NSTX

JOHNS HOPKINS UNIVERSITY

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Re-entrant Multi-Energy Soft X-ray Diagnostic for NSTX-U

Kevin Tritz

Johns Hopkins University

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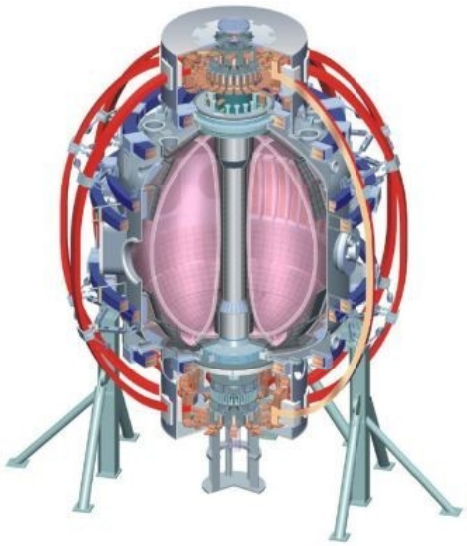

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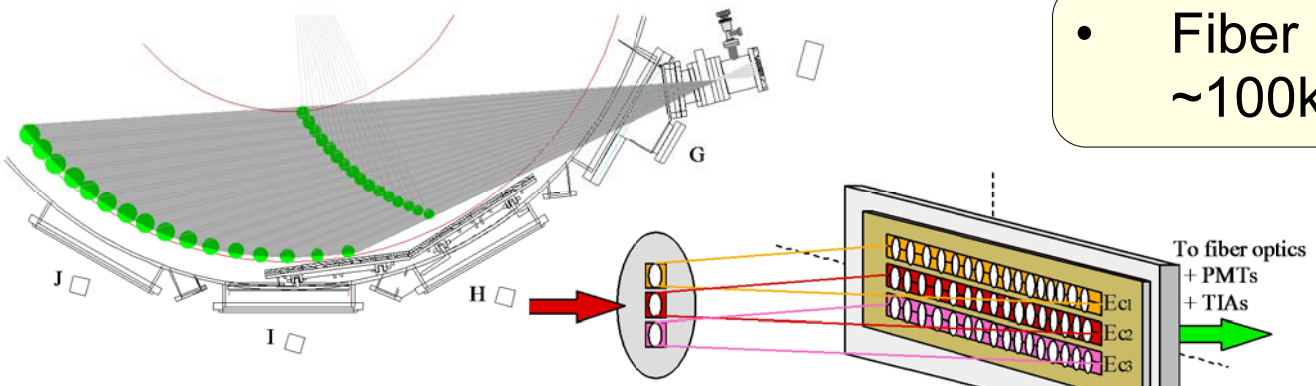
A compact, diode-based, Multi-Energy Soft X-ray (ME-SXR) is being designed for re-entrant, atmospheric installation on the inside wall of NSTX-U

Initial ME-SXR technique used filtered pinhole imaging on a phosphor screen

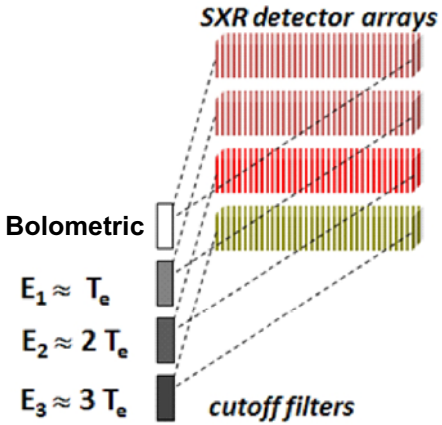
Multicolor Tangential Optical Soft X-ray Array



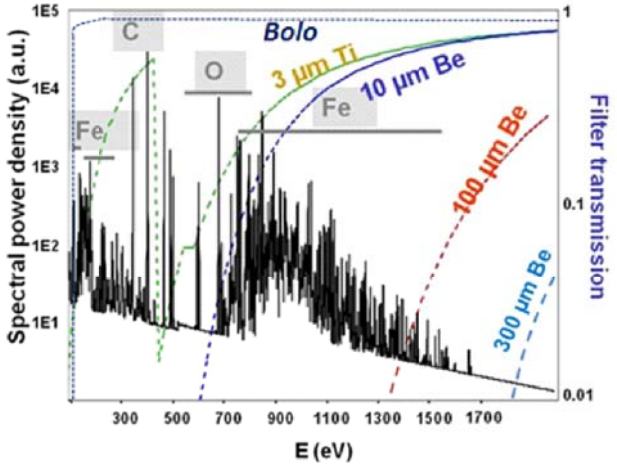
- Fiber coupled to PMTs with ~100kHz time response

SXR filters (10, 100, 300 μm Be)

$Energy_{cutoff}$ (0.6, 1.6, 2.4 keV)

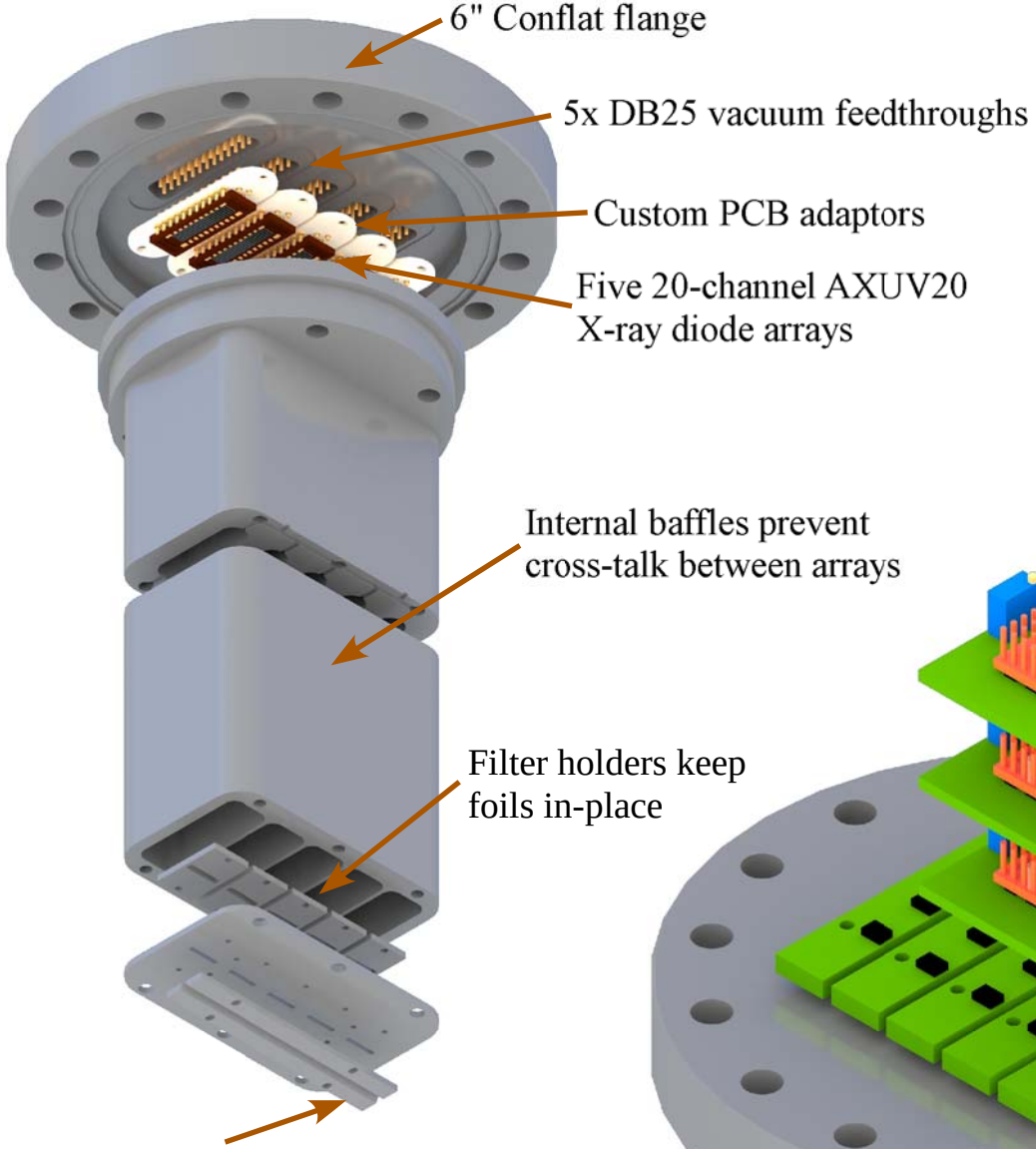


Modeled plasma SXR spectrum

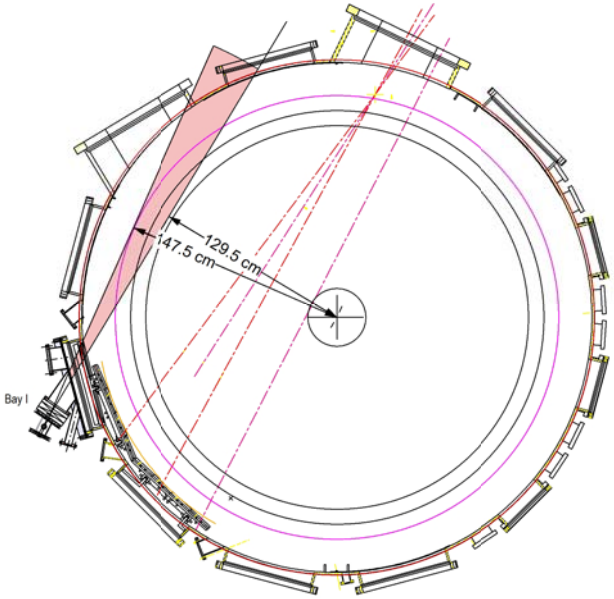


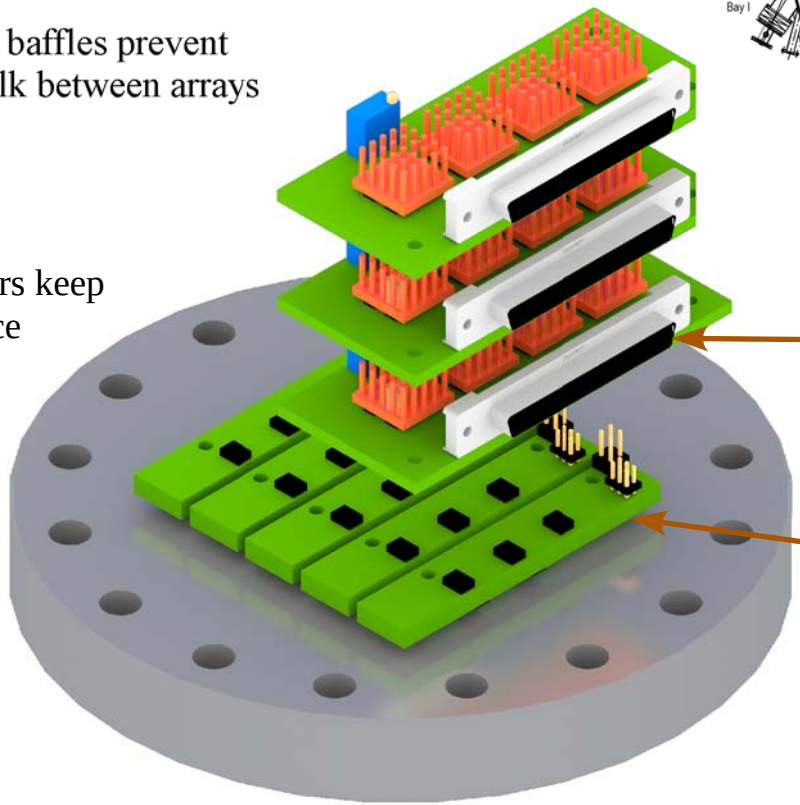
- ME-SXR arrays view same plasma volume through filters with different E_{cutoff}
- Division of SXR spectrum isolates T_e, n_z contribution
- New NN analysis provides fast T_e access to old data

Compact, high-resolution, 5-energy ME-SXR built for ~1cm spatial resolution edge measurements



Edge ME-SXR tangential, mid-plane view on NSTX

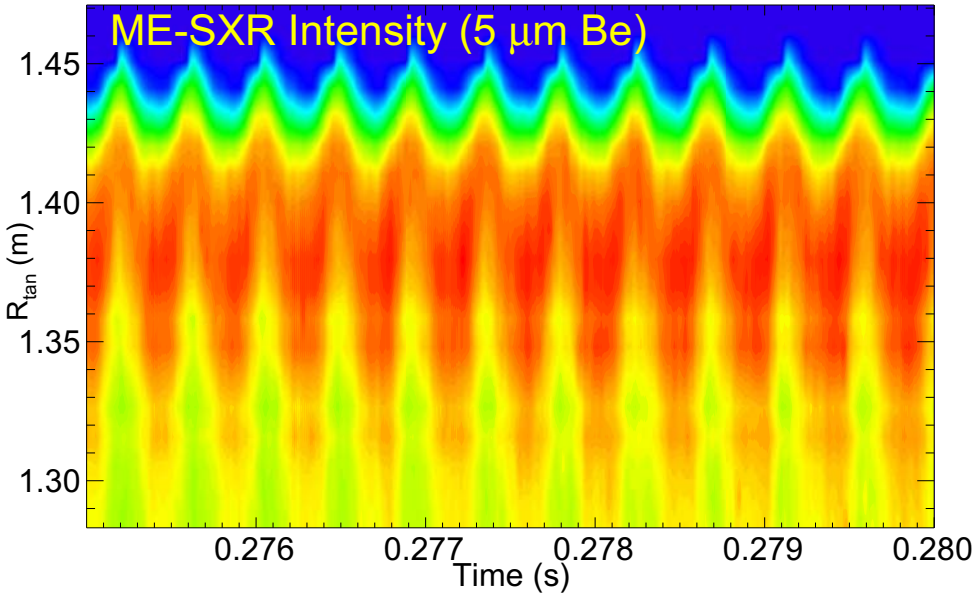


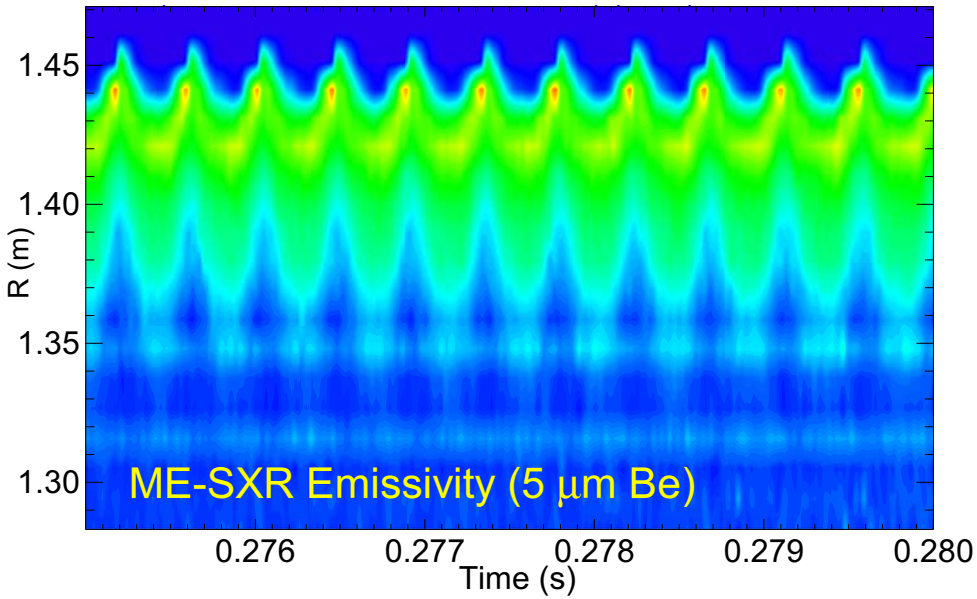


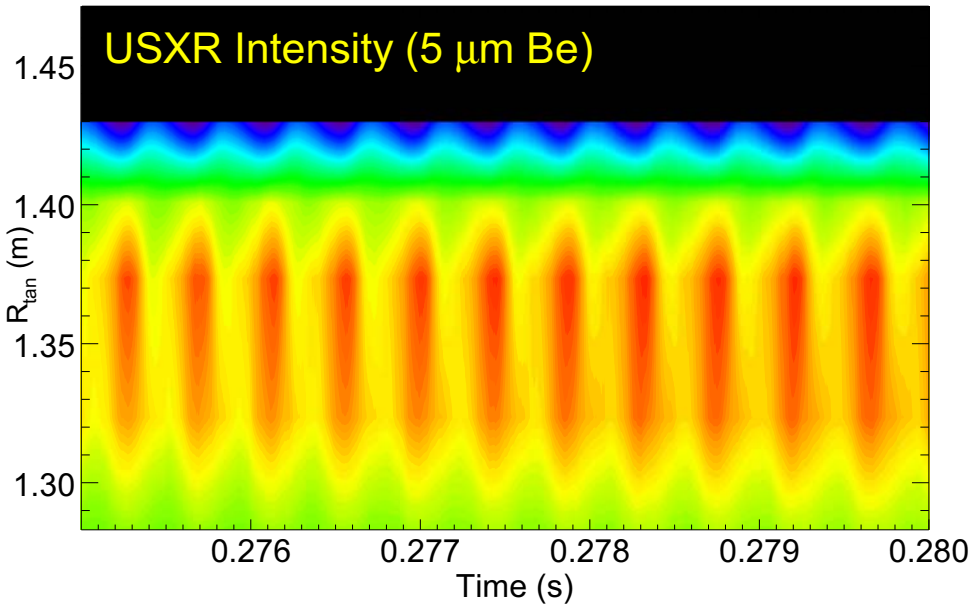
32 channel 10V/V
2nd stage amplifiers

20-channel transimpedance preamplifiers with digital gain control

High spatial resolution measures strong localization of emission during edge MHD activity

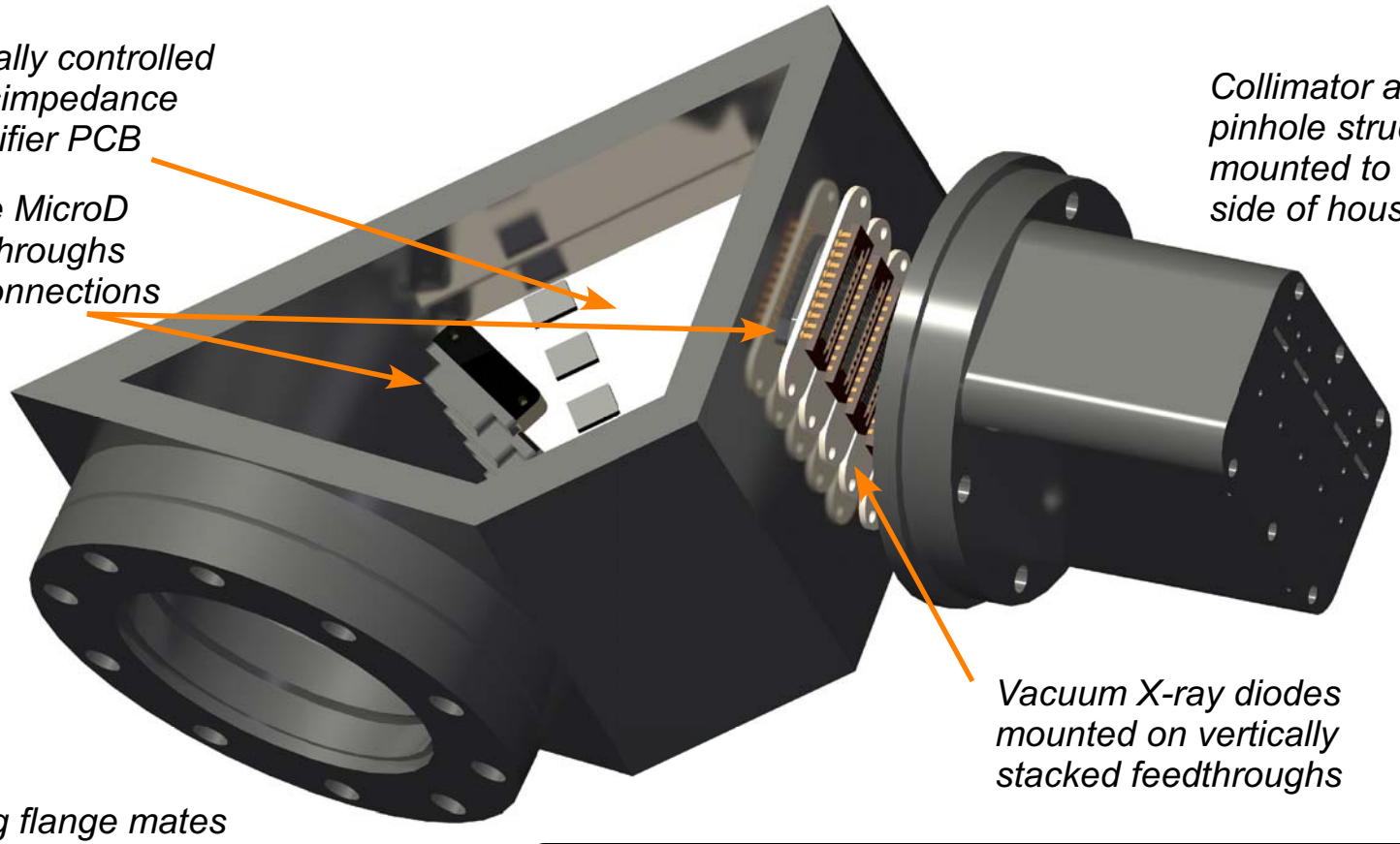






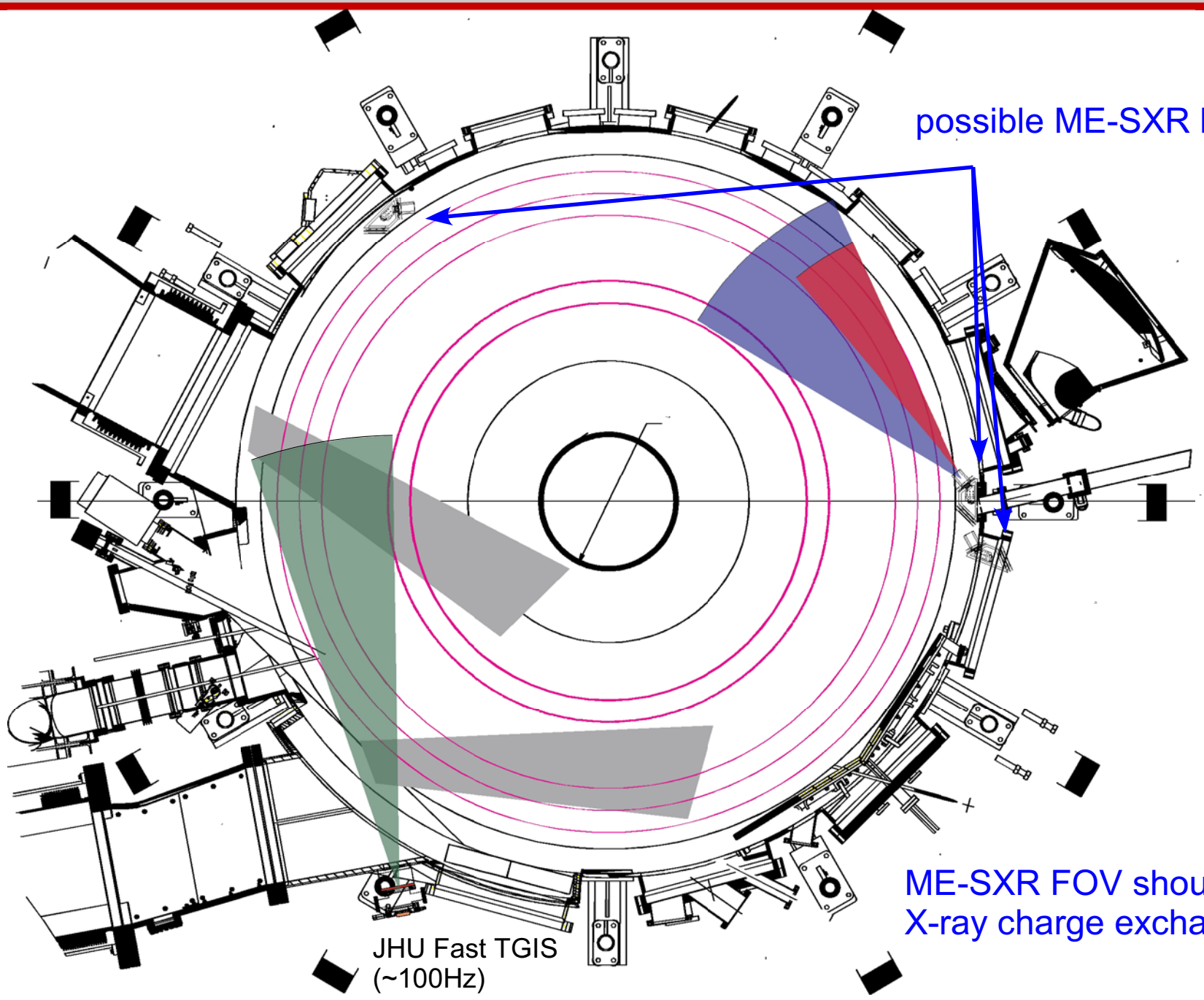
- Inversion shows highly localized MHD, $\Delta r \sim 1$cm SXR emission near edge (possible carbon accumulation?)
- High spatial resolution and Abel inversion provide advantages over poloidal USXR system

In-vessel ME-SXR provides compact design for flexible placement and viewing capabilities

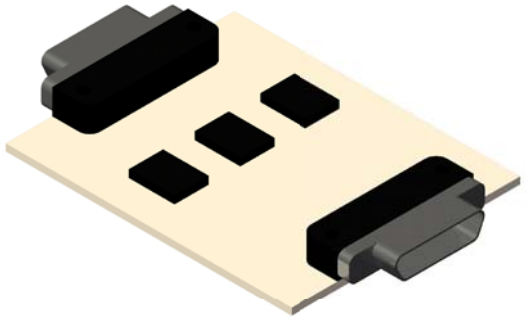


- Re-entrant housing provides atmospheric conditions for internals
- In-vessel electronics based off ME-SXR pre-amplifier design

Working with NSTX diagnostic team to finalize ME-SXR in-vessel placement



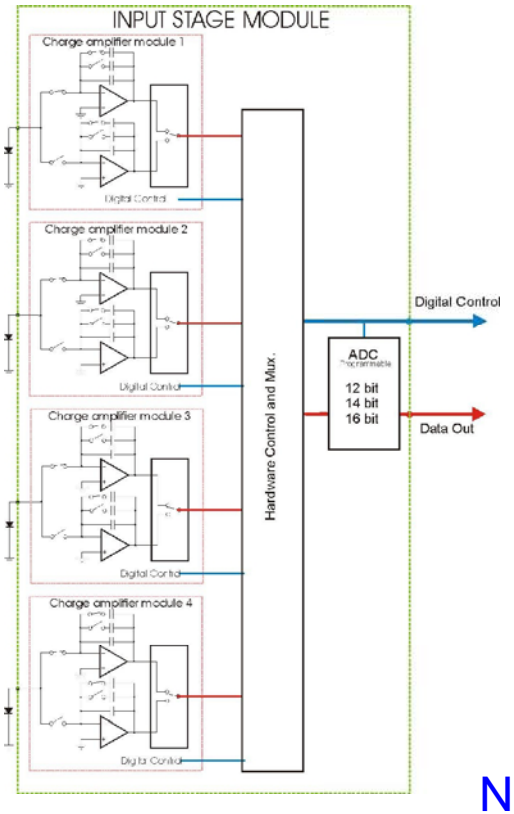
Development of first stage A/D serial acquisition can significantly reduce cabling requirements of ME-SXR

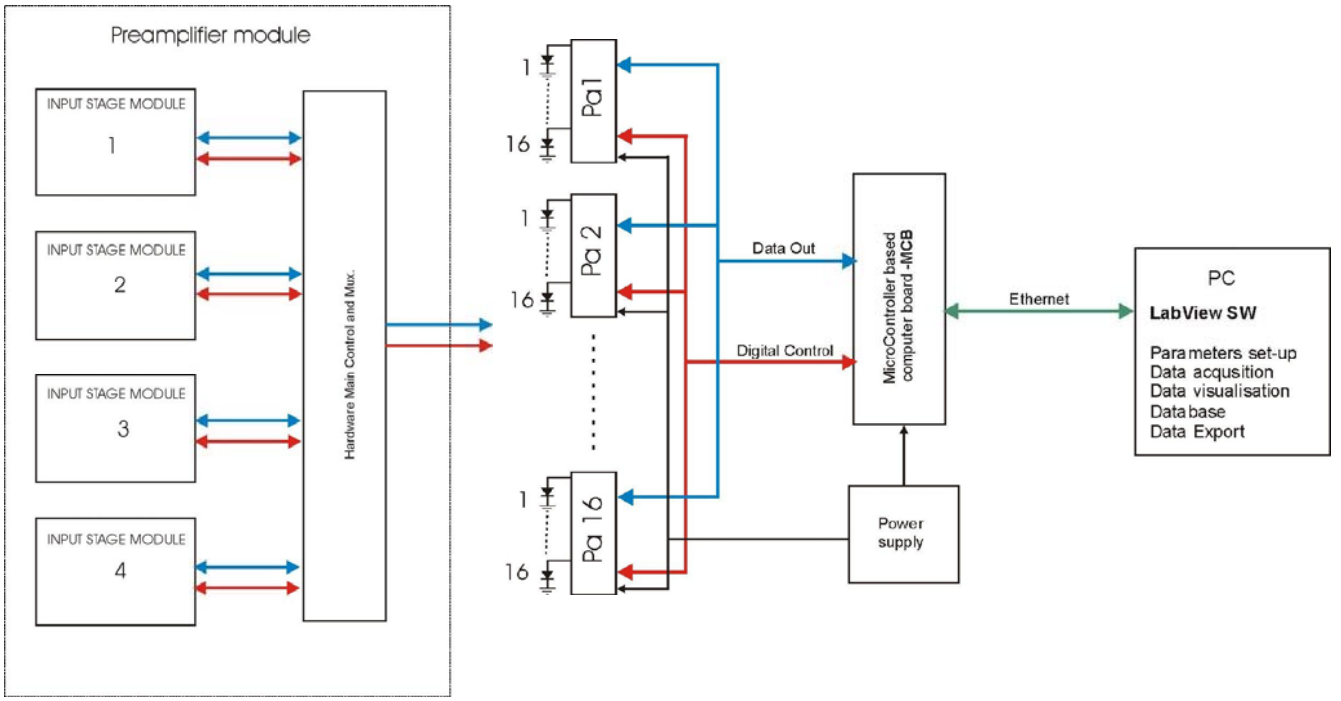


Present analog transimpedance pre-amplifier system:

- 20 signal lines
- 3 gain control lines
- 2 power lines

total 25 (x5)





New ME-SXR electronics reduces first stage cabling (~5 signal lines) and eliminates need for costly D-tacq acquisition system

ME-SXR diagnostic suite will provide essential measurements for physics studies on NSTX-U

MHD

- In-vessel ME-SXR arrays for study of:
  - resistive wall mode, NTM internal structure measurements
  - effects of 3D fields on global profiles and induced modes
  - thermal quench and other disruption phenomena

Transport

- Fast impurity profile and electron temperature measurements for:
  - high resolution edge/core impurity transport measurements
  - perturbative electron transport measurements (w/ laser blow-off)

Boundary

- High spatial, time resolution at the edge to measure:
  - edge profile response to applied 3D fields
  - ELM precursor and lifecycle details

Development of new acquisition electronics may significantly reduce cabling, increase modularity of ME-SXR (delivery TBD)