

Calibration Coffee Hour

MLI Temperature Dependent, no more (and gain)

2024/03/05 BG

CALDB 20240229 Update

https://heasarc.gsfc.nasa.gov/docs/heasarc/caldb/nustar/docs/release_20240229.txt

- Two main things:
 - 2022 gain pivot point for FPMA DET0
 - (corrects a 0.2% drop in high-energy lines)
 - <https://arxiv.org/abs/2206.04058v2> for details
 - Removing the FPMA Effective Area Temperature Dependence
 - What we'll talk about today
 - More on the MLI: <https://arxiv.org/abs/2005.00569>

What is MLI?

MLI = Multi-layer Insulation

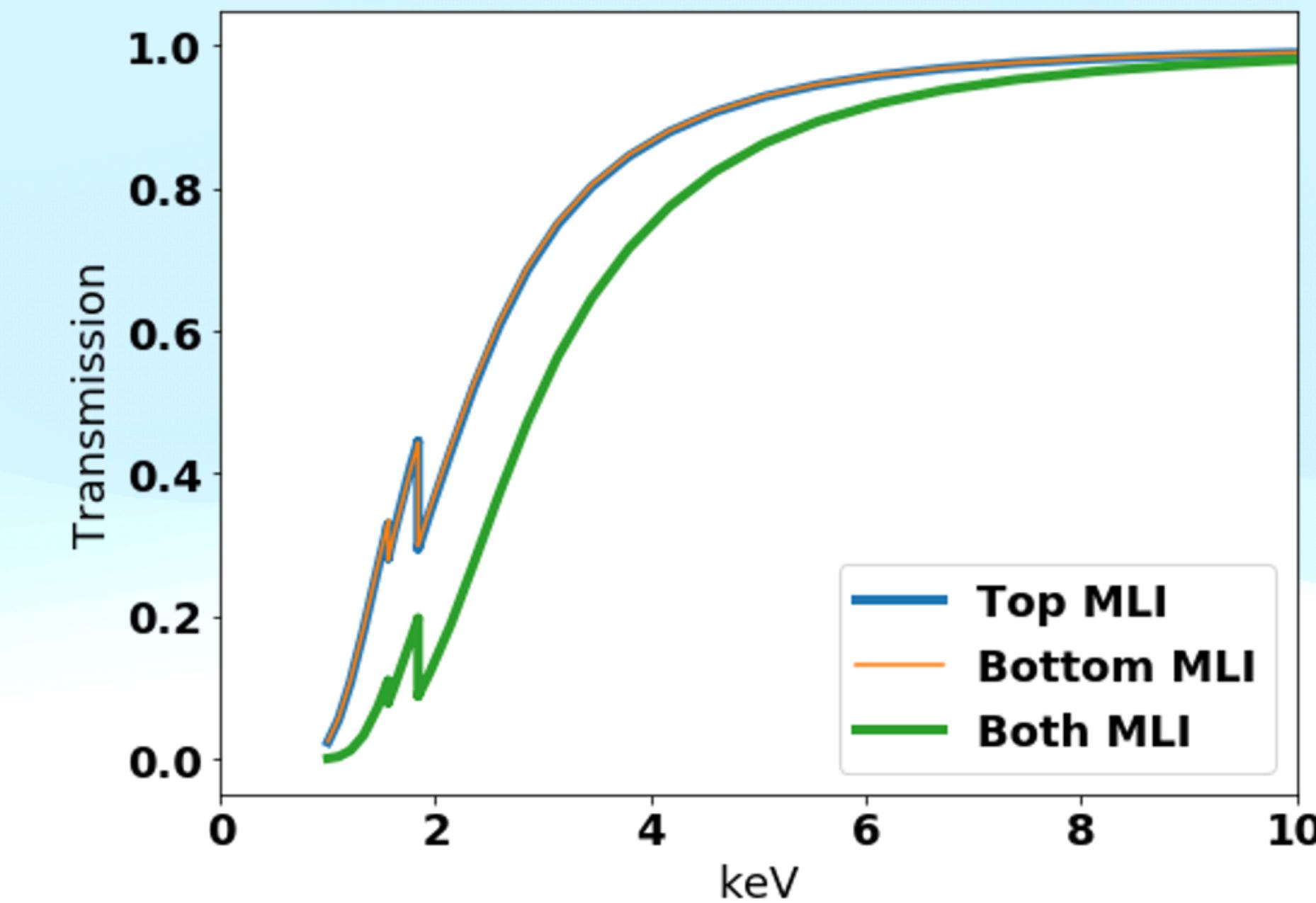
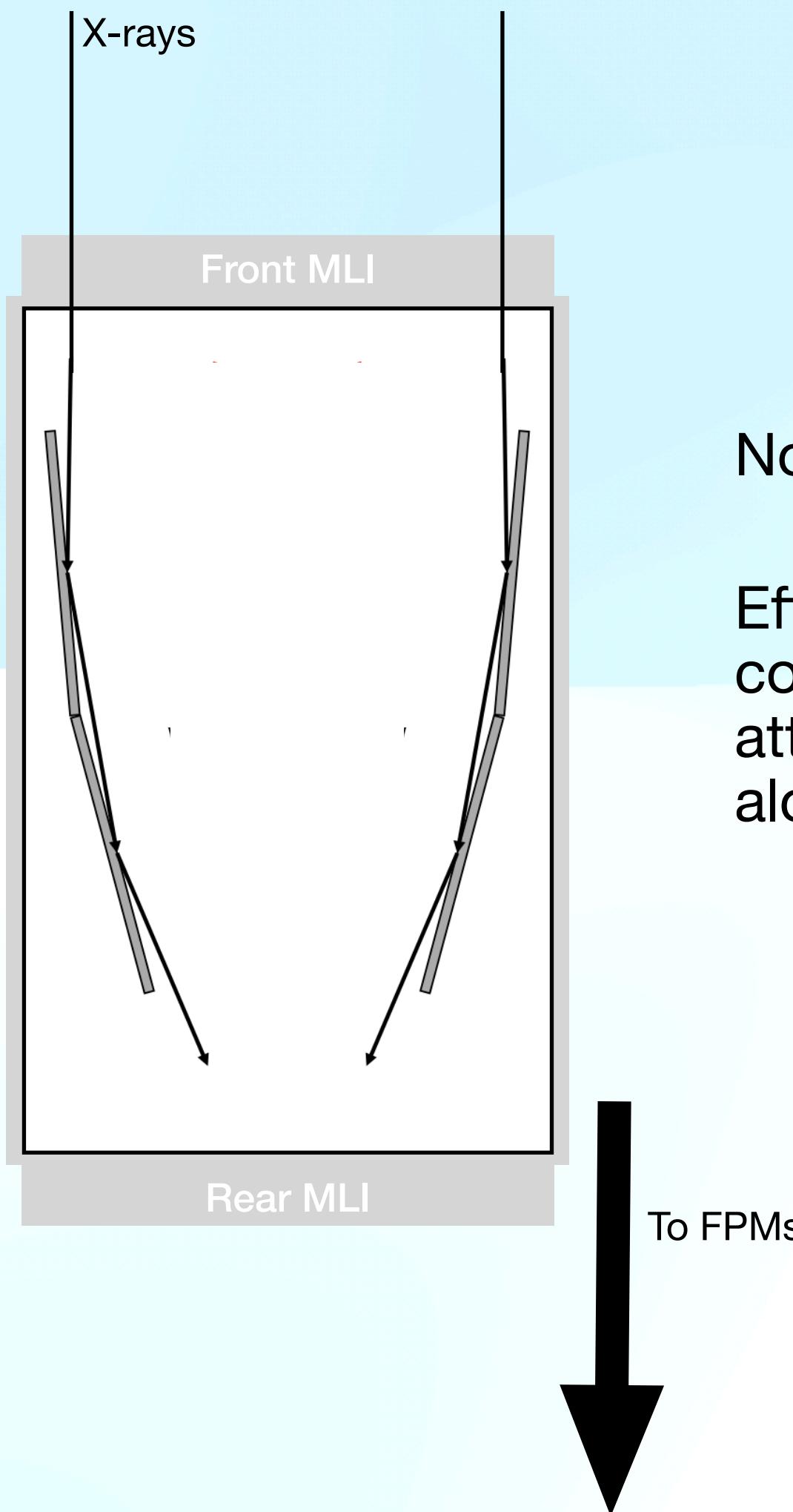
a.k.a, the shiny stuff

a.k.a, the stuff that keep things cool

Picture is NuSTAR pre-launch in the
Pegasus nose cone



X-ray absorption



MLI has an energy-dependent attenuation based on its composition

Thickness calibrated on the ground pre-launch

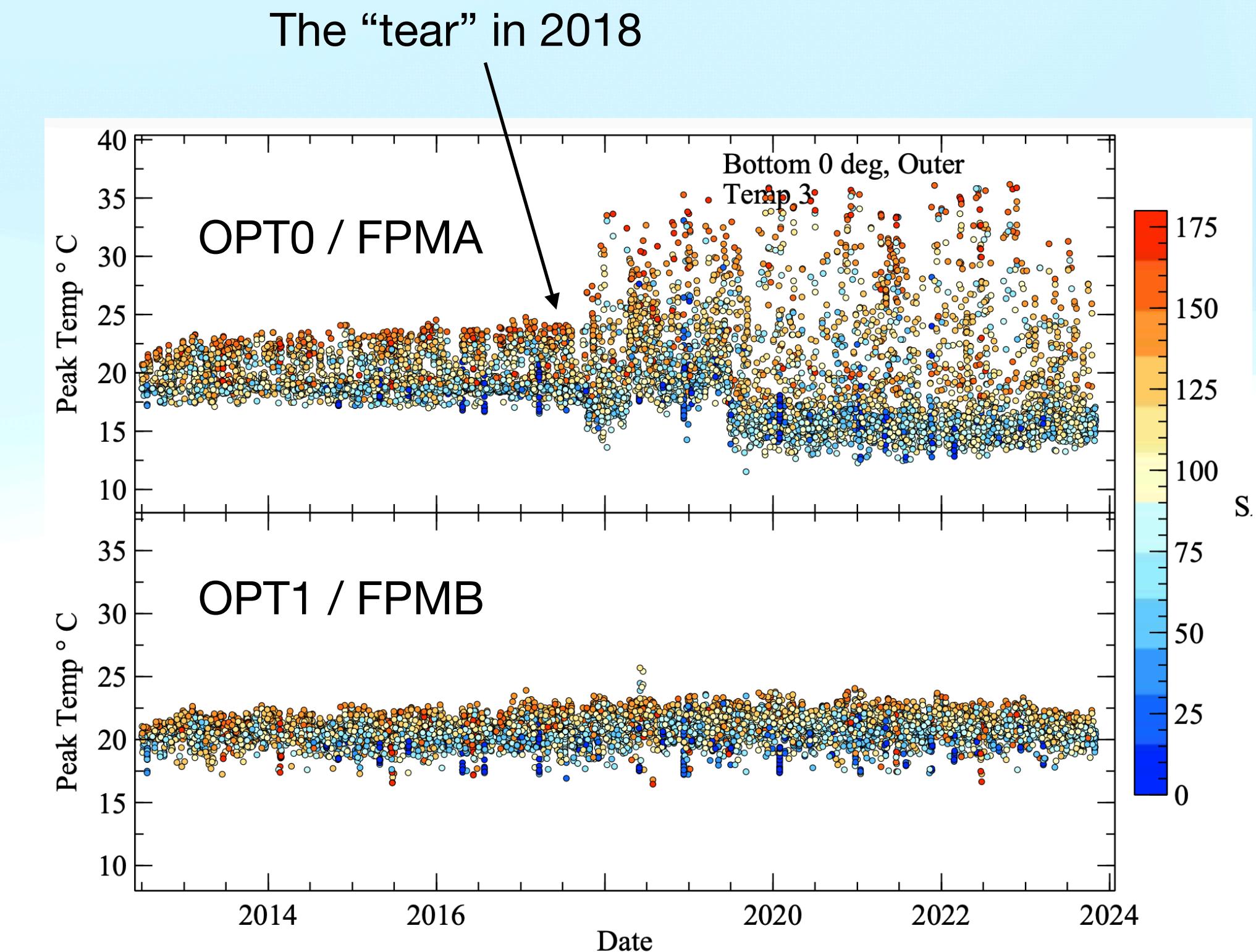
The “tear” in 2018

Plots show the peak temperature for every observation for a “rear” thermistor

OPT0 had some event in 2018 that shows heat is leaking out to space / leaking in from the Sun

OPT1 is “pristine”

Less thermal control → less MLI → more soft X-rays! → need to fix the ARF file...



The “tear” in 2018

From Kristin's paper here:

<https://arxiv.org/pdf/2005.00569.pdf>

If you get the MLI wrong, can see an
“excess” in FPMA vs FPMB (or split the
difference)

“Fixed” in 2019/2020. SOC tracks the long-term behavior of the MLI.

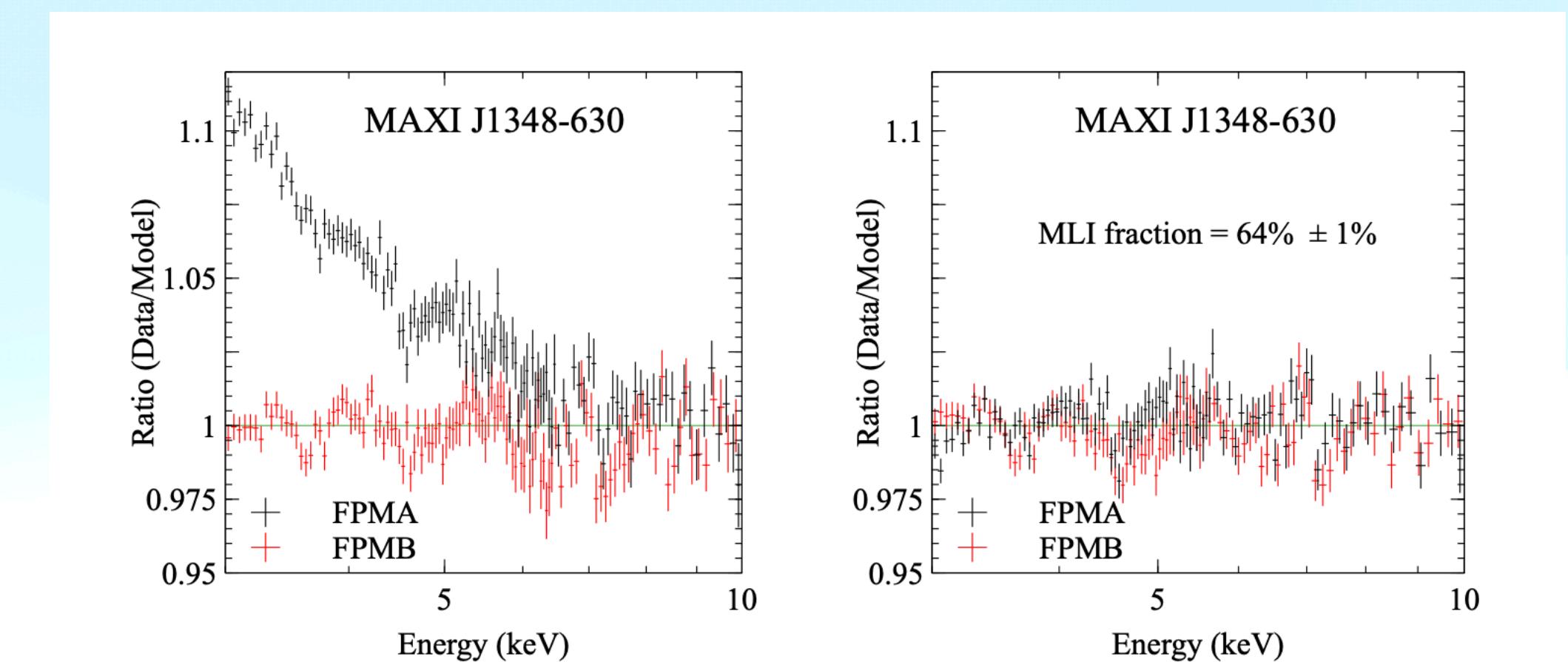


FIG. 1.— Left Panel: Spectra of MAXI J1348-630 (Obsid: 80402315010) fitted with the same model exhibiting a low energy excess for FPMA. Right Panel: Same spectra including a model for the MLI covering fraction where the FPMB covering fraction $\equiv 1.0$ and the FPMA covering fraction $= 0.64 \pm 0.01$.

The “cold dip”

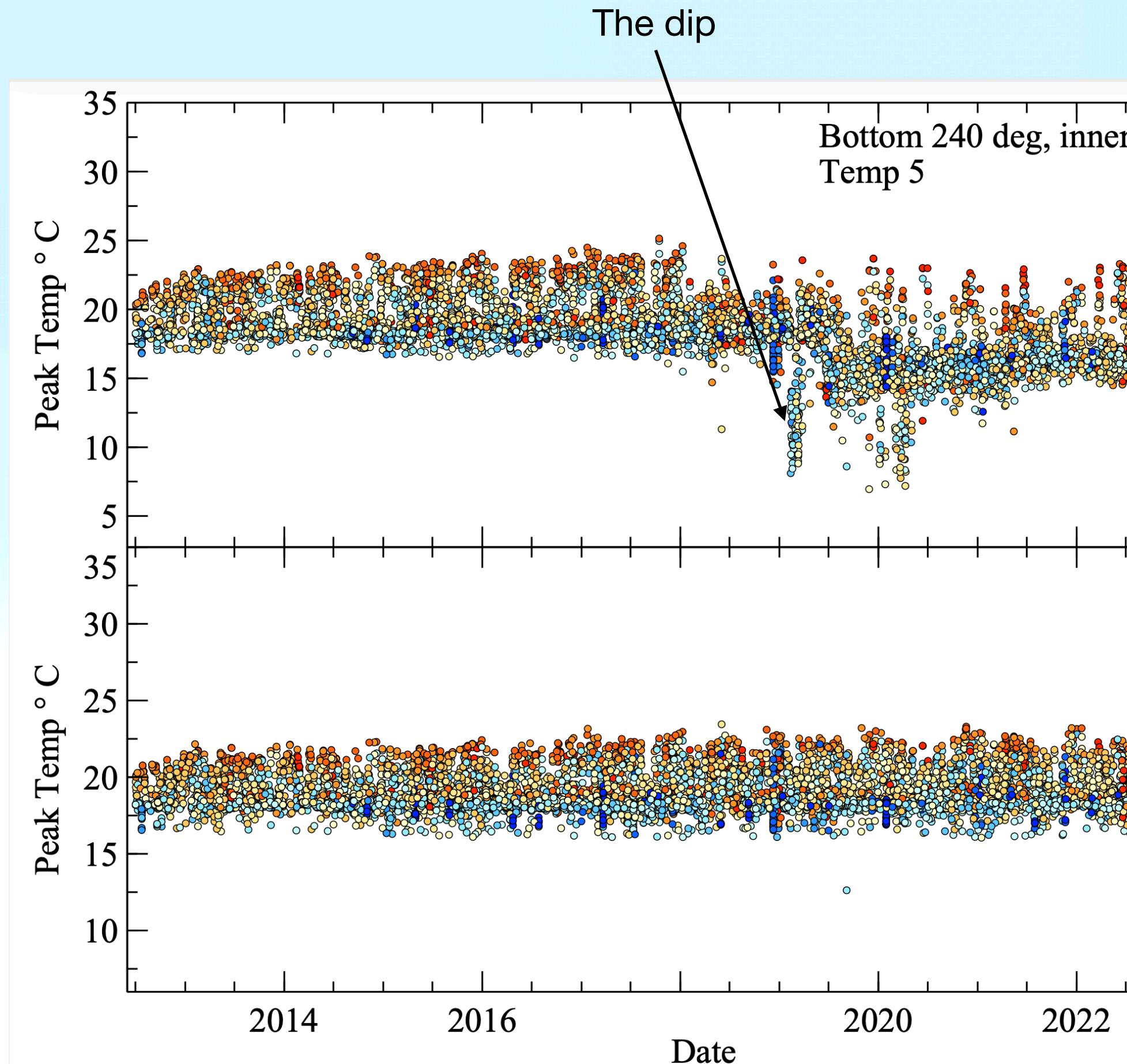
A different temperature probe on the optics correlates well with more lost MLI

—> added a temperature-dependent MLI correction using this thermistor

CALDB 20200429

Also see the SOC page on this for a list of affected observations in these dips:

[https://nustarsoc.caltech.edu/NuSTAR_Public/
NuSTAROperationSite/mli.php](https://nustarsoc.caltech.edu/NuSTAR_Public/NuSTAROperationSite/mli.php)



5TEMP goes wacky

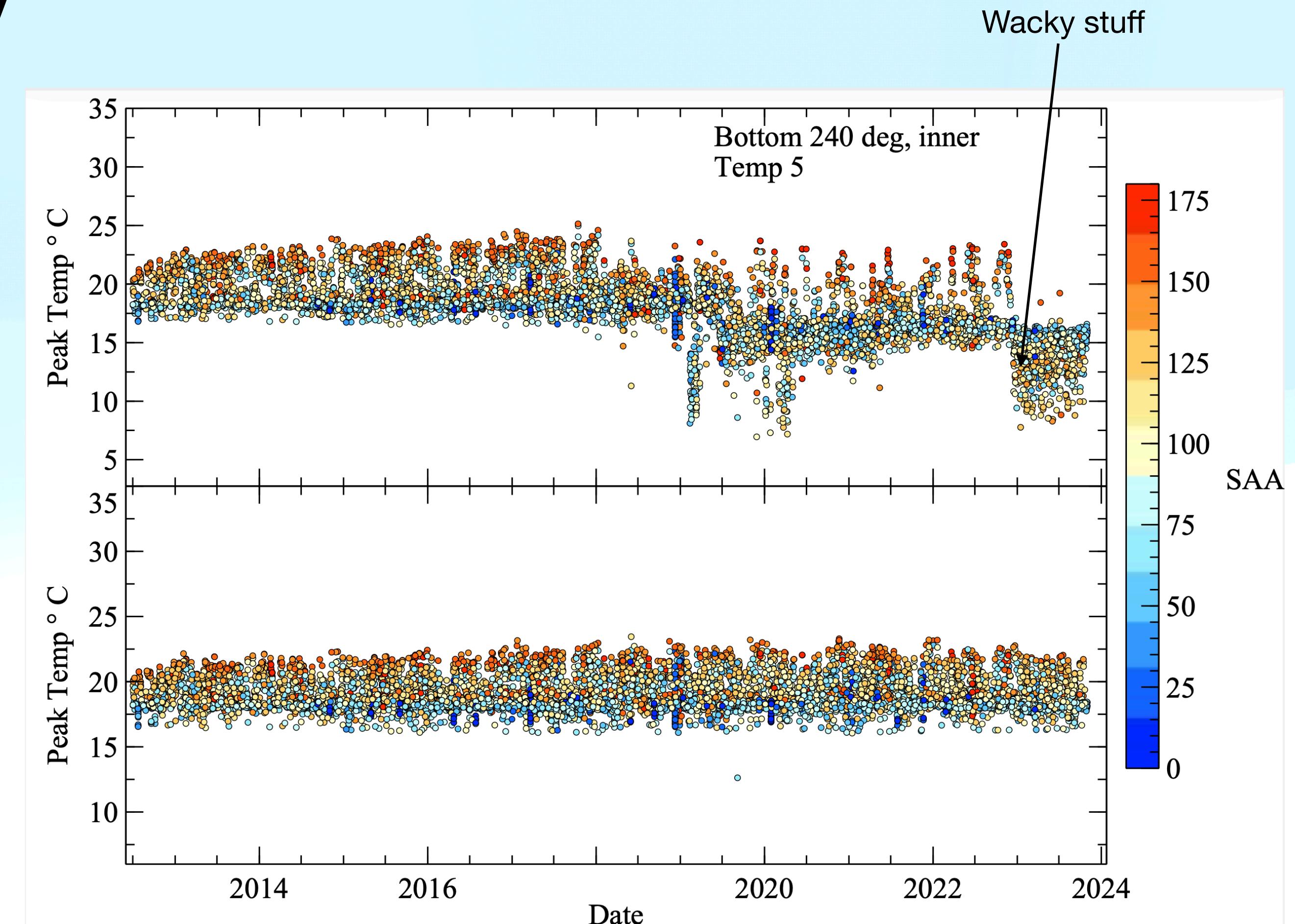
5TEMP no longer tracks reality (or other temperature sensor)

So don't want to use 5TEMP to "fix" the MLI.

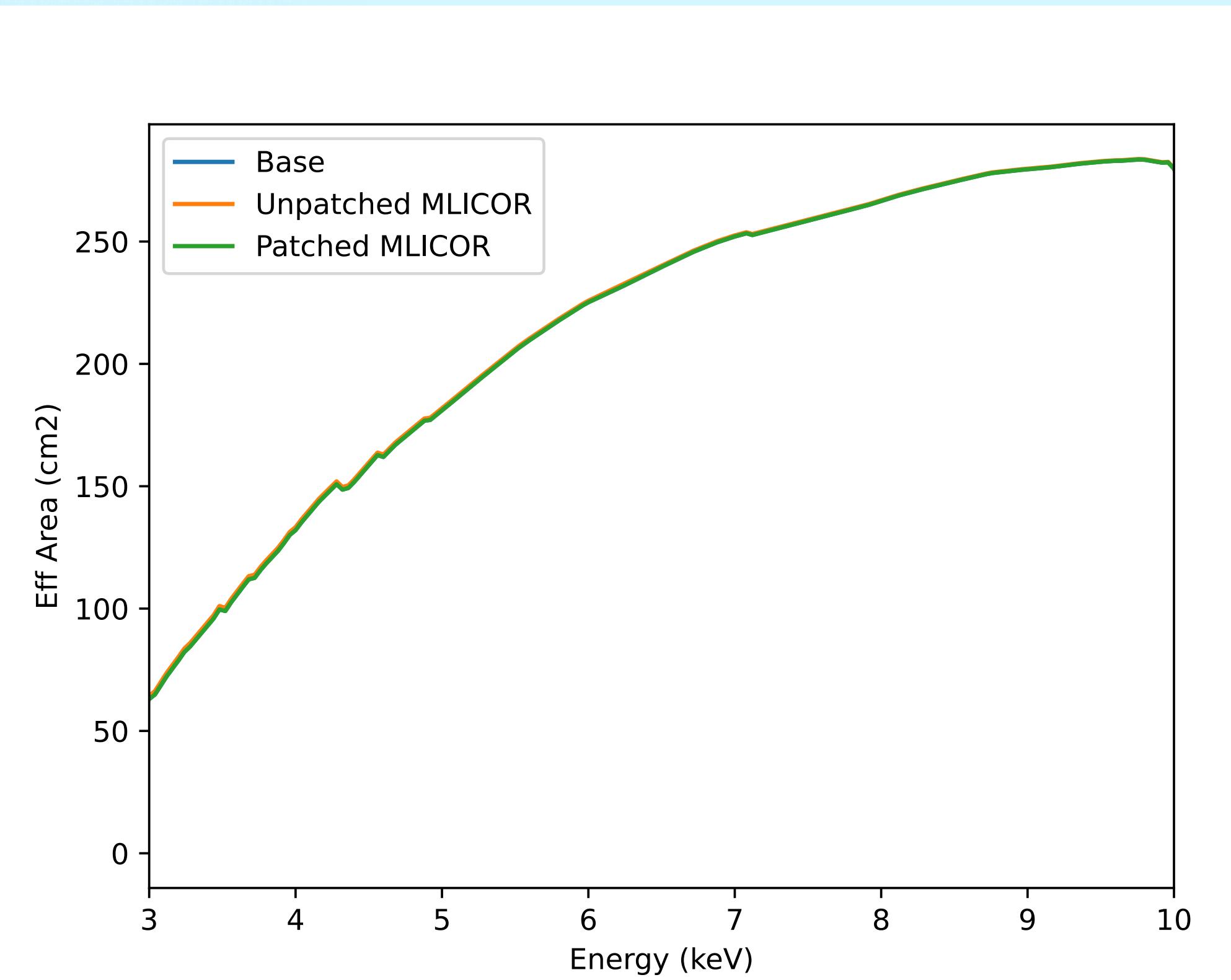
—> Will result in incorrectly amplifying FPMA throughput

Before CALDB 20240229, if the user sets "mlicorr=True" then this can happen

Simple fix: We turned off the temperature correction after 2023 so that a user won't see any difference if you "turn it on" yourself

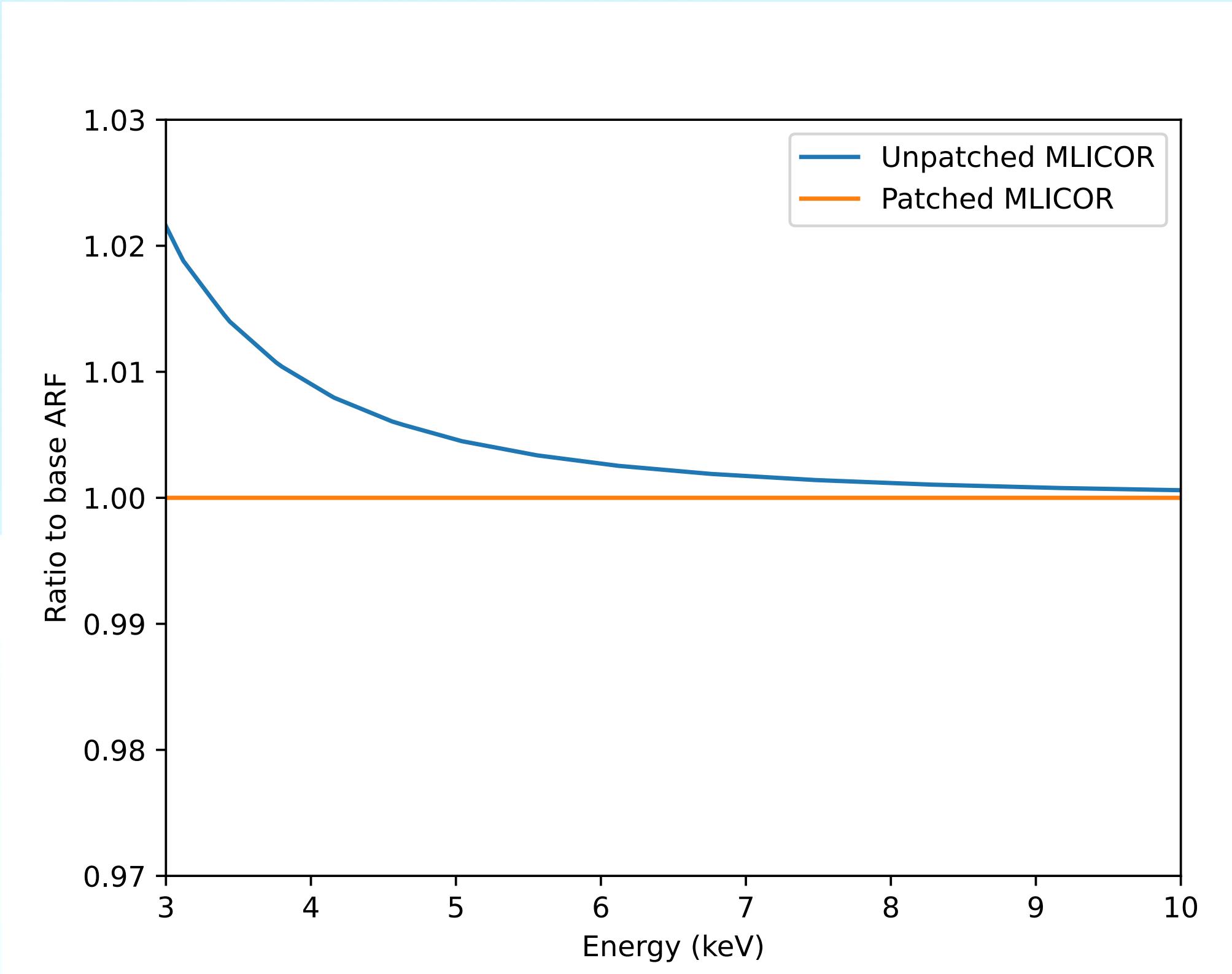


Science Impact



Impact is tiny in an absolute sense...

Science Impact



But **relative** tails at the few % level can be seen.

So, for very bright XRBs you could see this in comparison between FPMA and FPMB