Handling Calibration Uncertainties

Herman Marshall (MIT)
for Vinay Kashyap (SAO)

General Tasks

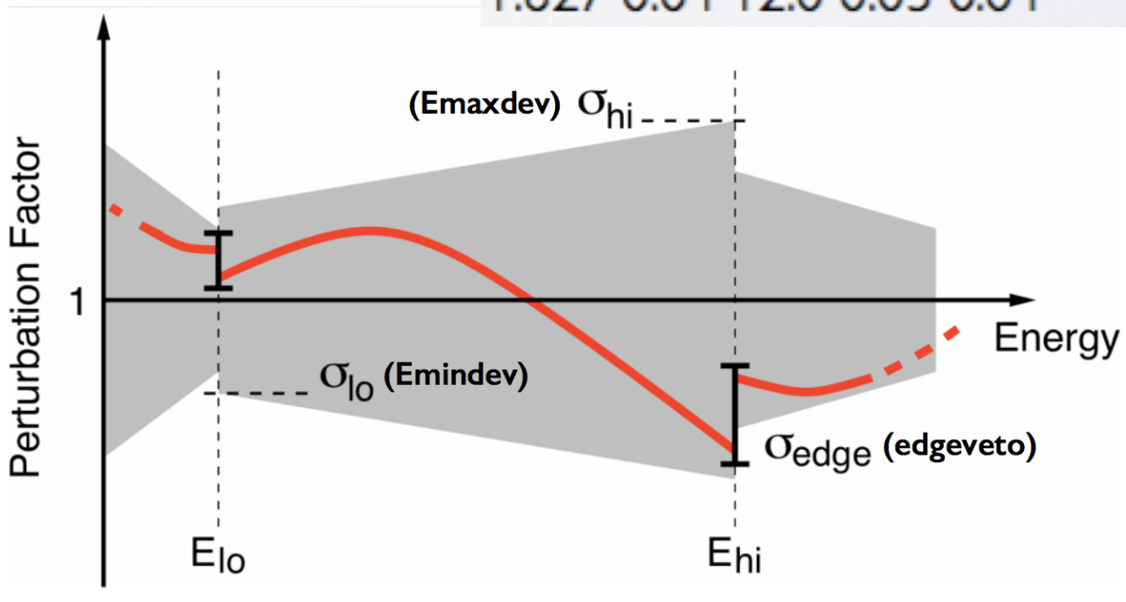
- pyBLoCXS to be released as download from github
  - https://github.com/astrostat/pyblocxs
  - Vinay: “Combined with http://hea-www.harvard.edu/AstroStat/Demo/pyBLoCXS/IACHEC2014/ it is possible for a determined person to use it from beginning to end.”
- WG alias: iachec-calerror@cfa.harvard.edu
- HLM: Systematic bias in use of χ^2 statistics
- How to achieve “concordance” across missions?

Applying pyBLoCXS to XMM

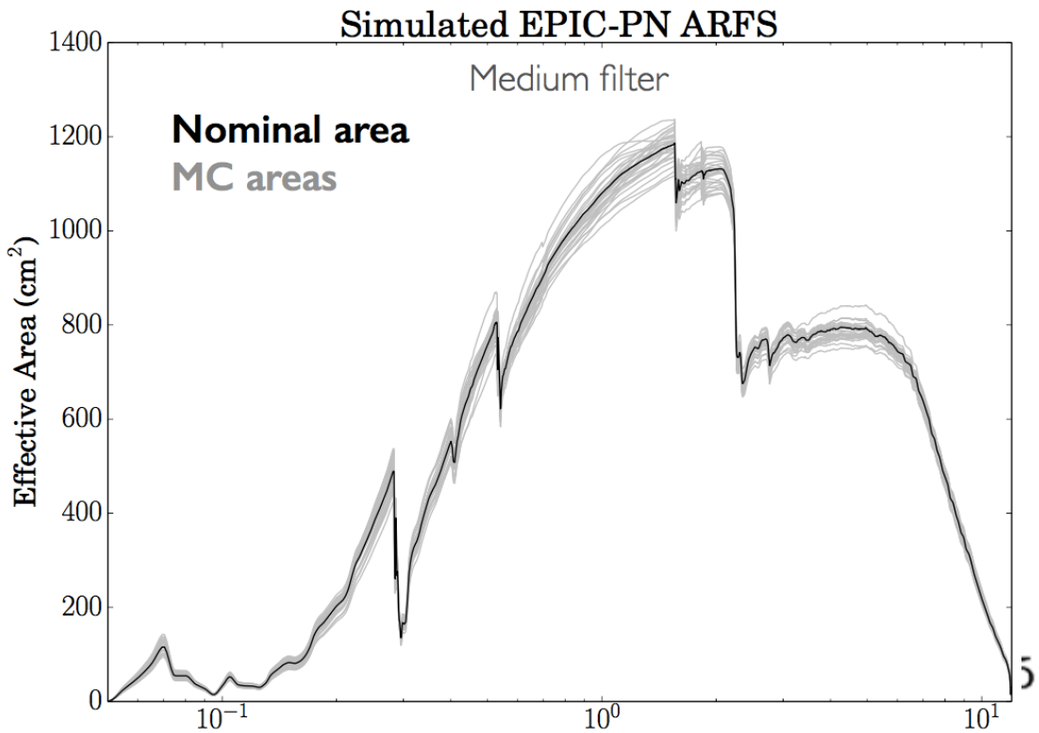
- JD project
- Simulations only
- Input is mere guess

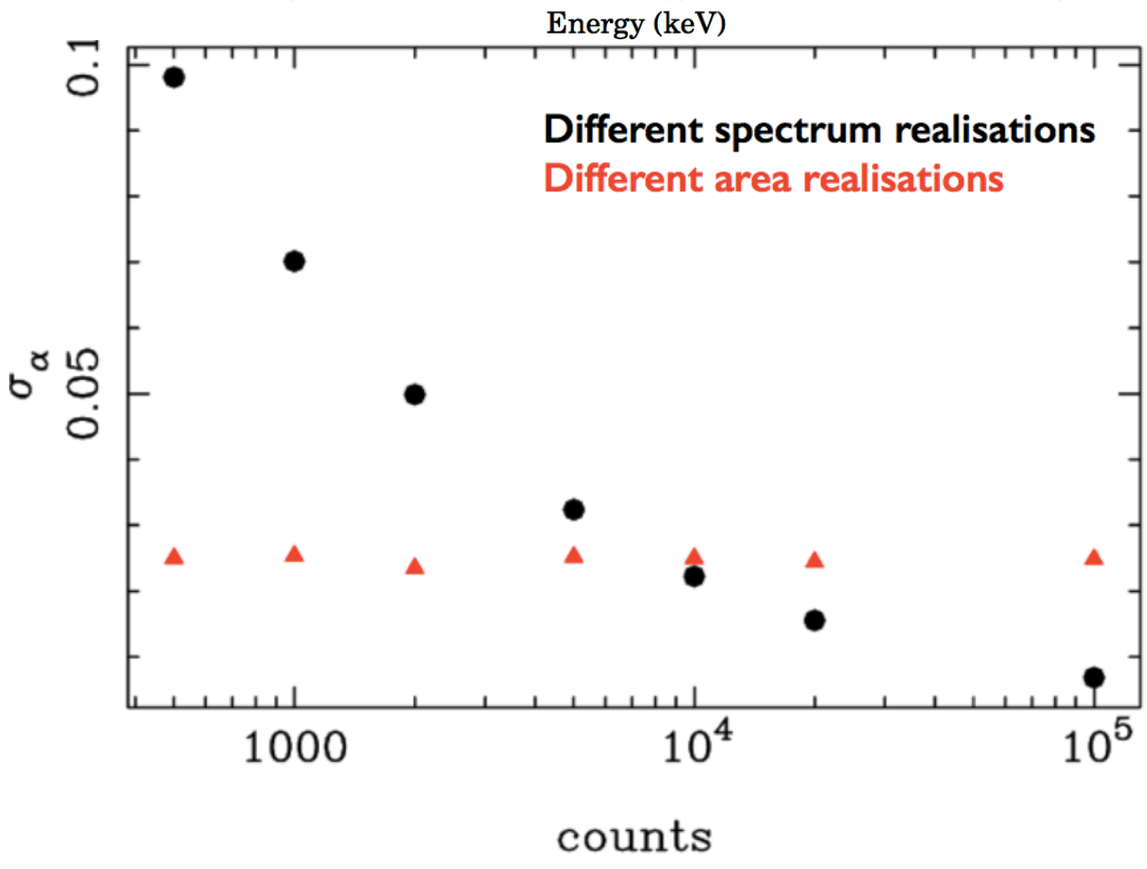
MM
0.05 0.04 2.291 0.04 0.03 0.04
2.291 0.03 3.425 0.03 0.01 0.03
3.425 0.03 7.000 0.03
7.000 0.05 12.0 0.10 0

EPICPN
0.05 0.20 0.132 0.10 0.11 0.20
0.132 0.15 0.539 0.05 0.03 0.15
0.539 0.04 1.827 0.04 0.03 0.04
1.827 0.04 12.0 0.03 0.04



Cal Uncertainties Summary





NuSTAR use of pyBLoCXs

Time line

- Phone call with Jeremy – Done
- Generate a routine that applies perturbations to the NuSTAR effective areas – May 2015
- The NuSTAR set will be sent to Jeremy D. and put into the correct format – TBD
- Test run - TBD

Summary

- Chisq fits: systematically low flux estimates
  - Fractional flux bias is ~ 1/(cnt/bin)
  - Applies to fluxes in lines as well
    - emission lines: underestimated
    - optical depths: overestimated
  - Results from approx. model of stat. variations
- Maximum likelihood fluxes are unbiased
- Flux summing method is same for ML and χ^2
  - Not "best" estimator if spectral shape is known
  - Biased if full band is not represented
    - e.g. PL model of 4-10 keV is larger than sum of 4-8 keV
  - "Best" if spectrum is not easily characterized

A Proposal

- Attend/read Prof. Meng's presentation (Wed. 9:00AM)
  - Start with C_{ij} = Counts for mission i (1..N), source j (1..M)
  - Assume "true" areas A_i, "true" fluxes F_j
  - Estimate F_j by $f_j = C_{ij} / a_i$ (a_i = 1st estimate of A_i)
  - Method determines "best" $\underline{F}_j$, computes w, and "better" $\underline{a}_i = a_i^{w} (C_{ij}/\underline{F}_j)^{1-w}$, brings f_j closer *but not precisely* to $\underline{F}_j$
    - $w = 1/(1+M\tau^2/\sigma^2)$, τ = "a priori" st.dev. in ln(a), σ = st. dev. in $\ln(C_{ij})$
      - w = 0 means instrument is very uncertain
- IACHEC team sets t for each instrument, runs Meng's analysis
  - IACHEC team recommends changes from a_i to $\underline{a}_i$
  - Process runs for each of many bandpasses "independently"

Action Items

- JD publishes summary of ACIS-S study in Chandra POG
- JD helps NuSTAR team try PyBLocXs
- HLM tries it on LETG/ACIS spectra
- HLM provides some xspec code for a spline approach
- HLM coordinates collection of fluxes and related data to try "Meng's method"
  - MG: test run on EPIC pn v. MOS
  - HLM: test run on ACIS contamination problem