NSTX

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Edge Impurity Transport Measurements with the New MESXR Diagnostic

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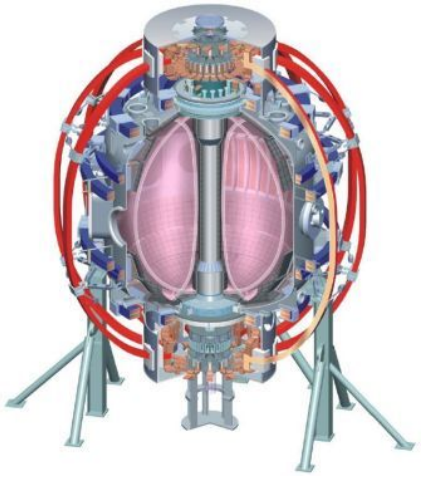
Johns Hopkins University

XP Team Review
Control Room Annex
October 18, 2010



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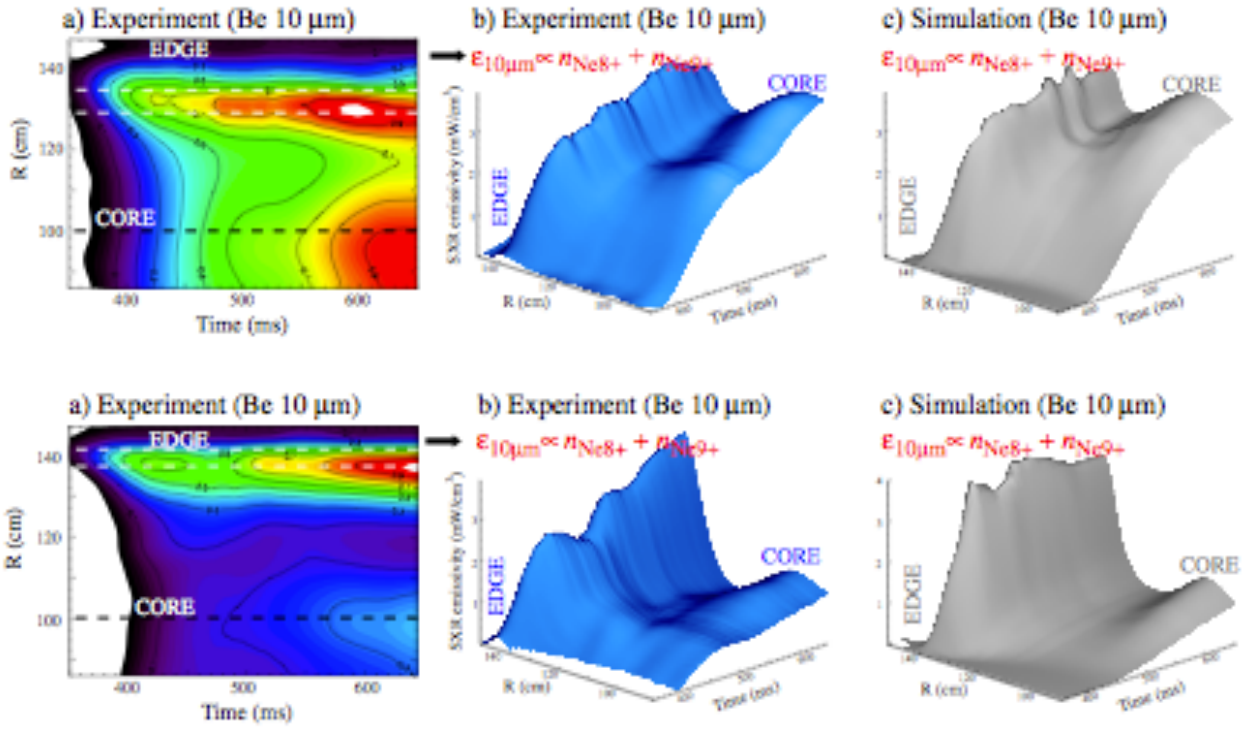
X-ray Emission from Plasma Impurities can be Utilized to Measure their Transport

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



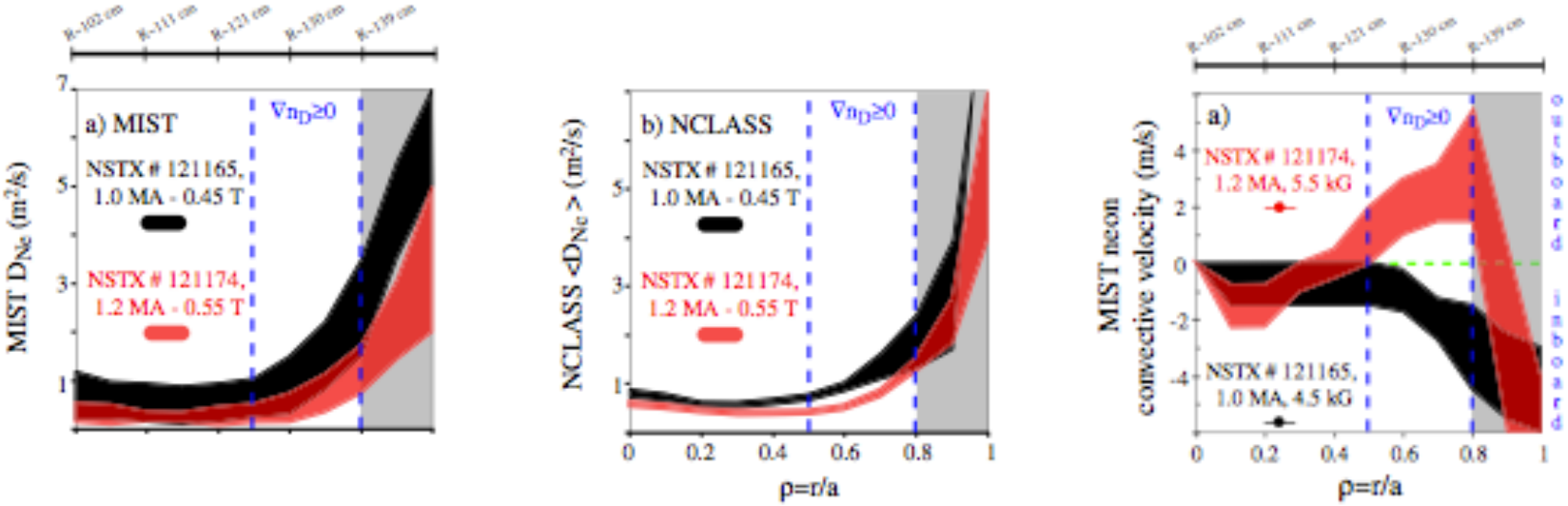
B_T = 0.45 T

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

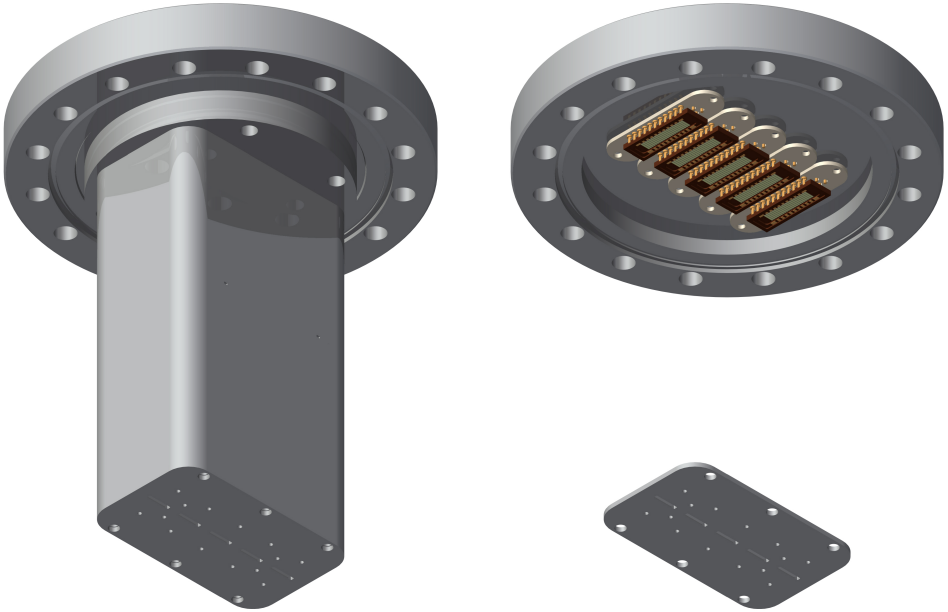
- Result: Impurity ion transport in the core is neoclassical
- Uncertainty in the edge was too large to draw conclusions
- Questions remain about transport in the edge
  - How does carbon build up in ELM-free discharges?
  - How does transport vary throughout the pedestal region?
  - Does the particle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

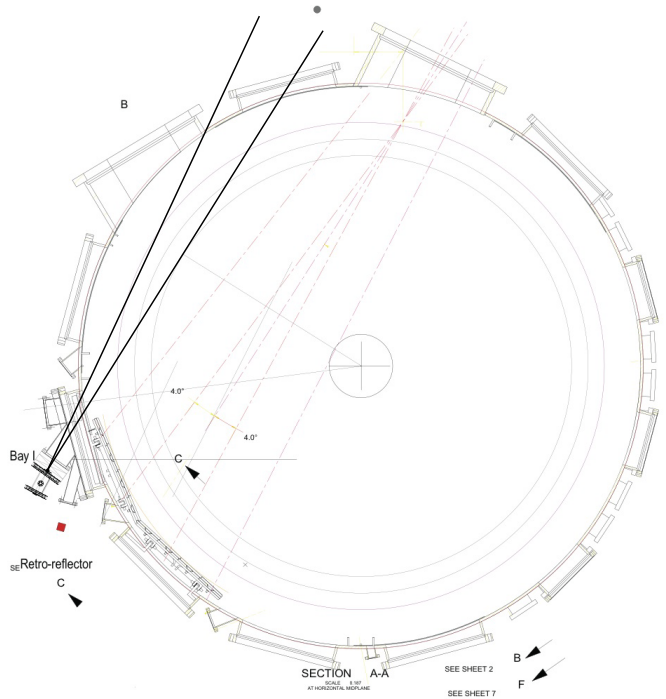


L. Delgado-Aparicio et. al., Nucl. Fusion (2009)

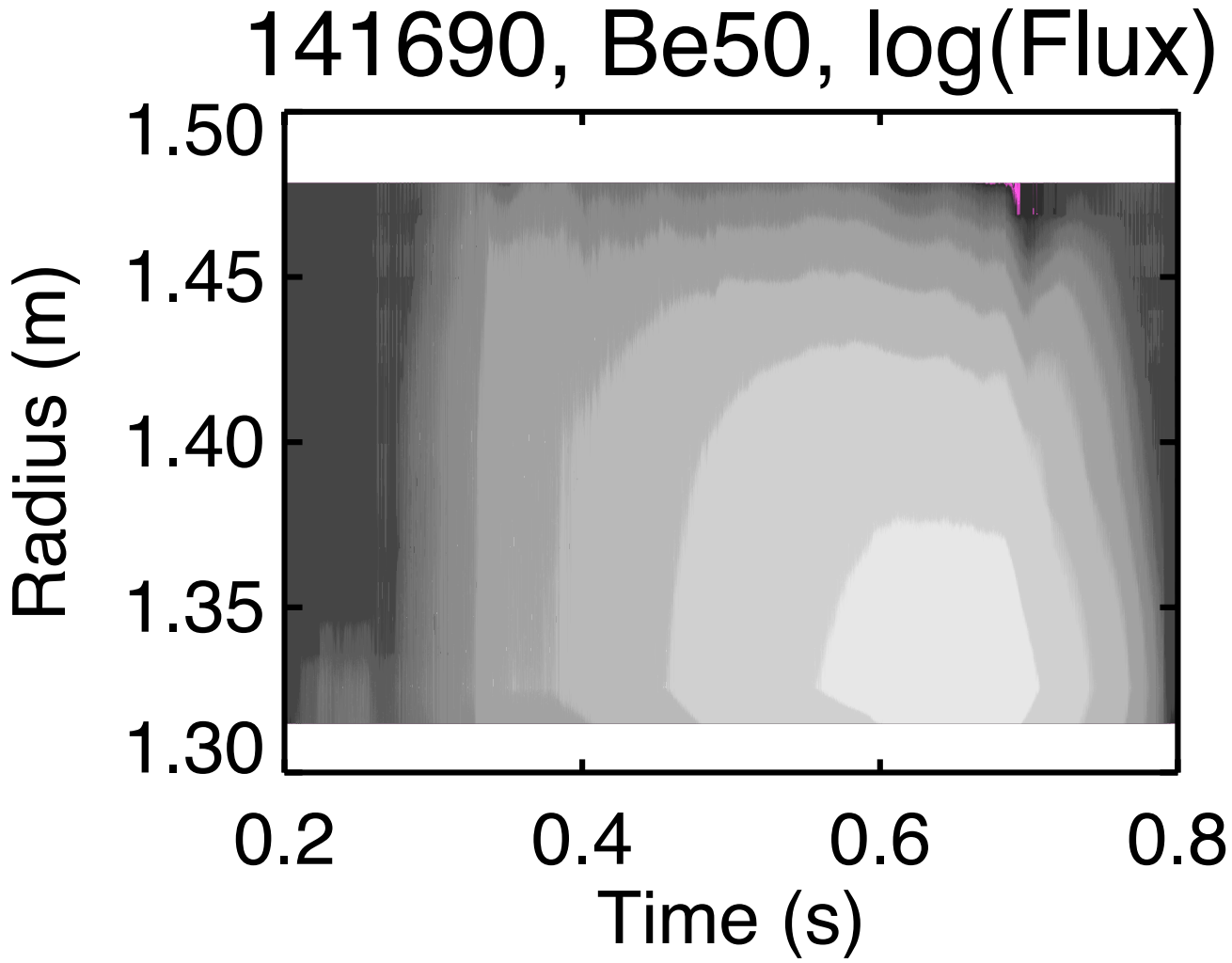
Improved Spatial Resolution, Better Sensitivity in the Edge with New Multi-Energy Soft-x-ray (MESXR) Diagnostic

- MESXR has five photodiode arrays, each with 20 spatial chords providing ~1 cm resolution (R~130-150 cm)
- Each array has a different filter (and one has no filter), with thinner filters for lower charge state (temperature) measurements in the edge



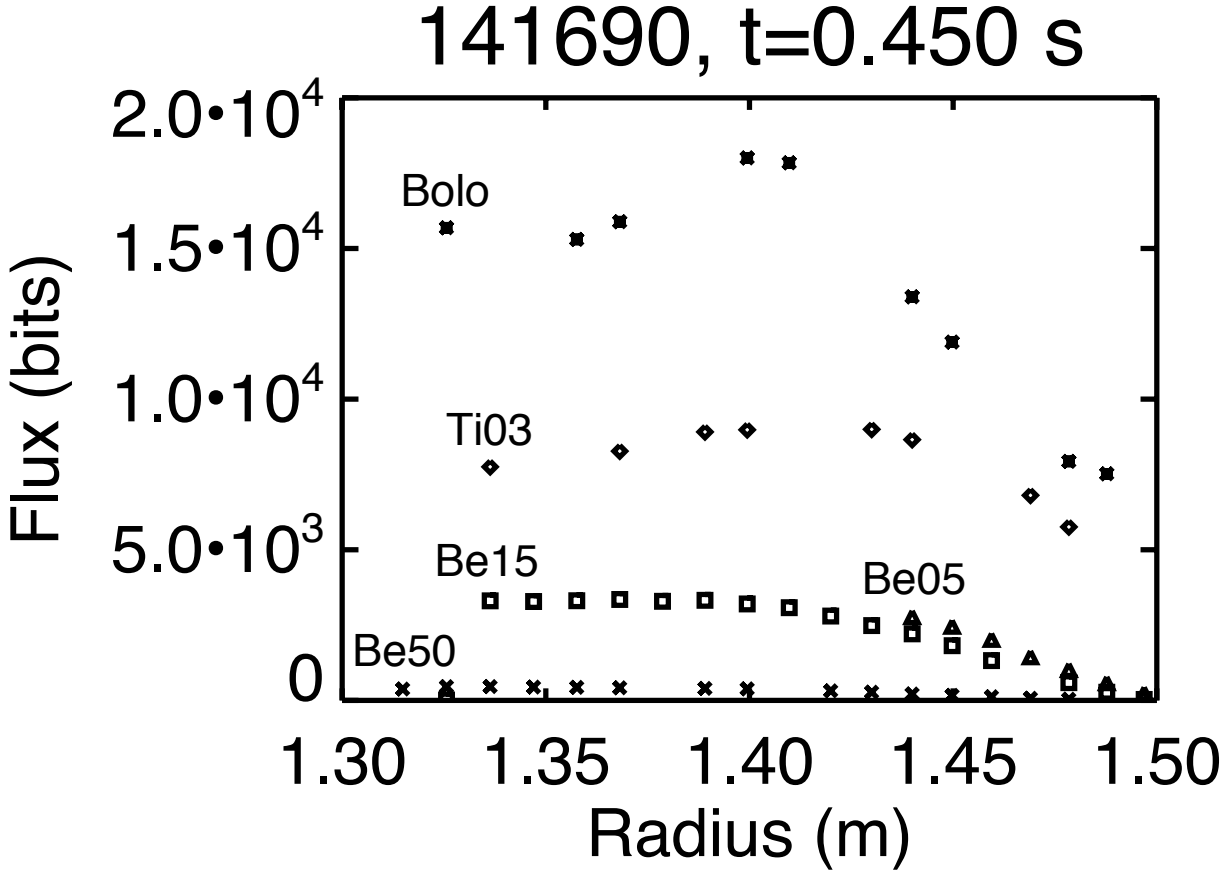


MESXR has Just Recently been Tested on NSTX and Appears to Operate as Expected



The Bolometer Array and One of the Beryllium Arrays are Required for this Experiment (Additional Arrays will Help)

- Missing bolometer channels due to a malfunctioning digitizer and will be swapped with another



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 (in the morning) or Li dropper will be required
  - 6 MW NBI to begin, stepped down to 4 MW to reduce energetic particle modes
  - Reference shot 141400 from XP1013 (Tritz)
- 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
- Time scan (vary the time of the neon 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?

Proposed Run Plan

Use shot #141400 for a reference

Neon puff tests (at 0.45 s, 4.5 kG)	2 shots + 2 contingency
B scan (at 0.45 s)	
0.9 MA, 4.5 kG (Ne puff + reference)	2 shots + 1 contingency
1.1 MA, 5.5 kG (Ne puff + reference)	2 shots + 1 contingency
Time Scan (at 4.5 kG)	
0.30 s (Ne puff + reference)	2 shots + 1 contingency
0.60 s (Ne puff + reference)	2 shots + 1 contingency
Total	10 shots + 6 contingency