

**Discovery of γ -ray emission spatially associated with S147/PSR
J0538+2817 by LHAASO WCDA and KM2A data**

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Background

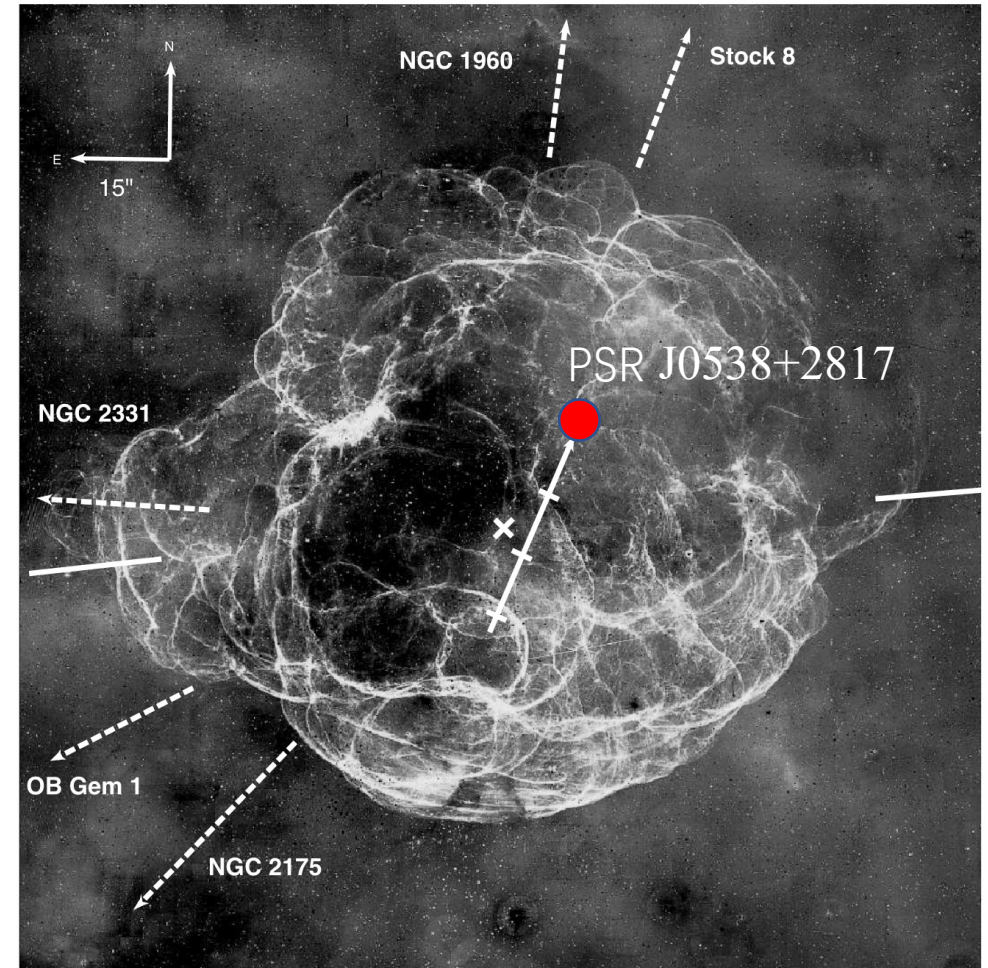
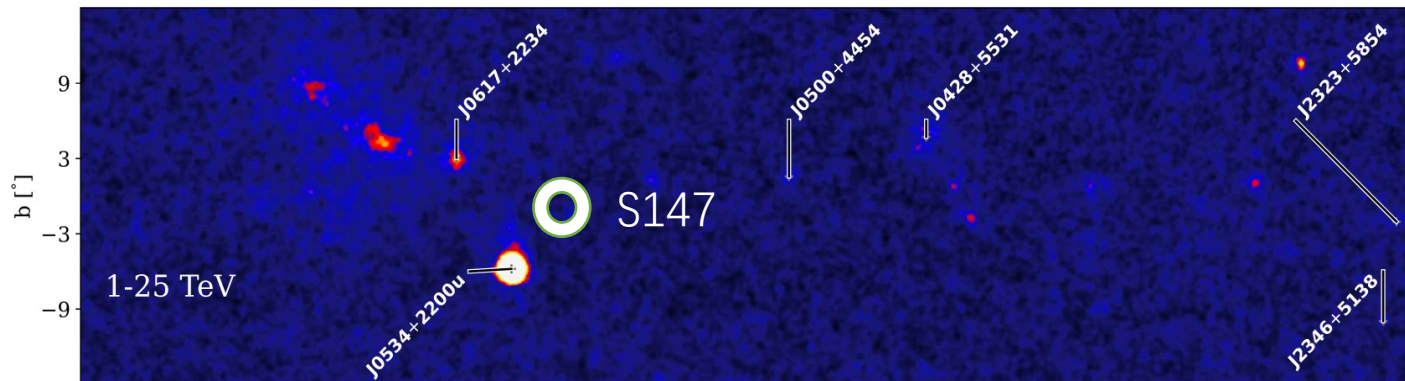
S147 :

Gal 180.170 -01.819

PSR J0538+2817

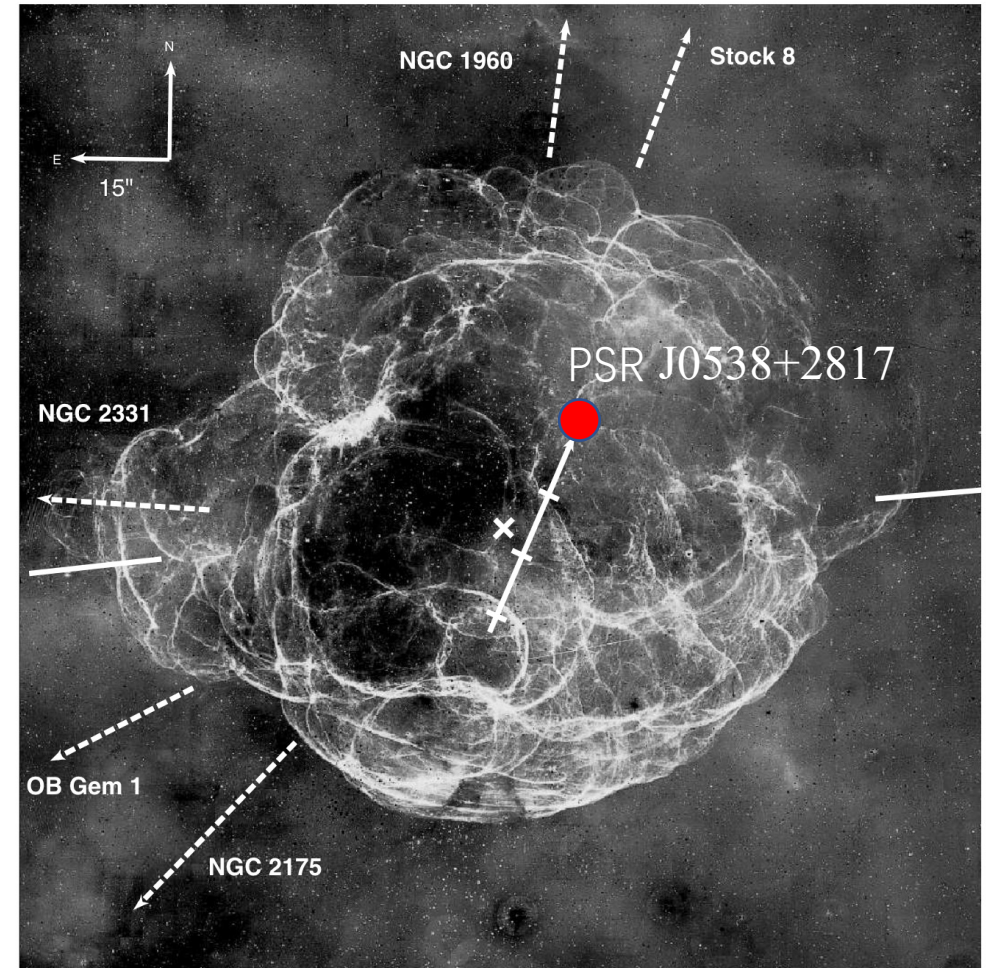
Name	RA (deg)	DEC (deg)	Distance (Kpc)	Size (pc)	Angular size θ (deg)
Simeis 147	84.75	27.83	1.2 – 1.5	76	3
PSR J0538+2817	84.60	28.29	1.47		

20 kyr - 100 kyr (pulsar's kinematic age of 30 kyr, SNR evolutionary model $\sim 10^5$ years)



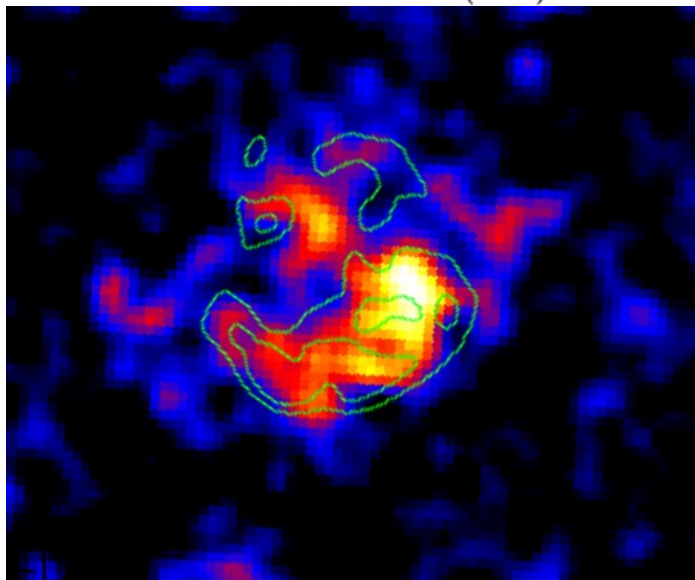
Data Used:

- **ROI:** centered at PSR J0538+2817 with a radius of 8°
- **WCDA:** March 5, 2021 – July 31, 2025, livetime of 1484 days.
- **KM2A:** December 2019 – July 31, 2025, livetime of 1944 days.

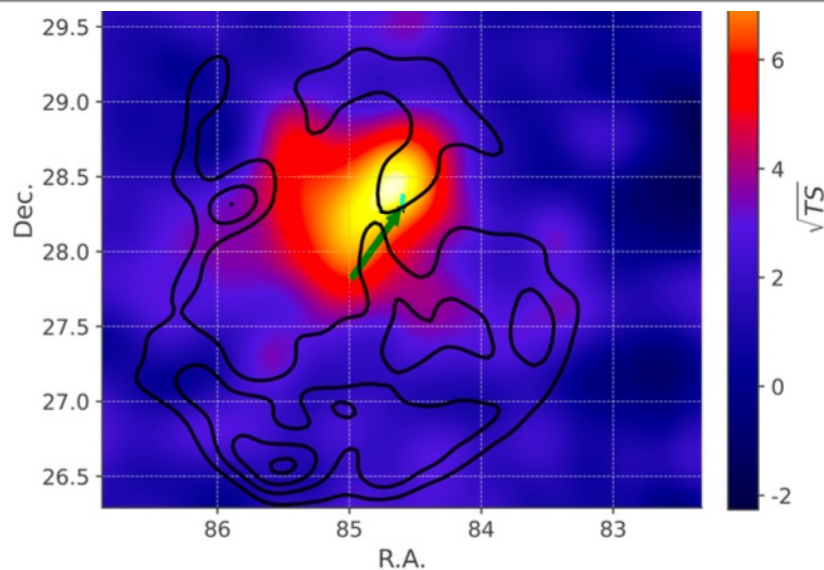


Result

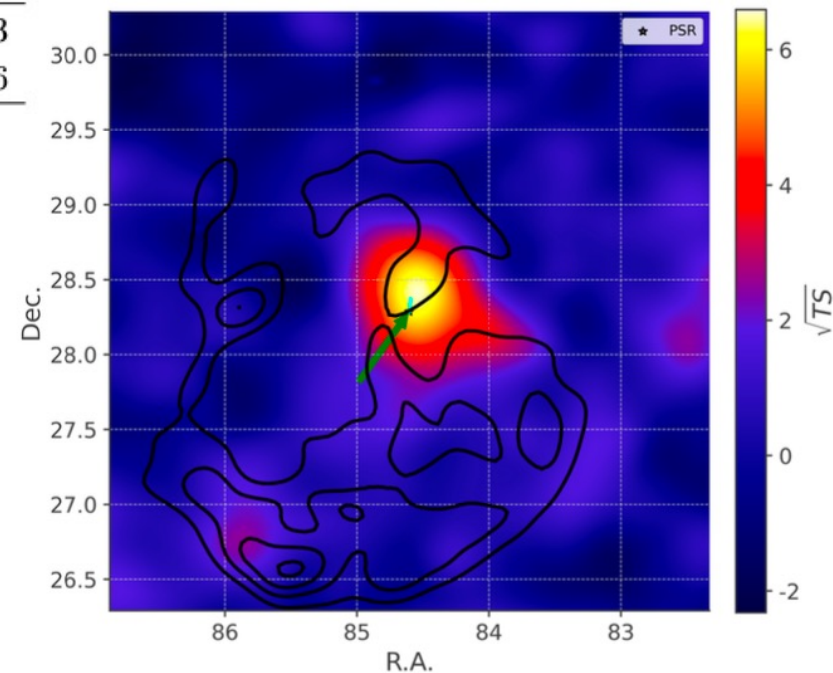
Model	Detector	R.A.	Dec.	r_{39}	ΔTS	Index
Point	WCDA	$84.61 \pm 0.04^\circ$	$28.49 \pm 0.04^\circ$		60.06	-2.37 ± 0.18
	KM2A	$84.55 \pm 0.05^\circ$	$28.41 \pm 0.06^\circ$		53.58	-3.37 ± 0.17
Gaussian	WCDA	$84.83 \pm 0.08^\circ$	$28.33 \pm 0.08^\circ$	$0.41 \pm 0.07^\circ$	76.47	-2.55 ± 0.15
	KM2A	$84.54 \pm 0.05^\circ$	$28.41 \pm 0.06^\circ$	$0.06 \pm 0.05^\circ$	53.59	-3.37 ± 0.16
Point + Gaussian	WCDA(point)	$84.60 \pm 0.04^\circ$	$28.51 \pm 0.04^\circ$		96.81	-2.10 ± 0.25
	WCDA(Gaussian)	$85.02 \pm 0.18^\circ$	$28.11 \pm 0.18^\circ$	$1.01 \pm 0.16^\circ$		-2.88 ± 0.15
Two Gaussian	WCDA(PSR)	$84.60 \pm 0.02^\circ$	$28.50 \pm 0.02^\circ$	$0.07 \pm 0.01^\circ$	96.92	-2.04 ± 0.23
	WCDA(Else)	$85.03 \pm 0.18^\circ$	$28.11 \pm 0.19^\circ$	$1.02 \pm 0.16^\circ$		-2.90 ± 0.16



Fermi-LAT

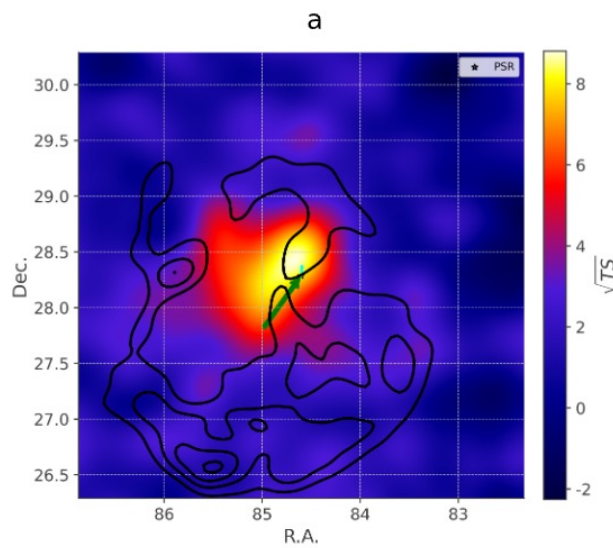


WCDA > 1 TeV

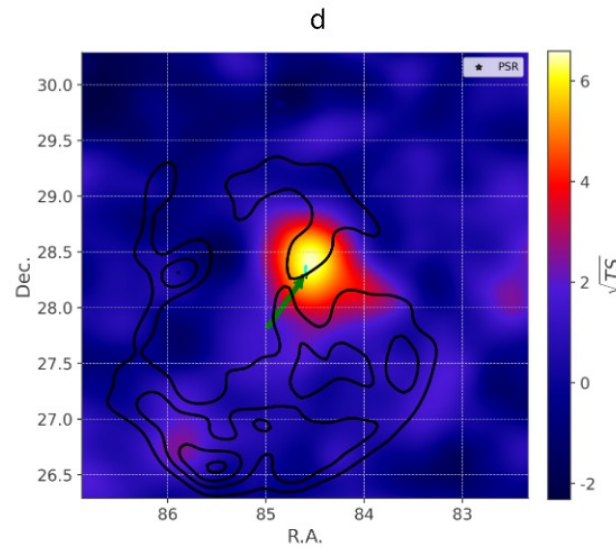


KM2A > 25 TeV

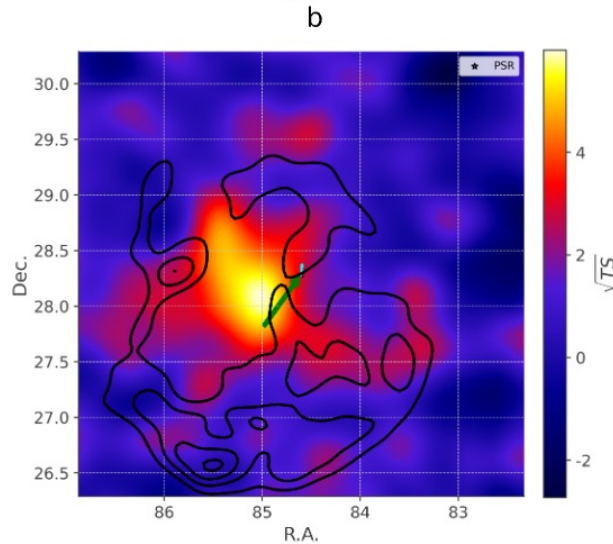
WCDA significance map



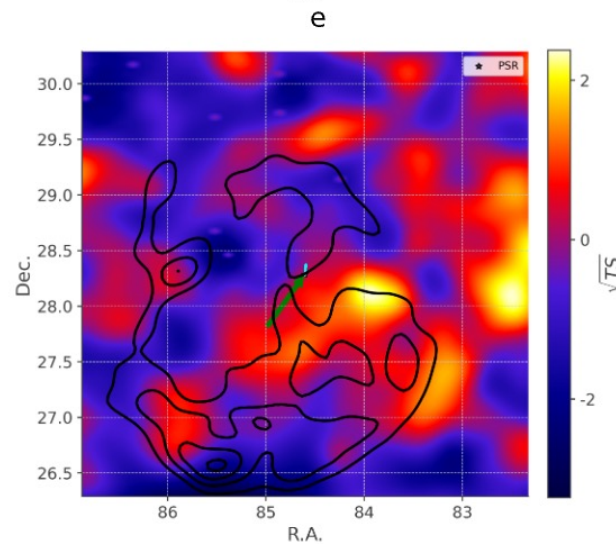
KM2A significance map



WCDA significance map
of the Gaussian
component

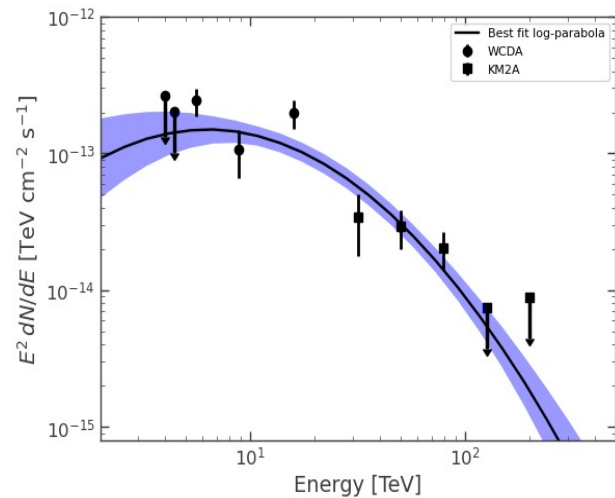


KM2A residual map

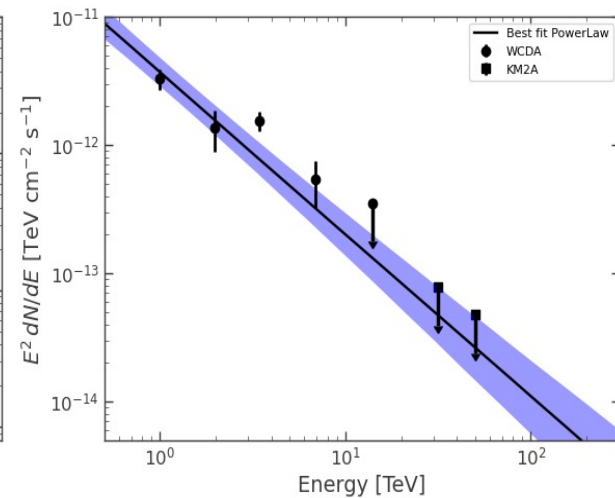




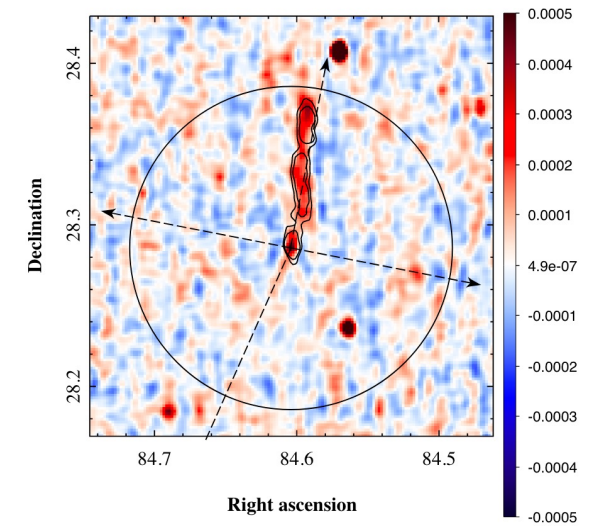
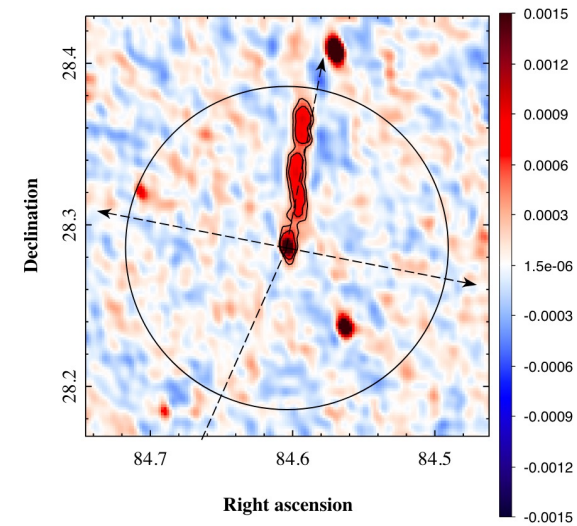
Result



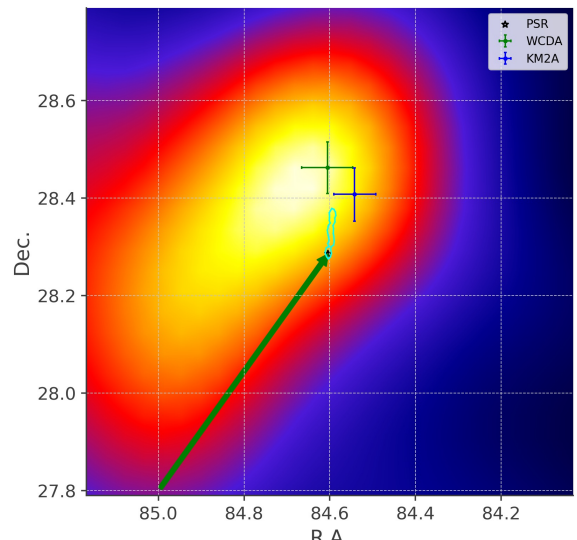
WCDA



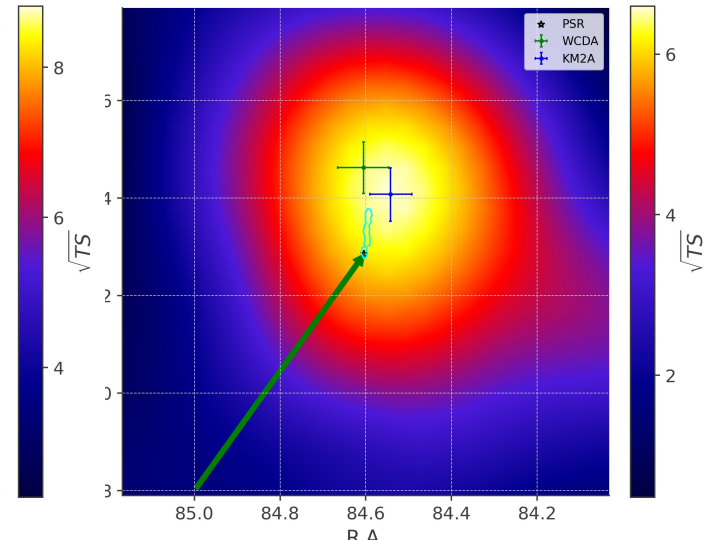
KM2A



Khabibullin, I. et al. (2024).



WCDA



KM2A

- We first detected TeV emission possibly originating from the PWN of PSR J0538+2817 in S147.
- We found a second component in WCDA, located at the center of S147, besides the pulsar, and its origin differs from the GeV observations by Fermi-LAT.
- The radio filaments of PSR J0538+2817 point to the best-fit position of the LHAASO point-source component.