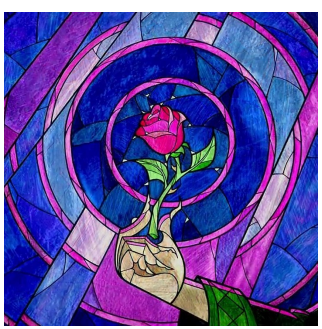
The high-energy view of Seyfert galaxies through broad-band monitoring campaigns

Francesco Ursini
INAF-Osservatorio di Astrofisica e Scienza dello Spazio di Bologna

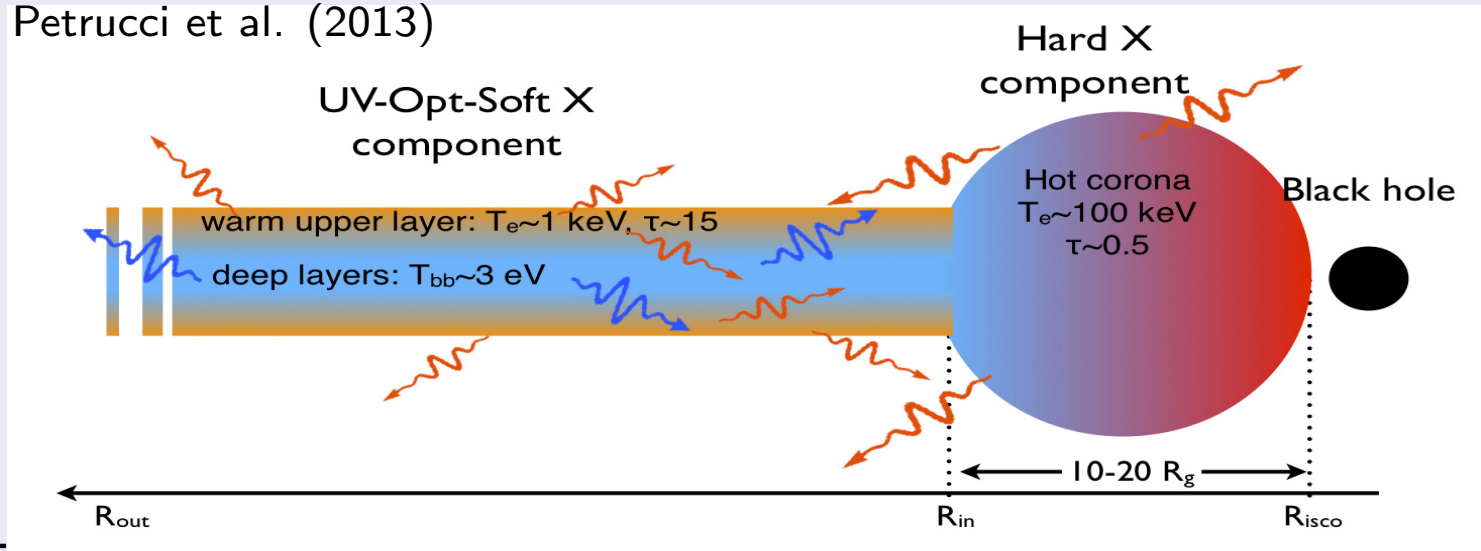
In collaboration with: P.-O. Petrucci, G. Matt, S. Bianchi, M. Cappi, B. De Marco, A. De Rosa, J. Malzac, A. Marinucci, R. Middei, G. Ponti, A. Tortosa

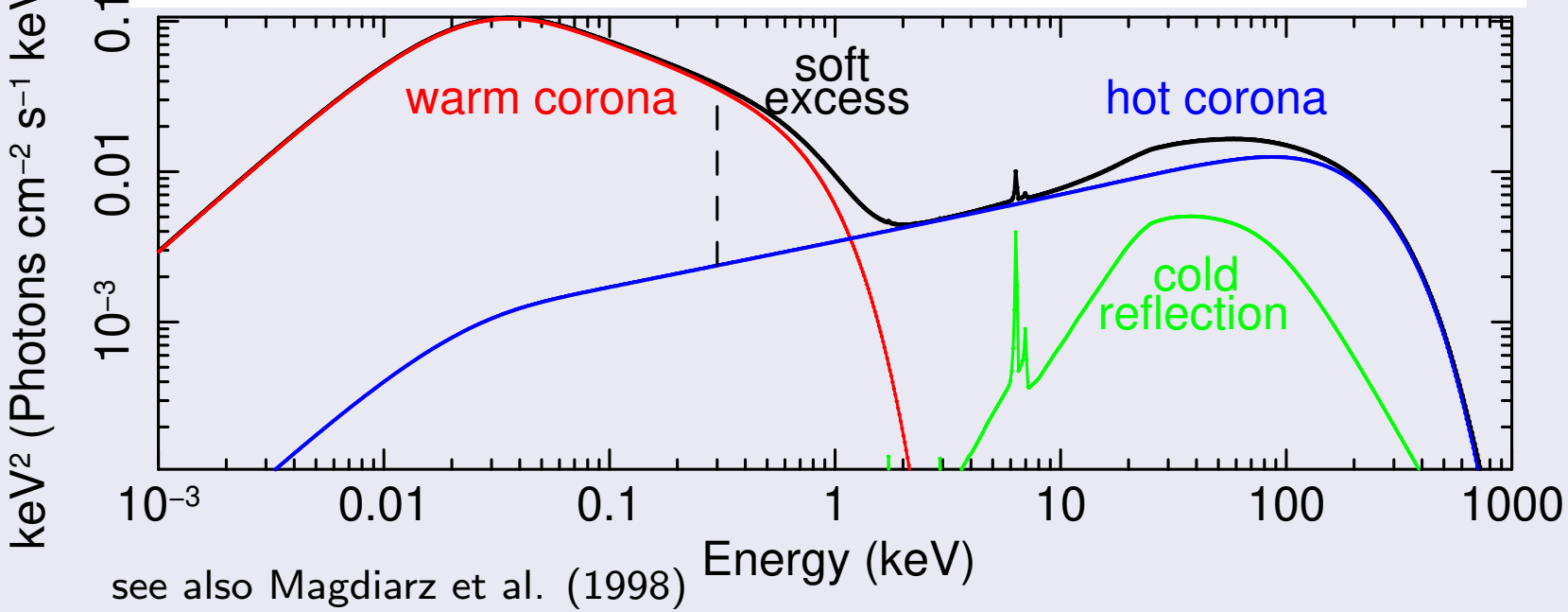


10th Oct 2018
AGN 13 - Beauty and the Beast

The two-corona model

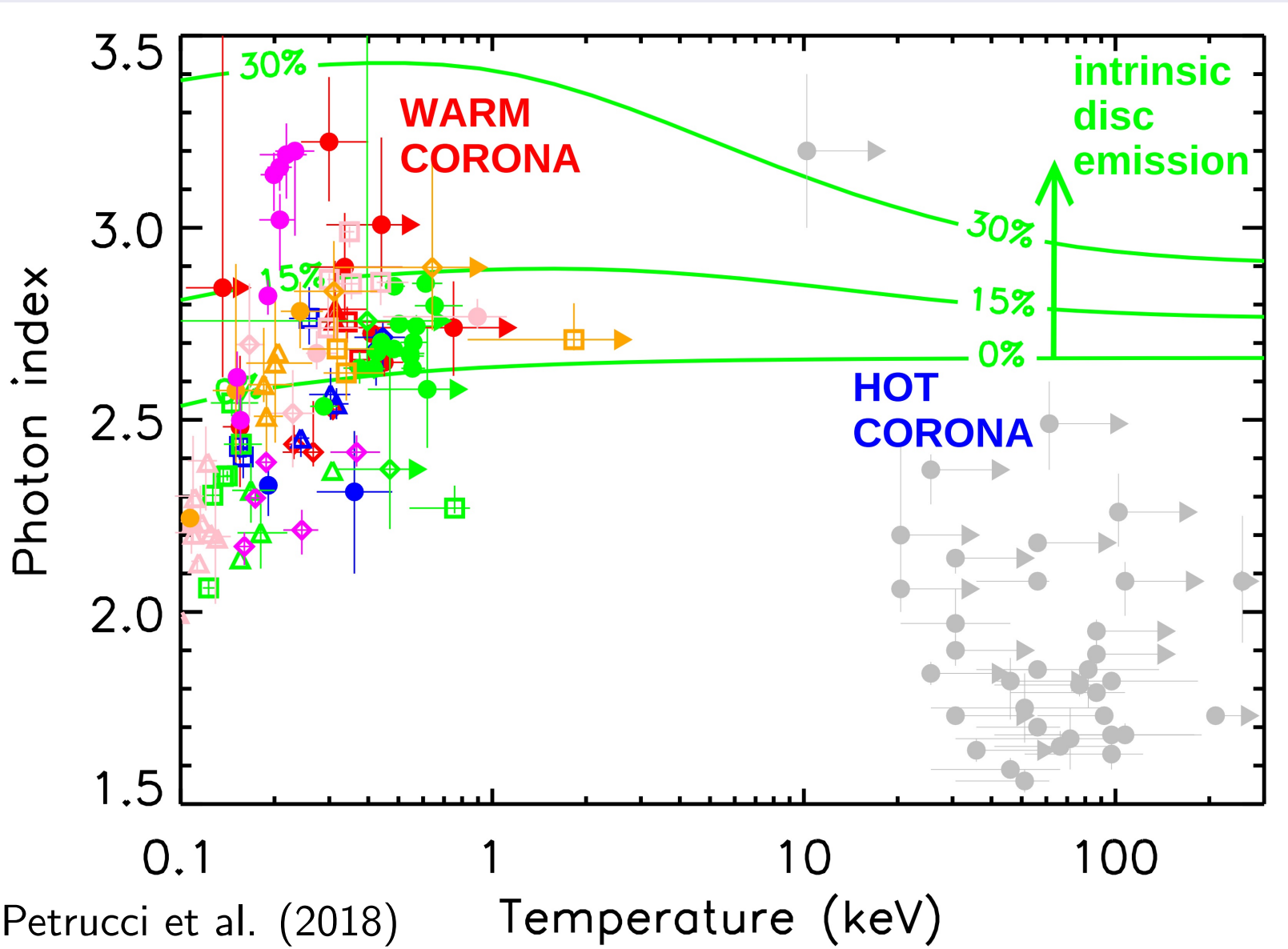
Petrucci et al. (2013)





see also Magdiarz et al. (1998)

The two-corona model

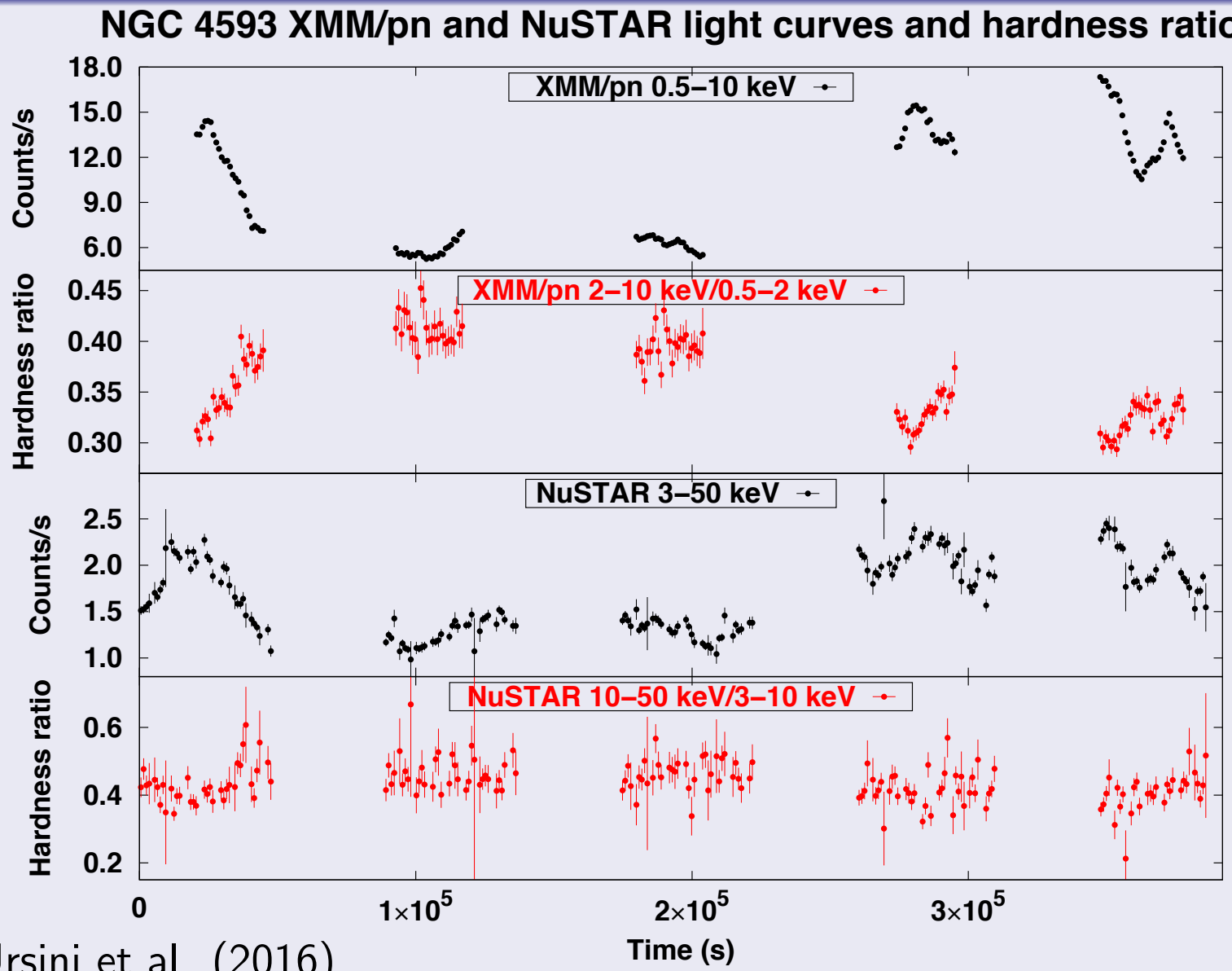


Petrucci et al. (2018)

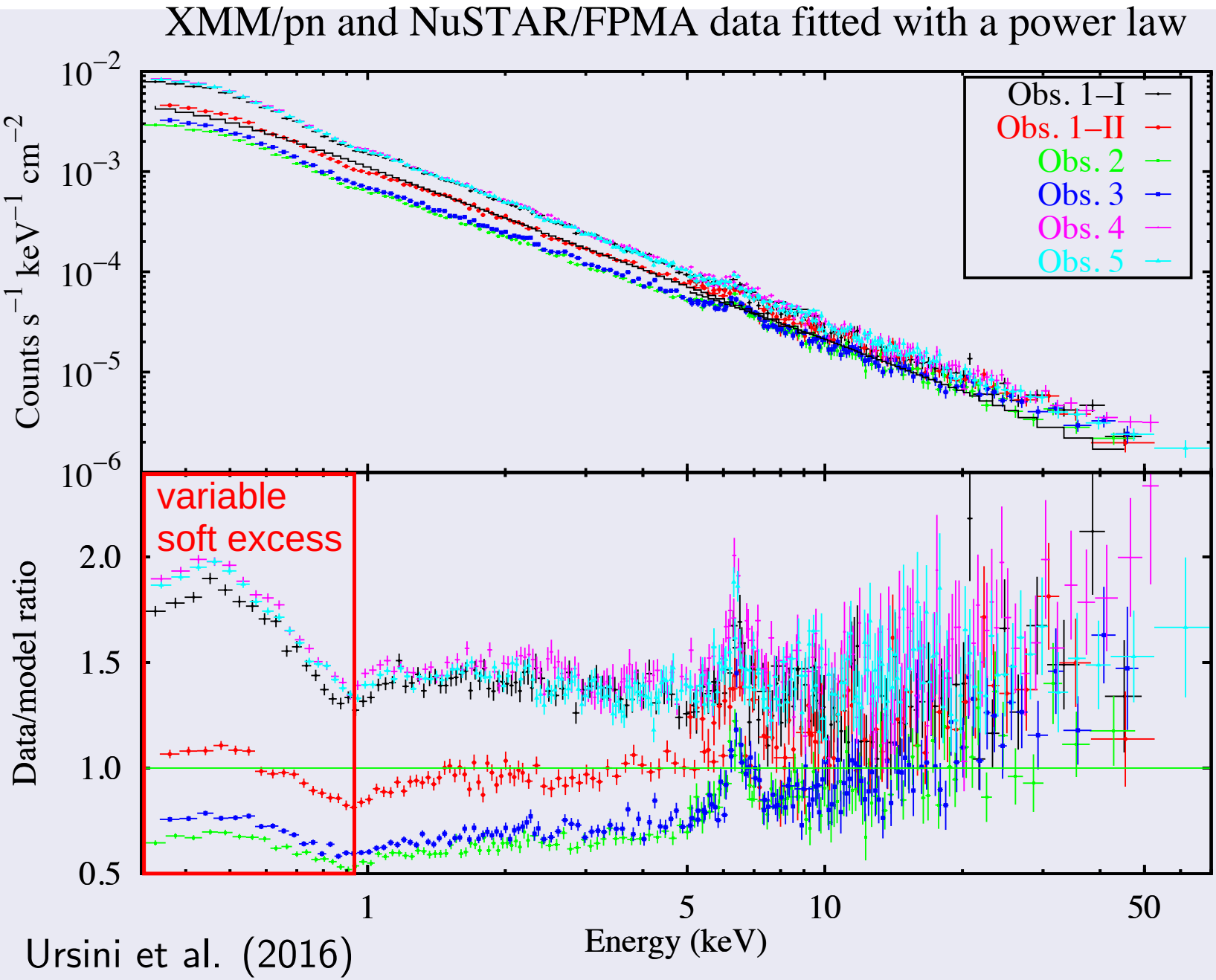
High-energy campaigns

- Goals: Study the spectrum and variability of AGNs testing physical models for the high-energy emission
- Broad-band: XMM+NuSTAR (optical/UV to 80 keV)
- Variability: 5×20 ks observations
- A classical Seyfert 1: NGC 4593
- A broad-line radio galaxy: 3C 382
- A highly accreting Seyfert 1: HE 1143-1810

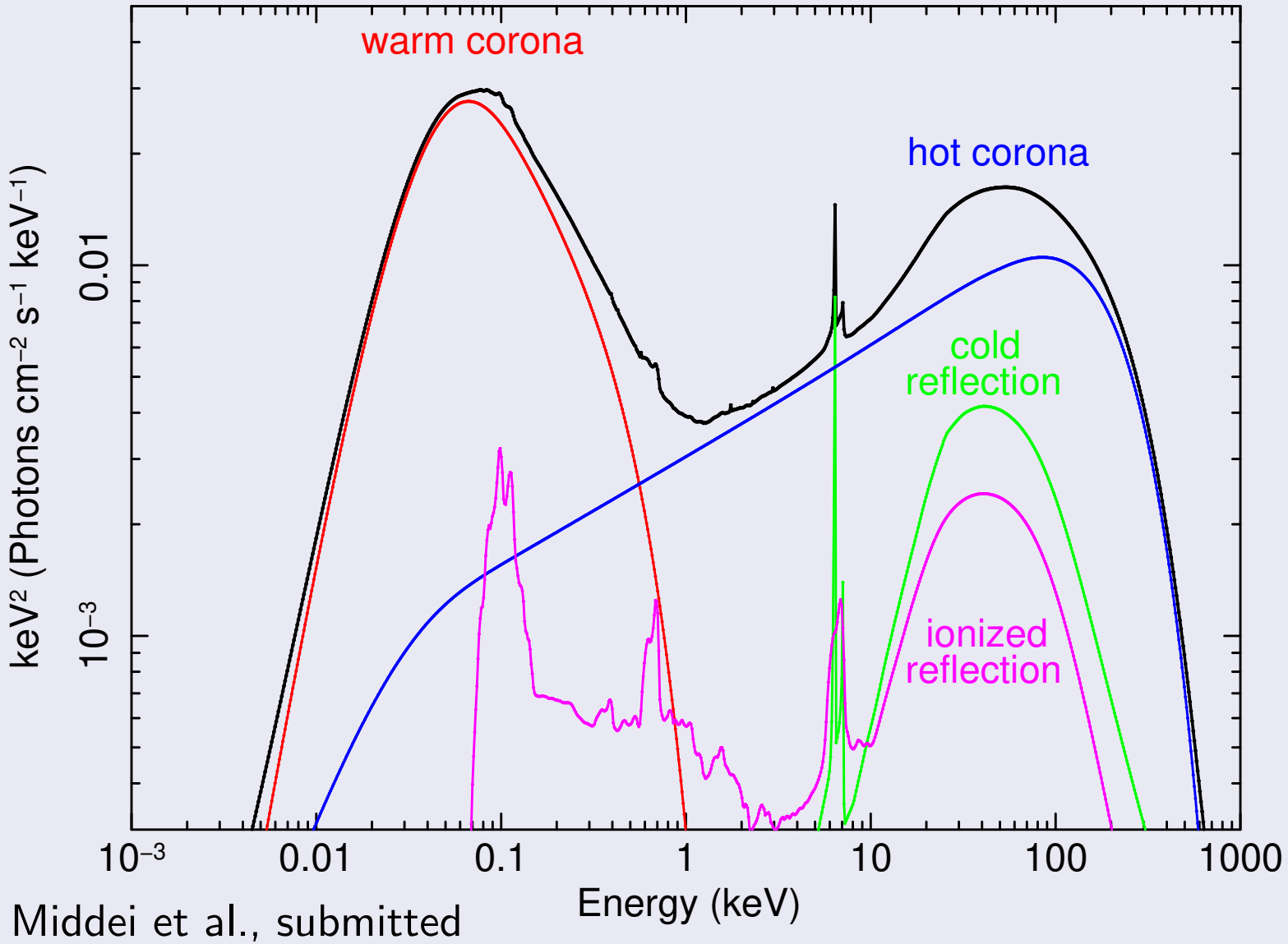
NGC 4593: a day time-scale monitoring



Ursini et al. (2016)

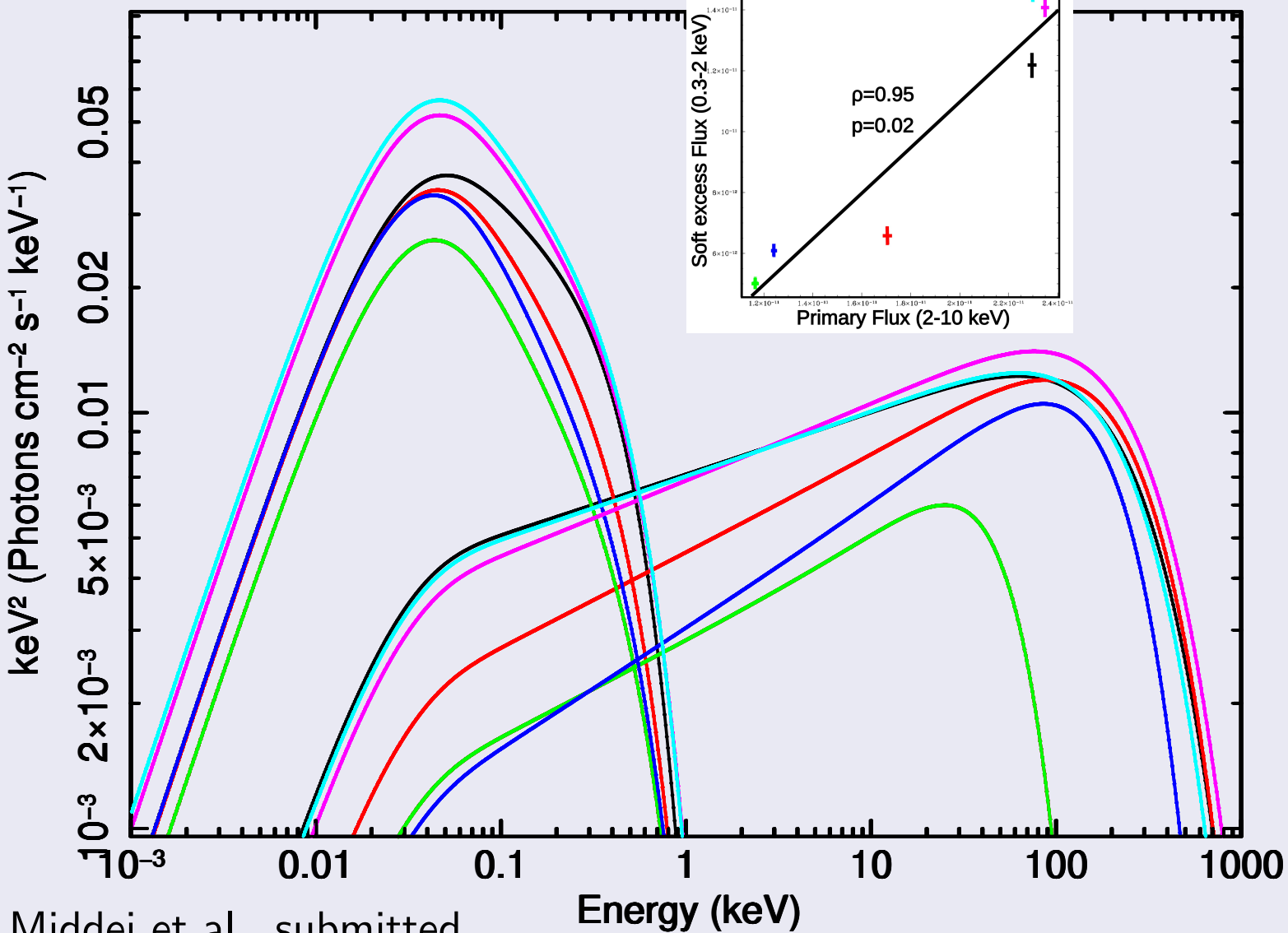

XMM/pn and NuSTAR/FPMA data fitted with a power law
Counts s^{-1} keV^{-1} cm^{-2}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
Obs. 1–I
Obs. 1–II
Obs. 2
Obs. 3
Obs. 4
Obs. 5
variable
soft excess
Data/model ratio
2.0
1.5
1.0
0.5
1
5
10
50
Energy (keV)
Ursini et al. (2016)

The average spectrum



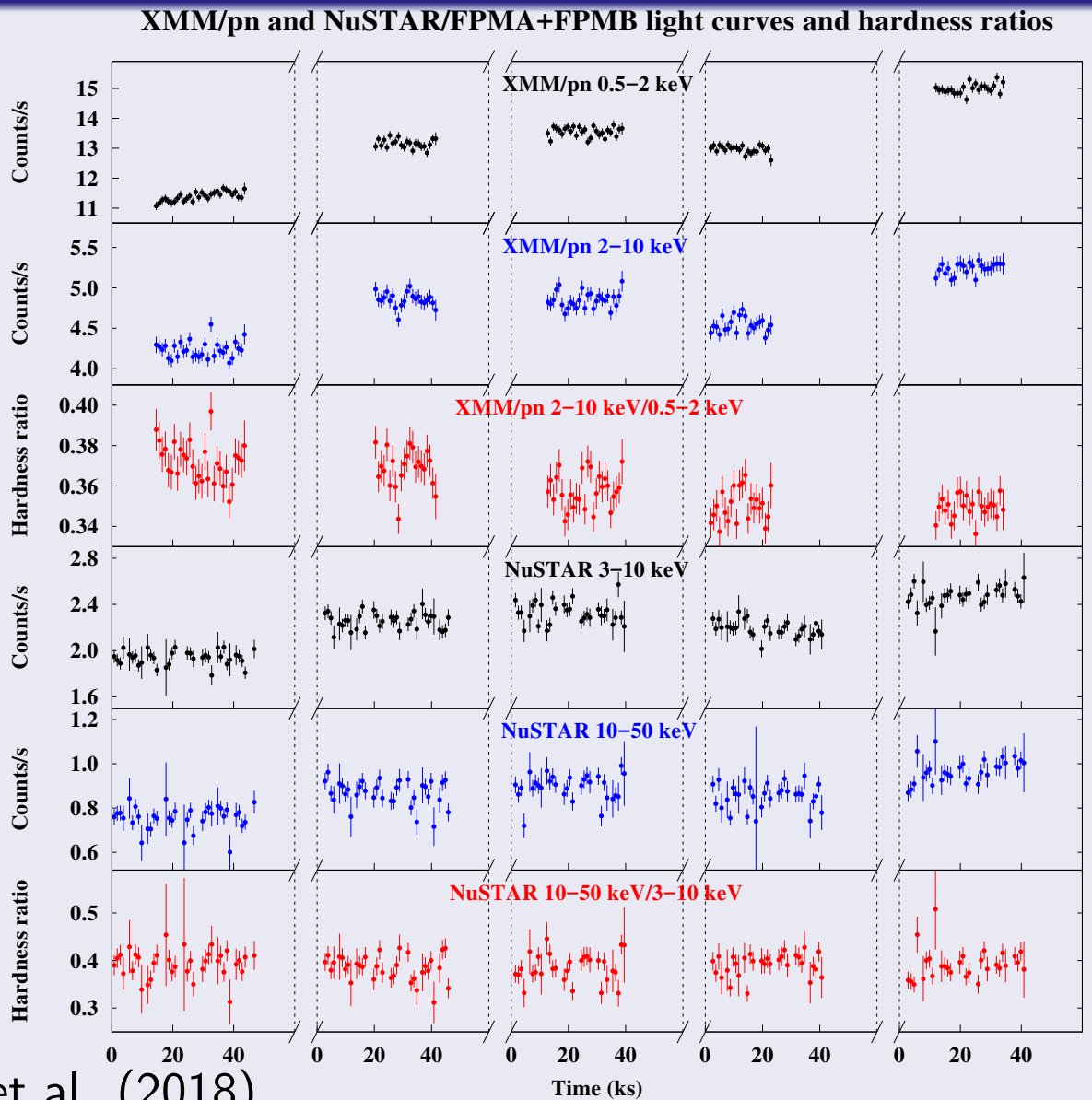
Middei et al., submitted

Warm/hot coronae: correlated variability

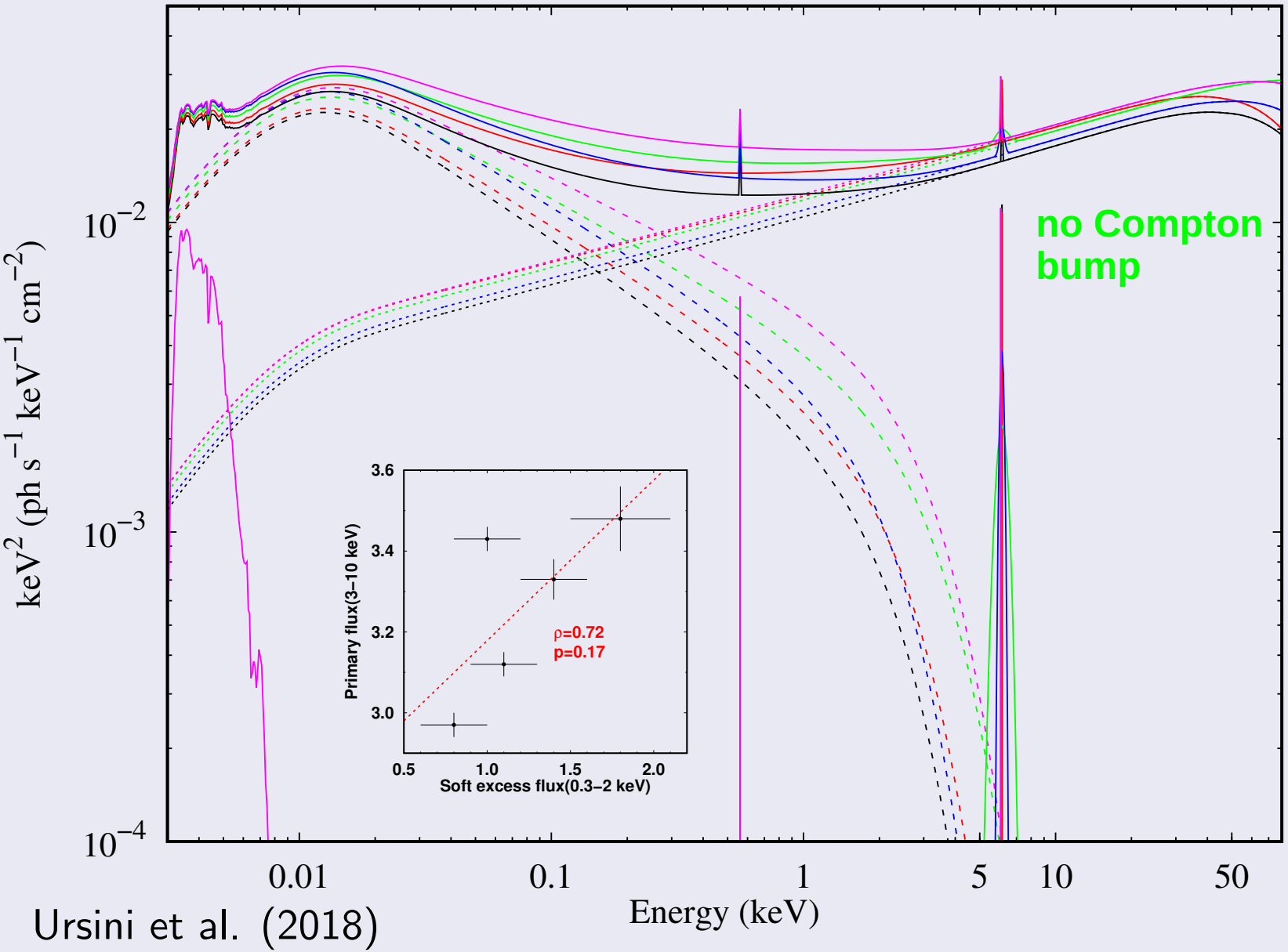


Middei et al., submitted

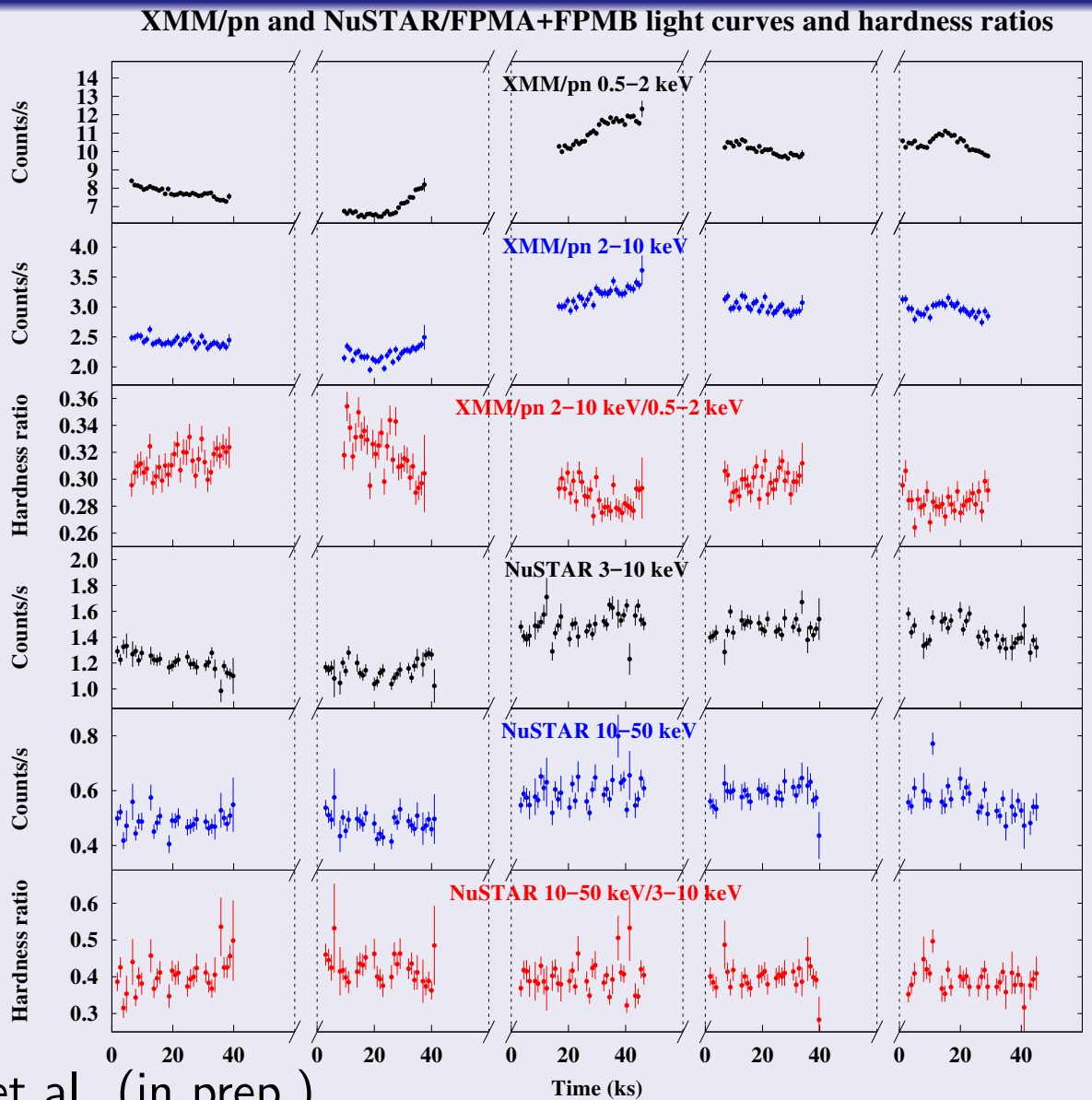
3C 382



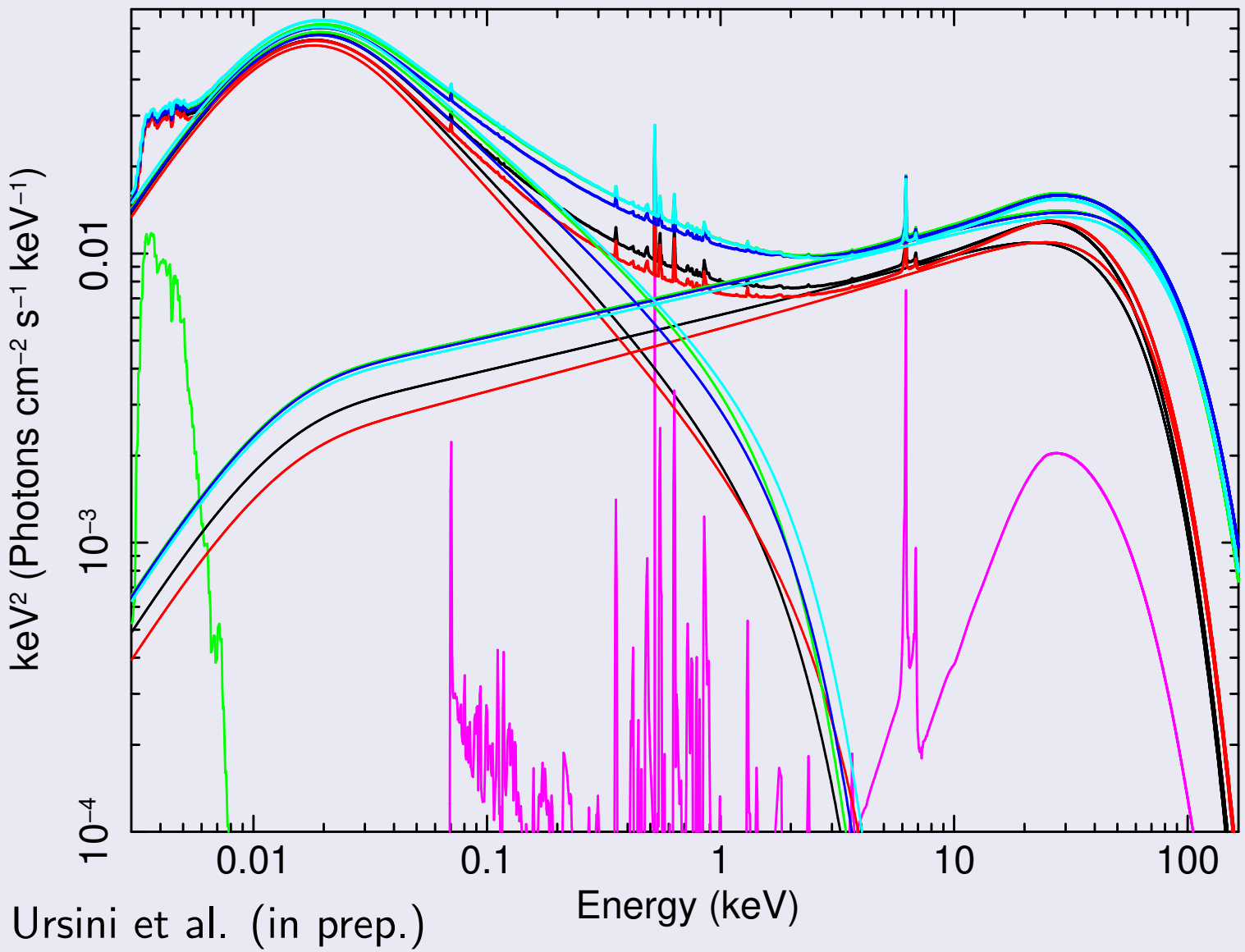
Ursini et al. (2018)


no Compton bump
10^{-2}
10^{-3}
10^{-4}
$\mathrm{keV}^2\ (\mathrm{ph\ s^{-1}\ keV^{-1}\ cm^{-2}})$
0.01
0.1
1
5
10
50
Energy (keV)
Primary flux(3–10 keV)
3.6
3.4
3.2
3.0
0.5
1.0
1.5
2.0
Soft excess flux(0.3–2 keV)
ρ=0.72
p=0.17
Ursini et al. (2018)

HE 1143-1810



Ursini et al. (in prep.)



Ursini et al. (in prep.)

Summary

	NGC 4593	**3C 382**	**HE 1143-1810**
$M_{\rm BH}$	$1 \times 10^7\ M_\odot$	$1 \times 10^9\ M_\odot$	$1 \times 10^7\ M_\odot$
Eddington ratio	~ 0.1	~ 0.01	~ 1
hot corona			
Temperature	variable ~ 30 to > 150 keV	high > 40 keV	low ~ 20 keV
Optical depth	< 0.9 to ~ 2	< 4	~ 4
Geometry	compact†	compact†/ outflowing?	slim disc??
warm corona			
Temperature	~ 0.12 keV	~ 0.6 keV	~ 0.5 keV
Optical depth	~ 35 to ~ 45	~ 20	~ 20
Geometry	slab	slab	slab
reflection			
Components	2 (cold+ionized)	none	1 (ionized)

† Covering factor $\simeq 10\%$

More to come: Mrk 359 (NLS1), archival data...

Conclusions

- The two-corona model provides a viable scenario in different types of AGNs - see also campaigns with different strategies on Ark 120 (Porquet et al. 2018) and NGC 7469 (Middei et al. 2018)
- A complex interplay is expected between the warm and hot coronae.
  - The warm corona provides the seed photons to the hot corona
  - The hot corona illuminates the warm corona $\rightarrow$ reflection features?
- The existence of a warm corona implies the presence of strong magnetic fields and/or outflows (Rozanska et al. 2015) $\rightarrow$ there could be a link with disc winds and/or radio jets!
- Potential limitations: e.g. absorption/emission lines due to the presence of the warm corona?

Bibliography

- Magdziarz et al., 1998, MNRAS, 301, 179: *A spectral decomposition of the variable optical, ultraviolet and X-ray continuum of NGC 5548*
- Middei et al., 2018, A&A, 615, A163: *Multi-wavelength campaign on NCG 7469. IV. The broad-band X-ray spectrum*
- Middei et al., submitted to MNRAS: *High-energy monitoring of NGC 4593 II. Broadband spectral analysis: testing the two-corona model*
- Petrucci et al., 2013, A&A, 549, A73: *Multiwavelength campaign on Mrk 509 XII. Broad band spectral analysis.*
- Petrucci et al., 2018, A&A, 611, A59: *Testing warm Comptonization models for the origin of the soft X-ray excess in AGN*
- Porquet et al., 2018, A&A 609, A42: *A deep X-ray view of the bare AGN Ark 120. IV. XMM-Newton and NuSTAR spectra dominated by two temperature (warm, hot) Comptonization processes*
- Rozanska et al., 2015, A&A, 580, A77: *The existence of warm and optically thick dissipative coronae above accretion disks*
- Ursini et al., 2016, MNRAS, 463, 382: *High-energy monitoring of NGC 4593 with XMM-Newton and NuSTAR. X-ray spectral analysis*
- Ursini et al., 2018, MNRAS, 478, 2663: *Radio/X-ray monitoring of the broad-line radio galaxy 3C 382. High-energy view with XMM-Newton and NuSTAR*