The γ-ray emission of 3HWC J1928+178

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On behalf of the HAWC collaboration

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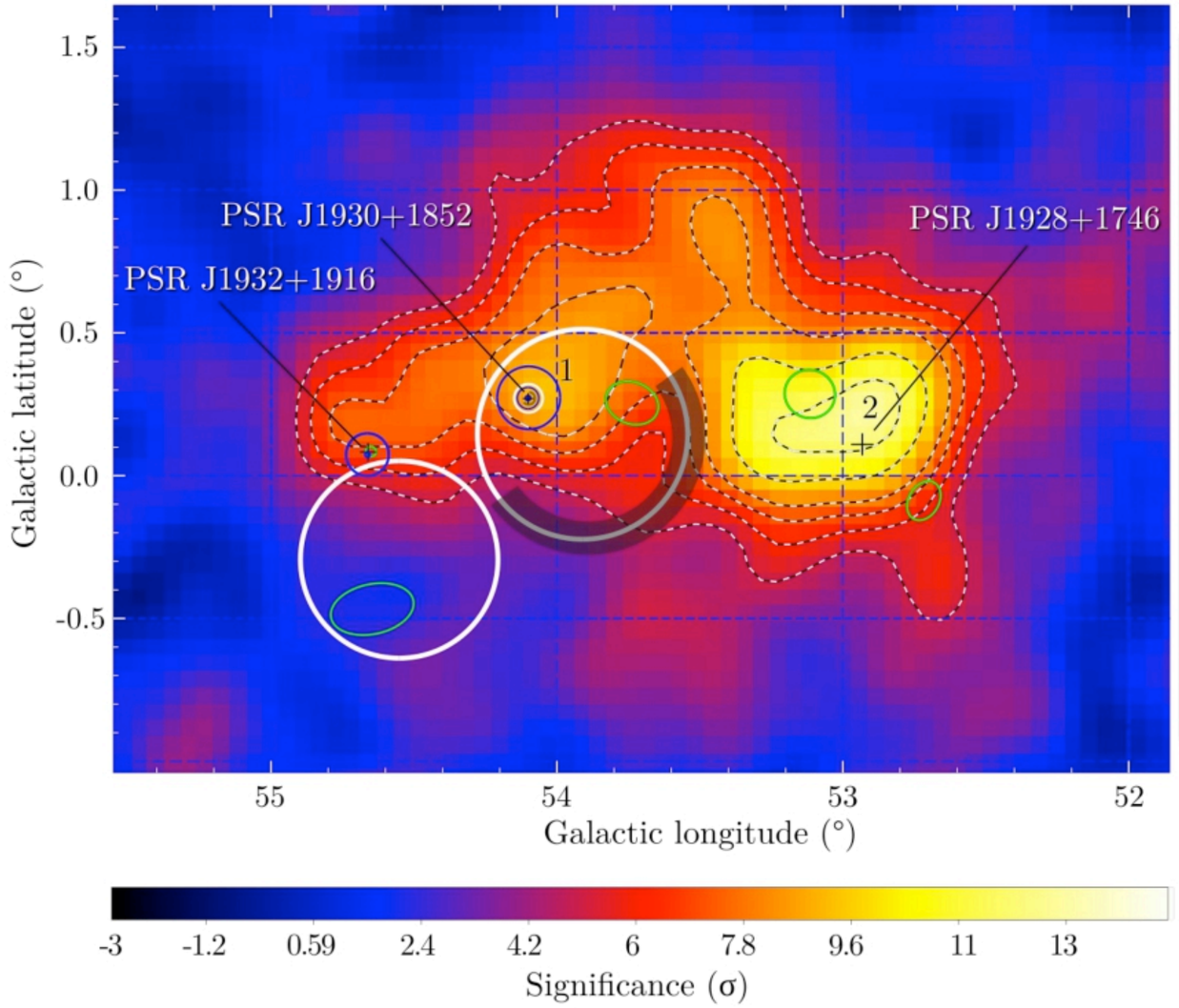
HAWC significance map



1 3HWC J1930+188
2 3HWC J1928+178

\+ Pulsar location

X-ray PWN, X-ray PSR } Chandra, XMM, Suzaku, Swift

4FGL sources

Radio shell

IR emission

HAWC contours for 5, 6, 7, 8, 10 and 12σ

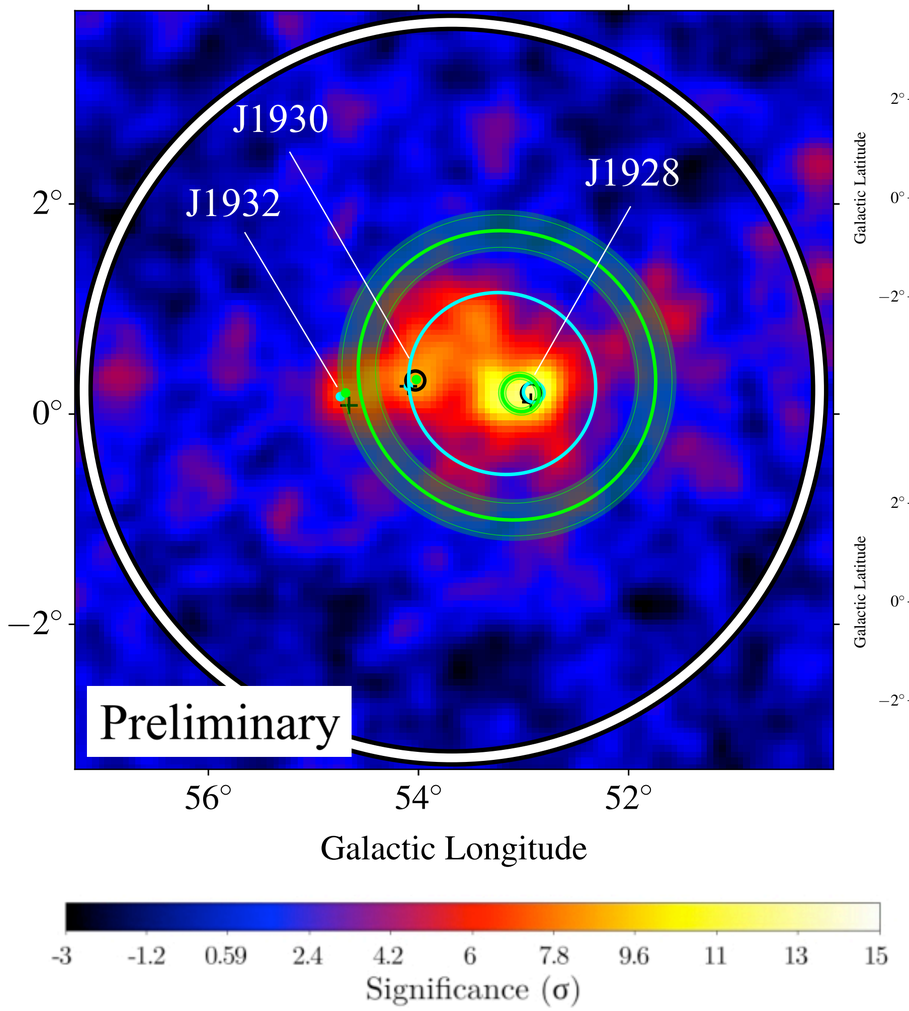
HAWC data

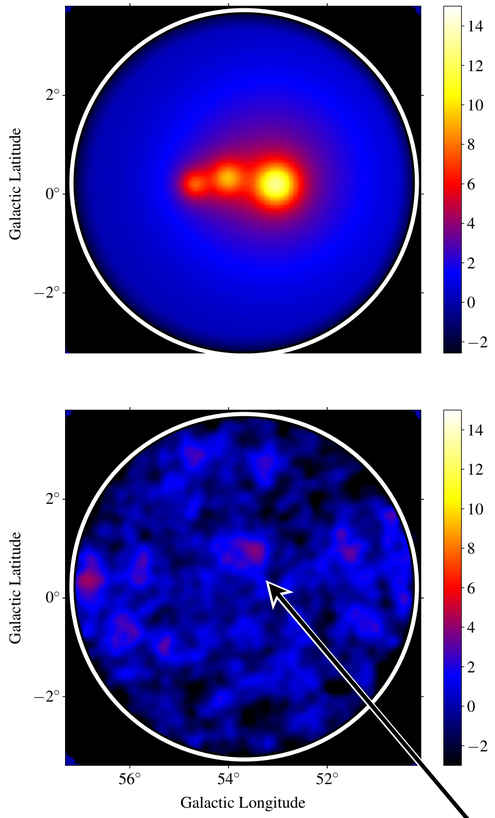
1523 days
Analysis bin 4 - 9
≈ 1TeV

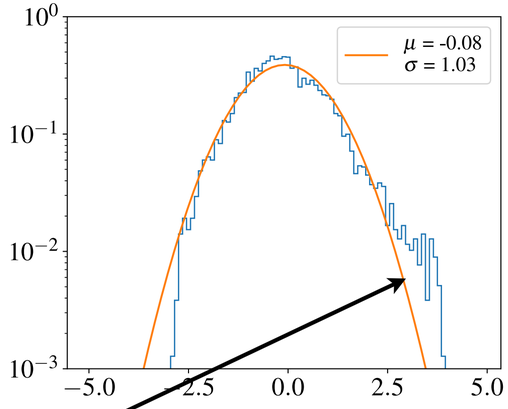
PSR J1928+1746

Distance = 4.3 kpc
Age = 82 kyr
Period = 68.7 ms
$\dot{P} = 1.32\ 10^{-14}$
$\dot{E} = 1.6\ 10^{36}$ erg s^{-1}

4 components model







3σ excess

	3HWC J1928+178
Angular size (39%, º)	$0.18^{o}\ \pm 0.03$
Angular size (68%, º)	$0.27^{o}\ \pm 0.03$
Diameter (pc)	~ 41
Energy flux [1-100TeV] (erg cm^{-2} s^{-1})	$3.12\ \pm 1.1\ 10^{-12}$
Spectral index	$-2.09\ \pm 0.15$
γ-ray luminosity (erg)	~ $7\ 10^{33}$
Energy density (eV cm^{-3})	~ 0.04

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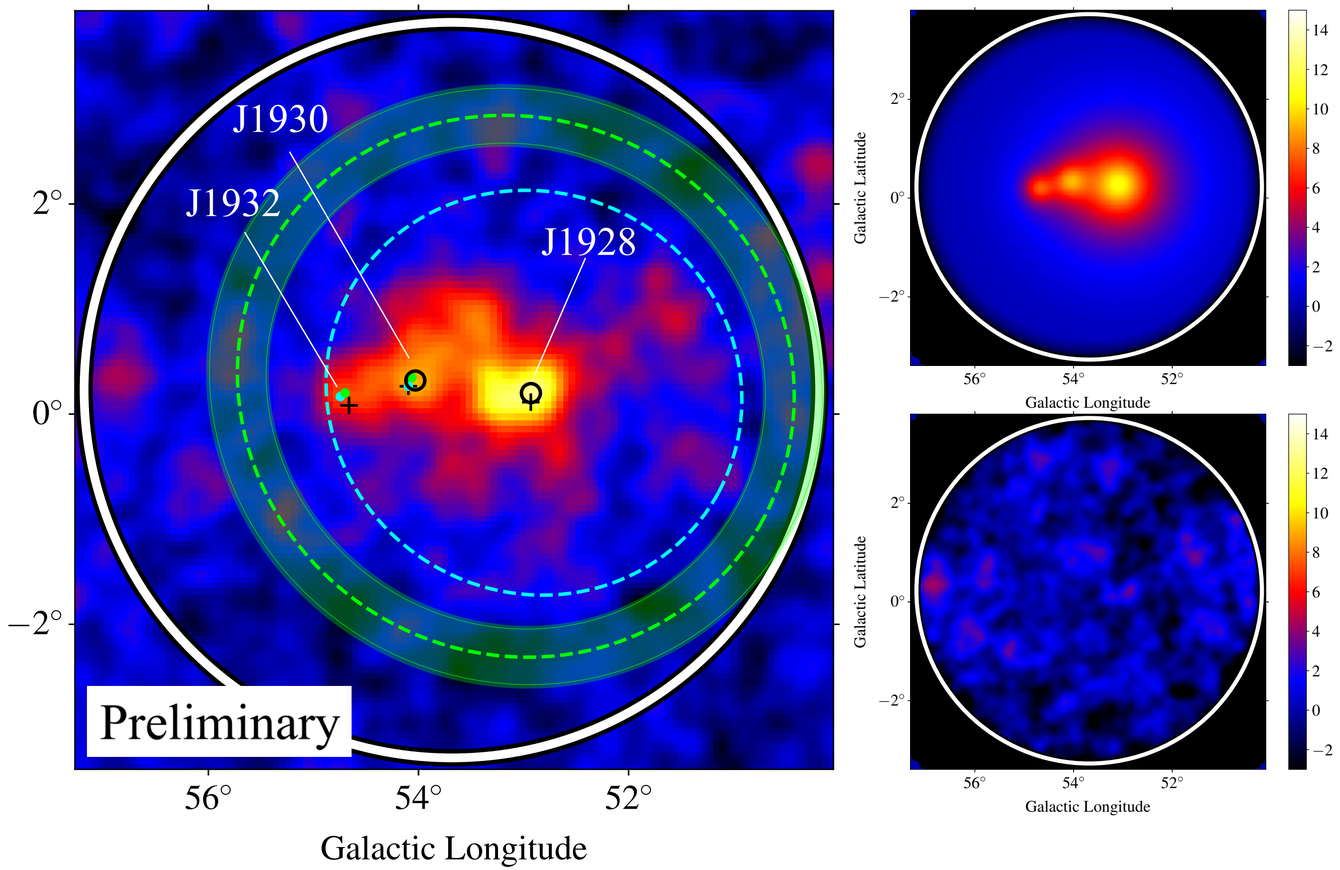
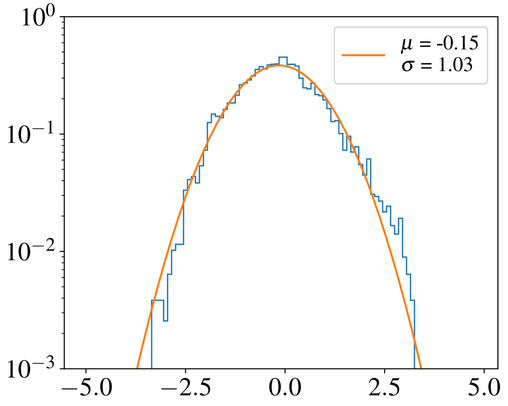
Diffusion model



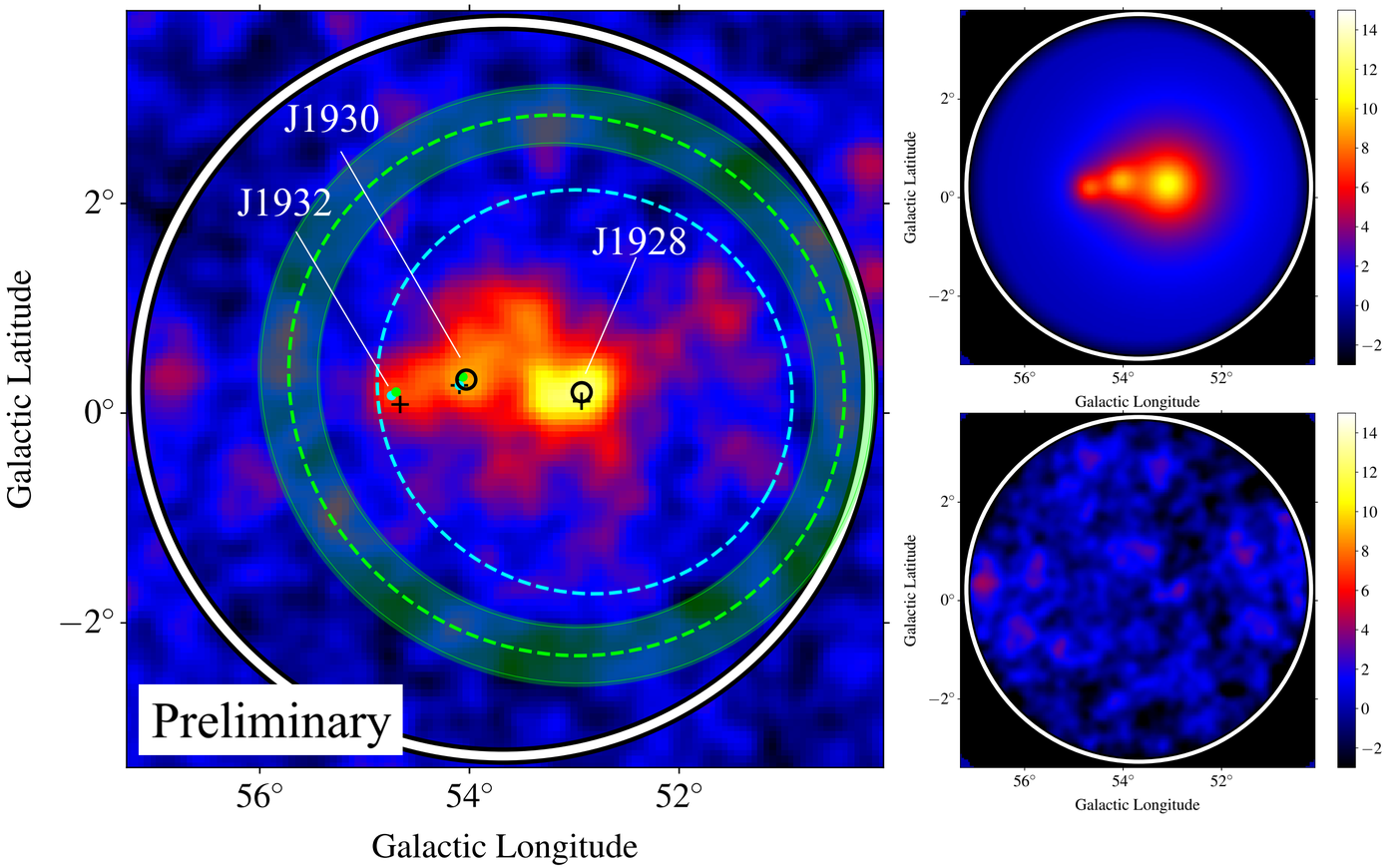
	3HWC J1928+178
Diffusion radius (º)	2.68º ±0.3
Radius 68% emission (º)	~ 1.2
Radius 68% emission (pc)	~ 90
Energy flux [1-100TeV] (erg cm^{-2} s^{-1})	4.6 ±0.4 10^{-11}
Spectral index	-2.58 ±0.05
γ-ray luminosity (erg)	~ 1 10^{35}
Energy density (eV cm^{-3})	~ 0.05

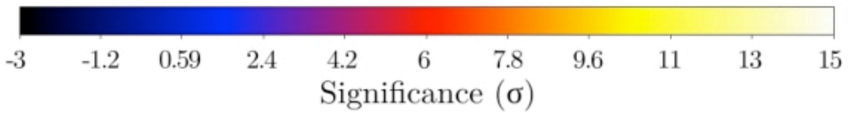


Flux ad a function of the distance d assuming continuous injection of e$^{\pm}$, with diffusion radius r_d ;

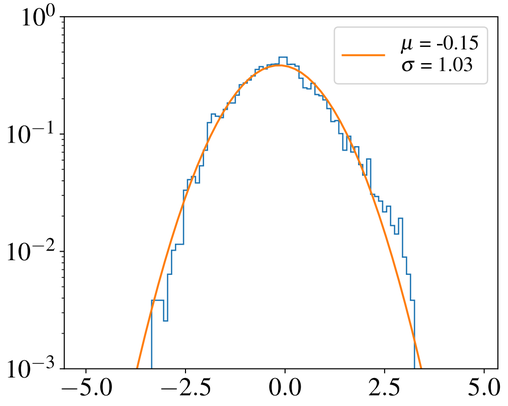
$$f_d = \frac{1.22}{\pi^{3/2} r_d (d + 0.06 r_d)} \exp \frac{-d^2}{r_d^2}$$

Diffusion model





	3HWC J1928+178	Geminga
Diffusion radius (°)	$2.68^{\circ}\ \pm 0.3$	$5.5^{\circ}\ \pm 0.2$
Radius 68% emission (°)	~ 1.2	~ 3.5
Radius 68% emission (pc)	~ 90	~ 16
Energy flux [1-100TeV] (erg cm^{-2} s^{-1})	$4.6\ \pm 0.4 10^{-11}$	$5.6\ \pm 0.8\ 10^{-11}$
Spectral index	$-2.58\ \pm 0.05$	$-2.34\ \pm 0.07$
γ-ray luminosity (erg)	~ 1 10^{35}	~ 2.1 10^{33}
Energy density (eV cm^{-3})	~ 0.05	~ 0.01



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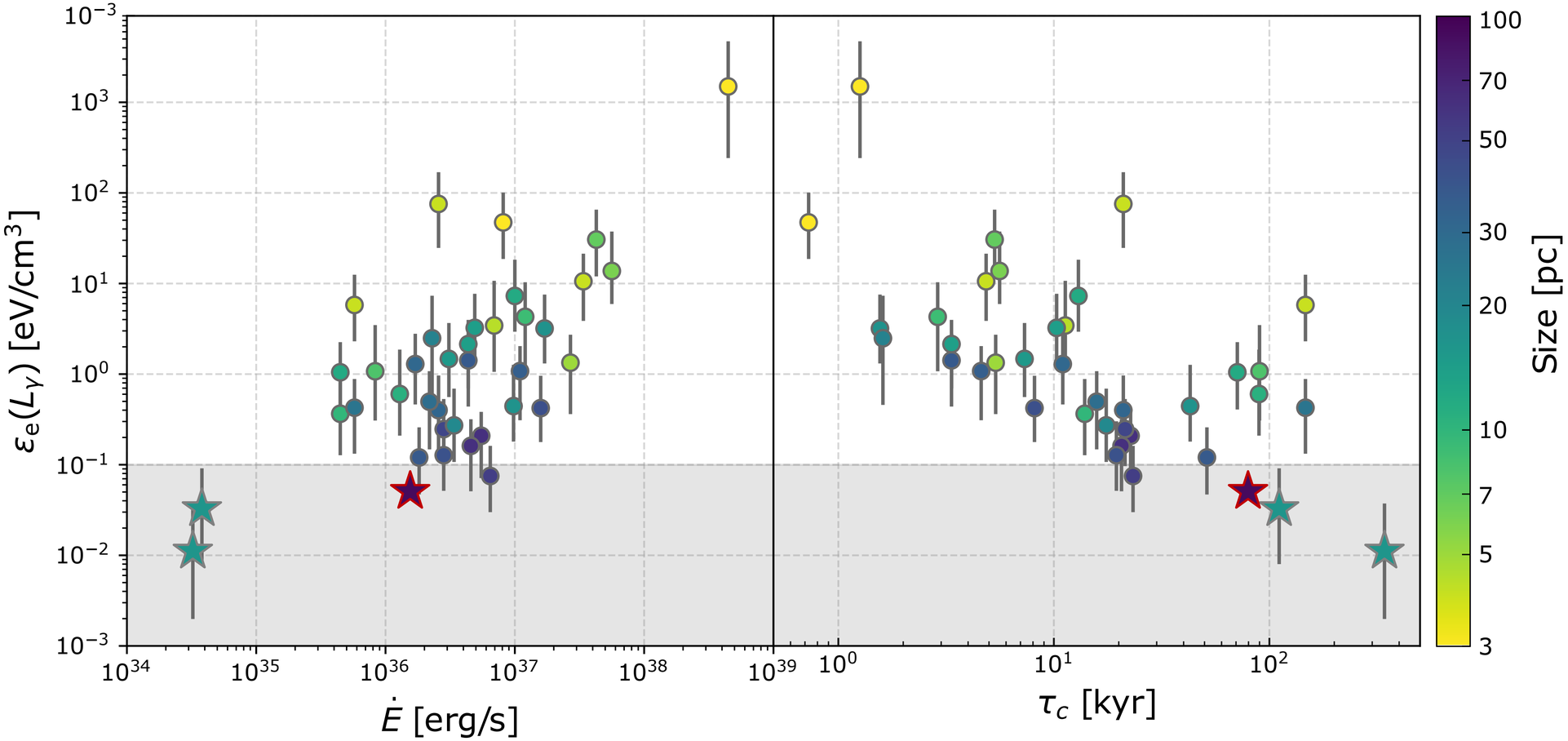
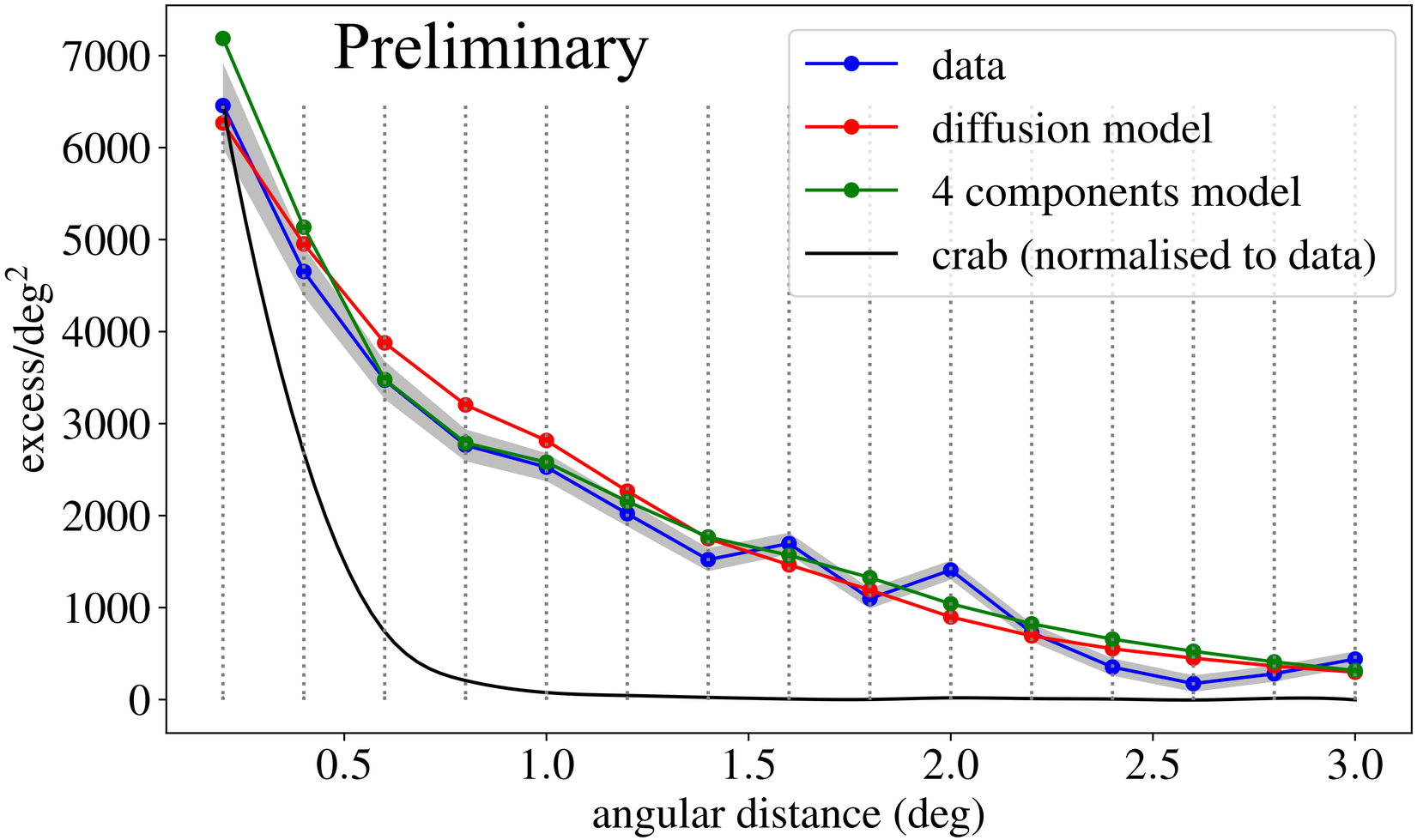
Giacinti et al., 2020, A&A, 636, A113

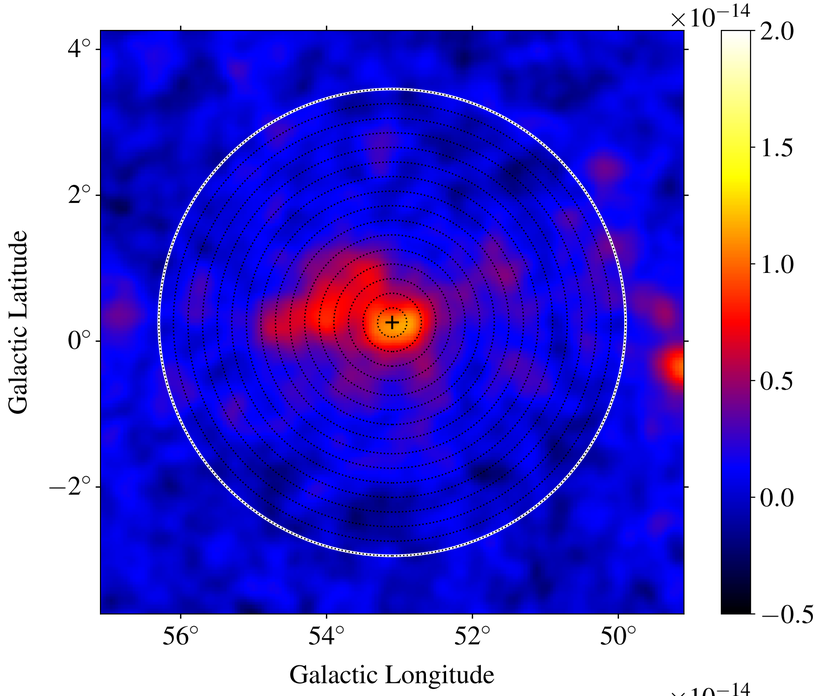
Comparison with Geminga

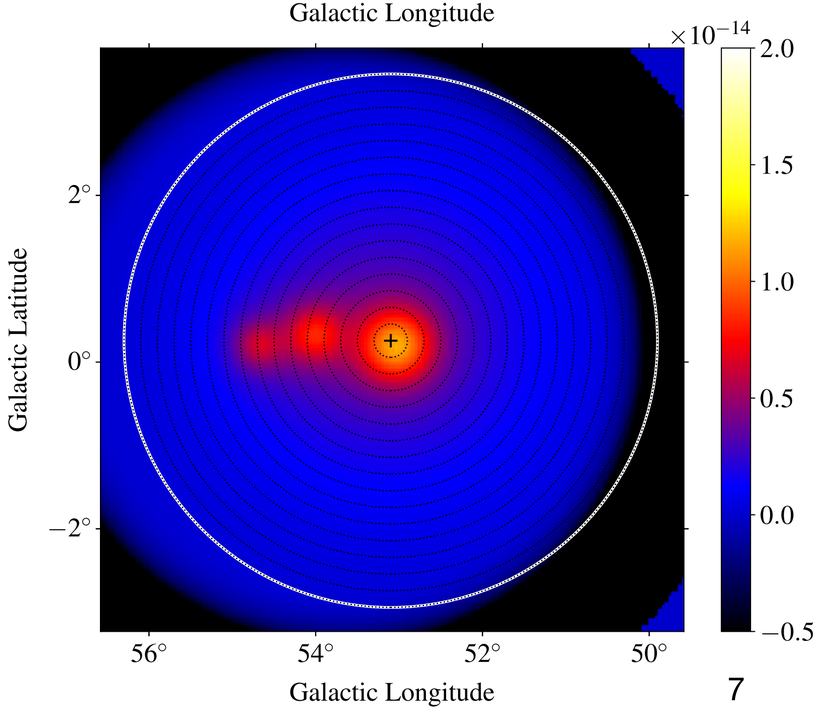


Giacinti et al., 2020, A&A, 636, A113

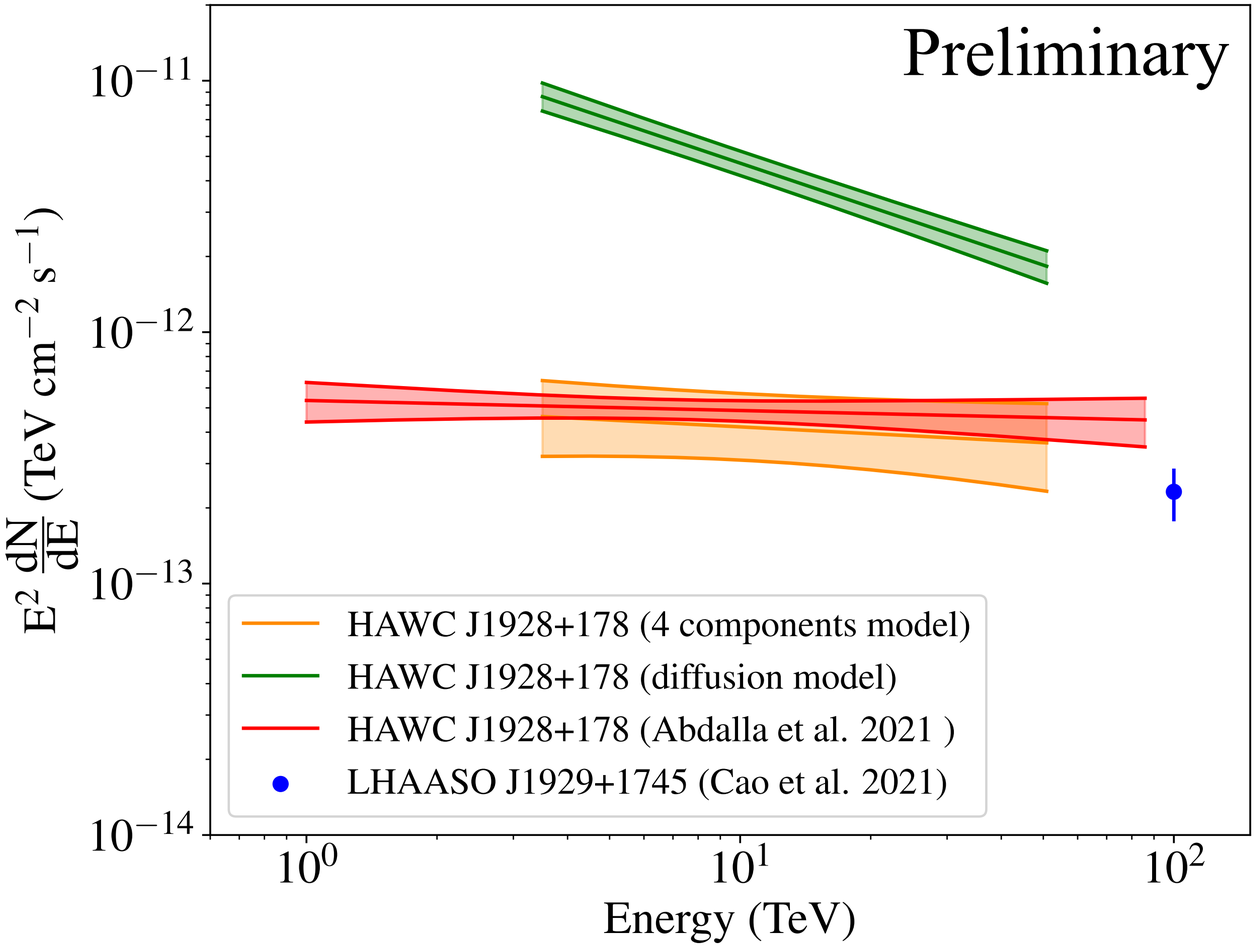
Radial profiles



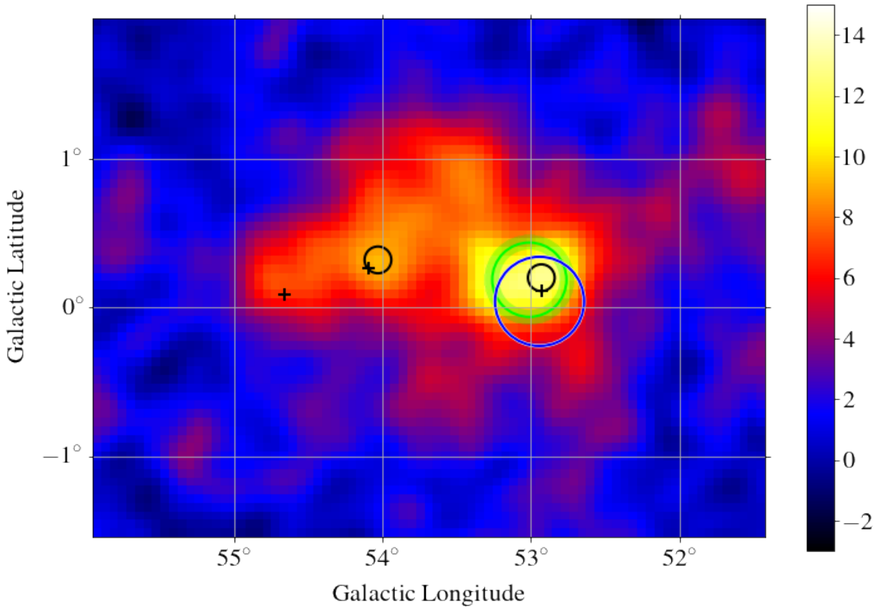




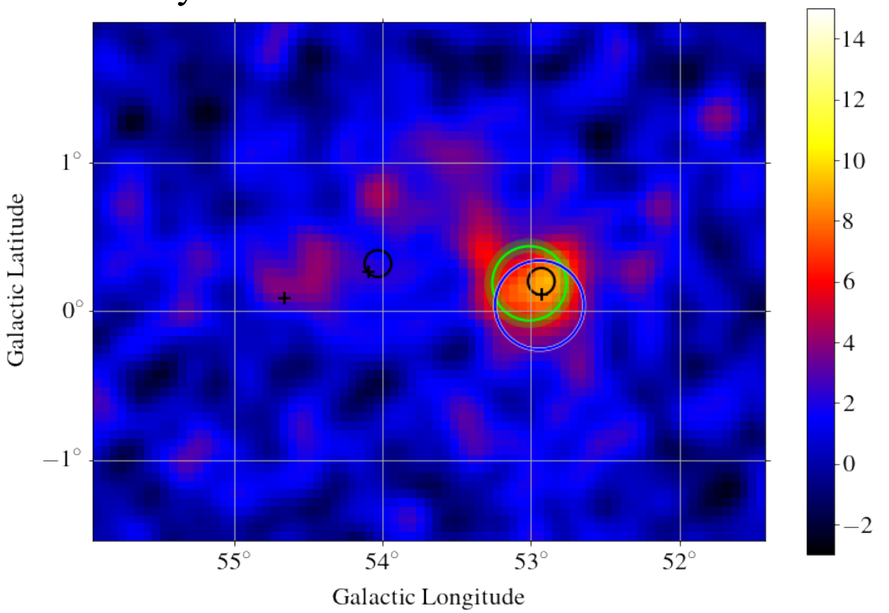
Spectrum



Analysis bin 4 - 9



Analysis bin 8 - 9



Conclusions

- The observed γ-ray emission from 3HWC J1928+178 can be described using 2 models

4 components model		Diffusion model
• σ (68%) = 0.27°	ΔBIC = 45	• r (68%) = 1.2°
• ε = 0.04 eV cm^{-3}		• ε = 0.05 eV cm^{-3}

- Is 3HWC J1928+178 a γ-ray halo candidate ?
  - Powered by PSR J1928+1746 – rather old pulsar
  - No X-ray counterpart
  - Extended γ-ray emission
  - $\varepsilon_{IC} < \varepsilon_{ISM}$ (= ~ 1 eV cm^{-3}) assuming IC scattering as γ-ray emission mechanism
  - The γ-ray emission possibly originates from $e^{\pm}$ cooling down and diffusing away from their source
- Extending the HAWC spectrum to ~100 TeV may help rejecting the diffusion model if no cut-off is observed
- Exploring other scenario : interaction with a molecular cloud

Thank you for you attention

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