Calibration of the *XMM-Newton* RGS

Andy Pollock

Summary for EPIC CAL/Ops

4-5 May 2006

XMM-SOC@ESAC & SRON Utrecht

Outline

- Review of ground calibration
- RGS stability
- RGS effective area
- Example comparisons of the newly recalibrated RGS with EPIC
- WHIMs

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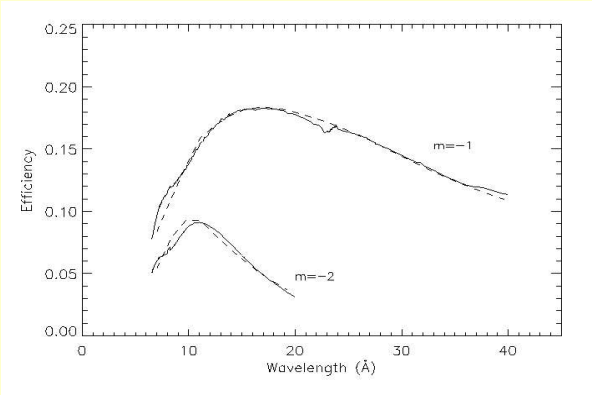
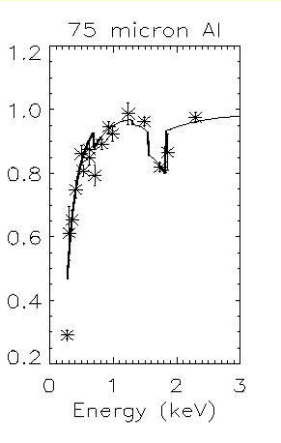
Ground calibration



⊗



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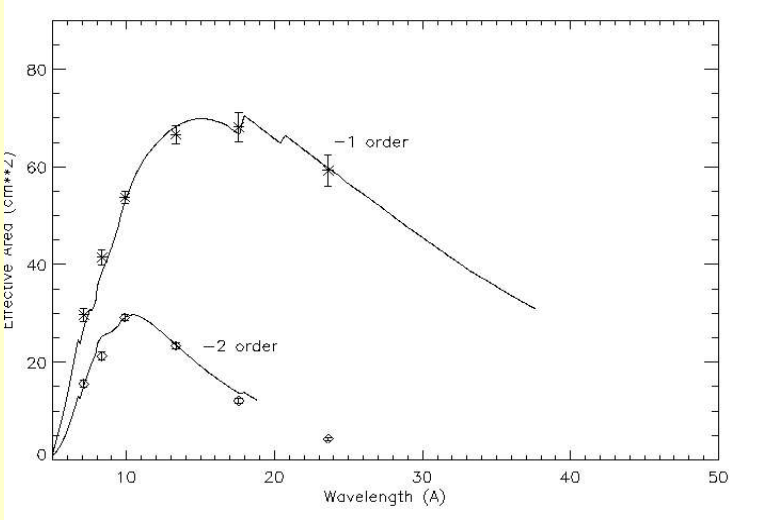

Grating efficiency ⊗ CCD QE = effective area

⇒ RGS calibration reference band 10 ≤ () ≤ 25

(6 ≤ () ≤ 38)

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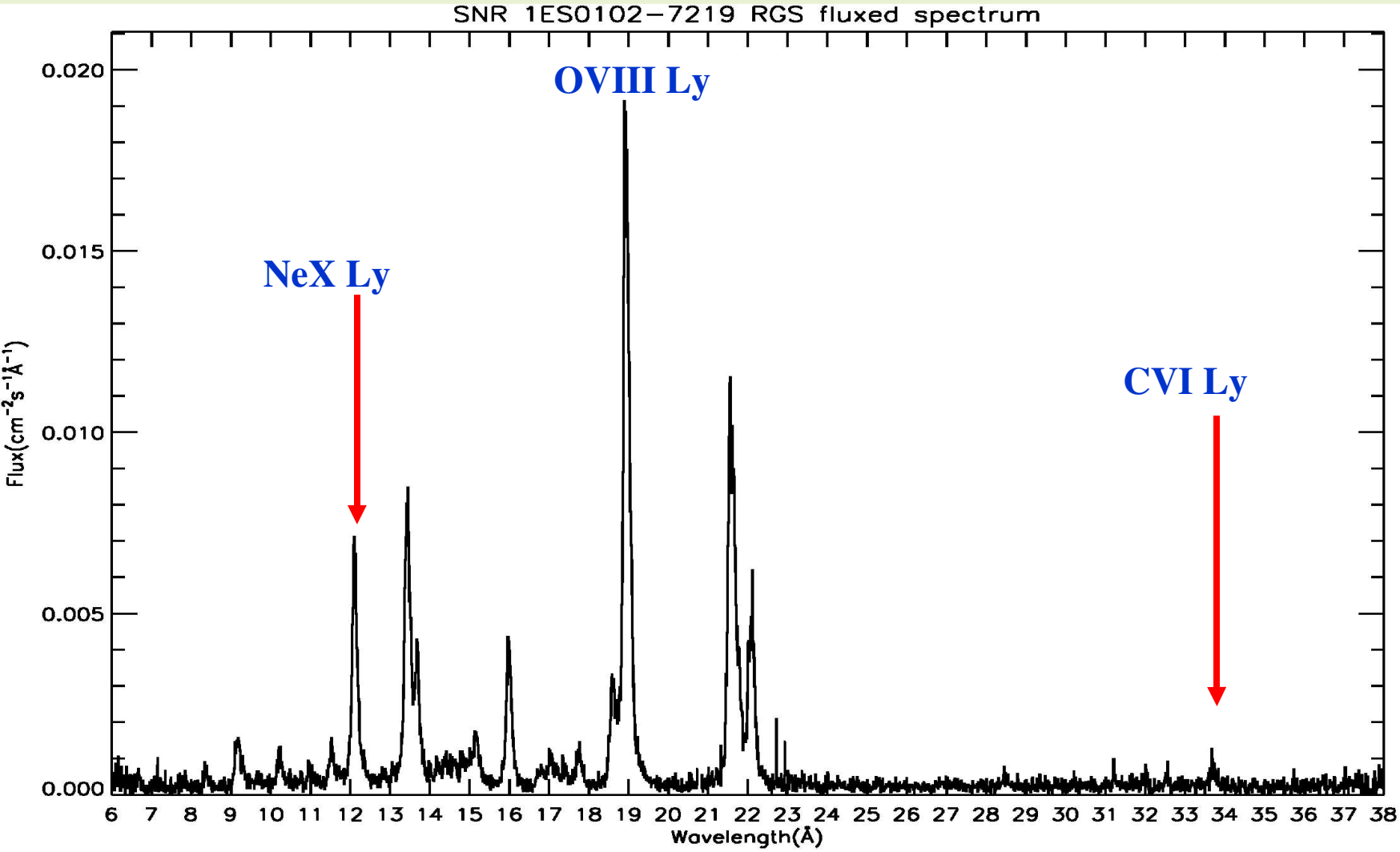
RGS stability from SNR observations



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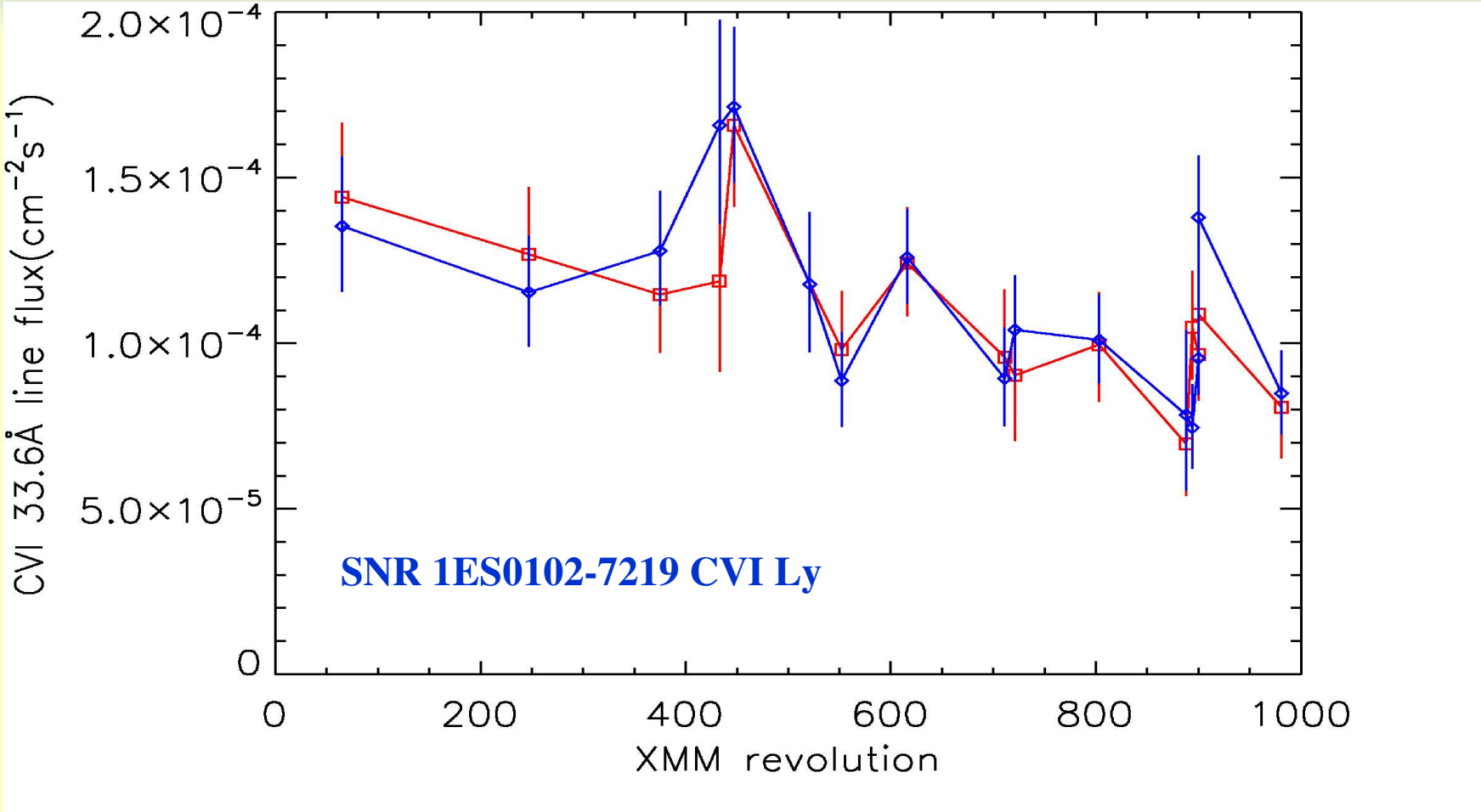
RGS stability from SNR observations



NeX(12.132) and OVIII(18.967) stable within a few %

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RGS effective area

- large scales and small scales
- correction strategy ⇒ EFFAREACORR* CCF for large scales
- 900ks accumulated Mkn421 data ⇒ COOLPIX* CCF for small scales
- this means a new CCF*

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RGS effective-area corrections

- empirical approach
- “featureless” blazar spectra show the same shape
- blazars have absorbed power-law spectra **(LETGS ratios ⇒ no RGS breaks)**
- calibrate α and normalisation with the Crab
- N_H (and absorption chemistry) vital

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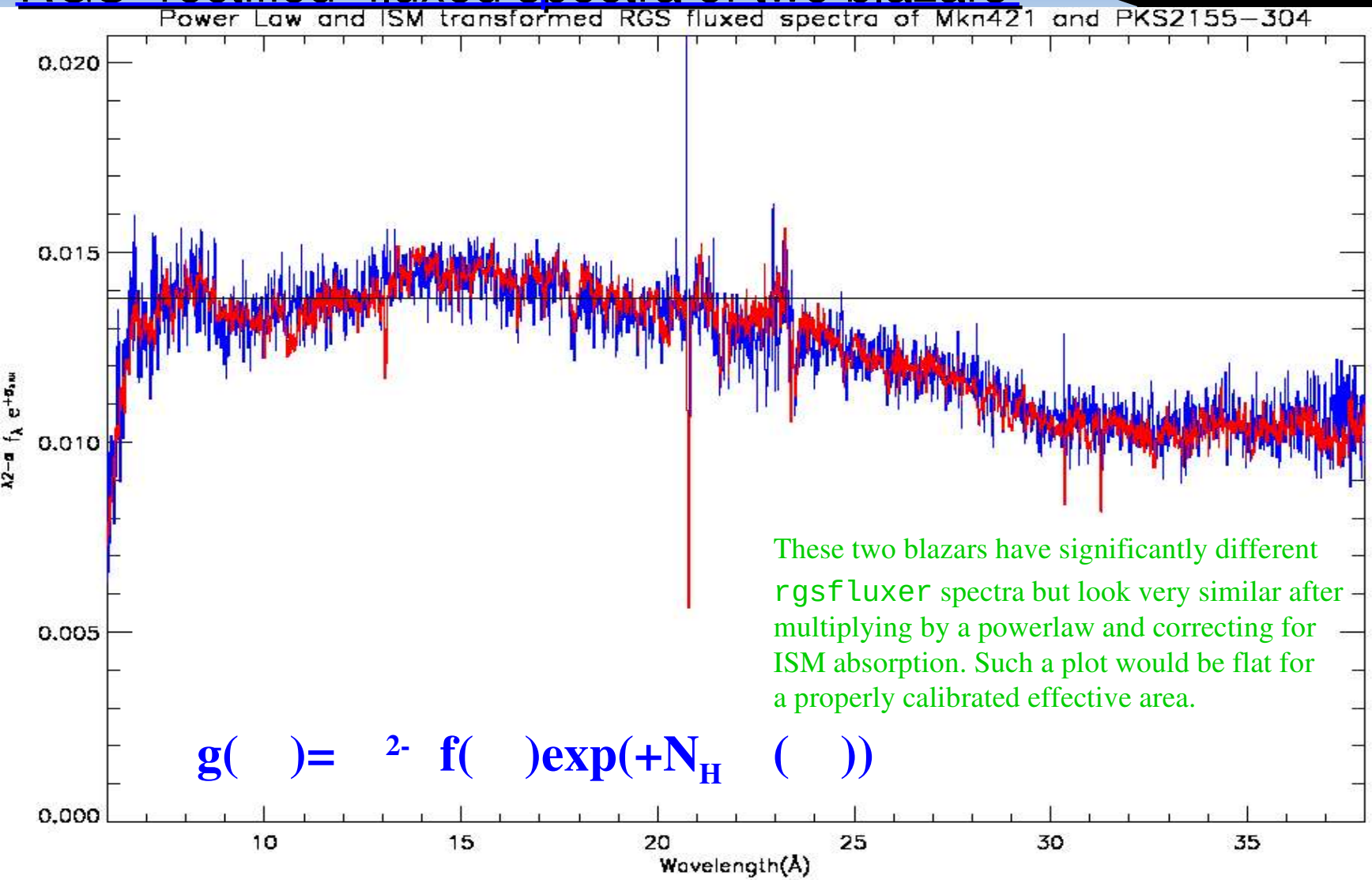
RGS "rectified" fluxed spectra of two blazars



These two blazars have significantly different `rgsfluxer` spectra but look very similar after multiplying by a powerlaw and correcting for ISM absorption. Such a plot would be flat for a properly calibrated effective area.

$$g(\quad) = \quad^{2-} \; f(\quad)\exp(+N_H \quad (\quad))$$

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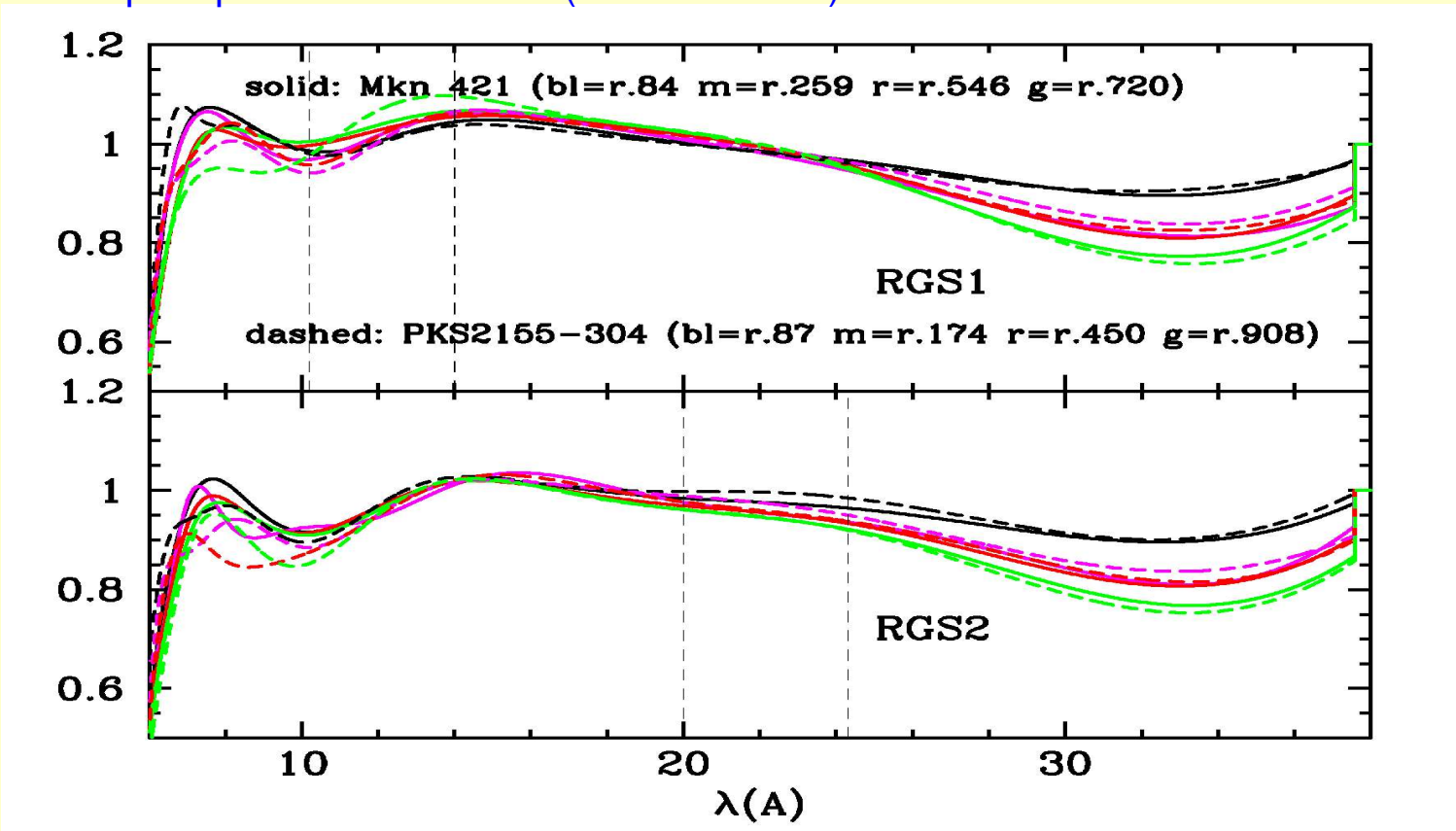
RGS effective-area corrections

- fit blazar spectrum with ISM-absorbed powerlaw 10< (Å)<25
- model residuals by sum of Chebyshev polynomials
- repeat throughout the mission ⊗ Crab normalisation and slope adjustments
- correction calculated at 5 epochs ⇒ EFFAREACORR* CCF
- 8 example epochs shown here (r == XMM rev)



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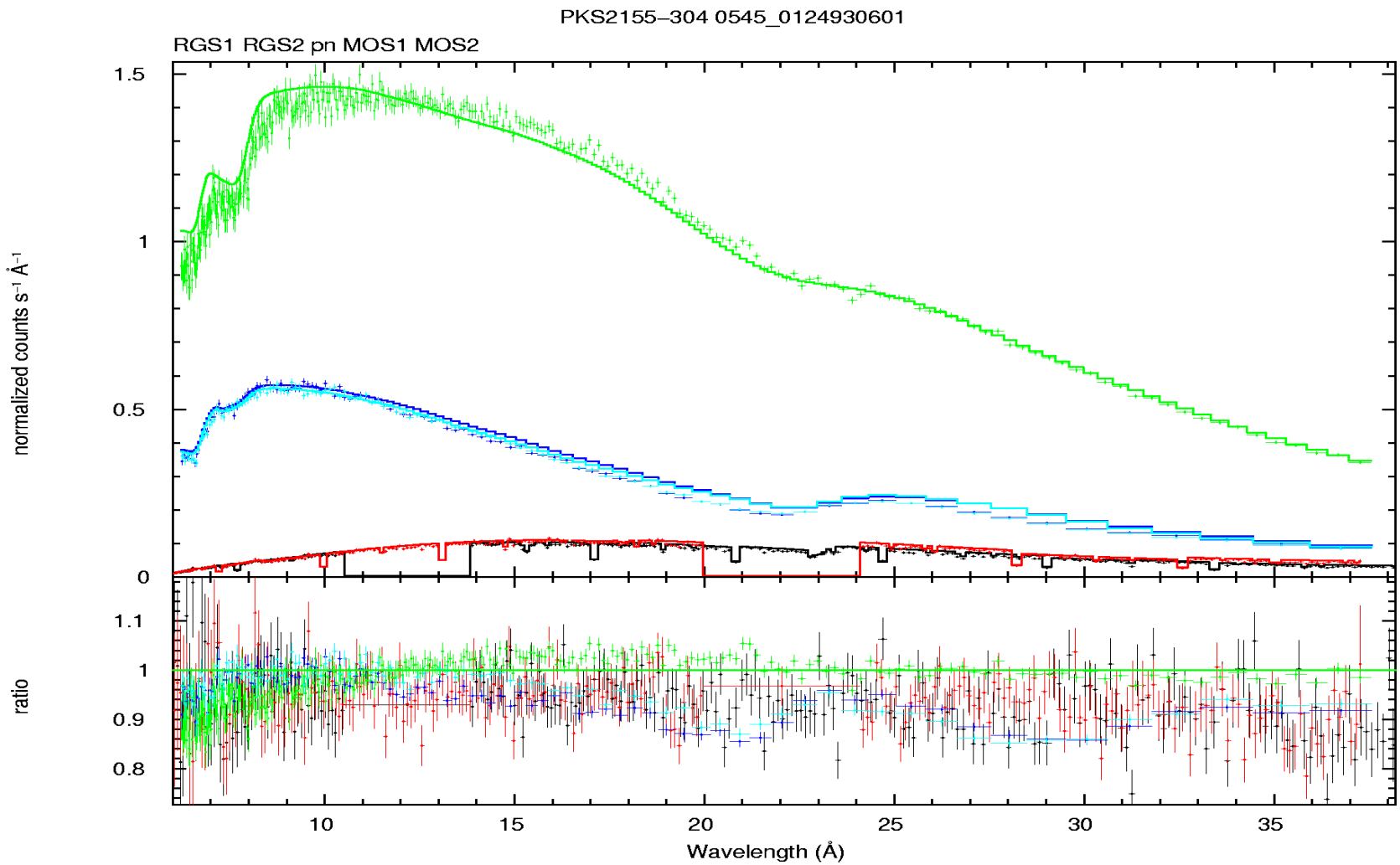
Corrected-RGS comparison with EPIC : PKS2155-304



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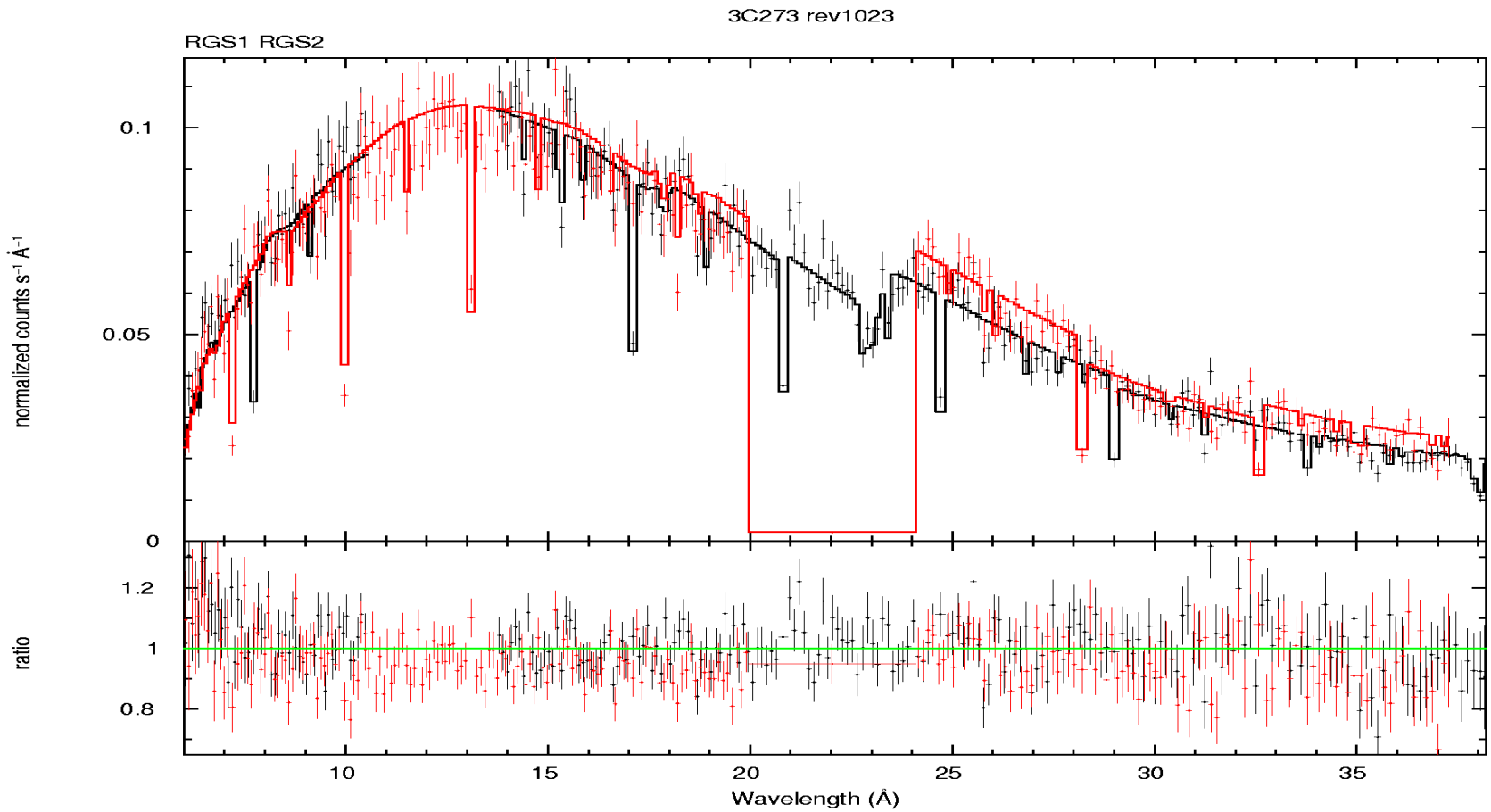
Corrected-RGS comparison with EPIC : 3C273

RGS response to Stuhlinger et al. XCal document spectrum without adjustment



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Moving on to small-scales in the RGS response using 900ks of accumulated data on Mkn421…

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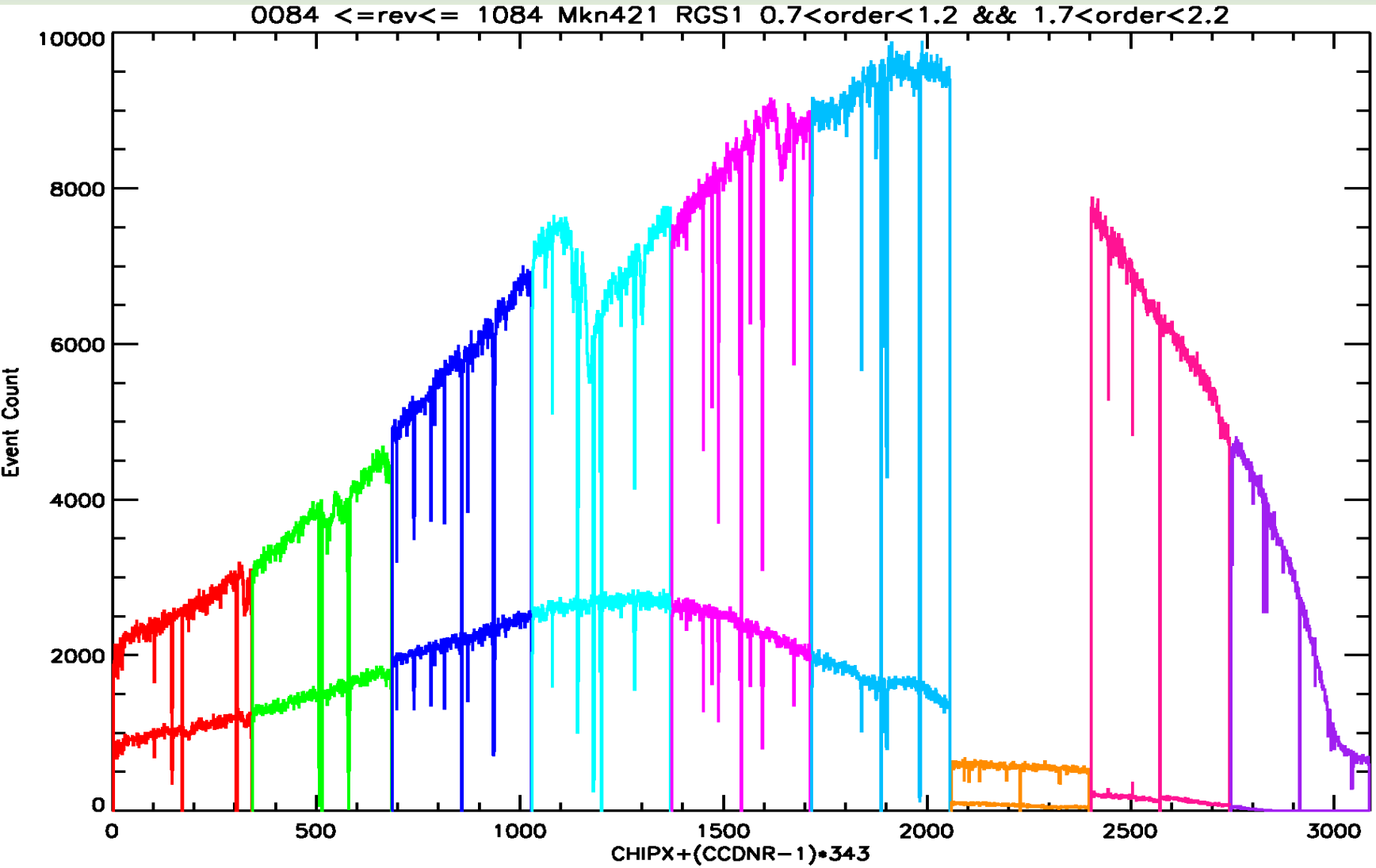
Mkn421's accumulated 900ks RGS1



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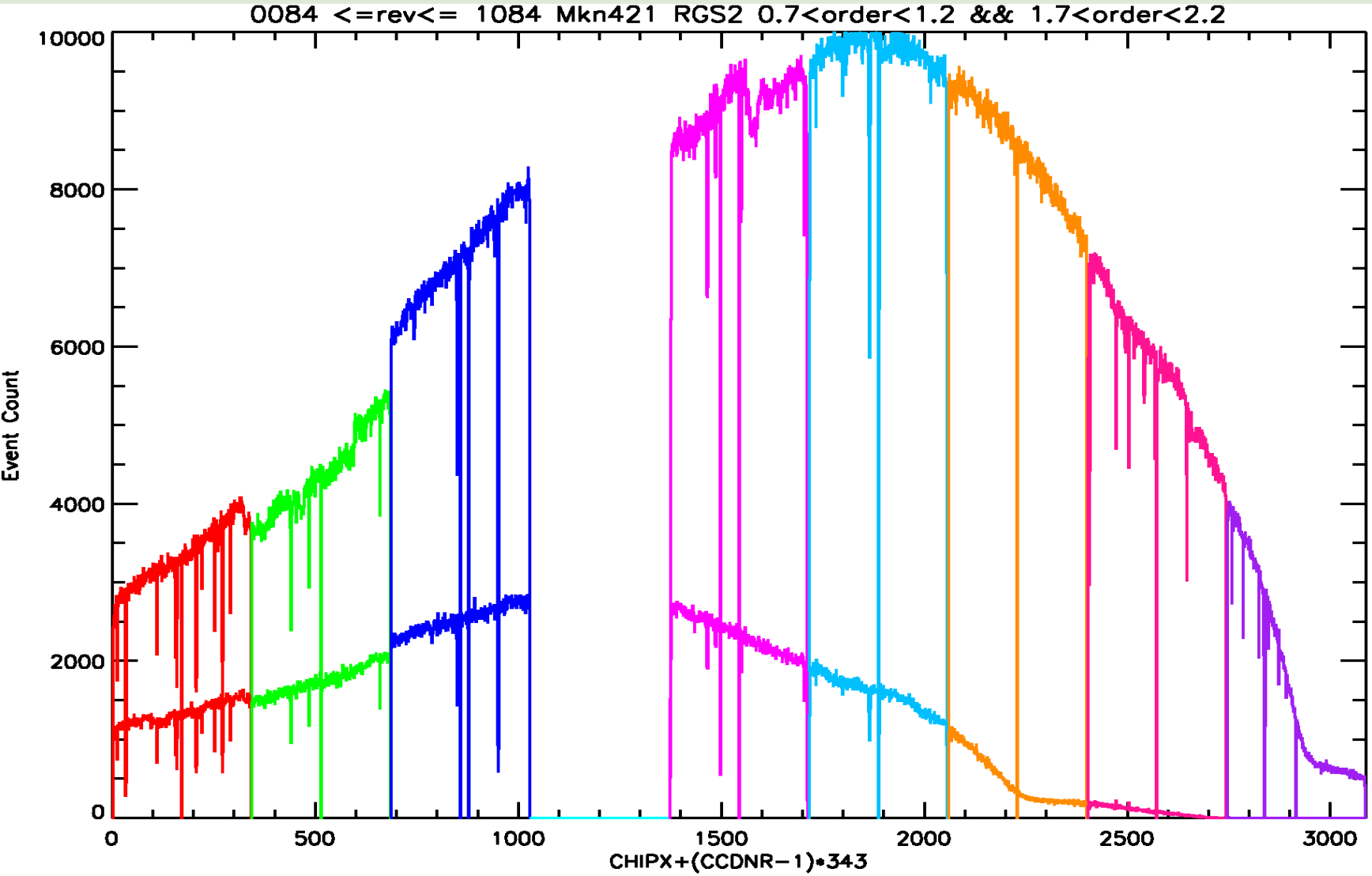
Mkn421's accumulated 900ks RGS2



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Mkn421's accumulated 900ks

- 85% of RGS data obey Poisson statistics
- 14% exceed $e^{-\mu}\mu^n/n!$ by <5%
- 1% hot pixels or columns
- 1% (new class of) cool columns

⇒ Nicastro et al.'s Mkn421 WHIMs were statistical fluctuations

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