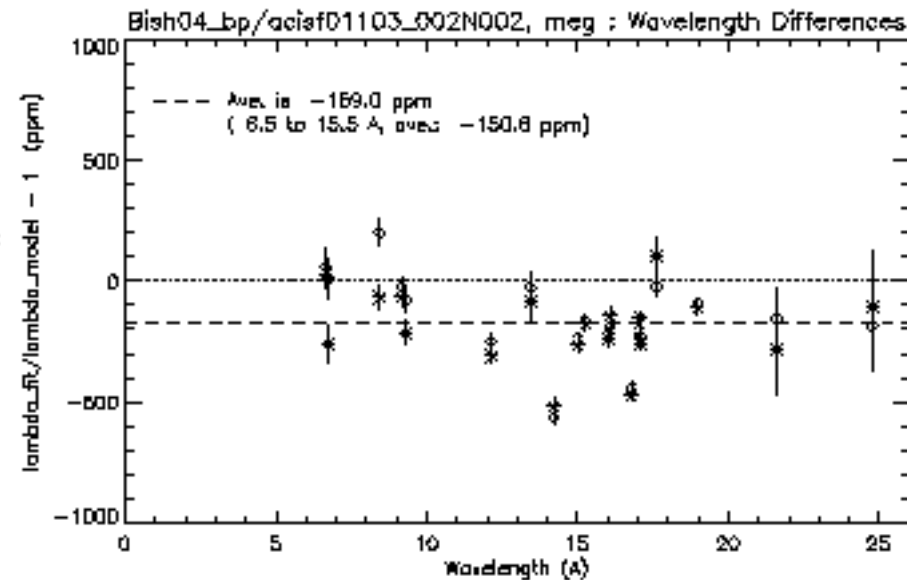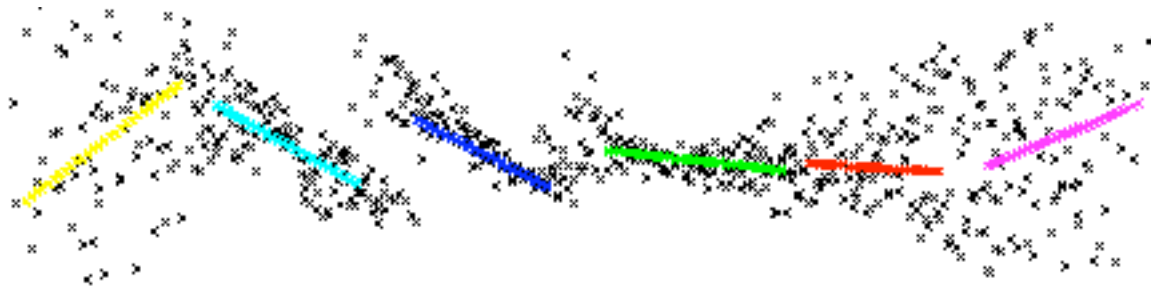# Overview of the HETGS Calibration

Herman L. Marshall

Chandra X-ray Center

HETGS Dispersion Relation

- Work by Dan Dewey and Bish Ishibashi
- See http://space.mit.edu/HETG/technotes/chip_gaps04/chip_gaps04.html
- Updating ACIS chip locations and rotations
- Update MEG grating period expected soon
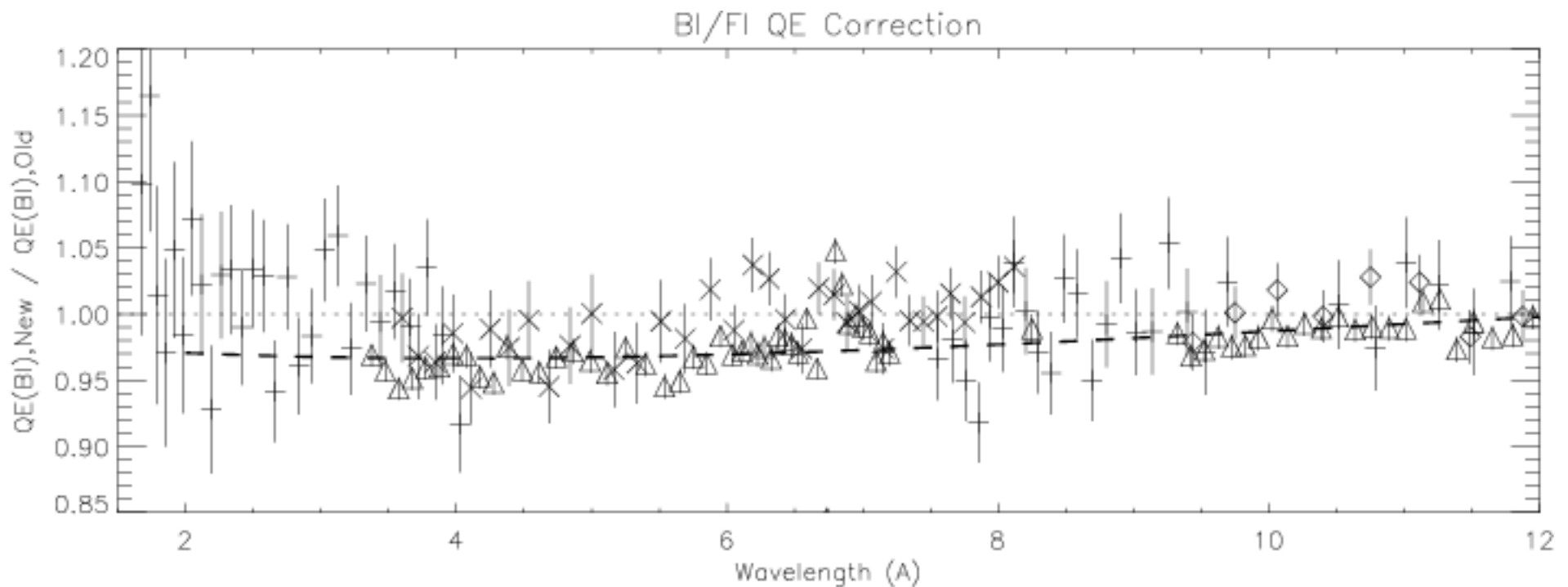- Result is dE/E to ~130 ppm (40 km/s)
- No change to HEG

HETGS Effective Area Calibration

- **ACIS-S**
  - BI QE vs. FI QE — now down from <15% to <5%
  - Pileup — impact depends on source brightness
  - Si-K edge — 6% edge residual
  - N-K edge in FI chips — more important for LETG/ACIS
  - Contamination — see later talk
- **ACIS OBF**
  - C-K edge energy shift — only important for LETG/ACIS
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- **HETG Efficiency**
  - MEG/HEG ratio to be updated — <7% for E > 0.8 keV
  - Compare LETG to HETG — incomplete
- **HRMA Effective Area**
  - Ir-M edge — 10% jump at 2.075 keV

ACIS BI/FI QE

- New BI QEs improve matters considerably
- I include FI loss due to CR blooms
- At most 3-4% differences in 2-10 keV range
- No problems within HETGS data
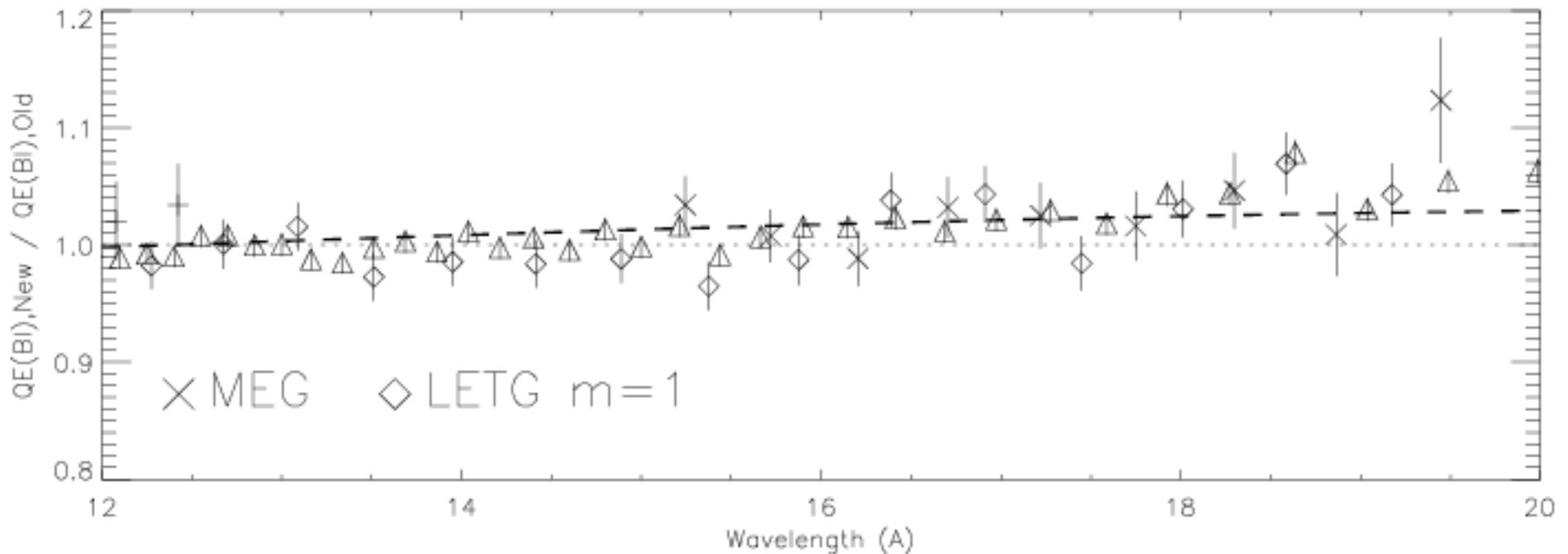
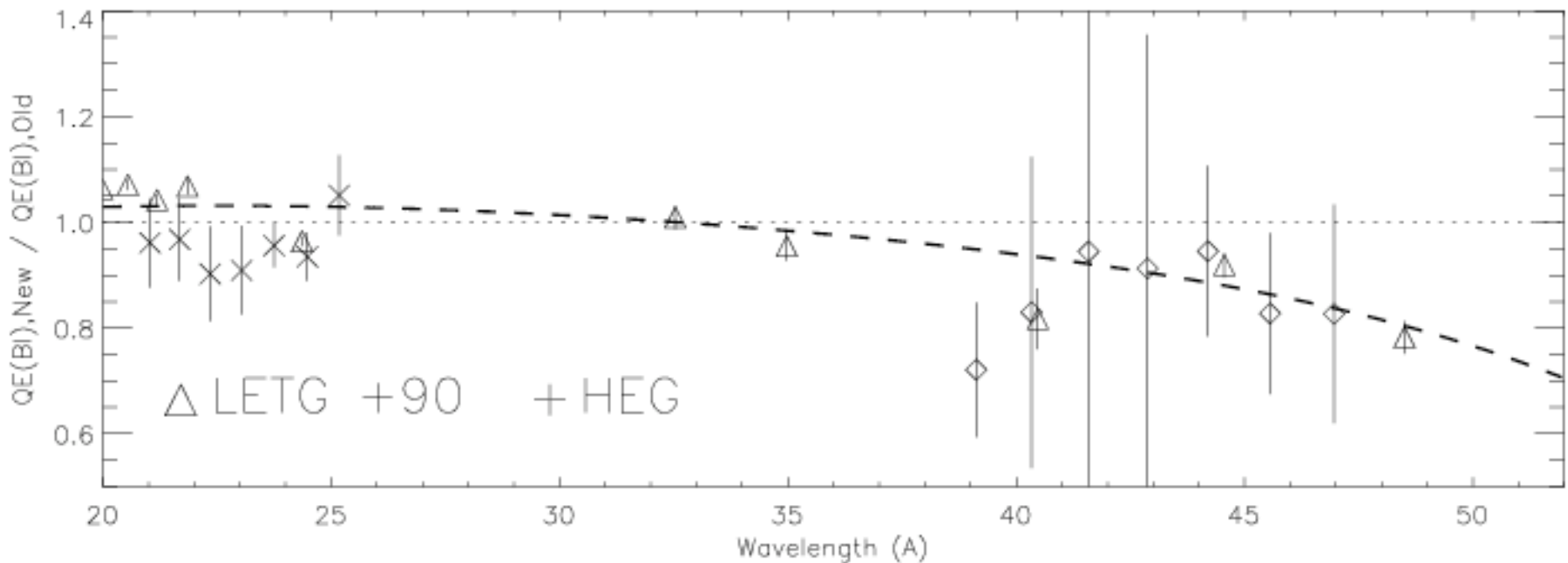BI/FI QE Correction

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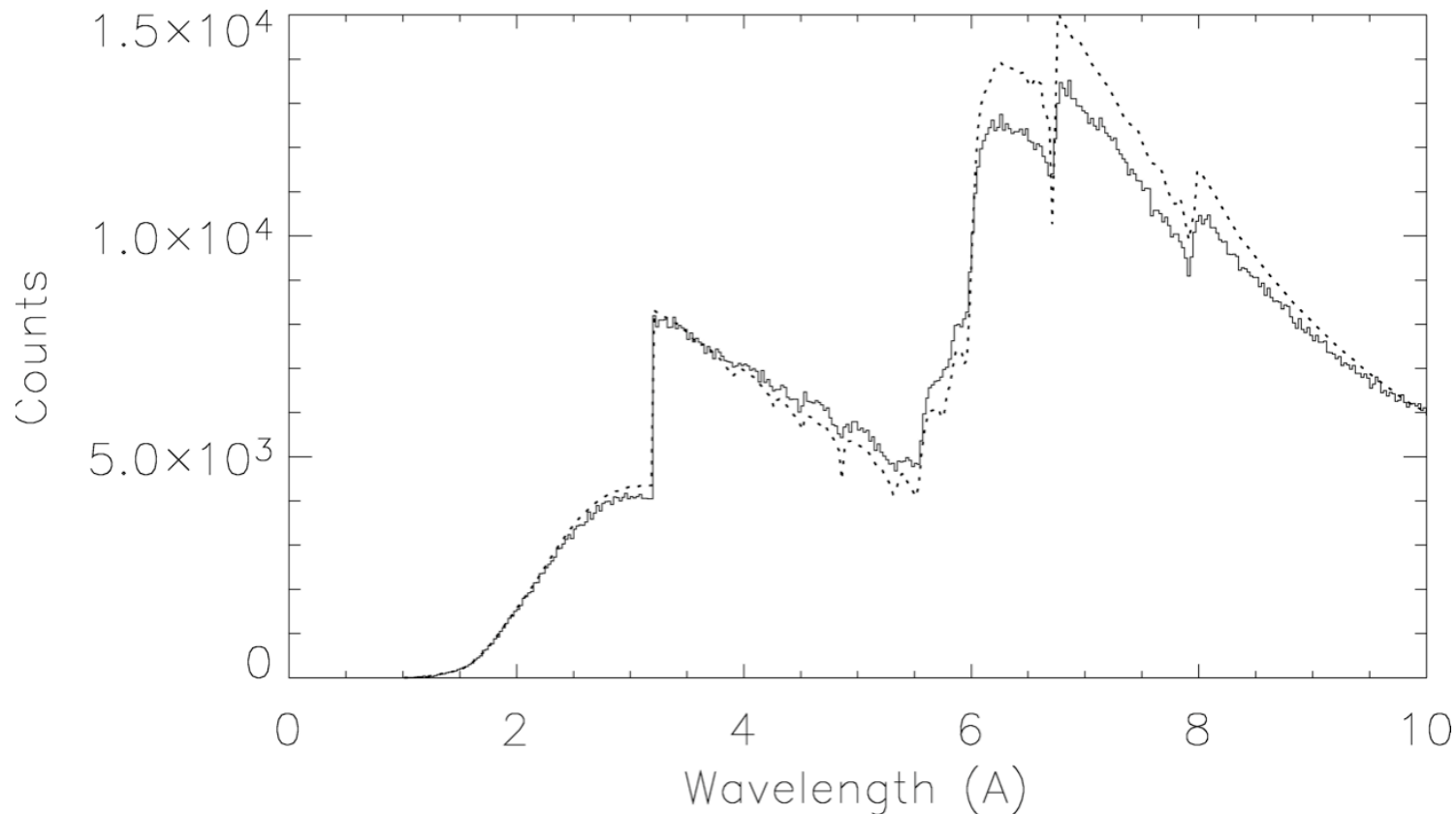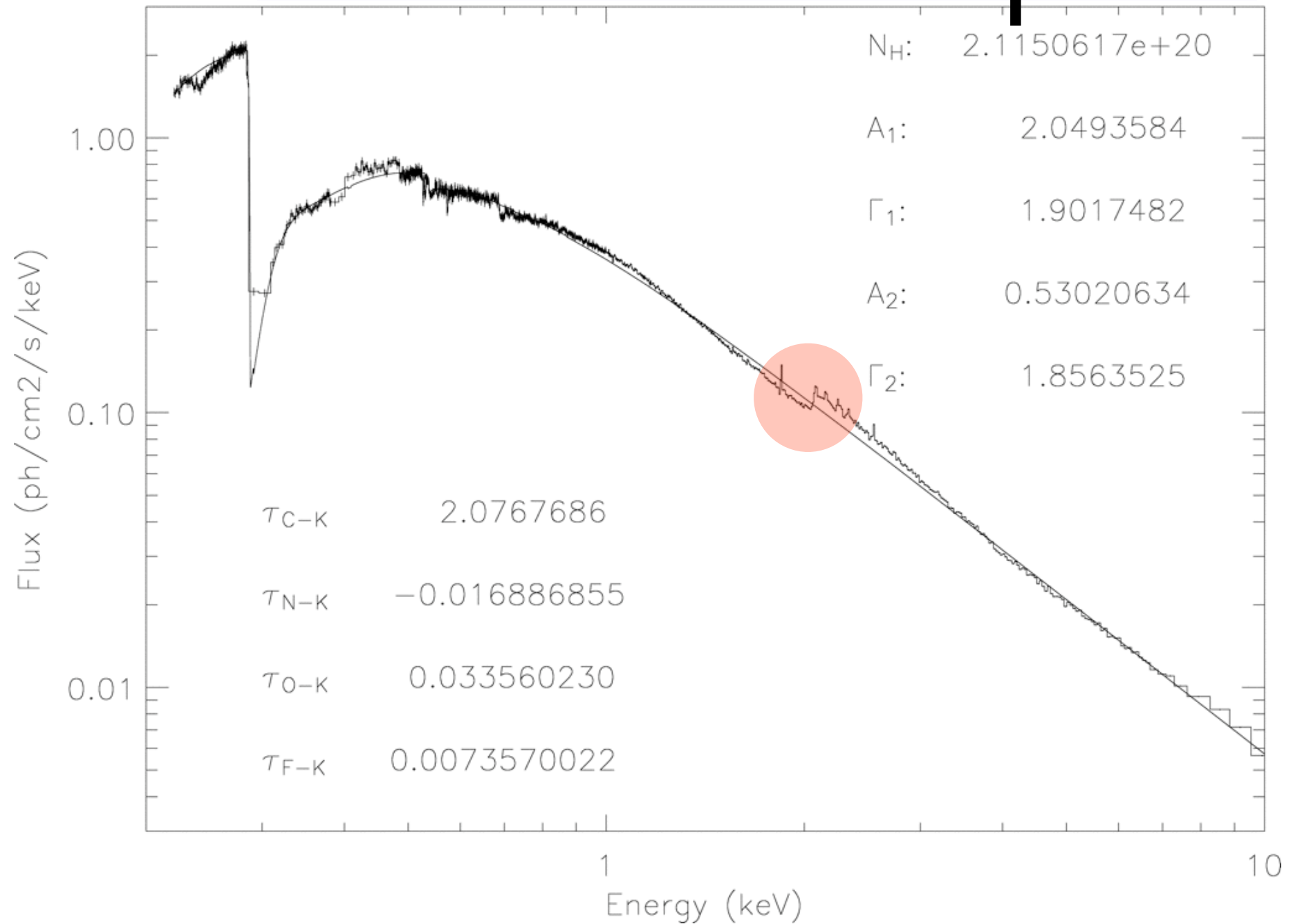
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HETGS — Pileup

- Edge appears at 2.1 keV due to effective area jump
- Rate (Rf) ~ 0.01 ct/frame/col., incur ~ 5% loss
- Mk 421 (4148): Rf = 0.05, giving jump of 19%

HETGS — Pileup

HETGS Effective Area Calibration

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Si-K Edge in BI QE

- Appears when using the new BI QE models
- Effect is an inverse, reversed edge
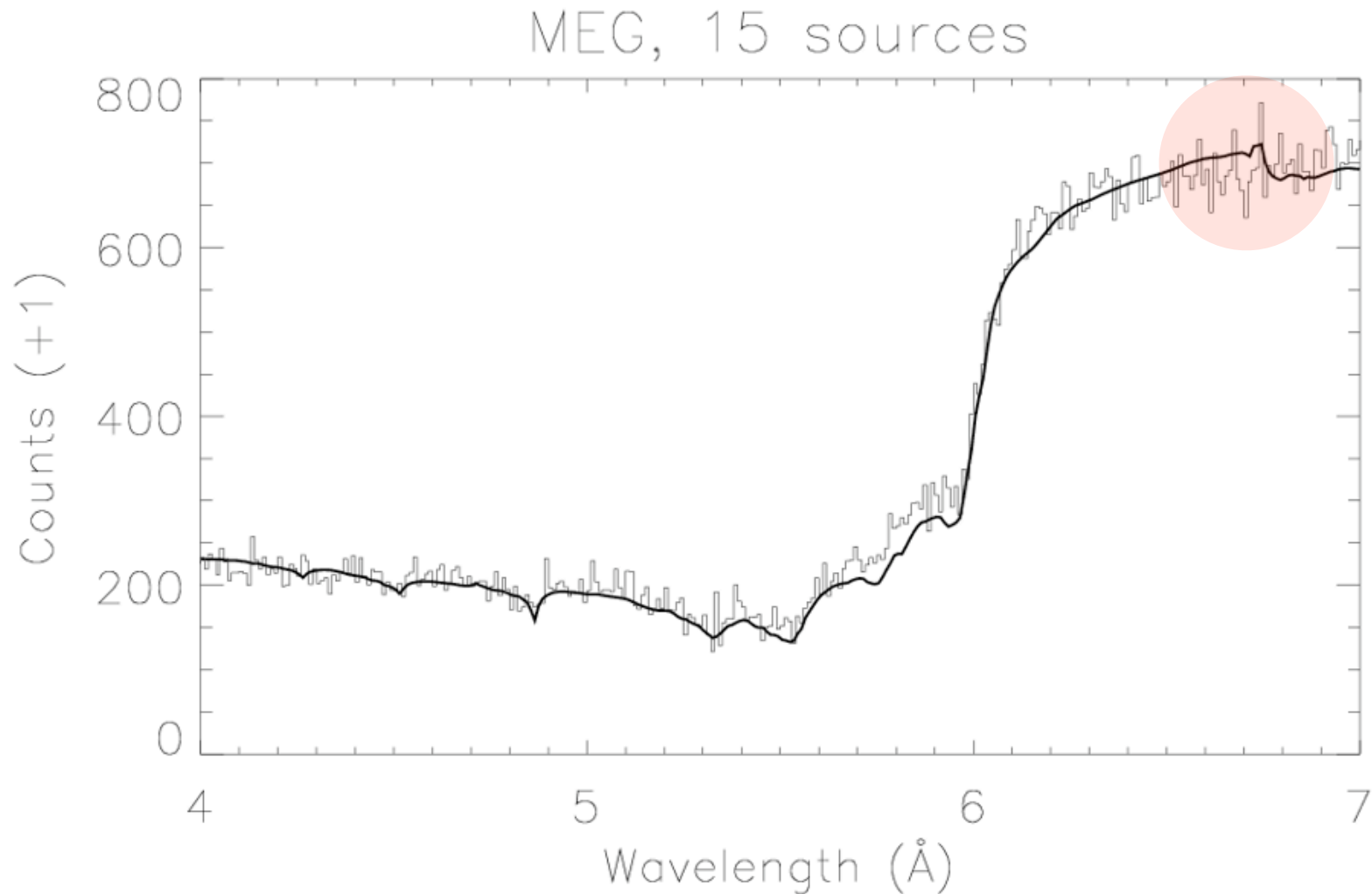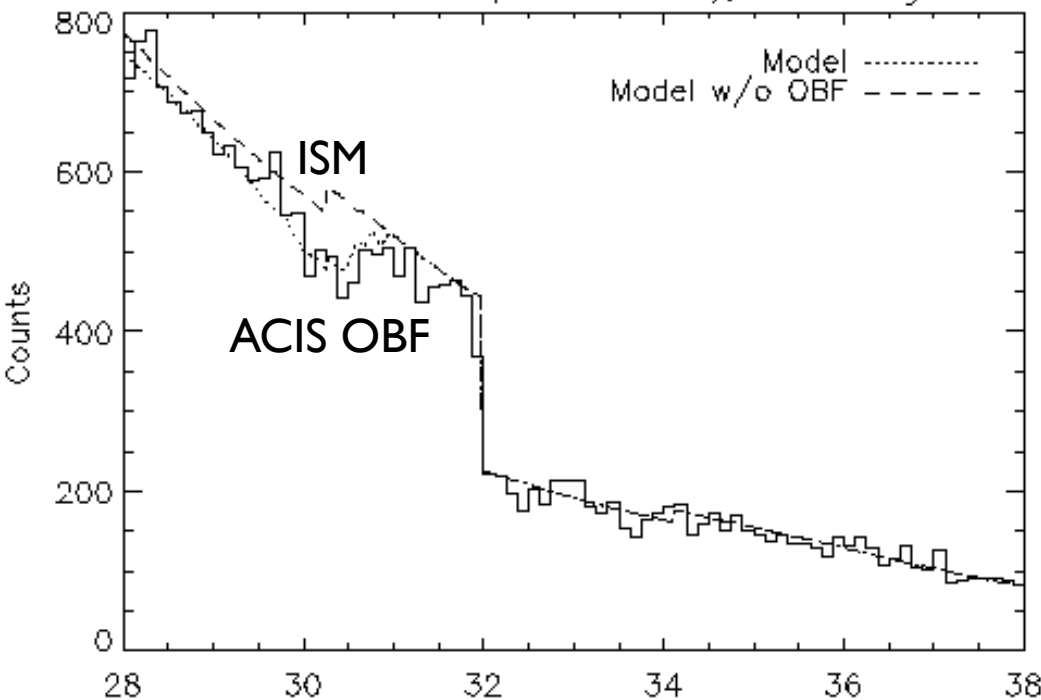- Jump is about 6%

MEG, 15 sources

HETGS Effective Area Calibration

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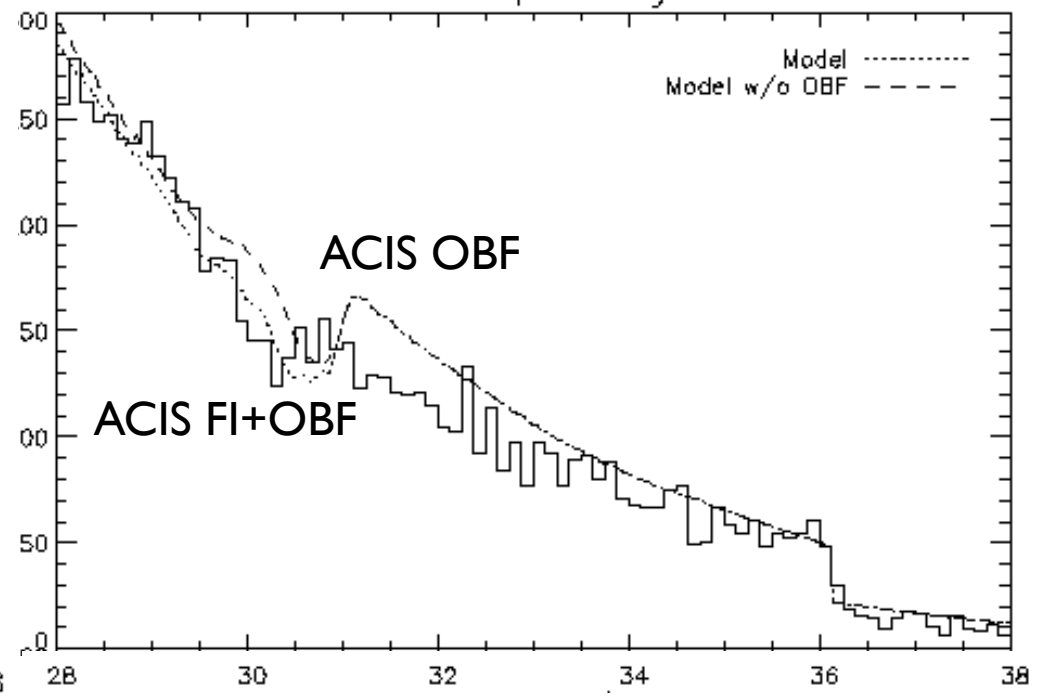 - Ir-M edge — 10% jump at 2.075 keV

N-K Edge in FI QE

- Found 2 yr ago in PKS 2155-304 data
- Objective was to find N-K in contaminant
- Target was offset to put N-K on BI chip
- N-K is OK in filter, not in FI chip

PKS 2155-304 (June 2002), N-K region

XTE J1118, N-K region

HETGS Effective Area Calibration

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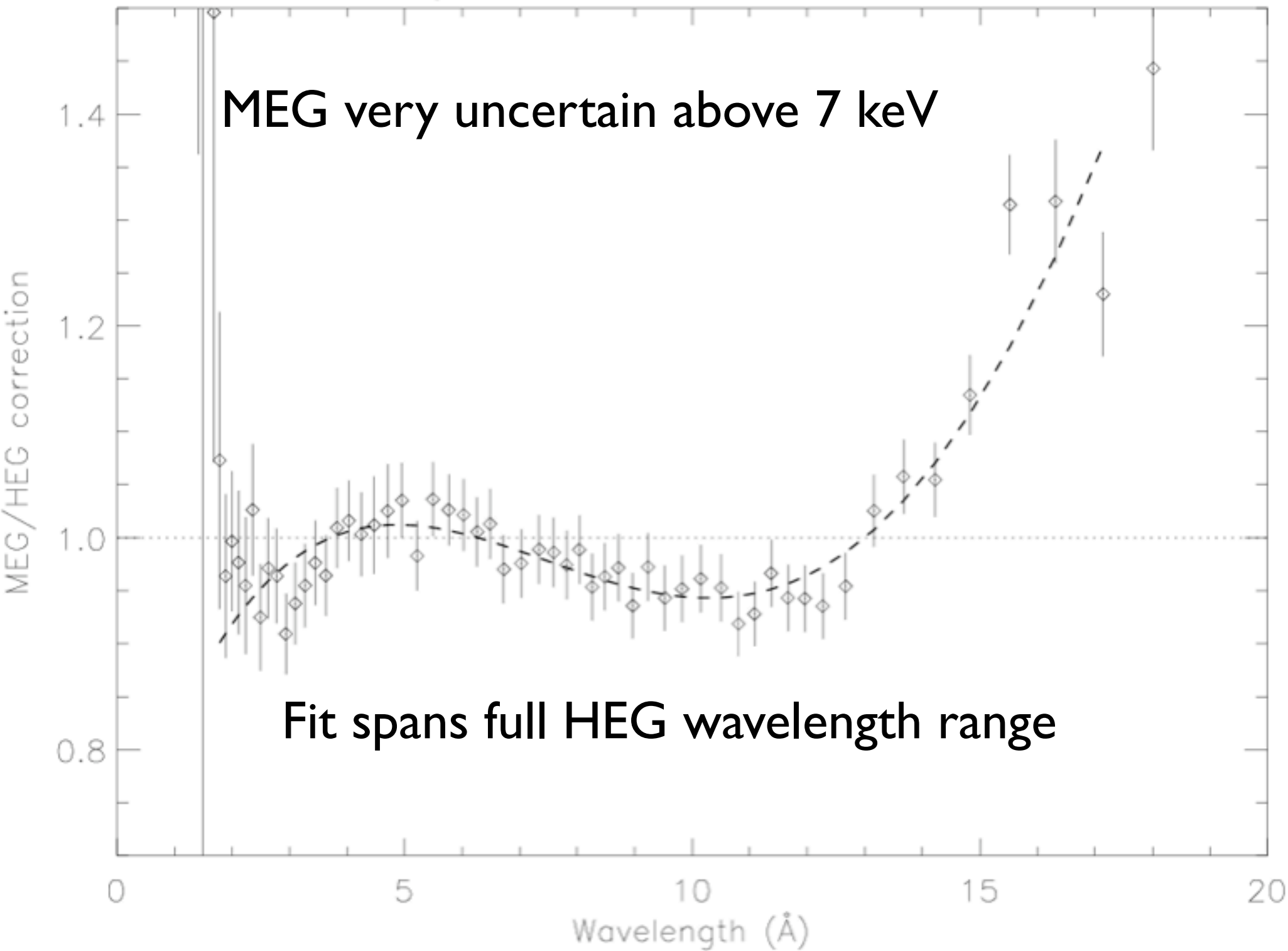 - Ir-M edge — 10% jump at 2.075 keV

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Comparison of MEG and HEG data

MEG very uncertain above 7 keV

Fit spans full HEG wavelength range

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HRMA Ir-M edge

- Jump is about 10%
- MEG and HEG agree
- See Diab Jerius' talk

Si–K edge removed (10/99 – 7/04)
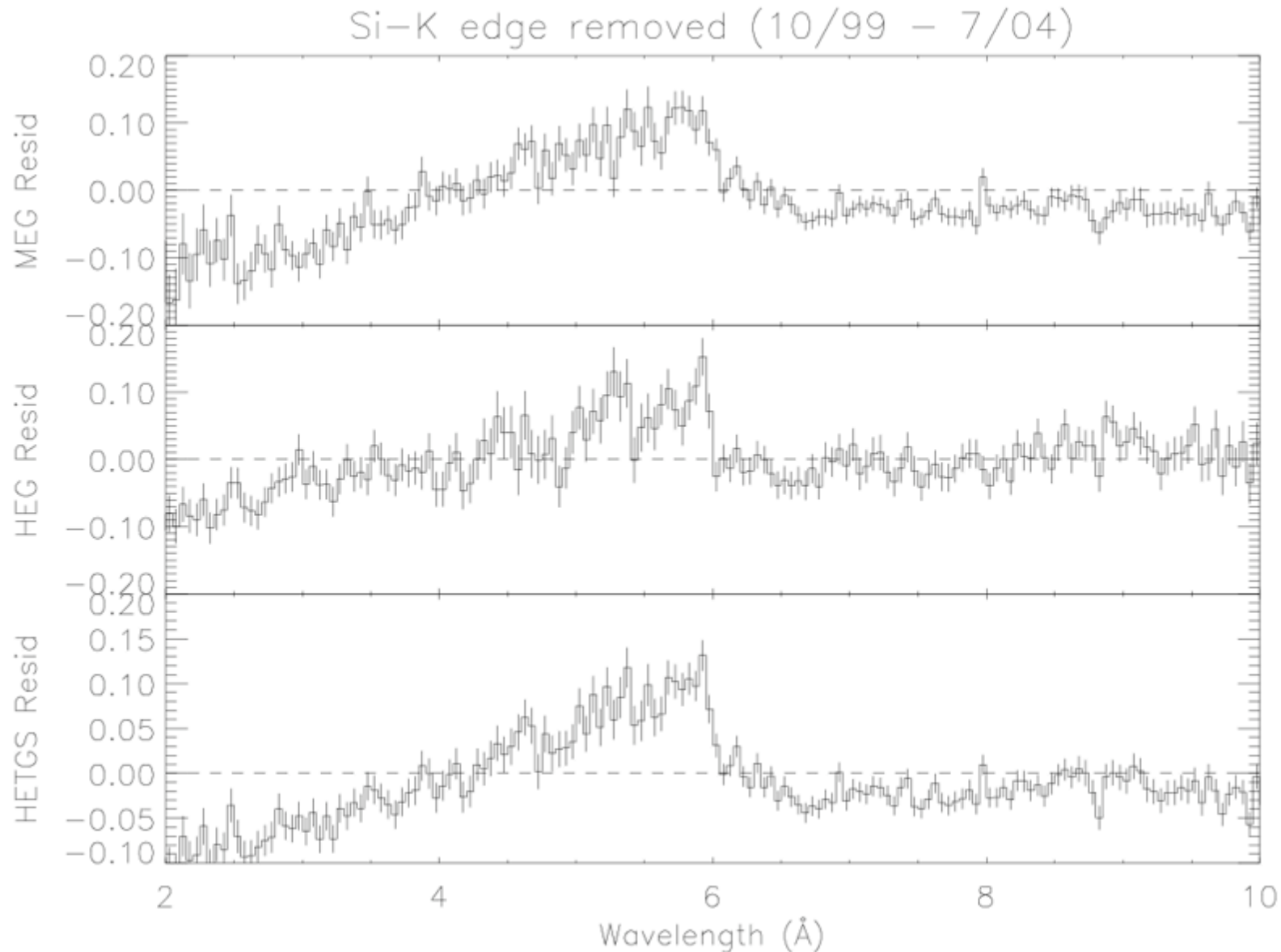
Upcoming Milestones

- October-November 2004
  - Continue work on the contaminant spectral model
  - Complete testing of MEG/HEG efficiencies
  - Release empirical fits to Ir-M edge
  - XMM cross-cal support

- December-January 2004
  - Verify HETG-LETG cross-cal
  - Iterate XMM-Chandra cross-cal (PN, RGS —TGs)