NSTX

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LH power threshold and H-mode pedestal height versus X-point height

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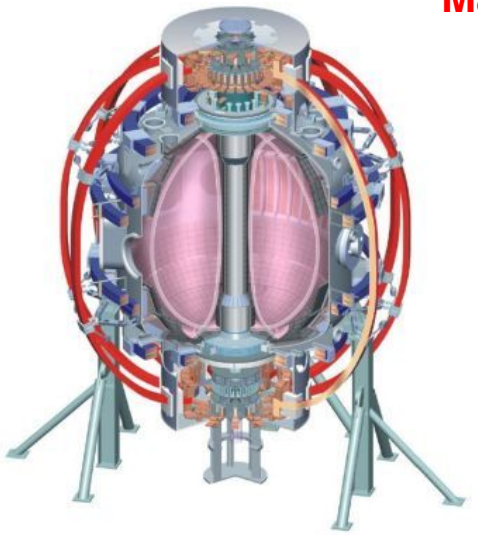

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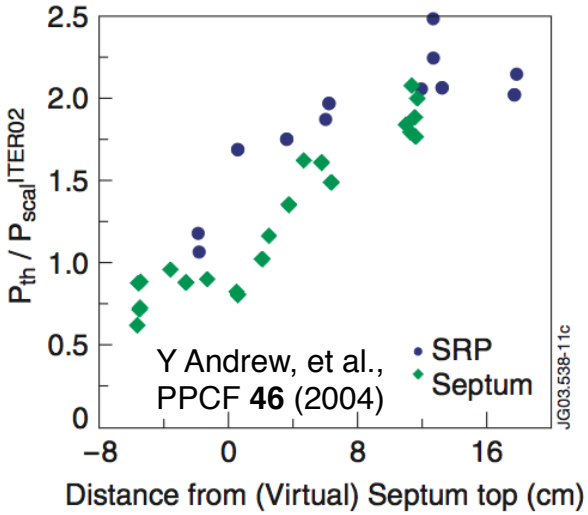
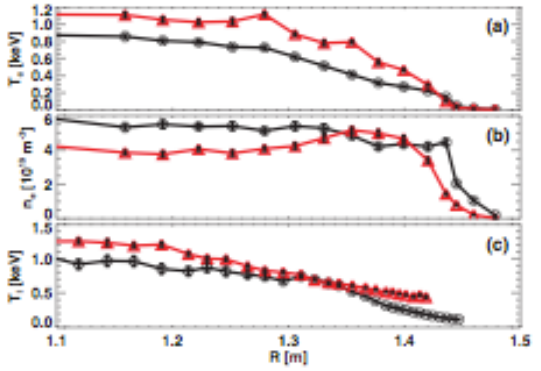
XP would use X-point height as a tool to explore the effect of neutrals on the plasma edge

- LH power threshold scaling with Z_X
  - JET, DIII-D reduction in P_{LH} as X-point moves closer to divertor (leg length shrinks)
    - Indications that P_{LH} decreases as recycling increases
  - NSTX lithium: P_{LH} decreases with divertor D_α
  - ITPA PEP-28: connection length or neutrals?
    - NSTX can decouple with lithium



- Impact of neutrals on H-mode pedestal
  - Density profile depends on neutral penetration
  - NSTX: Change H-mode density profile via lithium coatings
    - Low recycling regimes not as easy to achieve on other devices
    - Contributes to FY12 JRT



R Maingi, et al., PRL **103** (2009)

Experimental plan

- First ½ day: Shot development and H-mode pedestal measurements
  - X-point height and strike point control
  - Align strike points with tile probes (low triangularity shape)
  - Target Type-1 ELMS with 2 – 3 different X-point heights with low divertor recycling
    - Enhances impact of connection length
  - Repeat with reduced inter-shot lithium (or no lithium) if time

- Second ½ day: Use developed shots to measure P_{LH} vs Z_X
  - Use two different shapes and two levels of inter-shot lithium
  - NBI heating and all available turbulence diagnostics
  - If time, explore impact of fueling in private flux region

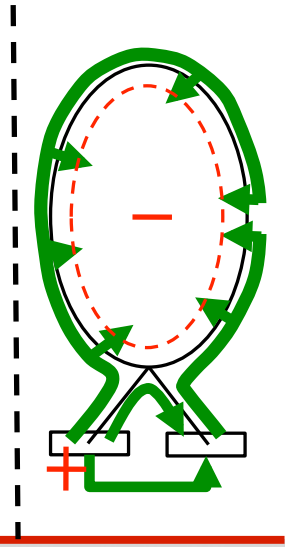
Backup

Shaing and Chang: ion orbit loss to divertor contribute to mean poloidal flows

- Shaing bifurcation model
  - Collisionless ions lost on banana orbits to wall or SOL collision
    - Source of mean poloidal flow (i.e., E_r)
  - Return current via reduction in collisional ion flux out of plasma
  - Two roots:
    - L root: low poloidal flows, ion current is finite
    - At critical edge collisionality, multiple roots
    - H root: large poloidal flow, small ion current

KC Shaing, and EC Crume, PRL **63**, 2369 (1989)

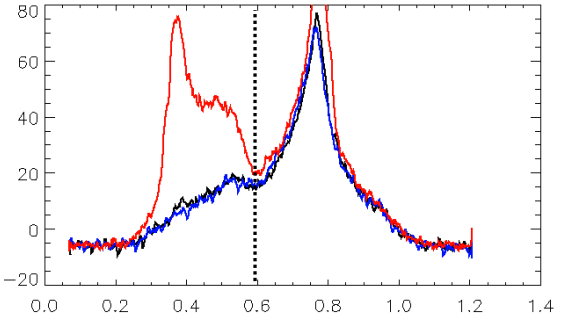
- Chang X-transport model
  - X-point enhances orbit loss
  - Ions primarily lost to inner divertor
  - Current loop closes through parallel currents through SOL and conducting divertor



C.S. Chang, S. Ku, H. Weitzner, PoP **9**, No. 9, 3884 (2002)

Low triangularity data on NSTX consistent with a transition from an L root to H root

- L-mode with $P_{heat} < P_{LH}$
  - D_α light primarily from outer divertor
  - Near-zero current through CHI gap
  - Negligible ion flux to inboard divertor probes



- L-mode with $P_{heat} \sim P_{LH}$
  - Large increase in D_α light from inboard divertor (precursor to transition)
  - Several hundred amps of current from inboard to ouboard divertor
  - Increase in ion flux to inboard divertor

- At LH transition
  - e- edge collisionality very similar, independent of P_{nbi}, gas, lithium
  - D_α drops on both inboard and outboard
  - Current through CHI gap reverses in sign, decays to zero ~ 20ms
  - Change in ion flux not well resolved (100 Hz sweep)