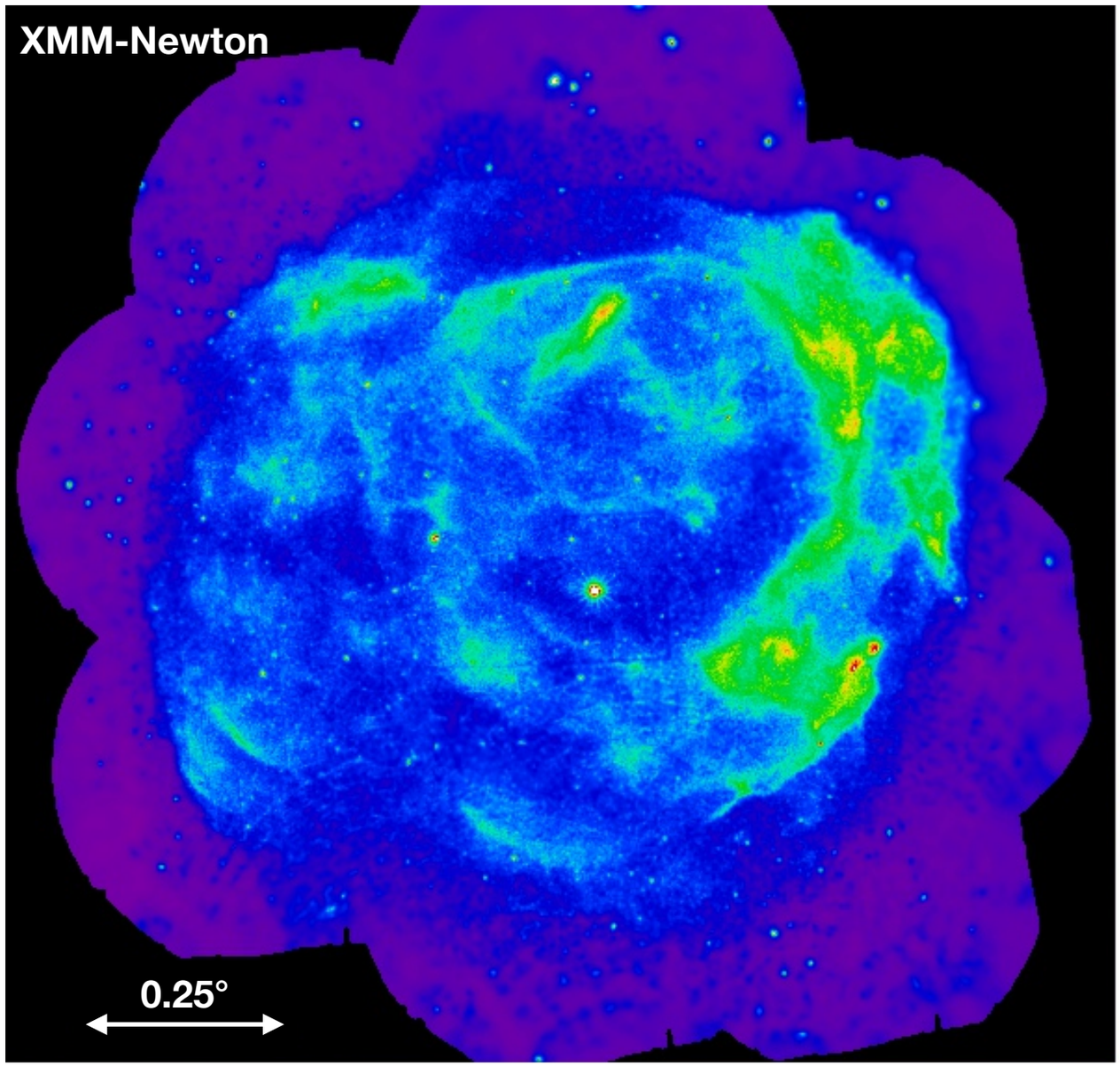
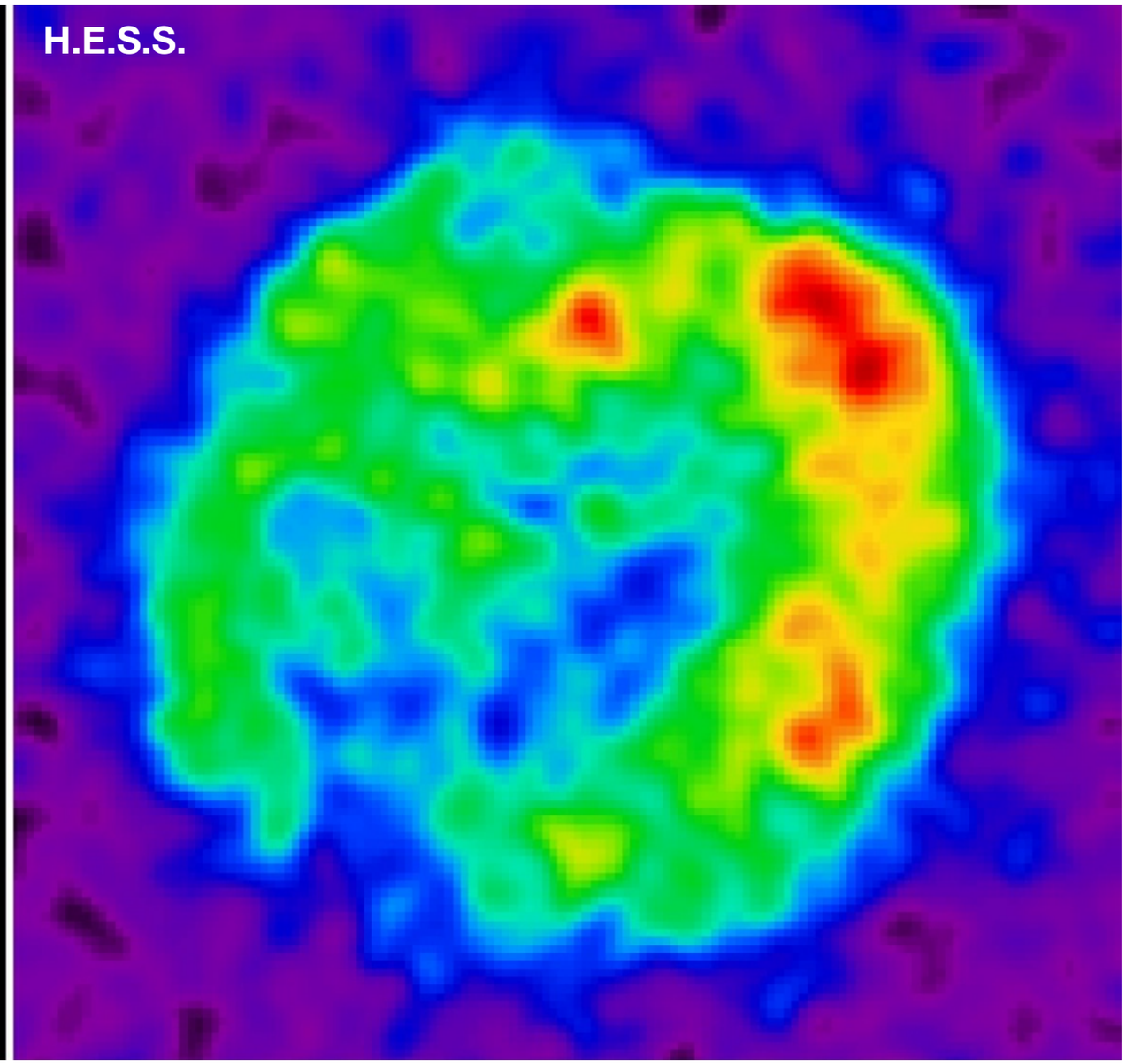
RX J1713-3946
First results from XMM Large Program





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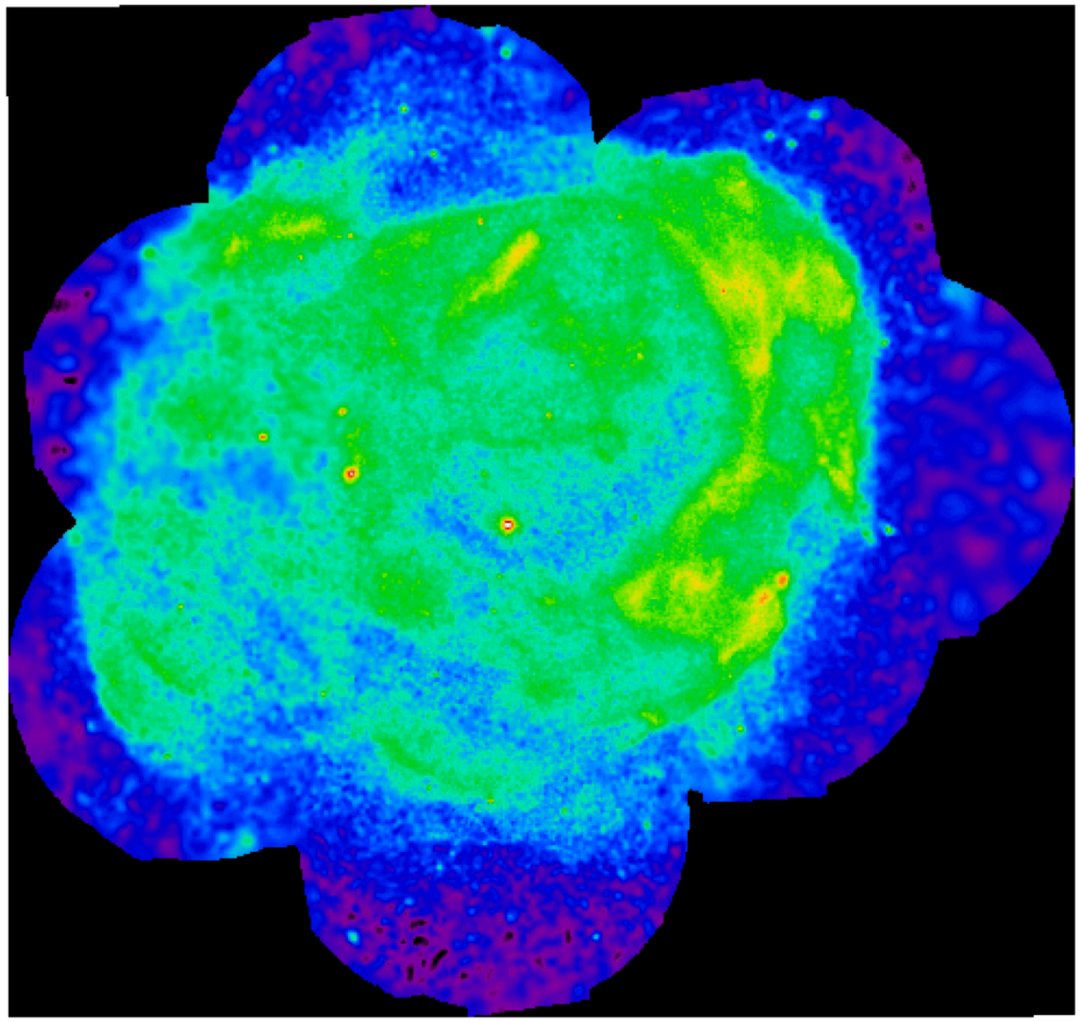
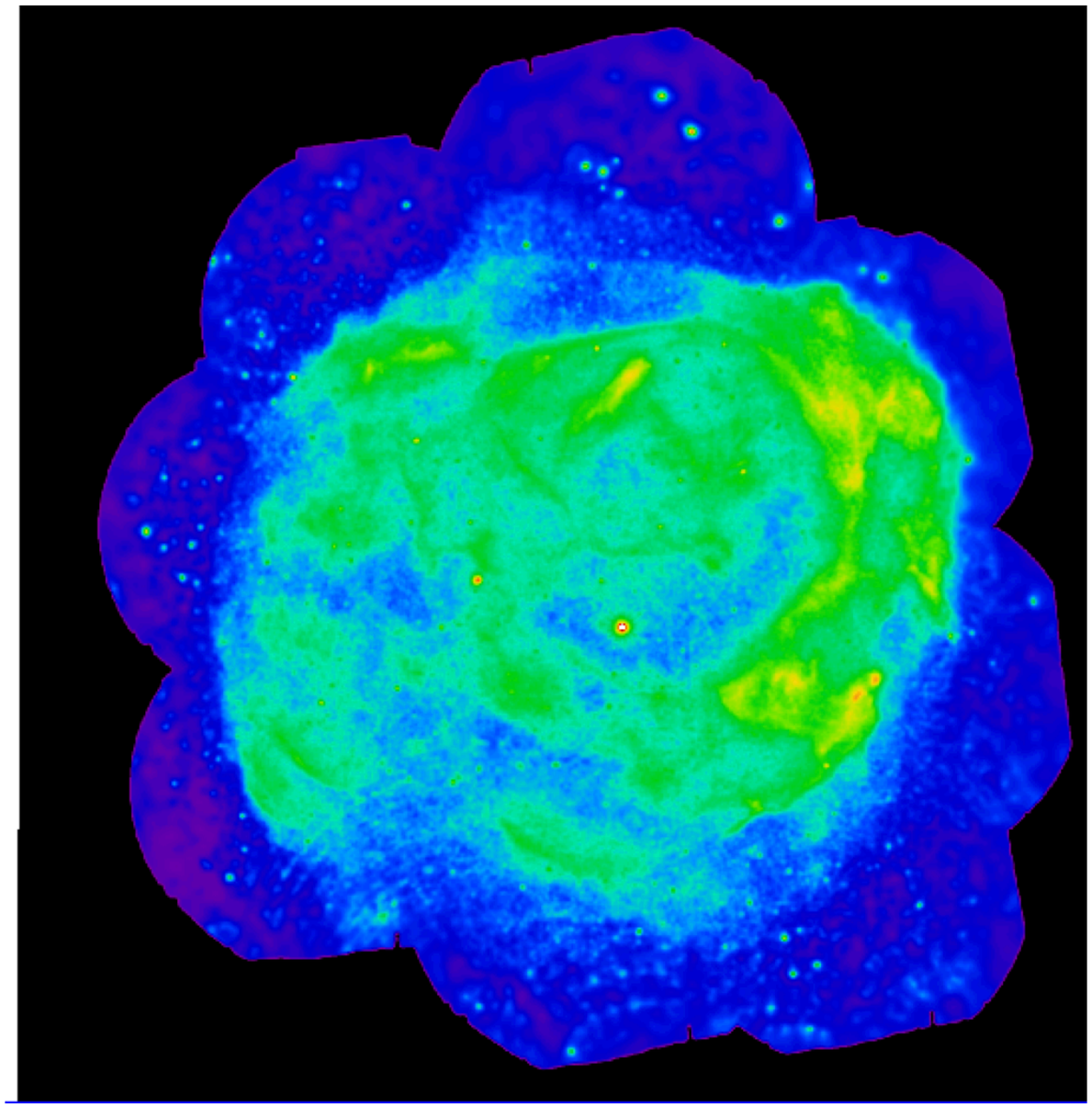
MODE workshop 2019, Orléans

A brand new look at the RX J1713, CR accelerator prototype

- **SNR of a CC supernova. Age ~ 1600 yrs (Historical SN 393). d ~ 1kpc**
- **Young SNR with fast shock ~3500 km/s**
- **X-ray emission is synchrotron dominated**
- **Brightest TeV SNR**



XMM-Newton
2009 mosaic



2018 mosaic
> 1 Ms exposure

Original Goals of the Large Program

- **Measure proper motion of the shock around the SNR**
  - **Constrain external densities, acceleration mechanism**
- **Map the thermal emission from ejecta and shocked ISM**
  - **Progenitor of SN, external densities**
- **Revisit the X-ray vs HESS comparison**
  - **Do the gamma-rays extend further out than X-rays**

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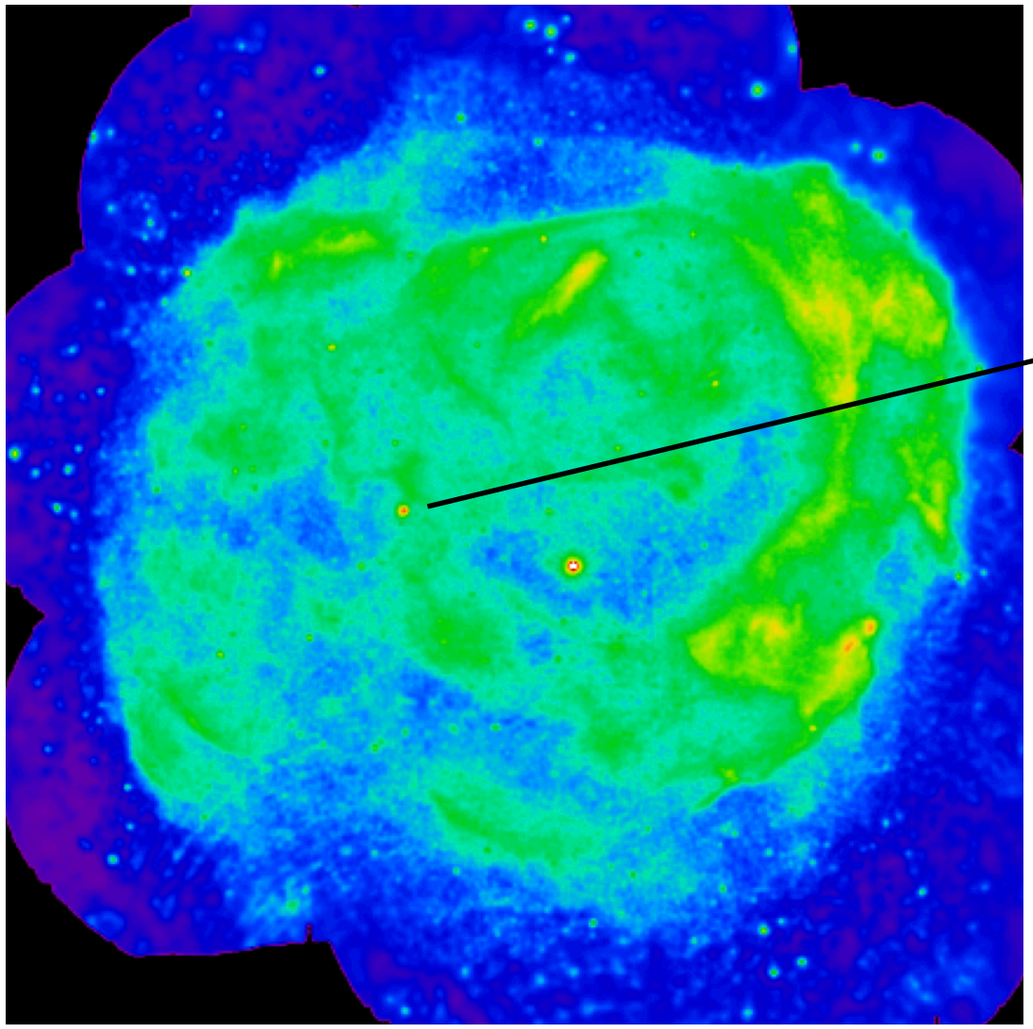
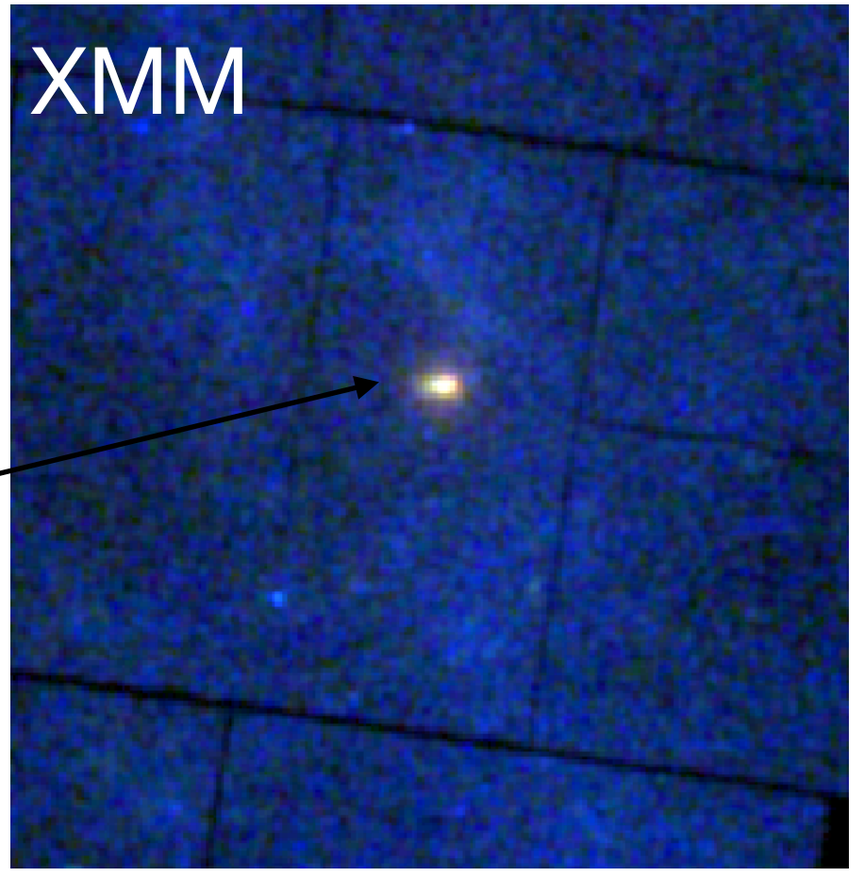
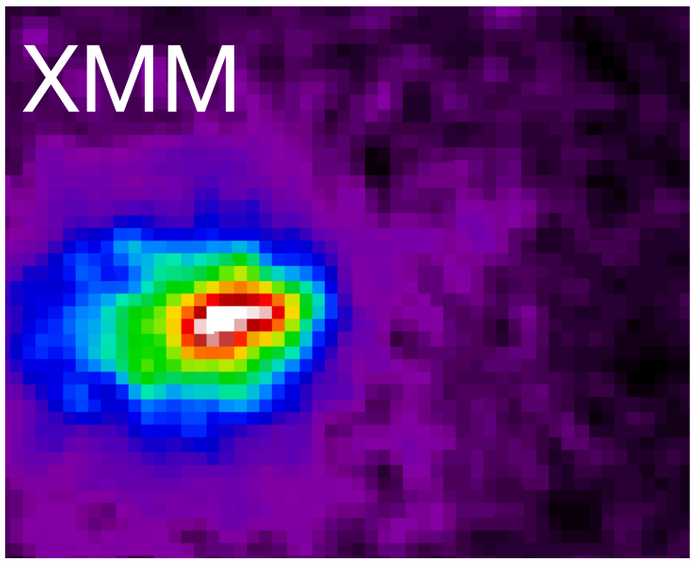
Work in progress

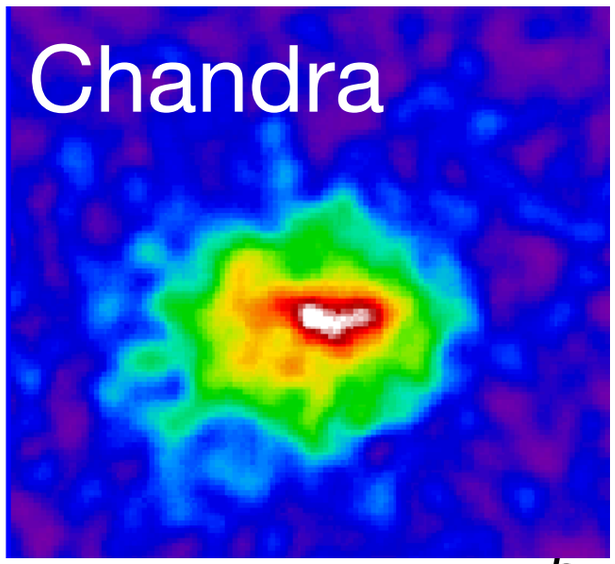
Nature of bright extended thermal source





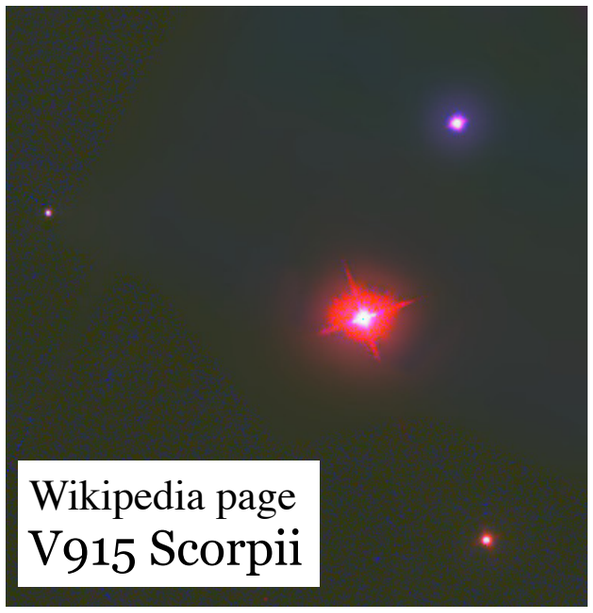
R: 0.5-1 keV
G: 1-2 keV
B: 2-4.5 keV



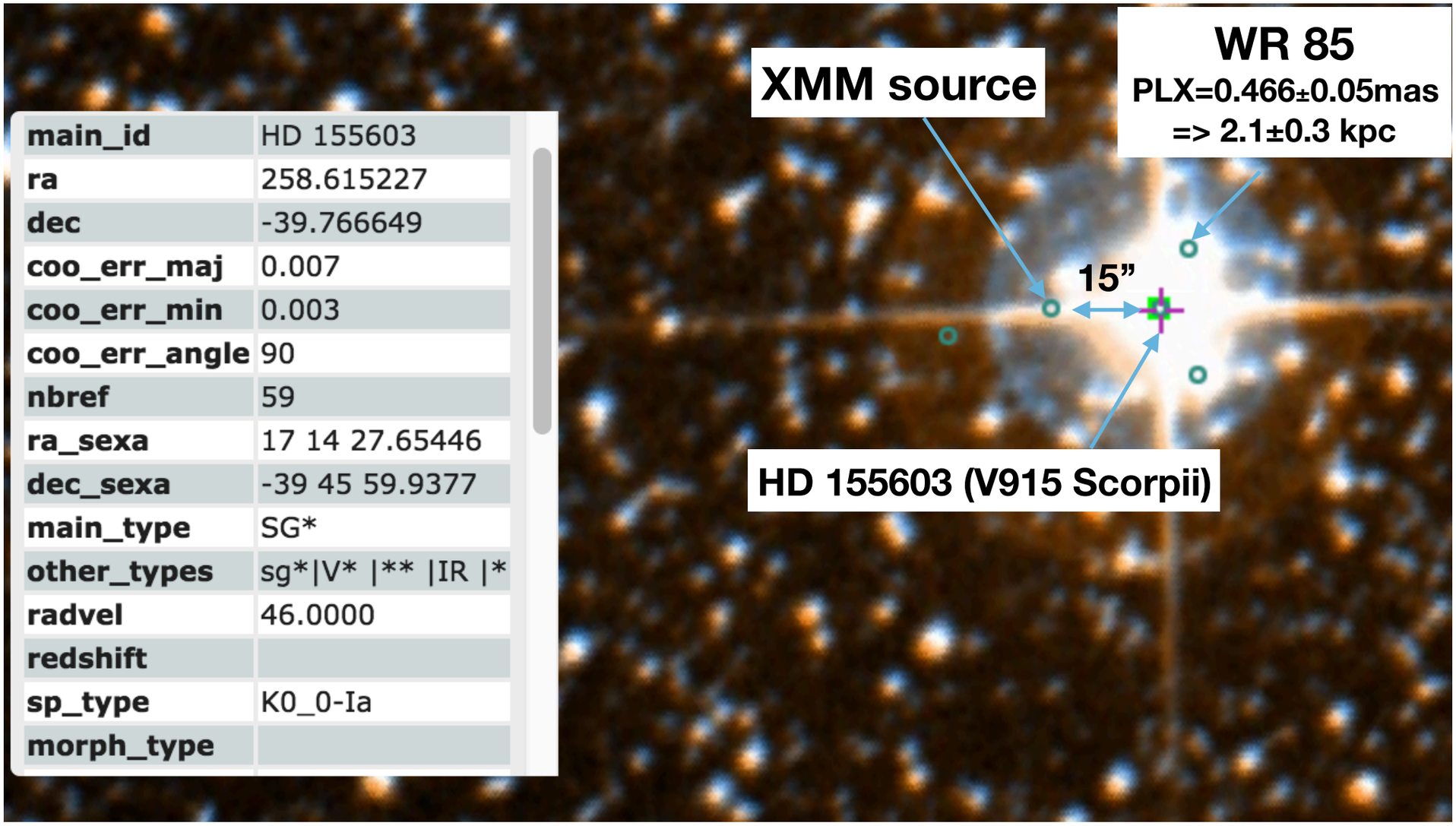


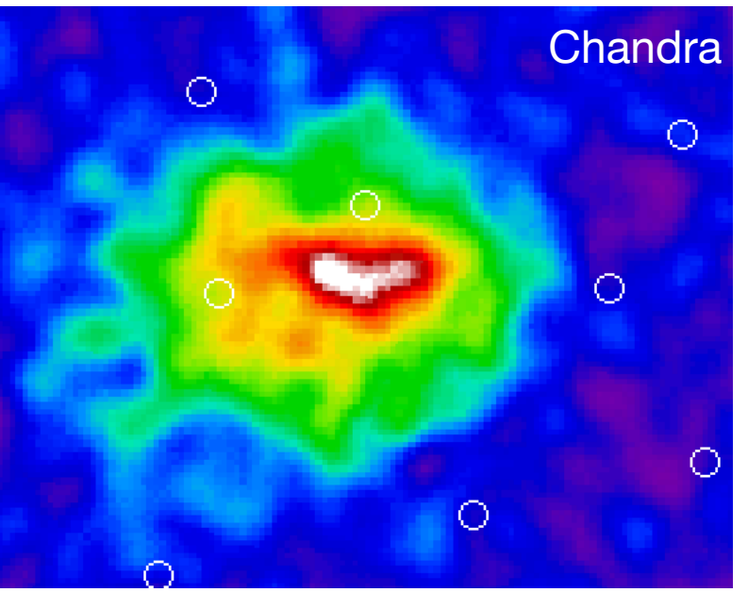
Source is extended (R~15 arcsec)

Brightest SRC is
HIP 84332
HD 155603
Vmag= 6.7
Kmag= 1.2
pmRA=-1.4
pmDEC=-1.5 mas/yr
PLX= 0.65±0.13mas
==> 1.5±0.2 kpc

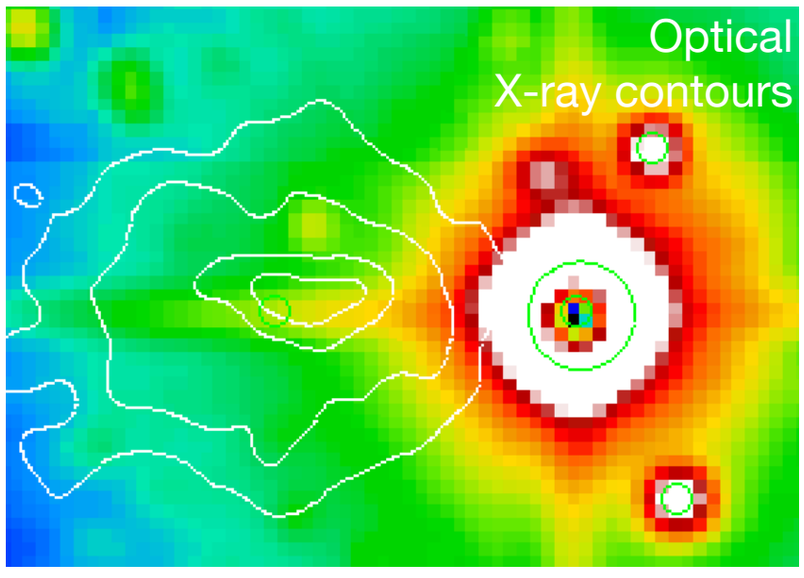


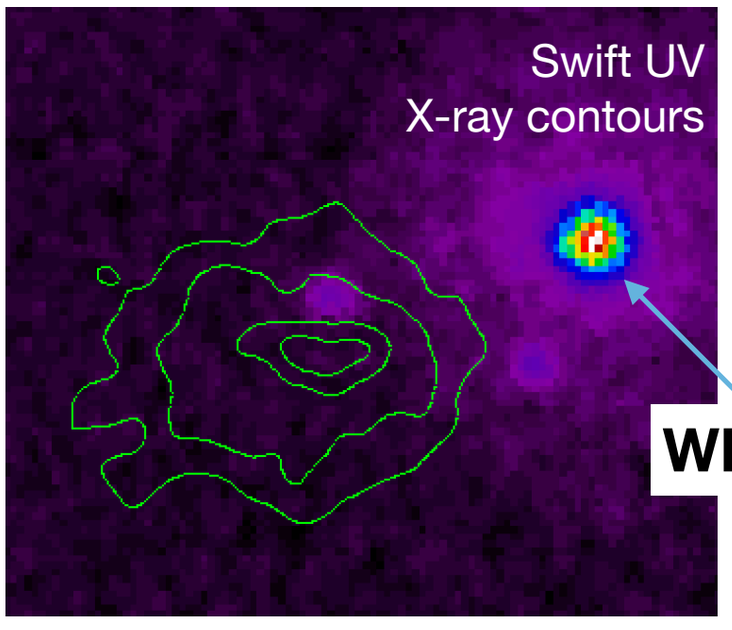
main_id	HD 155603
ra	258.615227
dec	-39.766649
coo_err_maj	0.007
coo_err_min	0.003
coo_err_angle	90
nbref	59
ra_sexa	17 14 27.65446
dec_sexa	-39 45 59.9377
main_type	SG*
other_types	sg*|V* |** |IR |*
radvel	46.0000
redshift	
sp_type	K0_0-Ia
morph_type	



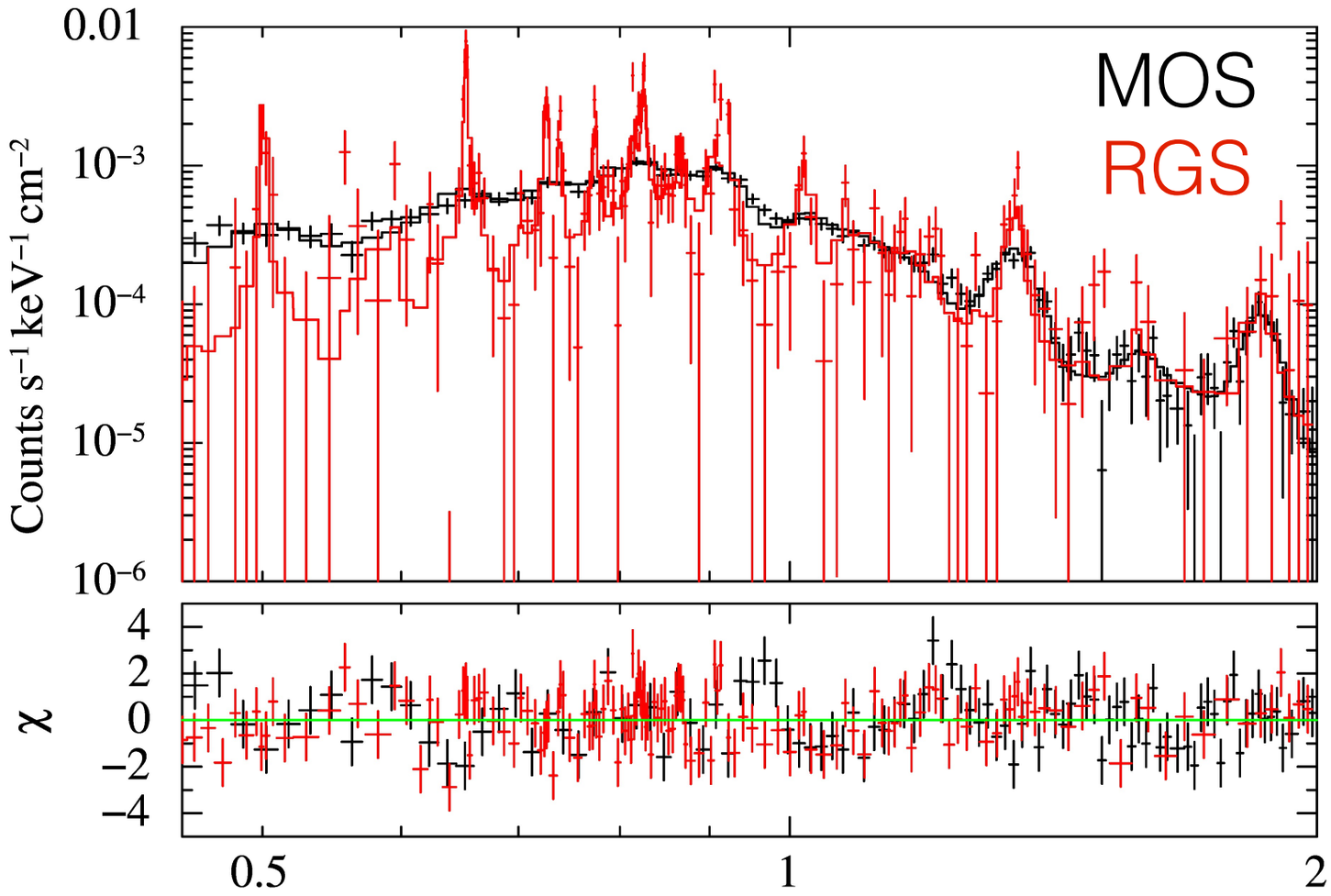


USNO star catalog





Riddle of the day: What is that source ?!



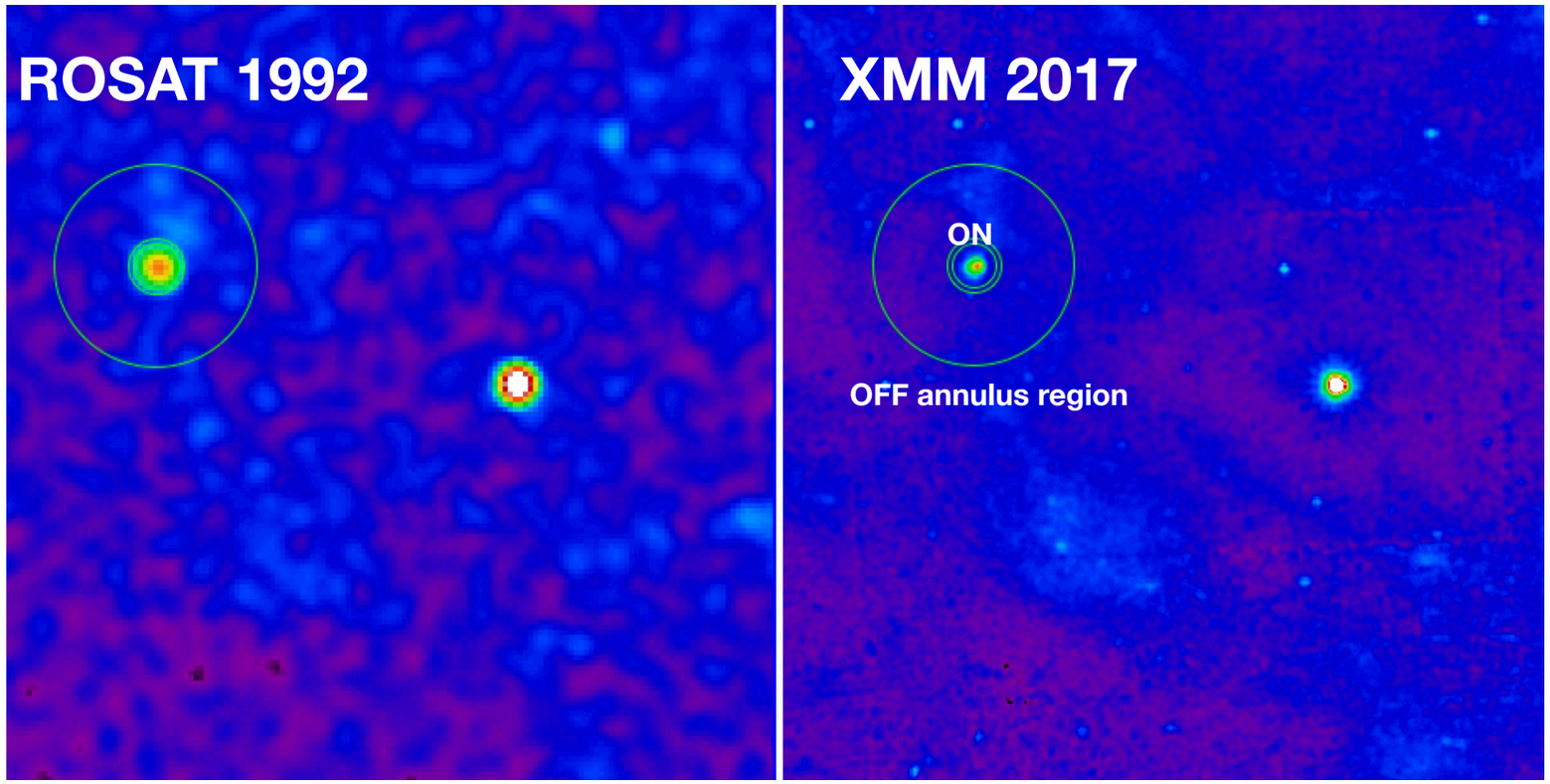
N_H: 0.72 (+0.7-0.6) e22 cm^{-2}
kTe: 0.55 (+/-0.05) keV
N: 11 (+/-6)
O: 0.91 (+/-0.33)
Ne: 1.8 (+1.3-0.6)
Mg: 1.2 (+0.3-0.4)
Si: 1.5 (+0.9-0.5)
Fe: 1.4 (+1.0-0.5)
Log(tau/cm^{-3} s): 10.78 (+0.10-0.13)
Redshift: -7.6 (+0.8-1.8) e-4

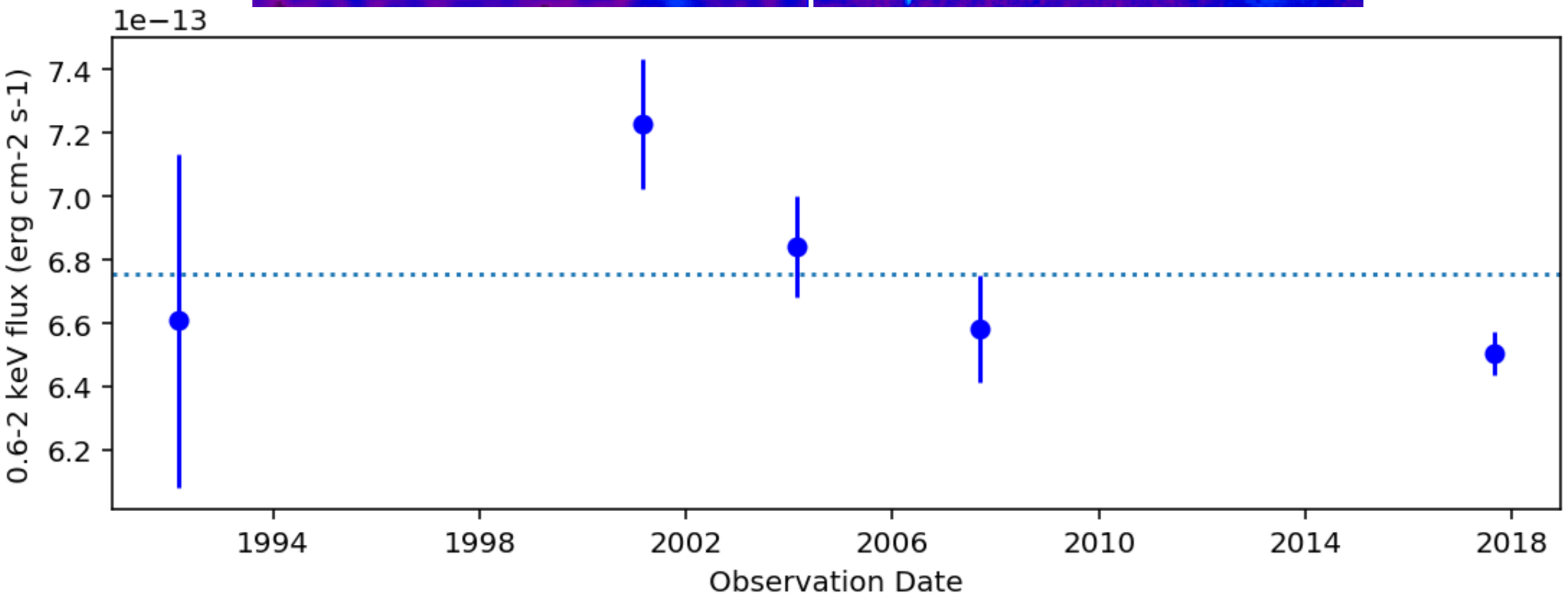
Not a SNR but
a shocked CSM
compatible kT, tau, abund, z
Look at past obs

- **Not the WR star !**
- **Extended. No bright pt src inside.**
- **Soft thermal (~0.5 keV)**
- **Nitrogen rich**
- **Blueshifted (~200 km/s)**
- **Nh(RXJ)< Nh < Nh(Gal)**
- **1e35 erg/s in 0.5-7 keV if at 4 kpc**

– ***What is it ?***

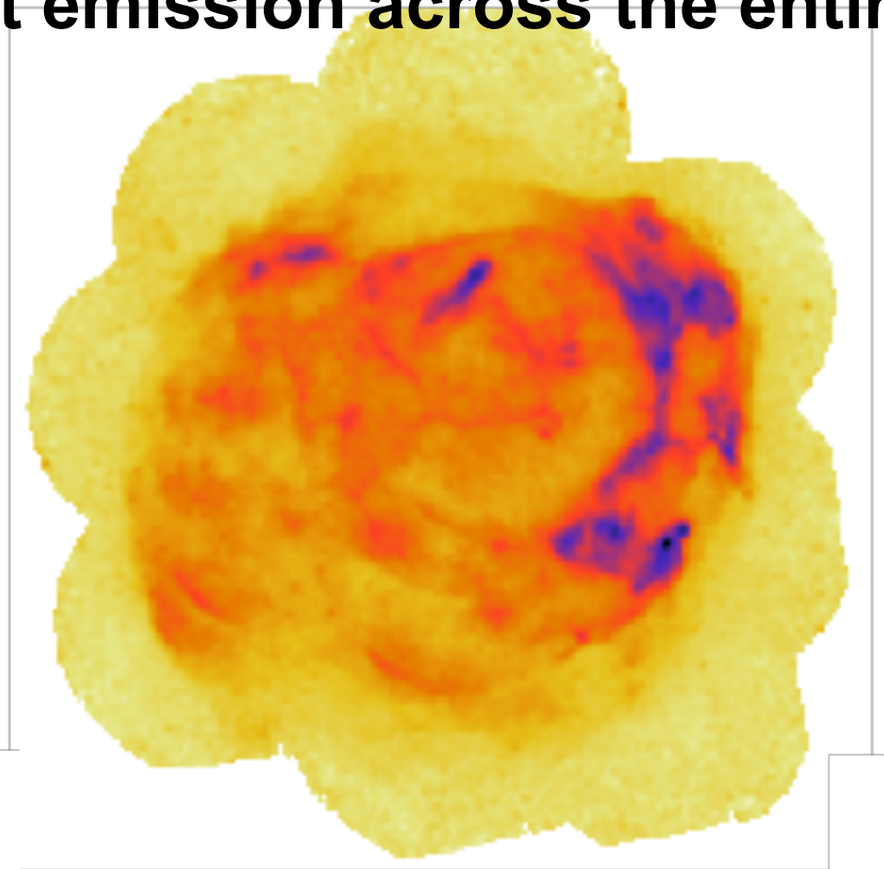
- ***Not a WR nebula***
- ***Not a young SNR***
- ***Insert your guess here***


ROSAT 1992
XMM 2017
ON
OFF annulus region

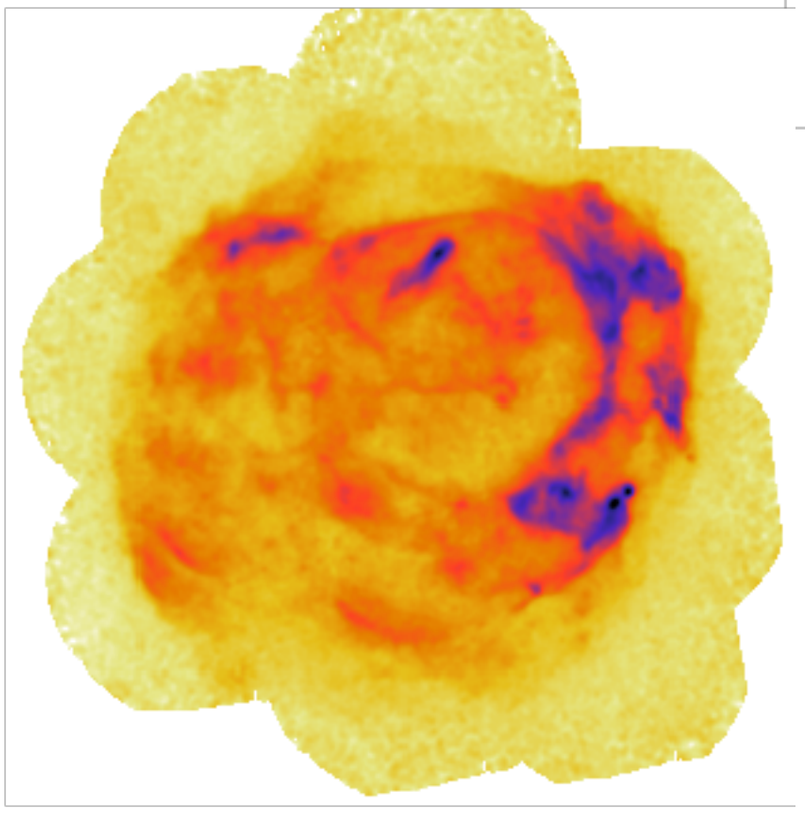

1e−13
7.4
7.2
7.0
6.8
6.6
6.4
6.2
0.6-2 keV flux (erg cm-2 s-1)
1994
1998
2002
2006
2010
2014
2018
Observation Date

Searching for large scale emission with GMCA

- **Mapping the soft emission across the entire SNR**

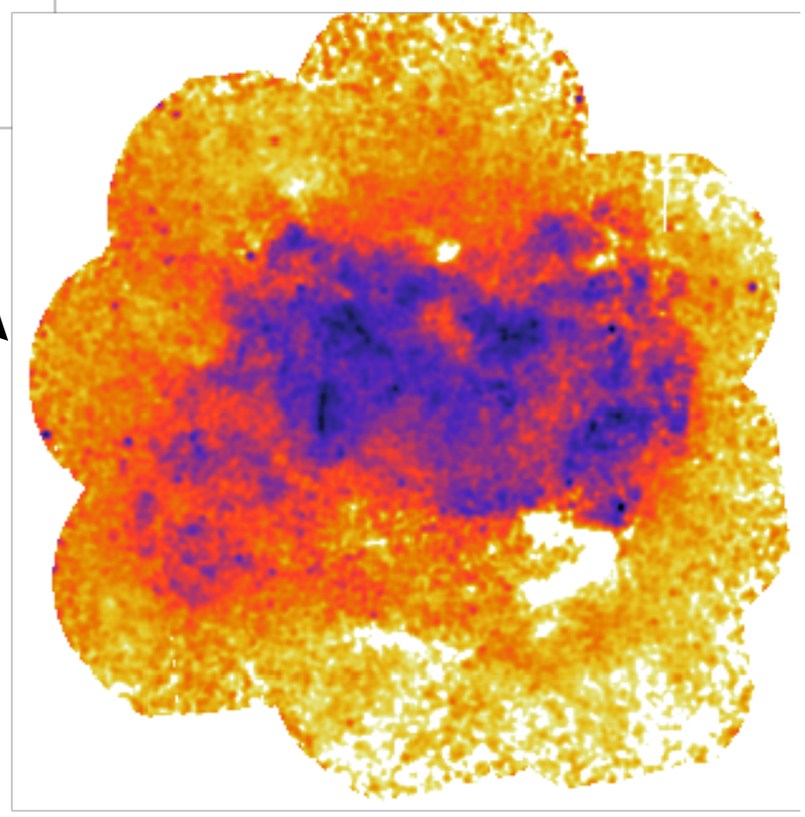


Synchrotron

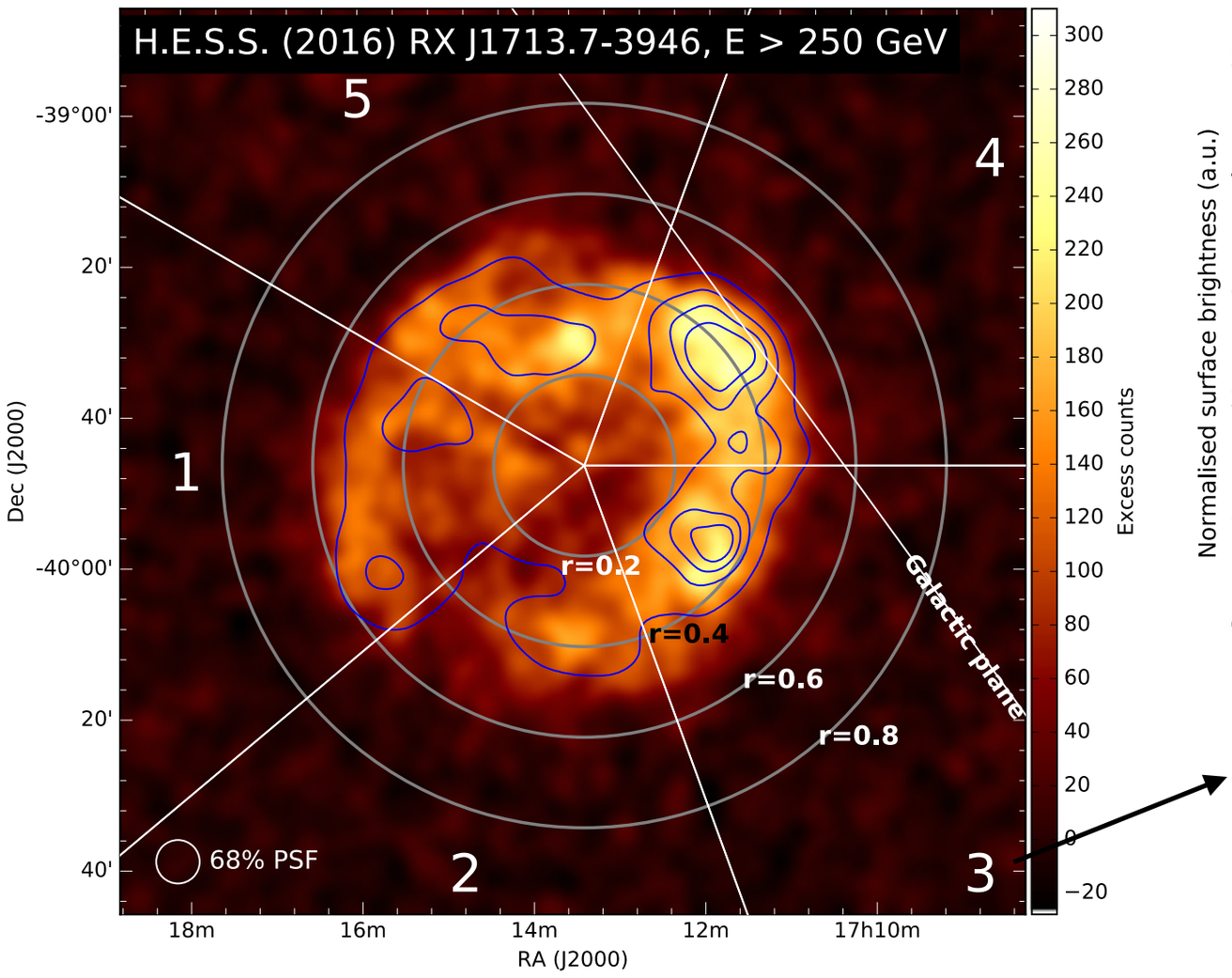


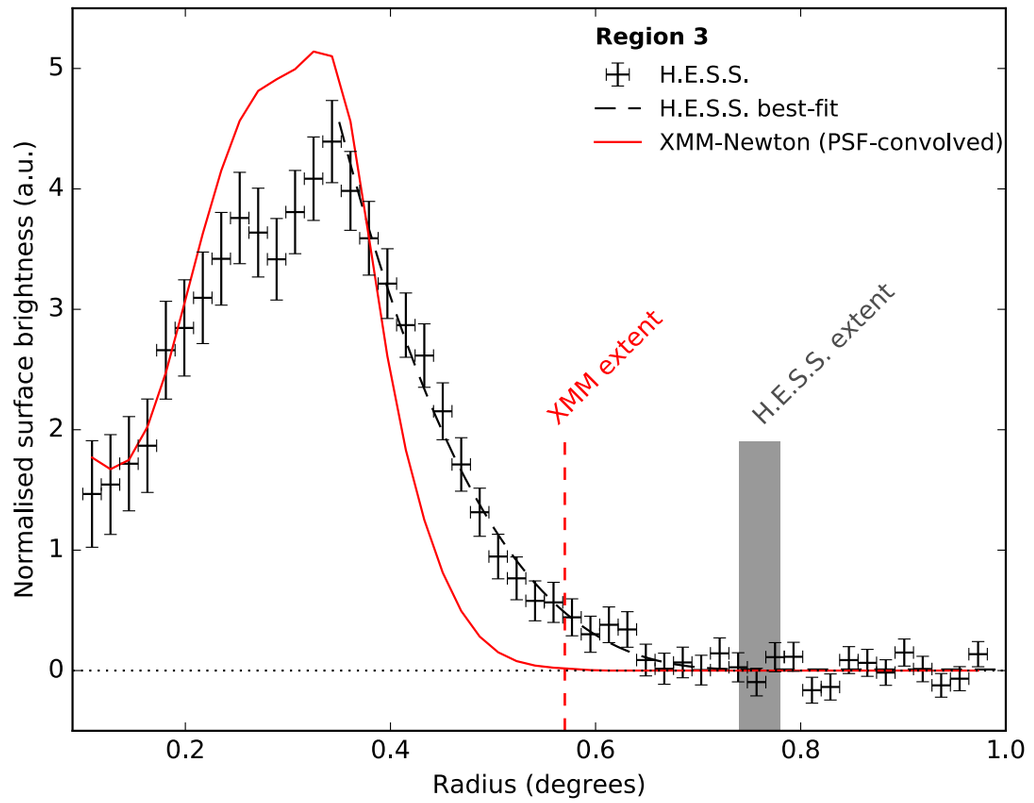
GMCA

Softer emission (thermal ?)



Revisiting XMM/HESS extension



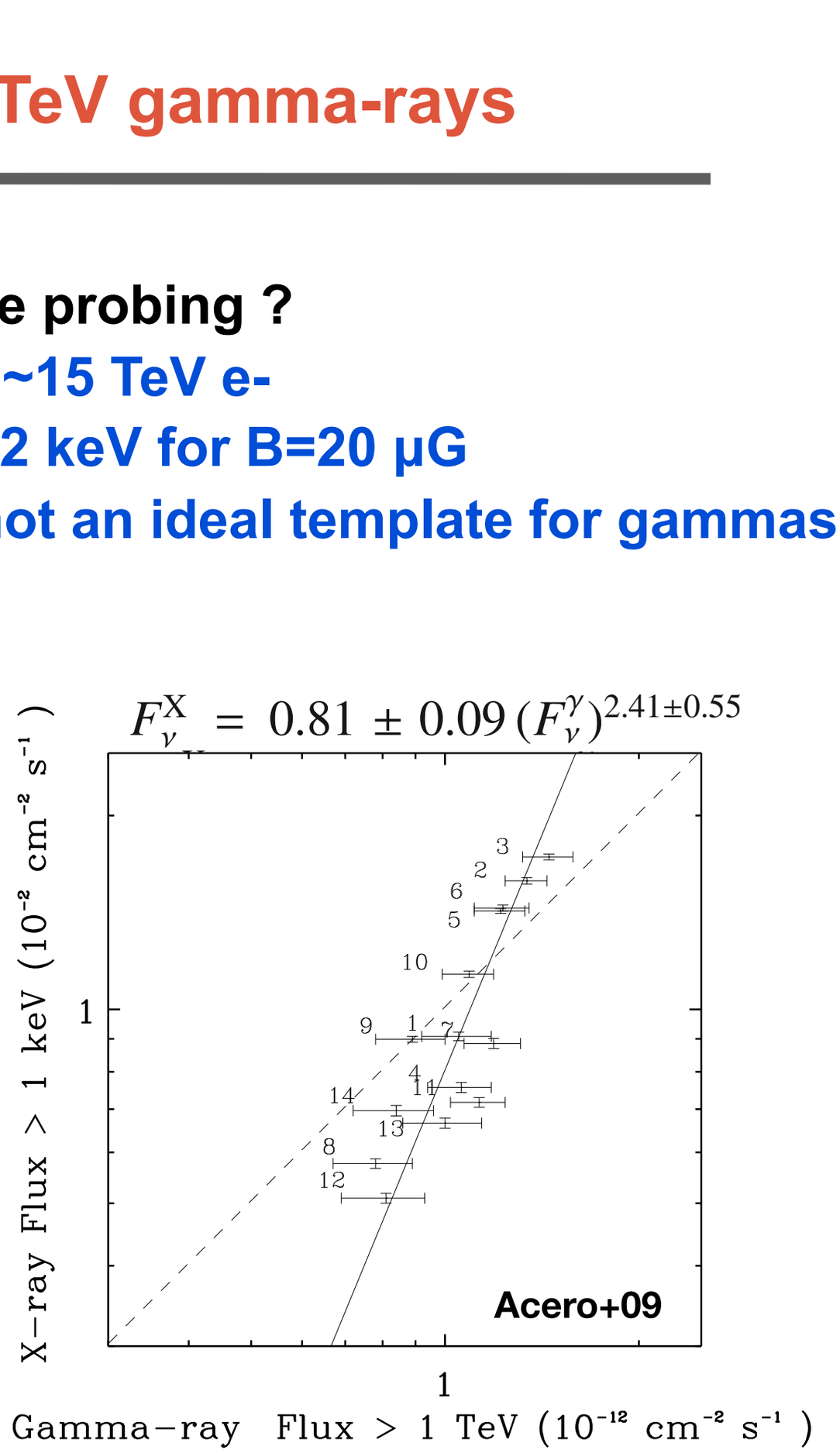


Gamma-rays extend further than X-rays ?
X-ray data: XMM in 1-10 keV
No XMM at large radius
Absorption along line of sight not corrected

Comparing X- and TeV gamma-rays

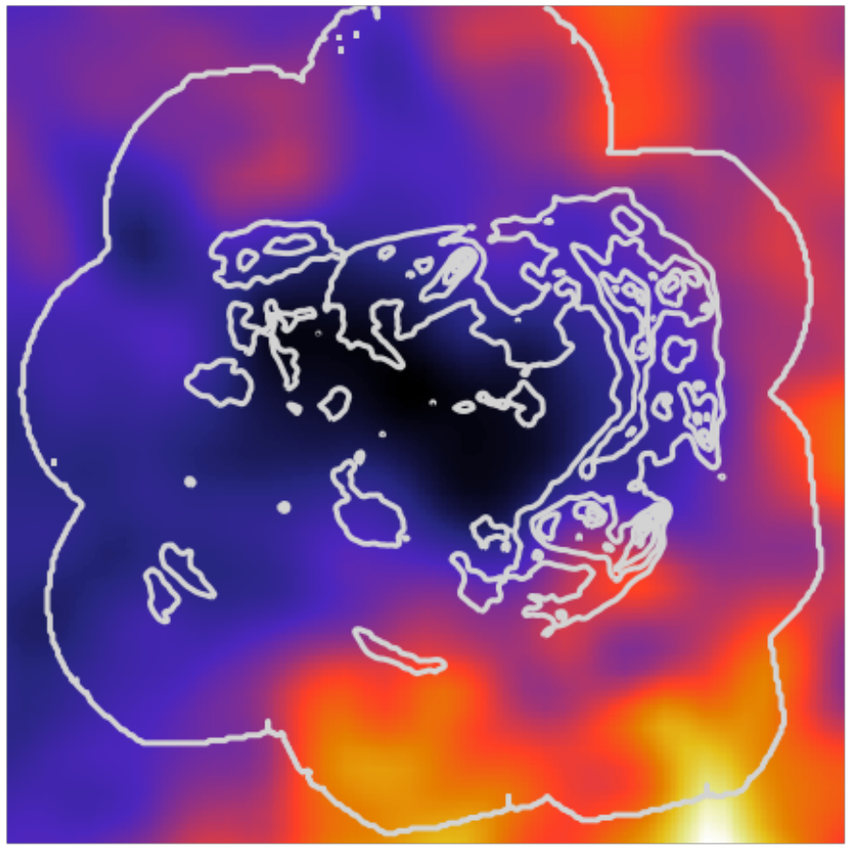
- **Which particle population are we probing ?**
  - **IC: 1 TeV photon comes from ~15 TeV e-**
  - **Synch: 15 TeV e- radiate at 0.2 keV for B=20 μG**
  - **==> A 1-10 keV X-ray map is not an ideal template for gammas**

- **Comparing F_X vs F_γ:**
  - **X-ray image has more contrast than gamma**

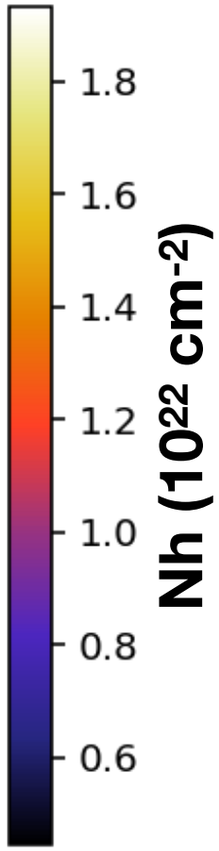


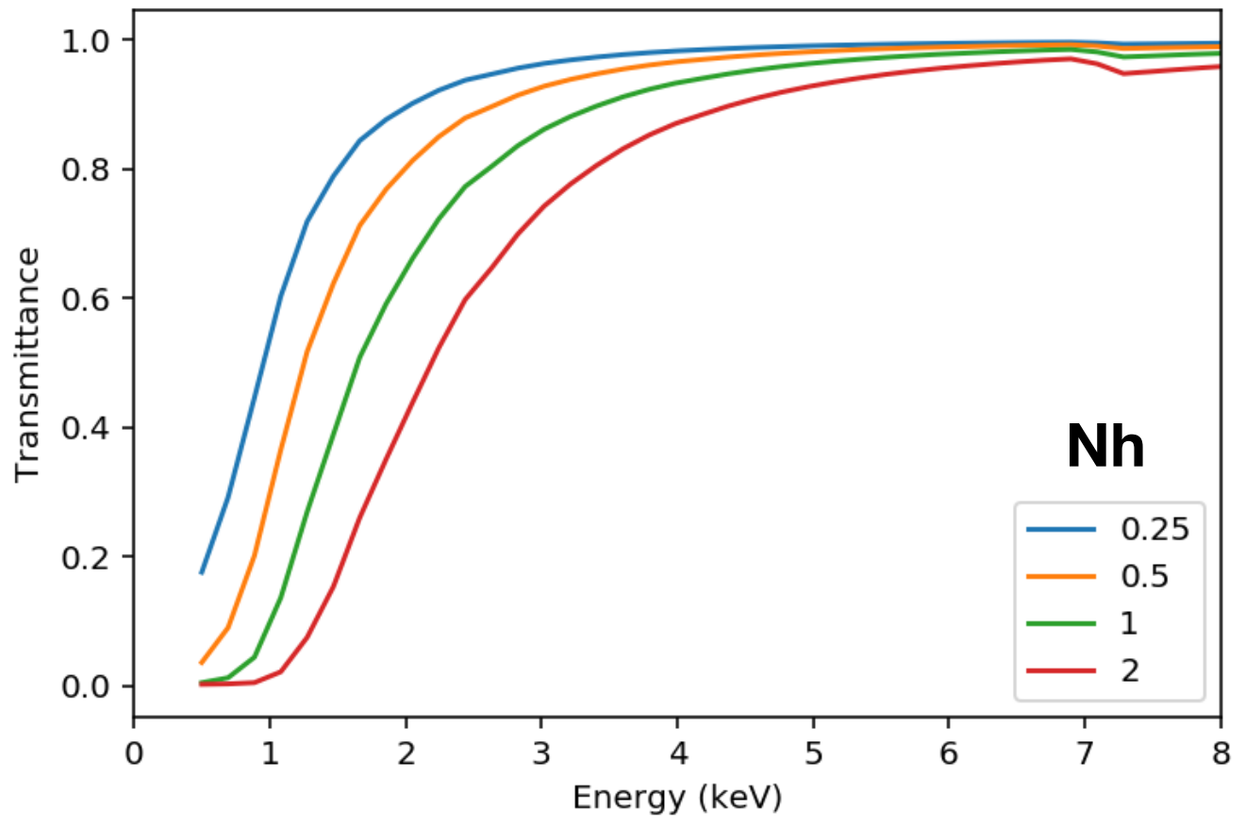
Absorption along line of sight

- **Absorption plays an important role even above 1 keV**



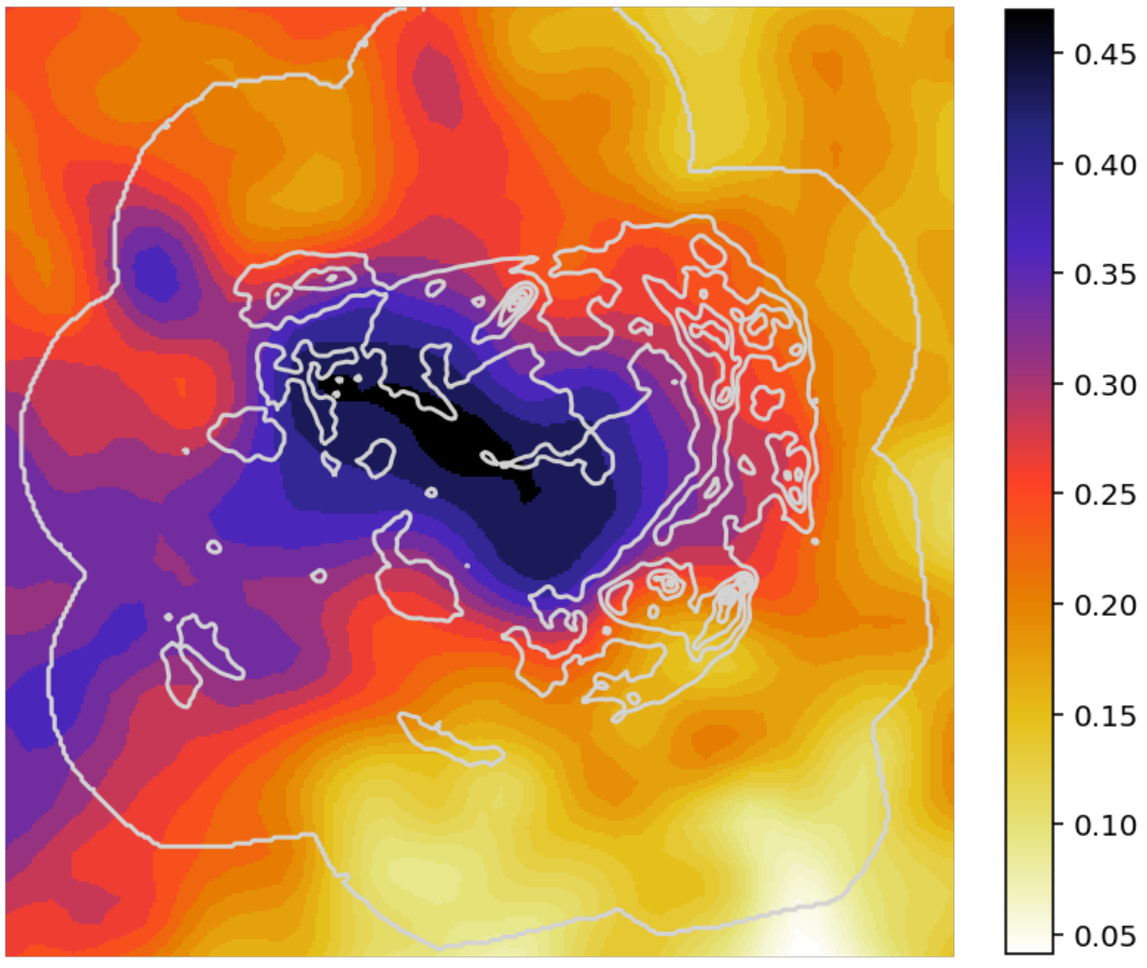
Nh from optical extinction



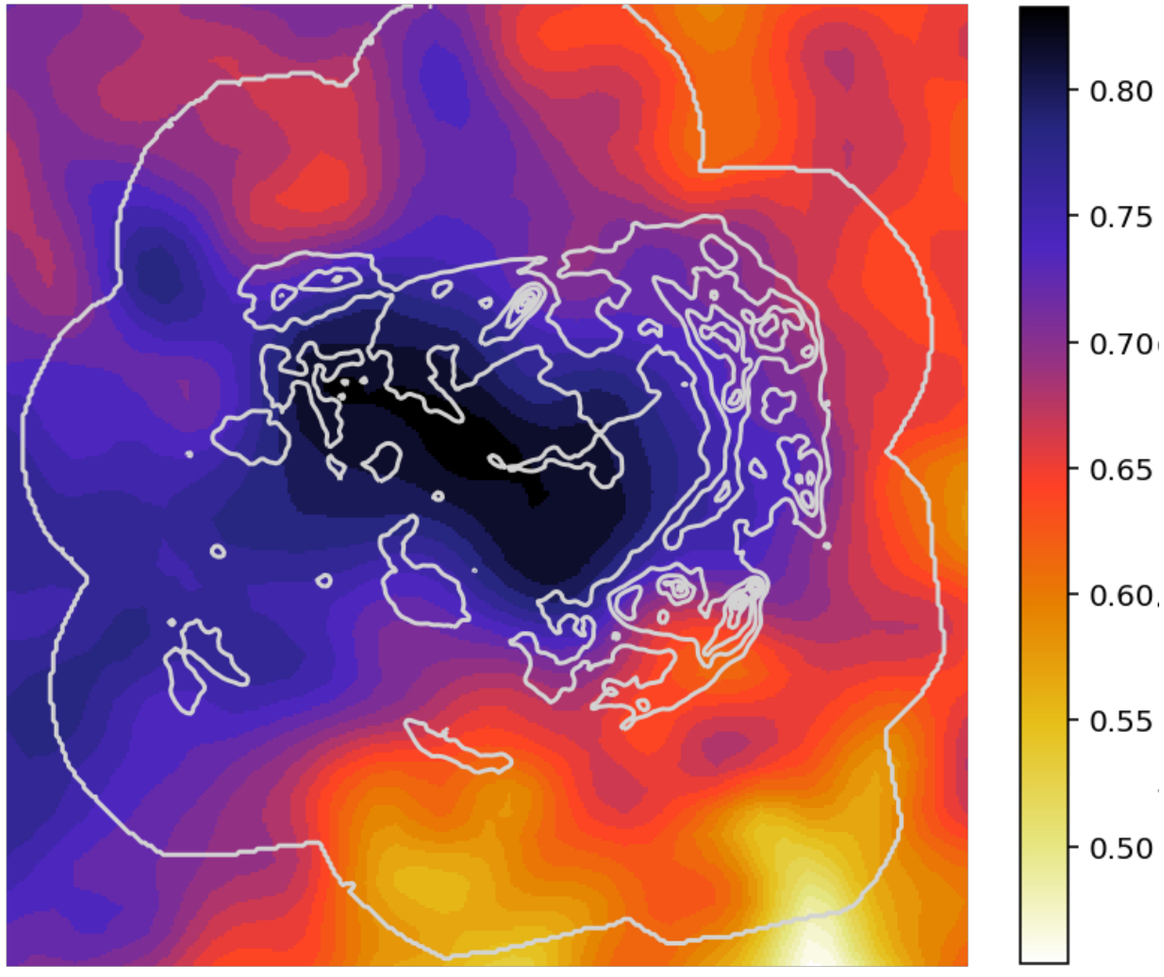


Absorption along line of sight

Transmittance at 1 keV



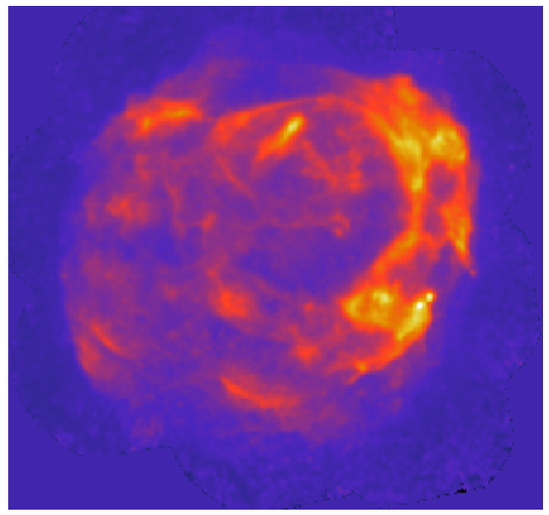
Transmittance at 2 keV



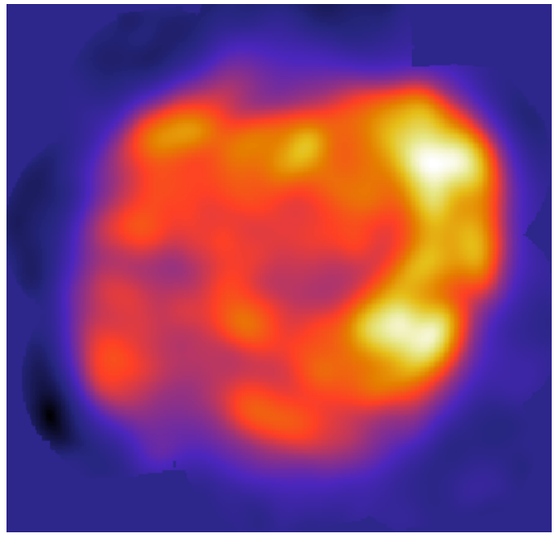
Constructing X-ray profiles

- **CubeXMM = (XMM_cube* - Astro_BKG_Cube) / cube_transmittance**

- **ImageXMM = SUM(CubeXMM, Energies) =>**

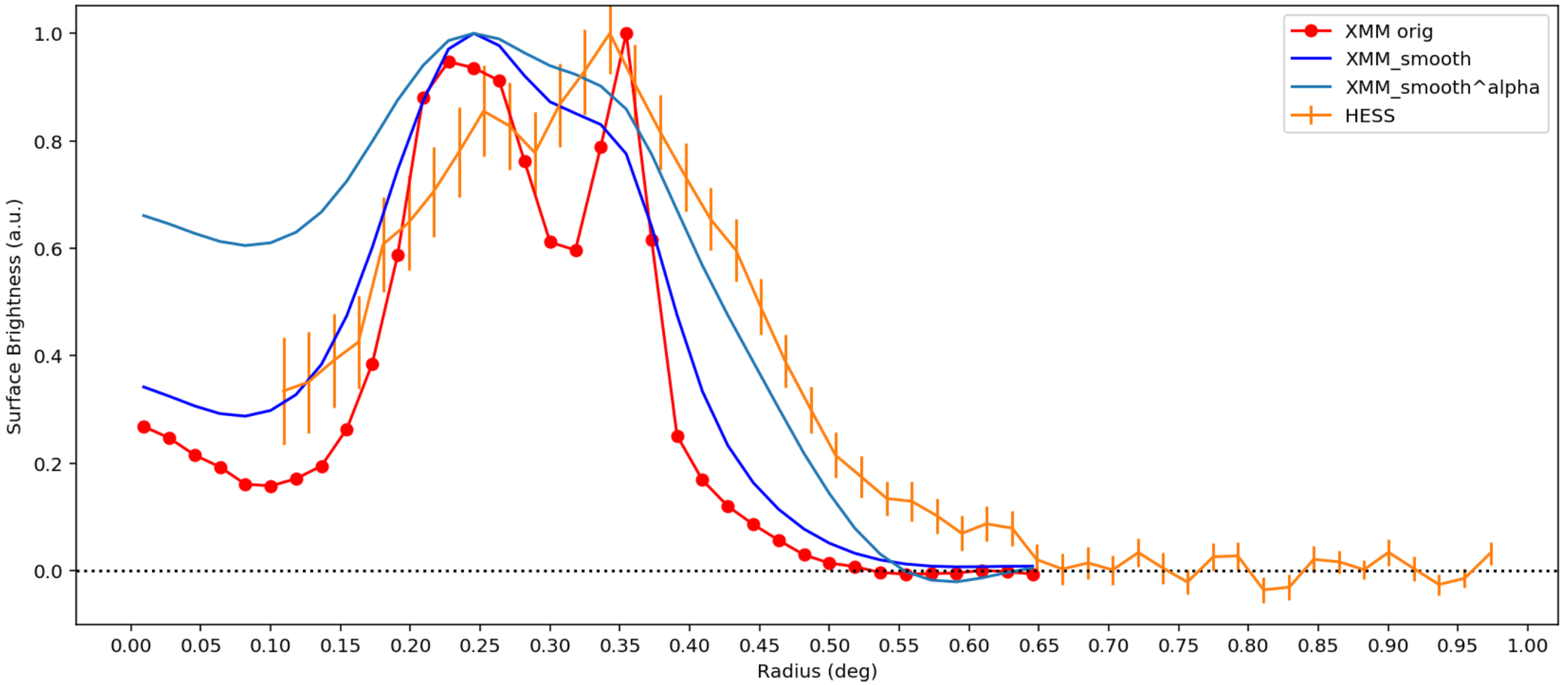


- **ImageXMM_smoo = PSF_HESS⁺(ImageXMM) =>**



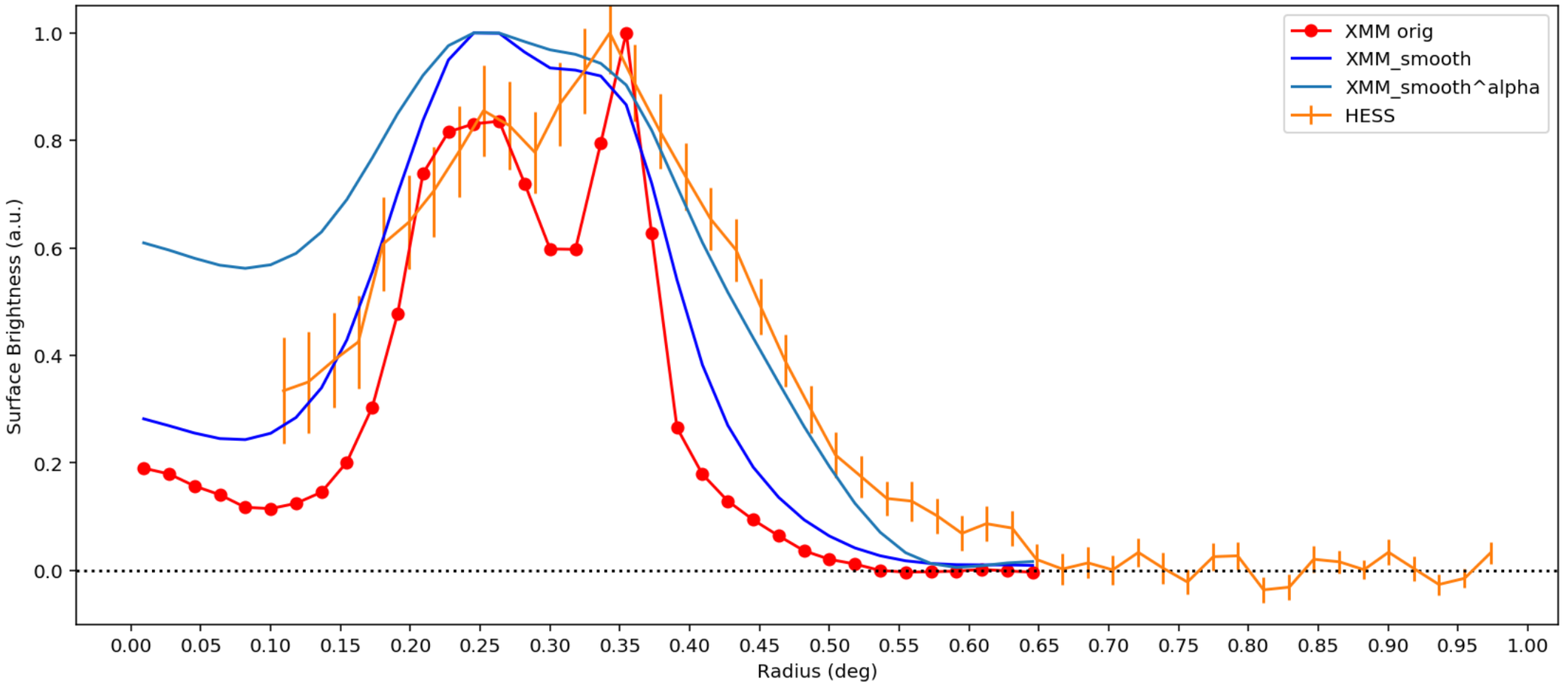
***: all point sources are inpainted**
+: PSF from HESS RXJ DL3 public release shrinken by 2

Radial profiles: 1-6 keV



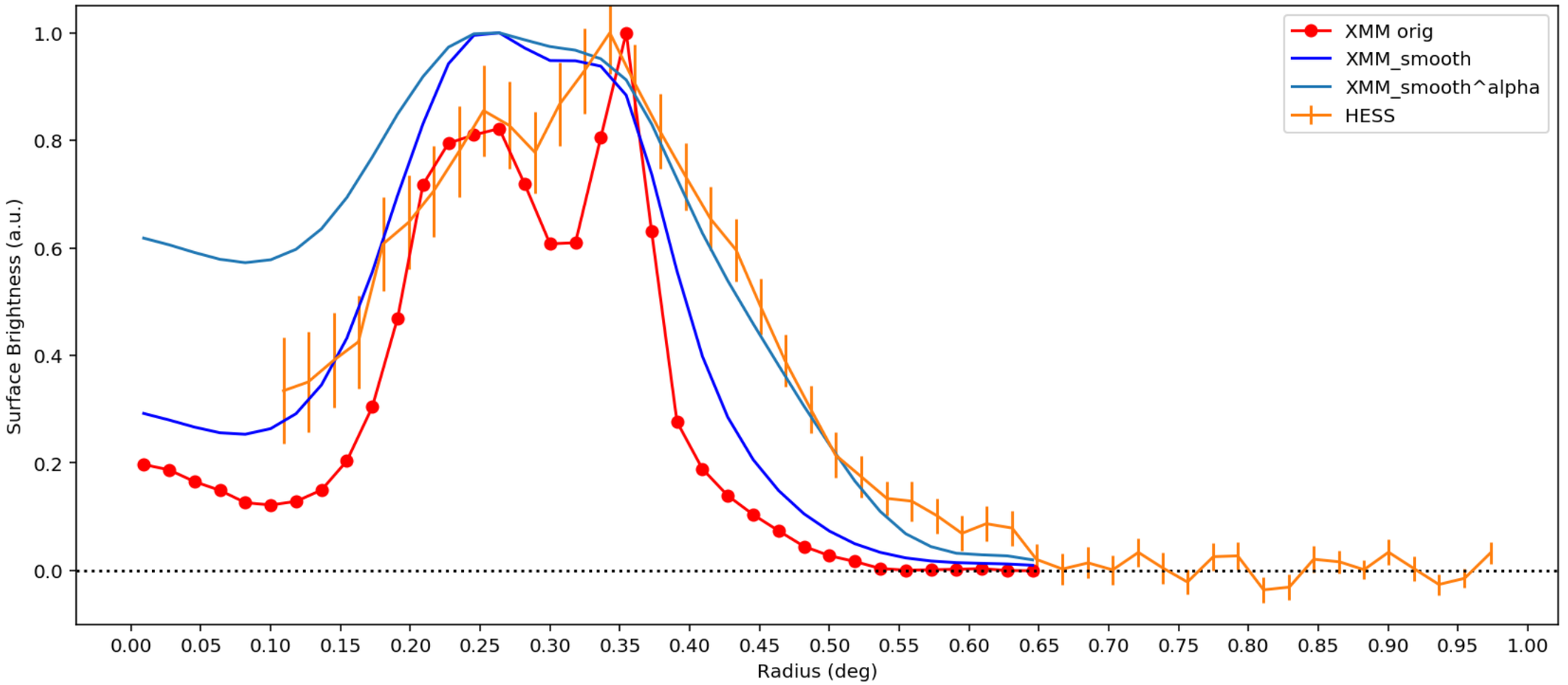
Radial profiles: 1-6 keV

Profile with absorption correction to NHref=0.5



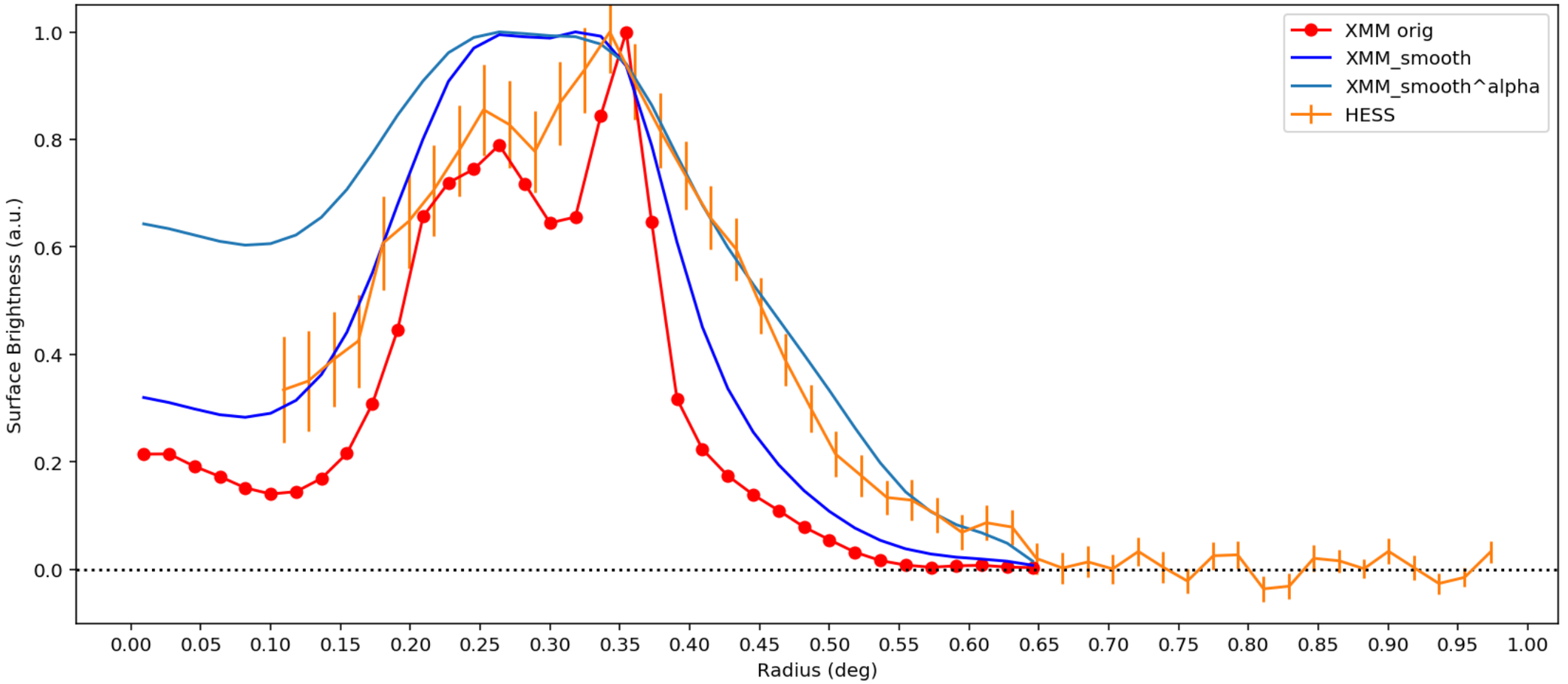
Radial profiles: 1-6 keV

Profile with absorption correction to NHref=0



Radial profiles: 0.9-2 keV

Profile with absorption correction to NHref=0



Conclusions

- **Deep, homogeneous X-ray coverage across the entire remnant**
- **First hints of diffuse thermal emission and clumps**
- **X- and gamma-rays comparison. New profile has:**
  - **Increased X-ray coverage in radius and statistics**
  - **Correction for absorption along the line of sight**
  - **Exploring energy ranges closer to the TeV electrons**
  - **Correct for X/gamma contrast factor**
- **New profile shows that X/gamma difference is reduced**