NSTX

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Edge Impurity Transport Measurements Using the New MESXR Diagnostic

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Dan Clayton

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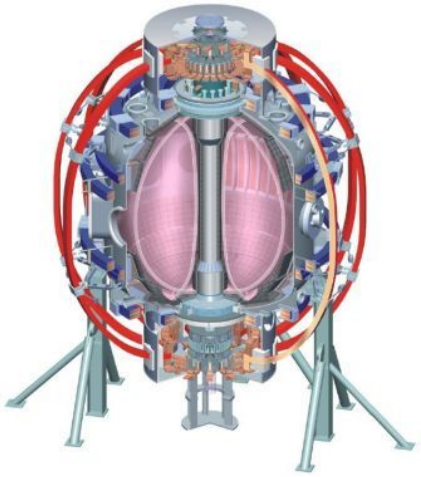
Johns Hopkins University

XP Group Review
Control Room Annex
October 5, 2010



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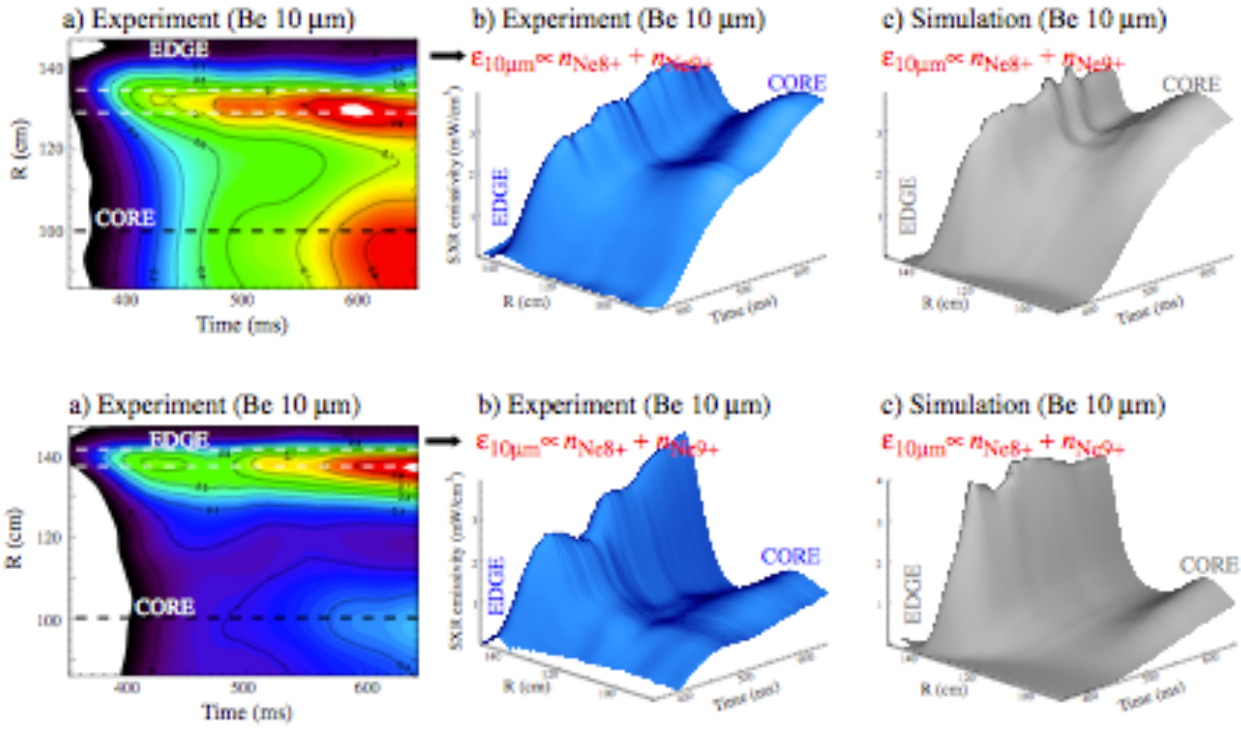
X-ray Emission from Plasma Impurities can be Utilized to Measure their Transport

- XP 613 (Delgado-Aparicio) measured transport of Ne from gas puffs using the optical SXR array (~5 cm resolution, weak signal in the edge)



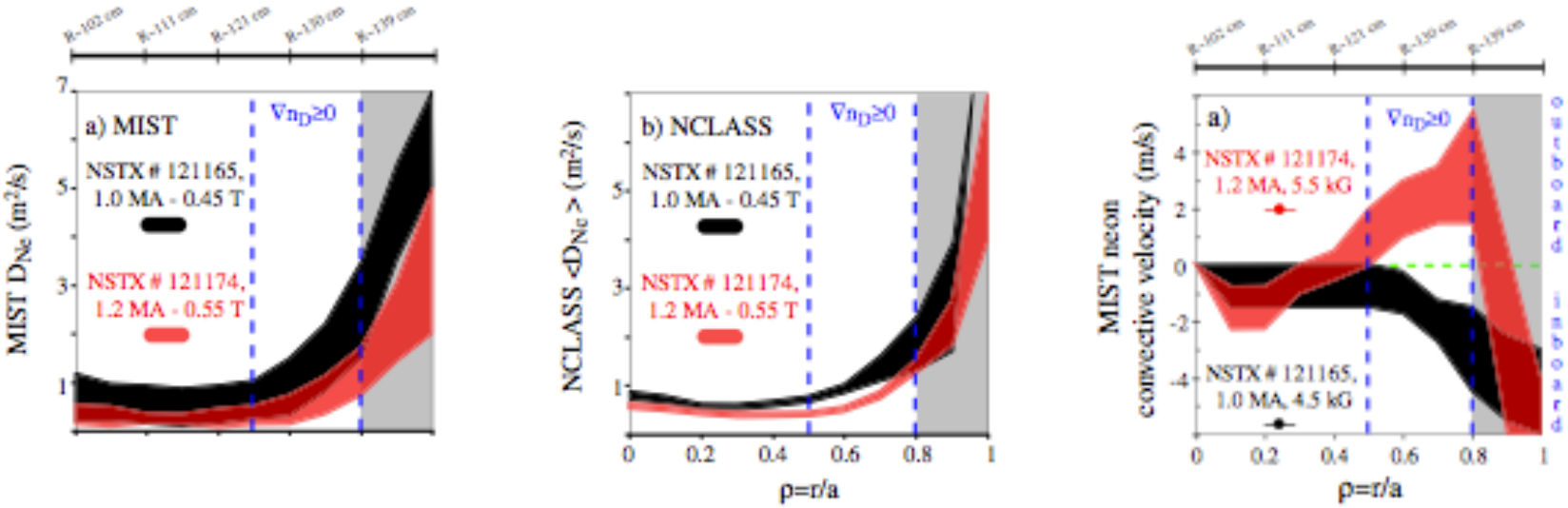
B_T = 0.45 T

B_T = 0.55 T

L. Delgado-Aparicio et. al., Nucl. Fusion (2009)

Impurity Ion Transport in NSTX H-mode Discharges is Neoclassical in the Core, Unknown in the Edge

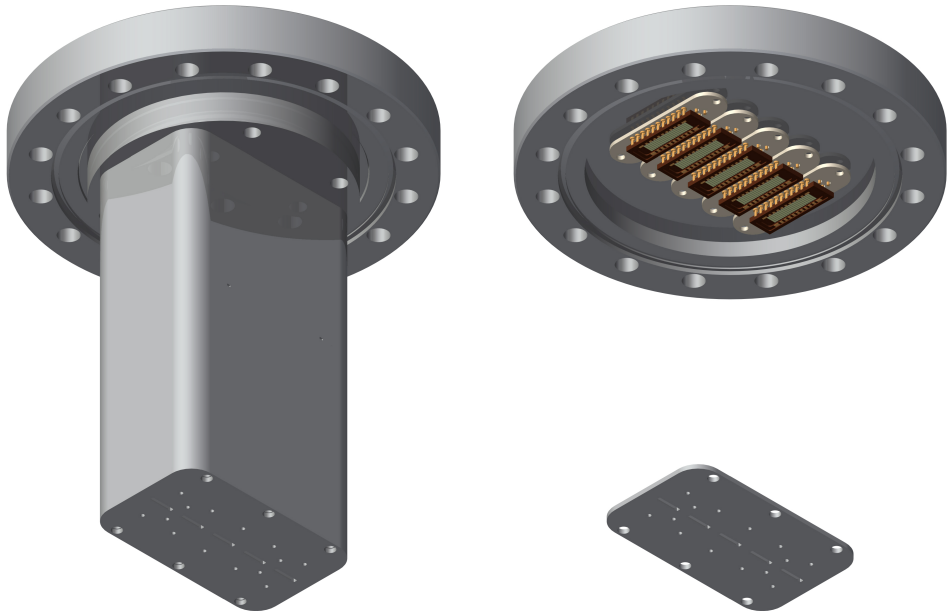
- Result: Impurity ion transport in the core is neoclassical
- Uncertainty in the edge was too large to draw conclusions
- Questions remain about transport in the edge
  - How does carbon build up in ELM-free discharges?
  - How does transport vary throughout the pedestal region?
  - Does the particle transport barrier broaden with lithium?

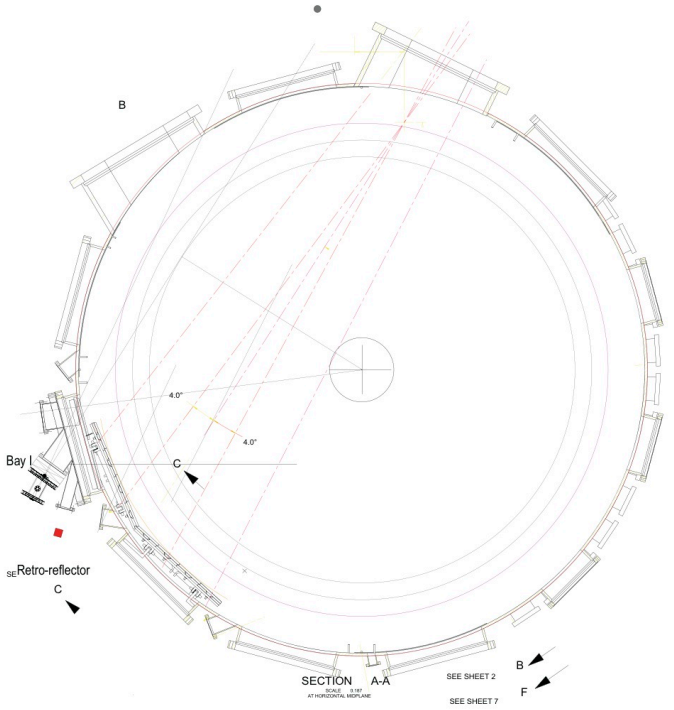


L. Delgado-Aparicio et. al., Nucl. Fusion (2009)

Improved Spatial Resolution, Better Sensitivity in the Edge with New Multi-Energy Soft-x-ray (MESXR) Diagnostic

- MESXR has five photodiode arrays, each with 20 spatial chords providing ~1 cm resolution (R~127-147 cm)
- Each array has a different filter, with thinner filters (and one with no filter) for lower charge state (temperature) measurements in the edge





Proposal: 1/2 Run Day to Measure Transport of Neon in the Pedestal Region using the New MESXR Diagnostic

- Target plasmas: ELM-free H-mode, edge MHD quiescent
  - LITER will be required
- Short neon puff some time after H-mode is well-established
  - Choose puff size that maximizes signal without perturbing plasma
- B_0 scan (constant q)
  - Neoclassical diffusion $D_{NC} \sim q^2/B_0^2$
  - Increased B_0 was shown to suppress impurity transport into the core
  - 1.0 MA, 0.45 T and 1.2 MA, 0.55 T previously used
- Transmission grating spectrometer (TGS) will be used to help verify concentrations of various charge states of Ne in the plasma edge (D. Kumar)

Proposed Run Plan

- A few shots will be required to determine optimum puff length, pressure of neon
- At least 2 discharges at each B_0: a shot with Ne puff and a reference shot without
  - See if Ne lingers in subsequent shots (not an issue pre-lithium)
- Additional parameter scans (time permitting)
  - Time scan: vary the time of the Ne puff
    - How is transport affected by the evolution of the pedestal?
    - Do impurities enter the plasma edge at the beginning of a discharge, or do they slowly accumulate over time?
  - q_{95} (I_p) scan