The region surrounding 1LHAASO J1928+1746u

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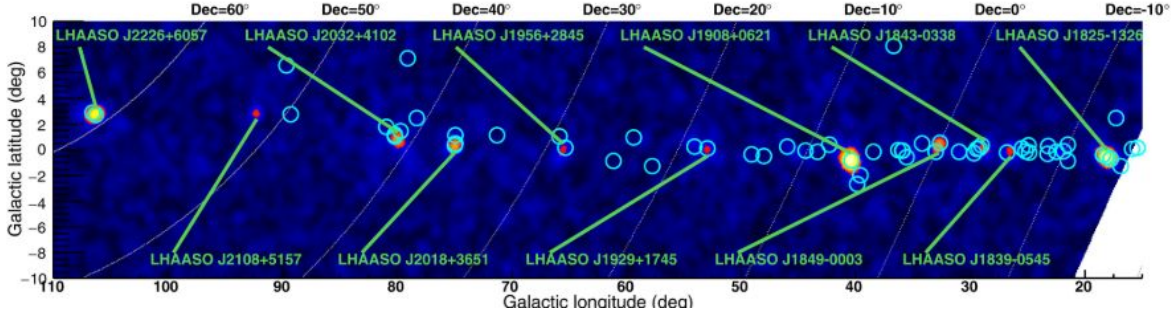
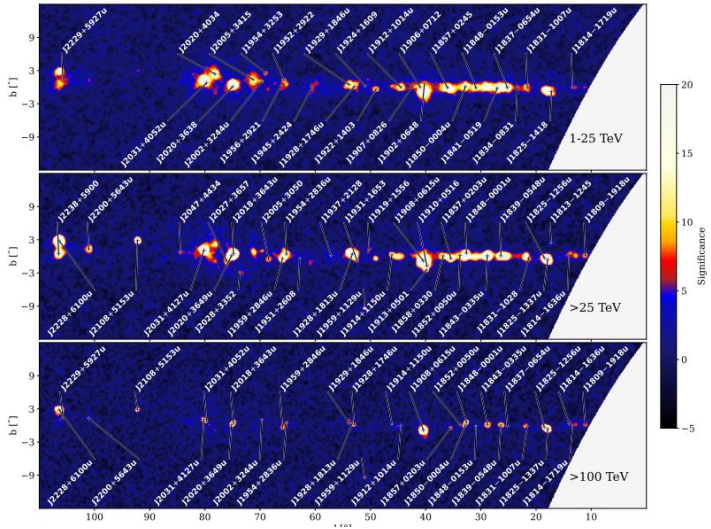
The LHAASO catalogue

Cao+2021

- 12 Sources
- KM2A, no WCDA
- E>25 TeV





Cao+2023

- 90 Sources
- KM2A + WCDA
- E>1 TeV

Good observational candidates

5σ with LST1
(E>1TeV) < 50 h

Table from Cao+2023

Source name	Components	α_{2000}	δ_{2000}	$\sigma_{p,95,stat}$	r_{39}	TS	N_0	Γ	TS_{100}	Asso.(Sep.[°])
1LHAASO J1928+1746u	WCDA	292.14	17.78	0.07	0.17±0.02	196.0	0.79±0.05	2.22±0.05		2HWC J1928+177 (0.01)
	KM2A	292.17	17.89	0.07	<0.16	127.7	0.72±0.07	3.10±0.12	44.9	
1LHAASO J1929+1846u*	WCDA	292.34	18.77	0.10	0.49±0.02	416.2	2.48±0.11	2.37±0.04		SNR G054.1+00.3 (0.29)
	KM2A	292.04	18.97	0.08	<0.21	130.0	0.64±0.06	3.11±0.12	26.0	

SNR G54.1+0.3: a PWN at a distance of ~6.5 kpc hosting a young, energetic pulsar, PSR J1930+1852

2HWC J1928+177: coincident with PSR J1928+1746, is older and less energetic than PSR J1930+1852. No PWN has been observed

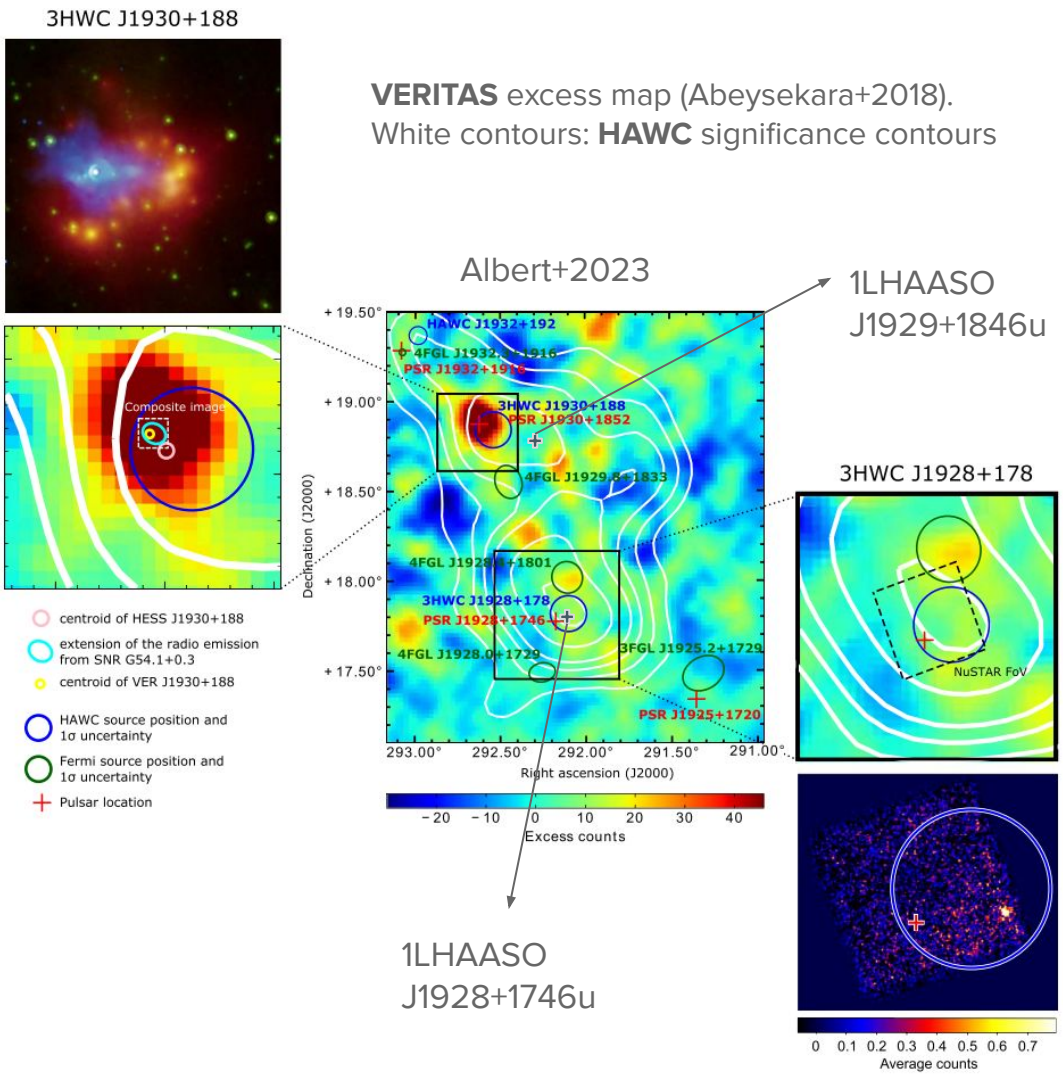
An interesting region

The region encompasses diverse astrophysical objects, exhibiting complex γ-ray, X-ray, radio, and infrared signatures.

Features significant γ-ray emissions, primarily from sources like 3HWC J1930+188, 3HWC J1928+178, and HAWC J1932+192.

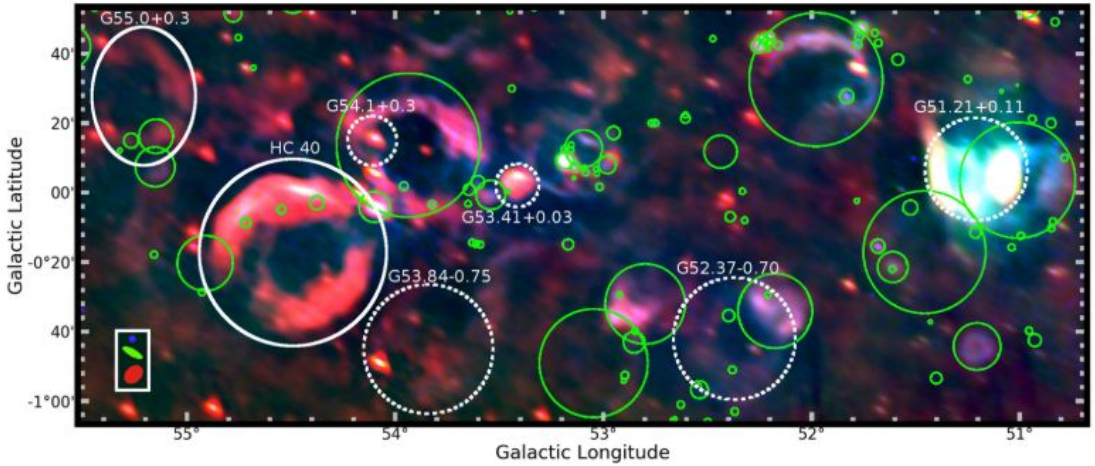
The region has not been studied much at VHE, only ~40 hrs by VERITAS and HESS

Complex mechanisms behind the observed gamma-ray emissions.

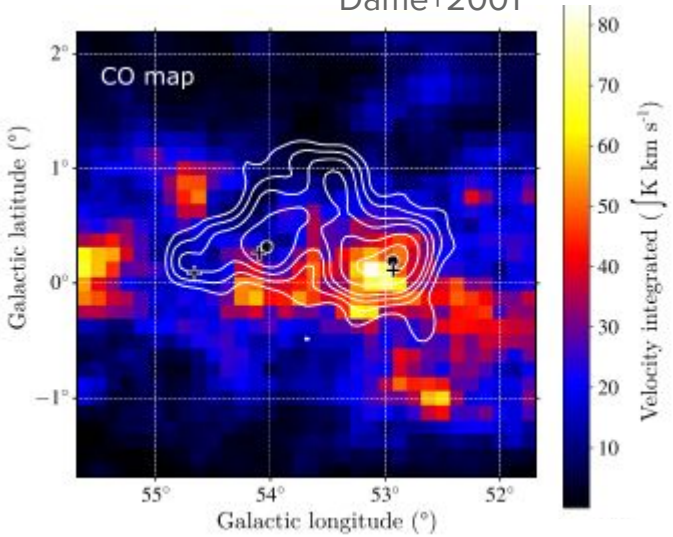


Association with a Molecular Cloud (?)

Driessen+2018



Dame+2001



VLA (1.4 GHz)
WSRT (327 MHz)
LOFAR (144 MHz)

Green Circles - HII
White Circles - SNR

1LHAASO J1928+1746u

3HWC J1928+178 is at 0.01° and it is extended (0.18°). H.E.S.S. confirmed a detection with > 5σ (Abdalla+2021)
Different hypotheses for the origin of the γ-ray emission :

1. e± from the pulsar started to cool and diffuse away from it, producing γ rays via IC scattering on ambient photons
2. cosmic-ray protons produced by the pulsar interacted with a nearby molecular cloud and produced γ rays via proton–proton interactions
3. combination of point 1 & 2
4. It may also be in a transitional phase between a classical PWN and a TeV halo

50h proposal to study the source with LST1
(Me, A. D'Aì, D. Maniadakis...)

Backup

Characteristics of the Components Associated with 3HWC J1930+188 - Fluxes are in erg cm^{-2} s^{-1}

Component	Observations		Parameter	Value	Comments and references
Pulsar PSR J1930+1852	Radio	Arecibo	period P (ms)	137	Cordes et al. (2006)
			$\dot{P}$	7.5×10^{-13}	
			$\dot{E}$ (erg s^{-1})	12×10^{36}	
			age (kyr)	2.9	
			surf. B field (G)	1.0×10^{13}	
———	X-ray	*Chandra*	F (0.3-10 keV)	2.1×10^{-12}	Pulsar, ring, jet, and diffuse elongated PWN Temim et al. (2010)
			index	-1.44 ± 0.04	
			size (°)	0.03×0.02	
			F (0.3–10 keV)	1.18×10^{-12}	
			index	-2.2 ± 0.04	
G54.1+0.3	Radio	Effelsberg	size (°)	0.025	Reich et al. (1985)
		FCRAO	distance (kpc)	6.2	Association with a molecular cloud - Leahy et al. (2008)
	γ-ray	*Fermi*			
		VERITAS	index	-2.18 ± 0.2	Detection of a point-like source consistant with the VERITAS measurements - Abeysekara et al. (2018)
			flux 1–100 TeV	$(3.31 \pm 1.47) \times 10^{-12}$	
		H.E.S.S.	size (°)	0.02 ± 0.025	H.E.S.S. Collaboration et al. (2018)
			index	-2.59 ± 0.26	
			flux 1–100 TeV	$(1.28 \pm 0.55) \times 10^{-12}$	
		HAWC	index	-2.76 ± 0.14	Albert et al. (2020)
			flux 1–100 TeV	$(4.48 \pm 0.43) \times 10^{-12}$	
Shell SNR G54.1+0.3	radio	VLA	size (°)	0.1	Gelfand et al. (2015)
	Sub-mm	*Herschel*	dust mass ($M_\odot$)	0.08-0.9	Rho et al. (2018)
			dust temperature (K)	27-44	
	IR	*Spitzer*	progenitor's mass ($M_\odot$)	15-27	
			size (°)	0.4	Temim et al. (2017)
	X-ray	*XMM*	size (°)	~0.1	Bocchino et al. (2010)
		Suzaku	age (kyr)	1.8–2.4	

Characteristics of the Components Associated with 3HWC J1928+178 - Fluxes are in erg cm^{-2} s^{-1}

Component	Observations		Parameter	Value	Comments
Pulsar PSR J1928+1746	Radio	Arecibo	period P (ms)	68.7	Cordes et al. (2006)
			$\dot{P}$	1.32×10^{-14}	
			$\dot{E}$ (erg s^{-1})	1.6×10^{36}	
			age (kyr)	82	
			distance (kpc)	4.3	
			surf. B field (G)	9.6×10^{11}	
PWN	γ-ray	EGRET	index	-2.23	Hartman et al. (1999)
			flux $>$ 100 MeV (ph cm^{-2} s^{-1})	157×10^{-8}	
		HAWC	index	-2.3 ± 0.07	Albert et al. (2020)
			flux 1–100 TeV	$(4.77 \pm 0.32) \times 10^{-12}$	