2012 Joint Research Target

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NSTX Research Forum

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Objective is to determine the source of transport in multiple channels, and the coupling among the channels

- Common approach being undertaken by C-Mod, DIII-D, NSTX
- Electron transport highlighted as one of the channels on which all will focus
  - ITG/TEM/neoclassical “accepted” as source of anomalous ion (and momentum) transport
  - Source of anomalous electron transport uncertain
- Particle and/or impurity transport is other channel to be highlighted
  - Include ion/momentum where possible, but JRT dedicated to momentum transport in 2008

2012 JRT

- NSTX contribution
  - Excellent complement of turbulence diagnostics
    - Unique high-k for localized electron-scale turbulence
    - High S/N BES with excellent spatial coverage
    - FIRETIP
    - Polarimetry (towards end of run?) for B-twiddle
    - Excellent coupling to gyrokinetic simulations
  - Sources of electron transport in NSTX
    - ETG (identified)
    - GAE (identified?)
    - Microtearing (to be identified) $\rightarrow$ R(11-1)
- Approaches to JRT XP
  - Key area is to determine ways to assess particle/impurity transport
    - Thermal transport comes along for the ride (?)
  - Need to use perturbative approach for particles/impurities

2012 JRT

- Particle transport
  - SGI to provide modulated edge particle source
  - UCLA reflectometer to measure perturbation
  - Scoping XP (Kubota)
    - Adjust SGI timing/pressure to avoid large core perturbation
    - Assess Fourier method to determine D/v
    - Are BES/CHERS compromised?
  - Other perturbation techniques
  - Steady-state analysis
    - DEGAS-II to determine particle source profiles (coordinate with Stotler)
    - Input source into TRANSP, D/v output
- Impurity transport
  - Can use SGI to seed with impurity gas at same time as D^+ puff
    - Is modulation of impurity source useful?
    - Potential difficulty in separating X-ray emission from two species
    - May have to separate the two puffs in time (use steady-state particle transport analysis in that case)

2012 JRT

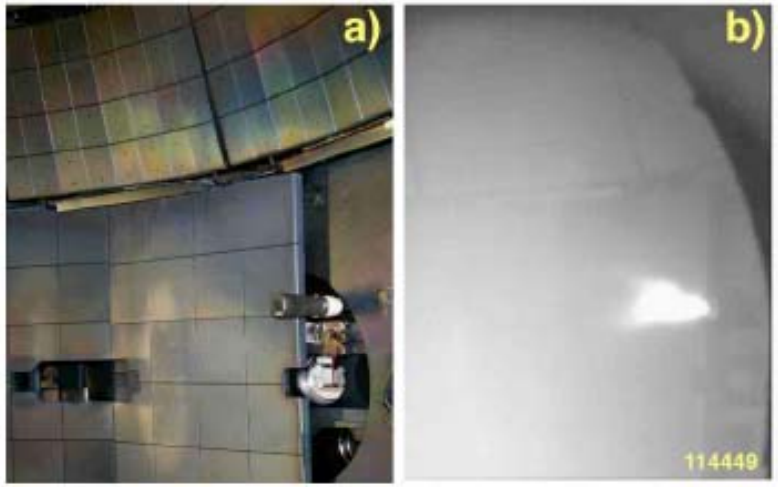
- Thermal e/i transport
  - Can assess D^{eff} from steady-state analysis
  - Possible HHFW modulation for determining D/v
    - Issues with HHFW-NBI coupling
    - Magnitude and profile of HHFW heating uncertain
- Desired discharge conditions/requirements
  - MHD-free for ~150 ms (10-15 SGI modulations)
  - BES needs full 2 MW source (A for MSE)
  - Low edge density for reflectometry measurements (≤3.5e19 m^{-3})
- L-mode: thermal/particle/impurity
  - Employ SGI modulation if Kubota XP successful
  - S-S (DEGAS-II) if not (or in addition) + impurity puffs
  - Use MHD-free discharges developed in earlier EP XP (shot #s)?

2012 JRT

- H-mode: thermal/impurity
  - S-S approach + impurity puffs
  - Vary ExB shear using n=3 to control ITG suppression
    - 2011 XP – analysis has to be done to determine how successful
    - Will 3D effects compromise analysis?
  - If equipment arrives from DIII-D to allow reflectometer access to ≤ 7e19 m^{-3} before run ends, repeat H-mode work using SGI modulation method
  - Don't delay initial work, however

XP to optimize diagnostic method employing supersonic gas injector for transport studies

- Gas injection for radial transport studies
  - Density pulse - deuteron transport (D_D, v_D)
  - Impurity density pulse propagation- impurity transport (D_{imp}, v_{imp})
  - Cold pulse propagation – heat transport (χ_e)
- Pulsed or modulated to resolve diffusive and convective parts
- Supersonic gas injector on NSTX
  - Any gas (D_2, He, CD_4, Ne, Ar)
  - Midplane location (Z=16 cm)
  - $\tau_{pulse} \geq 10$ ms, up to 100 pulses / shot
  - Flow rate $5 \times 10^{20} – 1.4 \times 10^{22}$ s^{-1}
    - Total plasma inventory $N_e \leq 10^{21}$ / shot
  - Delta-function-like perturbation affects T_e, n_e, n_Z in pedestal and core
  - Edge / divertor D_α spectroscopy in combination with DEGAS 2 can be used for source rate estimates



- Diagnostic issues
  - Need to optimize SGI flow rate and pulse times for edge reflectometry n_e cutt-off and FireTip / MPTS n_e sensitivity
  - SGI pulses generally cause CHERS background signal contamination
  - Need to optimize impurity inj. rate for soft X-ray diagnostic sensitivity for cold pulse and impurity transport