γ 2022

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Study of pulsar wind nebula candidates seen with H.E.S.S.

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H.E.S.S.

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Region of the Galactic plane at l=312°: 5 powerful pulsars

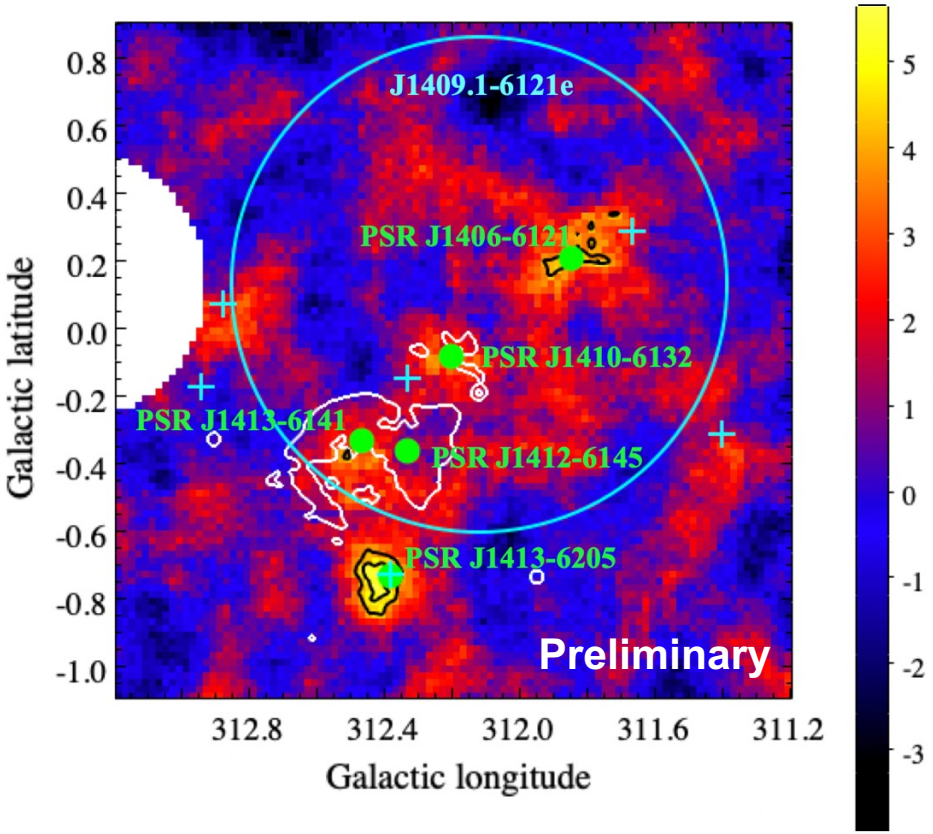
Twice the exposure time since the H.E.S.S. Galactic plane survey:
Extended emission sites in the pulsars' vicinity above 1TeV

ATNF Pulsar Catalogue
(τ_c = characteristic age, $\dot{E}$ = spin-down power)

PSR	τ_c (kyr)	$\dot{E}$ (erg s^{-1})
J1406-6121	61.7	**$2.2\ 10^{35}$**
J1410-6132	24.8	**$1\ 10^{37}$**
J1412-6145	50.4	**$1.2\ 10^{35}$**
J1413-6141	13.6	**$5.6\ 10^{35}$**
J1413-6205	62.8	**$8.3\ 10^{35}$**

- **Complicated region with many overlapping sources**
- **Reconstruction optimised at the highest energies**
- **3D Field of View likelihood analysis to separate PWN candidates**
- **All sources and the hadronic background modelled simultaneously**

Significance map above 1 TeV
(0.1° correlation radius)



Pulsar position

Fermi 12 yr catalog

white: radio contours of SNR G312.4-0.4 radio

black: H.E.S.S. 4σ and 5σ significance levels

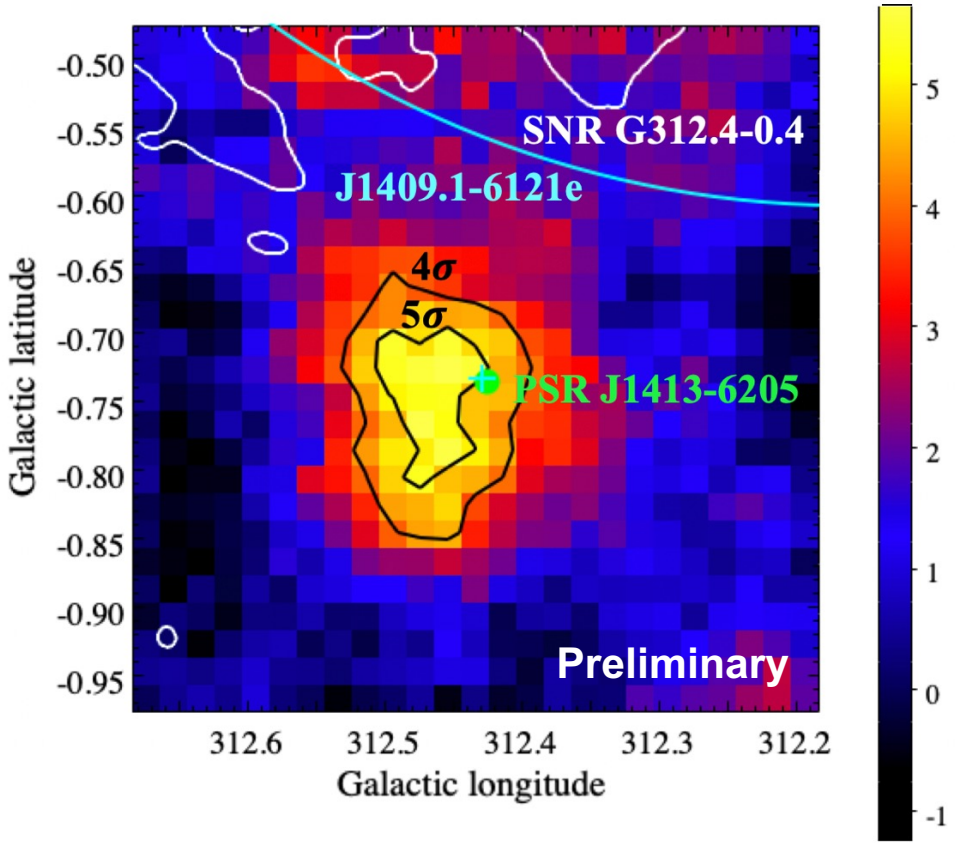
New TeV extended source around PSR J1413-6205

Morphology of the new source centered on the pulsar location

Test statistic	**44 (6σ)**
Disk radius (°)	**0.12 +/- 0.01**
Pulsar position (l°, b°)	(312.37, -0.74)

Extended emission detected on PSR J1413-6205 at 6σ above 1 TeV

Significance map above 1 TeV
(0.1° correlation radius)



● *Pulsar position*

\+ *Fermi 12 yr catalog*

white: radio contours of SNR G312.4-0.4 radio

black: H.E.S.S. 4σ and 5σ significance levels

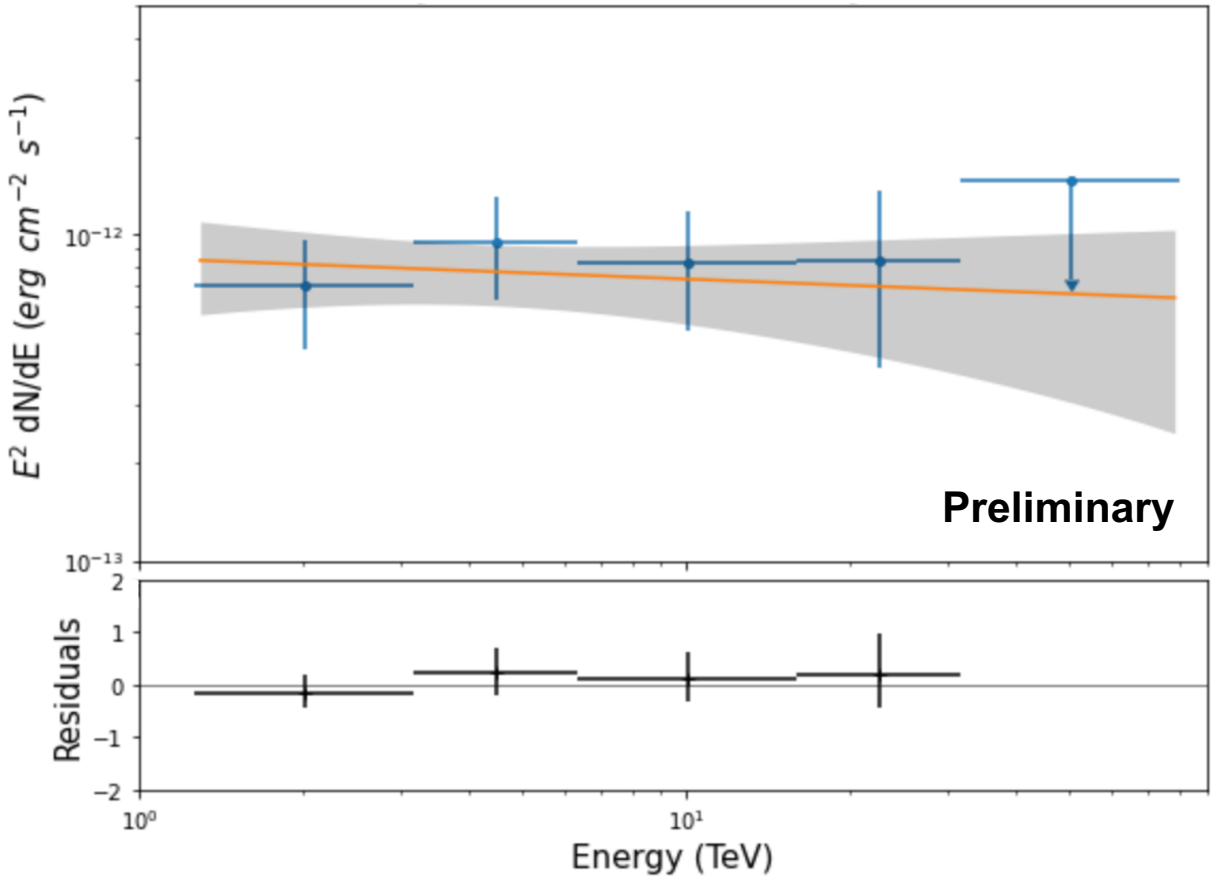
A hard spectrum for J1413-6205 above 1 TeV

Spectral parameters for the new source

Test statistic	**44 (6σ)**
Index	**2.06 +/- 0.20**
Norm (TeV^{-1} cm^{-2} s^{-1})	(2.47 +/- 0.52) 10^{-14}
Pivot Energy (TeV)	4.41

- **Flat spectrum above 1 TeV extending to tens of TeV**
- **Evidence of an efficient leptonic accelerator ?**

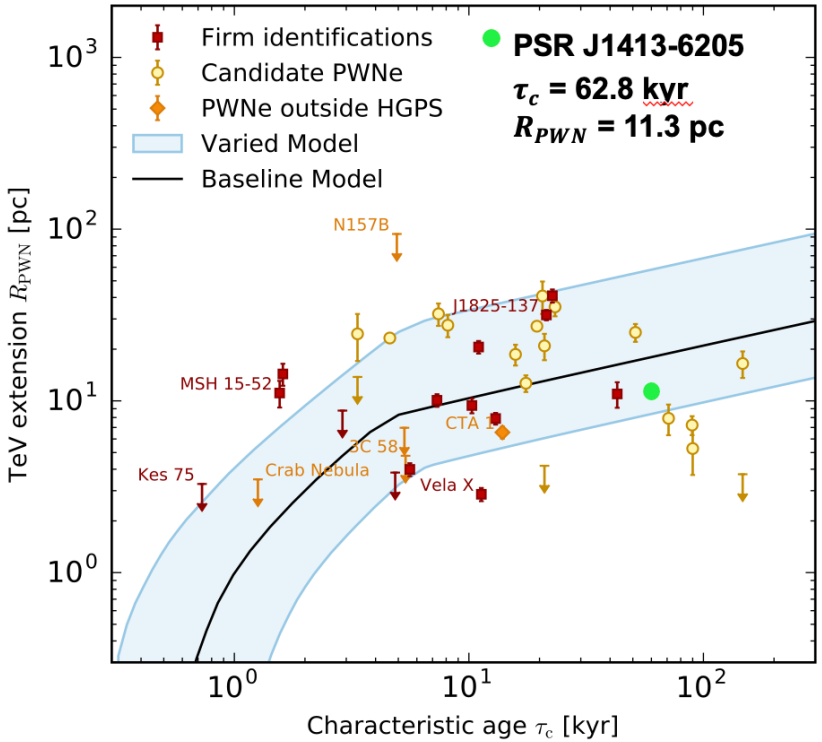
Spectral energy distribution

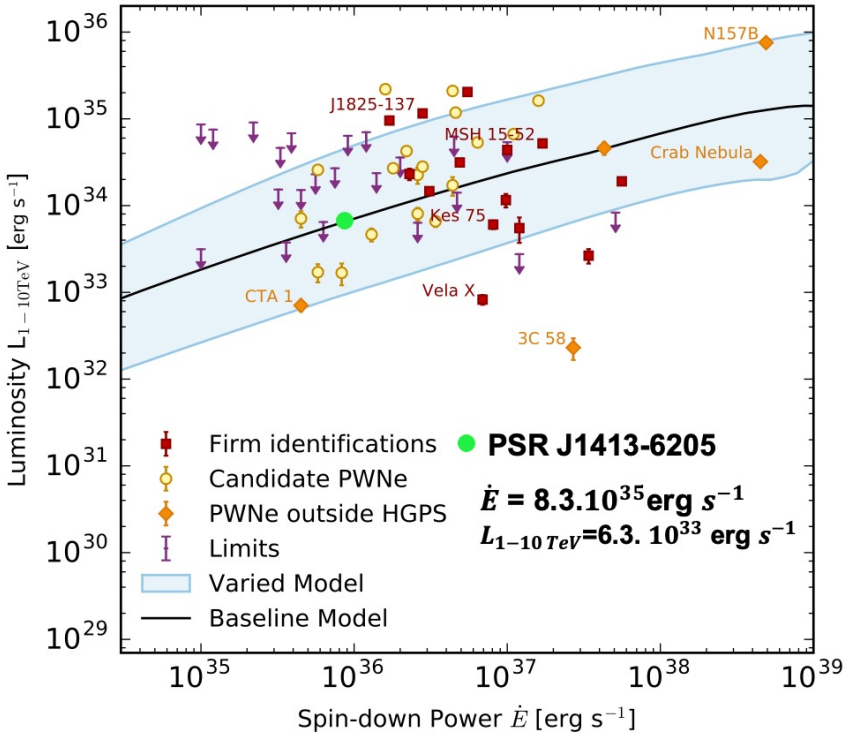


TeV PWN population study

Plots adapted from [H.E.S.S. Collaboration, 2018]:

PSR J1413-6205 distance: 5.4 kpc (tangent circle of galactic arm)





Conclusion: New TeV detection around PSR J1413-6205, an old powerful PWN

- **6σ-significant extended emission close to the pulsar → offset PWN morphology? Escaping leptons, transitioning PWN to halo?**
- **Spectral index of 2.06 → hard emission with no significant features?**