Perturbative Transport with the Ultrasoft X-ray Arrays

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PPPL

Background

- **Joint XP 29**
  - **I) Impurity transport in NBI plasma using Neon puff + USXR**
  - **II) 'Cold pulse' χ_e using Ne puff + EBW**

- **Impurity transport technique validated:**
  - **good Ne signals, without perturbing the background plasma**
  - **background subtraction using consecutive shots Ok**

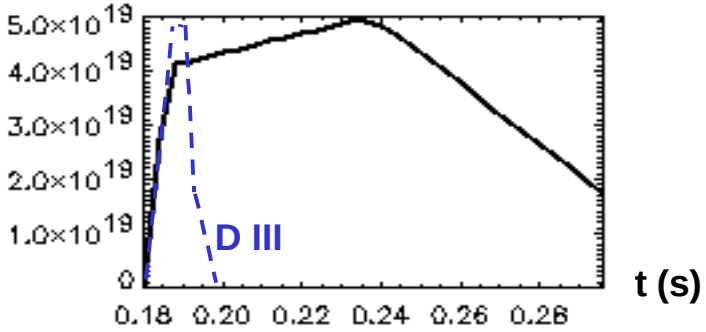
- **Very slow Ne penetration into the core**
  ('impurity barrier' at r/a ≈ 0.65, or q ≈ 2)

Background (continued)

- **Transport solutions:**
  - **$D \approx D_{neoclassical}$ for $r/a < 0.6$-0.7**
  - **$D \approx$ a few times $D_{neoclassical}$ and large outward V ('Neoclassical barrier', Houlberg *et al*., APS 2001)**

- **Injection provided only weak modeling constraint due to slow source evolution (slow wall pumping)**

Estimated Neon source evolution



- **'Cold pulse' not successful: stiff T_e profile, perturbation too slow**

Goals of new XP

- **Explore techniques to produce brief perturbations in NSTX**
- **Z-scaling / B-scaling of transport with NBI for comparison with NCLASS**
- **Impurity transport in RF, H-mode and sawtoothing discharges**
- **Retry 'cold pulse' χ_e measurements *(P. Efthimion, G. Taylor)***

XP Tools

- **Non-perturbing gas puff of various Z (e.g., CH_4, Ne, Ar)**
  - **high-temp bake should help create brief gas pulse (see DIII-D)**
  - **piggy-back experiments possible**

- **Slow pellet injector *(H. Kugel)* very interesting for impurity transport (e.g., Li, B, C, Al) and 'cold pulse' χ_e (see LHD)**
  (*off-axis* injection for improved radial localization)

- **Supersonic gas injector *(V. Soukhanovskii proposal)***

- **Four USXR arrays: bolo, $E_{cutoff} \approx 0.1 / 0.4 / 0.6 / 1.2$ keV**
  (horizontal up/down arrays also usable for χ_e measurements)

- **MPTS, CHERS (CH_4 puff), EBW**