Improvements to the HRC-S QE Uniformity & LETGS Effective Area

Deron Pease,
Jeremy Drake, Herman Marshall,
Vinay Kashyap, Brad Wargelin
Outline

1. HRC-S QEU update from in-flight data
2. Update to Low-E effective area & Mid-E adjustment
3. ⇒ Improved On-Axis QE
QEU Basics

- v1 - QEU=1.0
- v2 - HRC Lab FlatField
  - Fe-Kα, Ti-Kα, Al-Kα, Ni-Lα, O-Kα, C-Kα, B-Kα
  - ~3% stat. err. 1/2-tap bins
  - 3-tap slice along nominal LETG dispersion
QEU In-Flight Tune-Up

Data
- Center - PKS 2155-304 + MKN 421 ~160ks
- Wings - HZ 43 (8 obs) ~178ks
- Extract in TDET coords.
  - add obs. with similar aimpoints
  - 1/4-tap bins with ≤ 2% stat. err.

Method
- Ratio +/- Counts Spectra vs. Ratio +/- QEU
  - Independent of other model components
  - QEU correction = slope of line defined by the deviation of the QEU Ratio from the Counts Ratio at each wavelength
QEU Improved

- Separation of Pos. & Neg. is not possible
- Apply correction oppositely to Pos. & Neg. QEU v2
- Anti-symmetric wobbles required to transform on-axis QE to LETG dispersed Effective Area
Low-E Revisited: LETGS Effective Area

- Sirius B Extraction Discrepancy
  ~10%  1999 vs 2002
  - dead-time corrections & GTIs
  - total exposure times
  - status bit filtering
  - extraction region - parabolic vs bow-tie
Effective Area Adjustments

- Source model uncertainties ≥ 10%
- Macroscopic adjustments to HRC-S QE/QEU
- No sharp (~resolution) corrections; except UVIS edge structure

Adjust Instrument/Model Parameters

Observation

Model Prediction

Extraction Efficiency

UVIS Transmission Efficiency

LETG Diffraction Efficiency

HRMA Effective Area

Spectral Model
Low-E Improved: Thanks, Sirius B

- Sirius B 3 obs 1999 ~60ks
- best WD atmosphere model uncertainties ~10%
- “good” range $\lambda > 80$ Å
- data binned to $\leq 3\%$ stat
- Error evaluation:
  - Low-E + QEU 20% $\Rightarrow$ 15% ??
Mid-E Adjustment

- LETG efficiencies update
- PKS 2155-304 1999 ~60ks
- Single power-law model*
- range $\lambda < 60$ Å
- data binned to $\leq 2\%$ stat
- Modest smooth adjustment $< 5\%$
- uncertainties $\sim 10\%$
Apply the Improvements

Employ QEU to derive on-axis QE from Low-E & Mid-E EA updates

- R.M.S. deviation ~1.9%

History of on-axis QE
Remaining Ideas/Issues

- PKS 2155-305 PL Model
  - clearly complex data
  - 2PL vs. 1PL
    - $\lambda < 60 \, \text{Å}$ effect < 5%
- $60 \, \text{Å} < \lambda < 80 \, \text{Å}$
  - poor statistics, no data
    - no strong source
    - plate gaps
    - binning gets messy
  - SB & PKS indicate opposite
  - Can HZ 43 & MKN 421 help?
Conclusions/Speculations?

Go Sox!!!