

Calibration of X-Ray Observatories

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Accurate calibration of x-ray observatories has proved an elusive goal. Inaccuracies and inconsistencies amongst on-ground measurements, differences between on-ground and in-space performance, in-space performance changes, and the absence of cosmic calibration standards whose physics we truly understand have precluded absolute calibration better than several percent and relative spectral calibration better than a few percent. The philosophy "the model is the calibration" relies upon a complete high-fidelity model of performance and an accurate verification and calibration of this model. As high-resolution x-ray spectroscopy begins to play a more important role in astrophysics, additional issues in accurately calibrating at high spectral resolution become more evident.

Here we review the challenges of accurately calibrating the absolute and relative response of x-ray observatories. On-ground x-ray testing by itself is unlikely to achieve a high-accuracy calibration of in-space performance, especially when the performance changes with time. Nonetheless, it remains an essential tool in verifying functionality and in characterizing and verifying the performance model. In the absence of verified cosmic calibration sources, we also discuss the notion of an artificial, in-space x-ray calibration standard.



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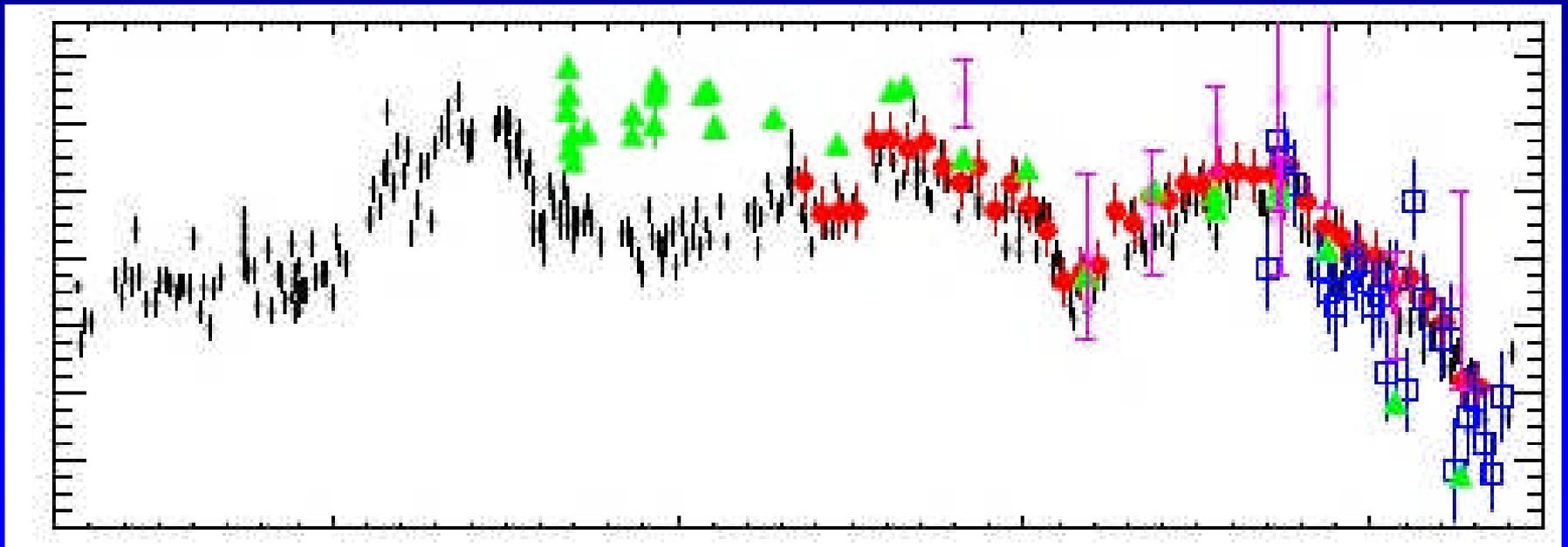


Events of the past year emphasize the challenges.





We have seen old cherished myths
fall apart.



Wilson-Hodge et al. 2011



We have begun to question certain assumptions.

- Ignoring uncertainties in response functions
 - ❑ We discussed a specific case last year.
- Over-attributing physics of our sources
 - ❑ We discussed a specific case two years ago.



Accurate calibration has been an elusive goal.

- Inaccuracies and inconsistencies amongst on-ground measurements
- Incomplete physical model of performance
- Differences between on-ground and in-space performance
- Changes in the in-space performance
- Absence of cosmic calibration standards whose physics we truly understand



“The model is the calibration.”

- Approach relies upon a verified, high-fidelity model of performance.
- On-ground testing may not achieve a high-accuracy calibration of in-space performance.
- Nonetheless, approach is an essential tool.
 - ❑ Verifies functionality, characterizes performance, and tests the model.



We should seriously consider an in-space calibration standard.

- Form a subgroup to define the questions.
- Identify and establish long-term goals.
- Report back next year.