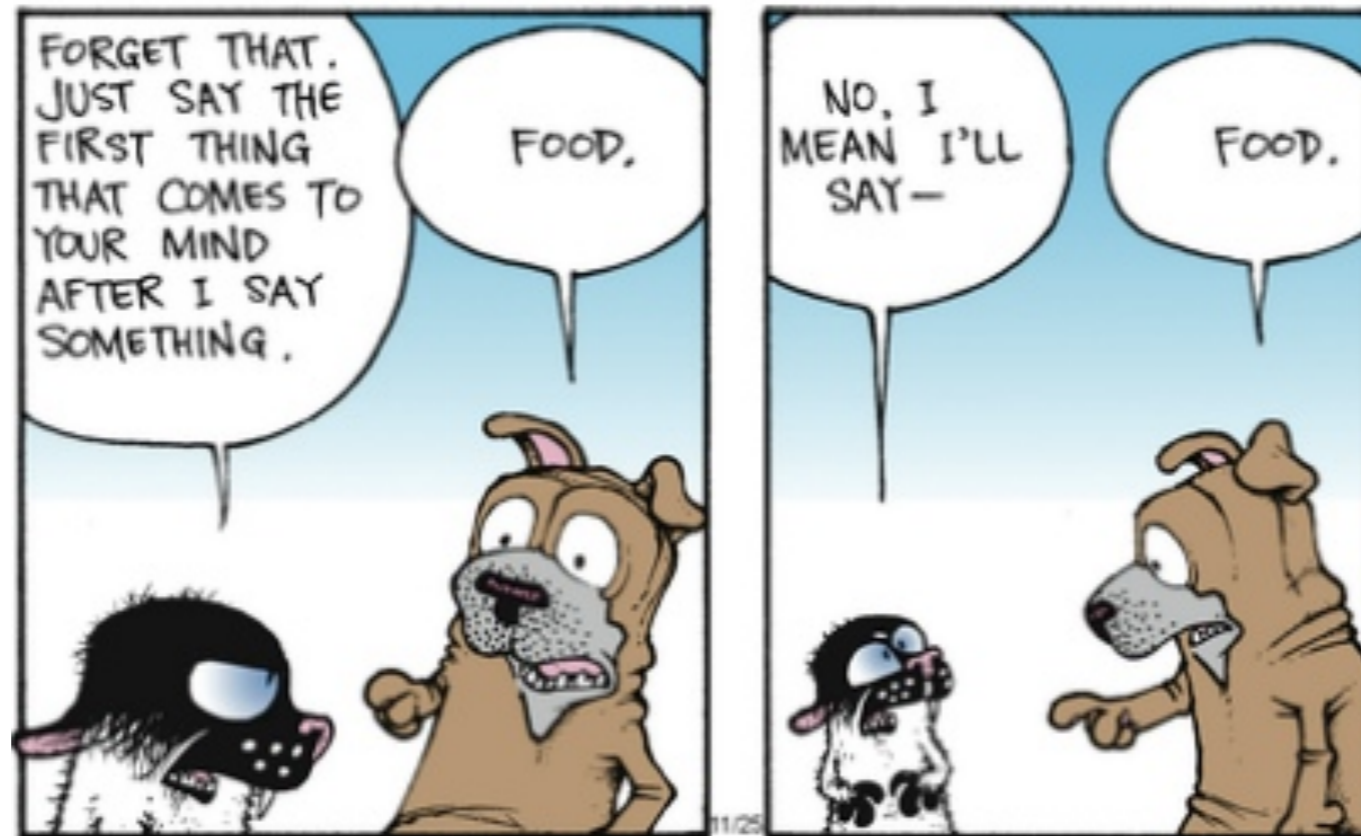


# Effective Area Cross-Calibration with Parallel Observations



# Effective Area Cross-Calibration with Parallel Observations



# EA WG Summary — 2011

- Working on papers
  - Ishida et al.: Suzaku, XMM, Chandra
  - Smith et al.: XMM, Chandra
  - Other working groups: clusters, IE0102, Crab
- Planning new observations
  - PKS 2155: XMM, Suzaku, Chandra — April 26-27, 2011
    - add Swift
  - other sources, some simultaneous
    - RXJ 1856: Chandra, Suzaku, XMM
    - IE0102
    - Crab: Suzaku, MAXI
  - NuSTAR in-flight cal with Swift BAT, IBIS: G21.5-0.9?, others?
- Putting it all together
  - Draw a line at some specific stage of calibration, publish
  - Smooth blazar, cluster spectra
- High energy
  - Fermi-LAT and AGILE/GRID cross-cal pilot project now exists using pulsars: Maura Pilia, Ozlem Celik
  - Integral SPI, JEM-X, IBIS; Swift BAT; MAXI GSC; and Suzaku GSO, PIN: working on Crab
- TeV joint observations: HESS, Veritas, MAGIC

# PKS 2155 Cross-Cal

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## Cross Spectral Calibration of Suzaku, XMM-Newton, and Chandra with PKS 2155–304 as an Activity of IACHEC

Manabu ISHIDA,<sup>1</sup> Masahiro TSUJIMOTO,<sup>1</sup> Takayoshi KOHMURA,<sup>2</sup> Martin STUHLINGER,<sup>3</sup> Michael SMITH,<sup>4</sup>  
Heriman L. MARSHALL,<sup>5</sup> Matteo GUAINAZZI,<sup>4</sup> Kohei KAWAI,<sup>2</sup> and Taiki OGAWA<sup>2</sup>

<sup>1</sup>*The Institute of Space and Astronautical Sciences (ISAS), 3-1-1 Yoshinodai, Chuo-ku, Sagamihara 252-5210  
ishida@astro.isas.jaxa.jp*

<sup>2</sup>*Department of Physics, Keio University, 2665-1 Nakano-cho, Hachioji, Tokyo 192-0015*

<sup>3</sup>*XMM-Newton Science Operations Centre, European Space Astronomy Centre (ESAC), Villafranca,  
PO Box 50727, 28080 Madrid, Spain*

<sup>4</sup>*European Space Astronomy Centre of the European Space Agency,  
PO Box 78, Villanueva de la Cañada, E-28091 Madrid, Spain*

<sup>5</sup>*Kavli Institute for Astrophysics and Space Research, Massachusetts Institute of Technology,  
77 Massachusetts Ave., Cambridge, MA 02139, USA*

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### Abstract

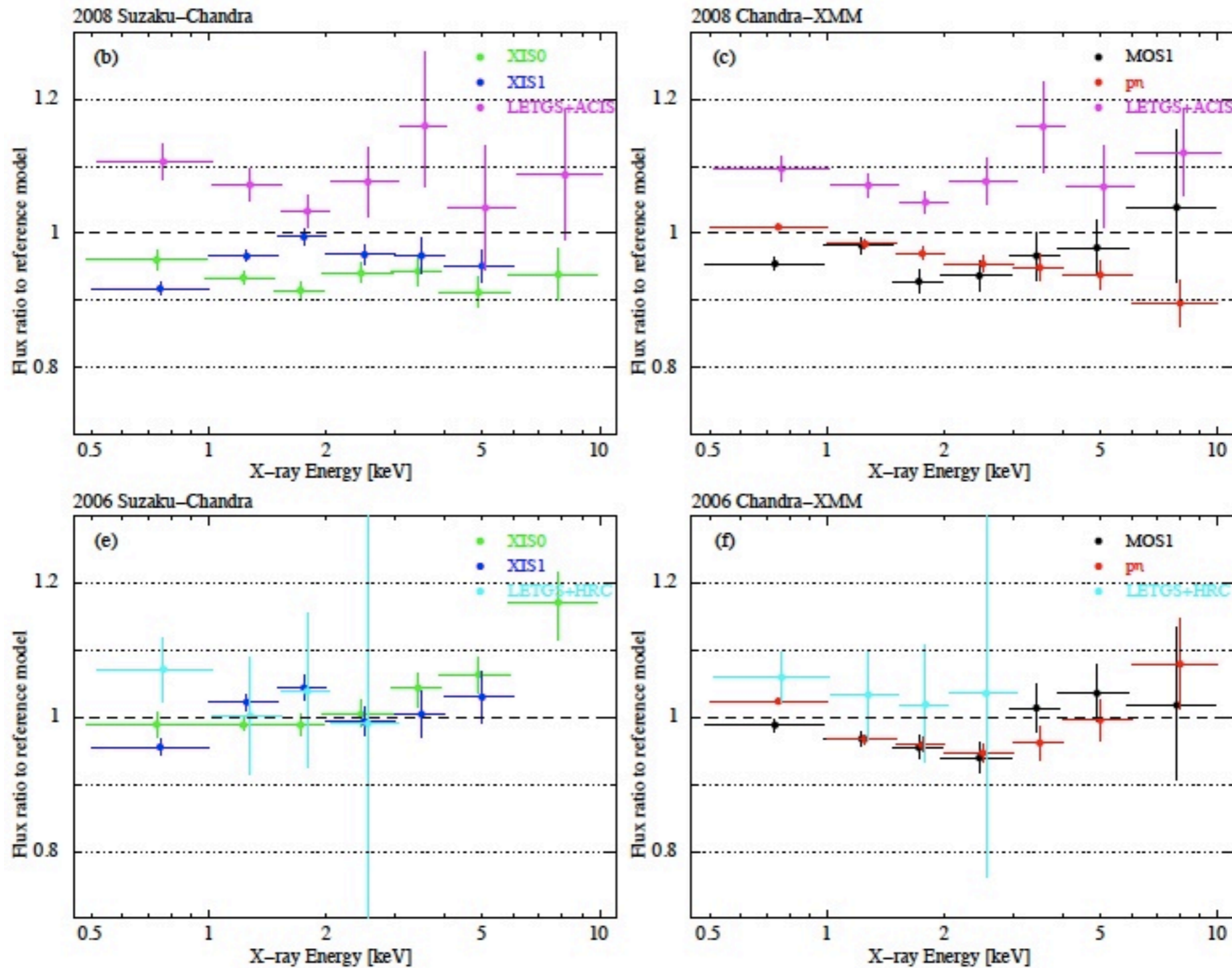
We report on comparisons of the energy responses of the Suzaku XIS, the Chandra HRC and ACIS with the LETG, and the XMM-Newton MOS and pn using simultaneous data of the BL Lac object PKS 2155–304 taken in 2005, 2006, and 2008. From power-law fits to individual spectra, we have found that the photon index agrees among all instruments within  $\pm 0.1$ , and that the resultant hydrogen column density values of the Chandra and XMM-Newton instruments differ from the value for PKS 2155–304 only by  $\leq 1 \times 10^{20} \text{ cm}^{-2}$ , while that of Suzaku bears a larger systematic error of  $4 \times 10^{20} \text{ cm}^{-2}$ , at most. We have carried out flux cross-calibration in seven small segments of energy bands between 0.5 keV and 10 keV. In the bands above 2 keV, the Suzaku fluxes are larger than those of XMM-Newton by  $\approx 20\%$ ,  $\approx 10\%$ , and  $\leq 5\%$  in 2005, 2006, and 2008, respectively, although the 20% difference in 2005 is still preliminary. The fluxes of the LETG+HRC in 2006 coincide with those of Suzaku below 2 keV. The fluxes of the LETG+ACIS are compared with those of Suzaku and XMM-Newton with the 2008 data, and are systematically larger than those of Suzaku and XMM-Newton by 10%. These results are in general consistent with those presented in one of the precedent papers from International Astronomical Consortium for High Energy Calibration (IACHEC) using G21.5–0.9.

**Key words:** instrumentation; detectors — X-rays: individual (PKS 2155–304)

Ishida et al. 2011, PASJ, 63, S657.

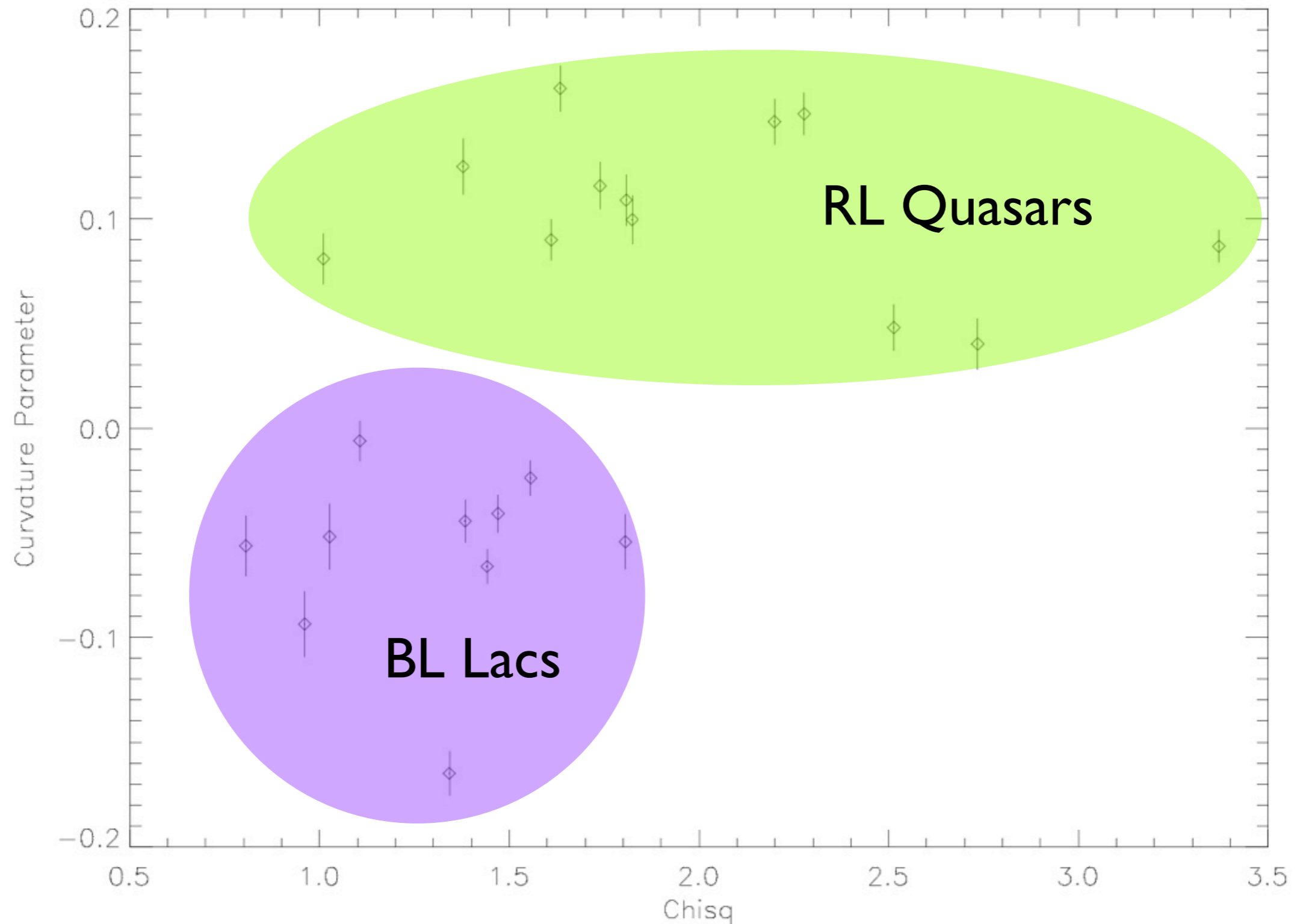


# PKS 2155 Cross-Cal



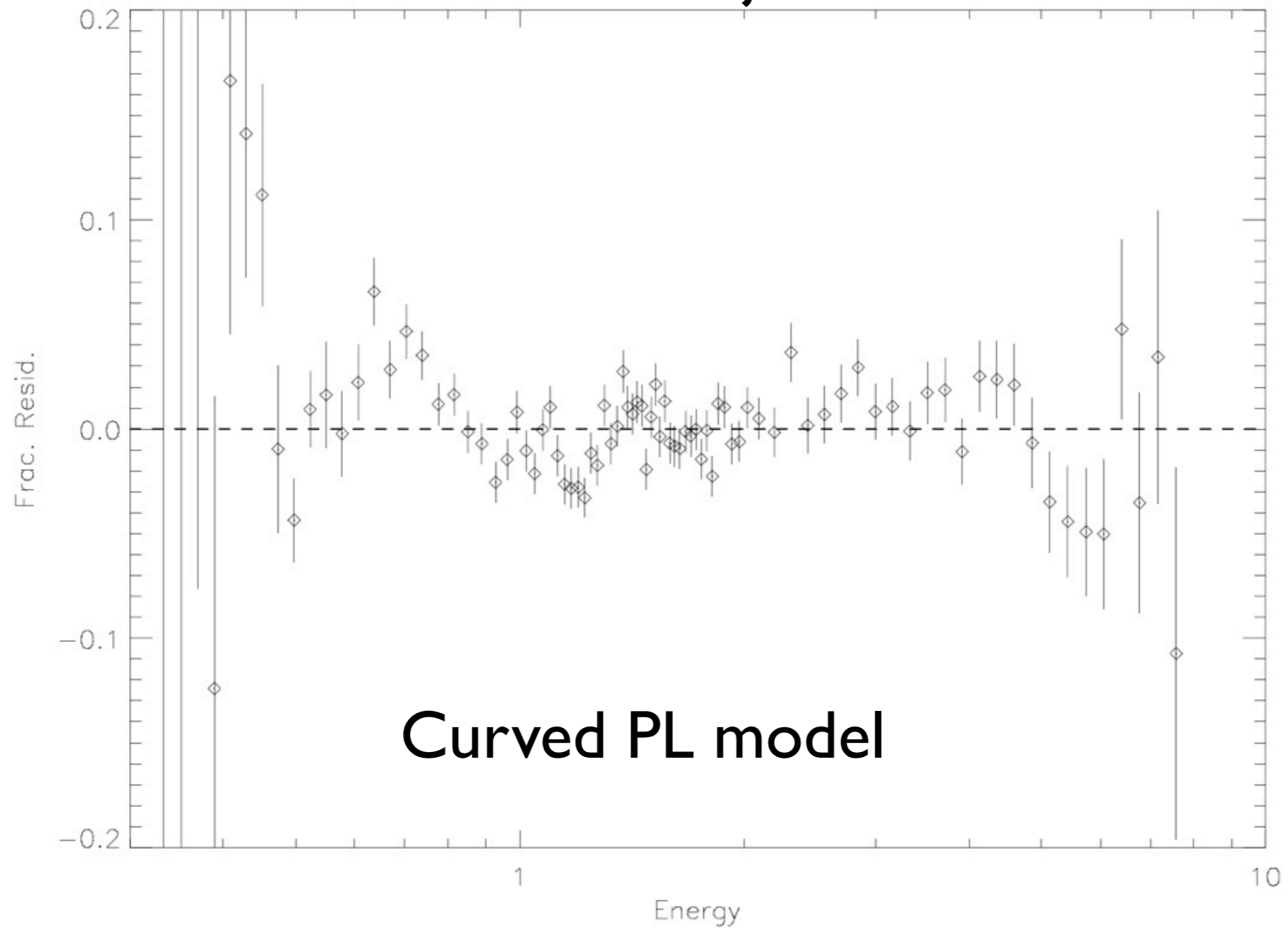
Ishida et al. 2011, PASJ, 63, S657.

# BLLs fit best



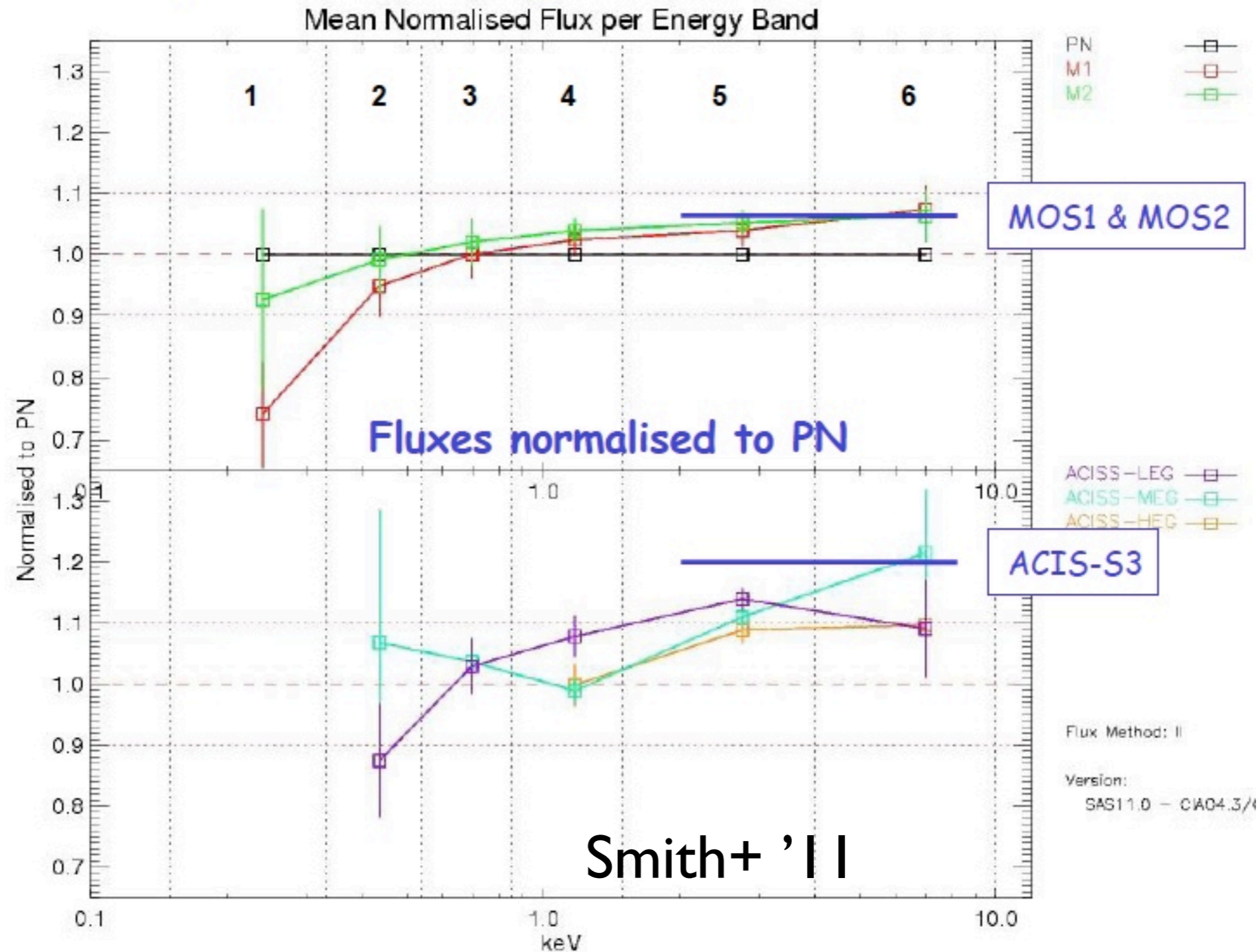
# Combining Residuals

8 BL Lac objects



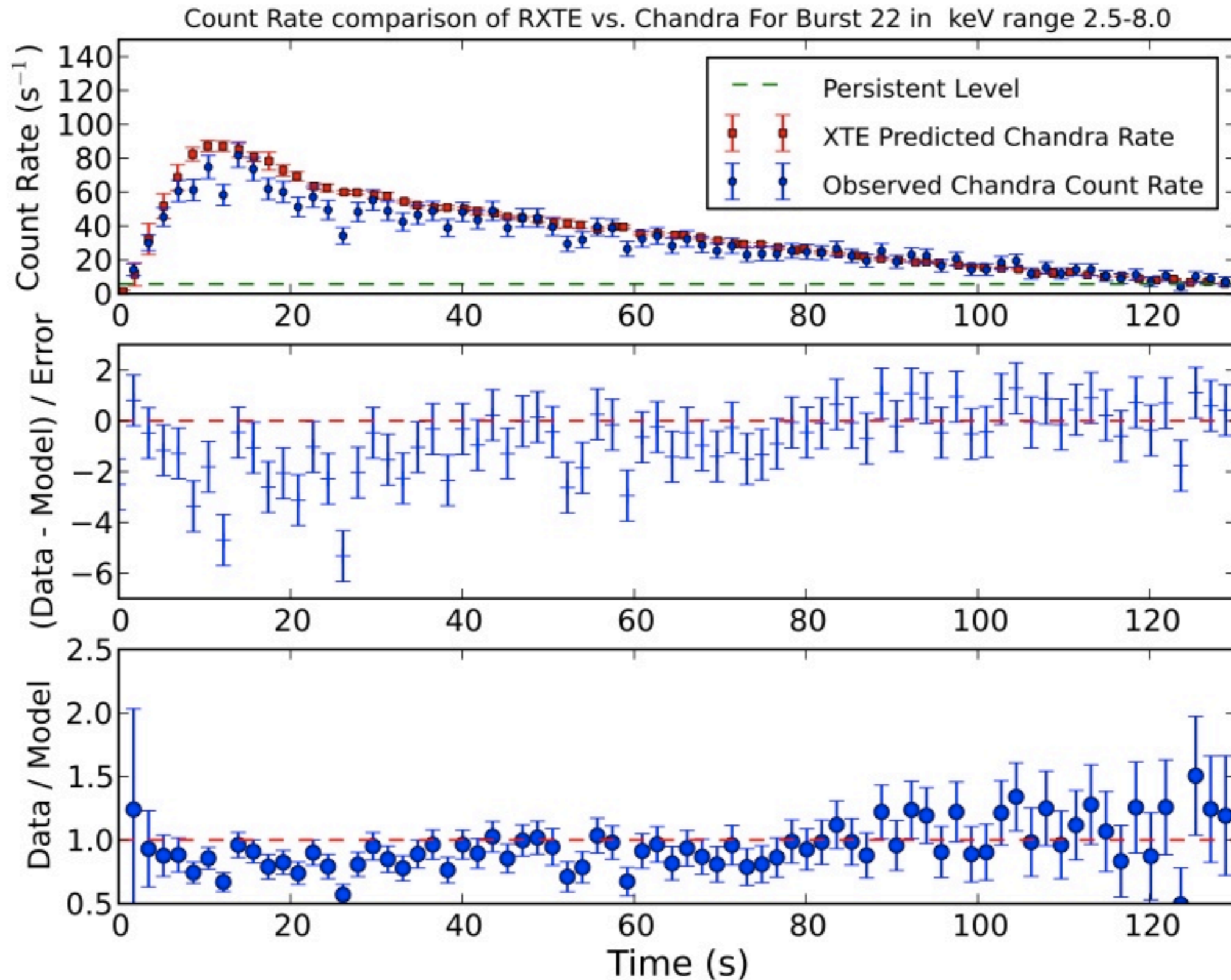
# XMM/Chandra

## Comparison with Tsujimoto et al. *G21.5-0.9* XCal





# Cross-Cal: XTE v. HETGS



# Cross-Cal Summary

- PKS 2155-304 with Suzaku, and XMM (Ishida et al. 2011, PASJ, 63, S657)
  - LETG/ACIS is 10-20% high of both Suzaku and XMM
  - LETG/HRC is consistent, perhaps 5-10% high
- New HETGS EA: smooth BL Lac spectra to  $< 3\%$  (.5-8 keV)
- Cross-cal with XMM-Newton on blazars near completion
  - New HETGS efficiency file provided to M. Smith
  - Latest SAS release to be used, need fixed LETG/ACIS data  $< 0.5$  keV
  - Expect paper draft “real soon now”
- What/how to fix?
  - Criteria for correction needed
  - Empirical v. physical corrections