

Back-Illuminated ACIS QE Revised

- Grating & Cluster data want BI/FI ratio higher than CALDB
- Size of effect: $\sim 10 - 15\%$
- wavelength dependent, especially notable for $E < 1.5$ keV.
- Astrophysical observations can't tell which is right.
- Absolute calibration from ground (XRCF) data settle the issue

Three effects:

- Dead area due to cosmic ray blooms: larger effect on FI than BI
- Mistake in BI QE model
- Misunderstanding of QE Uniformity factor definition

Nota Bene: This talk has nothing to do with contamination. We discuss the ACIS QE at the time of launch.

XRCF EXPERIMENTAL SETUP (SCHEMATIC)

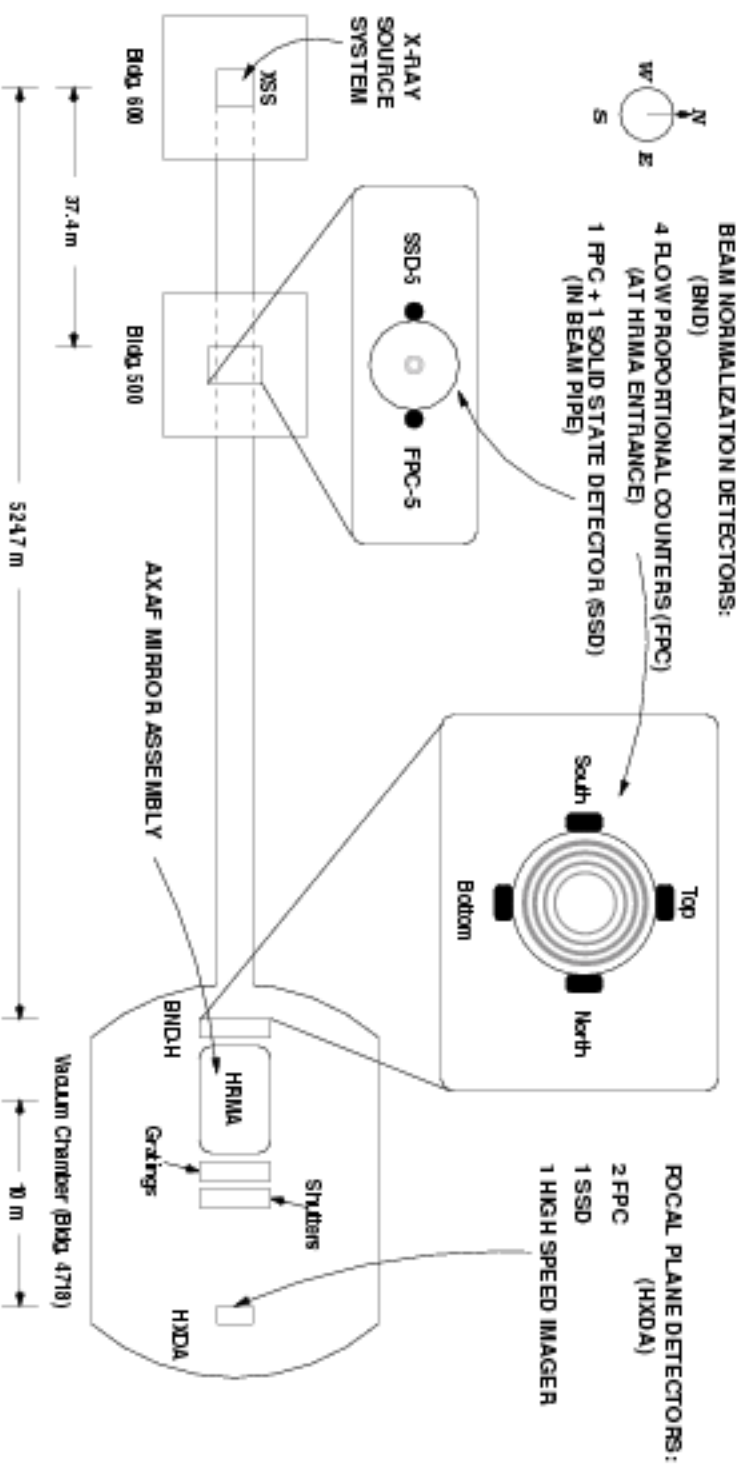


Figure 1: Schematic of XRCF Experiment

Re-analysis of XRCF Flat Field Data

- Better modelling of spectral features, teasing apart continua and lines.
- Accounts for non-Gaussian line shapes, especially important at low energies.
- Comparison to synchrotron-calibrated Flow Proportional Counter in same beam
- These are full-frame average chip QE, with the optical blocking filter included.

chip	line	energy (keV)	QE	QE_err
S3	C K- α	0.277	0.3394	0.0110
S2	O K- α	0.525	0.2279	0.0045
S3	O K- α	0.525	0.6147	0.0117
S2	Cu L- α	0.930	0.5577	0.0141
S3	Cu L- α	0.930	0.8412	0.0242
S2	Nb L- α	2.166	0.5939	0.0184
S3	Nb L- α	2.166	0.8056	0.0253
S1	Fe K- α	6.404	0.5027	0.0177
S2	Fe K- α	6.404	0.8787	0.0311
S3	Fe K- α	6.404	0.6855	0.0266

Table 1: Errors are statistical. Additional 1-2% Systematic errors are suspected.

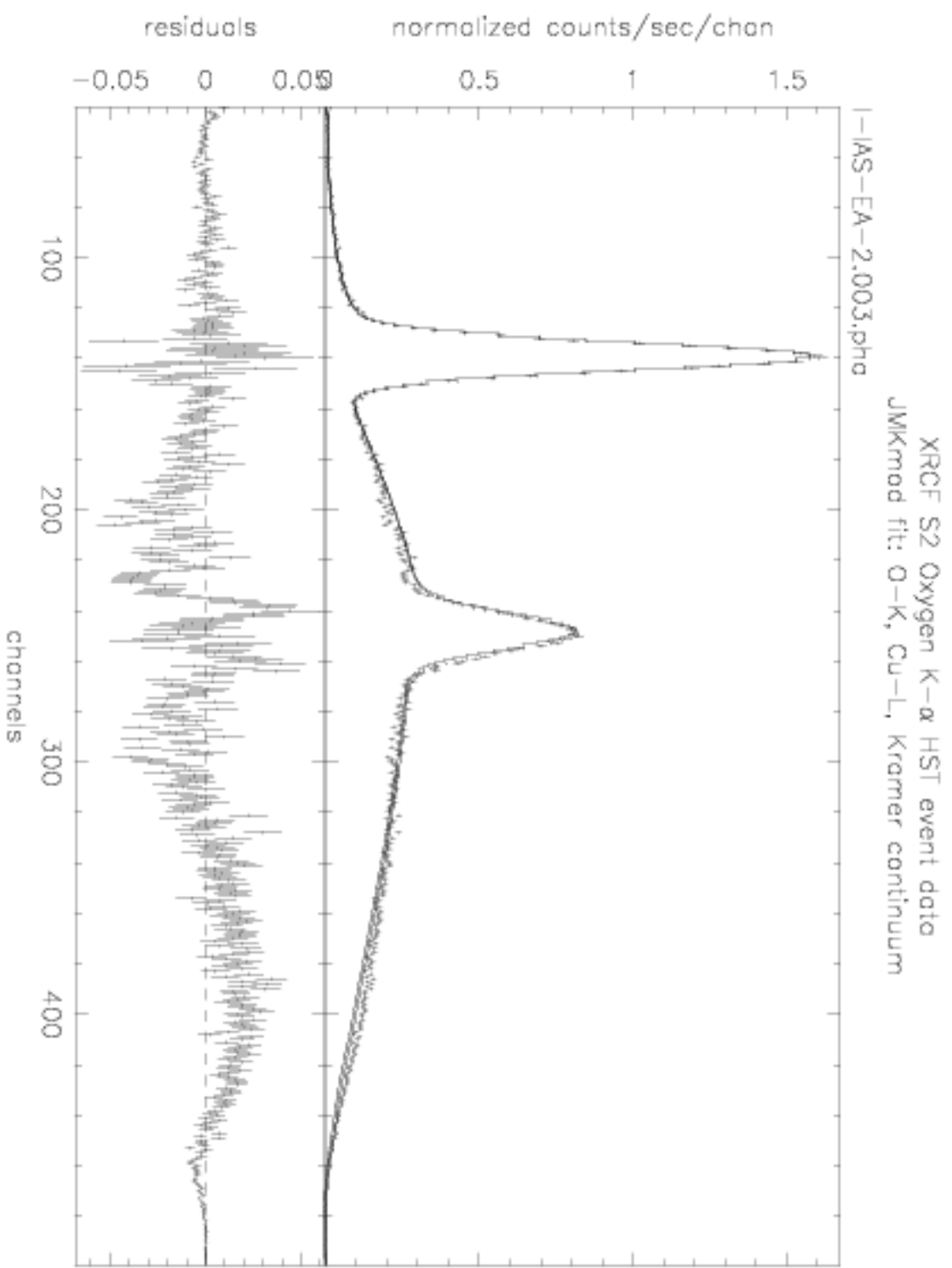


Figure 2: Fitted pulse-height spectrum for S2 (full chip).

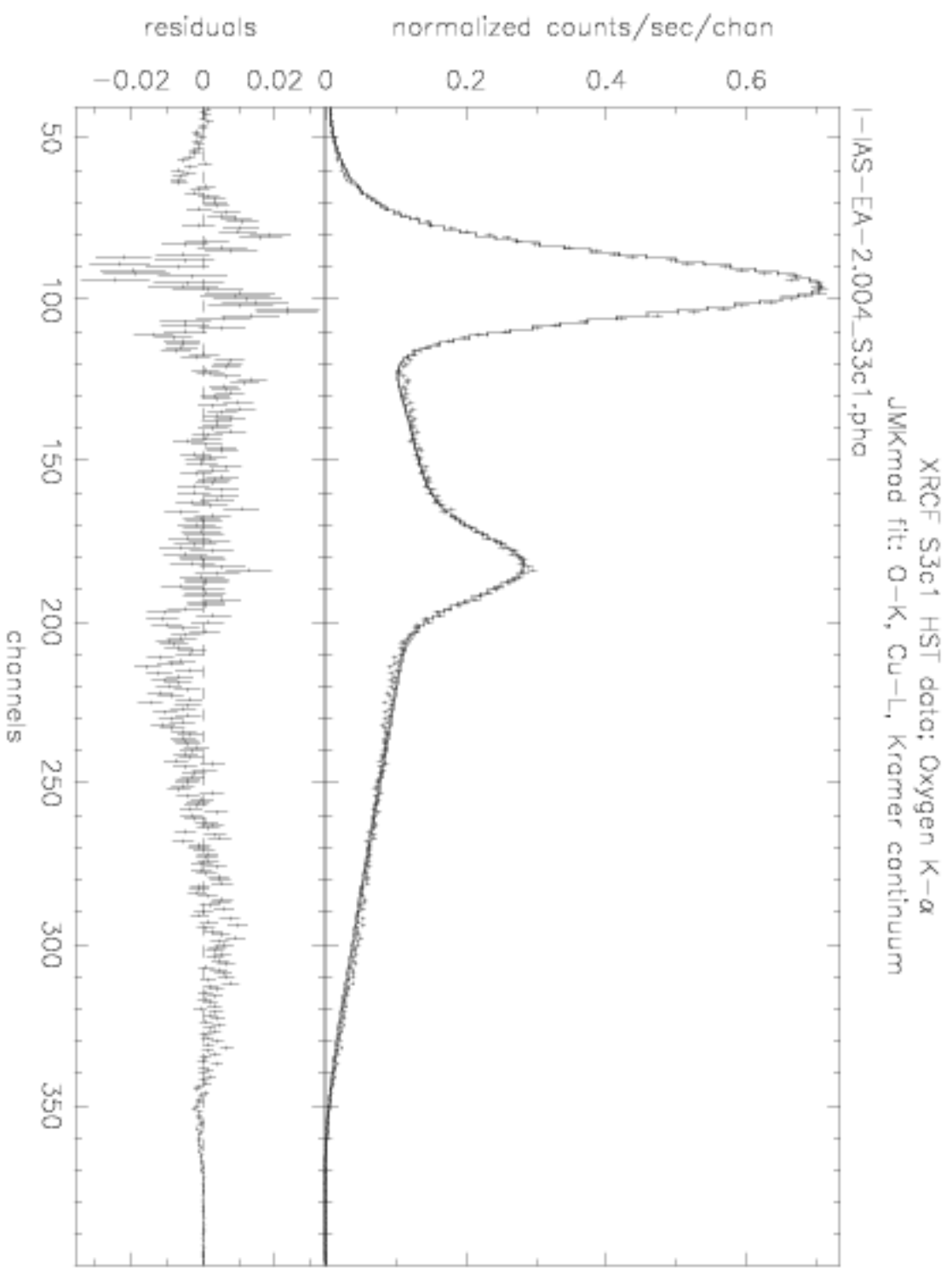


Figure 3: Fitted pulse-height spectrum for S3 (mode 1).

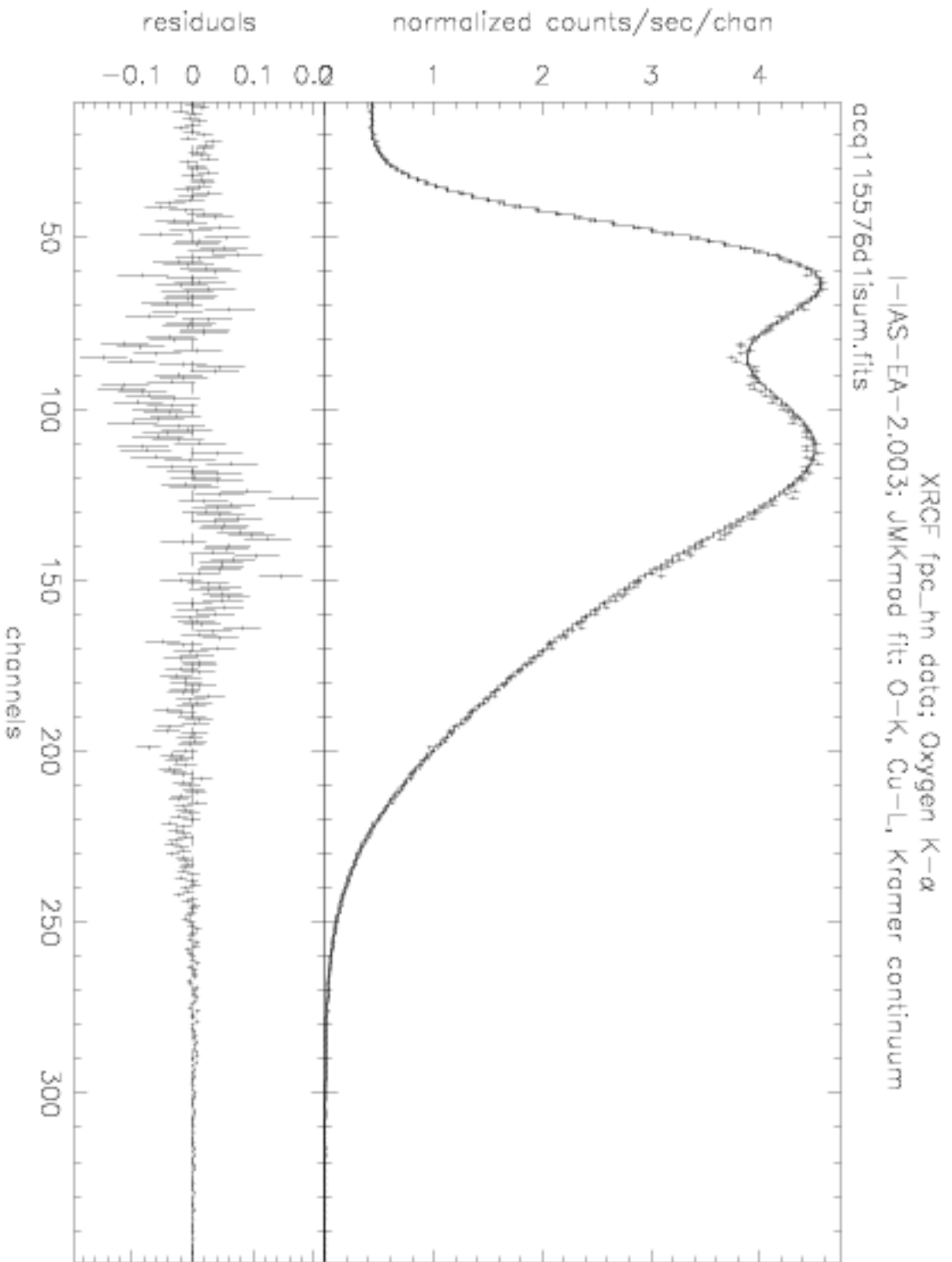


Figure 4: Fitted pulse-height spectrum for FPC.HN.

ACIS QE: Derivation from XRCF data

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For each detector, the source luminosity is given by:

$$S = \frac{C_{det}}{A_{det}QE_{det}} \times d_{det}^2 BU_{det}$$

where:

- C = countrate in the line (cts s⁻¹)
- A = active detector area (cm²)
- QE = quantum efficiency (cts photon⁻¹)
- d = source distance (cm)
- BU = Beam Uniformity factor (dimensionless).

Then:

$$QE_{ACIS} = QE_{hm} \times \frac{C_{ACIS}}{C_{hm}} \times \frac{A_{hm}}{A_{ACIS}} \times \frac{BU_{ACIS}}{BU_{hm}} \times \frac{d_{ACIS}^2}{d_{hm}^2}$$

To make QE at the readout (*i.e.* intrinsic QE for CALDB tables), we divide by the energy-dependent chip-averaged QEU factor (see A. Vikhlinin, this workshop).

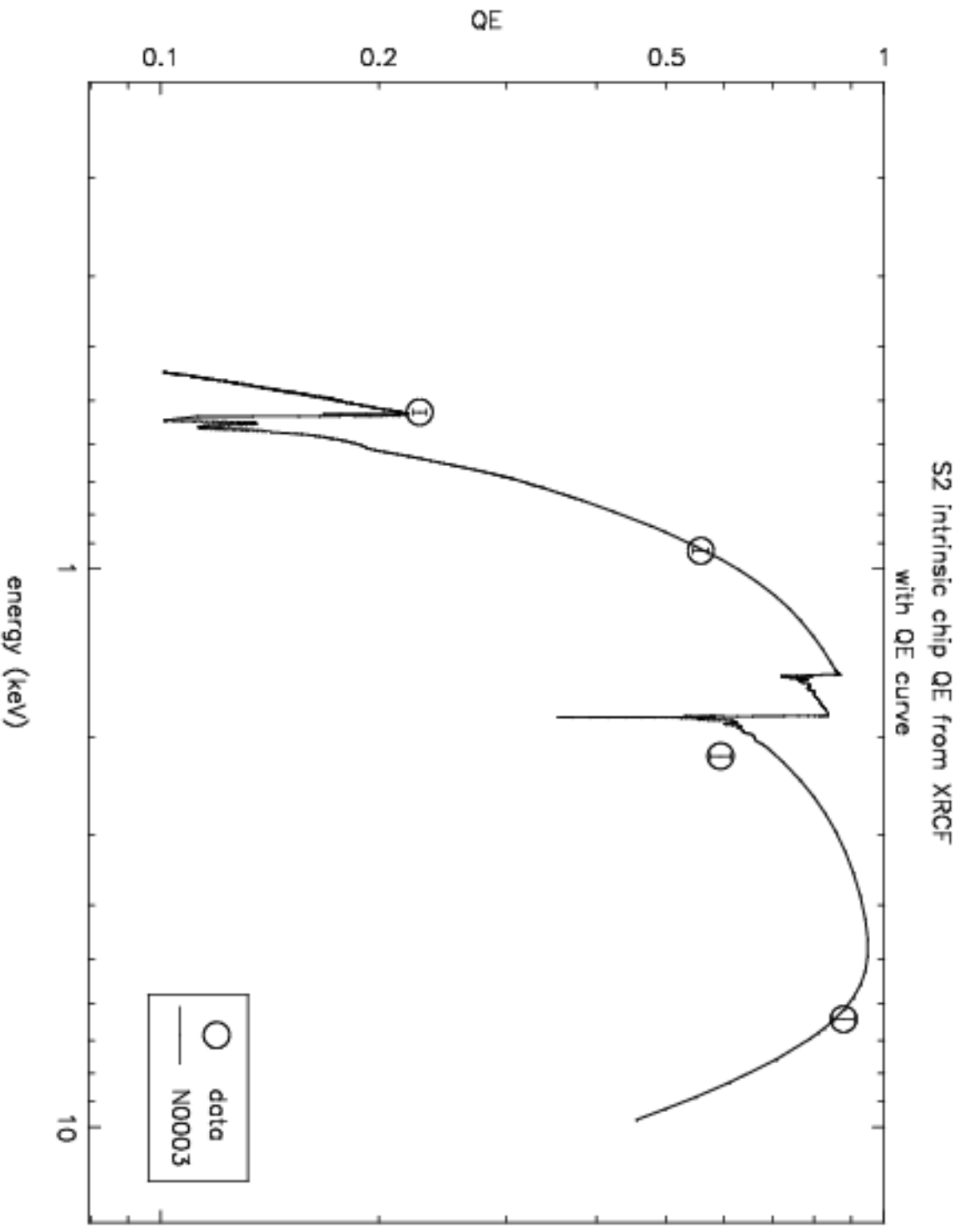


Figure 5: S2 quantum efficiency from CALDB N00003 (curves) and measured (data points).

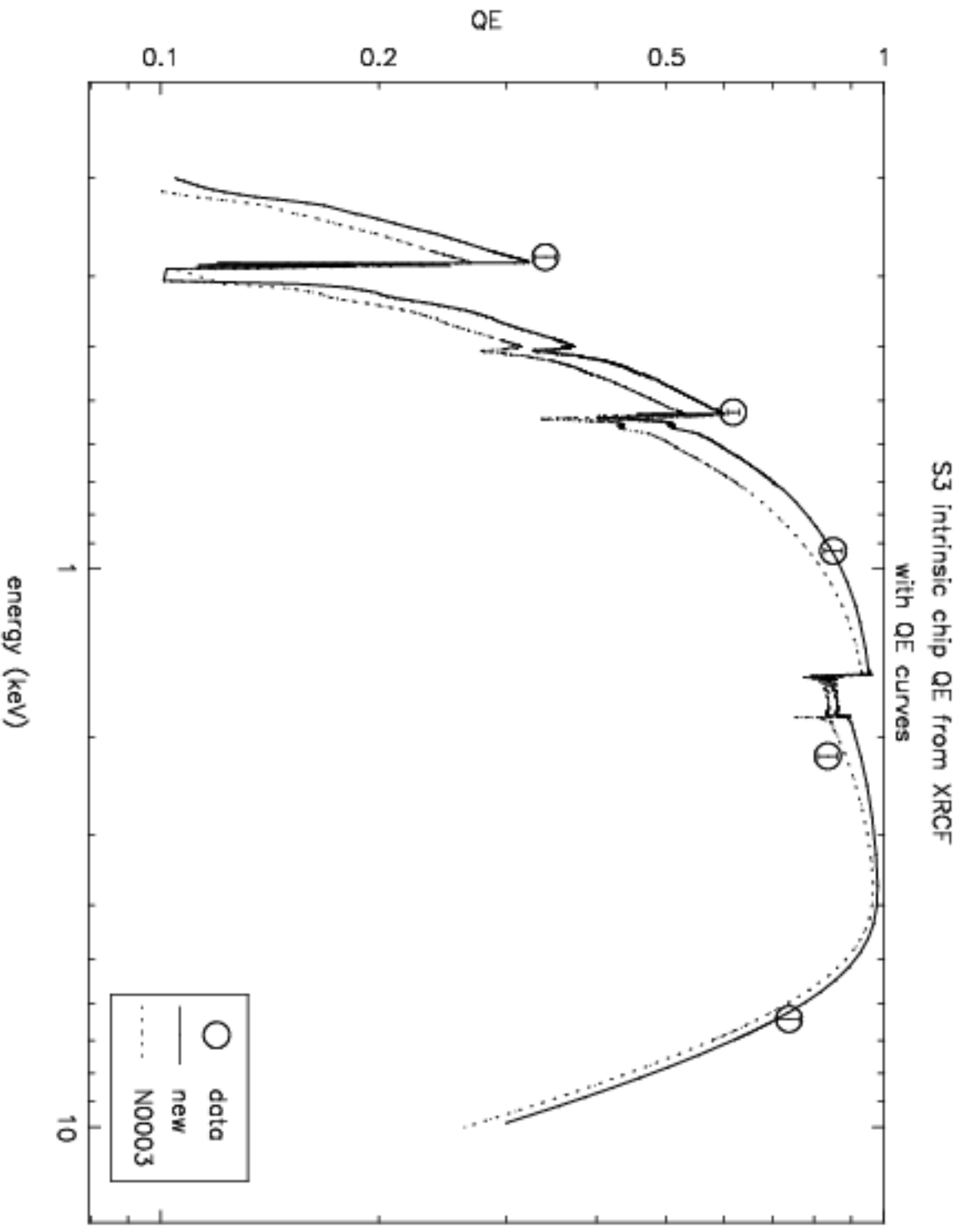


Figure 6: S3 quantum efficiency from CALDB N00003 and N00005 (curves) and measured (data points).

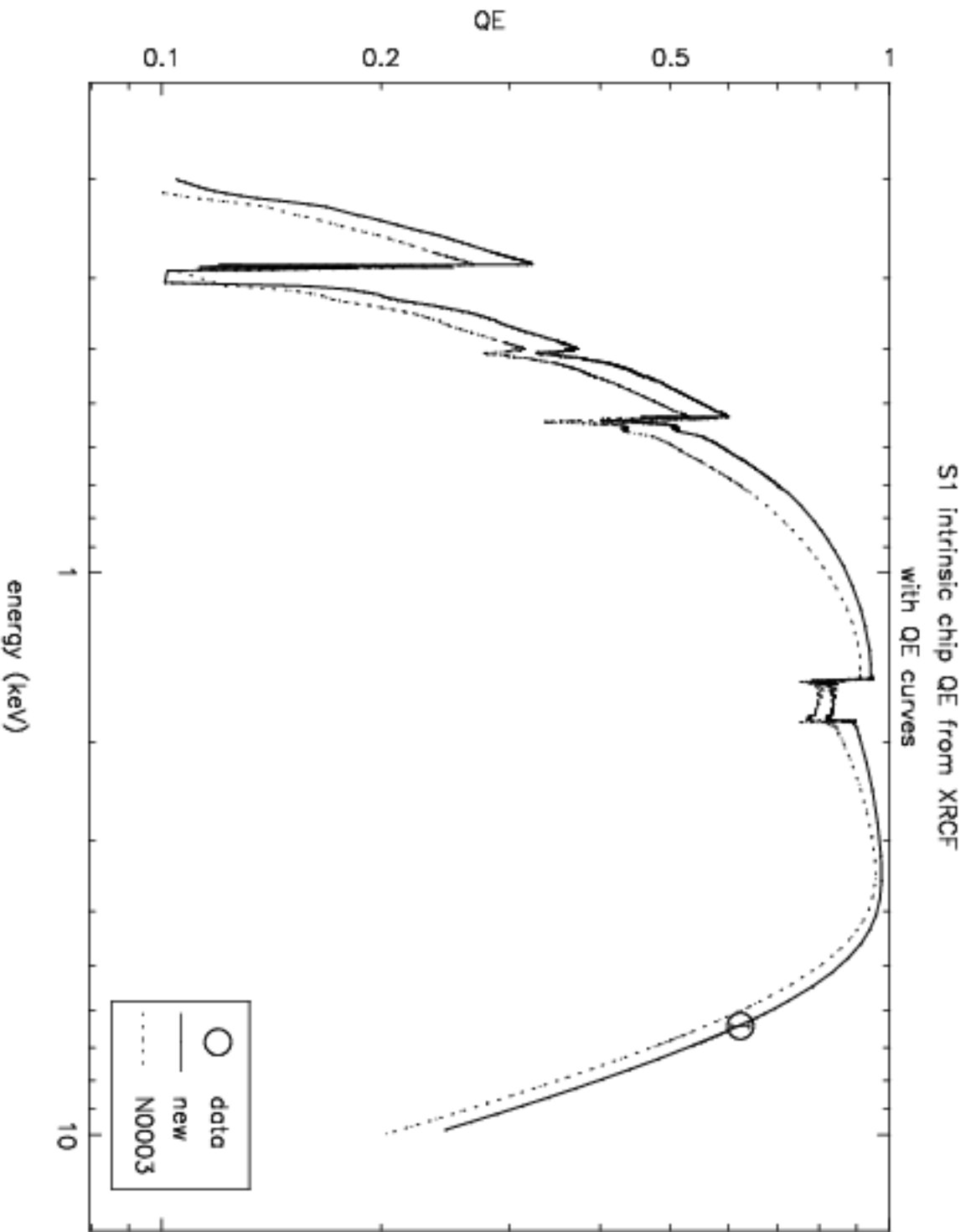


Figure 7: S1 quantum efficiency from CALDB N00003 and N00005 (curves) and measured (data points).

Results in Context

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- Ratio between N0005 BI and FI (unchanged since N0003) QE consistent with gratings analysis.
- N0005 QE curves were released (with new QEU maps) in CALDB version 2.28 in Summer, 2004.

Further information:

http://cxc.harvard.edu/cal/Acis/Cal_prods/qe/index.html

- ACIS Calibration Memo “Absolute QE of ACIS S1, S2 and S3 from XRCF data at selected energies” Edgar & Vikhlinin, 2004 Aug 11
 - ACIS Calibration Memo “Absolute QE of ACIS S2 and S3 from XRCF data at Oxygen K-alpha and Copper L-alpha” Edgar, 2003 Nov 13.
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