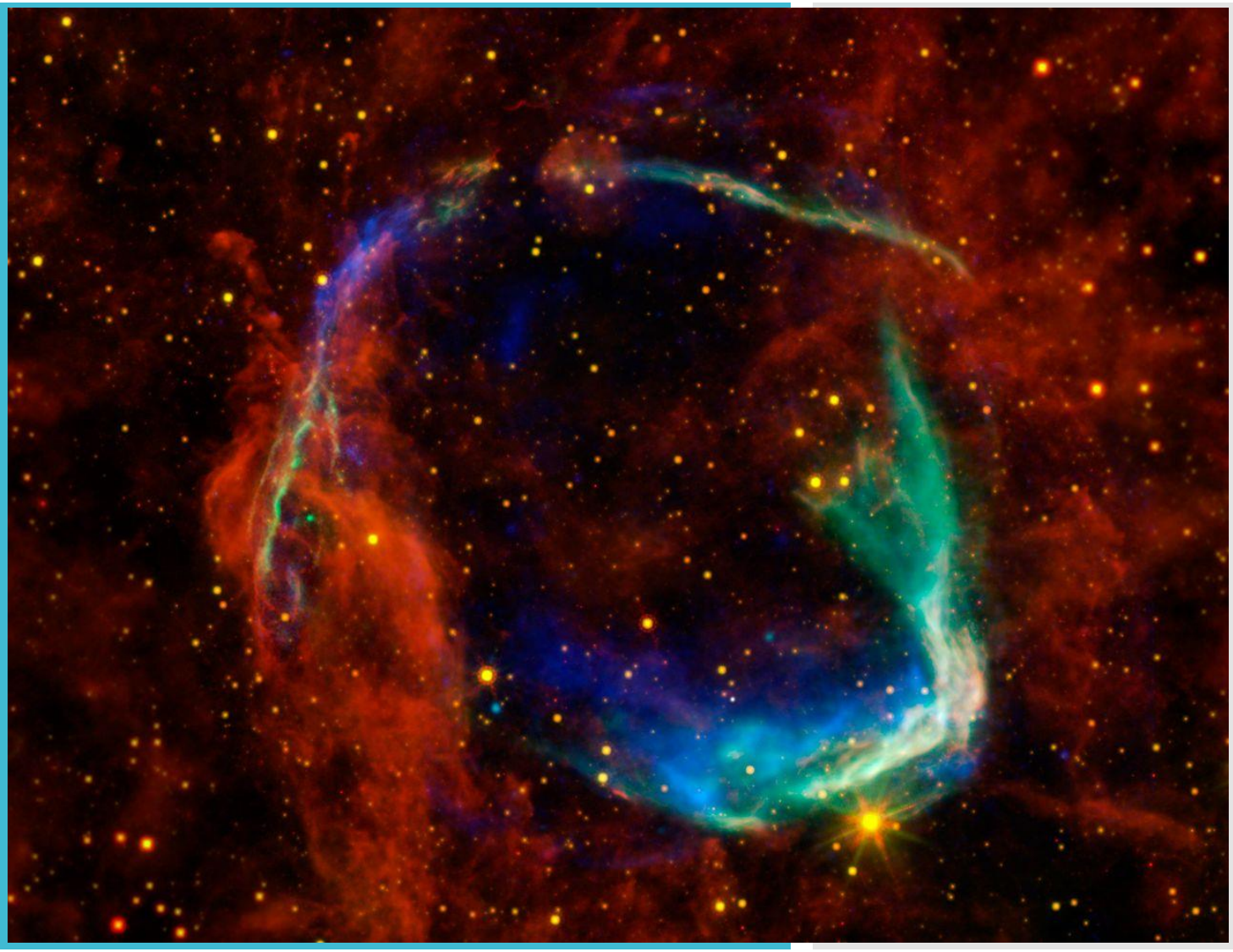
RCW-86
With Chandra

Çağıl Benibol



Combined image of RCW-86 with Spitzer, WISE, Chandra, XMM-Newton (NASA,2011)

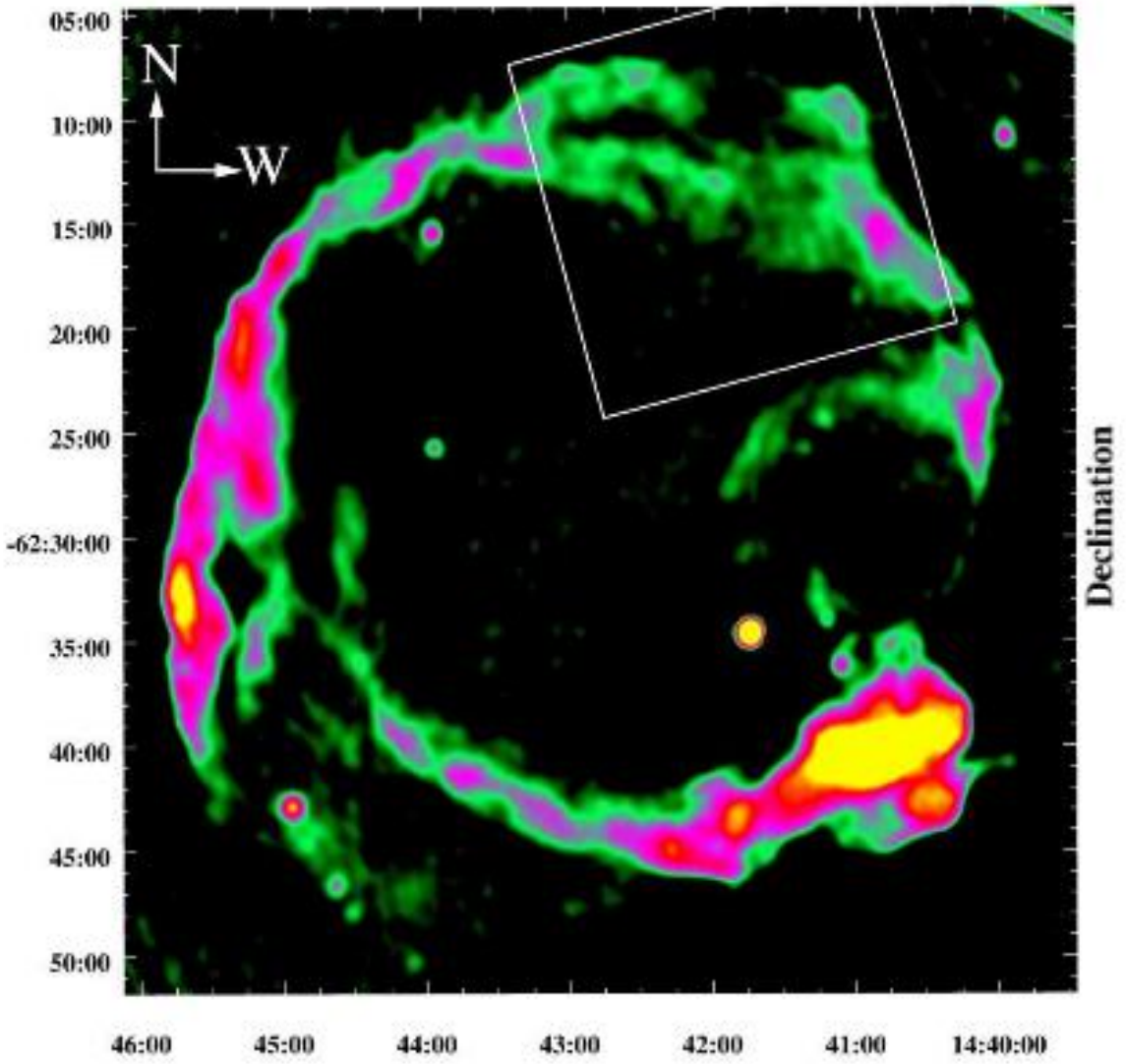
SN 185 and the link with RCW 86 & Properties

- SN 185 was observed in year 185 by Chinese astronomers. In the Book of Later Han, it claims that this event was remained for 8 months. With the observations by the telescopes XMM – Newton and Chandra it is suggested that RCW 86 is strongly linked with this event when the age estimations are done when counting the shock waves and the affected velocities due to synchrotron radiation.[1]

SN 185 and the link with RCW 86 & Properties

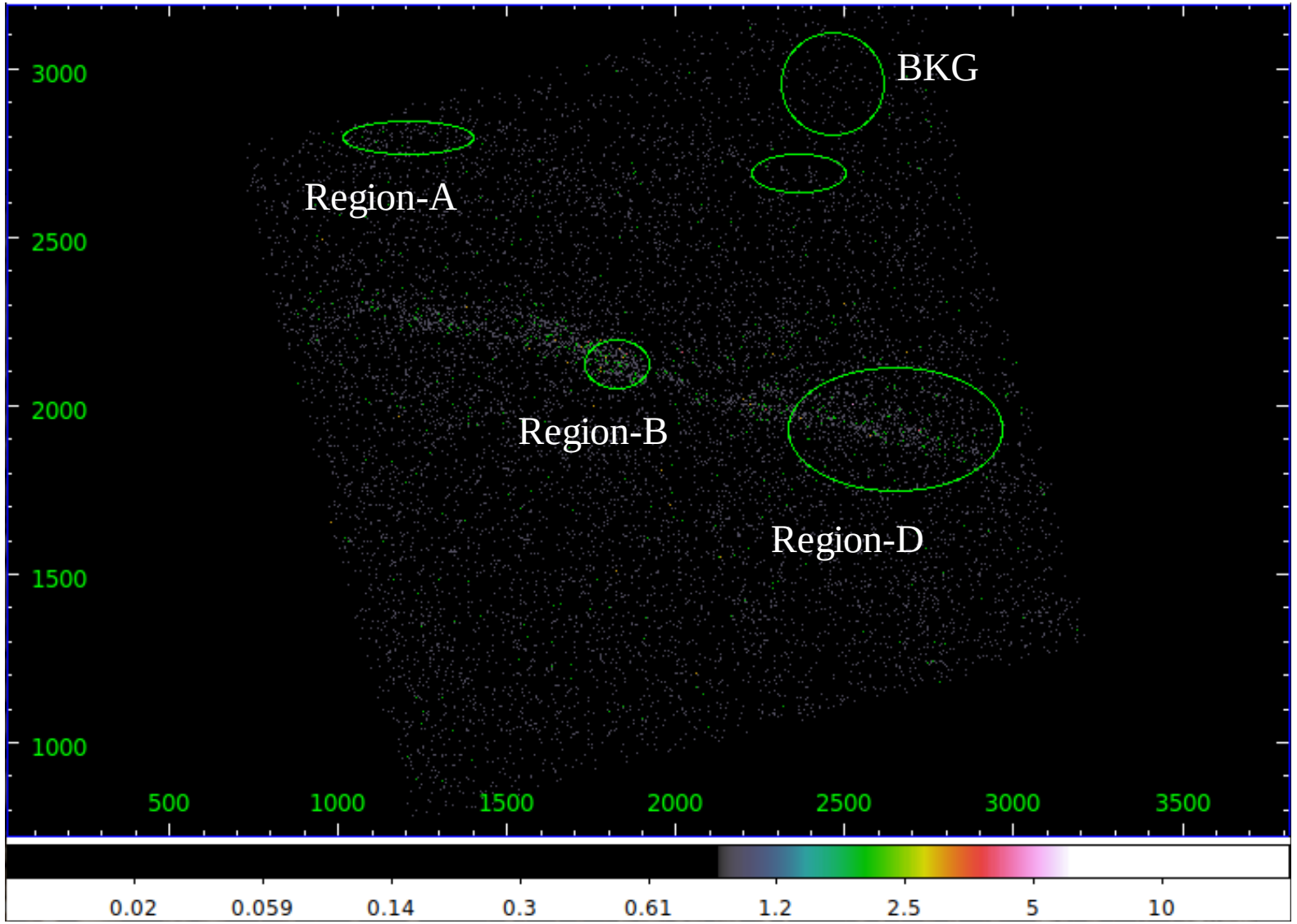
- It is known that synchrotron radiations are in TeV ranges. However, it is related with post-shock magnetic field strength. When the cut off energy is determined, it becomes independent to the magnetic field's magnitude. Shell-type SNR's synchrotron radiation confined into a narrow region. This explains post-shok magnetic field strength. Unlike them this is not the case for SN185. [3]

Selection and Reduction



SN185 (Castro et al.,2011)

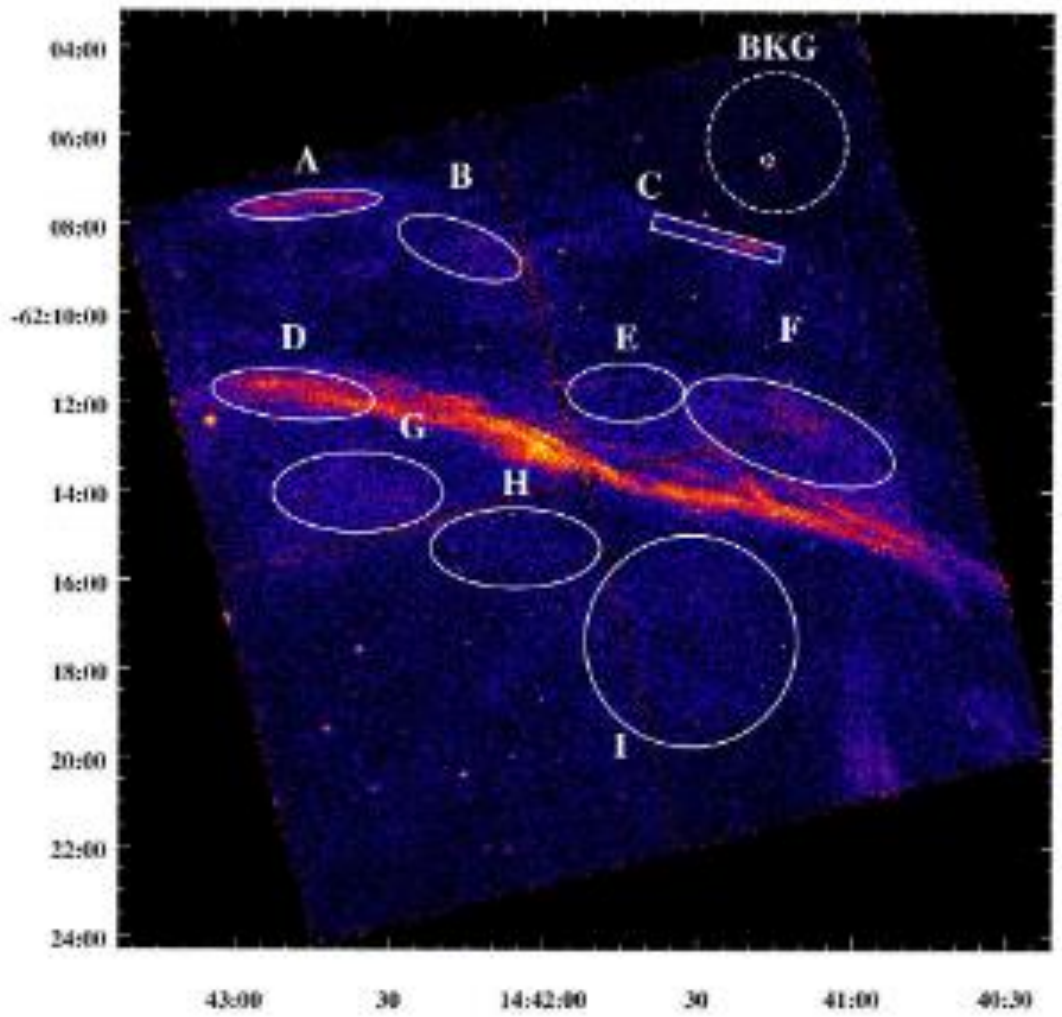
Selection and Reduction



ds9, (scale in degrees, fk5, energy scale in keV) (OBSID: 15608)

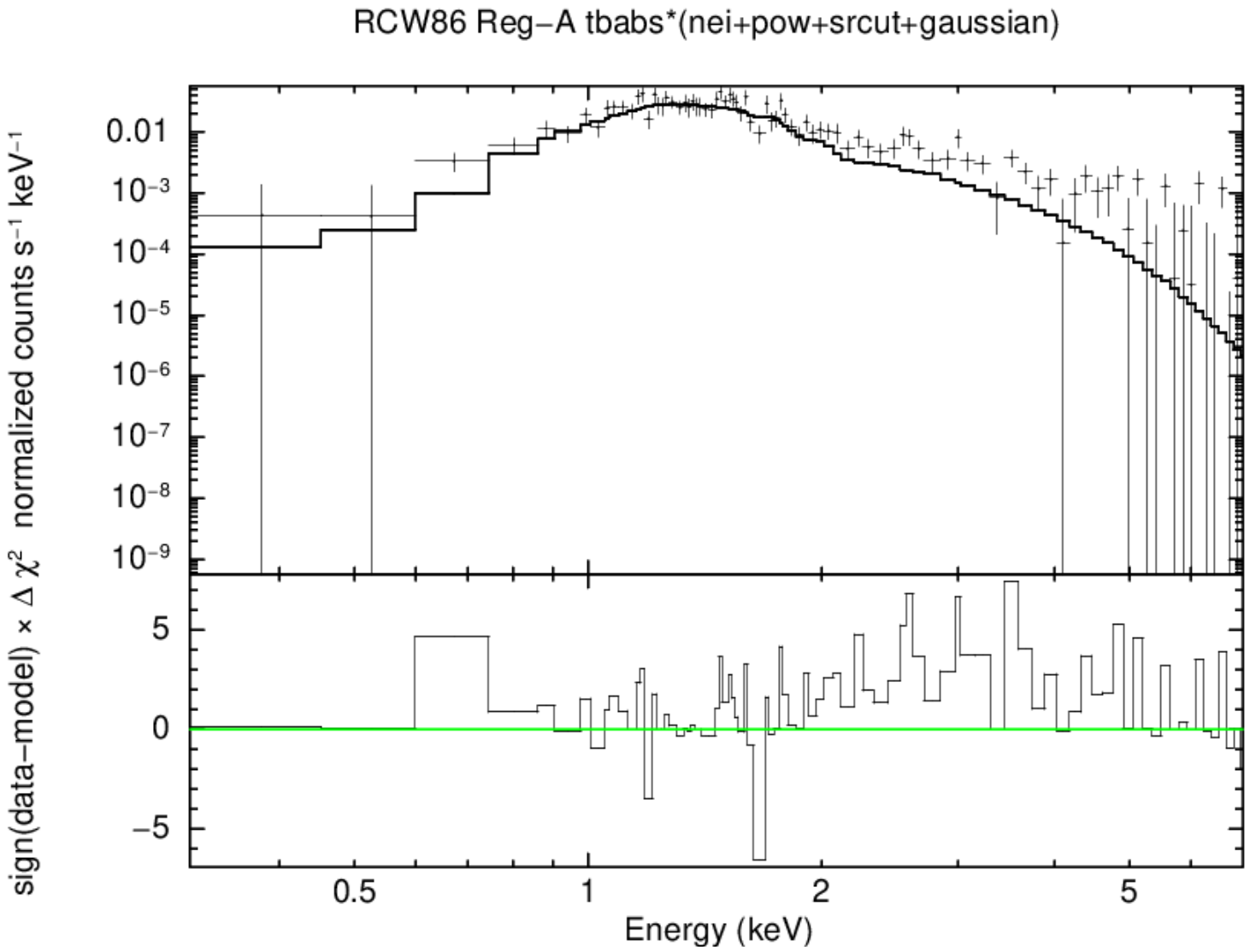
CIAO (v. 4.12), CALDB (v. 4.9.0), XSPEC (v.12.10.1f), specextract script and SAOimage ds9(v. 8.1).

Ref. Article, Castro et al.



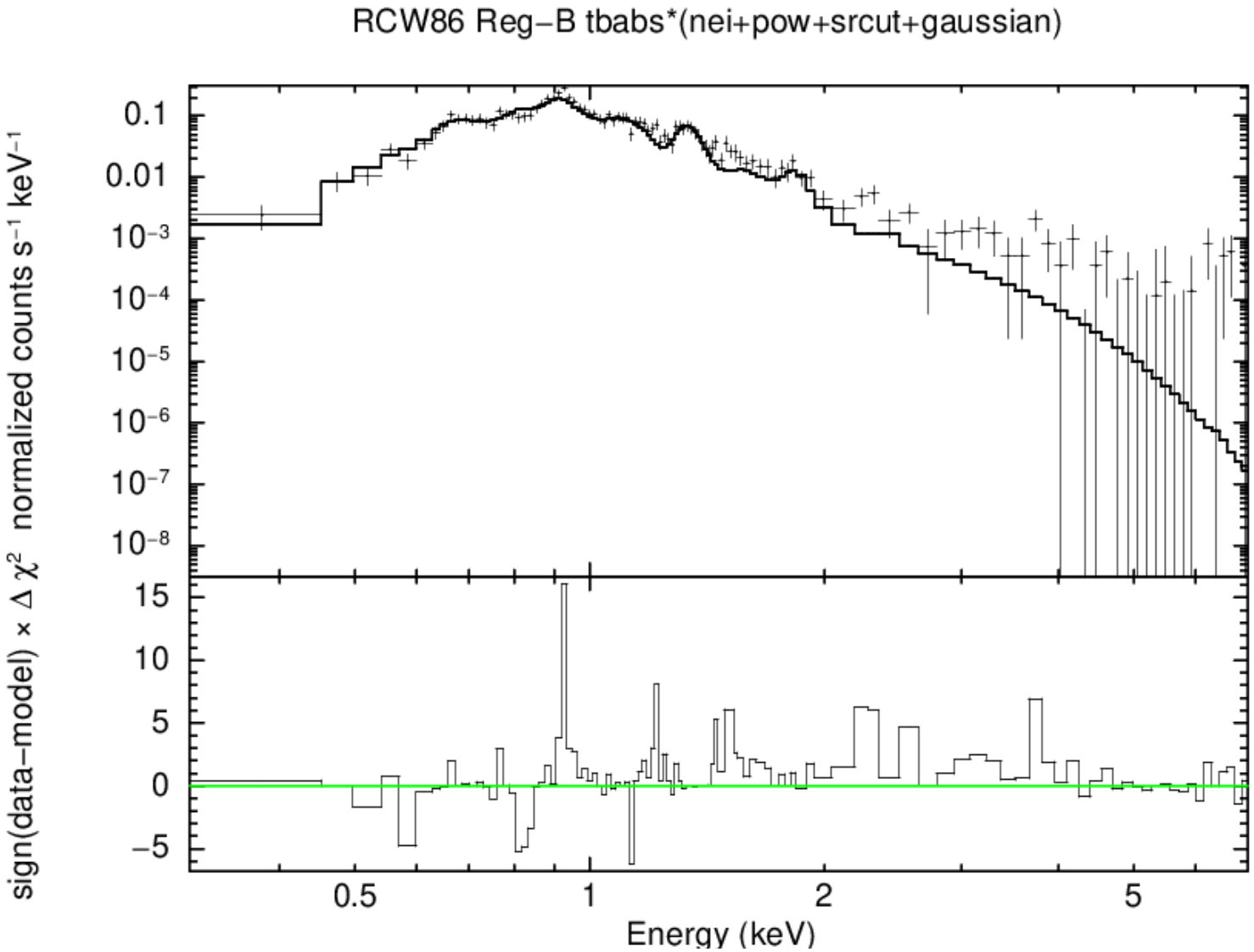
Reg A

- Chi-Squared = 457.22 using 458 PHA bins
- Reduced chi-squared = 1.0275 for 445 degrees of freedom
- Null hypothesis probability = 3.342835e-01



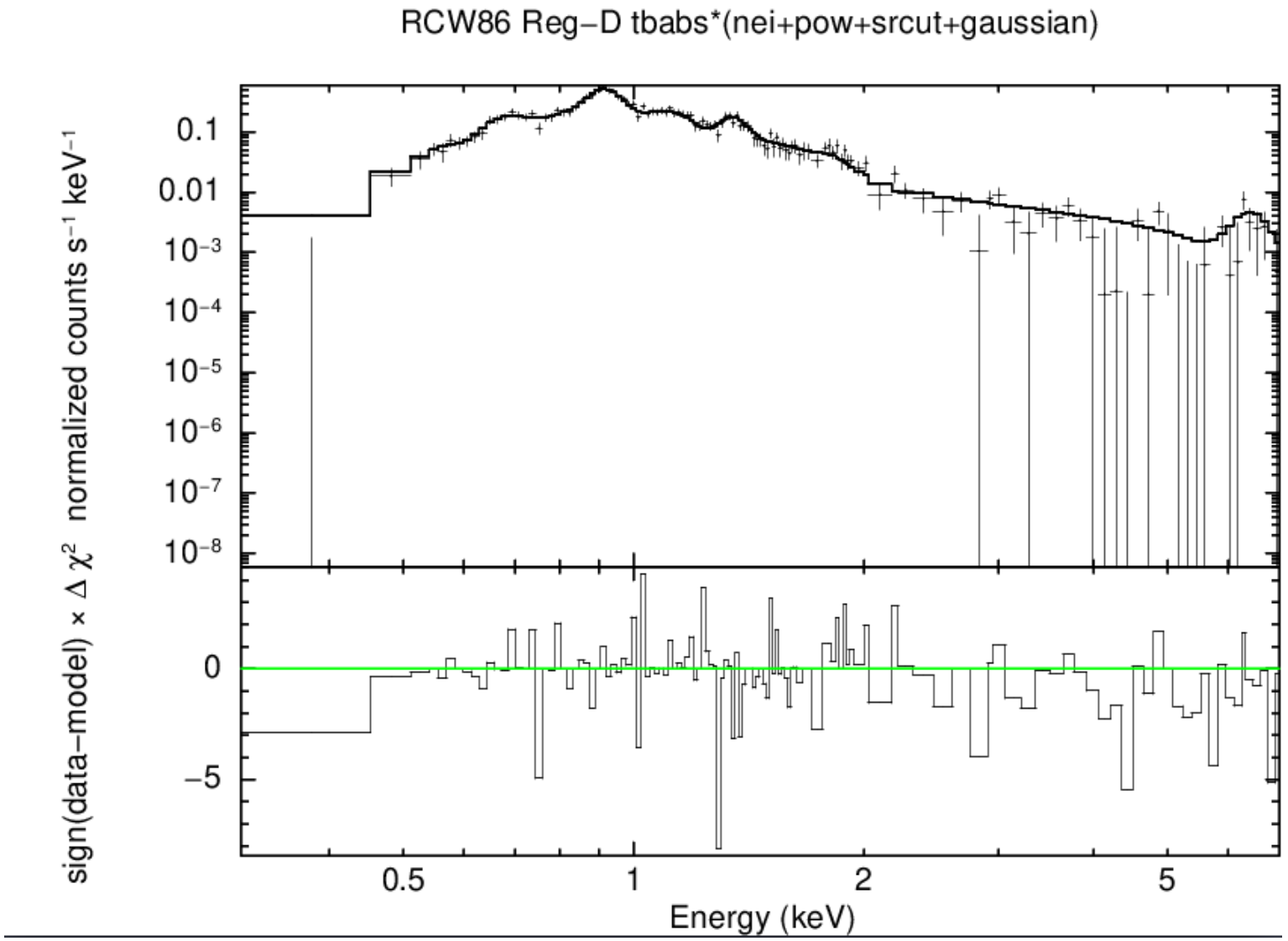
Reg B

- Chi-Squared = 478.58 using 458 PHA bins
- Reduced chi-squared =1.0754 for 445degrees of freedom
- Null hypothesis probability = 1.312439e-01



Reg D

- Chi-Squared =447.08 using 458 PHA bins
- Reduced chi-squared =1.0047 for 445 degrees of freedom
- Null hypothesis probability = 4.633582e-01

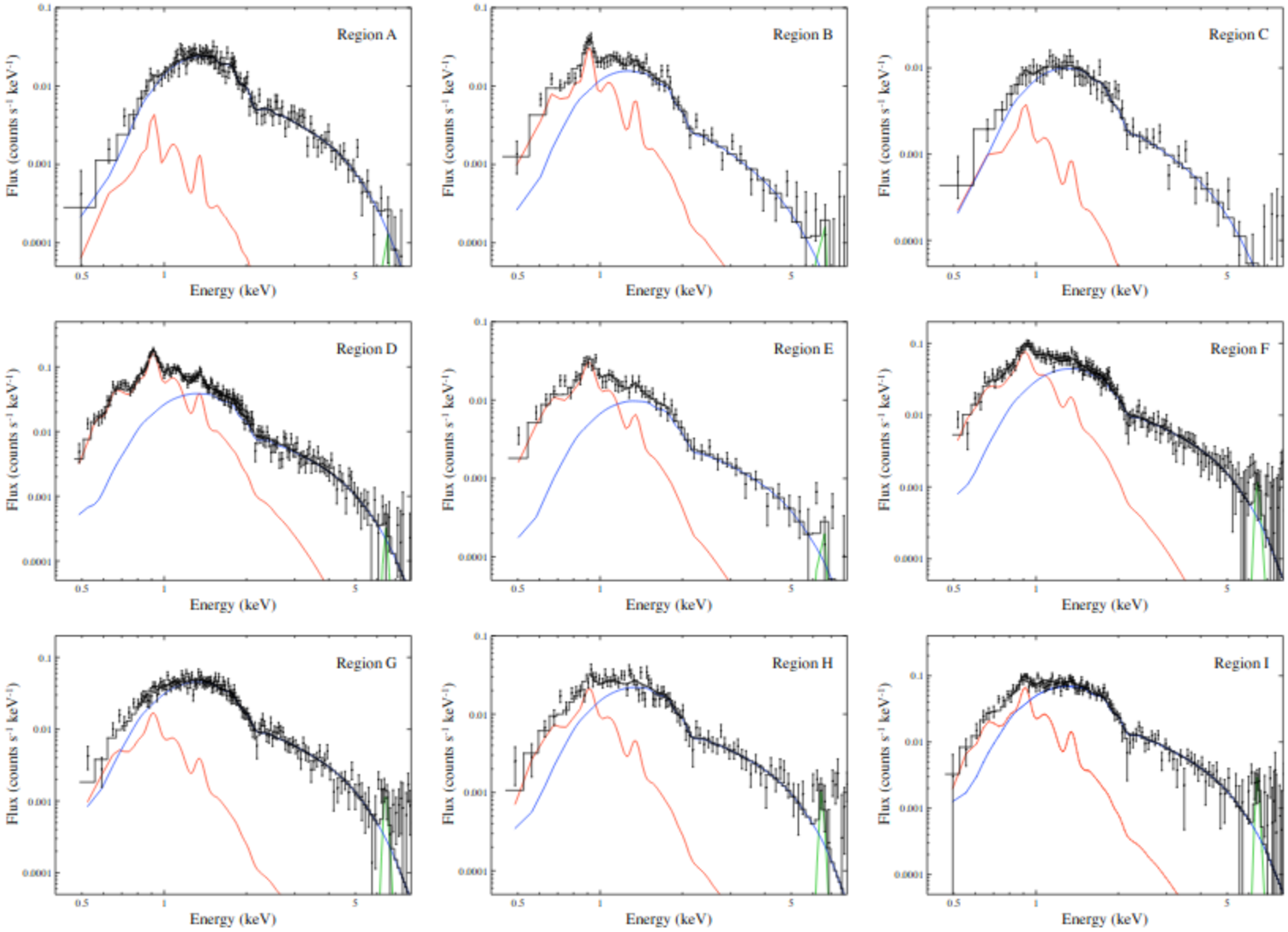


Table

Reg	Nei kT	Nei Ab.	Nei Tau	Nei Red.	Nei Norm	Pow ph in	Pow norm	Srcut br.	Srcut norm
A	0.919432 +/- 0.131855	3.89314E-03 +/- 2.20767E-02	3.93536E+13 +/- -1.00000	9.62702E-03 +/- 3.26769E-03	1.47182E-03 +/- 5.28313E-04	2.63745 +/- -1.00000	7.75751E-24 +/- -1.00000	1.00000E+10 +/- -1.00000	8.10979E-03 +/- -1.00000
B	0.679632 +/- 0.153004	1.16308 +/- 0.512883	8.63602E+09 +/- 1.57874E+09	2.02787E-03 +/- 5.59927E-03	7.38023E-04 +/- 4.02789E-04	1.00000 +/- -1.00000	0.0 +/- 7.93535E-06	2.42000E+17 +/- -1.00000	0.0 +/- 1.36568E-02
D	0.428414 +/- 0.104651	1.06729 +/- 1.47151	8.74474E+09 +/- 2.72109E+09	-7.42523E-03 +/- 5.84004E-04	7.23776E-03 +/- 1.09402E-02	3.21047 +/- 3.51364	2.98680E-04 +/- 7.22446E-04	1.00000E+25 +/- -1.00000	5.56213E-03 +/- 6.19275E-03

kT(keV), Tau(s/cm^3), brake(Hz)

Article, Castro et al.



Blue curves show non-thermal emission, red lines show NEI emission, and the green component is a gaussian model representing the Fe-K line

Discussion & Conclusion

- I used several models on this work,
- Vpshock → Plane parallel shock plasma model.
- Nei → Collusional plasma model
- Tbabs → Reduces ISM radiation
- Powerlaw → Responsible from radiations that obey power-law. Most probably Compton scattering radiation and some parts of blackbody radiation. It also models red-shift.
- Srcut → This model basically fits cut-off on powerlaw, It shows that there are accelerated electrons. In this work accelerated electrons are associated with synchrotron radiation.
- Gaussian → It corrects the Fe-Kalpha spectrum.

Discussion & Conclusion

- By the derivation Vink et al.(2206), and Einstein's famous equation. The radiation is near 0.511 Mev. It is concluded that RCW has low shock velocities. Castro et al. Found velocity on their region A as 2200 km s^-1. I found similar region (mine called A too) 2435 km s^-1.

$$V_S \approx (2650\ \mathrm{km\ s^{-1}}) \left(\frac{h\nu_{\mathrm{peak}}}{1\ \mathrm{keV}} \right)^{1/2}$$

$$E = \frac{(c\ \text{(speed of light)})^2\ (m_e\ \text{(electron mass)})}{\sqrt{1 - \frac{(2435\ \mathrm{km/s}\ \text{(kilometer per second)})^2}{(c\ \text{(speed of light)})^2}}}$$

References

[1]https://www.esa.int/Science_Exploration/Space_Science/New_evidence_links_stellar_remains_to_oldest_recorded_supernova

[2] THE X-RAY SYNCHROTRON EMISSION OF RCW 86 AND THE IMPLICATIONS FOR ITS AGE, Vink et al. ,2018

https://arxiv.org/pdf/astro-ph/0607307.pdf

[3] A CHANDRA VIEW OF NONTHERMAL EMISSION IN THE NORTHWESTERN REGION OF SUPERNOVA REMNANTRCW 86: PARTICLE ACCELERATION AND MAGNETIC FIELDS, Castro et al. ,2011

https://arxiv.org/pdf/1309.2936.pdf