

XRISM/Resolve Mid-res Analysis

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Supported by Resolve and SOT teams

1. Mid-res events among 5 Grades (Hp, **Mp, Ms**, Lp, Ls)
2. How to analyze?

Proposer Observatory Guide (POG)

<https://heasarc.gsfc.nasa.gov/docs/xrism/proposals/POG/Resolve.html>

Things to Watchout (TTW)

<https://heasarc.gsfc.nasa.gov/docs/xrism/analysis/ttwof/index.html>

Quick Analysis Guide

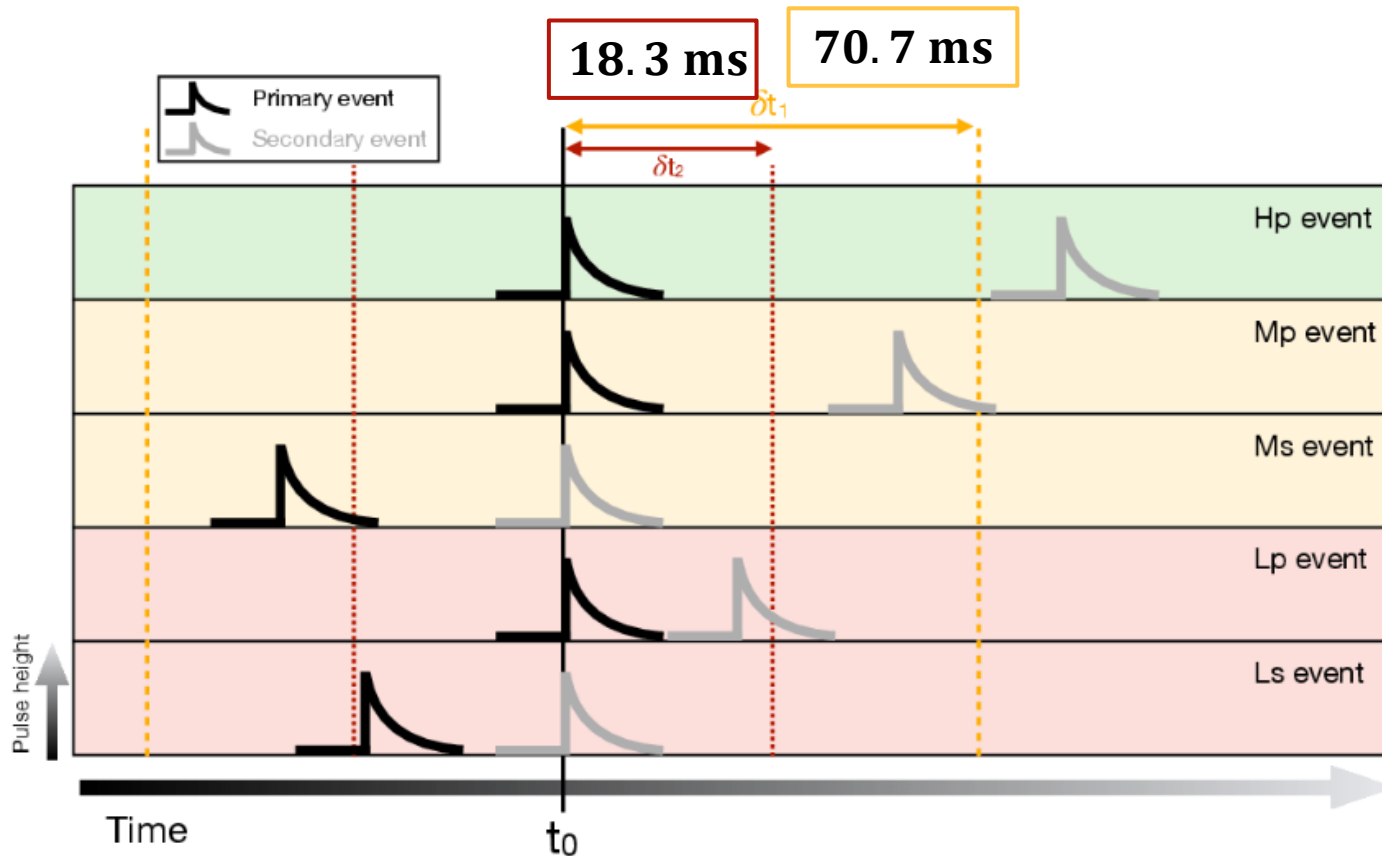
<https://heasarc.gsfc.nasa.gov/docs/xrism/analysis/quickstart/index.htm>



JAXA

Event grade of *XRISM*/Resolve

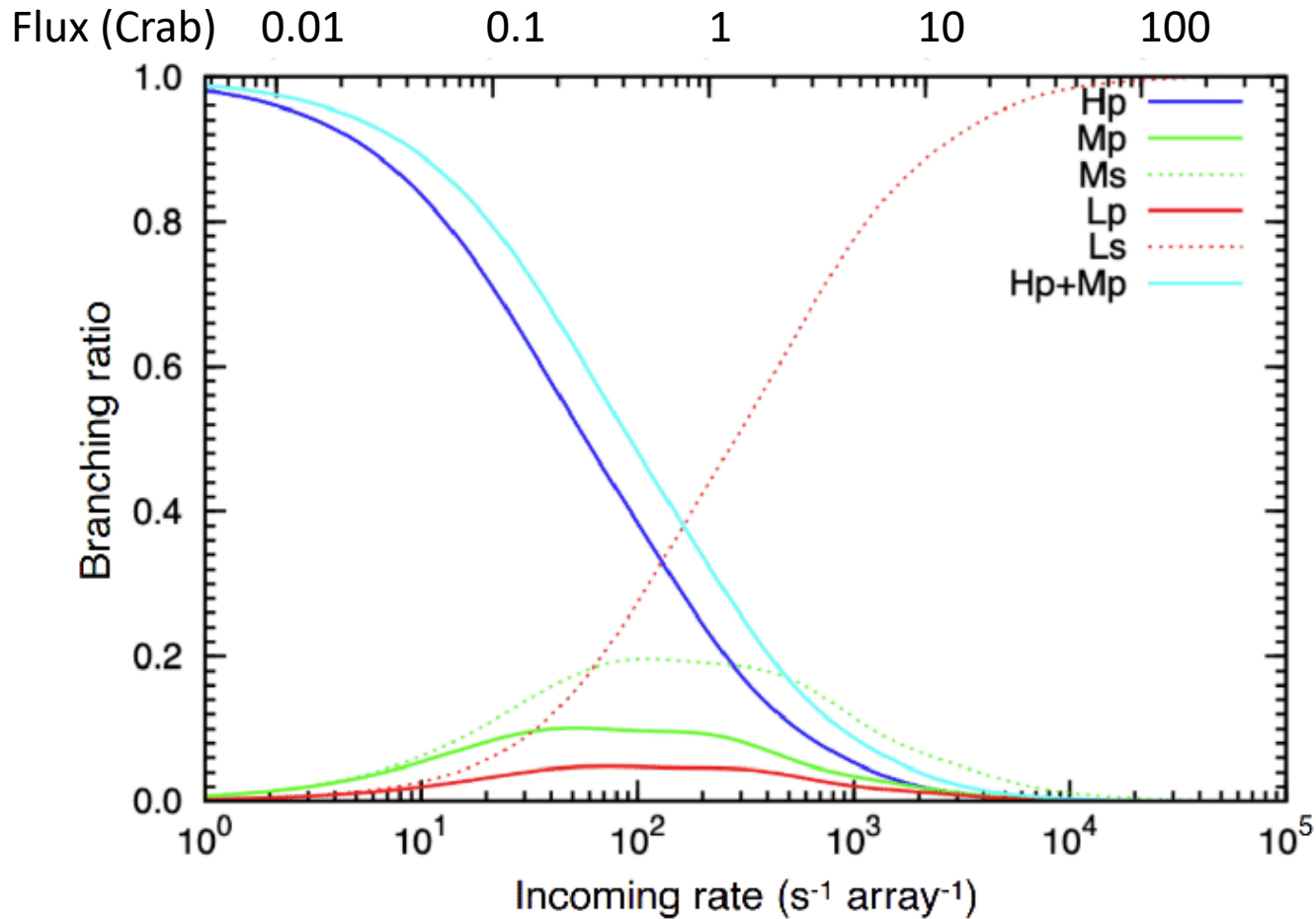
<https://heasarc.gsfc.nasa.gov/docs/xrism/proposals/POG/Resolve.html>



- High-res \Rightarrow Hp ($\sim 4 \text{ eV}$)
- Mid-res \Rightarrow Mp ($\sim 5 \text{ eV}$), Ms ($\sim 6 \text{ eV}$)
- Low-res \Rightarrow Lp, Ls

Currently many papers analyze only **Hp** events.

Event grade branching ratios



For **Bright sources**, Hp ratio is decreasing.

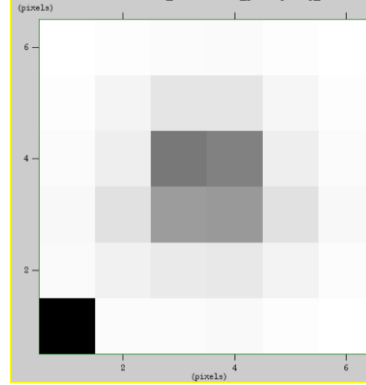
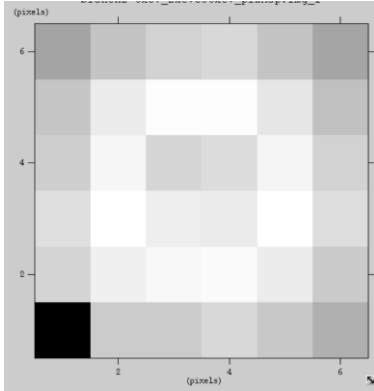
It is nice to analyze Mid-res (Mp, Ms) data, to improve the statistics.

Rslbratios (ftool) outputs (GX 340+0)

Counts

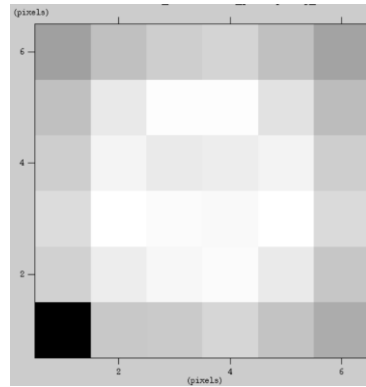
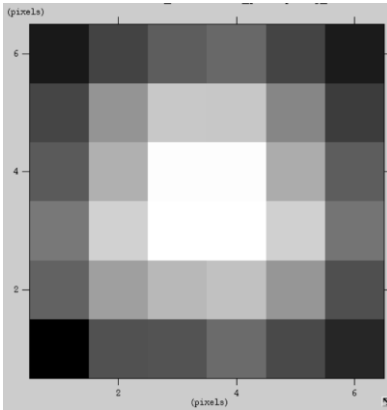
Fraction per pixel

Hp

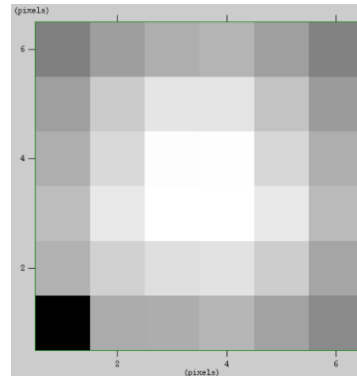
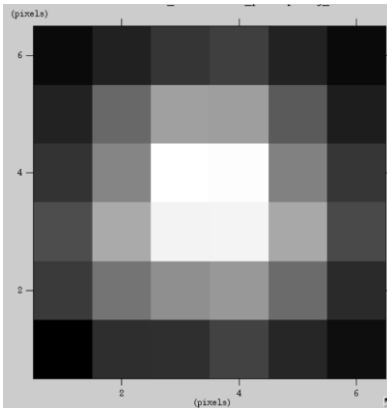


If analyzing Hp, more outer.
(Dust scattering contribution?)

Mp

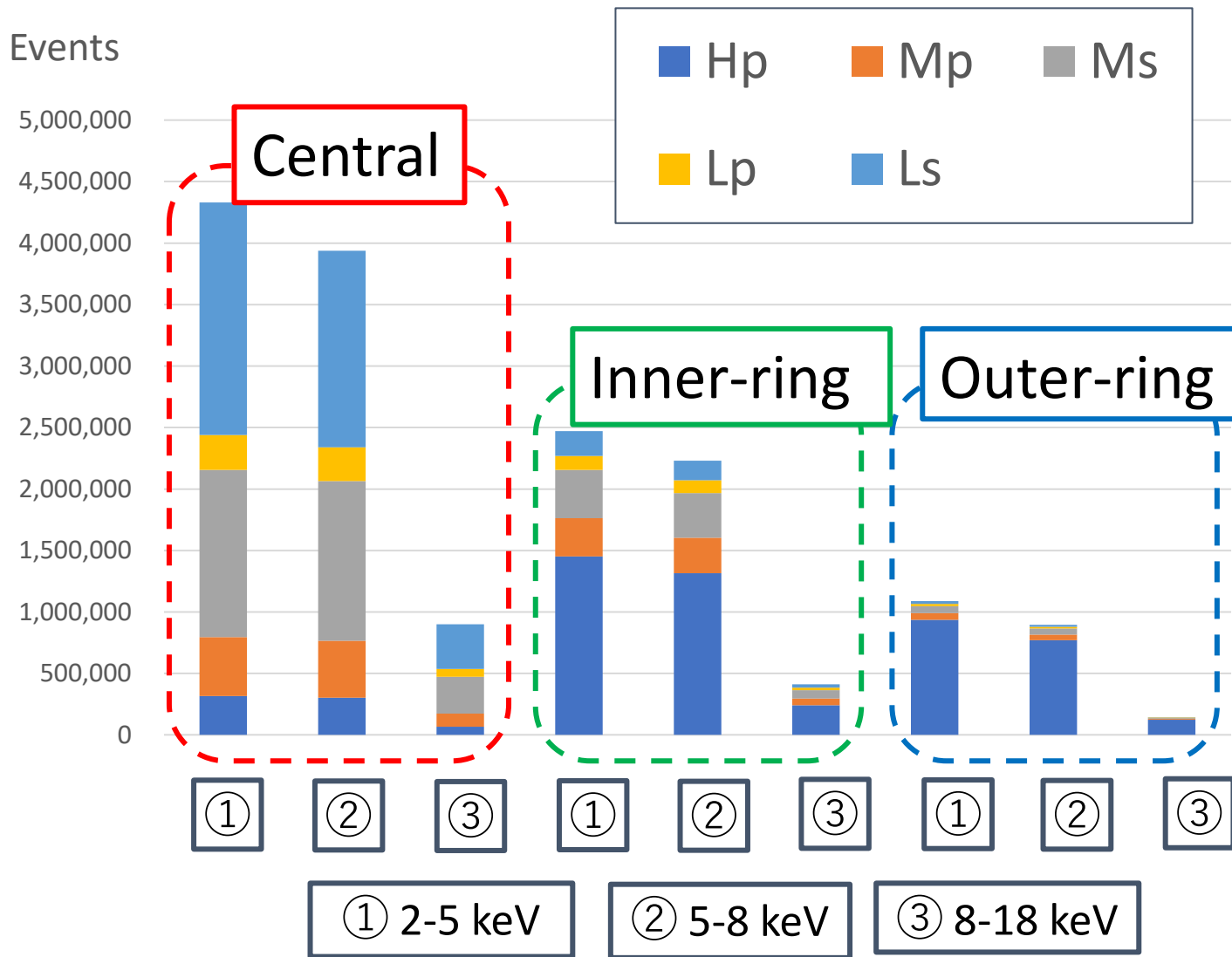


Ms



If analyzing Mp/Ms,
More (only) central.

Fraction of Event Grades (GX 340+0; 1 Crab, LMXB-NS)



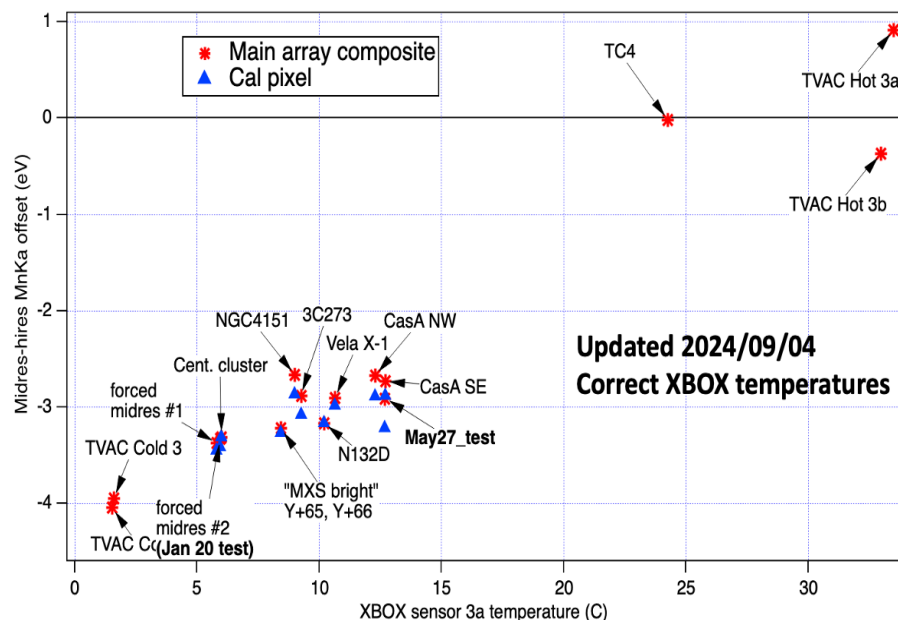
If we include Med-res (especially Ms) events, the number of events increases by ~ 2 .

Mid-res correction: **rslmpcor** (ftool)

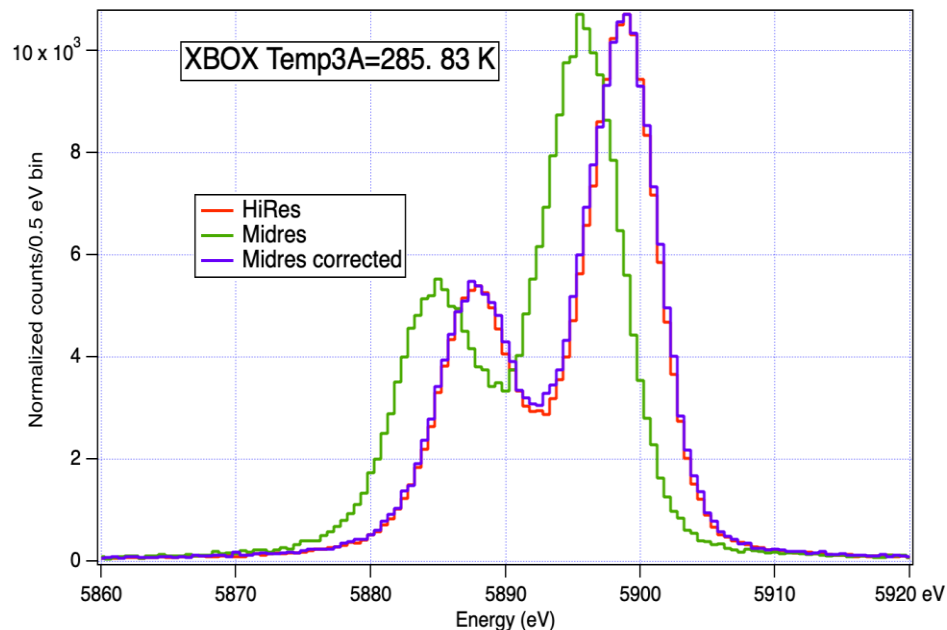
By Scott Porter

- Temperature change of an electronics box (XBOX) makes an offset of the detector bias.
- Only the gain correction for Hp and application of the Mid-res energy scale on-ground (different T), there still remained ~ 3 eV offset.
- **rslmpcor** corrects this secondary effect for Mid-res.

Temperature v.s. Mid-res gain offset

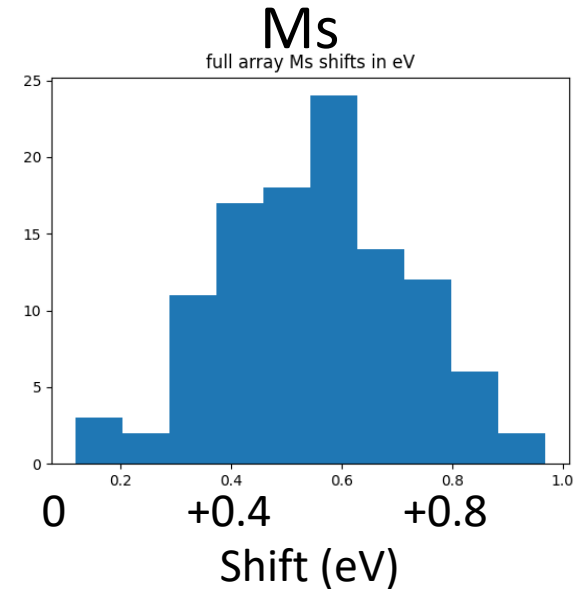
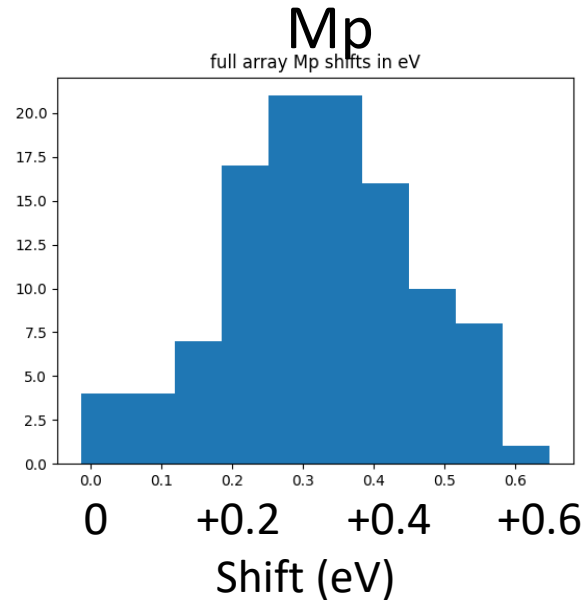
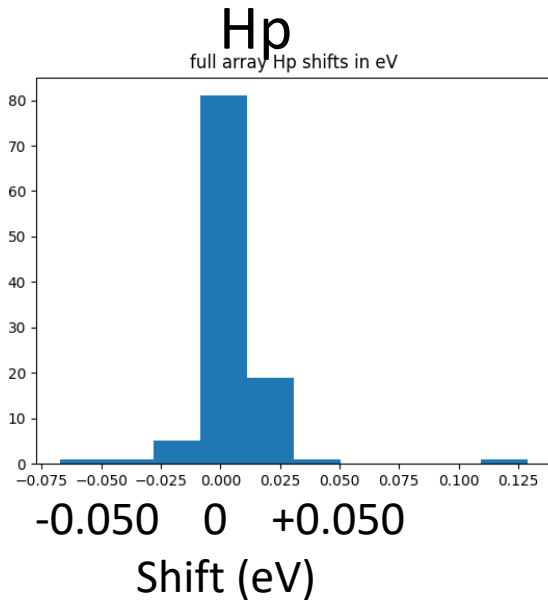


Mid-res spectra before/after rslmpcor



Gain of Hp, Mp, Ms

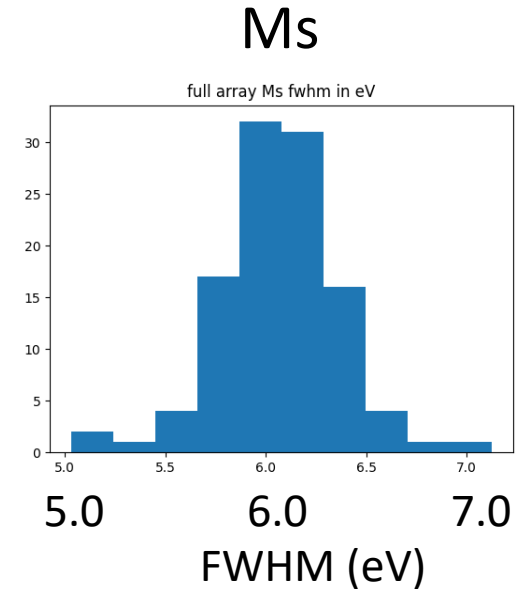
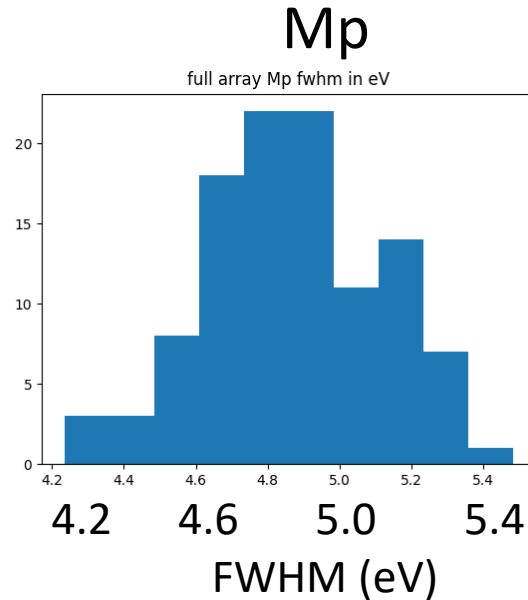
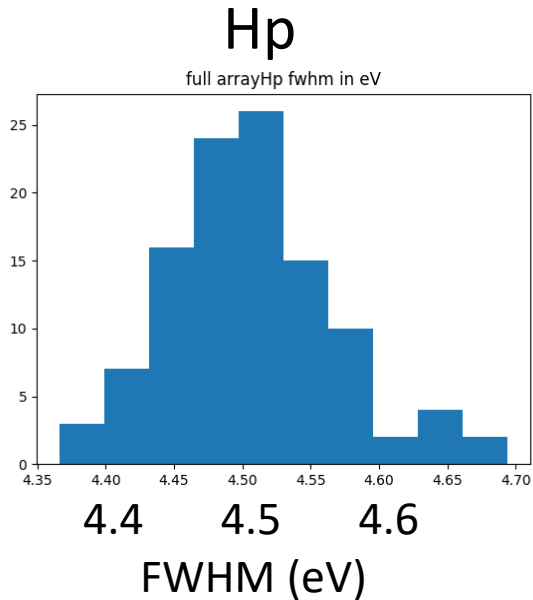
From fitting PV and AO1 (as of Feb 2025) sequences
Fe55 full-array spectra



- Mp has a shift ~ 0.3 eV
 - Ms ~ 0.5 eV
- => If analyzing >1 eV accuracy (e.g., board lines), Mp and Ms can be included.

FWHM of Hp, Mp, Ms

From fitting PV and AO1 (as of Feb 2025) sequences
Fe55 full-array spectra



- Mp has FWHM of ~ 5 eV (\Leftrightarrow Hp ~ 4 eV)

- Ms ~ 6 eV

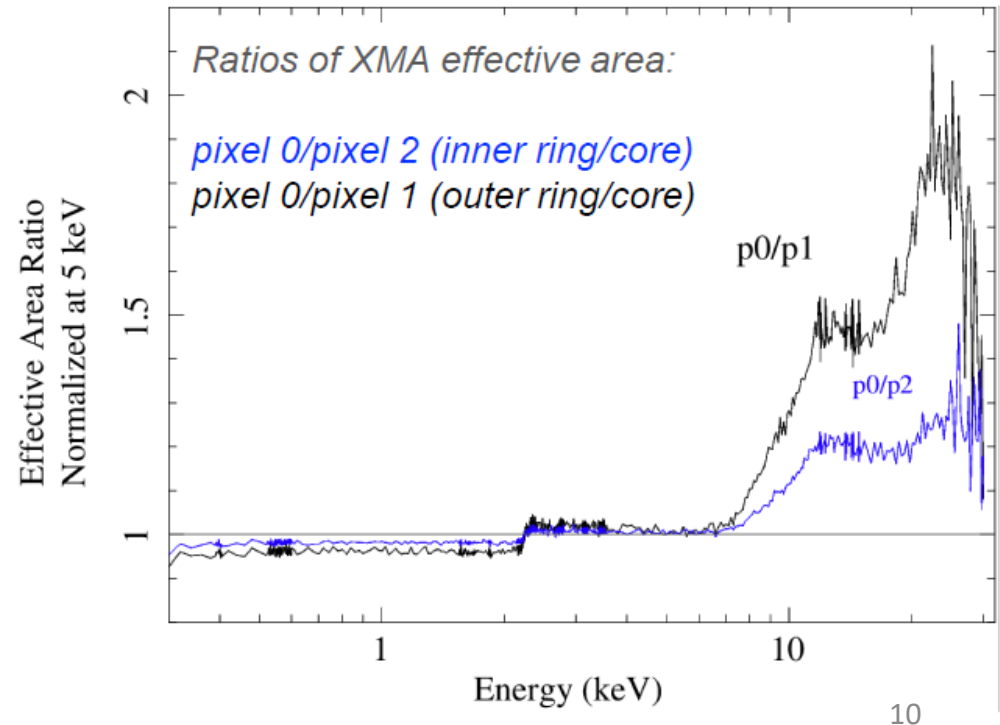
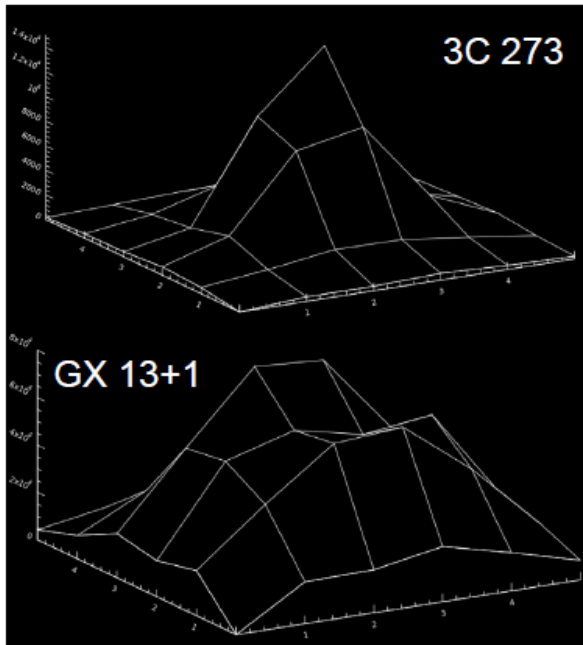
=> If analyzing >1 eV accuracy (e.g., board lines), Mp and Ms can be included.

New Resolve response generator tool rslmkrsp will call rslrmf and xaarfgen.

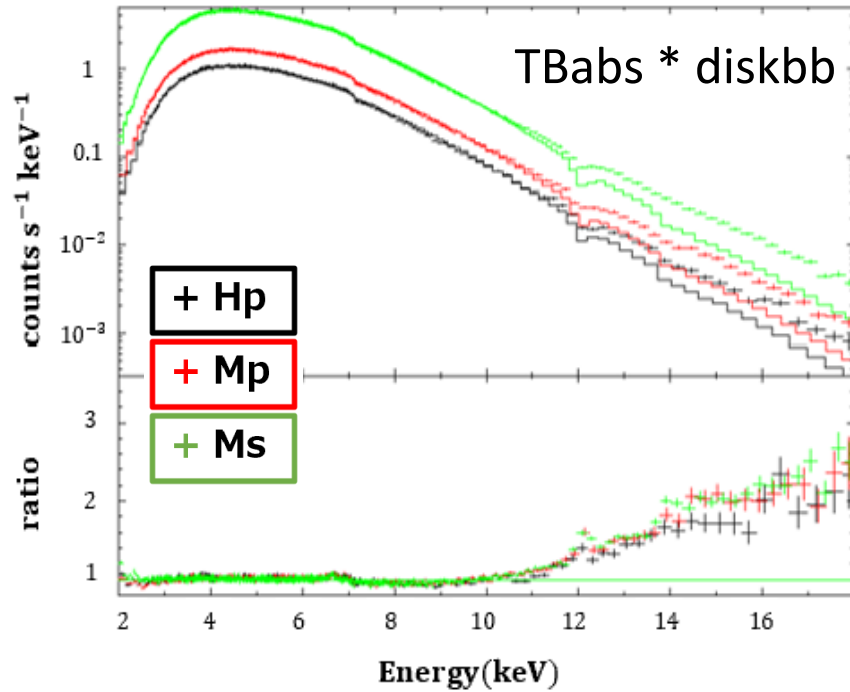
The current scheme for making an RMF and ARF for Resolve is only valid if the Hp fraction is the same or similar for every pixel. This is only true for weak sources with an Hp fraction of ~ 1 . New tool will be correct for arbitrary pixel grade distributions.

There are pixel-to-pixel differences in the XMA effective area as a function of energy, and as the source brightness increases, the current method assigns weights to the per-pixel effective area functions that are increasingly erroneous.

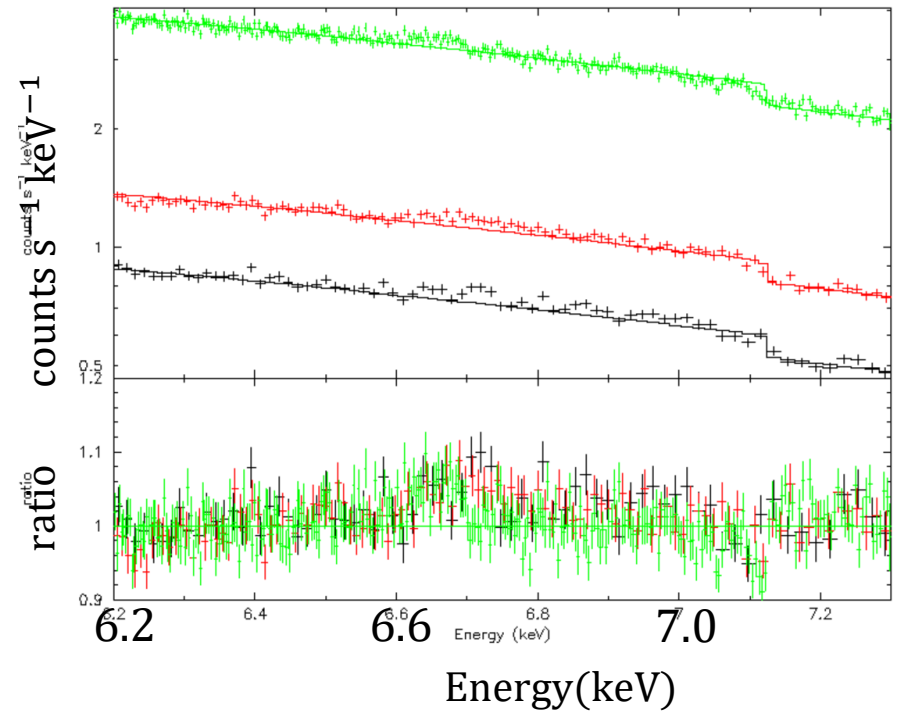
Depression of PSF Hp core in bright sources



2-18 keV



6.2-7.3 keV



Spectra/RSP are consistent among Hp, Mp, Ms.

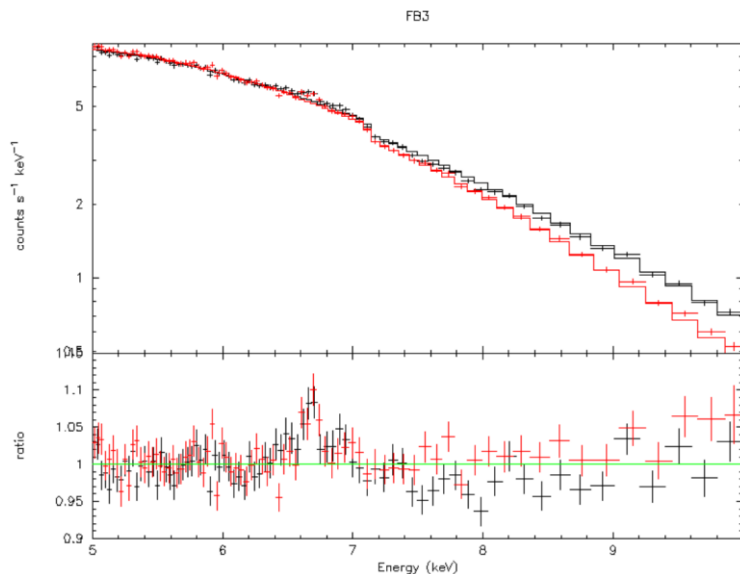
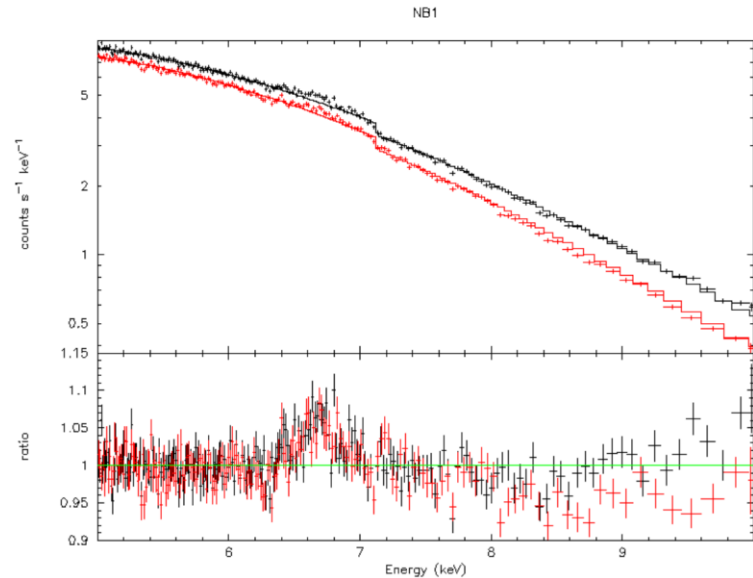
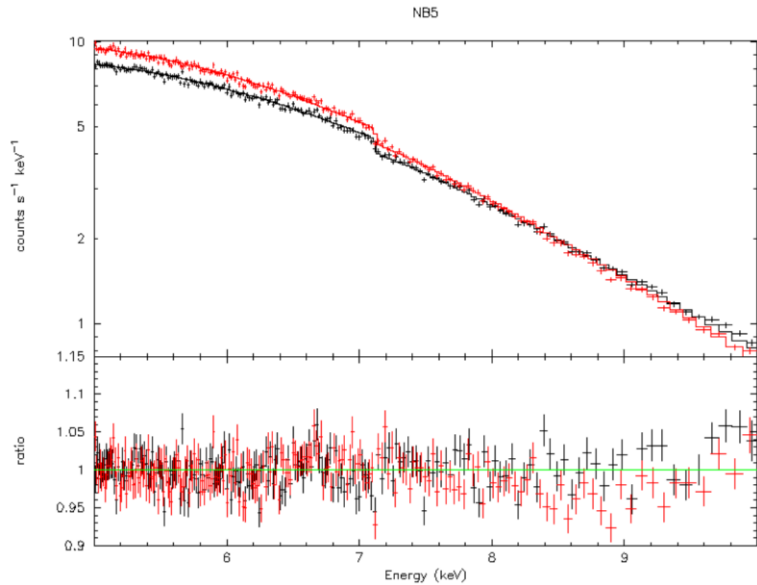
GX 340+0 itself has flux/spectral variability.

- Harder spectrum when brighter.
- 6.7 keV emission line?

State analysis: Hp+Mp+Ms spectra for different regions

Central, Inner (5-10 keV)

GX340+0



When selecting the GTI with flux levels, 6.7 keV emission line matches between center and inner (and the line is variable).

XRISM/Resolve Mid-res Analysis

- Mid-res events (Mp, Ms) among 5 Grades are calibrated
 - Gain **<1 eV**
 - FWHM: **Mp~5 eV, Ms~6 eV** (\Leftrightarrow Hp~4 eV)
- For bright sources & broad features >1 eV, recommend to try including Mid-res events.

Proposer Observatory Guide (POG)

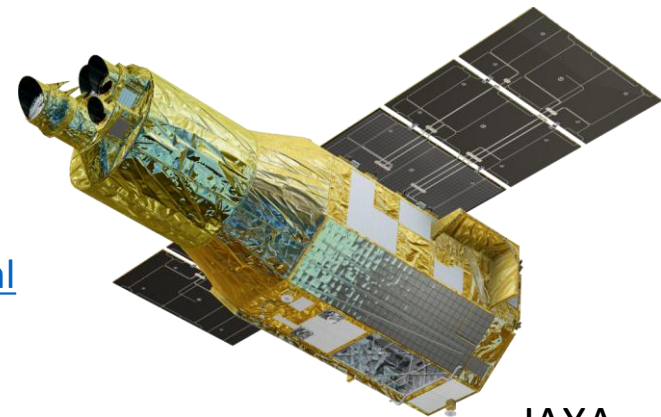
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