AGENDA
CalStats Working Group

IACHEC XVII

Vinay Kashyap (CXC/CfA) : 2025-may-13

The Cal/Stats Working Group

Anything and everything about tools and methods having to do with the analysis and interpretation of calibration data

- Mailing List — iachec-calstat@cfa.harvard.edu
- Web page — https://iachec.org/calibration-statistics/
- Library — https://iachec.org/calibration-statistics/#library
- Wiki page — https://wikis.mit.edu/confluence/display/iachec/Calibration+Statistics
- Slack channel — iachec.slack.com #calstats

I. Main WG Session

Pileup, Methods, Cal uncertainties (MCCal, Athena)

1. Pileup — Robert Zimmerman (Imperial)
2. Statistical methodology — Johannes Buchner (MPE)
3. Calibration uncertainties
    a. MC Cal — Pete Ratzlaff, Jeremy Drake, Vinay Kashyap (CfA/CXC)
    b. Science implications for Athena — Matteo Guinazzi (ESA/ESTEC)
4. Future Directions

II. Concordance

Wednesday May 14 3:40-4pm — Herman Marshall

- Upgrades since IACHEC 16
- Discussion of systematic error estimates
- Dealing with outliers

III. Hidden Markov Models

Tutorial by Robert Zimmerman Wed May 14 7:45pm-8:45pm

- HMMs are a way to incorporate changes in state that are manifested indirectly
- If you tie an observable to an underlying state (e.g., could be as simple as intensity during a high or low accretion state, or plasma temperature during flaring or quiescence), you can model variations in the data as arising from discrete changes in state, which greatly reduces the dimensionality of the problem and makes it more tractable
- Well suited to calibration problems because things constantly shift underfoot, and HMMs can provide a useful framework to handle changes
  - varying background (over time, over orbit)
  - drifts in detector characteristics (whether due to temperature or non-linearity of detector response)
  - ??

I. Pileup

Robert Zimmerman (Imperial)

II. Statistical Methods for X-ray Analysis

Johannes Buchner (MPE)

I.3.a Calibration Uncertainty

MC Cal — Peter Ratzlaff, Jeremy Drake

- A long time ago in a conference far away, we came up with a way to describe systematic variations in Chandra effective areas (Drake et al. 2006, Kashyap et al. 2008, Lee et al. 2011, Xu et al. 2014, Drake et al., 20192X)

- The principle is simple: if you know the typical uncertainties in your subsystems, you can propagate them to build a sample set of calibration products which will cover the possible variations, and you can narrow down the range by comparing the predictions of each of the samples to actual data.

- What we have now is a github repository of the code to generate the samples at **https://github.com/pratzlaff/mccal**

- What we need is for instrument teams to try it out and generate representative samples.

I.3.b. Calibration Uncertainty

Science implications for Athena — Matteo Guinazzi

On the scientific impact of the uncertainties in the *Athena* mirror effective area

Matteo Guainazzi,[a,*] Richard Willingale,[b] Laura Brenneman,[c] Esra Bulbul,[d] Jan-Willem den Herder,[e] Erik Kuulkers,[a] Jan-Uwe Ness,[f] and Lorenzo Natalucci[g]

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IV. Future Directions

- Difficulties with high spectral resolution (large RMFs)
- Codifying systematic calibration uncertainty
- Concordance
- Machine Learning tools and techniques for calibration? (Ivan Valtchanov)
  - Pileup
  - XMM super-resolution
  - ??

I.1.a Pileup with Neural Networks

Emulating the Effects of Pile-Up on X-ray Spectra

Justina R. Yang* [1,2], *Daniela Huppenkothen*[3], *Rafael Martínez-Galarza*[2], *Vinay Kashyap*[2], *Pile-Up ABC Team*

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A neural network can emulate simulated pile-up in relativistic reflection spectra