RGS Calibration Status

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on behalf of the SRON and ESAC RGS Teams

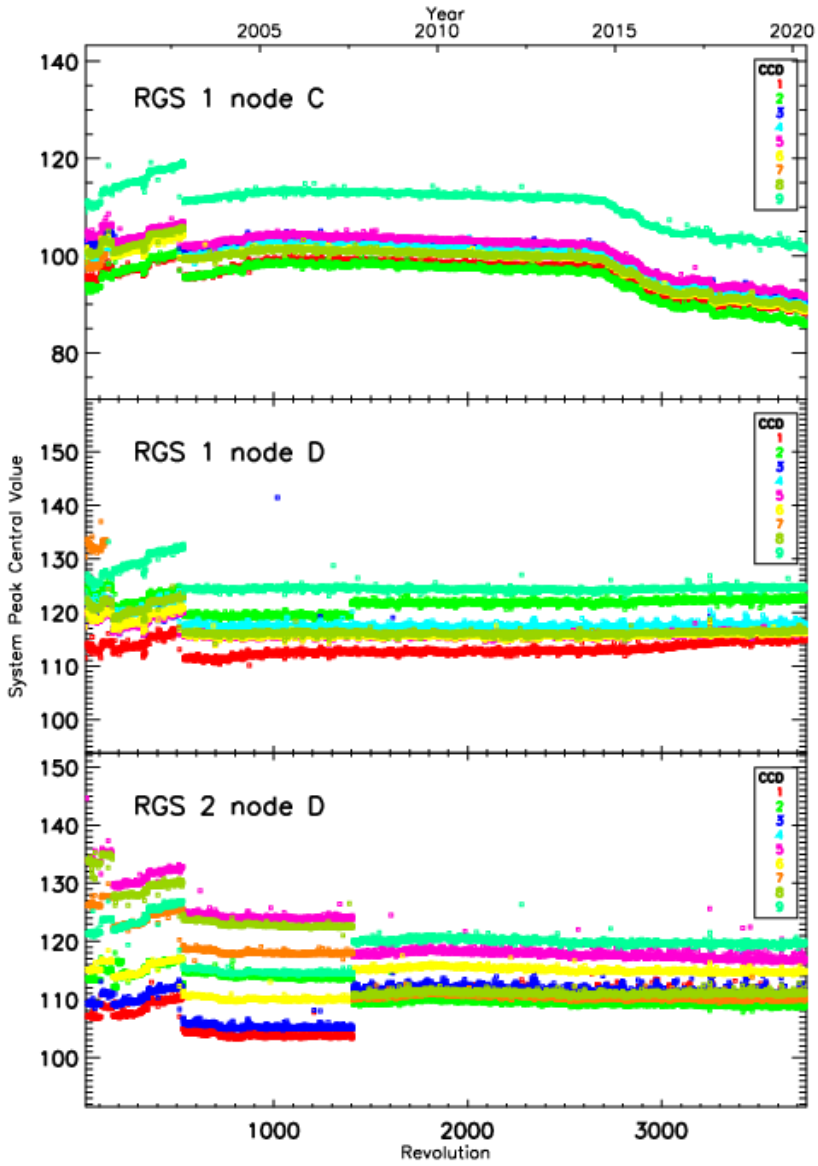
Outline

Instrument Status	Operations
	System Peak
	Charge Transfer Efficiency
	Bad Surface
Calibration	Wavelength Scale
	Contamination
	Effective Area

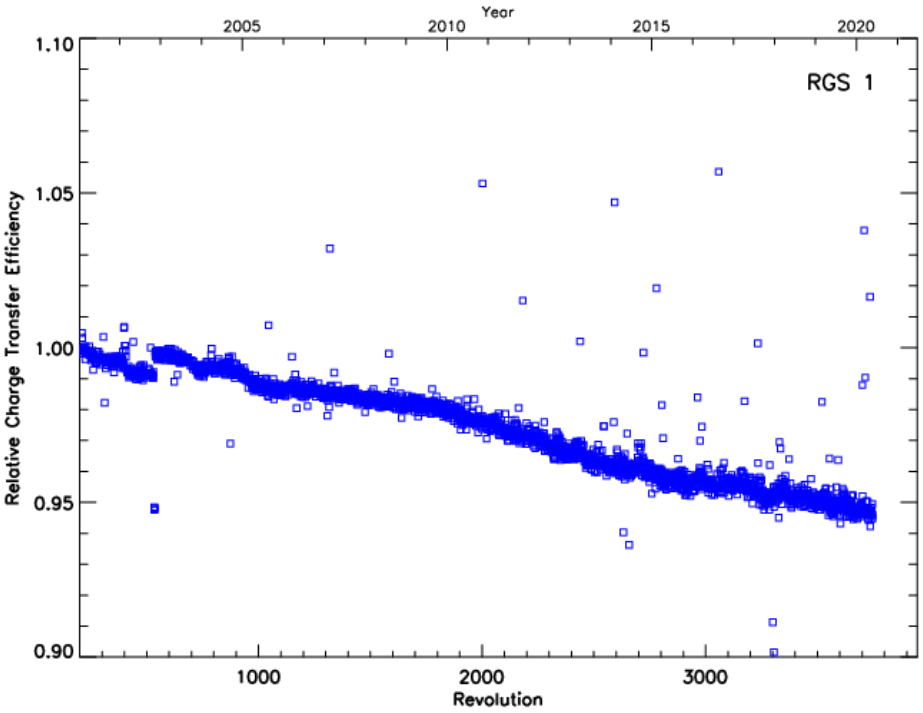
Instrument Status -> Operations

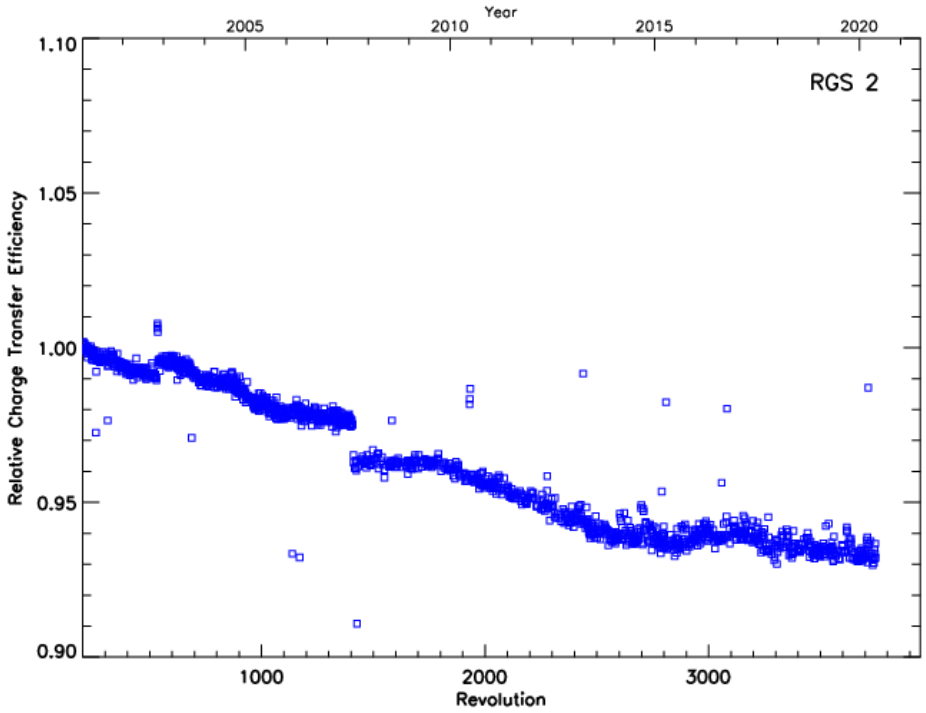
- ✓ RGS operations are running smoothly
- ✓ No changes in operational configuration
- ✓ No anomalies

Instrument Status -> System Peak

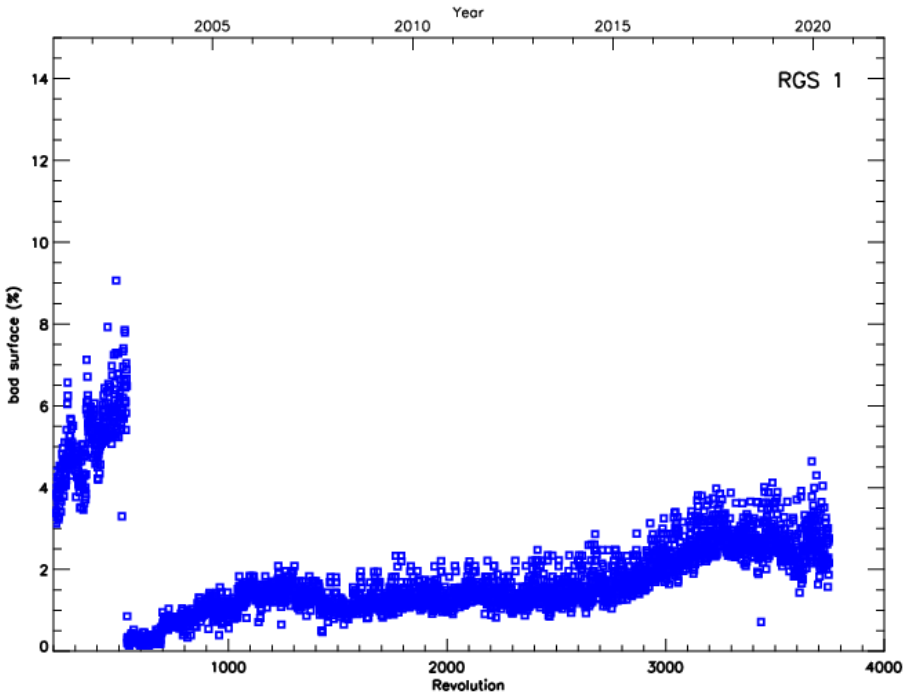


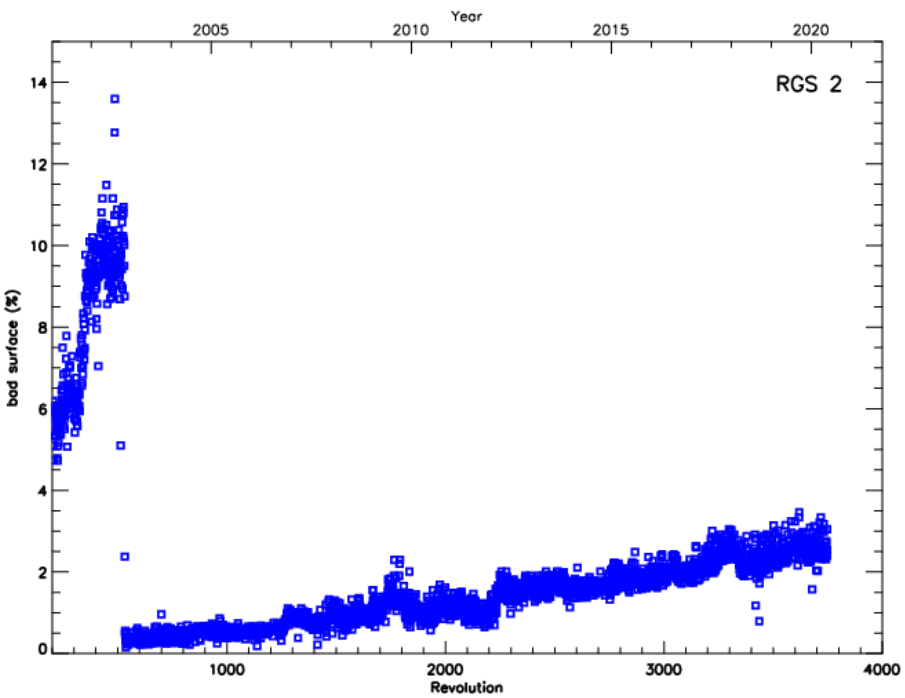
Instrument Status -> Charge Transfer Efficiency





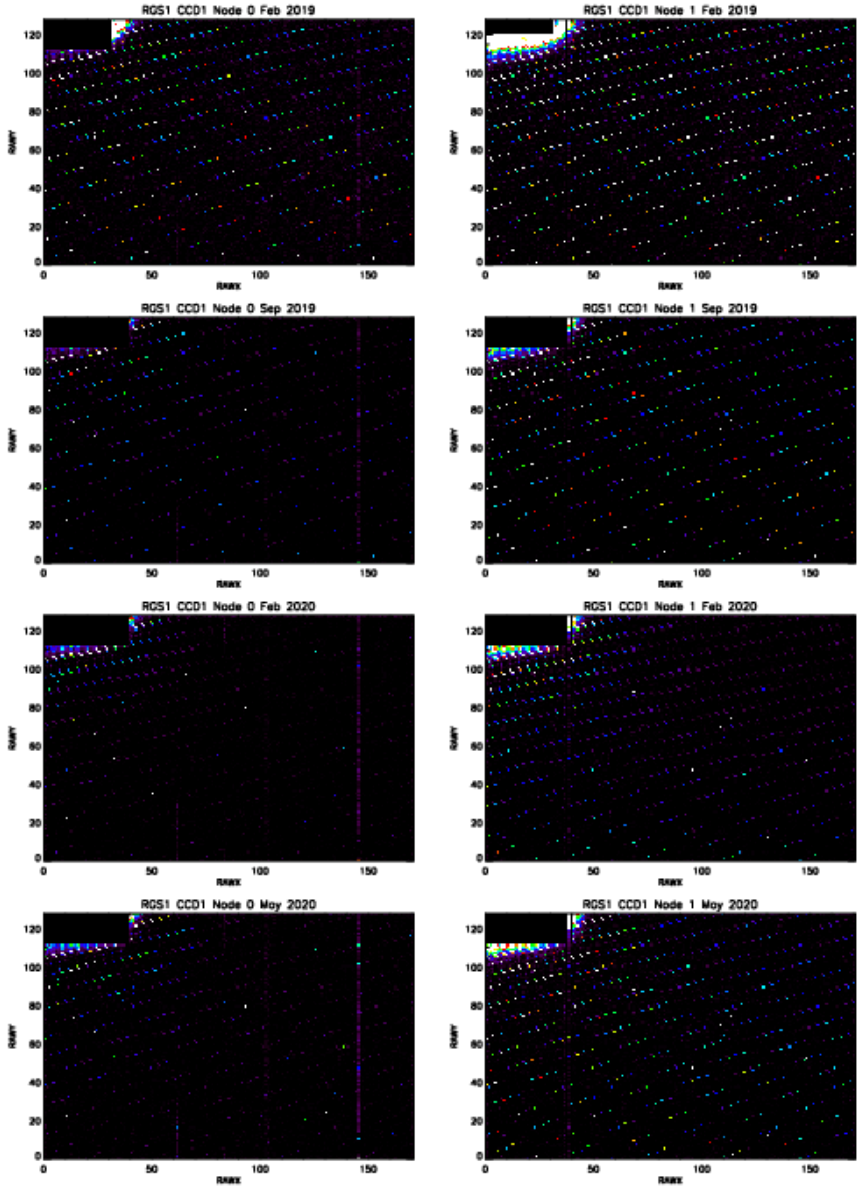
Instrument Status -> Bad Surface -> Bad Pixels





Instrument Status -> Bad Surface -> RGS1 CCD1 spots

node C | node D



Evolution of Hot Spots in RGS1 CCD1: Enlarged regions masked on-board in March 2019

February 2019

September 2019

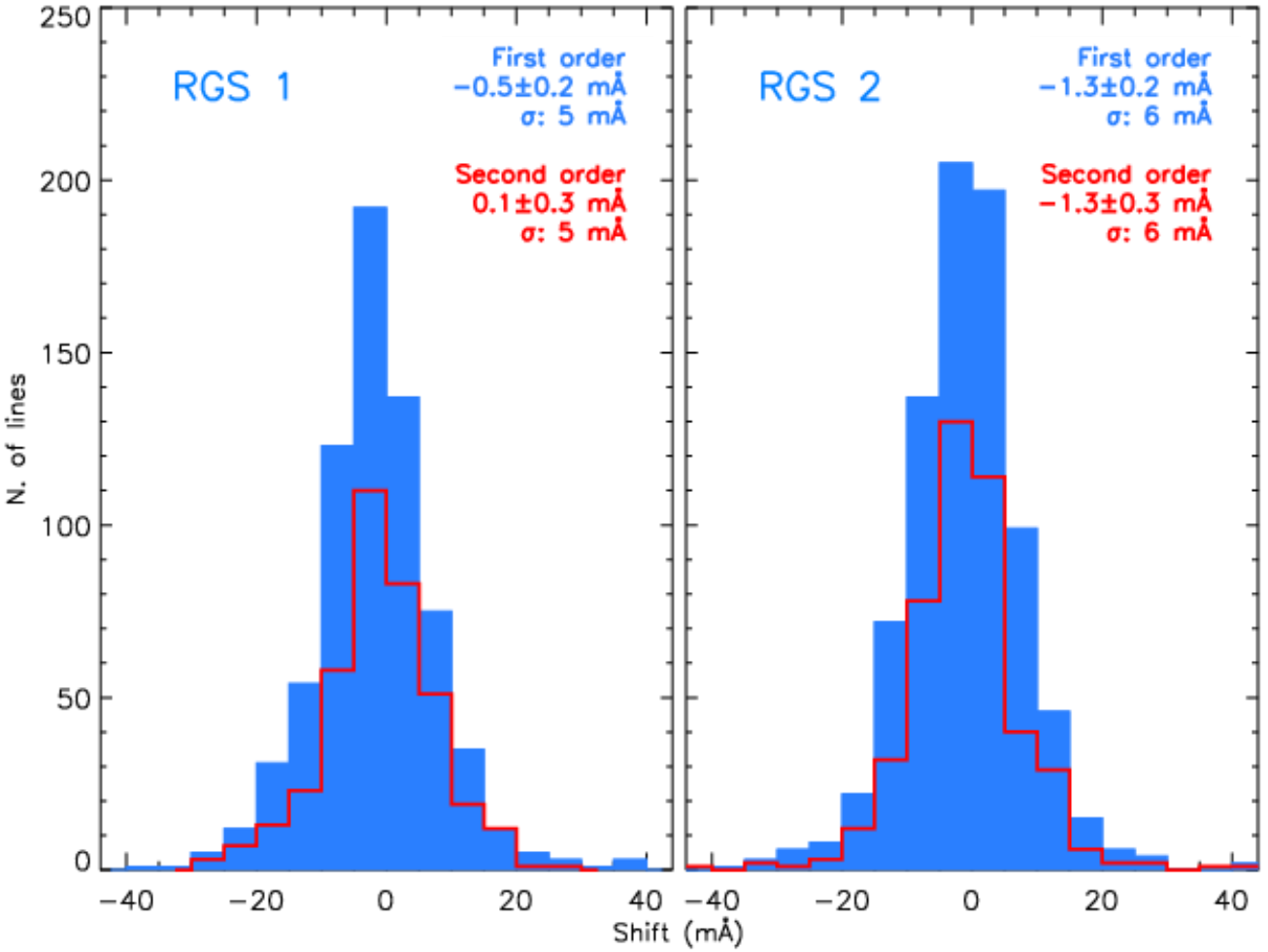
February 2020

To be revised soon

May 2020

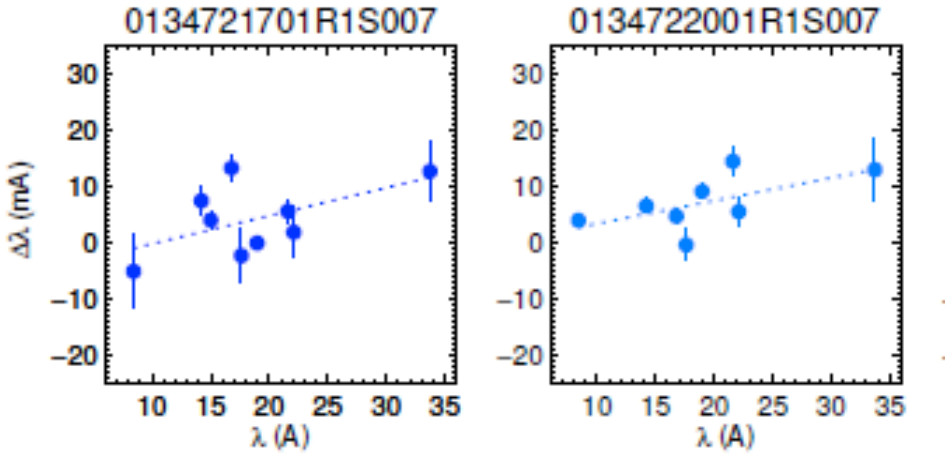
Calibration -> Wavelength Scale

Sun Aspect Angle and Heliocentric corrections applied
Most recent XMM BORESIGHT (#30)



Calibration -> Wavelength Scale -> Work in progress

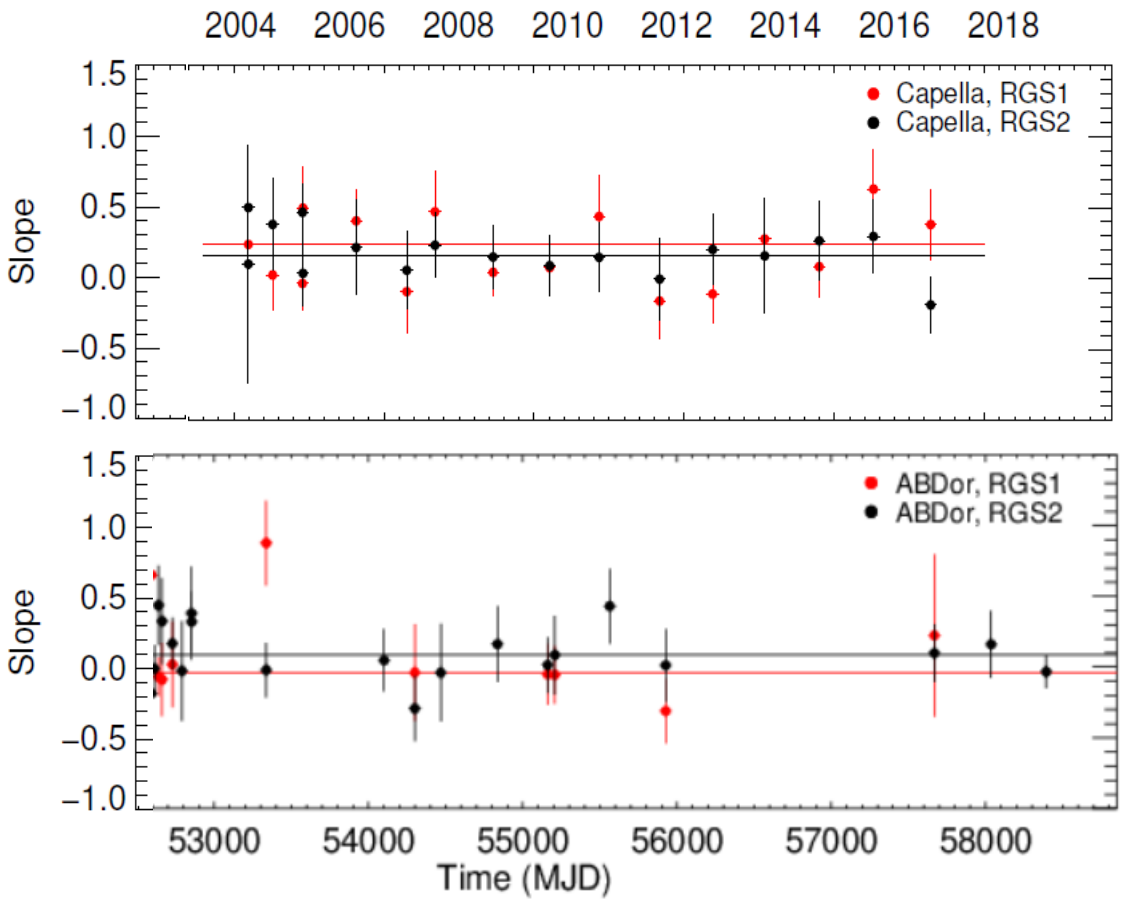
Can the wavelength accuracy be improved?



Testing the wavelength dependence of the shift

Done for Capella, AB Dor and HR 1099 [few points]

Calibration -> Wavelength Scale -> Work in progress



Slope Δλ vs λ		
	RGS 1	RGS 2
Capella	0.24 ±0.24	0.16 ±0.17
AB Dor	-0.04± 0.35	0.09± 0.19

C. Sánchez

Calibration -> Wavelength Scale -> Summary

- Wavelength scale stable
- Accuracy ≤ 6 mÅ
- Work in progress to study potential systematic effects

Calibration -> Effective Area -> Model

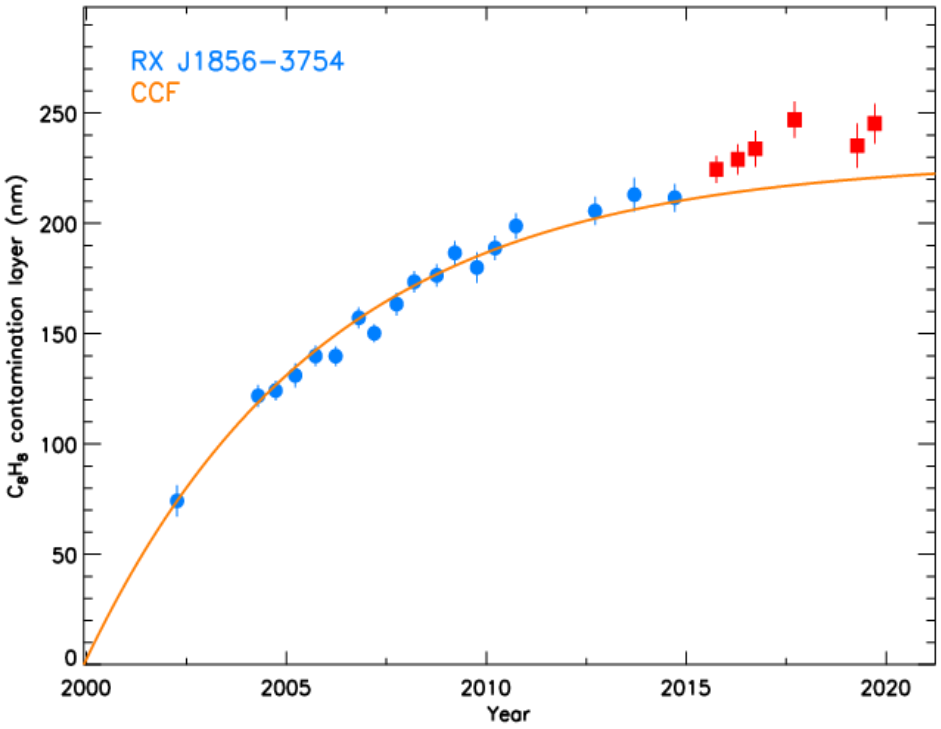
Includes:

a) Contamination

b) Small scale Effective Area variations (RGS1 vs RGS2)

c) Effective Area changes with respect to EPIC-pn
(aka Rectification Factors)

Calibration -> Contamination

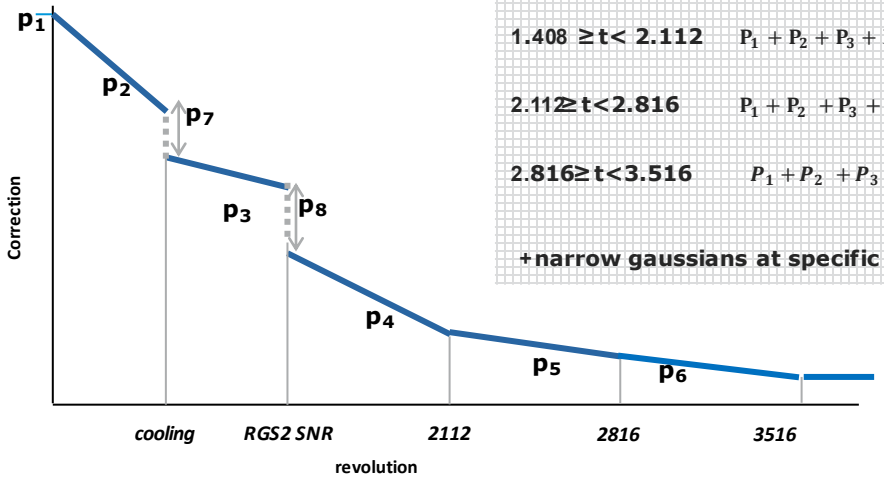


Contamination estimated from the change in the observed flux of the ISN RX J1856-3754 at long wavelengths.

Red points: apparent increase in the thickness of the contamination layer, but flux decrease due to a different reason, as it shows a spectral dependence not compatible with the assumed contaminants.

Calibration -> Effective Area -> Small scale variations

In steps of 0.05 A



For each 0.05 Å bin:

t<0.538 $P_1 + \left(\frac{t}{0.538}\right) P_2$

0.538≥t<1.408 $P_1 + P_2 + P_6 + \left(\frac{t - 0.538}{0.870}\right) P_3$

1.408 ≥t< 2.112 $P_1 + P_2 + P_3 + P_7 + P_8 + \left(\frac{t - 1.408}{0.704}\right) P_4$

2.112≥t<2.816 $P_1 + P_2 + P_3 + P_4 + P_7 + P_8 + \left(\frac{t - 2.112}{0.704}\right) P_5$

2.816≥t<3.516 $P_1 + P_2 + P_3 + P_4 + P_5 + P_7 + P_8 + \left(\frac{t - 2.816}{0.700}\right) P_6$

+narrow gaussians at specific wavelengths

J. Kaastra, C. de Vries & J.W. den Herder, 2019

Updated

- Data up to end 2018
- Refinement of the treatment of the Galactic absorption
- Use of smoothed background in the fitting
- Extrapolation of the broken power–law model out of the 5-37 Å range
- More accurate detection of chip boundaries
- Improvements in the fitting and smoothing of the correction factors

Calibration -> Effective Area -> time-dependent Rectification Factors (TdRF)

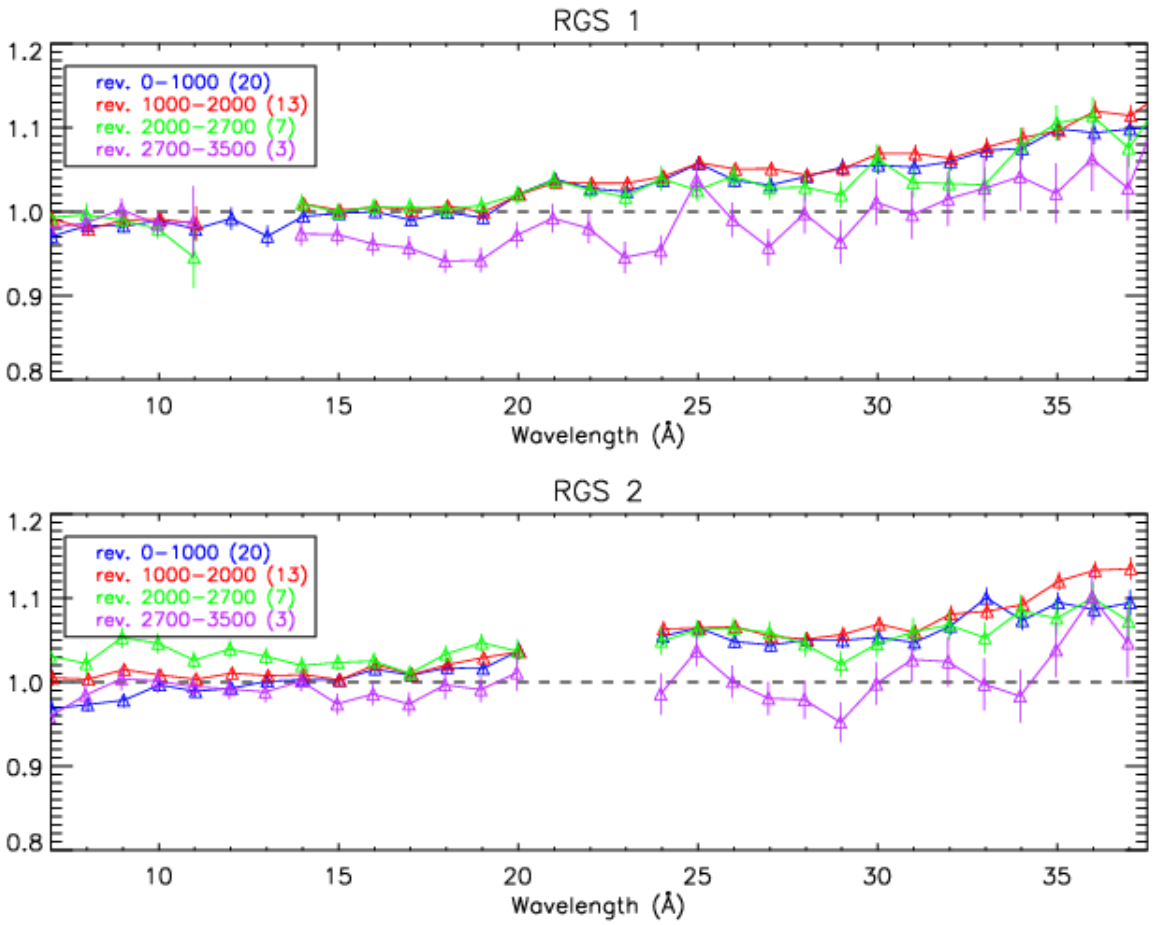
Rectification Factors re-derived using also the last version of the small scale correction

All observations of the BL Lac 3C273 and PKS2155 processed with CCF13 and

rgsrmfgen option

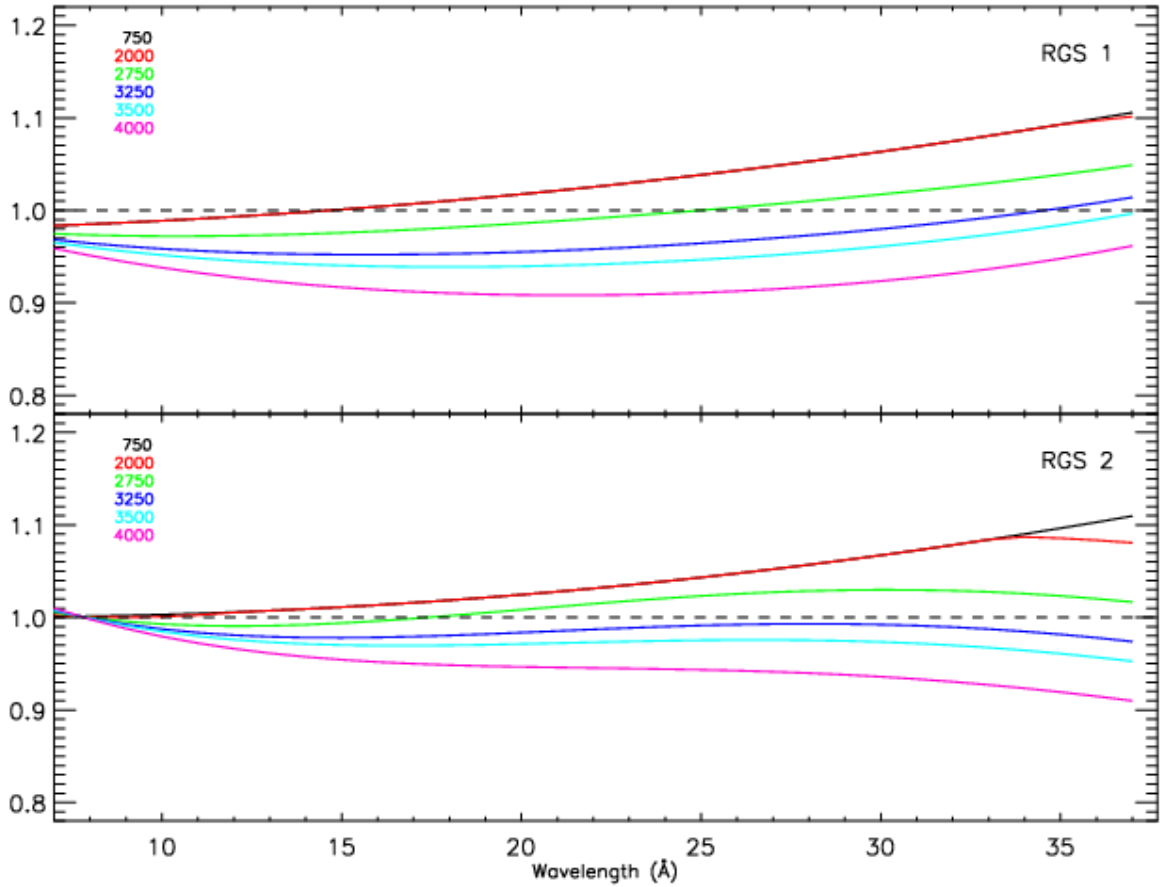
witheffectiveareacorrection=yes

Method: comparison with EPIC-pn best fit model



Calibration -> Effective Area -> TdRF

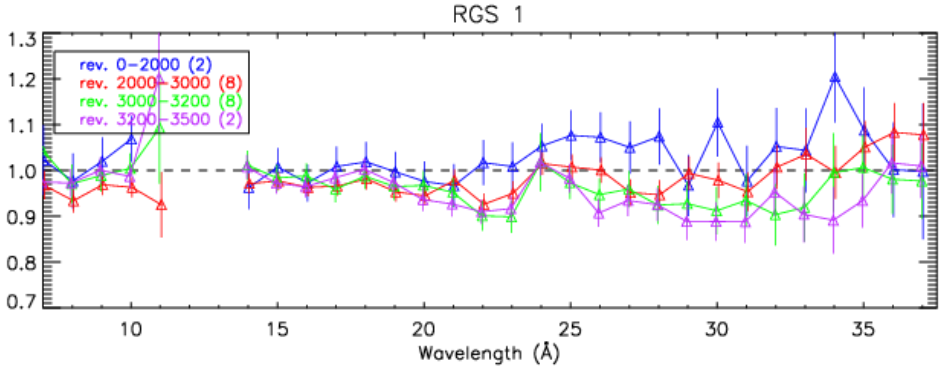
As implemented in the CCF

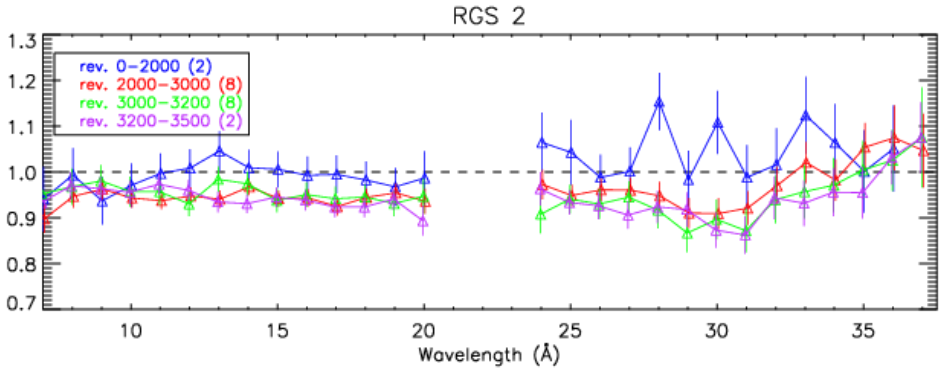


Calibration -> Effective Area -> TdRF -> Results

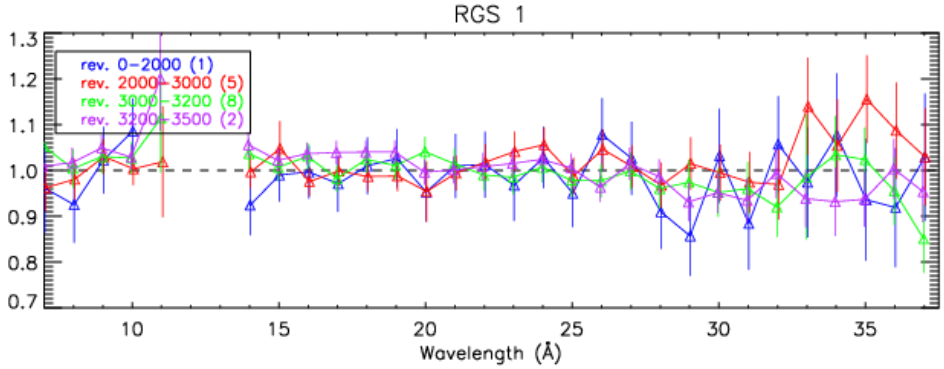
1ES 1553

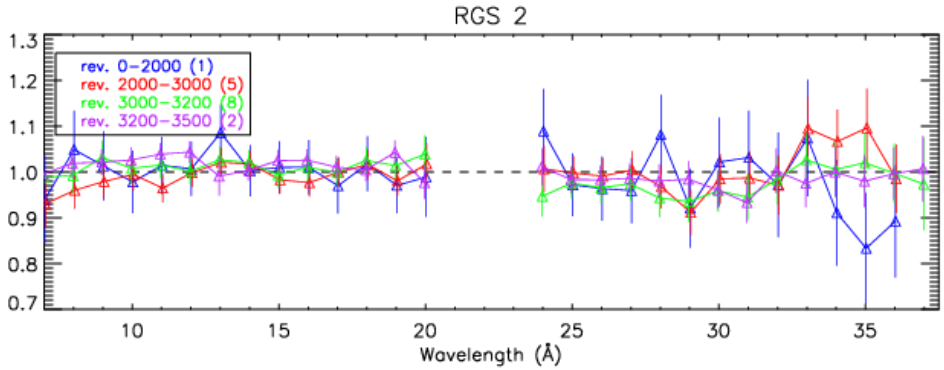
without correction



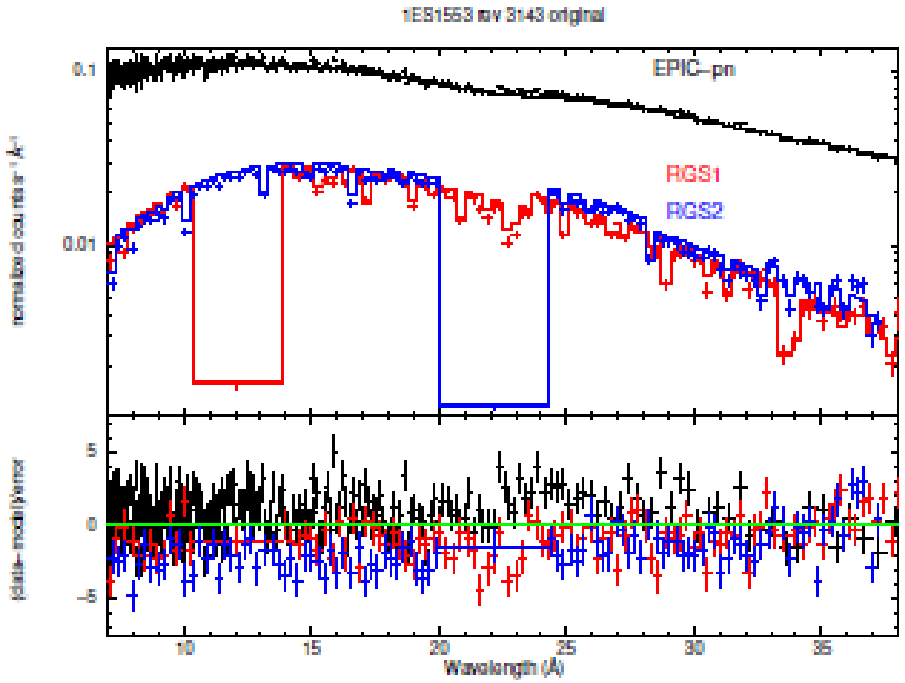


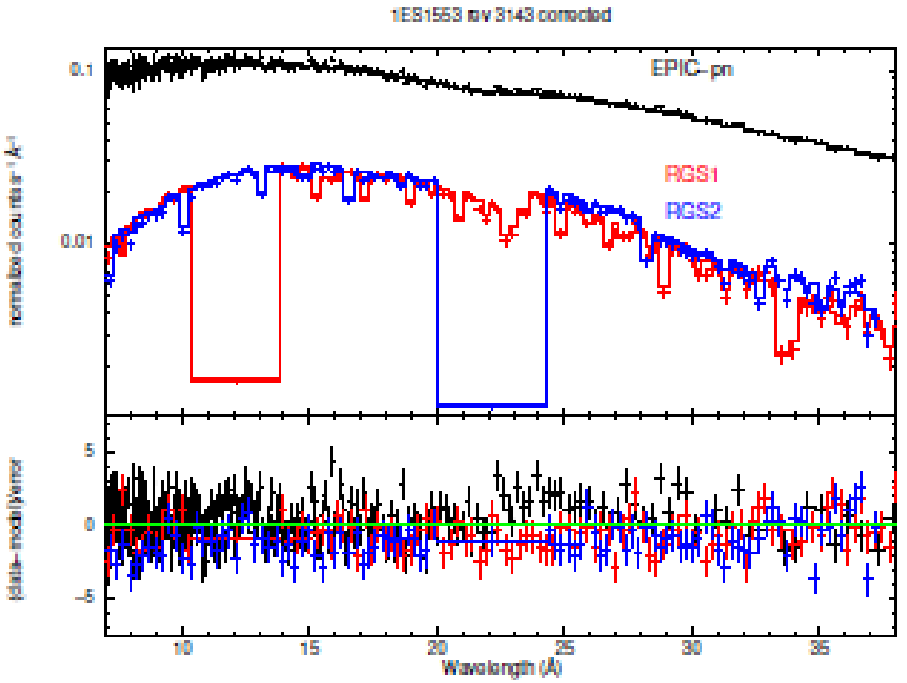
corrected





1ES 1553 in rev 3143



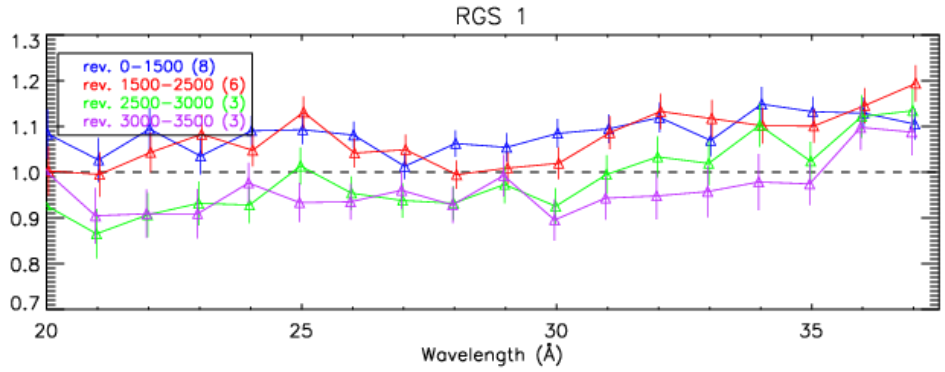


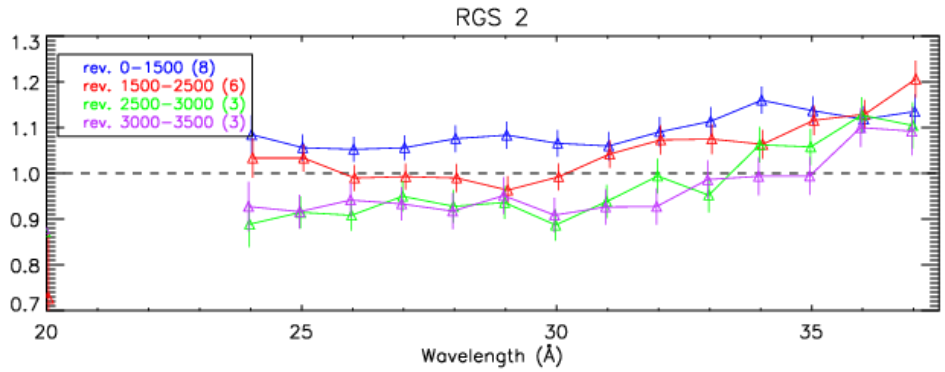
C-statistics decreasing from 6371 to 5985 (for 5398 d.o.f.)

Calibration -> Effective Area -> TdRF -> Results

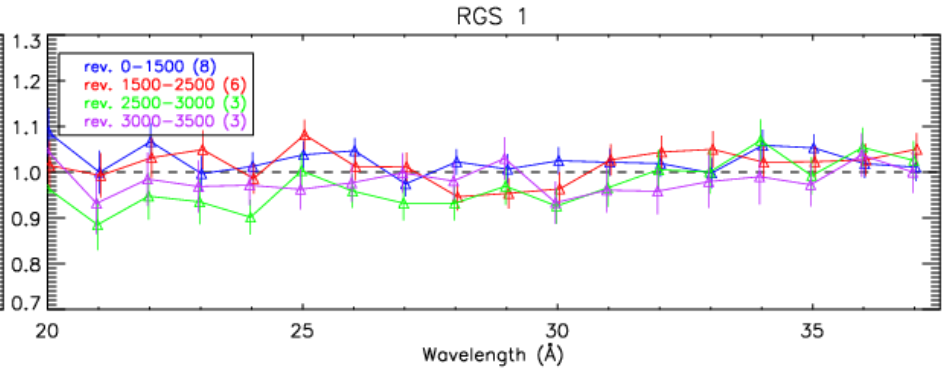
RX J1856-3754

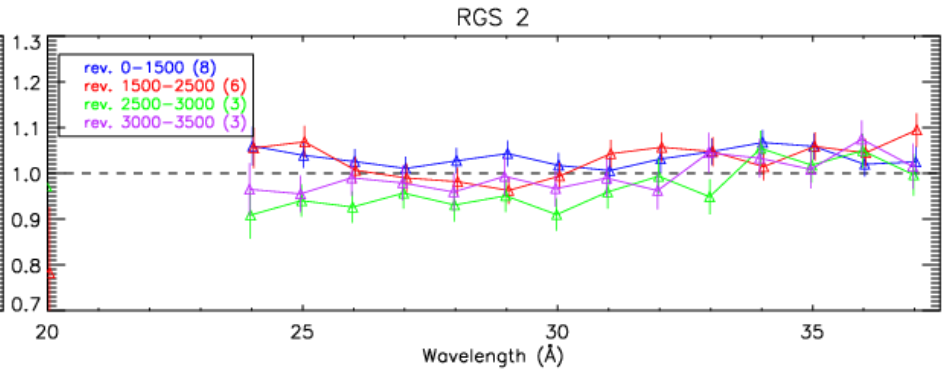
without correction



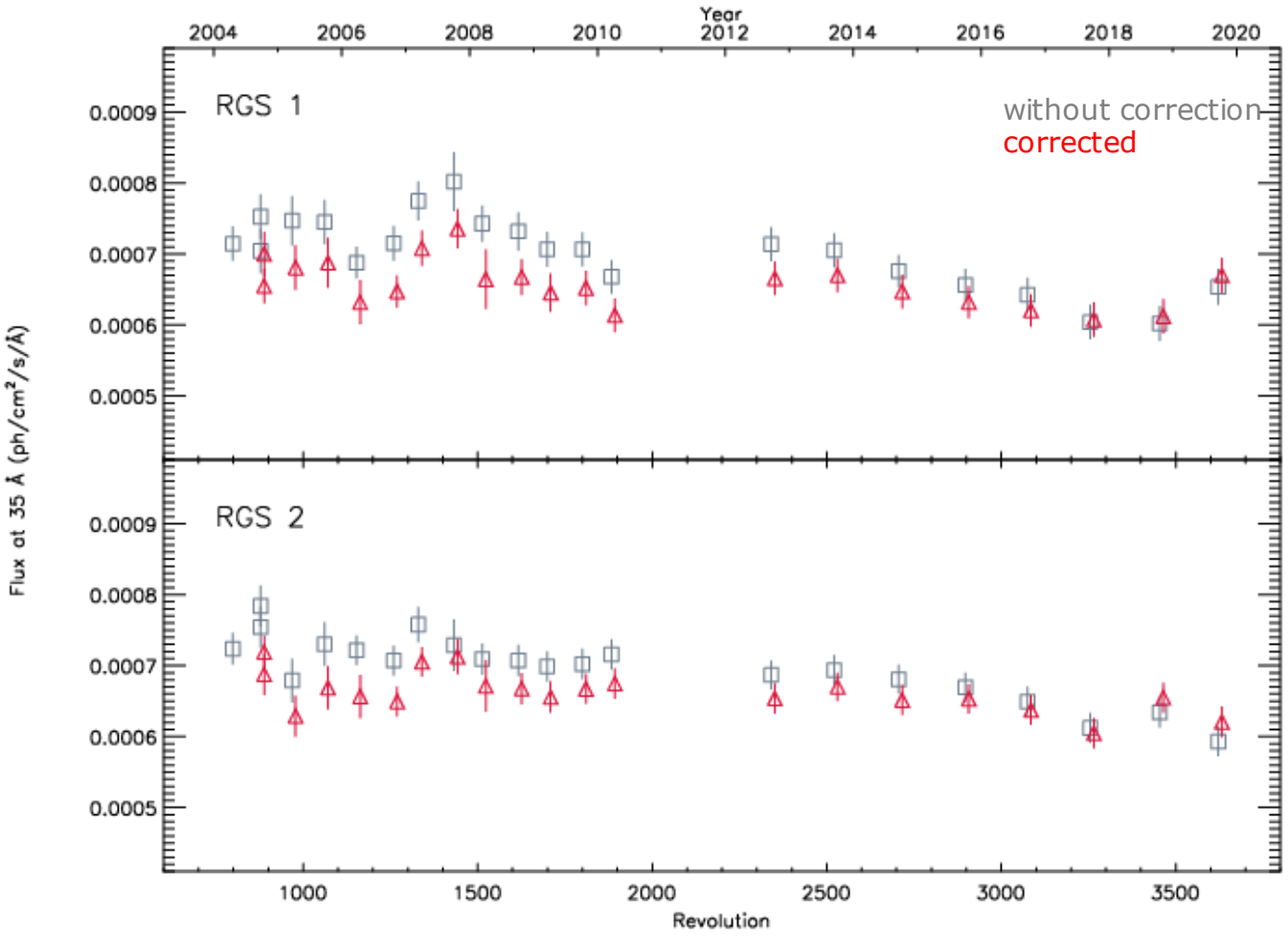


corrected





RX J1856-3754



Flux at 35 Å
10^{-4} photons/cm^2/s/Å

RGS 1	
w/o correction	7.07± 0.51
corrected	6.55 ± 0.33

RGS 2	
w/o correction	7.07± 0.46
corrected	6.55 ± 0.28

Calibration -> Effective Area -> Summary

- Issued EFFAREACORR 13 with updates time-dependent small scale correction

CCF	RGS[12]_EFFAREACORR_0013
Release Note	371
Date	June 2019

- Issued EFFAREACORR 14 with time-dependent rectification factors

CCF	RGS[14]_EFFAREACORR_0014
Release Note	372
Date	December 2019

SASv19 will include

- witheffectiveareacorrection=yes as default
- check/warning so that if withrectification is set to yes, witheffectiveareacorrection should also be set to yes, for consistency

Summary and Plans

- ✓ RGS operations are running smoothly
- ✓ No unexpected degradation in the instrumental parameters
- ✓ Wavelength scale is stable. Accuracy is ≈ 6 mÅ
- ✓ Corrections to take into account the observed change in Effective Area implemented
- ✓ Update of masks for the RGS1 CCD1 hot spots
- ✓ Monitoring of the Wavelength scale:
  - ✓ Increase the sample
  - ✓ Study of systematic effects
- ✓ Monitoring of the changes in Effective Area
- ✓ Evaluation of new methods for background subtraction