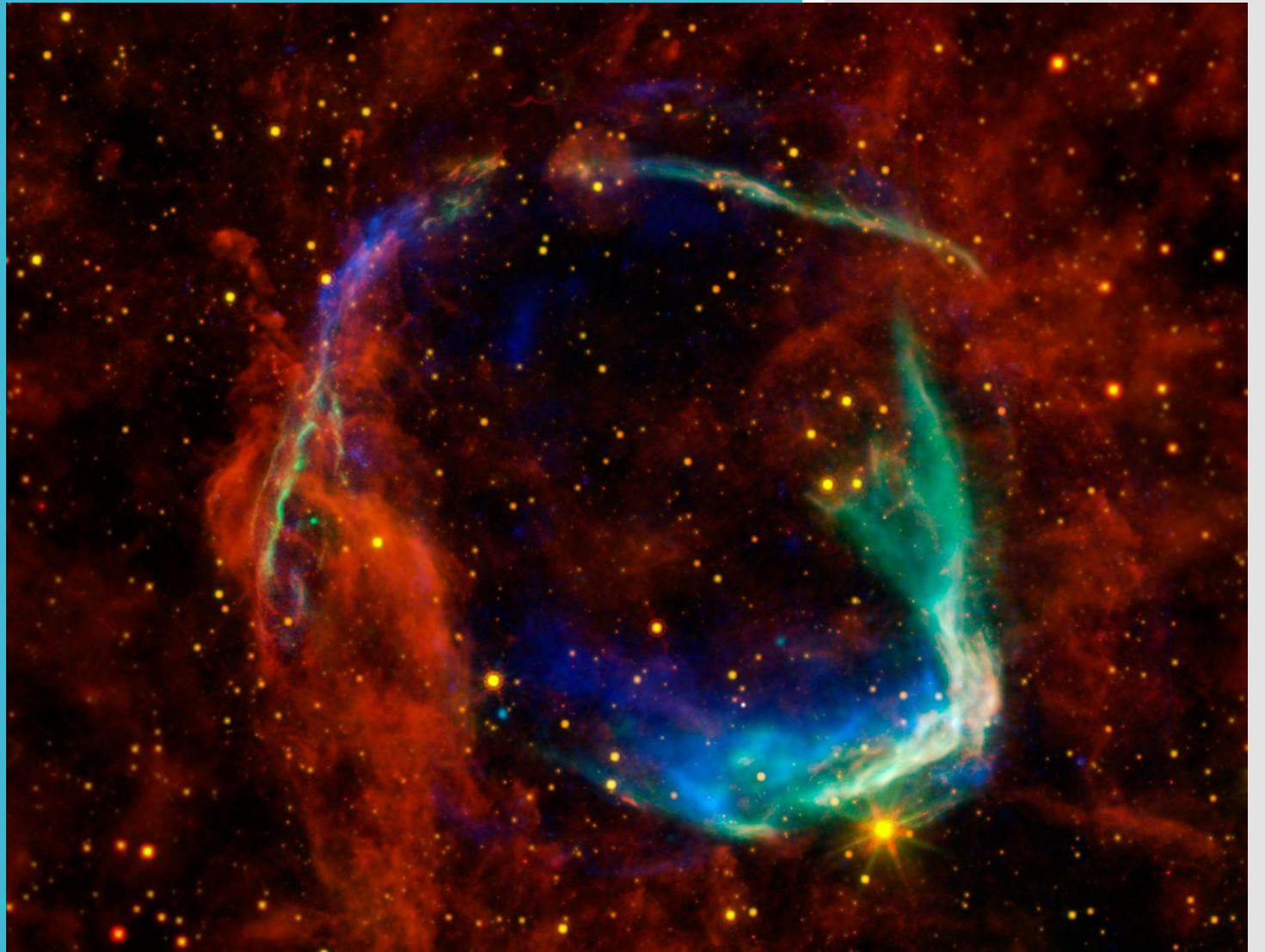


RCW-86

With FERMI-LAT

Çağıl Benibol



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

Contents

- SN 185 and the link with RCW 86 & Properties
- Selection and Reduction
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- Discussion & Conclusion
- References

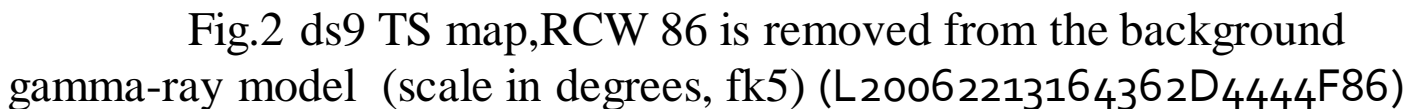
SN 185 and the link with RCW 86 & Properties

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 their velocities.[1]

RCW 86 & Properties

Diffusive shock acceleration (DSA) is responsible for magnetic field amplification in outer parts. Since this SNR's outer rims aren't confined in narrow regions, densities are low. Synchrotron emissions are key for finding velocities of post-shocks. Due to synchrotron radiation both x-ray and gamma radiation ranges (depending on the particle type) have cut-offs visible on the spectrum.[2,3,4]

Fermitools, CFITSIO (v3.43), Python (2.7.14),
Fermi-4FGL catalog, fermipy, make4FGLxml.py
(python 2.7 version), plot_sed.py,
P8R2_SOURCE_V6 (IRF),
iso_P8R2_SOURCE_V6_v06.txt (Isotropic diffuse
background), gll_iem_v06.fits (Galactic diffuse
background), gtselect, gtmktime, SAOImage DS9(v
7.5)



Selection and Reduction

- `gtselect evclass=128 evtype=3`
- max. zenith angle was set to 90 degrees
- The data are filtered by `gtmktime` script with `(DATA_QUAL>0)&&(LAT_CONFIG==1)` configuration
- 200-300000 MeV
- 2013-01-28 02:37:18, 2020-06-09 13:21:38
- 220.121, -62.645 (Equatorial coordinates, degrees)

Tables

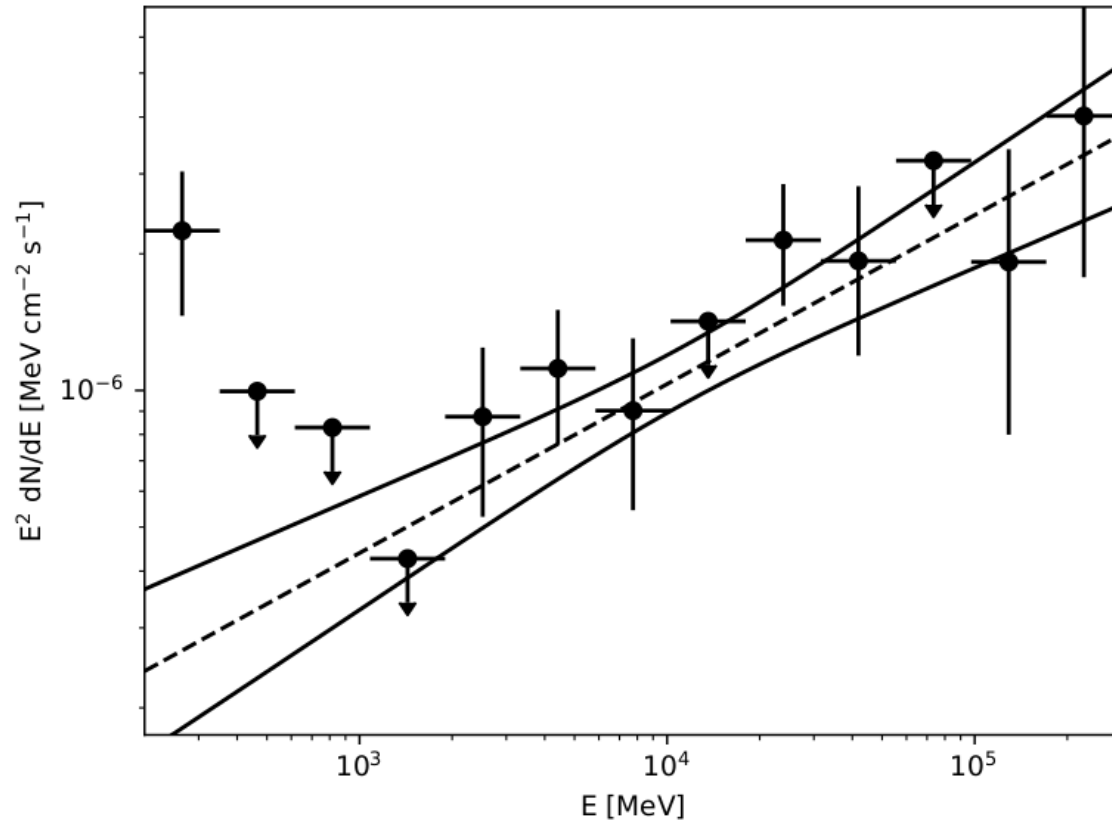
name	SpatialModel	SpectrumType	offset	ts	npred
RCW 86	SpatialMap	PowerLaw	0.354	79.62	543.0

Table 1. Spectrum Table

energy	energy_edge_lo	energy_edge_hi	flux	flux_error_lo	flux_error_hi	ul
float	float	float	float	float	float	long
MeV	MeV	MeV	1 / (cm ² MeV s)	1 / (cm ² MeV s)	1 / (cm ² MeV s)	
264.96286	200.0	351.02658	2.2479305e-06	7.8774053e-07	7.8774053e-07	0
465.05038	351.02658	616.1125	9.956625e-07	0.0	0.0	1
816.2346	616.1125	1081.3593	8.284957e-07	0.0	0.0	1
1432.6167	1081.3593	1897.9729	4.261444e-07	0.0	0.0	1
2514.4617	1897.9729	3331.1946	8.753654e-07	3.4860696e-07	3.6771922e-07	0
4413.265	3331.1946	5846.8237	1.1178053e-06	3.590108e-07	3.866429e-07	0
7745.9556	5846.8237	10261.952	9.0257544e-07	3.5790373e-07	3.9961267e-07	0
13595.338	10261.952	18011.504	1.4199709e-06	0.0	0.0	1
23861.898	18011.504	31612.584	2.142871e-06	6.069277e-07	7.0455746e-07	0
41881.285	31612.584	55485.562	1.9288675e-06	7.360482e-07	8.879875e-07	0
73508.07	55485.562	97384.54	3.2067749e-06	0.0	0.0	1
129017.91	97384.54	170926.73	1.9187141e-06	1.1196098e-06	1.4792515e-06	0
226446.19	170926.73	299999.12	4.0230143e-06	2.2473894e-06	2.9691769e-06	0

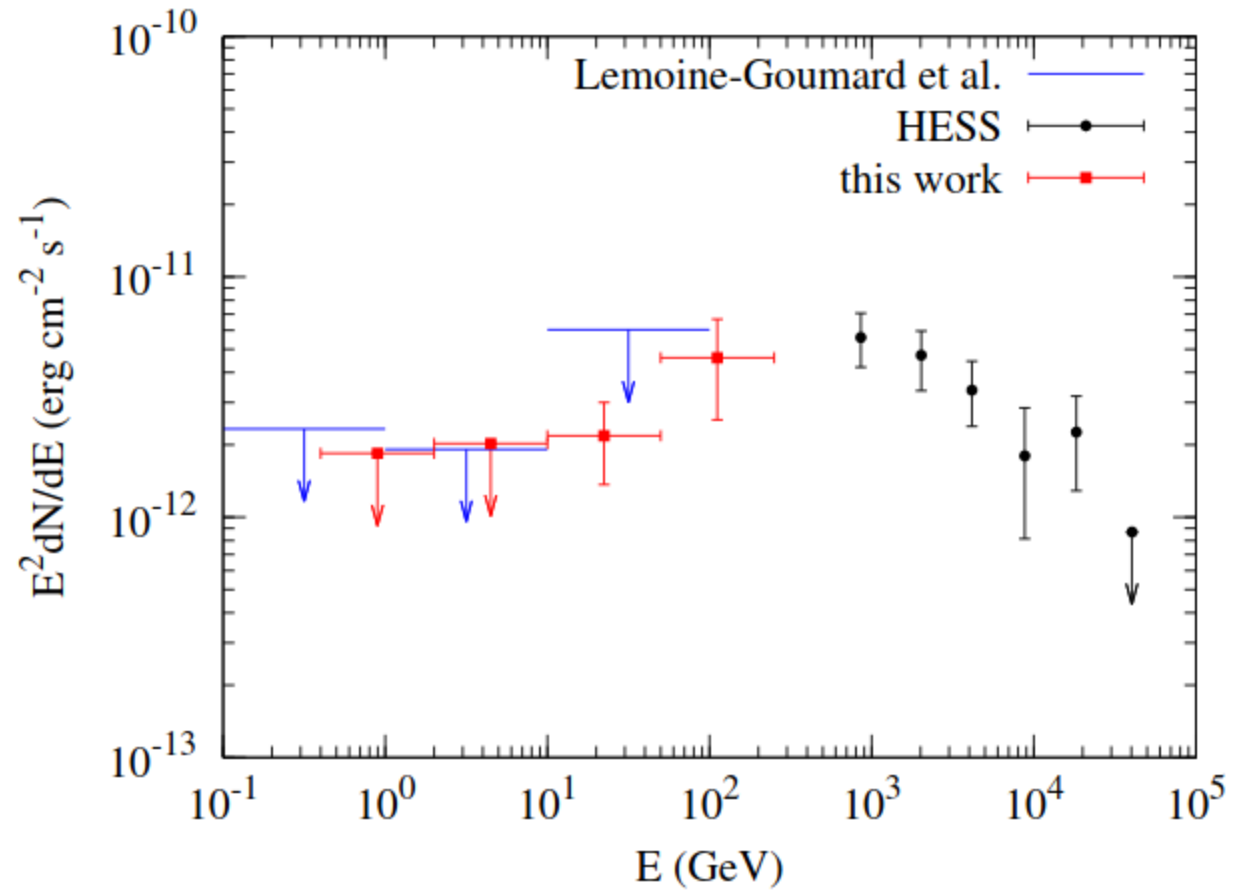
Table 2. SED Table

Data Analysis (SED graph)



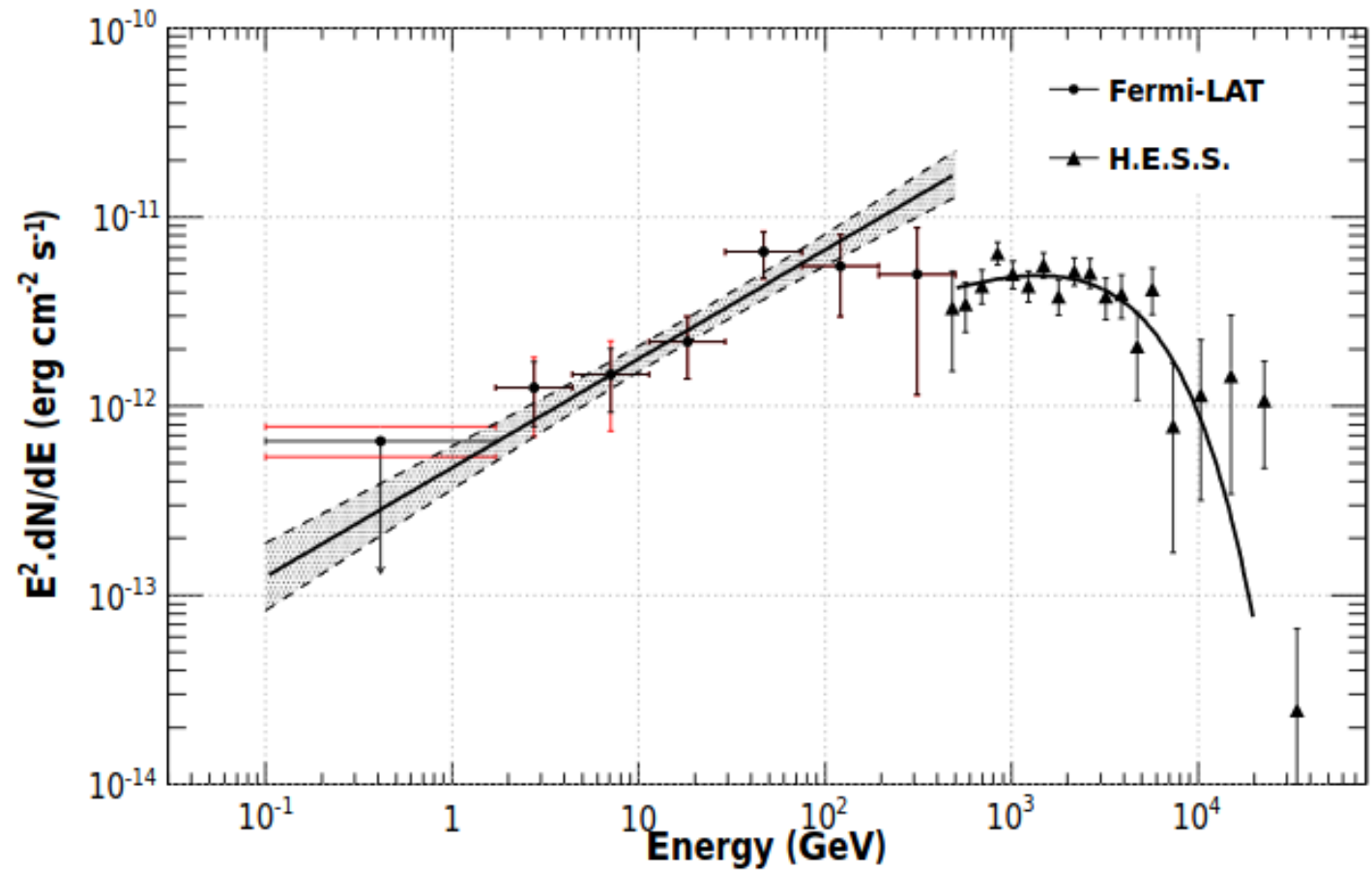
(Fig.3 Spectral SED graph of RCW 86 current analysis TS=79.62)

Ref. Article,
Yuan et al.
2018



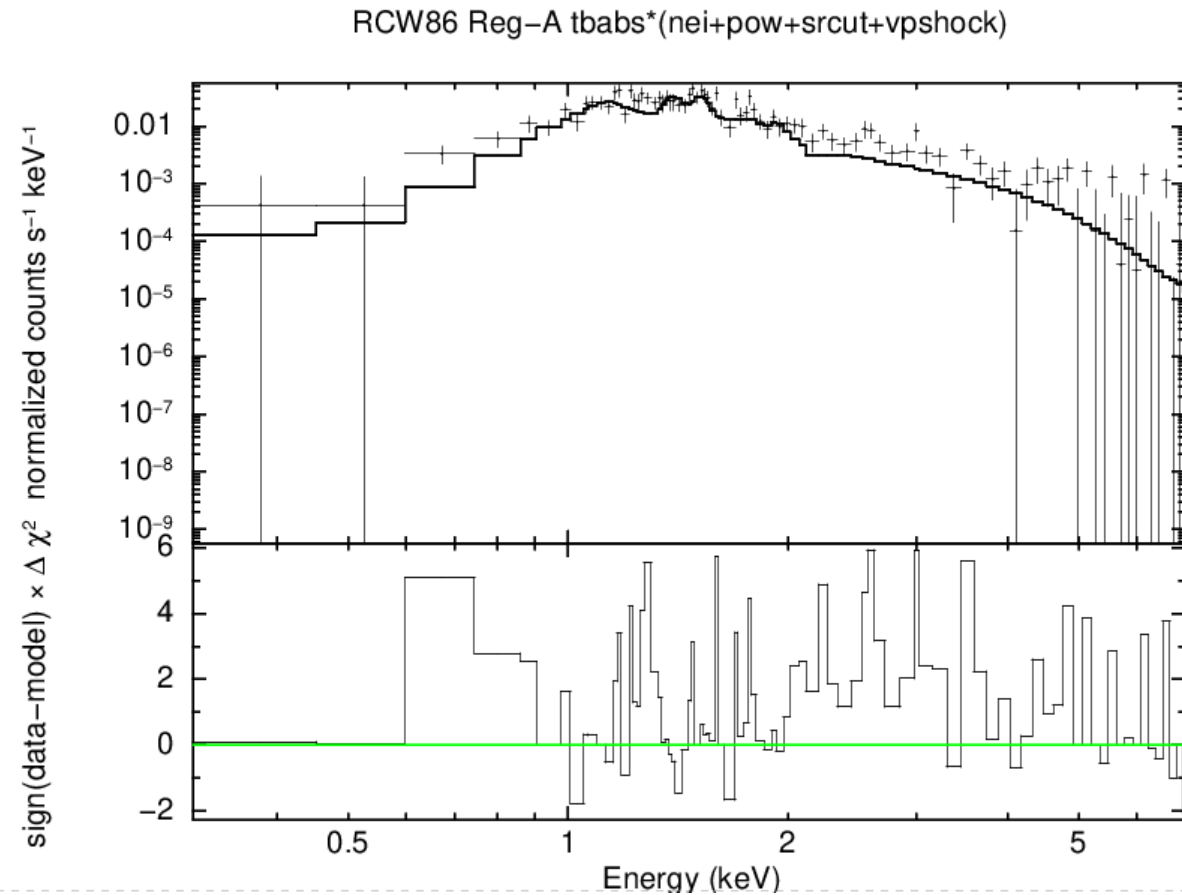
(Fig.4 Yuan et al. RCW 86 gamma spectrum TS=30)

Ajello et al.
2016



(Fig.5 Ajello et al. RCW 86 gamma spectrum TS=68)

RCW Chandra X-Ray Spectrum



(Fig. 6 one of the regions's X-Ray spectrum analysis RCW 86, cut-off can be seen from 2 keV due to synchrotron loss)

Discussion & Conclusion

- SED graph has two peaks that shows leptonic behaviour. (Inverse compton and bremsstrahlung)
- Previously, x-ray spectrum was known which shows 2 keV cut off due to synchrotron.
- New peak is rising but this analysis couldn't show higher cut offs due to synchrotron loss. Even it shows it is hard to explain hadronic emissions due to low density shocks. [4]

References

[1][https://www.esa.int/Science_Exploration/Space_Science/
New_evidence_links_stellar_remains_to_oldest_recorded_supernova](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 REMNANT RCW 86: PARTICLE ACCELERATION AND MAGNETIC FIELDS, Castro et al. ,2011

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

[4] FERMI LARGE AREA TELESCOPE DETECTION OF SUPERNOVA REMNANT RCW 86, Yuan et al. , 2018

<https://arxiv.org/pdf/1403.4915.pdf>

[5] DEEP MORPHOLOGICAL AND SPECTRAL STUDY OF THE SNR RCW 86 WITH FERMI-LAT, Ajello et al. 2016

<https://arxiv.org/pdf/1601.06534.pdf>