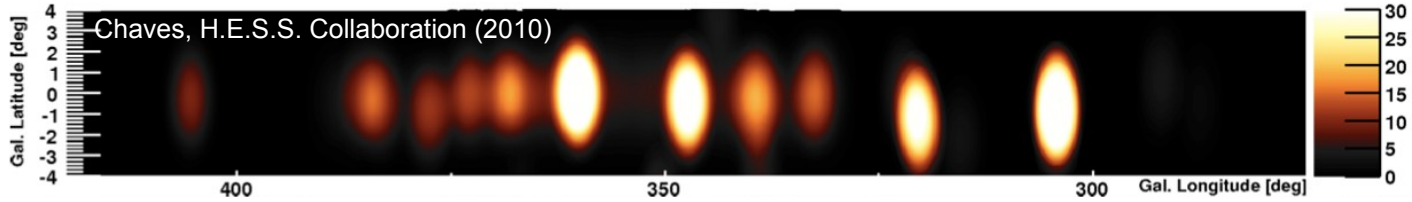
Exploring Galactic TeV Gamma-Ray sources with H.E.S.S.

Peter Eger
on behalf of the H.E.S.S. Collaboration
May 2011, RICAP, Rome

The High Energy Stereoscopic System – H.E.S.S.

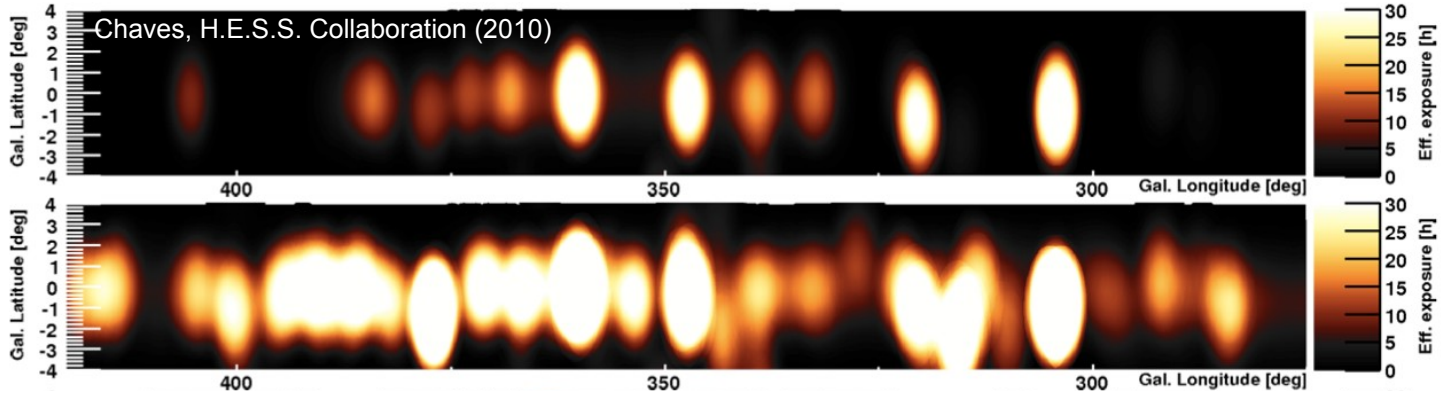
- Mirror diameter: 13 m
- Total mirror area: 4 x 107 m^2
- Array spacing: 120 m
- Effective area: 5 x 105 m^2
- Energy range: 100 GeV – 50 TeV
- Field of view: 5°
- Angular resolution: 0.07°
- Energy resolution: 15%

The H.E.S.S. Galactic Plane Survey: Exposure

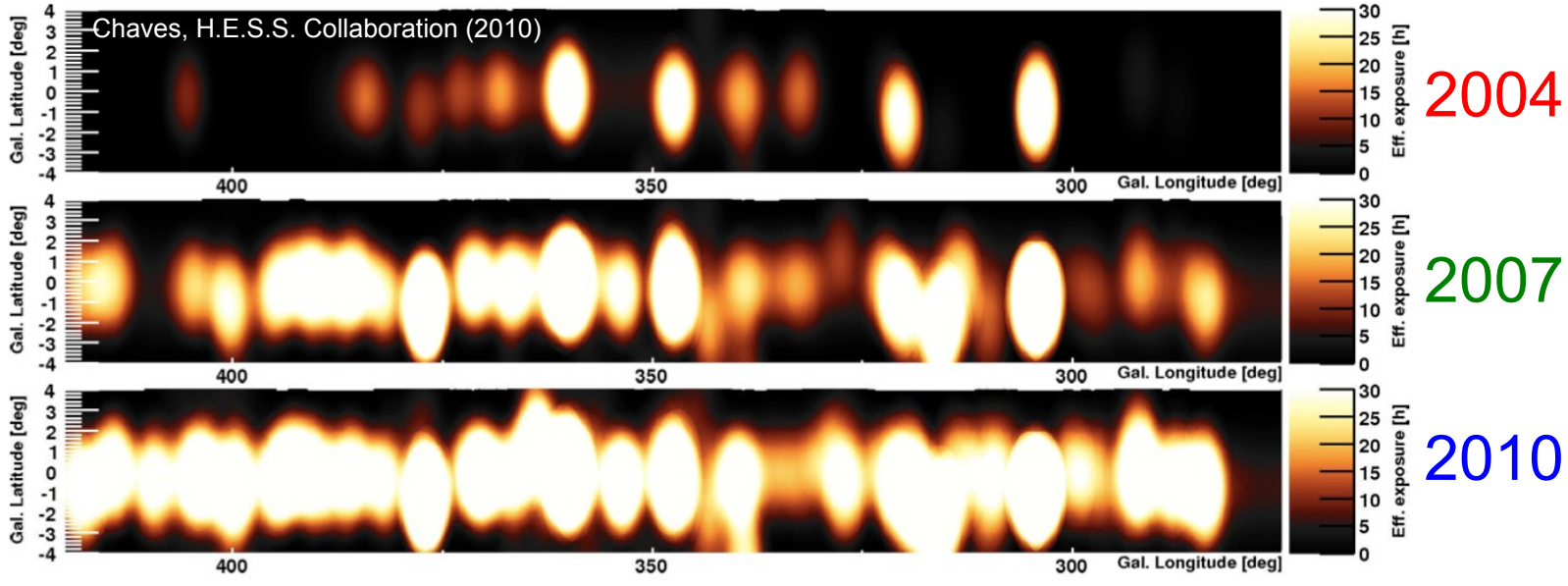


2004

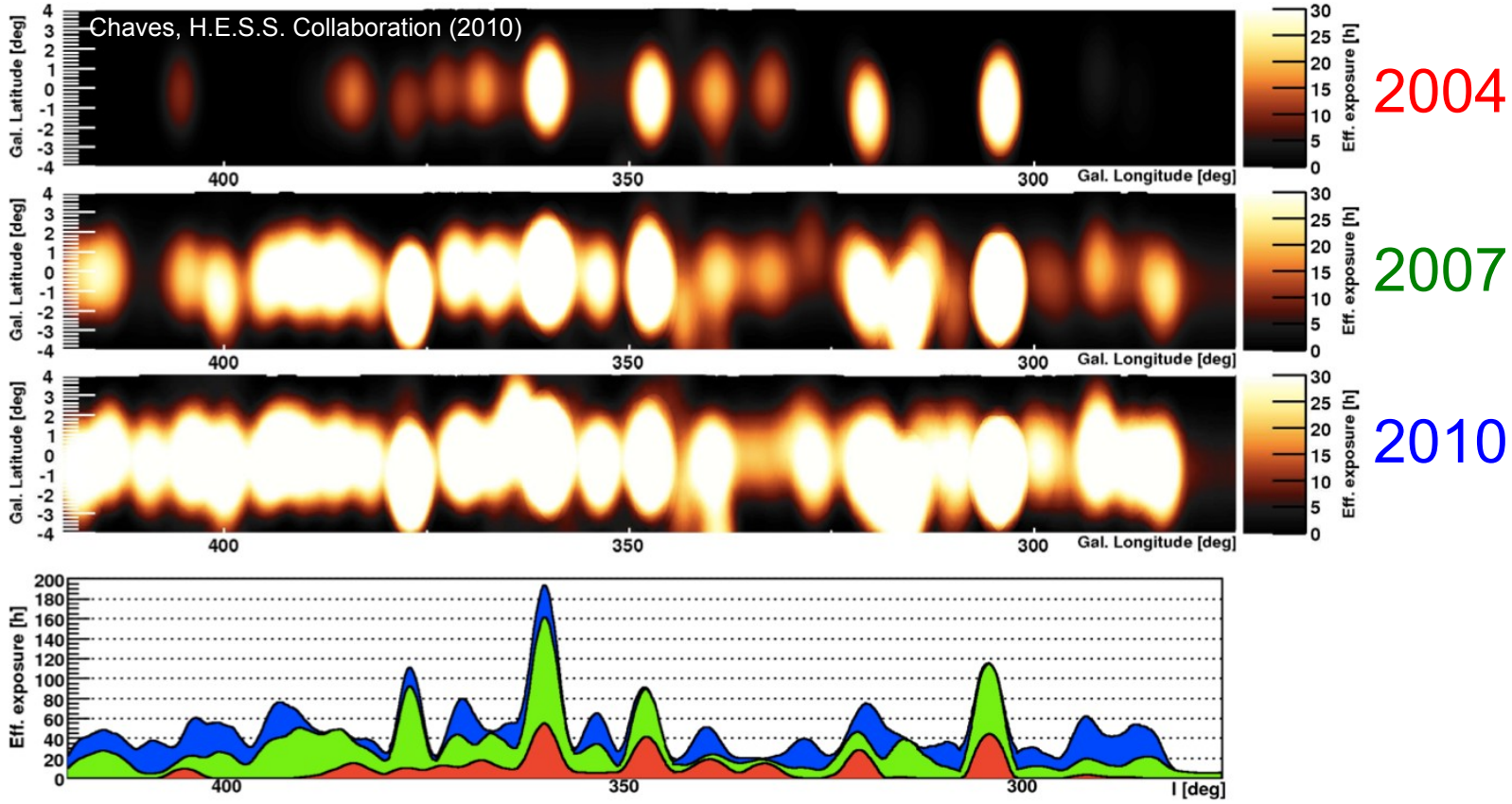
The H.E.S.S. Galactic Plane Survey: Exposure



The H.E.S.S. Galactic Plane Survey: Exposure



The H.E.S.S. Galactic Plane Survey: Exposure

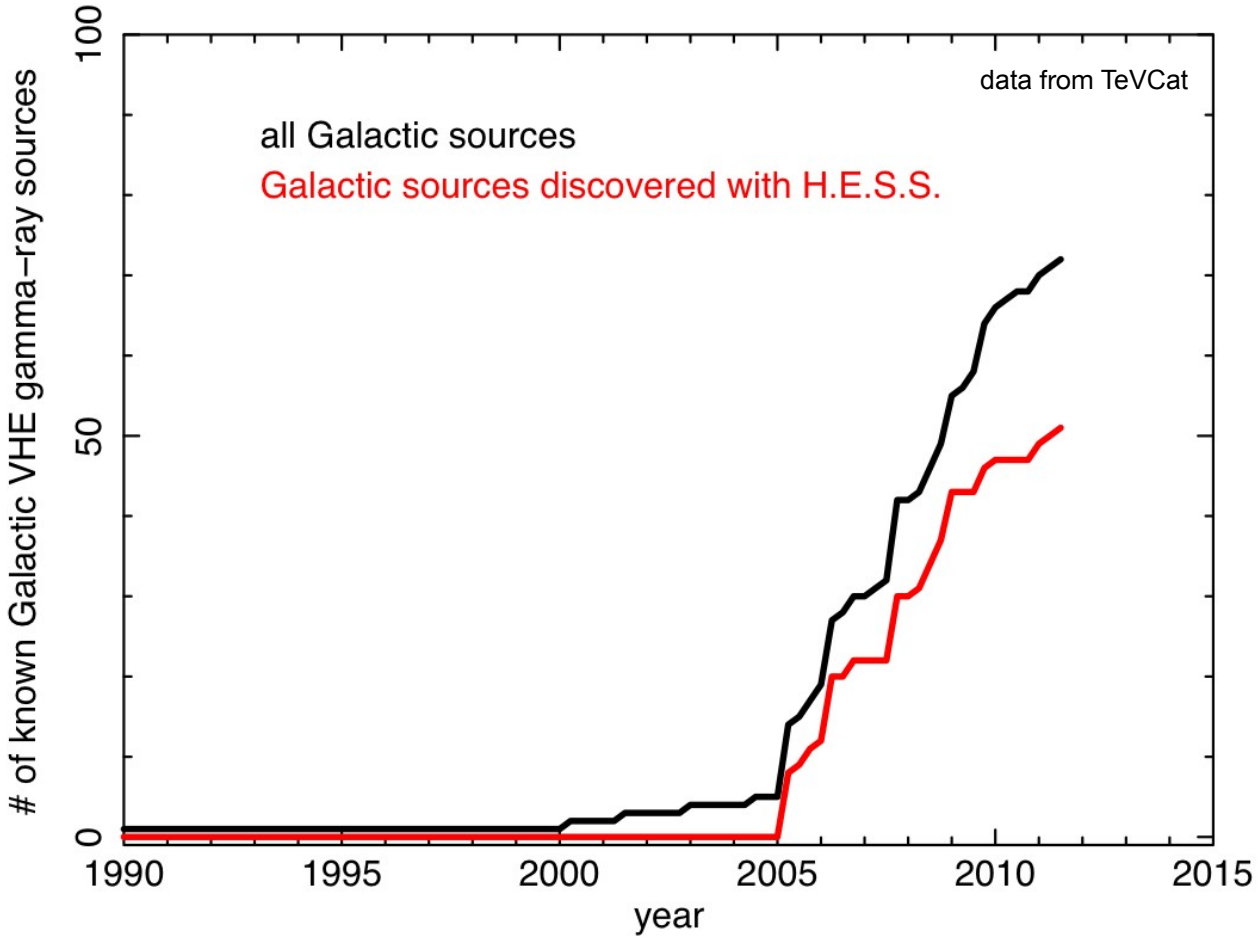


The H.E.S.S. Galactic Plane Survey continues

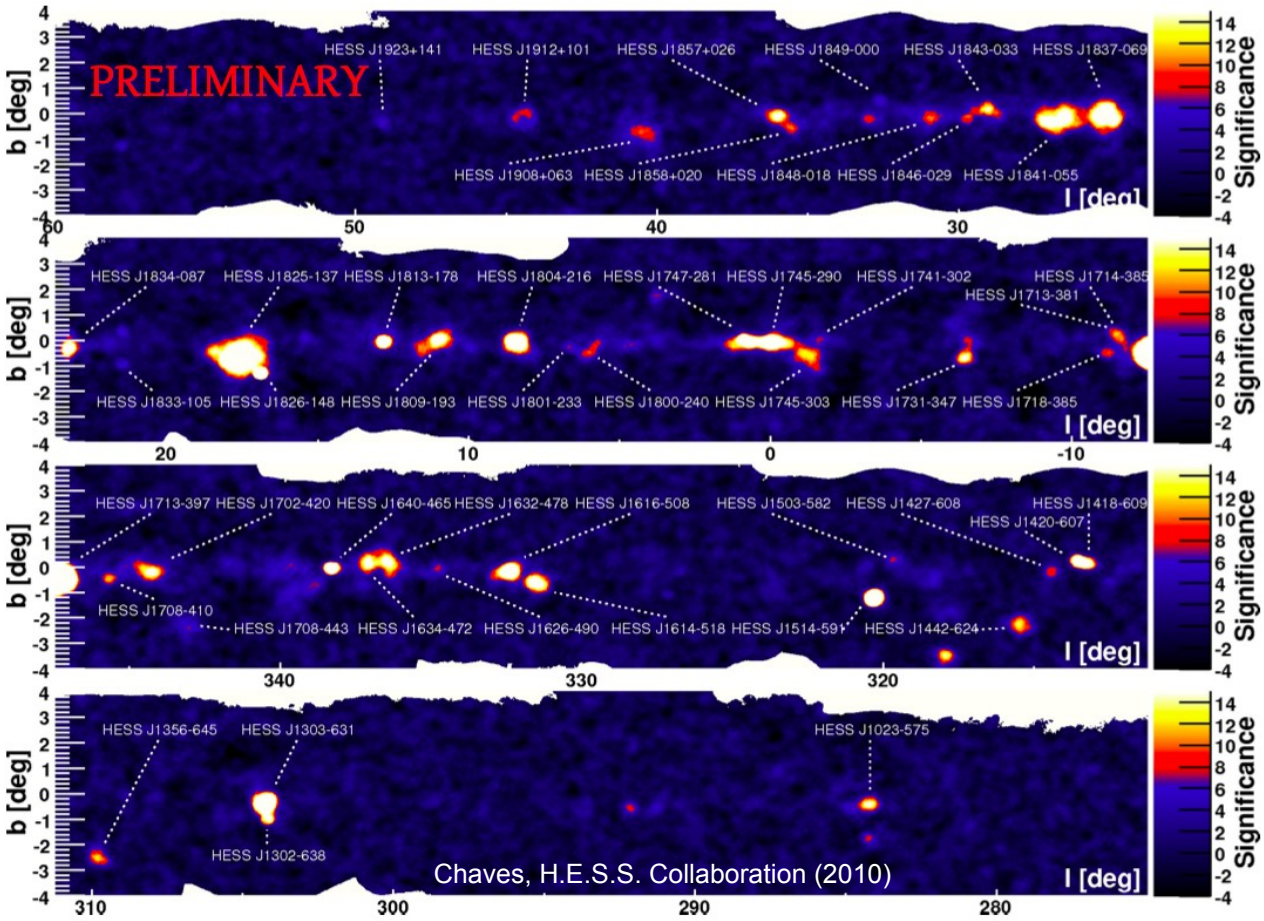
- $60° > l > 280°$, $|b| < 4°$
- > 2300 hours of total live-time

- Hot-spot follow-up
- Longitude extension
- Latitude extension

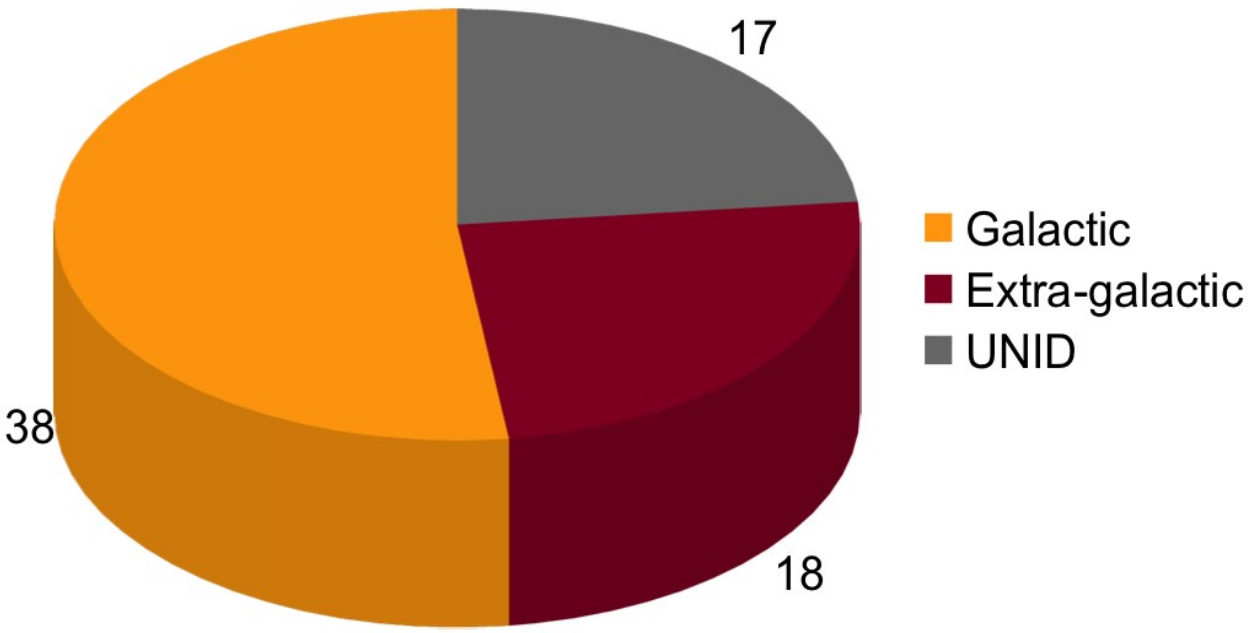
Discoveries of Galactic VHE gamma-ray sources



VHE gamma-ray sources detected with H.E.S.S.



VHE gamma-ray source classes detected with H.E.S.S.



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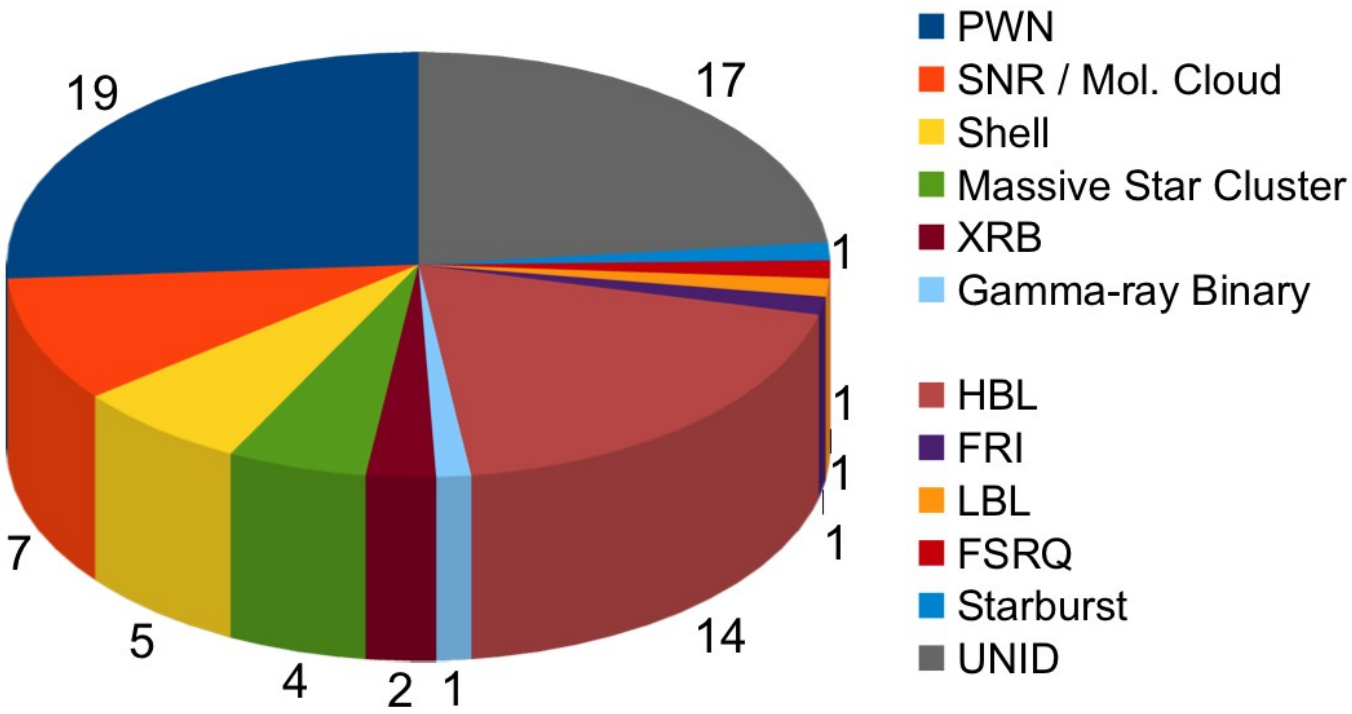
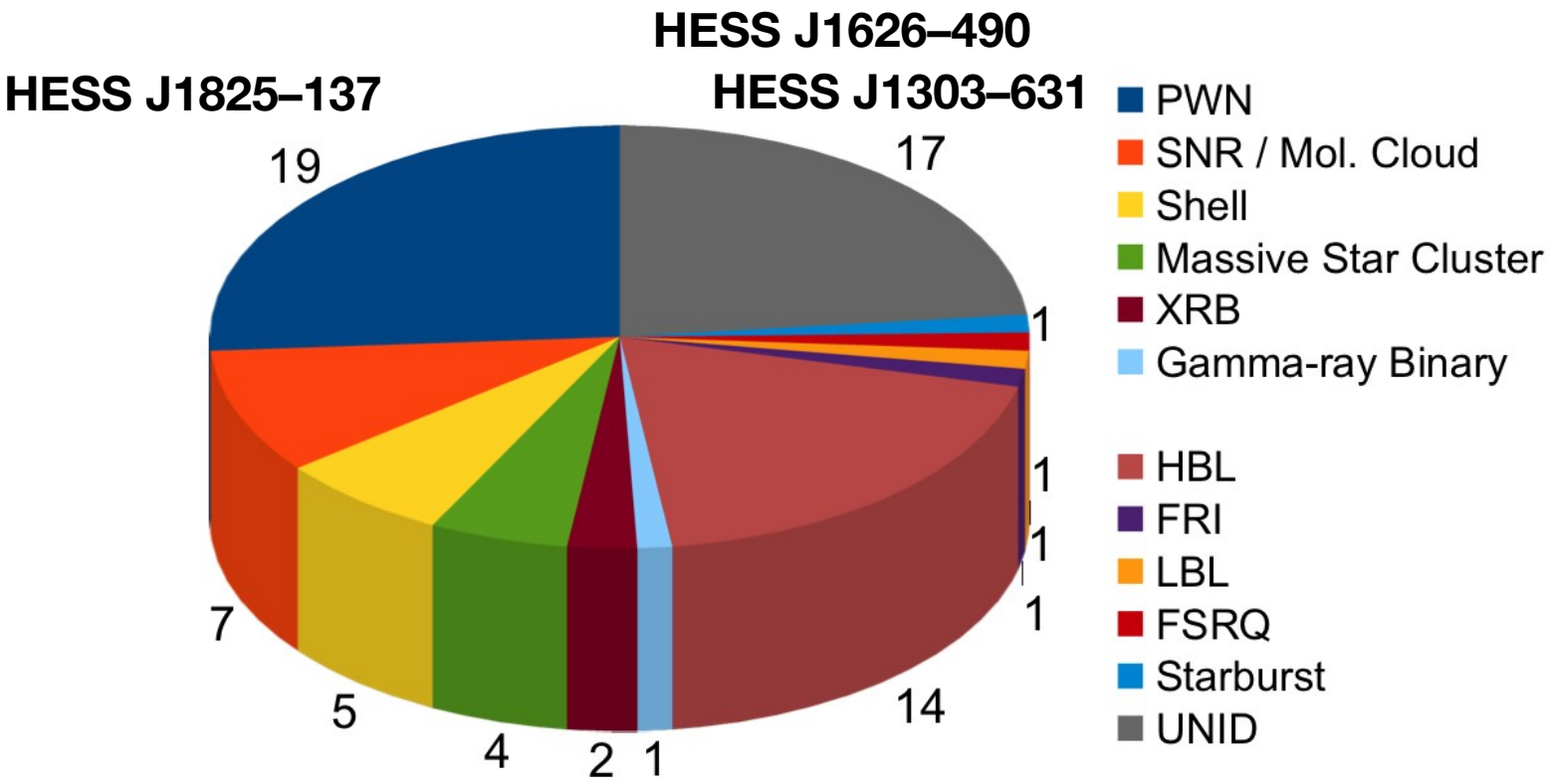


VHE gamma-ray source classes detected with H.E.S.S.

Terzan 5



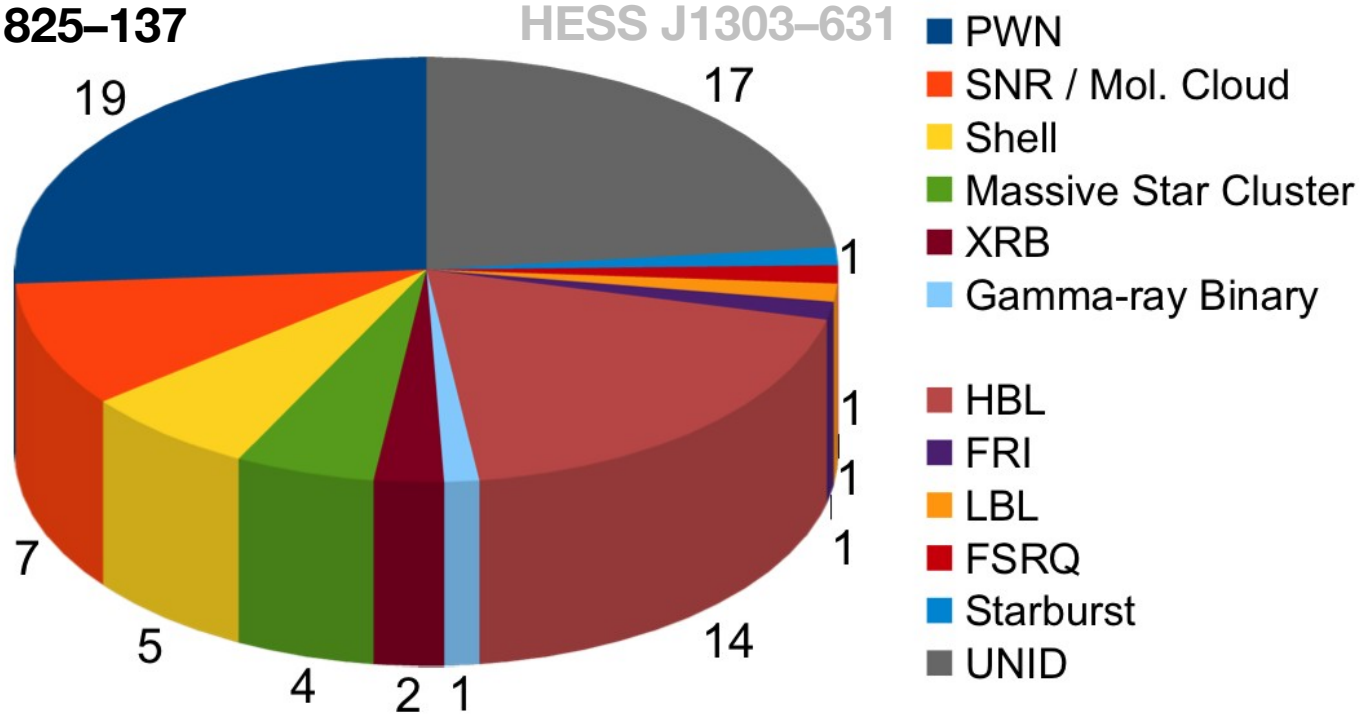
VHE gamma-ray source classes detected with H.E.S.S.

Terzan 5

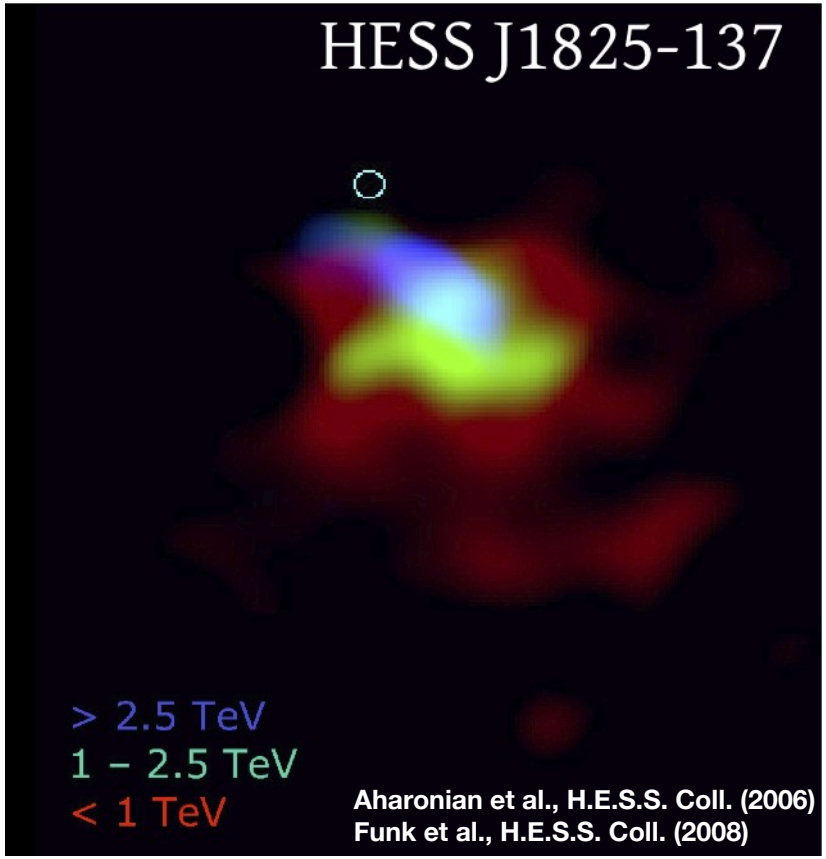
HESS J1626–490

HESS J1303–631

HESS J1825–137

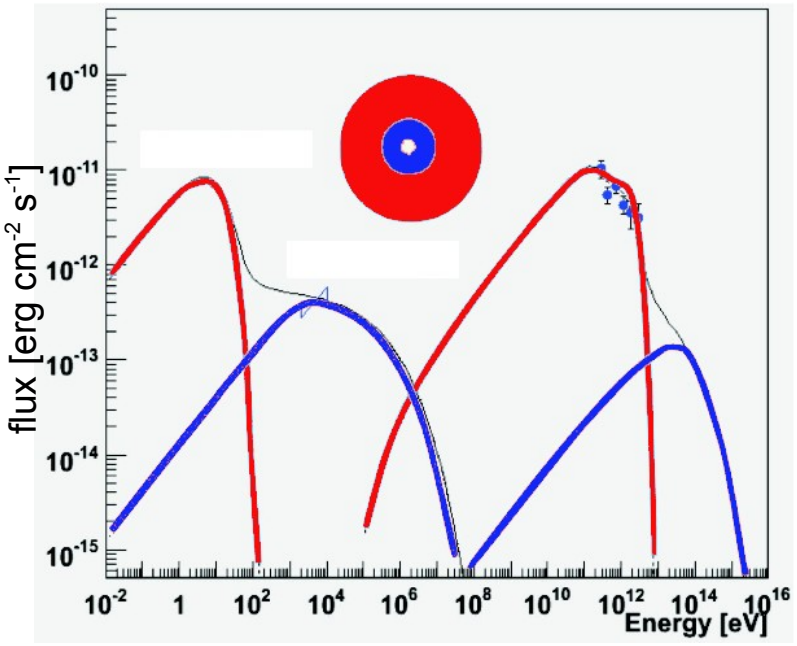


PWNe with an energy-dependent morphology: HESS J1825–137



Aharonian et al., H.E.S.S. Coll. (2006)
Funk et al., H.E.S.S. Coll. (2008)

2-component leptonic model



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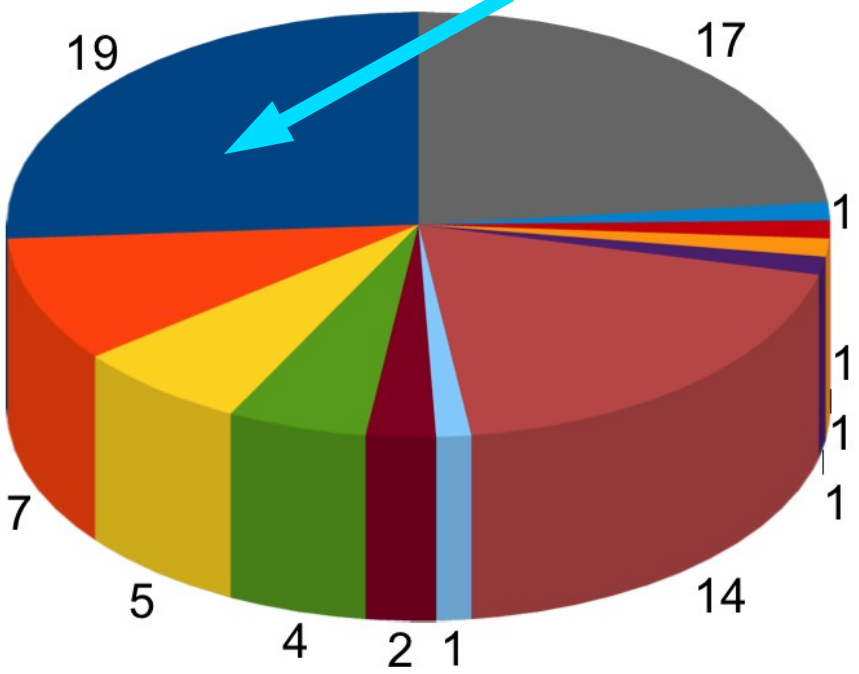
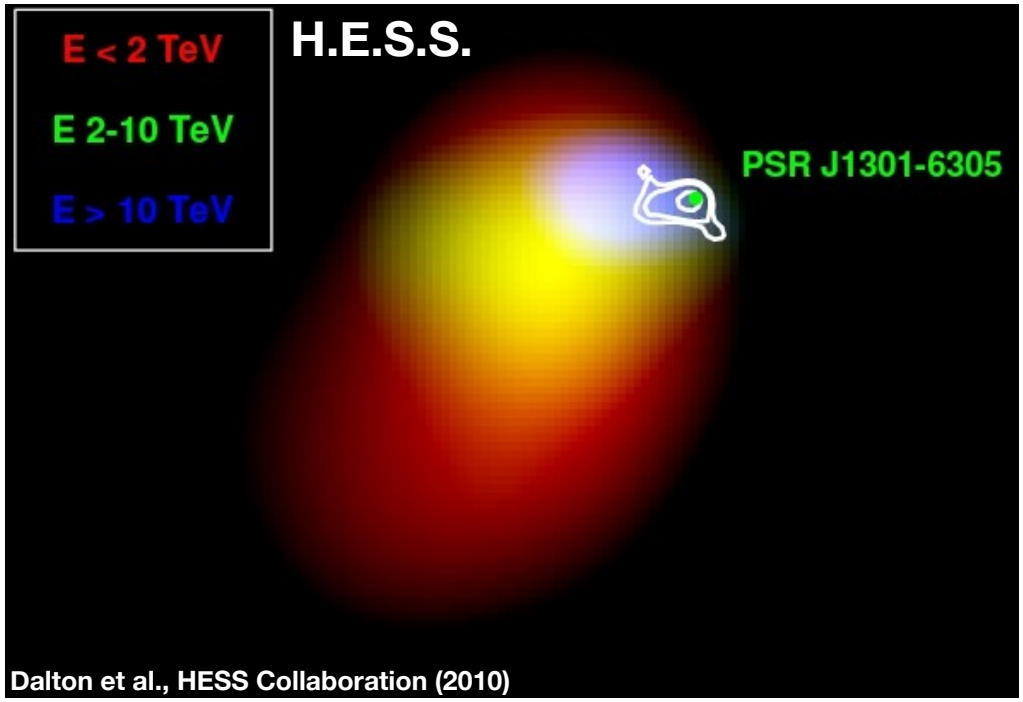


- PWN
- SNR / Mol. Cloud
- Shell
- Massive Star Cluster
- XRB
- Gamma-ray Binary
- HBL
- FRI
- LBL
- FSRQ
- Starburst
- UNID

HESS J1303–631 is another PWN with an energy-dependent morphology



Dalton et al., HESS Collaboration (2010)

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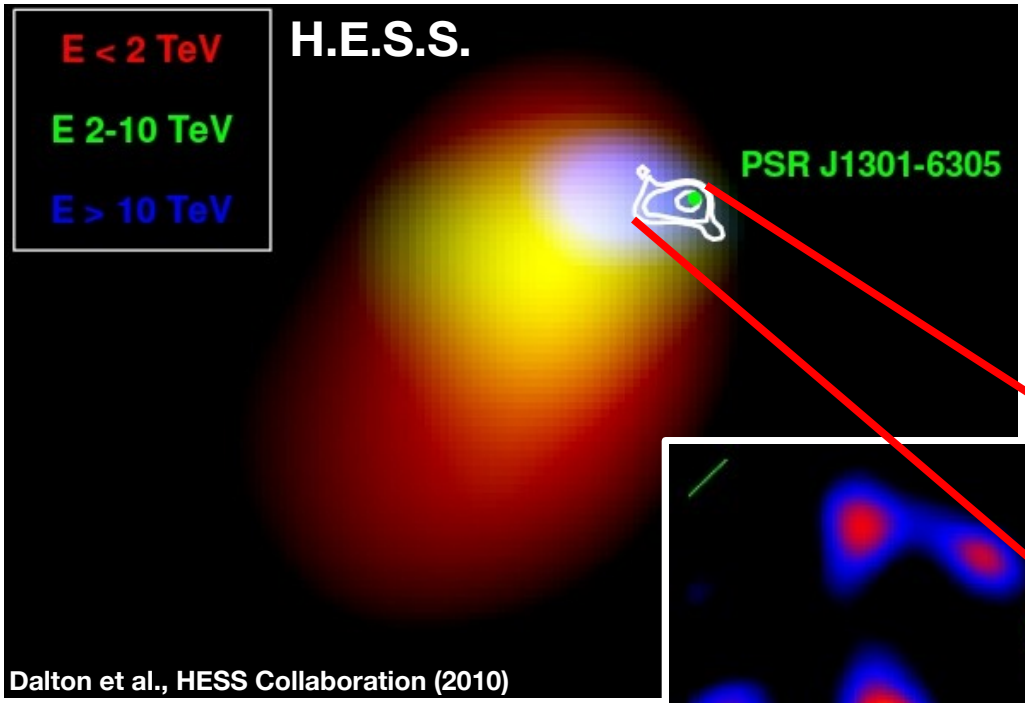

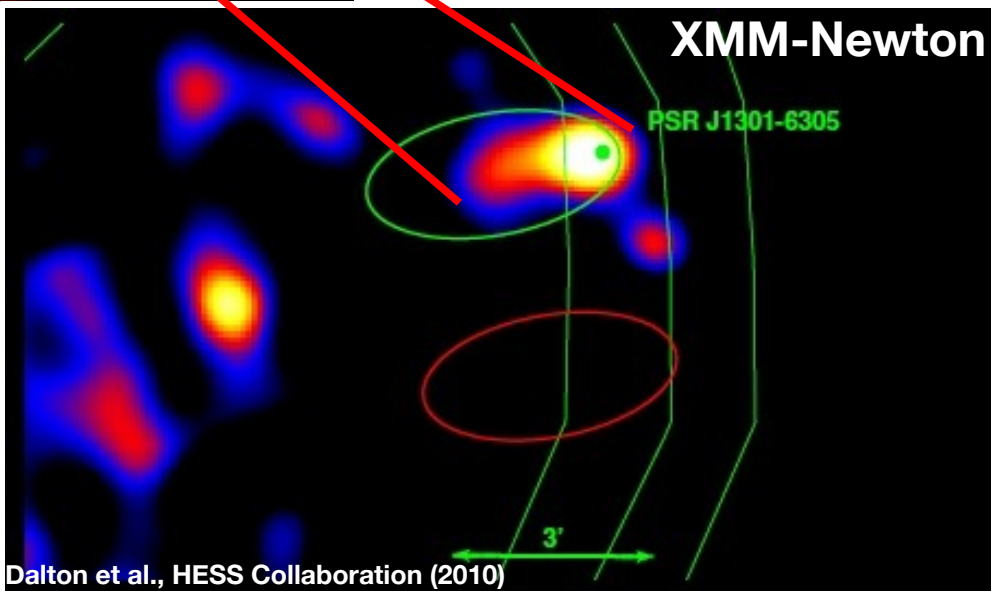

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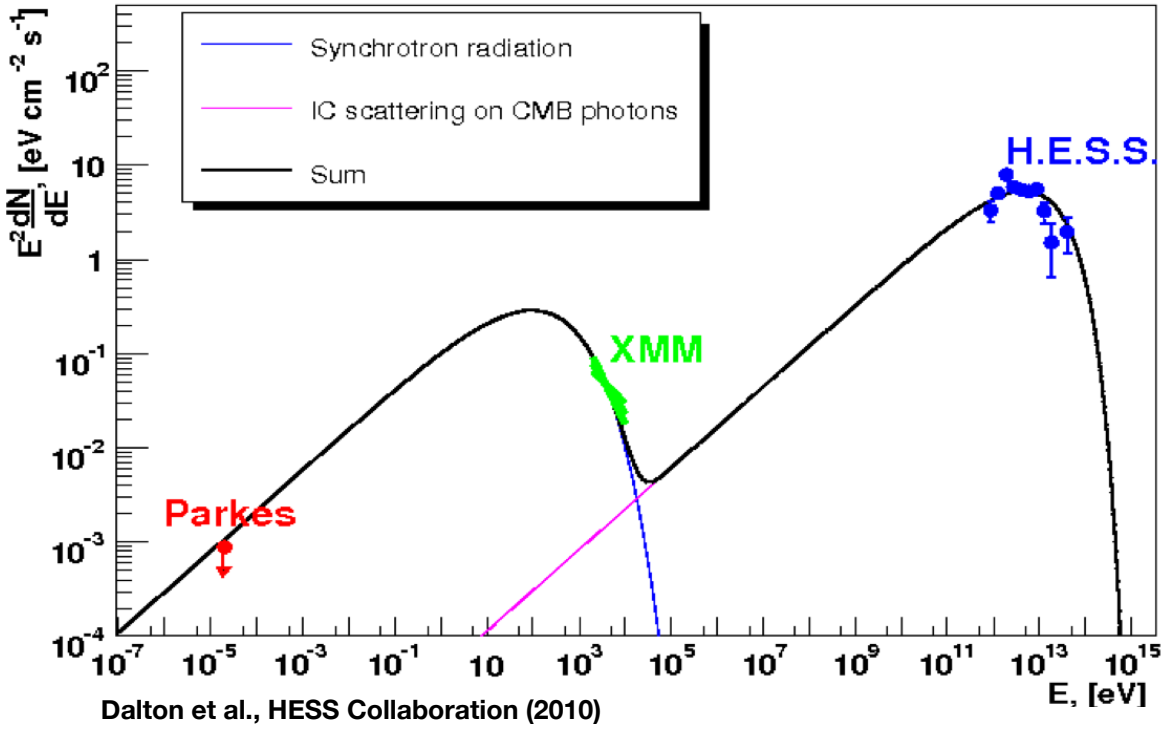
Spectral energy distribution



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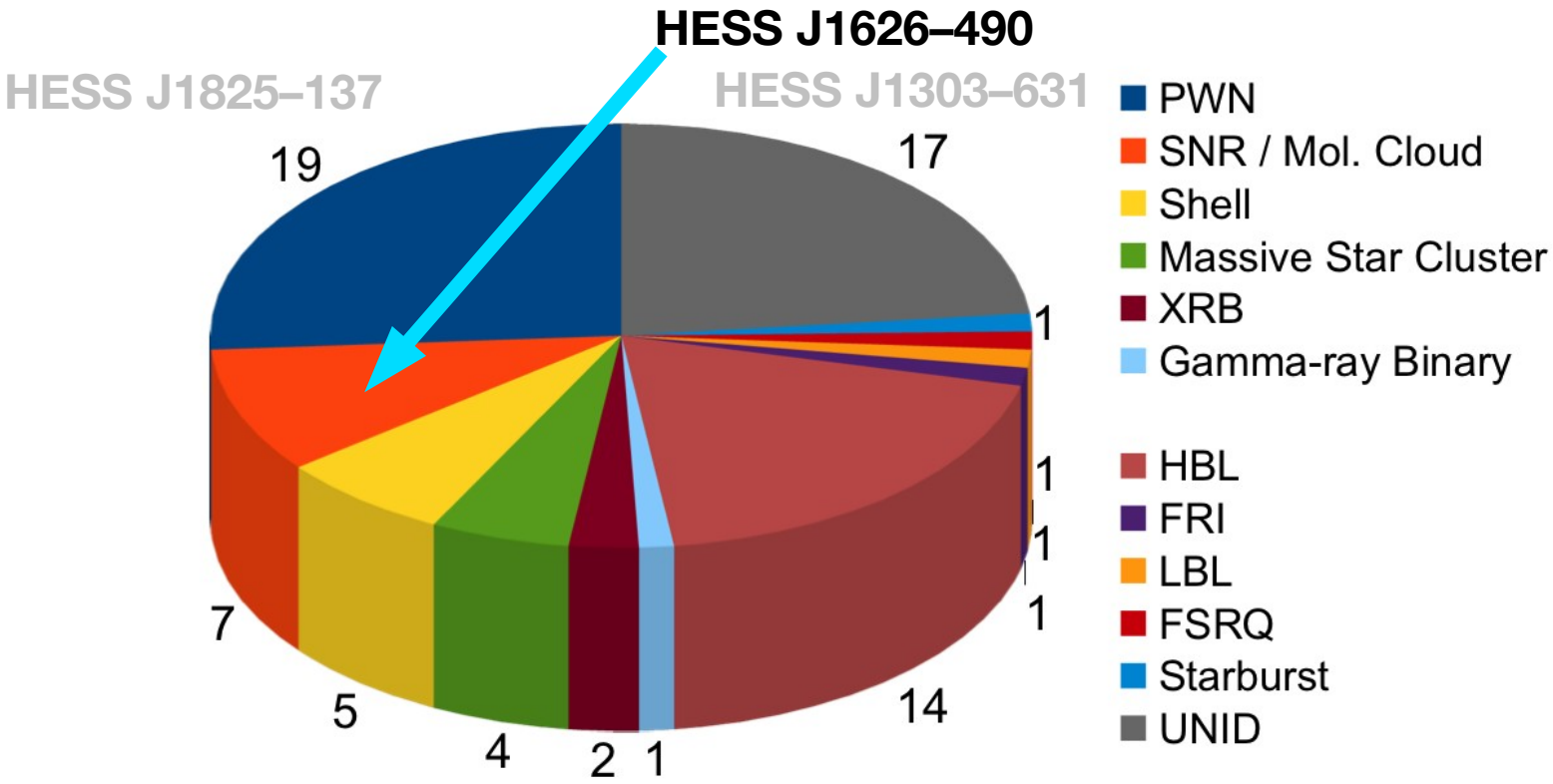
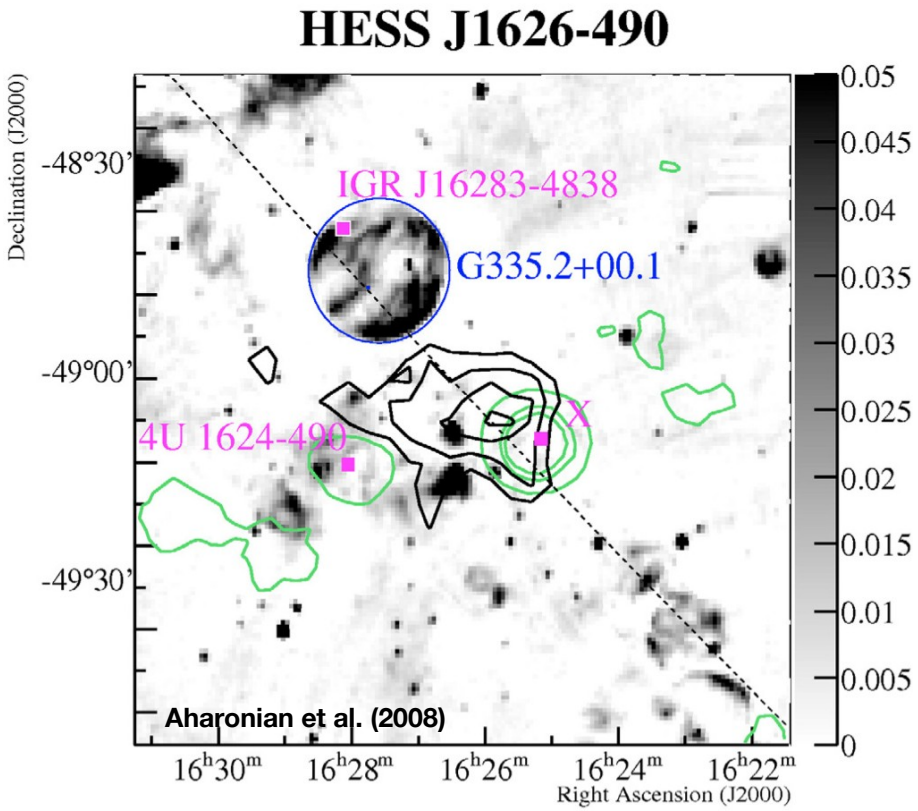
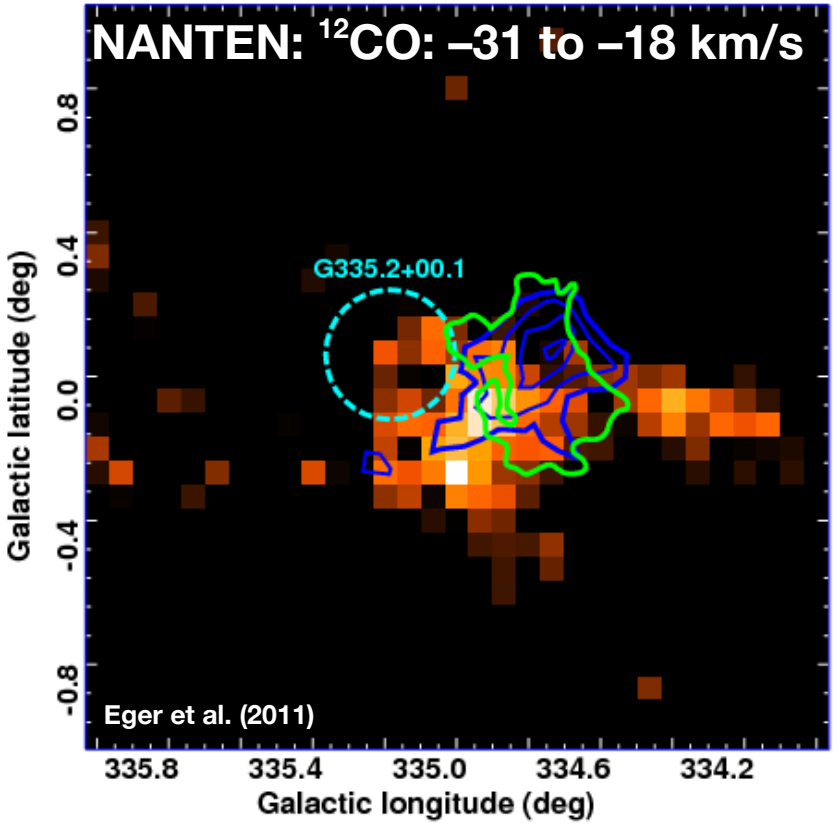


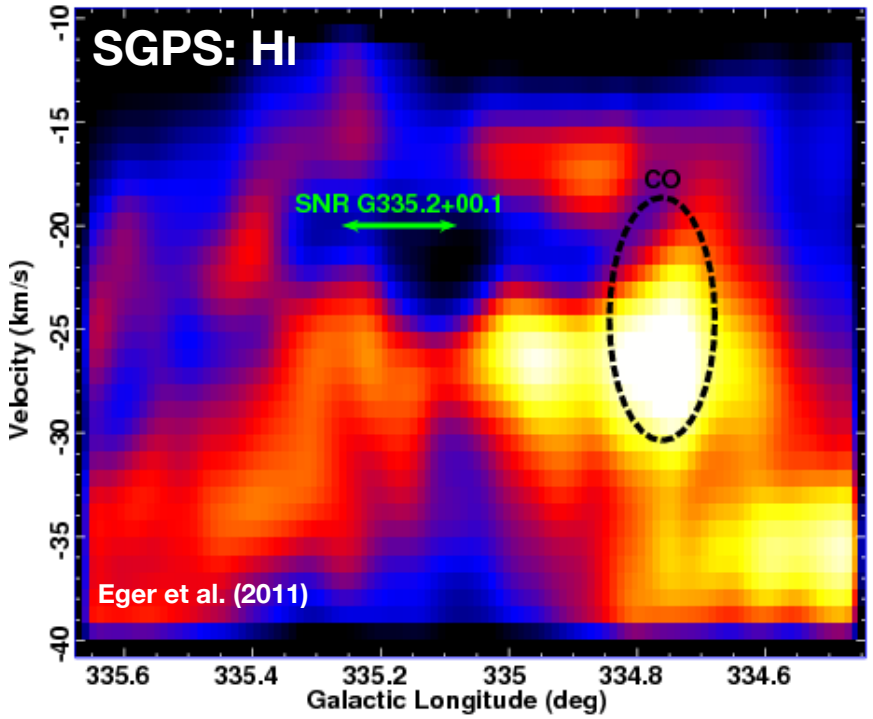
The unidentified source HESS J1626–490

- Published in 2008 as “unidentified”
- Intrinsic extent: 5'
- Spectral index: 2.2, no cut-off
- No obvious counterparts, such as:
  - Energetic pulsars
  - X-ray binaries
  - Supernova remnants

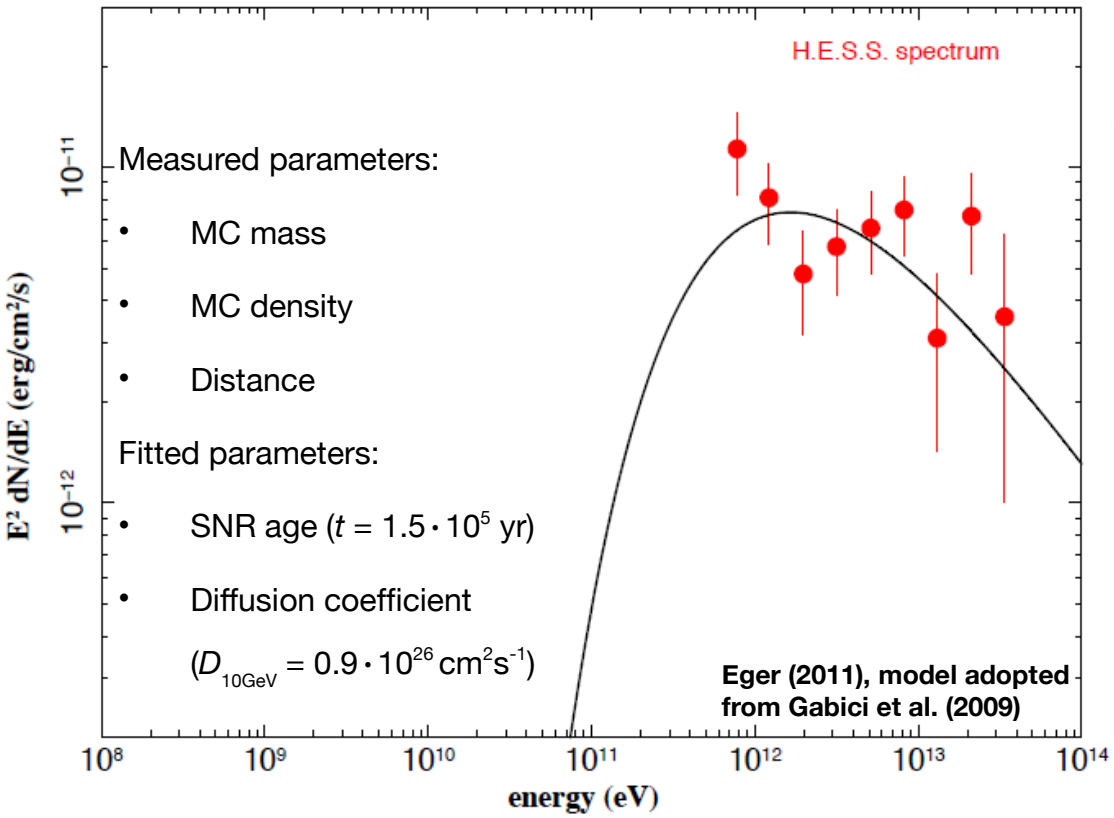


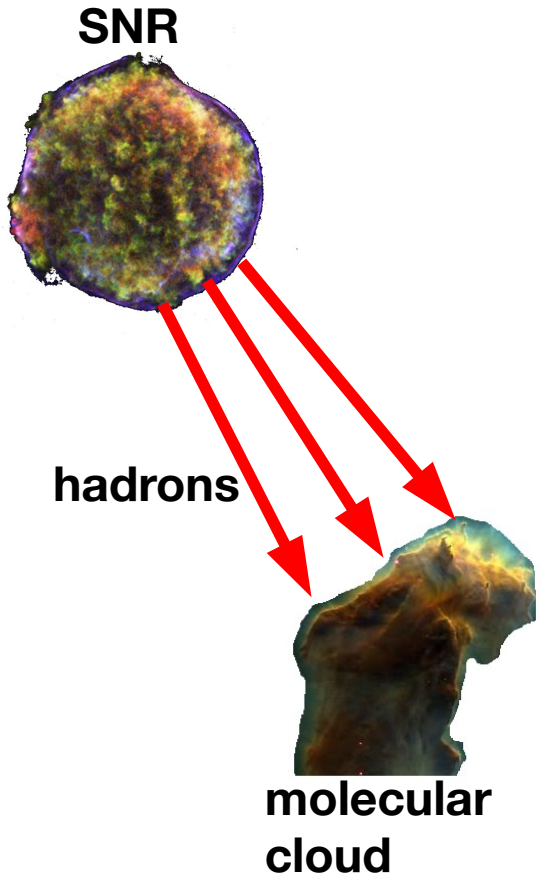
Radio data: ^{12}CO(J=1–0) and HI (21 cm)





HESS J1626–490: exploring an hadronic scenario





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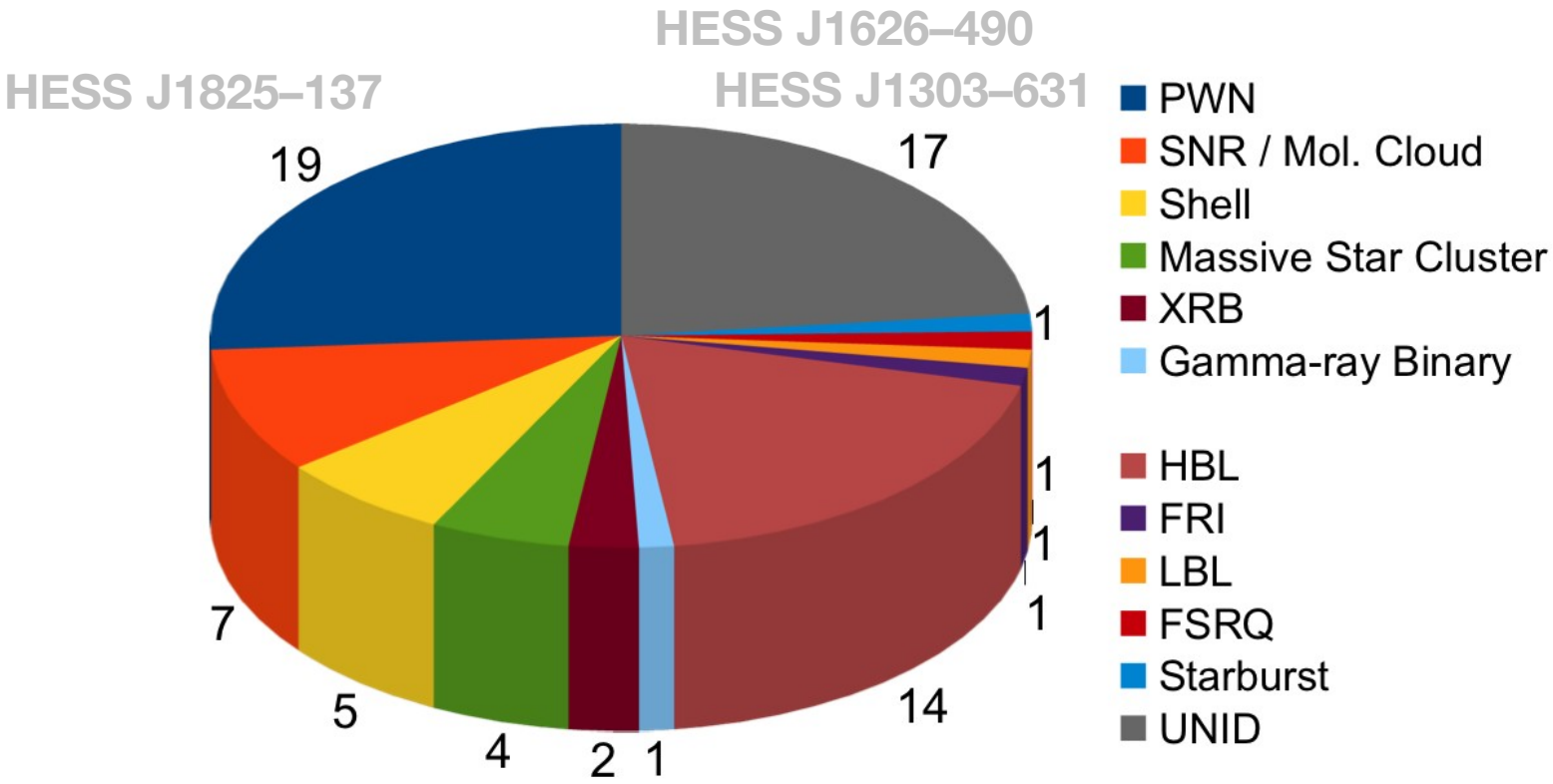
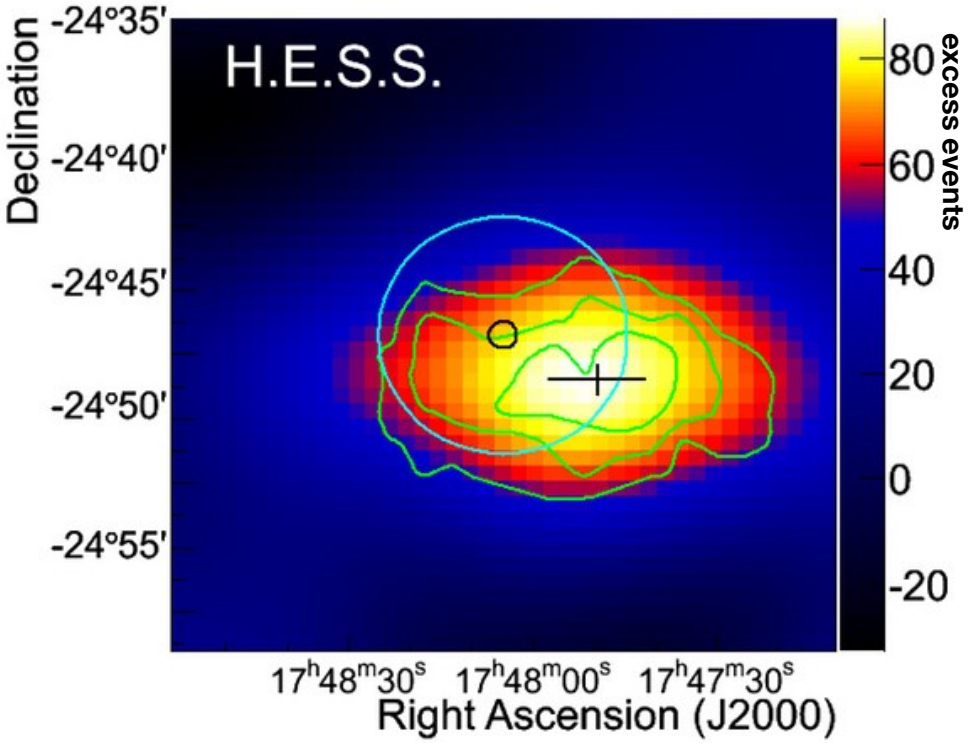


VHE gamma-ray emission from the vicinity of Teran 5



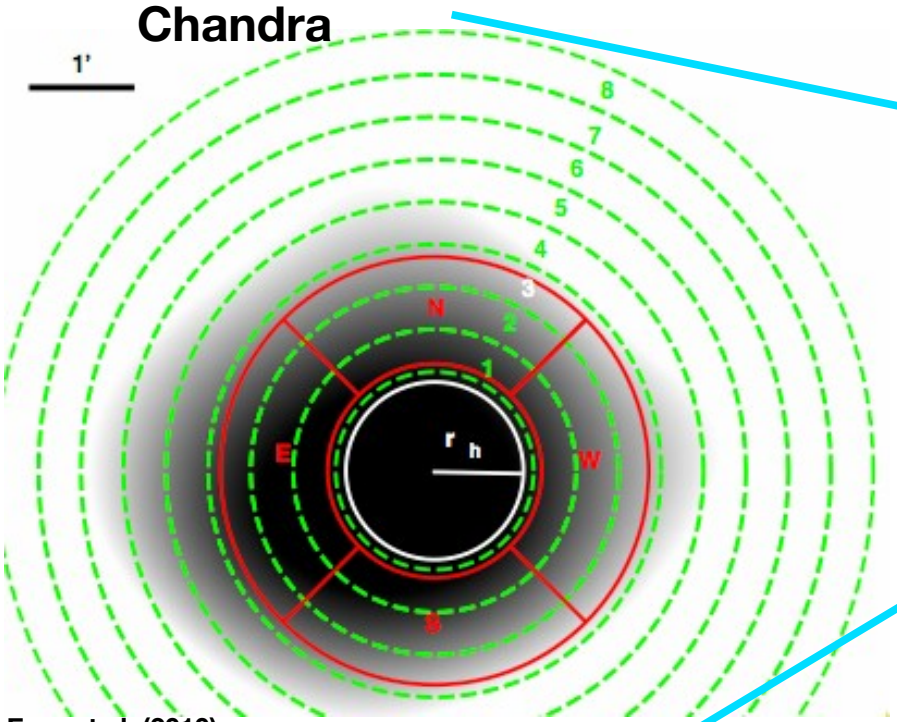
- 7σ detection with a total live-time of 90 h
- Marginally offset from the core by 4'
- Slightly elongated
- Chance coincidence probability ~0.01%
- Stay tuned for the ICRC and the forthcoming publication...

Is there something special about Terzan 5?

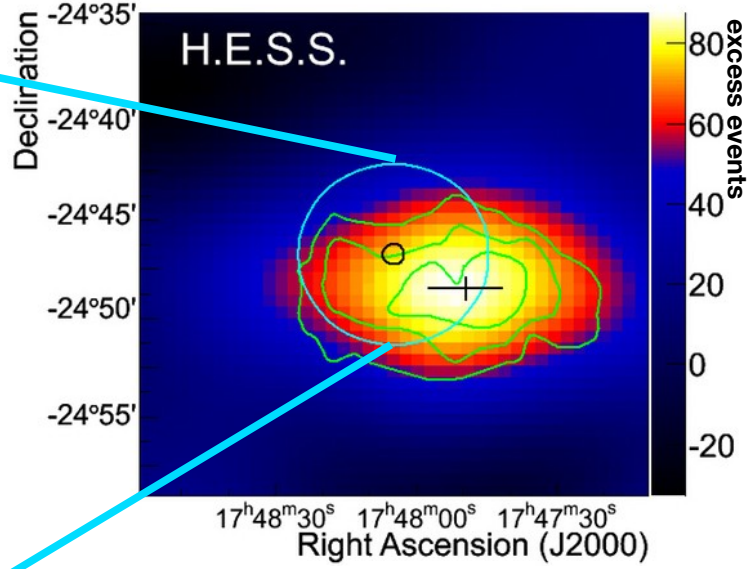
Near infrared image of Terzan 5 (ESO)

- Extremely high core density
- Largest number of individually detected millisecond pulsars (33)
- Brightest GC detected by Fermi-LAT: emission related to the millisecond pulsars population?
  (Abdo et al., 2010)

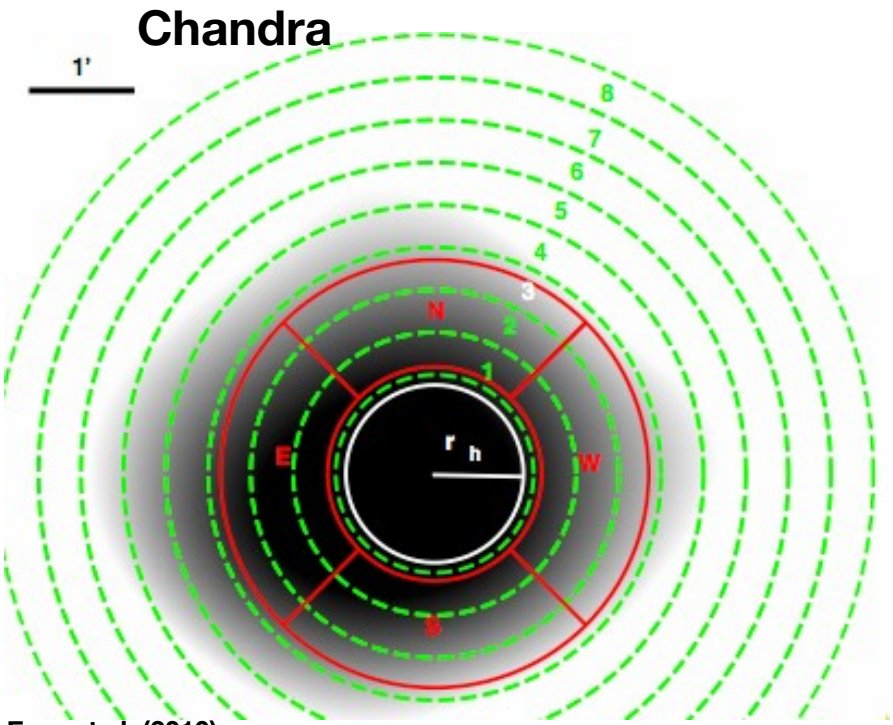
Diffuse non-thermal X-ray emission from Terzan 5



Eger et al. (2010)



Properties of the diffuse X-ray signal



Eger et al. (2010)

- Hard spectrum (1 – 7 keV)
- Extendend beyond 3'
- Centered on the core
- Bow shock?

  → non-thermal bremsstrahlung
- Millisecond pulsars

  → Inverse Compton

  → Synchrotron

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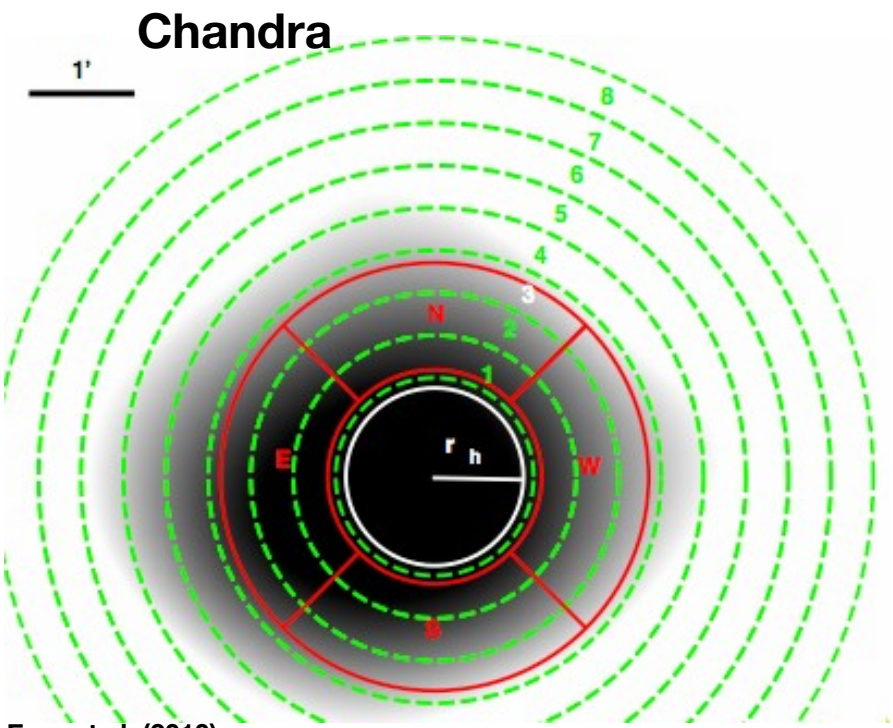

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Potential relation to the VHE gamma-ray signal

Summary

- The H.E.S.S. Galactic Plane Scan continues
- Various populations of VHE gamma-ray sources are now established
- Successful identification of VHE gamma-ray sources through multi-wavelength studies

Thank you for your attention

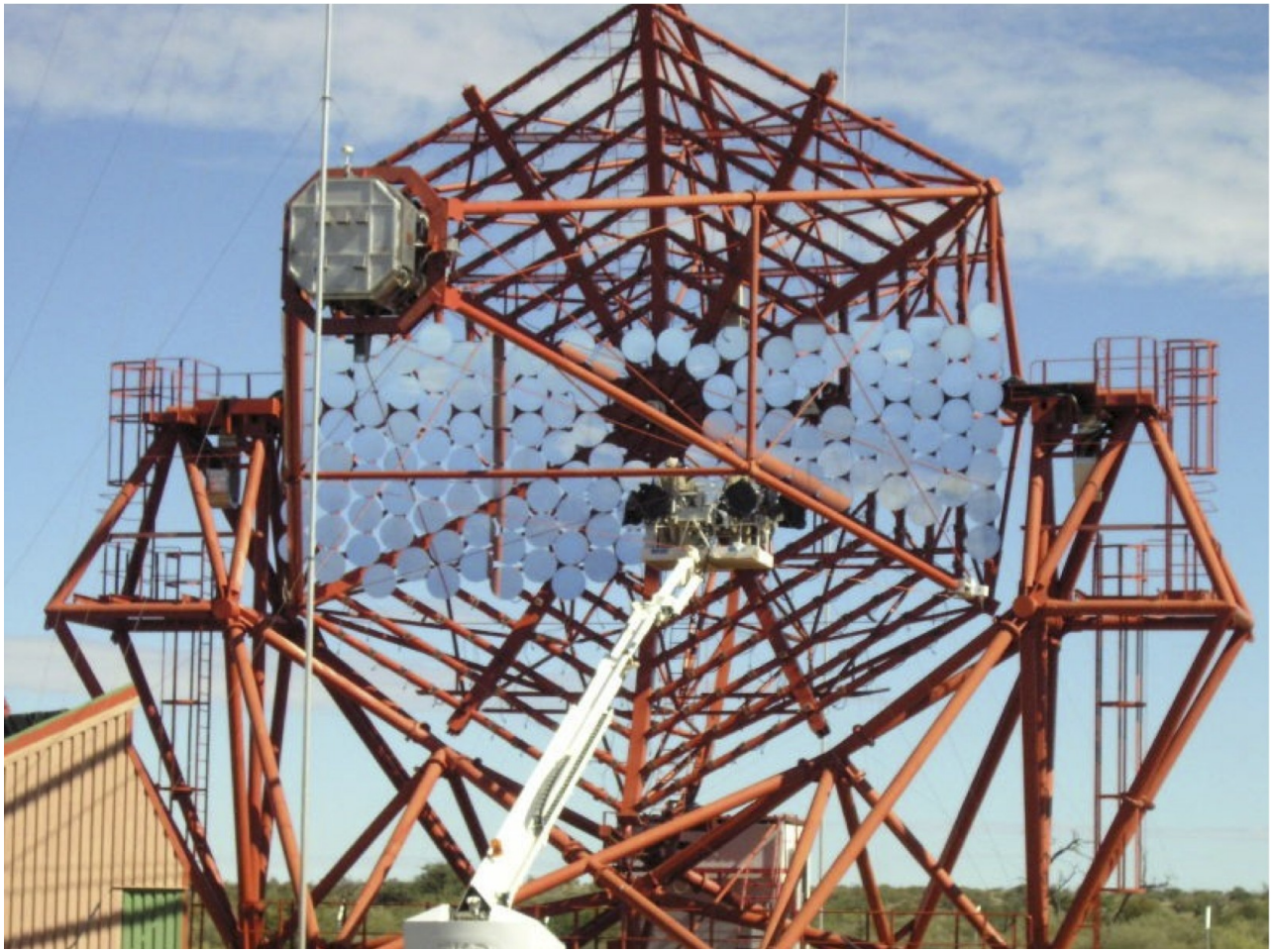
Backup slides

H.E.S.S. mirror refurbishment

- Mirrors on 3 telescopes successfully recoated
- 4th telescope is due in September 2011
- Array continued to operate in 3-telescope mode during mirror exchange

Naked telescope

Partially covered telescope



H.E.S.S. Goes phase 2

New AGN detected with H.E.S.S. during the last year

Source name	RA	Dec	z	LT	ϕ_0	θ_{zen}	N_σ	Strat.
1ES 0414+009 **[8]**	64.22	1.08	0.287	74	0.5%	26°	7.8	[3]
SHBL J001355.9−185406	3.48	-18.90	0.095	38	$\sim$ 1%	13°	$\sim$ 5	[3]
PKS 0447−439 **[18]**	72.35	-43.84	[0.176, 0.5]	14	4.5%	23°	14	[4]
AP Lib **[20]**	229.42	-24.37	0.049	11	2%	13°	7	[4]
1RXS J101015.9−311909	152.57	-31.32	0.14	33	$\sim$ 2.5%	13°	7.2	[3]
1ES 1312−423	198.76	-42.61	0.105	168*	0.4%	24°	6.8	[5]

Becherini et al., HESS Collaboration (2010)