

# Modeling the background: a case study with Suzaku XIS and N132D

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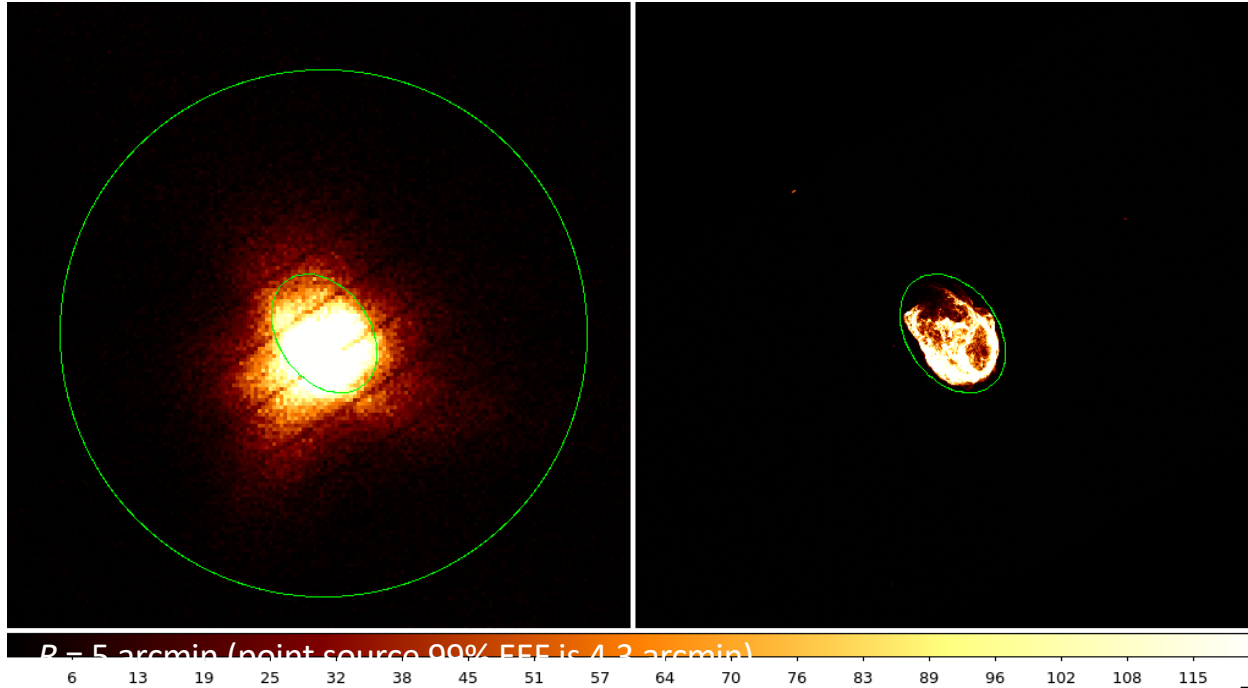
# Motivation

CXB = cosmic X-ray background; focused  
NXB = non-X-ray background; unfocused

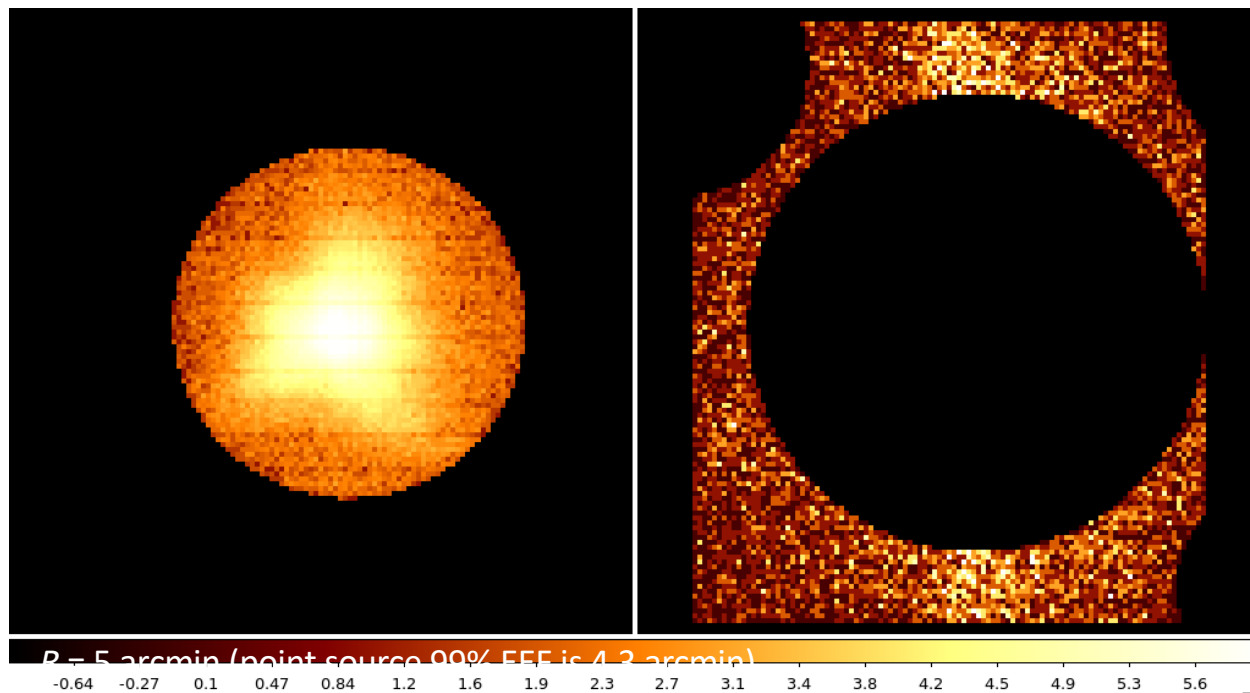
- Fit the Fe K spectral region of N132D observed with Suzaku/XIS to extend the IACHEC model.
- Background is challenging:
  - Source, CXB, and NXB are all about the same level at 6 keV
  - No useful local background region due to Suzaku PSF scattering
  - Different ARF and RMF at different locations
  - Background region from offset pointing likely has different NXB characteristics

Simply subtracting background is not ideal, and probably incorrect.

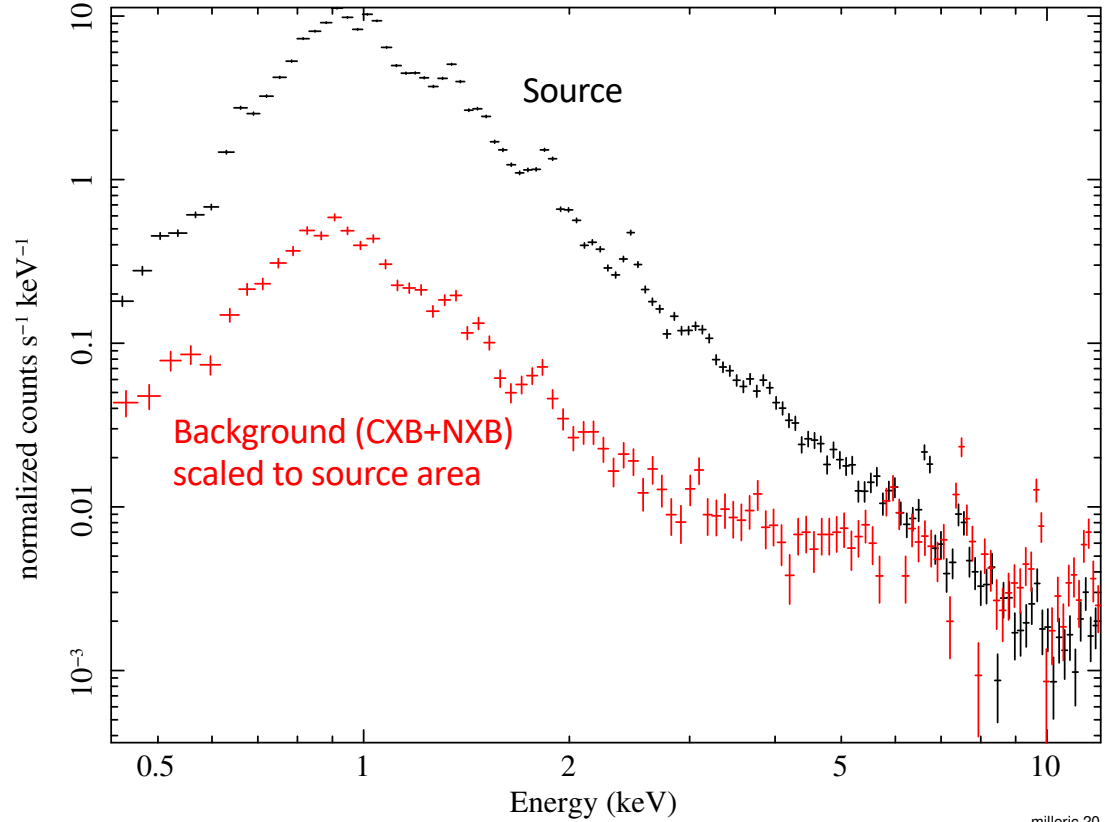
# N132D — Suzaku vs. Chandra



# Suzaku Source vs. “BG” Regions

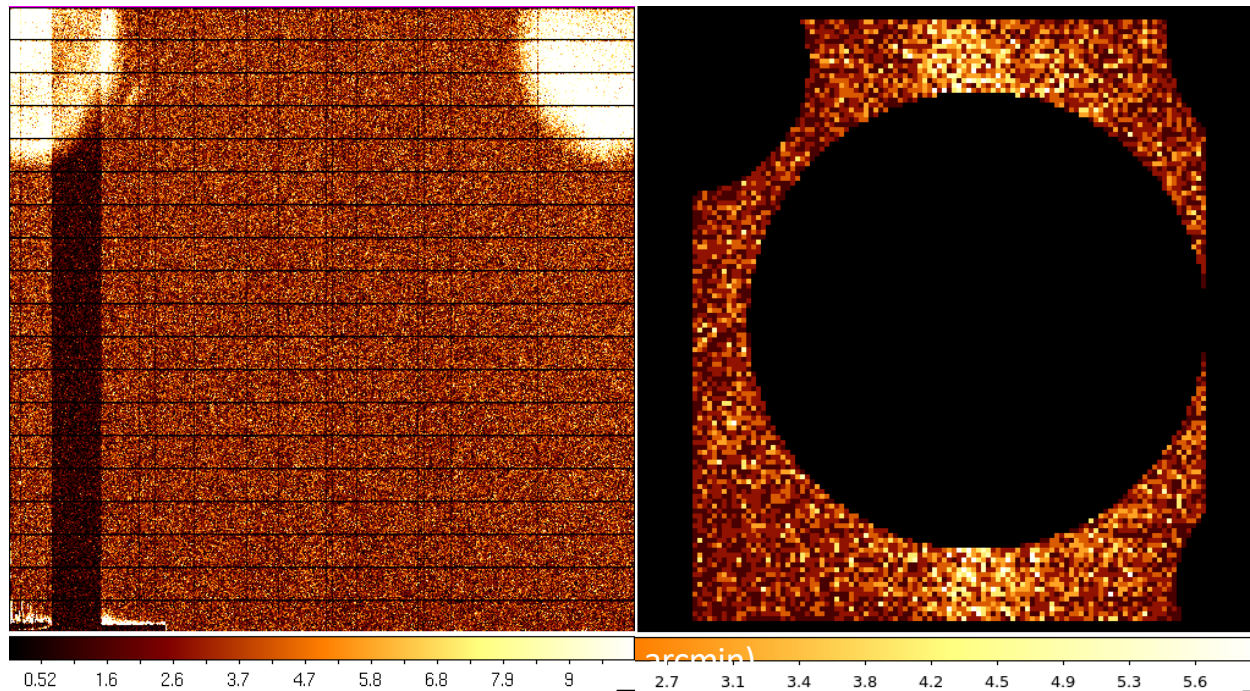


N132D – XIS0 20100727, source & BG



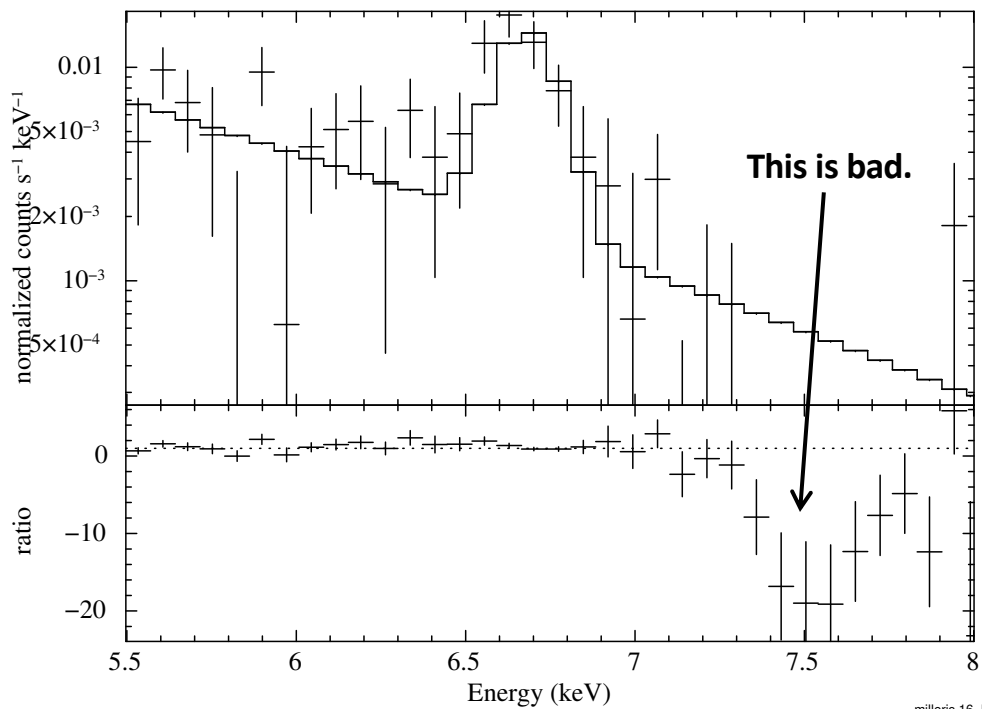
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# Suzaku NXB vs. “BG” Regions



# Previous fit subtracting local “BG”

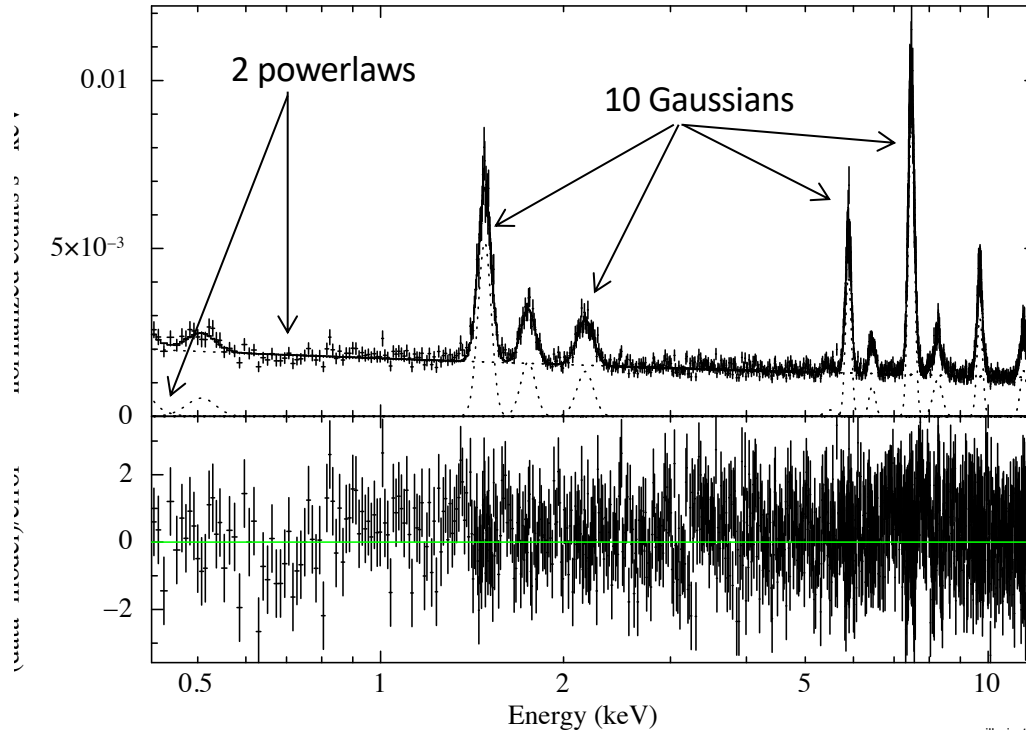
N132D – XIS3 20100727, IACHEC model v2.11\_20180406, contami\_20140825



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# XIS NXB data from night Earth obs.

NXB – XIS0 20100727



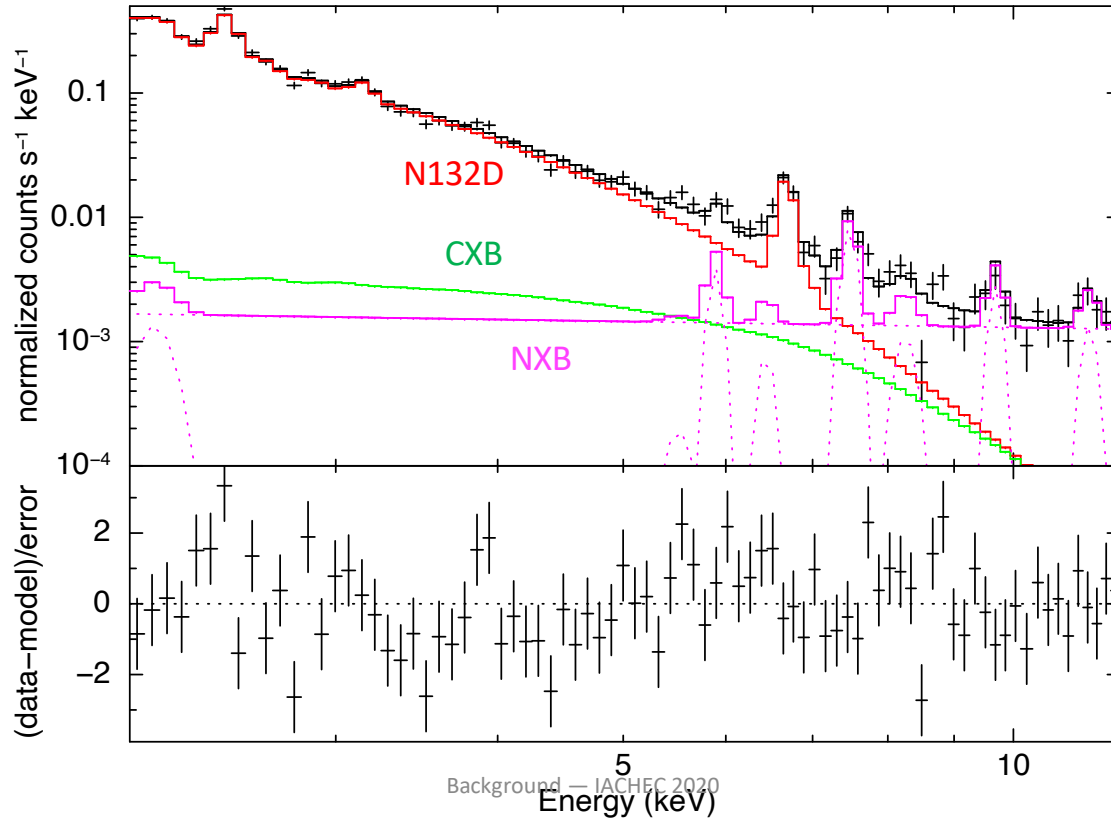
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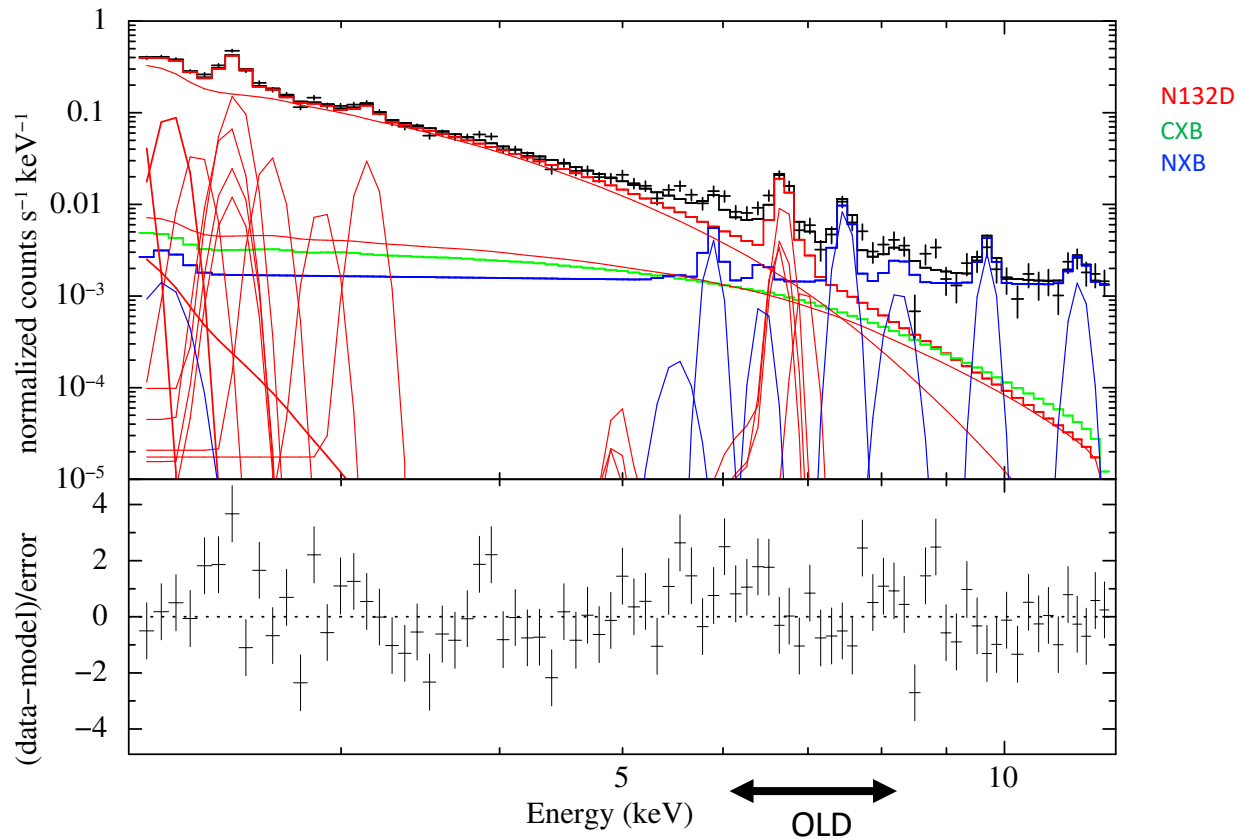
# Methodology

- Create model for NXB (powerlaws + Gaussians)
- Extract source spectrum
- Extract NXB spectrum from night Earth data using same DET coords, geomagnetic cut-off rigidity (COR) distribution as source extraction
- For single N132D observation:
  - Read source spectrum, RMF, ARF
  - Read NXB spectrum, diagonal RMF, no ARF
    - Instrumental lines are also produced in framestore, so RMF with CTI is too broad.
    - Could use narrow or pre-flight RMF (calibration vs. model errors).
  - Simultaneously fit source + CXB + NXB models to source spectrum and NXB model to NXB spectrum
    - If we had an offset pointing, we'd fit CXB+NXB to that.

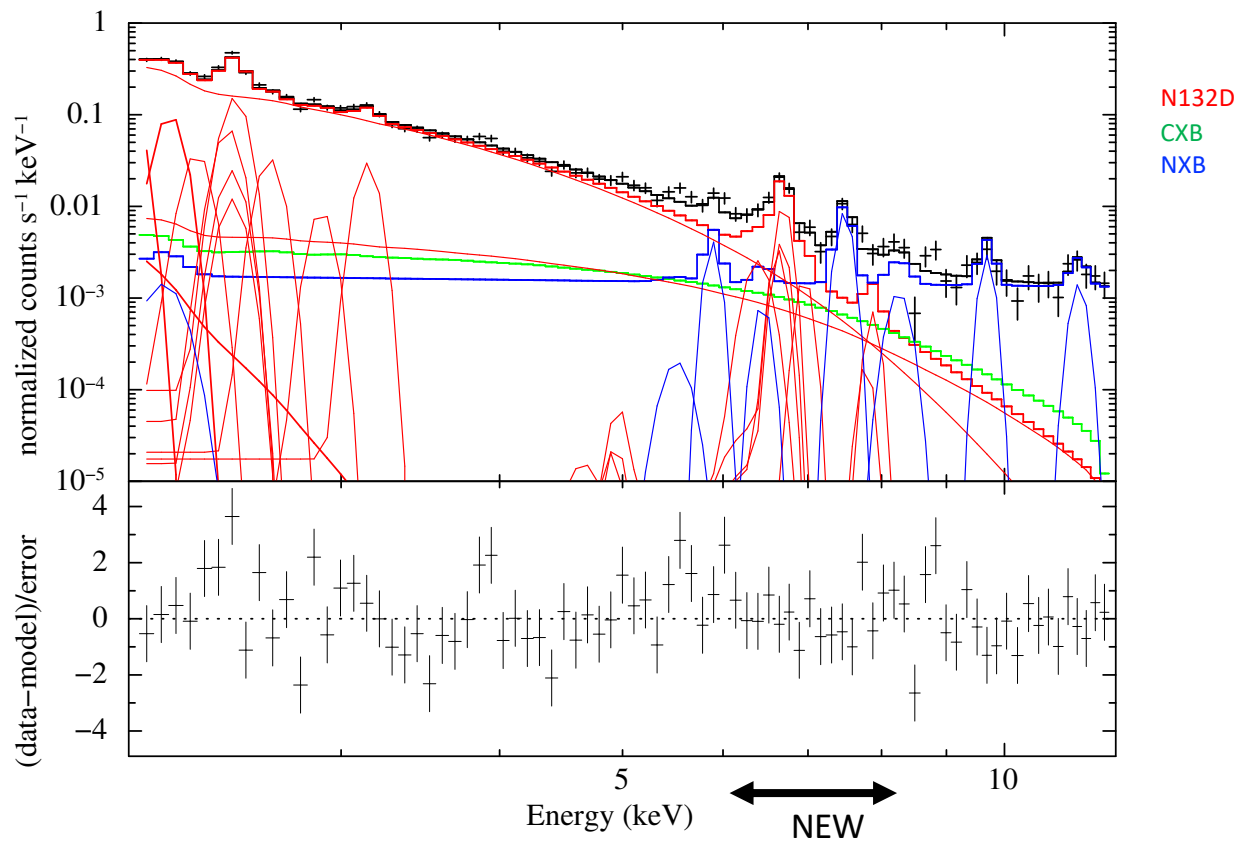
# Combined source+CXB+NXB fit



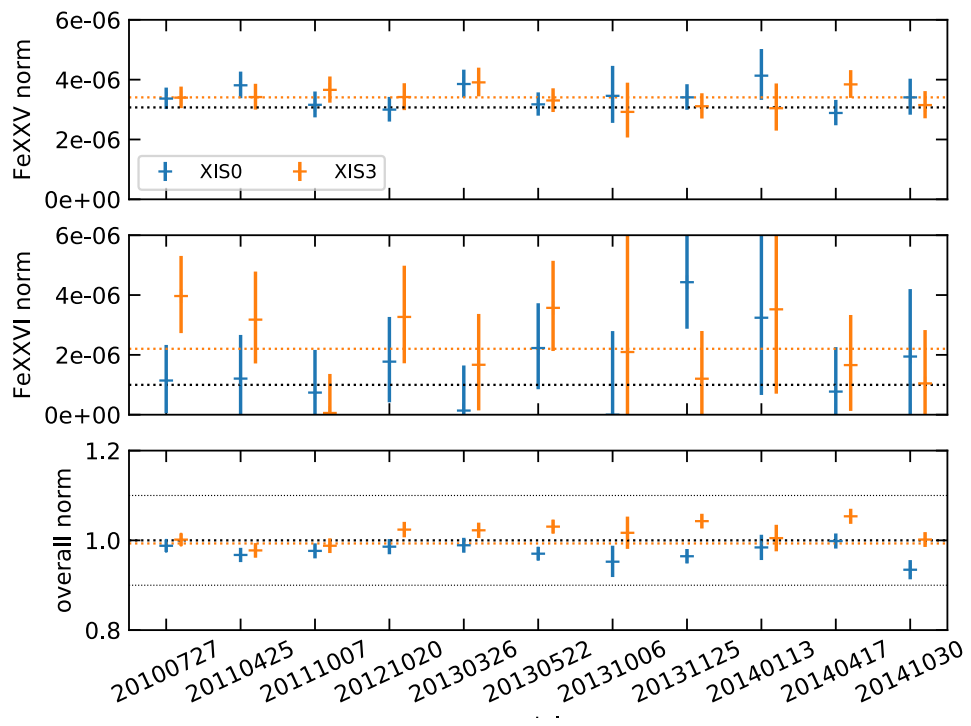
N132D – XIS0 obs 20100727, IACHEC model v2.11b\_20190806



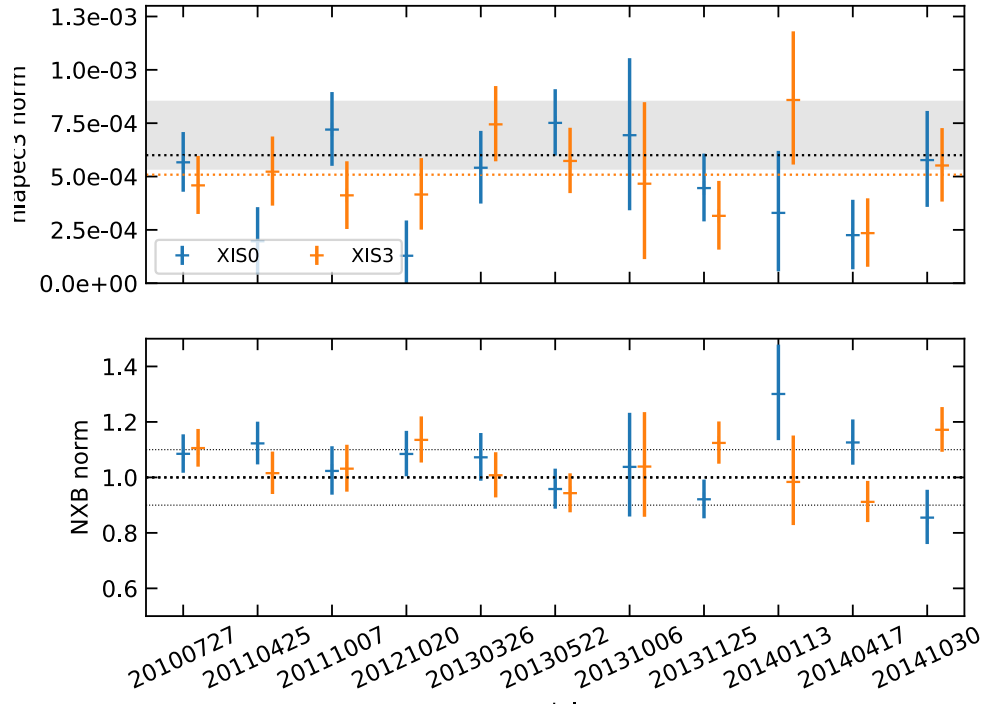
N132D – XIS0 obs 20100727, IACHEC model v2.12\_20200324



# N132D Fit Parameters



# Background Fit Parameters



# Final thoughts

- Subtracting background can introduce systematic errors in your spectral fit.
- By modeling the background, we can more easily incorporate temporal differences and calibration uncertainties in the spectral fit.
- NXB spectrum creation and fitting procedures are now being planned for XRISM Resolve and Xtend
  - How to structure and store the NXB database?
  - What HK information is needed for filtering?
  - What should we use for the instrument models?
  - What parameters should vary?