The XMM-Newton in-flight calibration plan: origins, evolution and lessons learned

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Outline

- Early history
- Time budget
- Lessons learned (= summary)

Calibration time budget

- Routine Calibration Plan: ~5% of the total observing time
  - ~40% EPIC, ~40% RGS, ~20% cross-calibration
- *Non-Routine Calibration Observations* (NRCOs) possible, specific (and fast!) approval cycle
- Yearly reviewed in the instrument calibration meetings
- IACHEC role: drives cross-calibration, impact on several calibration areas (endorsed by User's Group)

History

- 1996: *System Calibration Document* - first list
- June 1997: change of orbit - list to be rewritten
- May 1998: first serious simulations - list to be rewritten
- Sep^{er} 1998: conflicts with GT/PV - list to be rewritten
- Dec^{er} 1998: sparse ground data - too late to change!
  - GT, PV, AO observations take priority

… December 1999: launch

Lesson learned

1. plan early, but not too early
2. do not plan calibration obs.^{ns} as subsidiary to PV/GT/AO
3. long baseline with stable configurations pay off
4. allow time for unforeseen experiments (NRCO)
5. calibration is done not only with calibration time
6. plan cross-calibration experiments early enough

Original content (mainly driven by EPIC)*

Blue = see next slide

- PSF (pile-up limits): ArLAC, HZ43, LMCX-3 (we used MCG-6-30-15 in facts)
- Area (no Crab): G21.5-0.9, 3C58, Mkn421, 3C273, CasA (AXAF), Abell1060
- Vignetting: Abell1060 (compact cluster) - we used G21.5-0.9/3C58 in facts
- Flat field: Coma or Perseus (large relaxed cluster)
- Astrometry: NGC2516 (also LH, NGC253, M31)
- Contamination: RXJ1856-3754, PG1658+441, PG0136+251, 1E0102-72, N132D
- Timing: PSR0540-069 (we used Crab pulsar in facts)
- Energy scale: Coma/Perseus/Ophiucus clusters, N132D, PuppisA, 1E0102-72
- Straylight: Tycho (PV)

*"RGS difficult due to lack of point-sources with non-time varying well understood line [spectra]"

RCP sources in 2015

(Guainazzi et al., 2014, XMM-SOC-CAL-PL-0001)

Source	T	goals	past alternatives
1E0102-72	70	EPIC contamination/ redistribution	
1ES1553+113	30	cross-calibration	PKS2155-304
3C273	30	cross-calibration	
Capella	60	RGS λ	ABDor, HR1099, ScoX-1
Crab	10	EPIC timing	
Mkn421	9	RGS area, λ	
N132D	45	EPIC redistribution	Tycho
PKS2155-304	160	RGS area	Mkn421
PSRB0833-304	80	RGS contamination	
RXJ1856-3754	140	EPIC contamination	RXJ0720.4+3125
Vela SNR	60	EPIC resolution, λ	Coma, MS1229.2+6430
ζPuppis	22.5	EPIC resolution/RGS long-λ	ζOrionis/Capella

"λ"= energy scale, CTI, gain - NGC2516/OMC2-3/LH used for boresight stability
regular **CAL_CLOSED** (EPIC energy scale) and 10 ks/yr **CLOSED** (background) exposures

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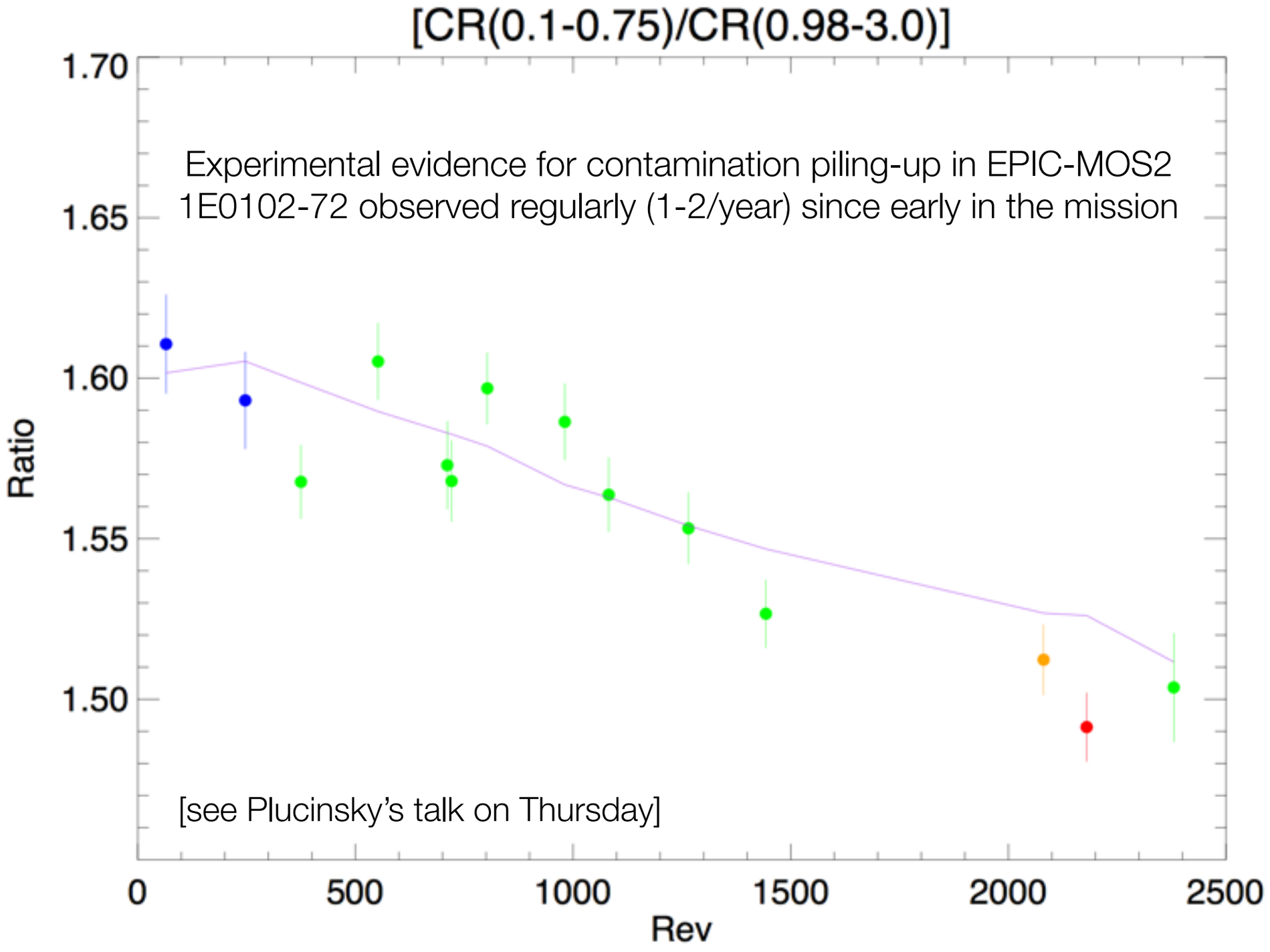
Long baseline with stable configurations pay off

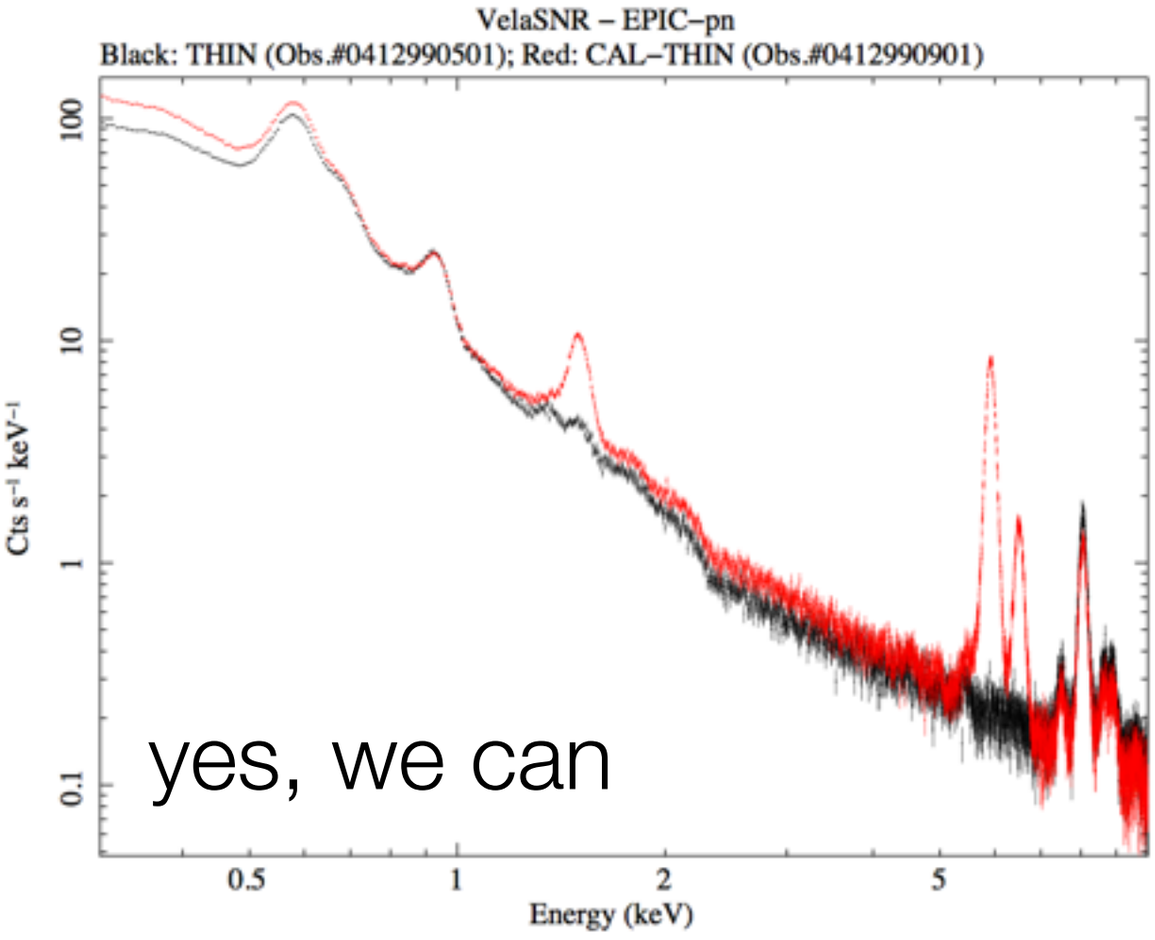
(Sembay & Saxton, 2013, XMM-CCF-REL-0305)

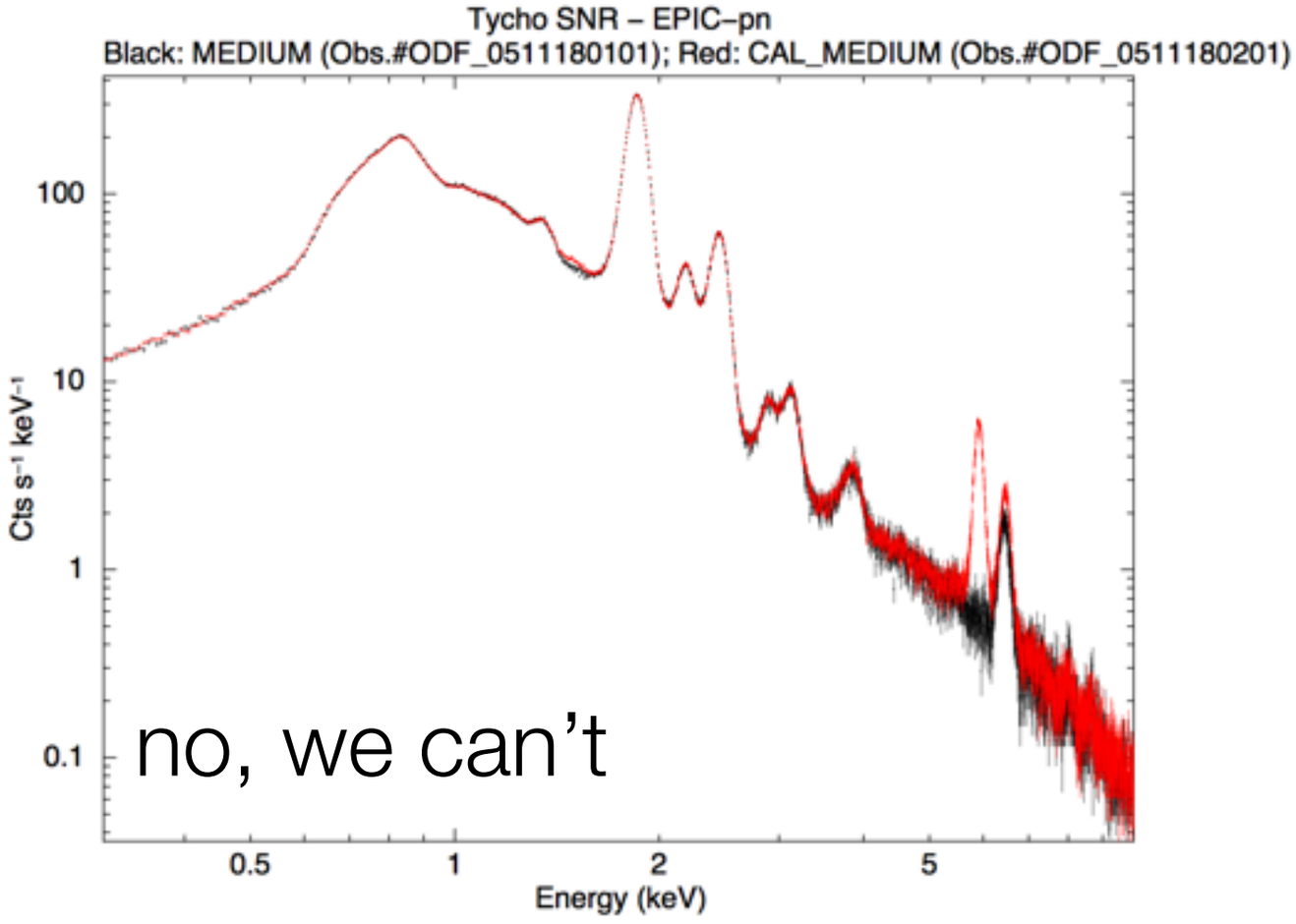


Allow time for unforeseen experiments

(Guainazzi et al., 2013, XMM-SOC-USR-TR-0020)

Two longish experiments (NRCOs) to establish if we can observe with the calibration source in the field-of-view …

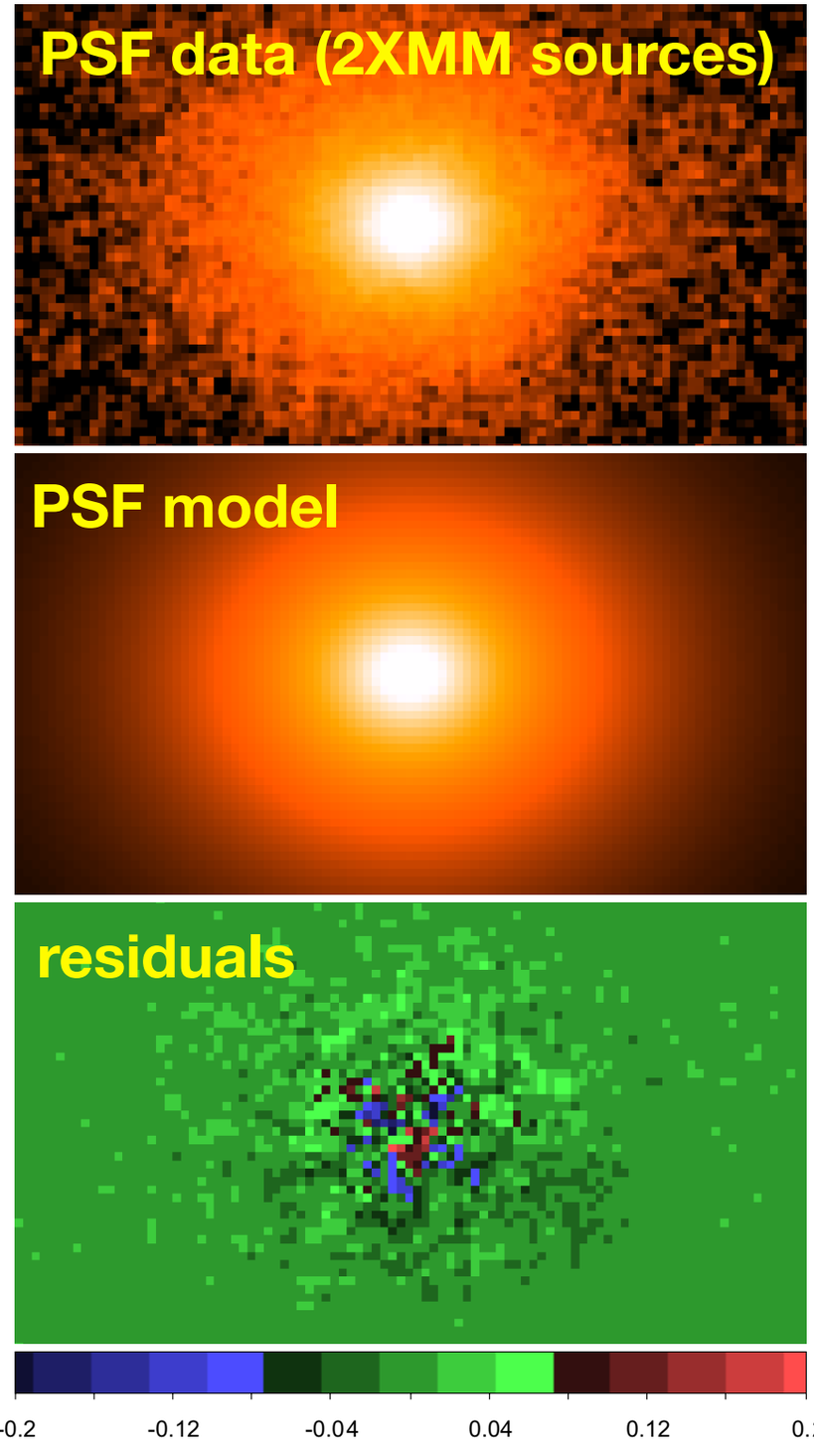




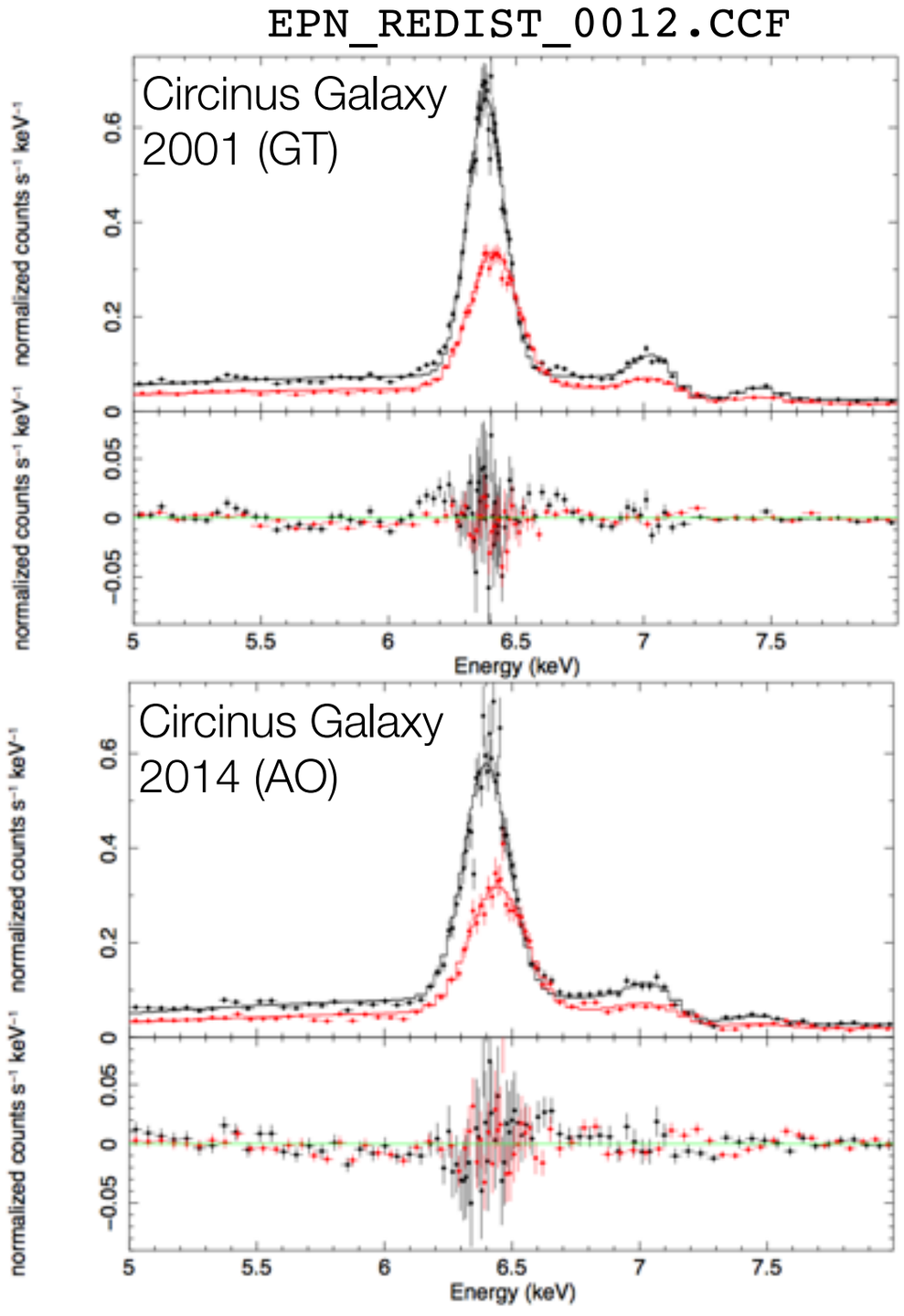
[… other examples in the EPIC talks at the CCD WG]

Calibration is done not only with calibration time

(Read et al., 2011, A&A, 534, 34)



(Saxton et al., 2014, XMM-CAL-SRN-0322)



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