevant time resolved surface deposition monitors

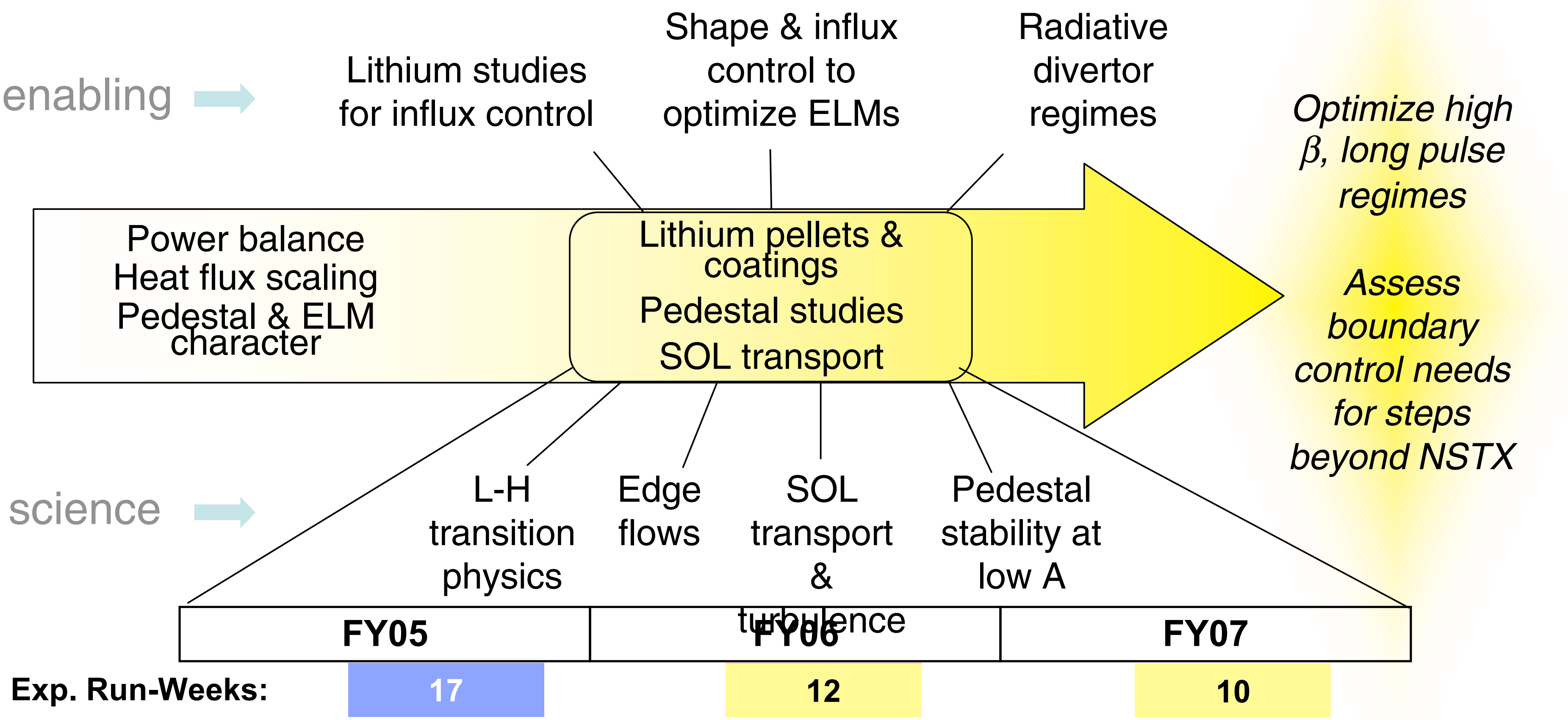






- Issue for ITER: tritium retention/transport. ITPA activity.
- Quartz microbalance: time resolved deposition measurements
- Also, novel electrostatic surface particle detector: tested in lab, installed on NSTX

Edge transport, stability, & interfaces



Characterize pedestal & SOL of low-A, H-mode, high P/R plasmas

Characterize Li pellet & evaporator coating effectiveness

Assess long-pulse heat of low-A, H-mode, high P/R plasmas

Accelerate with increased budget

- *MHD: Stability & helicity injection*
- *Core transport and turbulence*
- *Wave/particle interactions*
- *Edge physics and plasma/boundary interfaces*
- *Integration*

To follow:

- *A near-term fully non-inductive goal: prediction and performance*
- *Beyond 2007: tools and goals*

Improved projections to highest β_T, $V_{loop} = 0$ plasmas will be grounded in improved diagnosis, stronger shaping, more routine high beta

- High δ, high κ shaping, approaching the shape of targeted 40% β_T, long pulse plasmas, will be developed this run.

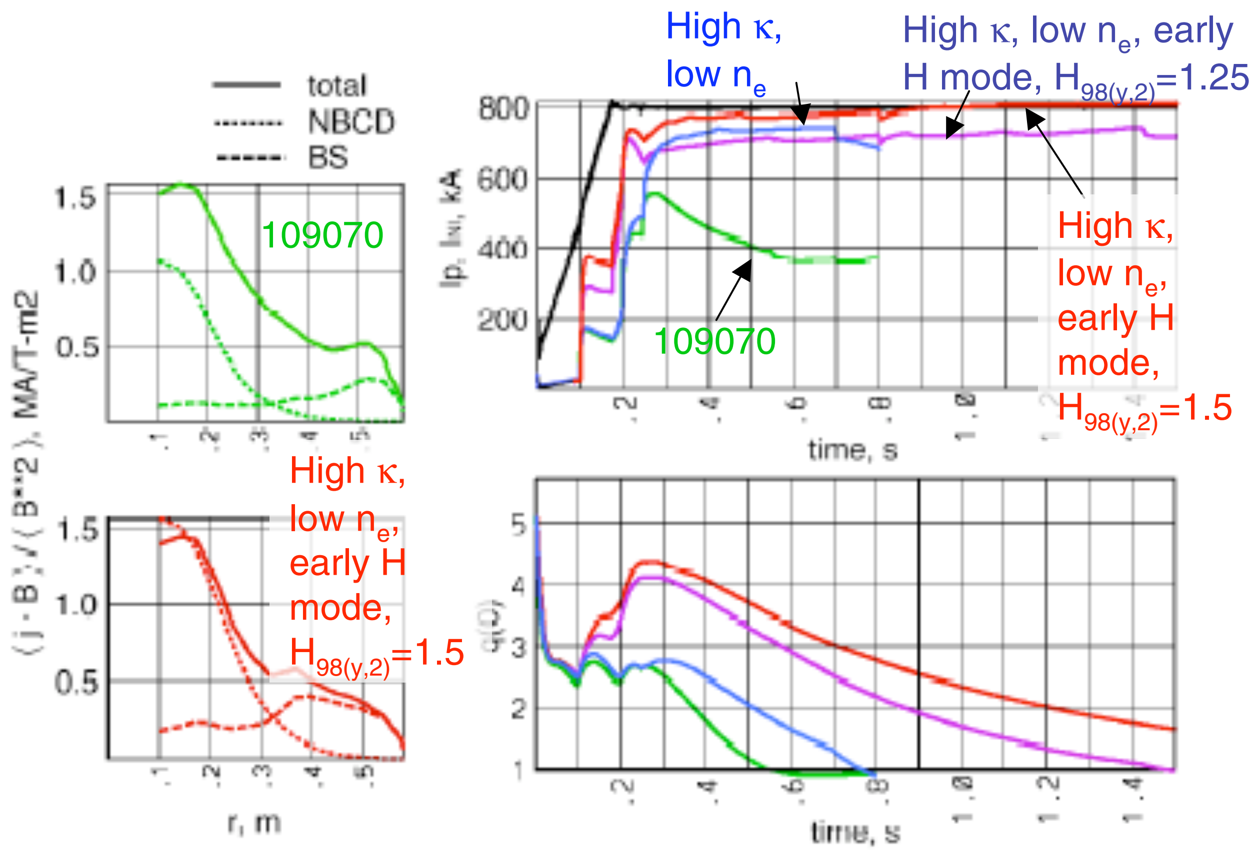
- Studies of MHD effects on fast ions will be performed to improve understanding of J_{NB}. Near term, compare/contrast with ITER hybrid scenario being addressed by the ITPA
  - Will fast ion broaden J_{NB}, yielding a plasma closer to a stationary state?

- Improved diagnostic capability includes
  - 10 - 12 channel MSE
  - MPTS: additional 10 channels split between core and edge will be deployed - 30 channels by end of run

Milestone for FY05 on Physics Integration: *Characterize high bootstrap fraction, low loop voltage plasmas with duration > τ_{skin}*

Strong shaping & particle control will help in generating plasmas with surface V_{loop} = 0 for $\tau_{flat} > \tau_{skin}$ in 2007

- Requires
  - κ -> 2.6, δ > 0.5
  - Lower density ($n_e(0)$ from 5×10^{19} for 109070; modeling demands ~ 3×10^{19} m^{-3})
  - NBI (> 5 MW)
- Confinement improvements will help $J_{BS,}$ increase relaxation time
- Current evolution may depend on fast ion MHD: will it help?

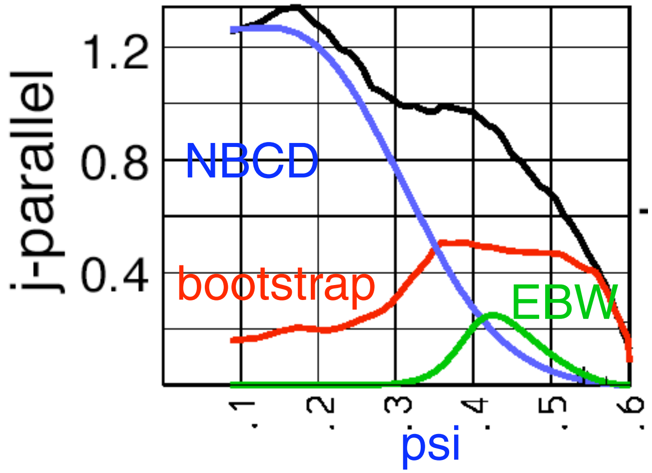


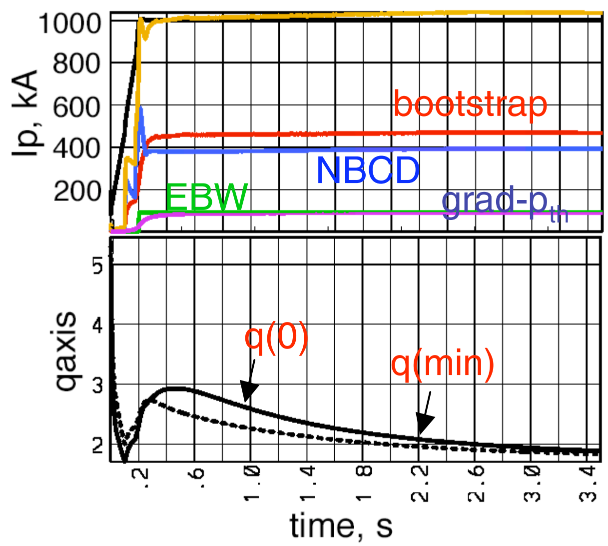
Milestone for FY 07 on physics integration (if budget is increased): *Evaluate surface V_{loop} ~ 0 plasmas with $\tau_{flat} > \tau_{skin}$*

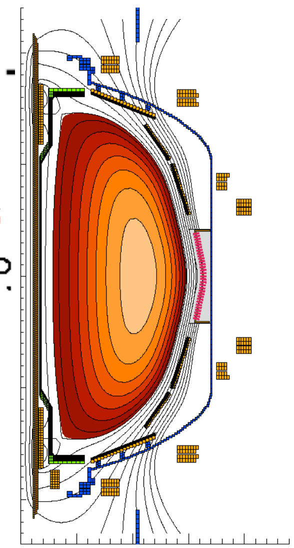
Beyond 2007: 40% β_T with ~100% I_{NI}, $\tau_{pulse} >> \tau_{skin}$, demands near-term development of new tools and their understanding

Establishing extrapolability requires progress in all of the research program's scientific elements

- Enhanced shaping improves ballooning & kink stability through simultaneous high δ and κ
- Near with-wall limits ⇒ mode control + rotation are key
- Critical issues include J_{NB} in the ST & thermal confinement improvement
- NBI + EBW. NBI provides J_{NB} + J_{BS} EBW drives current off-axis, less J_{BS}
- Particle control required to maintain moderate n_e for CD (4×10^{19} m^{-3})







Integration: towards high beta, long pulse

Assess high β, low A physics with passive control

Strengthen physics basis with advanced measurements & control at high β & low A

Optimize long-pulse, high β

Strengthen physics understanding

FY05	FY06	FY07
17	12	10

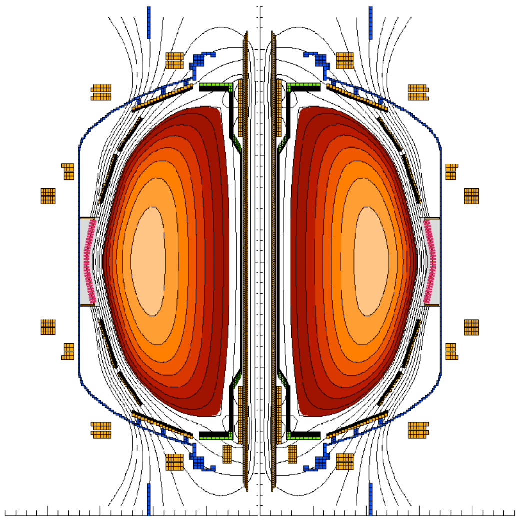
Exp. Run-Weeks: 17 (FY05), 12 (FY06), 10 (FY07)

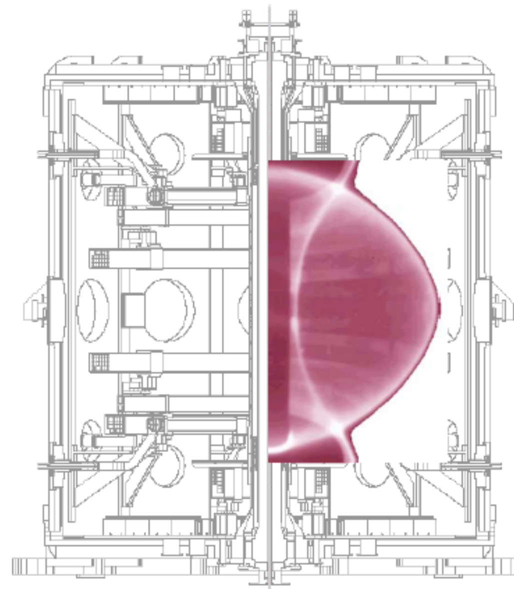
Characterize high-bootstrap
surface
induction plasmas for ≥ τ_{skin}

Characterize
V_L = 0
plasmas for ≥ τ
skin

← Accelerate if budgets are increased

MAST & NSTX complementarity strengthen ST scientific contributions to toroidal confinement





Complementary aspects include

MHD	Nearby wall & conducting plates vs. ~ no wall
Core transport	Wide range of beam momentum and Mach number
Startup	Internal vs. external PFs. CHI on NSTX
EBW	MAST deployment at 28 GHz basis for collaboration with NSTX
Pedestal	Influence of differences in particle sources on pedestal & ELMs
Divertor & SOL	In-out biased with CHI CD on NSTX. Biasable non-axisymmetrically on MAST. Near wall (NSTX) vs. larger volume (MAST)

NSTX research for '05 - '07 is well aligned with the fusion program's scientific priorities and supports ITER

FESAC Theme: Understand the role of magnetic structure on confinement, & plasma pressure limits

Stability pressure limits & magnetic reconnection vs. A, shape, profile, q & flows, for internal & external modes with $V_{flow}/V_A < 0.4$ & unity β; helicity transport

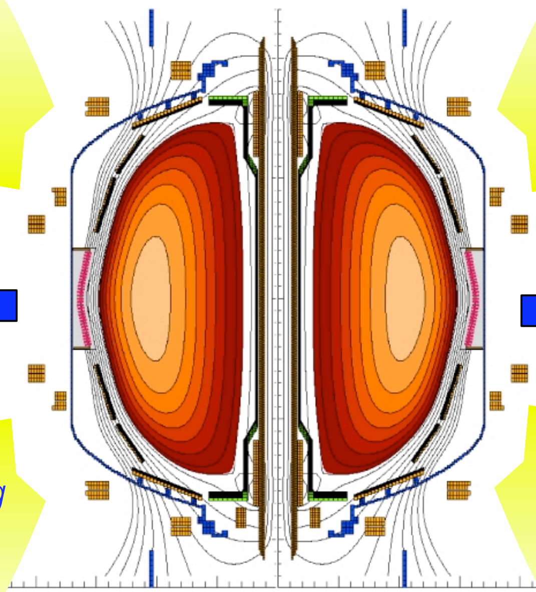
Demonstrate Feasibility with Burning Plasmas

Develop Understanding and Predicitve Capability

Microscopic ion, electron, and tearing turbulence measurement & theory comparison over wide range in β, flows, and magnetic shear, with good average curvature and high trapping

FESAC Theme: Understand & control the processes that govern confinement of heat, momentum, and particles

NSTX



FESAC Theme: Learn to use energetic particles & e-m waves to sustain and control high temperature plasmas

EM waves in overdense plasma; Phase space manipulation with high electron trapping; energetic ions with large orbits; Alfven eigenmodes and turbulence with $V_{fast}/V_A >> 1$

Determine Most Promising Configurations

Develop New Materials, Components, & Technologies

Physics of ELMs, pedestal, SOL turbulence & high divertor heat flux, with large in/out asymmetry; Li coatings & liquid surface interactions with plasma.

FESAC Theme: Learn to control the interface between a 100 million degree plasma and its room temperature surroundings

NSTX research for FY ‘05 - ‘07 will advance toroidal confinement science, and fusion energy development

- A strength in the science is maximizing the scientific leverage afforded by unique plasma properties, joint research within the ITPA,and novel diagnostics.

- NSTX research makes contributions in many areas of strong need to the ITER program and burning plasmas in general

- The research plan makes balanced progress towards achieving high beta, long pulse capability and for advancing toroidal confinement science.

- The scientific opportunities afforded by this program are well aligned with the national program’s scientific priorities

- Full utilization will yield significantly faster realization of programmatic goals