NSTX

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Impurity Transport Measurements in the NSTX Plasma Edge

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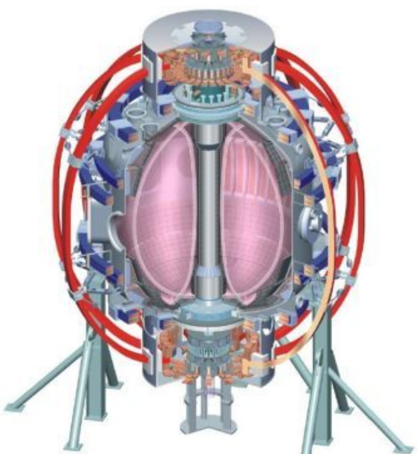

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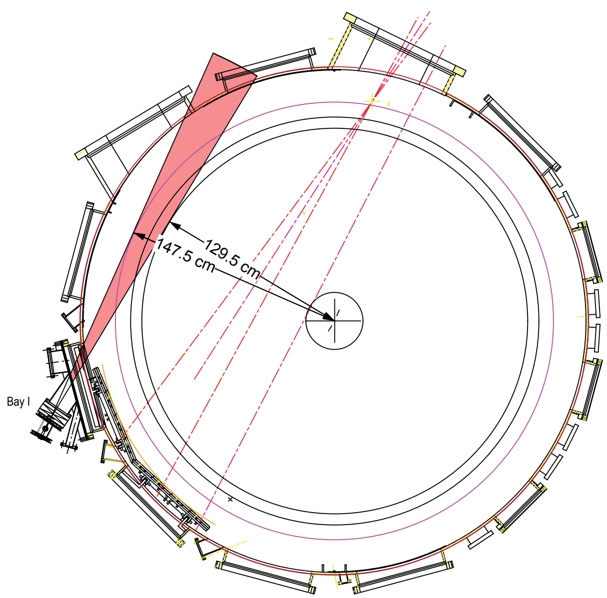
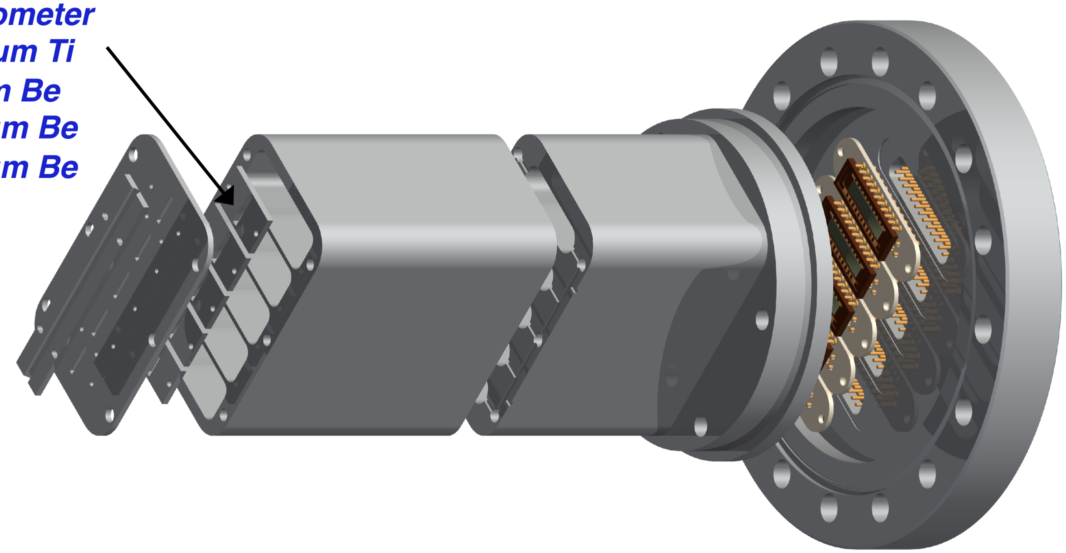
Proposal: Use the New ME-SXR Diagnostic to Measure Impurity Transport in NSTX

- An impurity transport XP would help accomplish the NSTX FY11 research milestone R(11-1): Measure fluctuations responsible for turbulent electron, ion and impurity transport
  - "Impurity transport will be studied by coupling impurity puff and edge SXR measurements."
- Soft-x-ray emission from impurity gas puffs can used to determine the impurity transport coefficients *D* and *v*
  - ME-SXR provides high spatial (1 cm) and time (0.1 ms) resolution multi-color measurement from r/a ~ 0.6 to 1.0
  - Impurity transport modeling (STRAHL) used to determine *D* and *v*
- Turbulence diagnostics will be used in conjunction with transport measurements to look for correlations
- Results will be compared to neoclassical calculations, linear (and possibly nonlinear) gyro-kinetic codes

The ME-SXR Diagnostic Measures X-Ray Emission with 1 cm and >10 kHz Resolution from r/a ~ 0.6 to 1.0

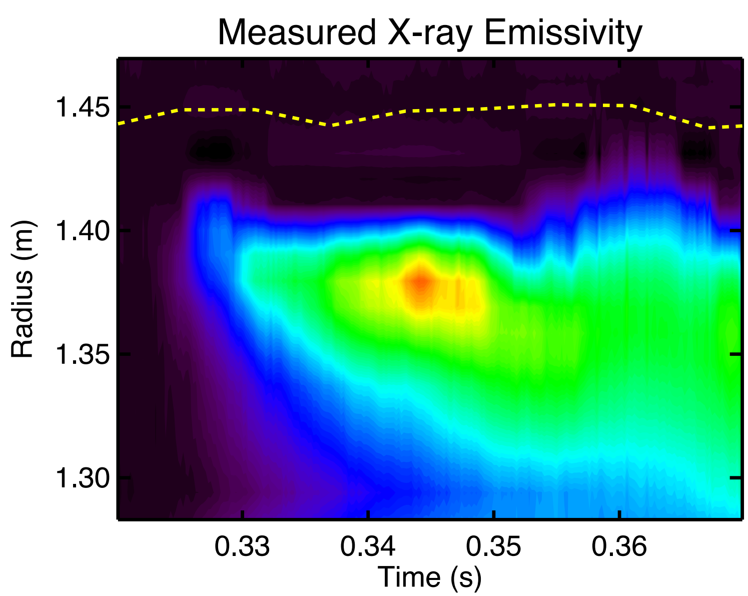
- 5 photodiode arrays, each with a different filter (0.3 μm Ti, 5, 15, and 50 μm Be, and one without a filter for bolometry)
- 20 spatial channels provide ~1 cm resolution from r/a ~ 0.6 to SOL (R = 127-147 cm) with a time resolution >10 kHz
- Digitally-controlled variable gain amplifiers provide excellent signal-to-noise for low intensities measured in the edge

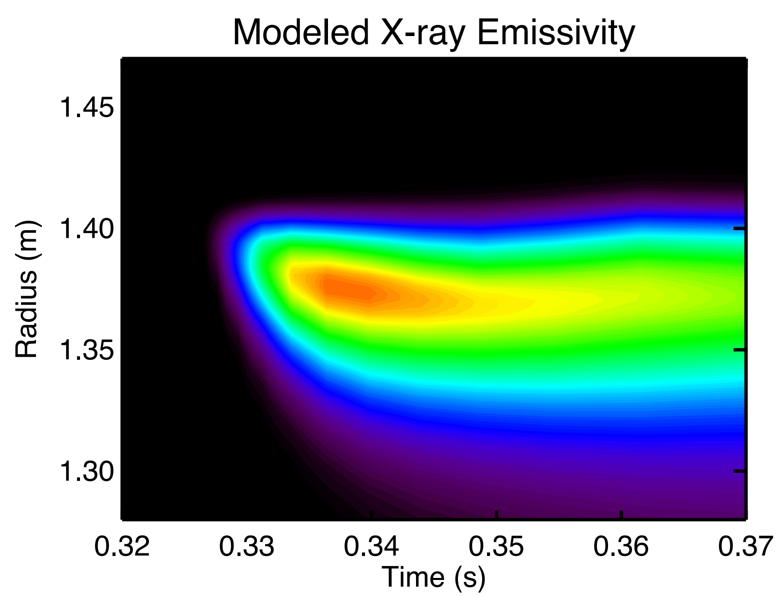




The Impurity Transport Code STRAHL is being Used to Determine the Transport Coefficients

- The STRAHL impurity transport code, with ADAS atomic rates and emission coefficients, can be used to model emission for a given source, diffusion, and convection, which are varied to find the best fit to the data
- Example of emissivity measured/modeled with 5 µm Be filter with initial guesses of D = 3 m^2/s, v = -4 m/s in the edge:





Run Plan: One Day to Perform *B* Scan and *Z* Scan

- Impurity puffing technique was established last year (XP1073) with limited diagnostic capabilities
- Baseline discharge: H-mode plasma with 4 MW beam power, MHD and ELM-free (with Li)
- Shots with and without impurities for background reference
- *B* scan with fixed gradients for transport code validation
  - Correlate measurements with turbulence diagnostics: BES, high-*k* scattering, reflectometry
- Neon was used previously; additional gases would provide *Z* scaling of transport (CD_4, Ar, Kr are possibilities)
- Given additional runtime, other scans could be useful
  - If results appears neoclassical, consider a *q* scan
  - To test turbulence codes, vary gradients, perhaps a P_{NBI} scan