"Observations of the SNR RCW 86 and RX J1713.7-3946 with *Fermi*-LAT"

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MODE SNR-PWN Workshop

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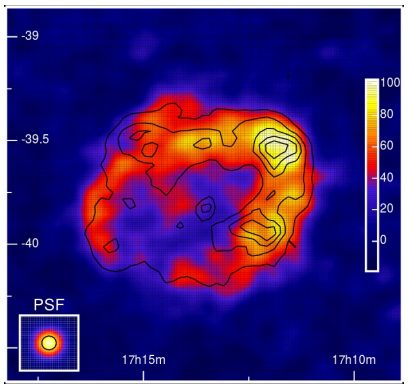
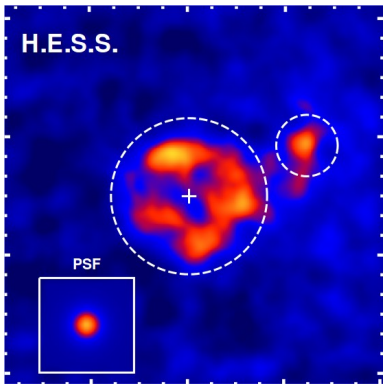
Introduction

- Young shell-type remnants are a type of SNR of particular interest
- Thought to be efficient CR accelerators (fast/energetic shock wave)
- They share some characteristics :
  - age ~ 1000-2000 years
  - in the Sedov phase (or about to reach it)
  - the morphology, of course (a shell structure)

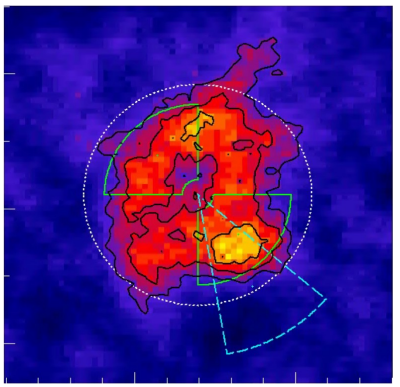
Examples of shell-type remnants detected by H.E.S.S. at TeV energies



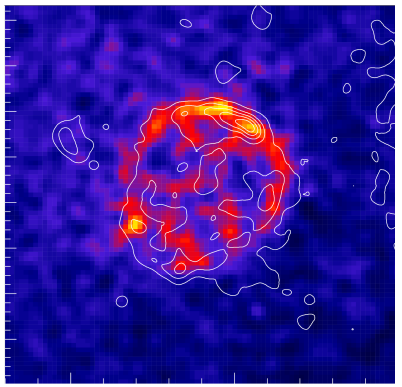
RX J1713.7-3946



HESS J1731-347



RCW 86



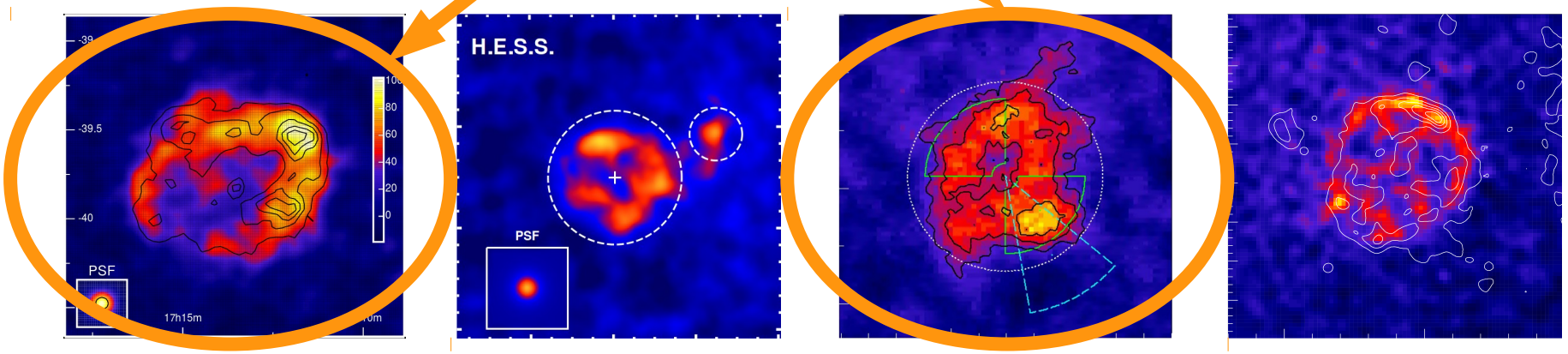
RX J0852.0-4622

Introduction

- Young shell-type remnants are a type of SNR of particular interest
- Thought to [redacted] ergetic shock wave)
- They share [redacted]
  - age ~ 10[redacted]
  - in the Se[redacted]
  - the morphology, of course (a shell structure)

We have studied those two with *Fermi*-LAT

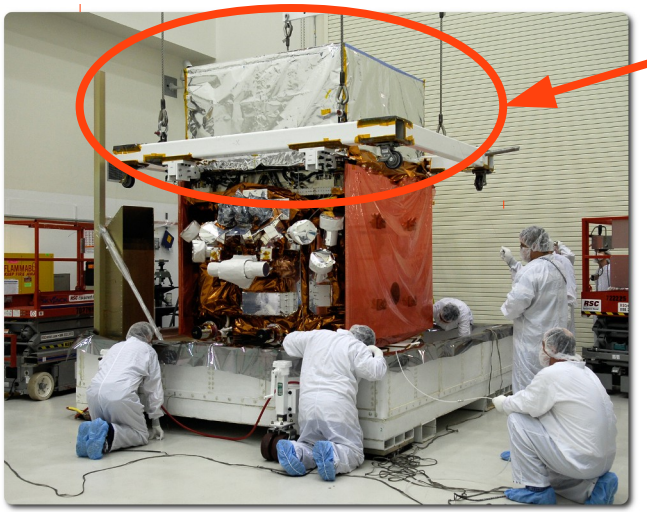
Examples of shell-type remnants detected by H.E.S.S. at TeV energies



RX J1713.7-3946 **HESS J1731-347** **RCW 86** **RX J0852.0-4622**

About the *Fermi*-LAT

The Large Area Telescope is an e^-/e^+ pair conversion space detector.

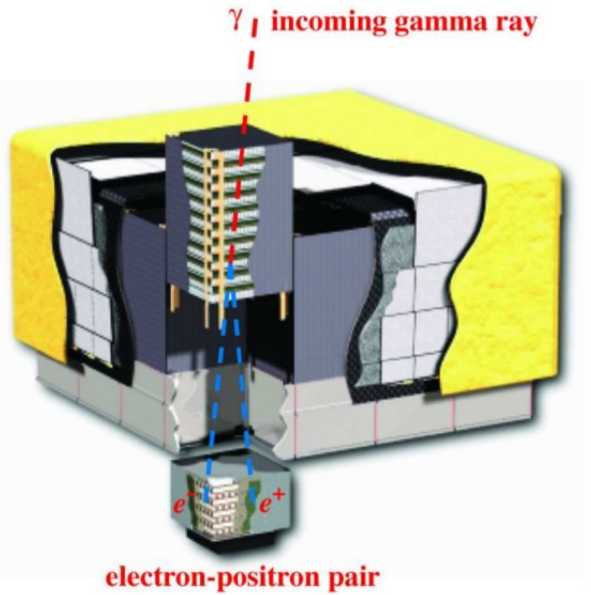


Structure of the LAT

- Converter/tracker
- Calorimeter
- Anti-coincidence system

Performances

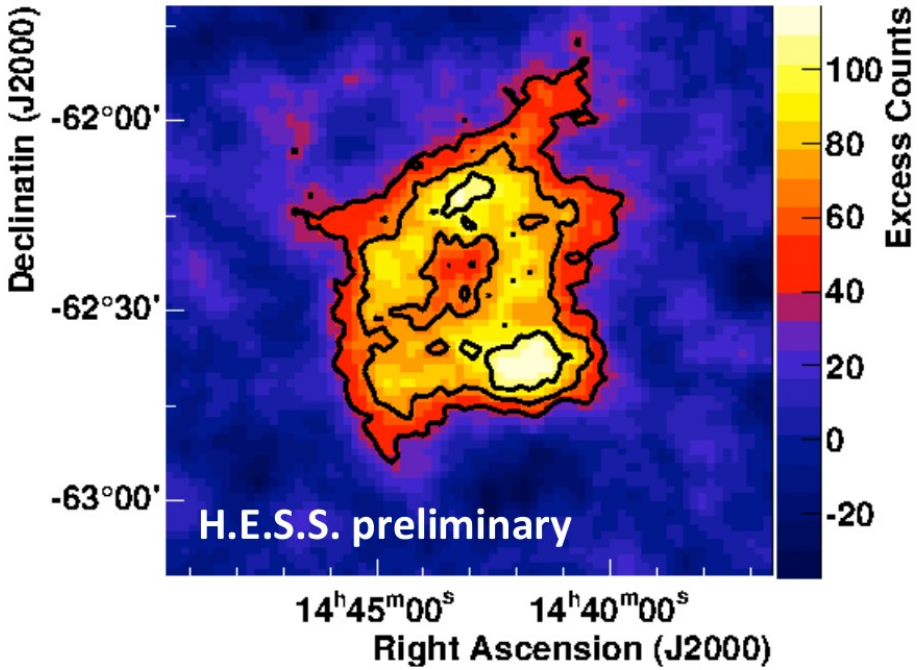
- Energy range : 20 MeV - 500 GeV
- Large field of view (~ 2.4 sr)
- PSF ~ 0.08° (68% contain.) at 10 GeV with the best event class



About RCW 86

ID Card

- Remnant of a Type Ia SN
- Associated to the historical SN 185
- Age ~ 1850 years
- Distance ~ 2.5 kpc

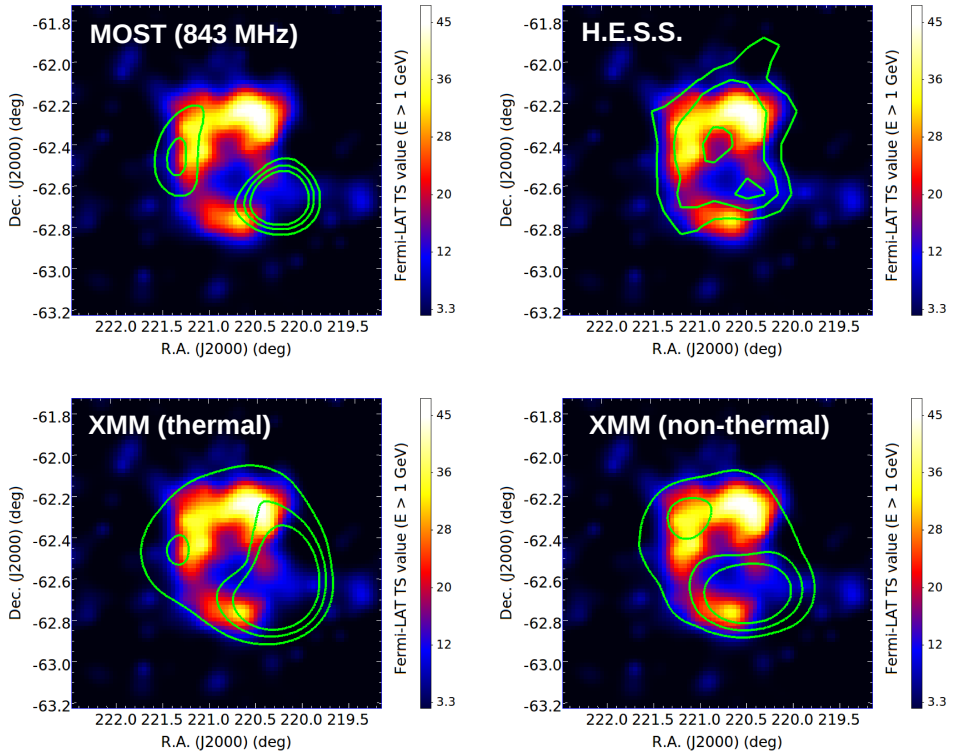


Why this remnant ?

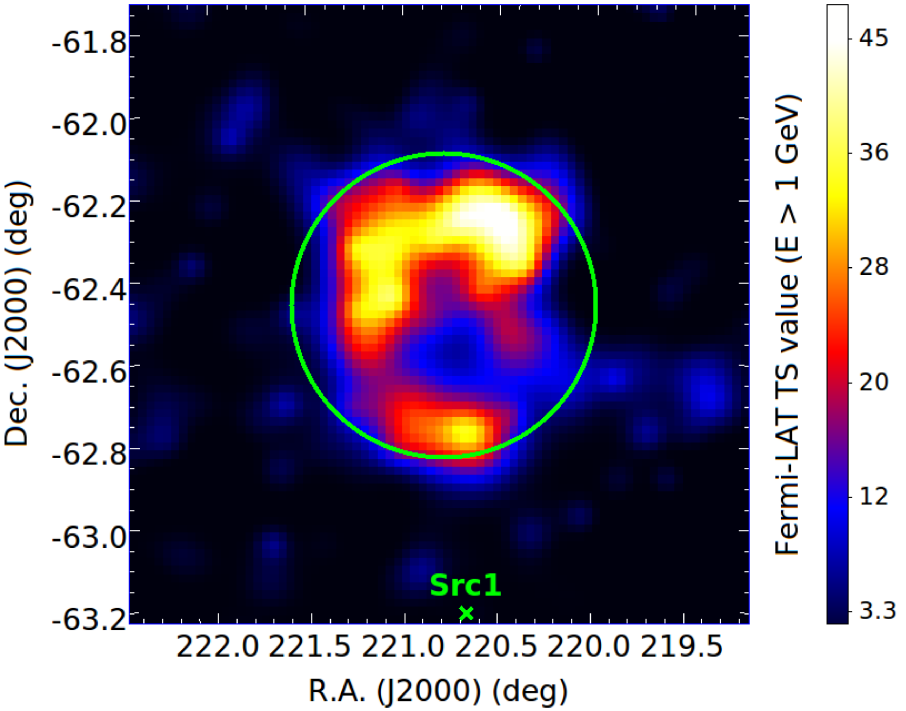
- young remnant
  (efficient CR accelerator ?)
- detection of non-thermal X-rays
- lots of multiwavelength observations

RCW 86 as seen by *Fermi*-LAT

- Now detected as an extended source with the LAT (radius = 0.37° ± 0.2°)
- No good correlation between LAT data and multiwavelength templates



TS map above 1 GeV
(contours of the best uniform disk template)

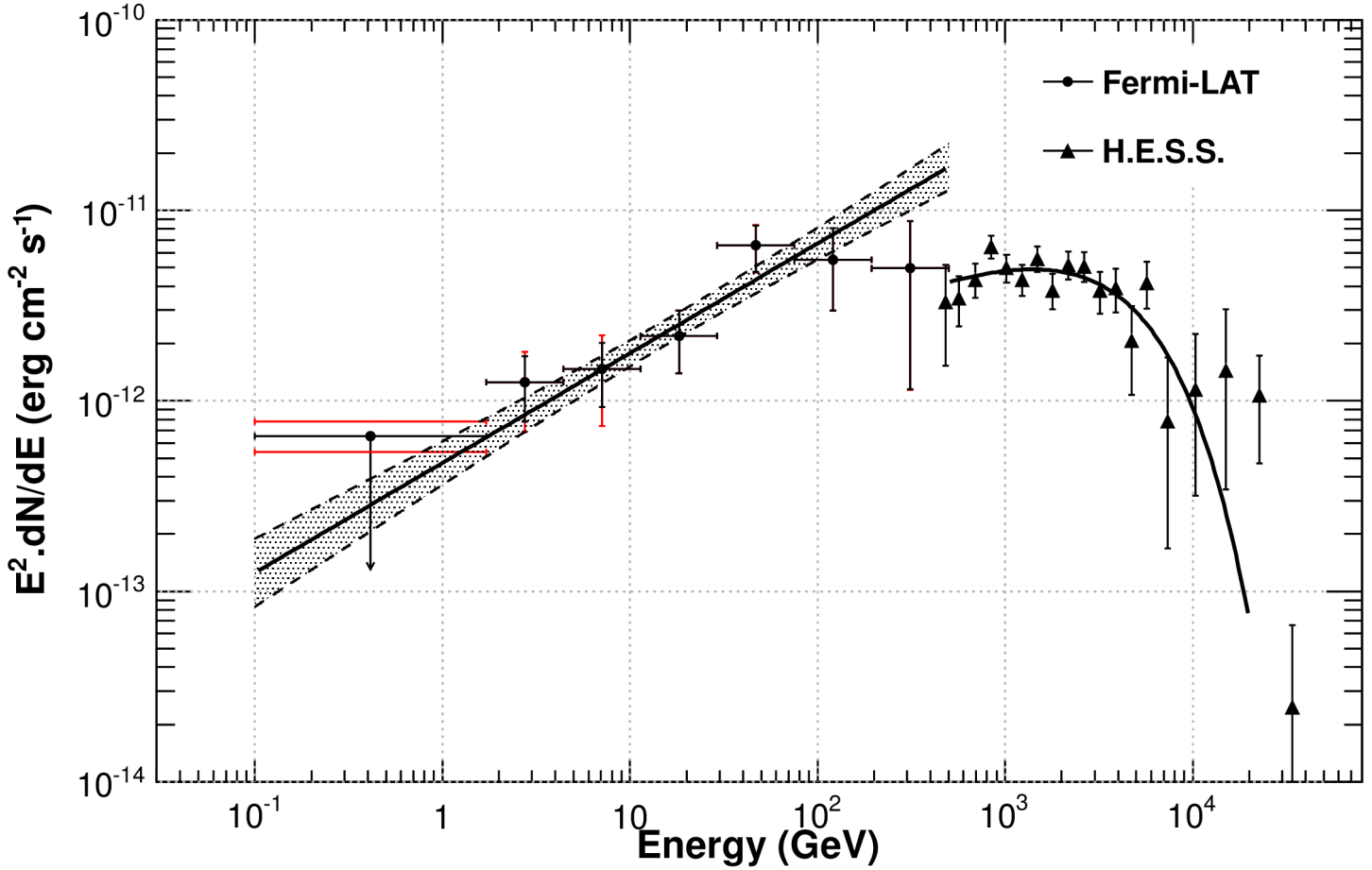


→ HESS template for the spectral analysis

Spectral analysis

Energy range : 100 MeV - 500 GeV

- Spectral model : Power Law ($\Gamma = 1.42 \pm 0.1_{stat} \pm 0.06_{syst}$)
- Power Law → Broken Power Law : ~ 2 σ (not significant enough)



Modeling of the non-thermal emission

- SED modeling : one unique population of emitting leptons
- Inverse Compton on CMB only

Parameters

Density = 0.1 cm^{-3}

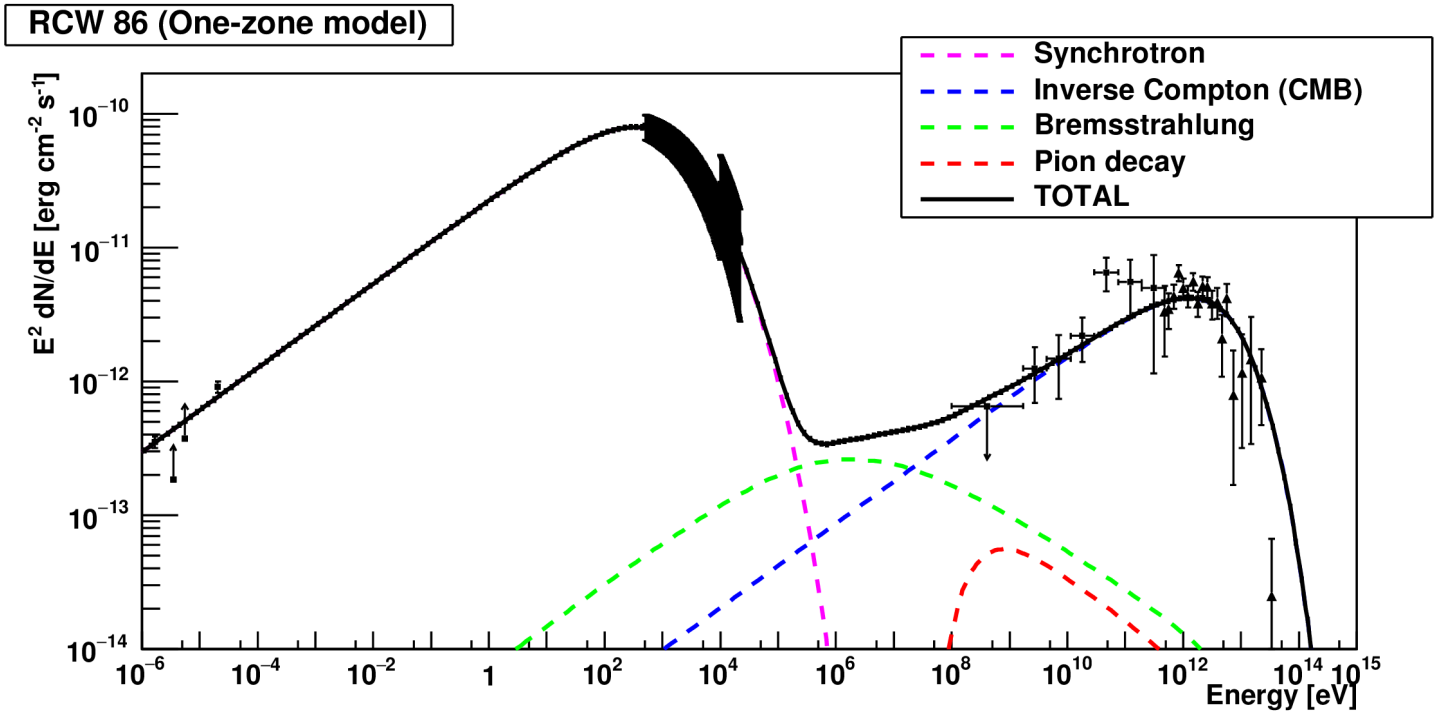
B-field = 10.7 µG

$\Gamma_{e,p} = 2.37$

$E_{max} = 75$ TeV

η_e (% of E_{SN}) ~ 3.84

η_p (% of E_{SN}) < 2



Modeling of the non-thermal emission

- SED modeling : two populations
  - one population of radio emitting particles
  - one population of X-ray/gamma-ray emitting particles
- Inverse Compton on CMB only

Parameters

Density = 1.0 cm^{-3}

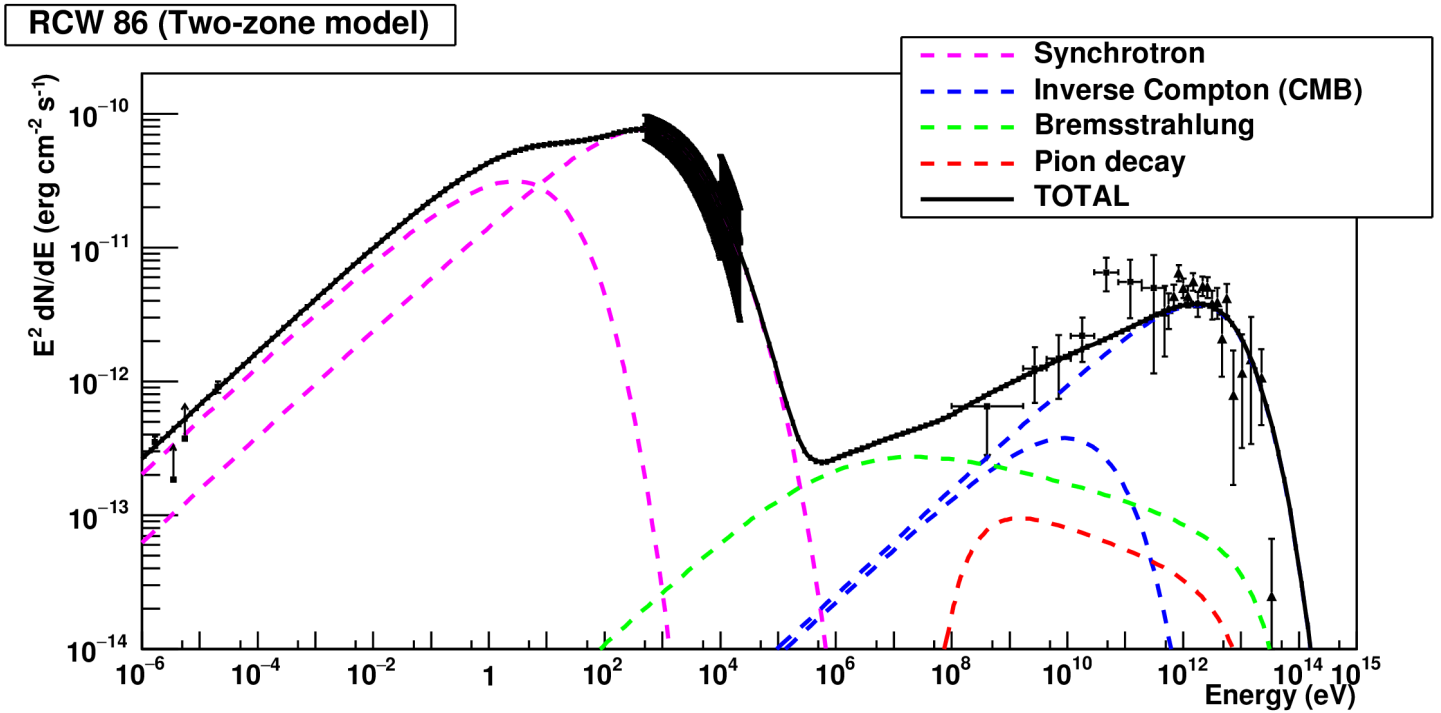
B-field = 10.5 µG

$\Gamma_{e,p} = 2.37$

$E_{max} = 67$ TeV

η_e (% of E_{SN}) ~ 0.37

η_p (% of E_{SN}) < 2



All those results (and more !) are available in : *Ajello et al. 2016, ApJ, 819, 98*

Conclusions about RCW 86

- A promising SNR :
  - young remnant
  - non-thermal emission detected in X-rays
  - detected at TeV energies

- The GeV analysis is interesting :
  - the morphology seen by Fermi-LAT does not corrolate very well with the radio, X-ray and TeV morphologies
  - the SED and the modeling points toward a pure leptonic γ-ray emission (no protons... ?)

- But :
  - A Power Law seems a bit too simple to describe the spectrum, when looking at the SED
  - It's a faint remnant, low statistics at GeV energies