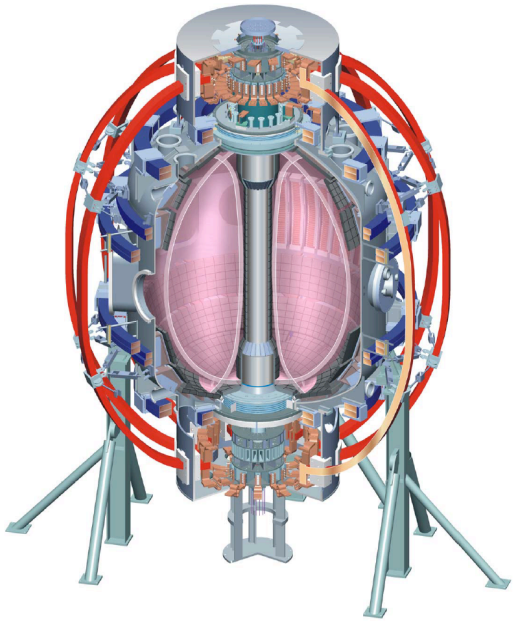
Supported by Office of Science

Divertor heat flux reduction and detachment in lower δ, κ LSN plasmas

V.A. Soukhanovskii
and NSTX Team

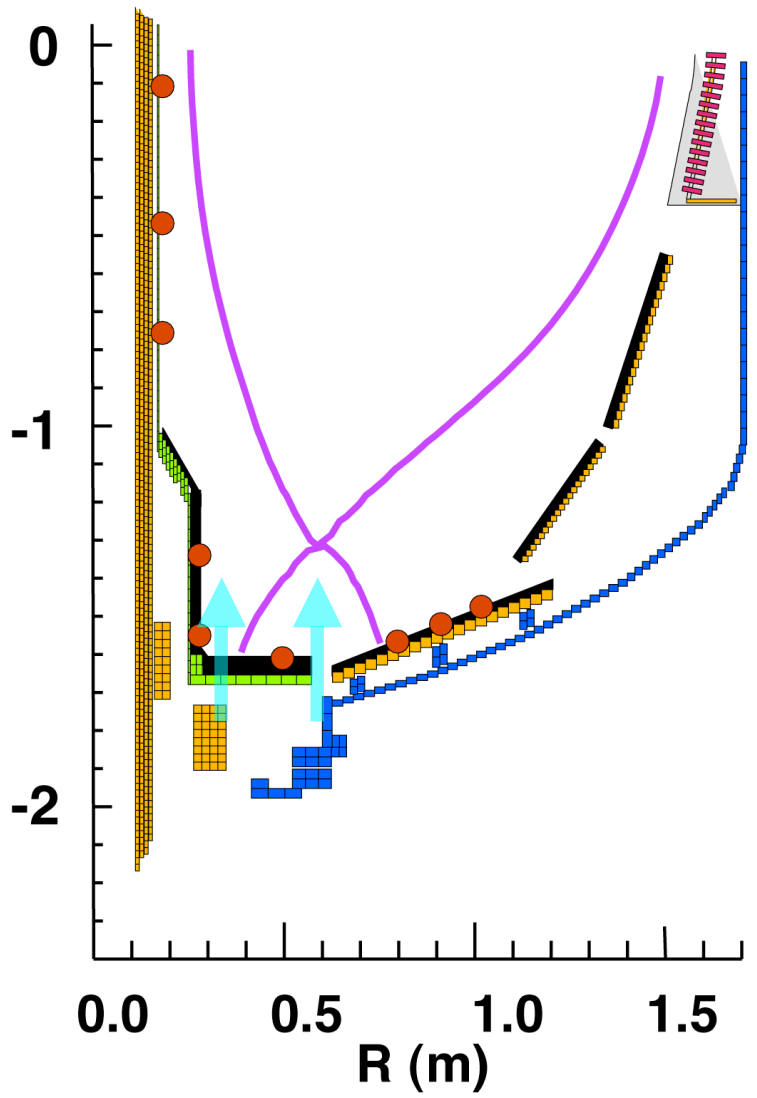


NSTX Monday Physics Meeting
03 March 2006
Princeton, NJ

Understand and control divertor heat and particle fluxes at low aspect ratio

- XP 605 includes three parts - study divertor heat flux mitigation techniques and detachment
  - in LSN shape with $\delta \sim 0.5$, $\kappa = 1.8\text{-}2.0$ with D_2 puffing
  - in LSN shape with $\delta \sim 0.7$, $\kappa = 2.2\text{-}2.5$ with D_2 puffing
  - in LSN shape with $\delta \sim 0.5$, $\kappa = 1.8\text{-}2.0$ with CD_4 puffing

- Challenges
  - Run XP in the first week of plasma operations
  - Figure out how to puff deuterium from B5 / LDGIS
  - Need rtEFIT to control X-point height in low δ, κ LSN shape for divertor Langmuir probe measurements

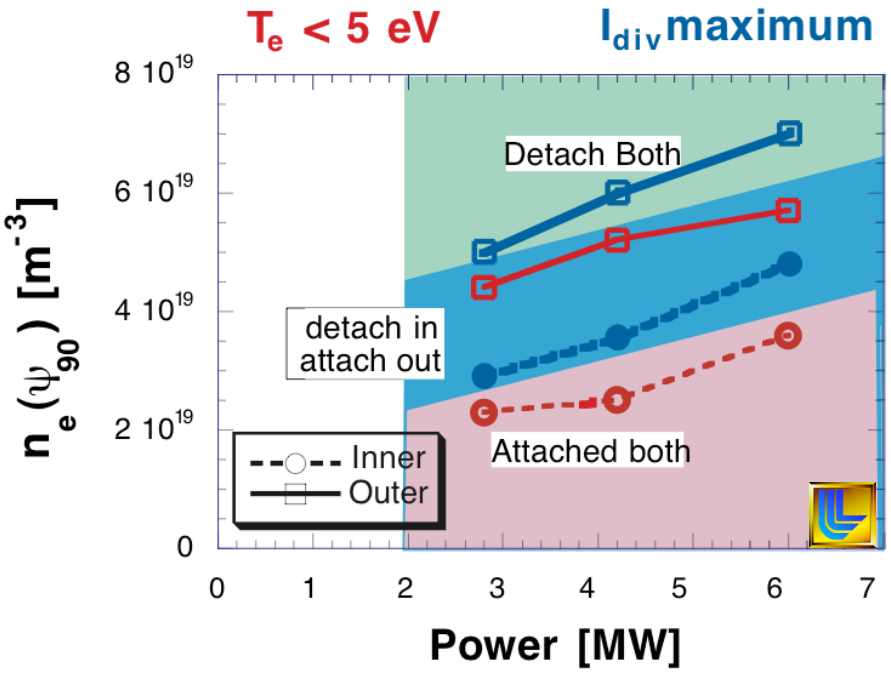


XP 605 results

- Figured out how to trick PCS software to puff deuterium from Branch 5 and LDGIS in steady-state mode (acknowledgements: R. Gernhardt, R. Raman)
- Established target - rtEFIT-controlled low δ,κ LSN - 4 MW NBI-heated H-mode with small ELMs (acknowledgements: D. Gates, D. Mueller)

- Puffed deuterium from B5 and LDGIS using rates 20 - 200 Torr.l /s - observed partial detachment (PD) at outer strike point (OSP)
- Found lower and upper thresholds of divertor gas puffing needed for OSP PD and retaining good confinement:
  - Onset of OSP PD occurs at ~ 50 Torr.l /s - start seeing spectroscopic signs of volume recombination and peak heat flux reduction
  - Upper limit is < 180 Torr.l /s - observe OSP detachment clearly, however, H-mode confinement is not maintained
- By-product of XP - obtained good **4 MW NBI L-mode** by puffing gas from B5 / LDGIS during front-end of discharge (0.0 - 0.20 s)
- Need to execute part 2 - high δ,κ LSN shape
- Continue analysis with UEDGE and DEGAS 2

Backup slides



G. Porter, N. Wolf

Attempt to change parallel momentum and power balance:

$$\frac{d}{ds}(m_i n v^2 + p_i + p_e) = -m_i(v_i - v_n)S_{i-n} + m_i v S_R$$

$$\frac{d}{ds}((-\kappa T_e^{5/2}\frac{dT_e}{ds}) + n v_{||}(\frac{5}{2}(T_i + T_e) + \frac{1}{2}m_i v_{||}^2 + I_0)) = S_E$$