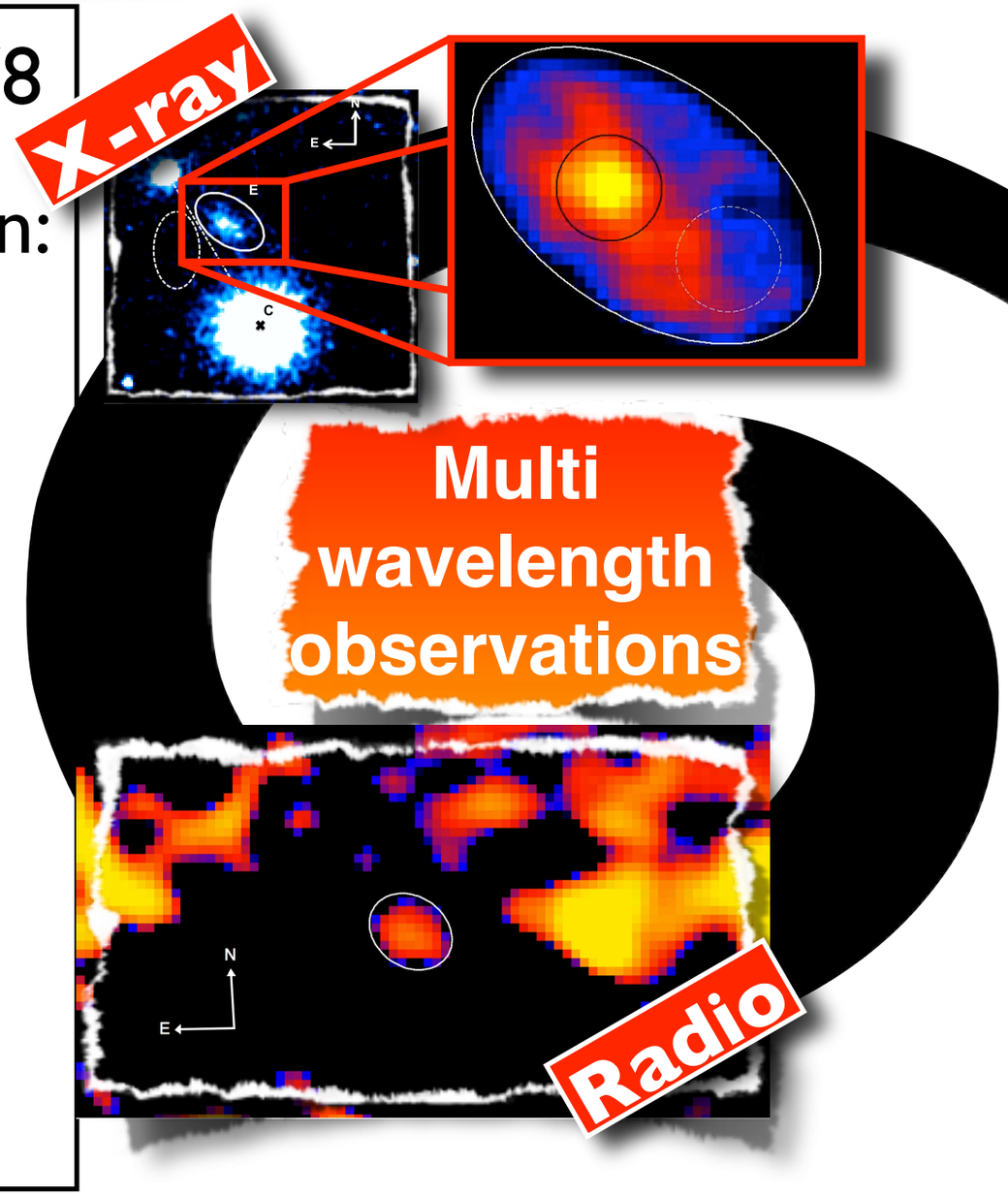
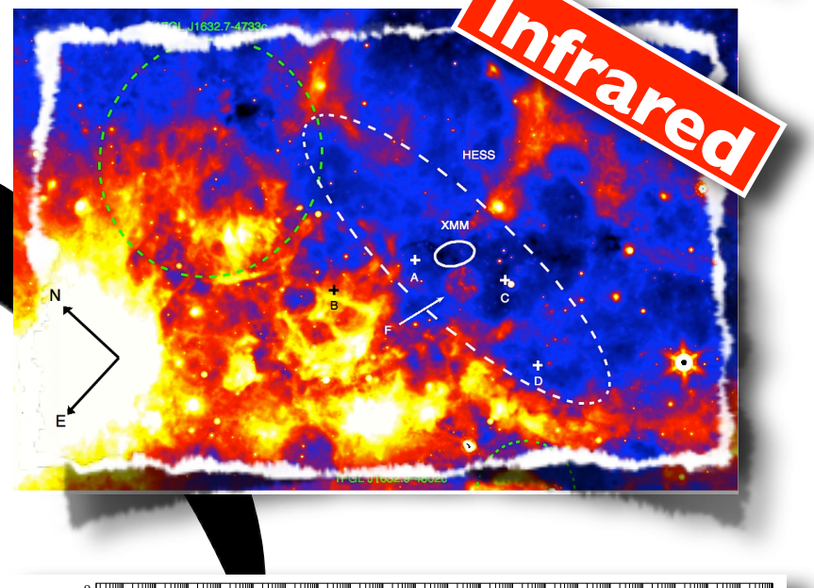
Recent results on HESS J1632-478

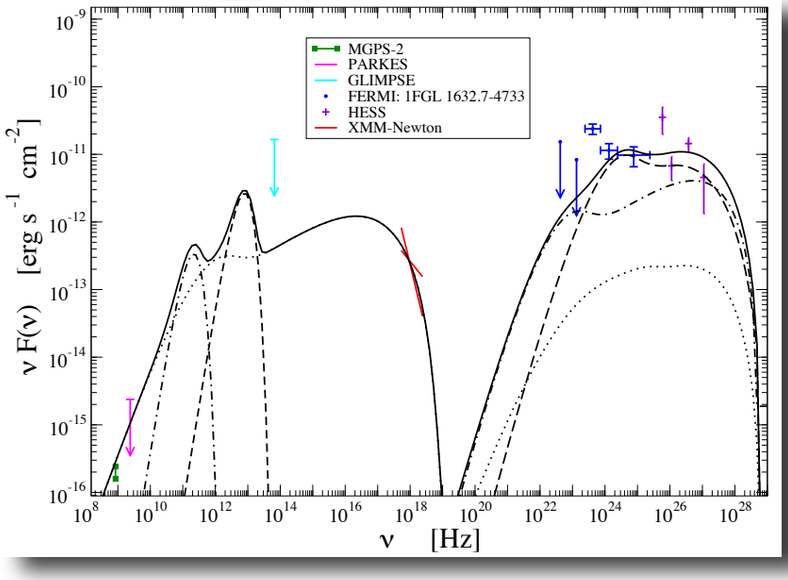
M. Balbo, P. Saouter, R. Walter, L. Pavan, A. Tramacere, M. Pohl, J. Zurita

ISDC

- HESS J1632-478
- Data extraction:
  - X-ray
  - Radio
  - Infrared
- Discussion & Model
- Conclusion



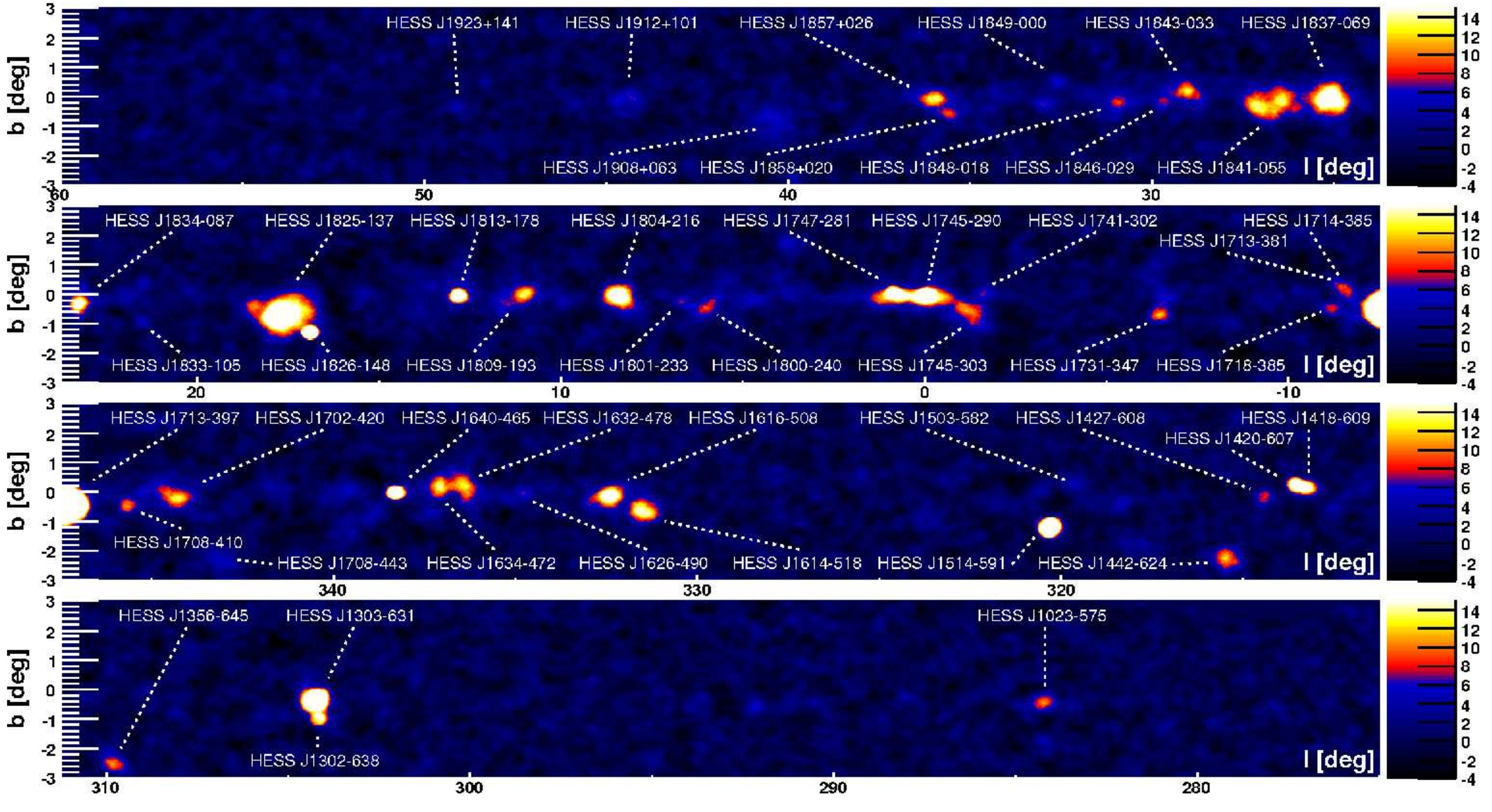




Balbo et al. A&A, in press, arXiv: 1007.1970

H.E.S.S. Galactic Plane

(Chaves, H.E.S.S., 2009 ICRC)



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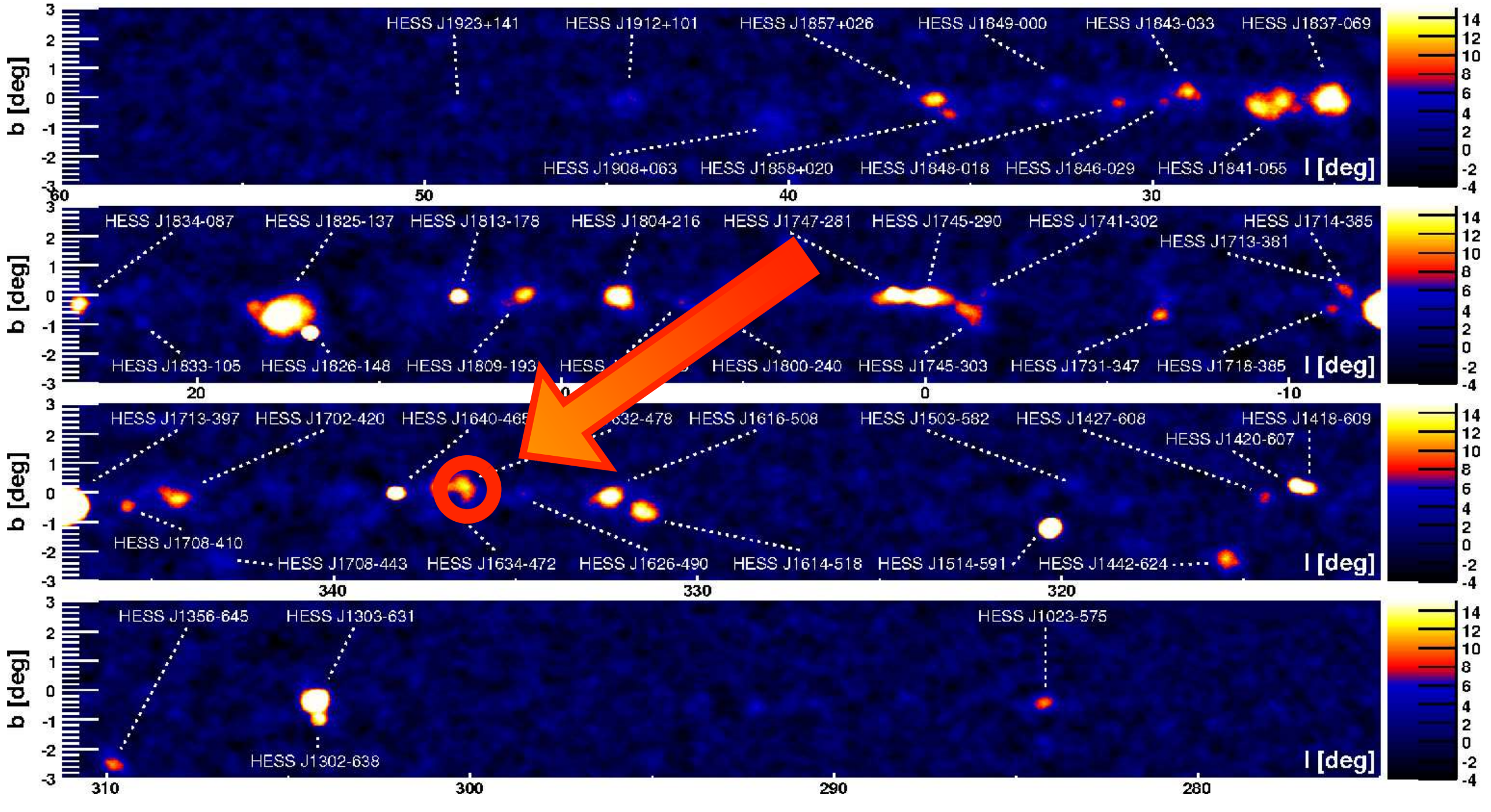
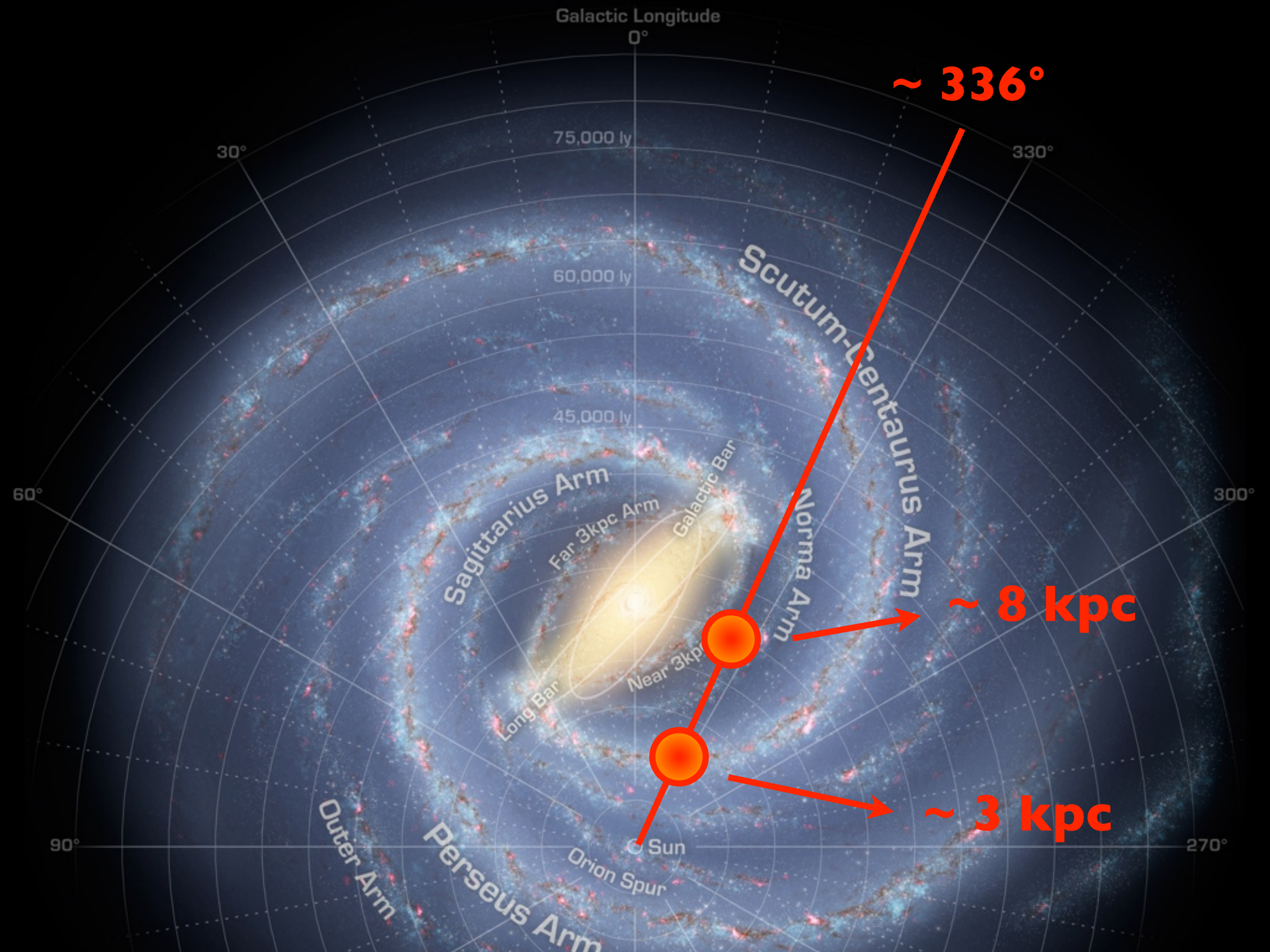
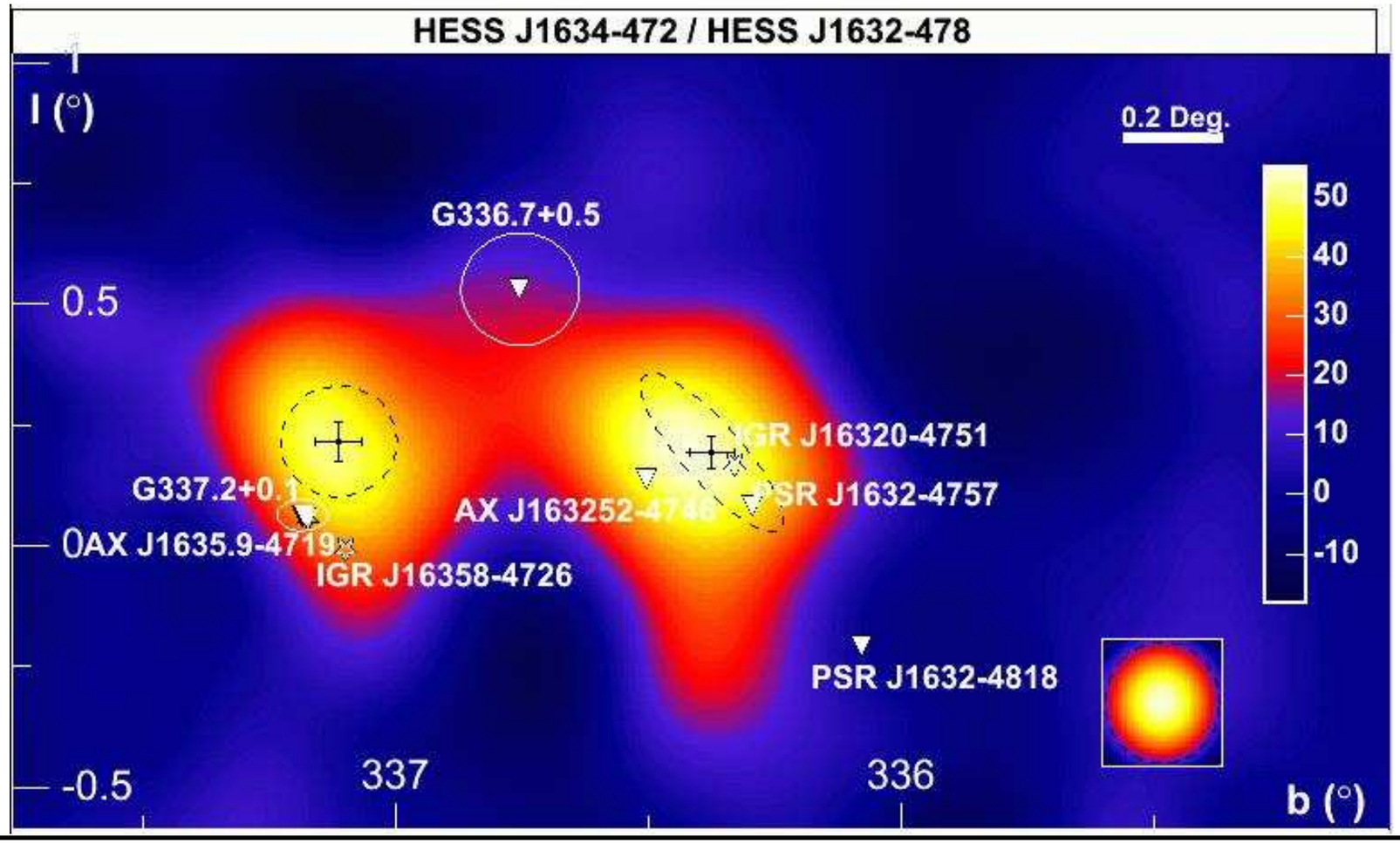



Galactic Longitude
0°
30°
330°
60°
300°
90°
270°
75,000 ly
60,000 ly
45,000 ly
~ 336°
~ 8 kpc
~ 3 kpc
Scutum-Centaurus Arm
Norma Arm
Sagittarius Arm
Far 3kpc Arm
Near 3kpc
Long Bar
Outer Arm
Perseus Arm
Orion Spur
Sun

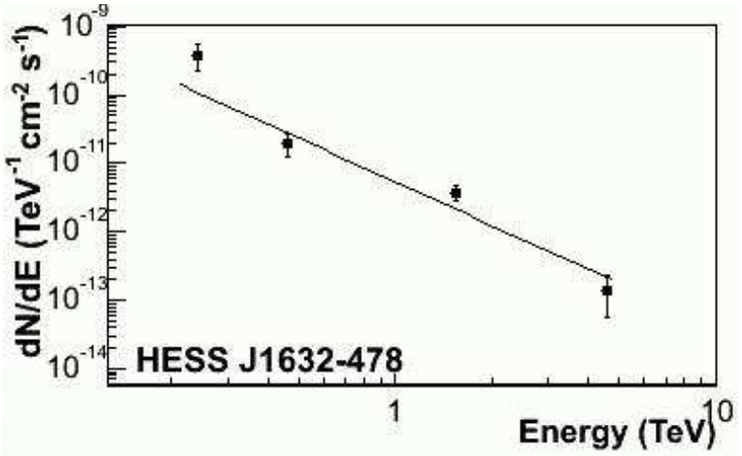
H.E.S.S. detection:

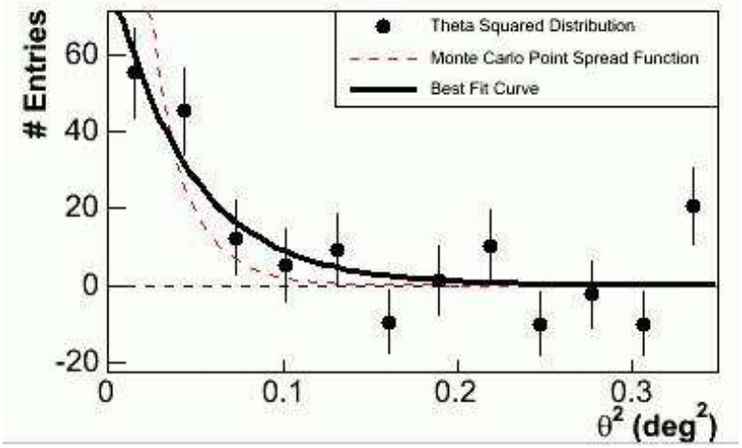
RA = 16:32:09
DEC = -47:49:12

(Aharonian et al. 2006)



Γ = 2.12±0.20

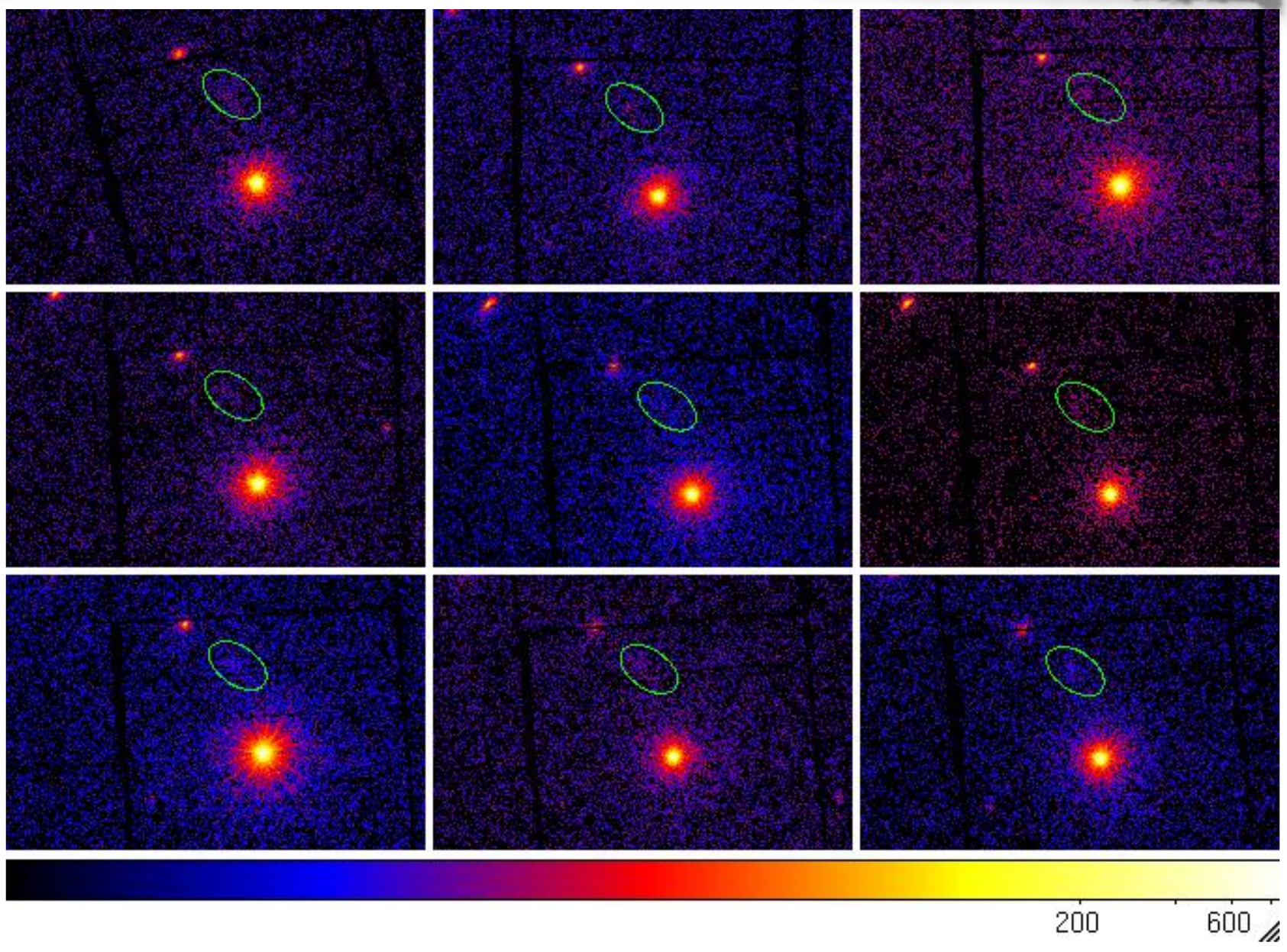




- Elongated shape: (12±3)' x (3.6±2.4)' semi-axes
- Flux > 200 GeV = (28.7±5.3) x 10^{-12} ph cm^{-2} s^{-1} ~ 12% Crab Nebula
- Positional coincidence:
  - hard X-ray source IGRJ16320–4751 above 15 keV (Tomsick et al. 2003) INTEGRAL & XMM-Newton observation 2-10 keV (Rodriguez et al. 2003)
  - soft X-rays ASCA source AX J1631.9-4752, ASCA Galactic Plane Survey (Sugizaki et al. 2001)

XMM-Newton detection:

- 9 observations from august to september 2008, ~90ks.
- In each observation the source is not visible, but it appears in the final mosaic



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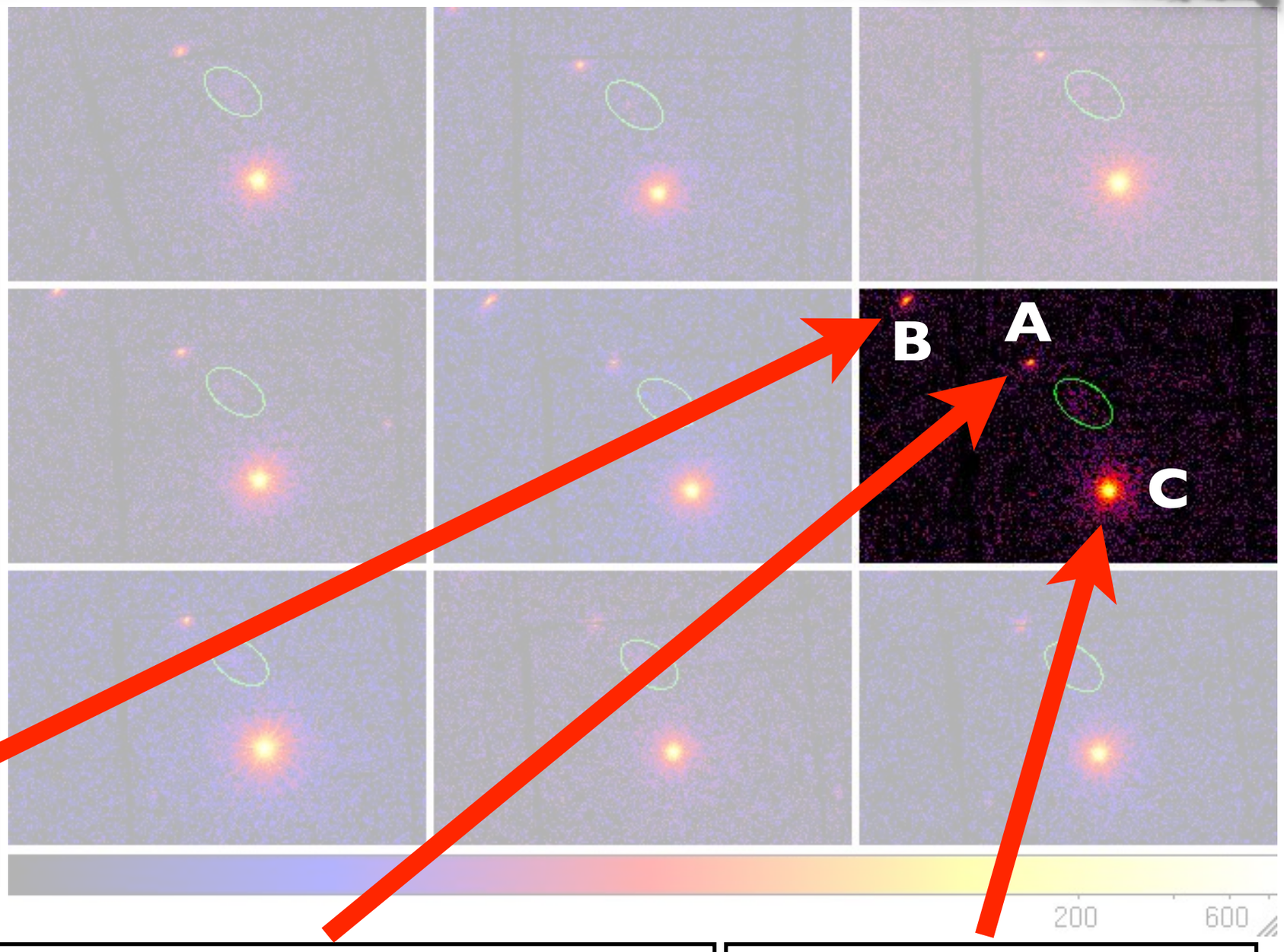
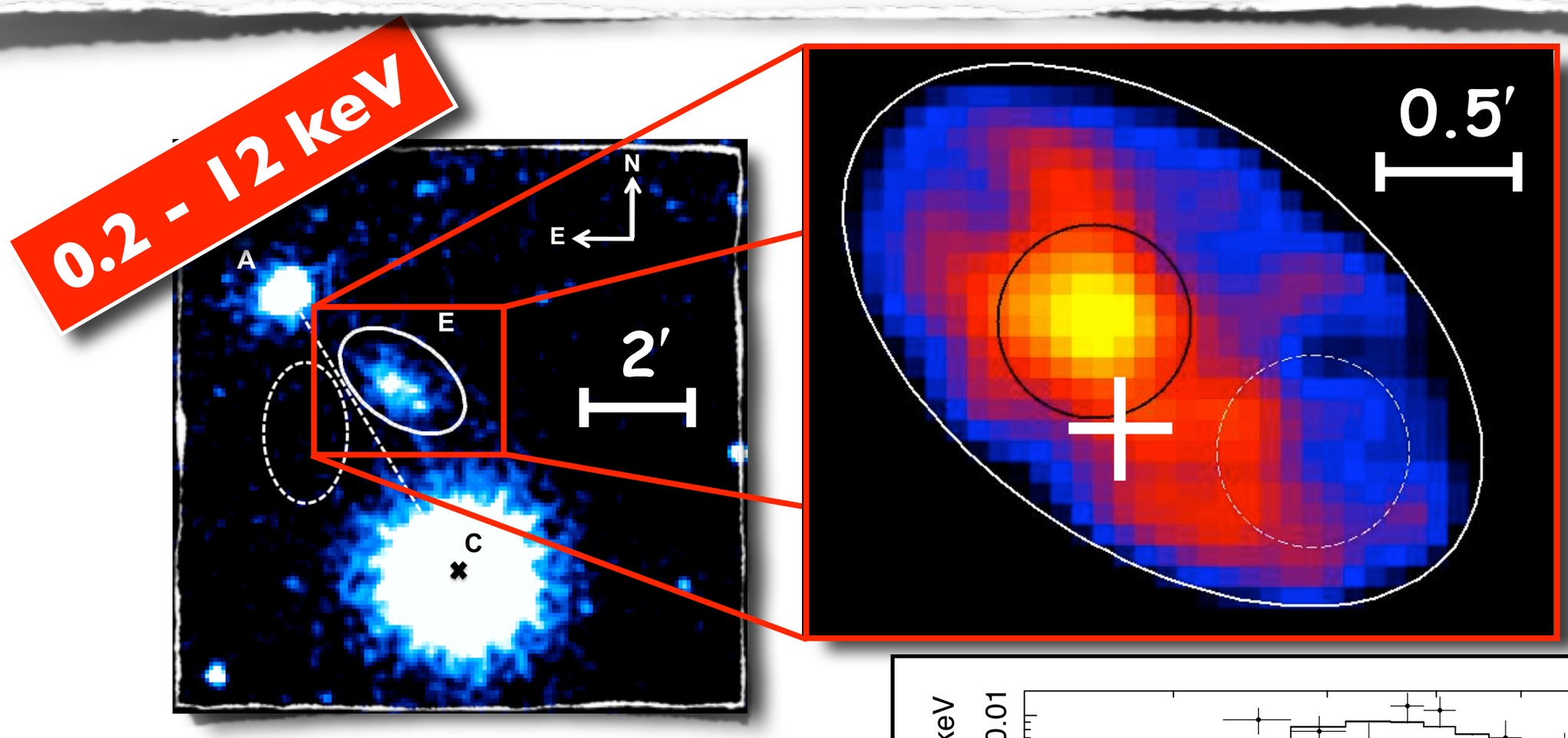


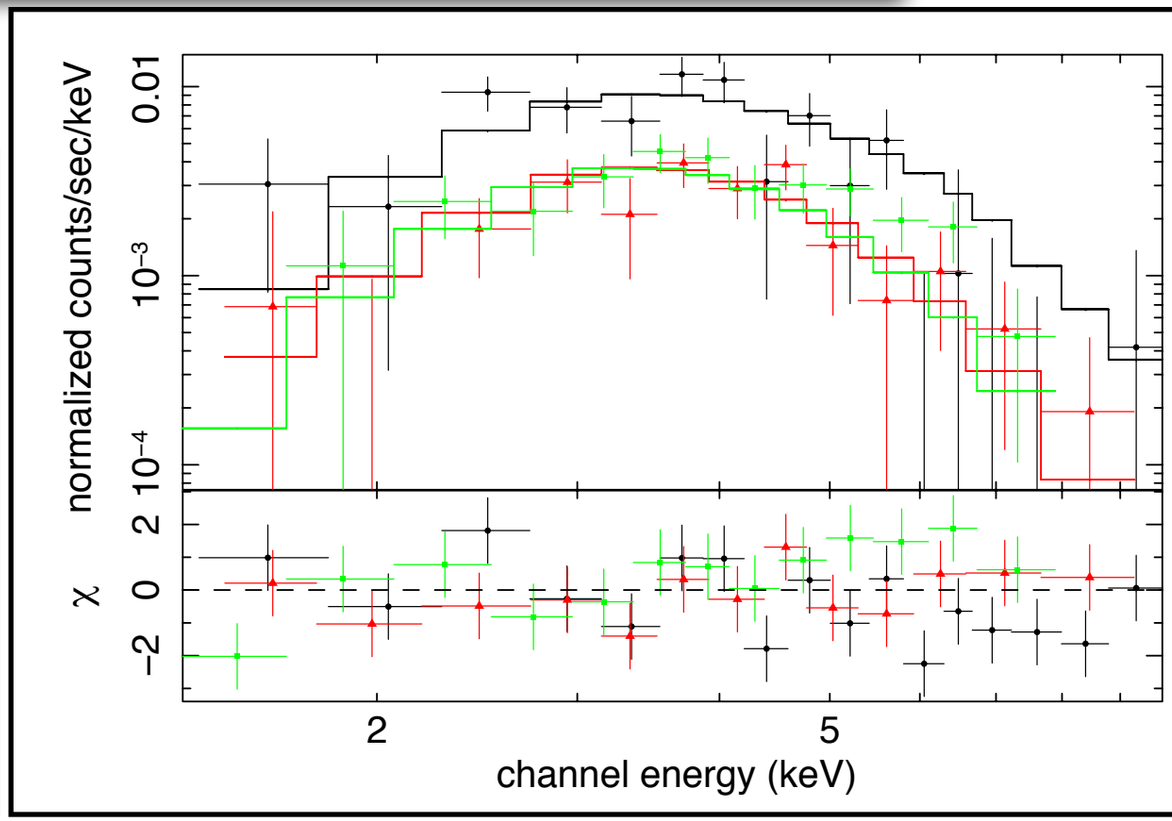
AX J1632.8-4746	XMMU J163219.9-474731	IGR J16320-4751
Massive Star	Massive Star	HMXB

XMM-Newton detection:



Absorbed power-law model

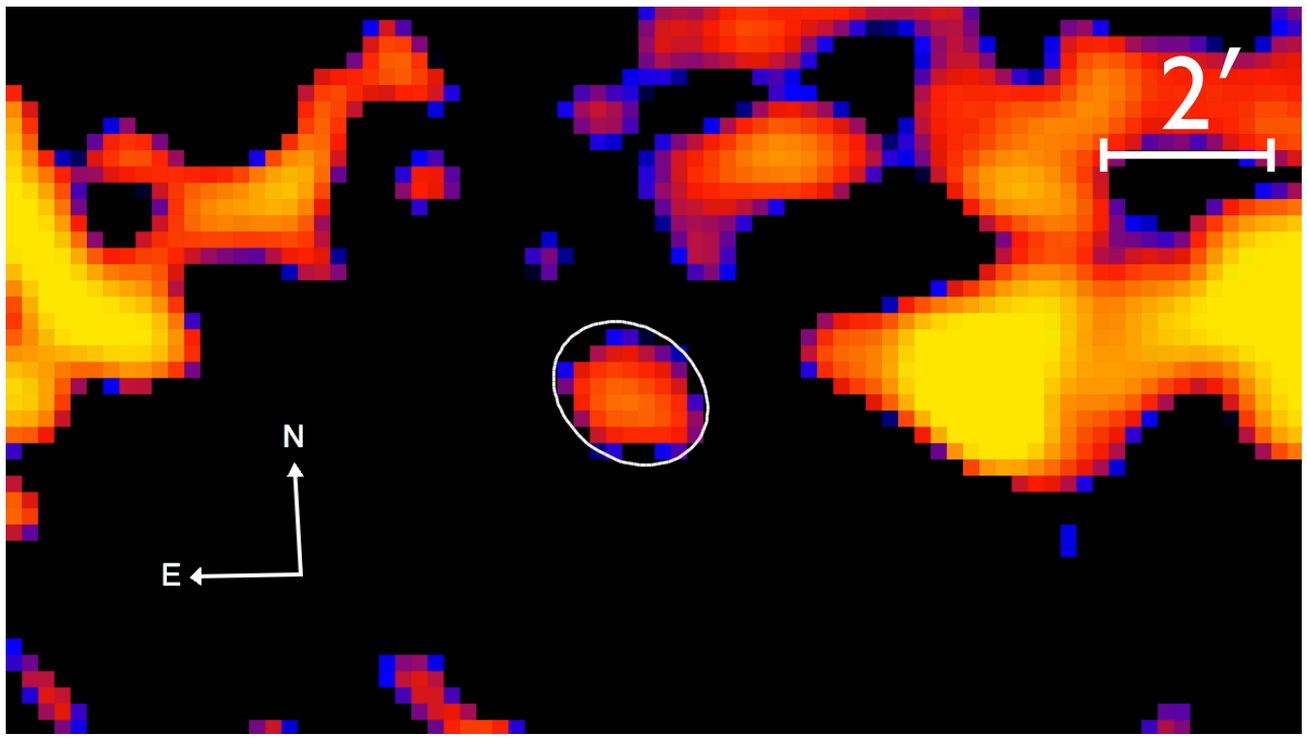
Parameter	Point	Extended	Unit
N_H	13^{+6}_{-4}	$11^{+2.2}_{-2.7}$	10^{22} cm^{-2}
Γ	$2.6^{+1.3}_{-0.8}$	$3.4^{+0.6}_{-0.8}$	
$F_{2-10\mathrm{keV}}$	$2.3^{+0.3}_{-1.0}$	$4.3^{+0.8}_{-0.4}$	10^{-13} erg cm^{-2} s^{-1}
χ^2_ν	1.8	1.9	



MGPS-2 @ 843 MHz

(Murphy et al. 2007)

- Rms sensitivity ~ 1-2 mJy/beam
- Excess count ~ 16 mJy/beam
- Source size: 35” x 26” ~ beam
- Total flux density ~ 25 mJy



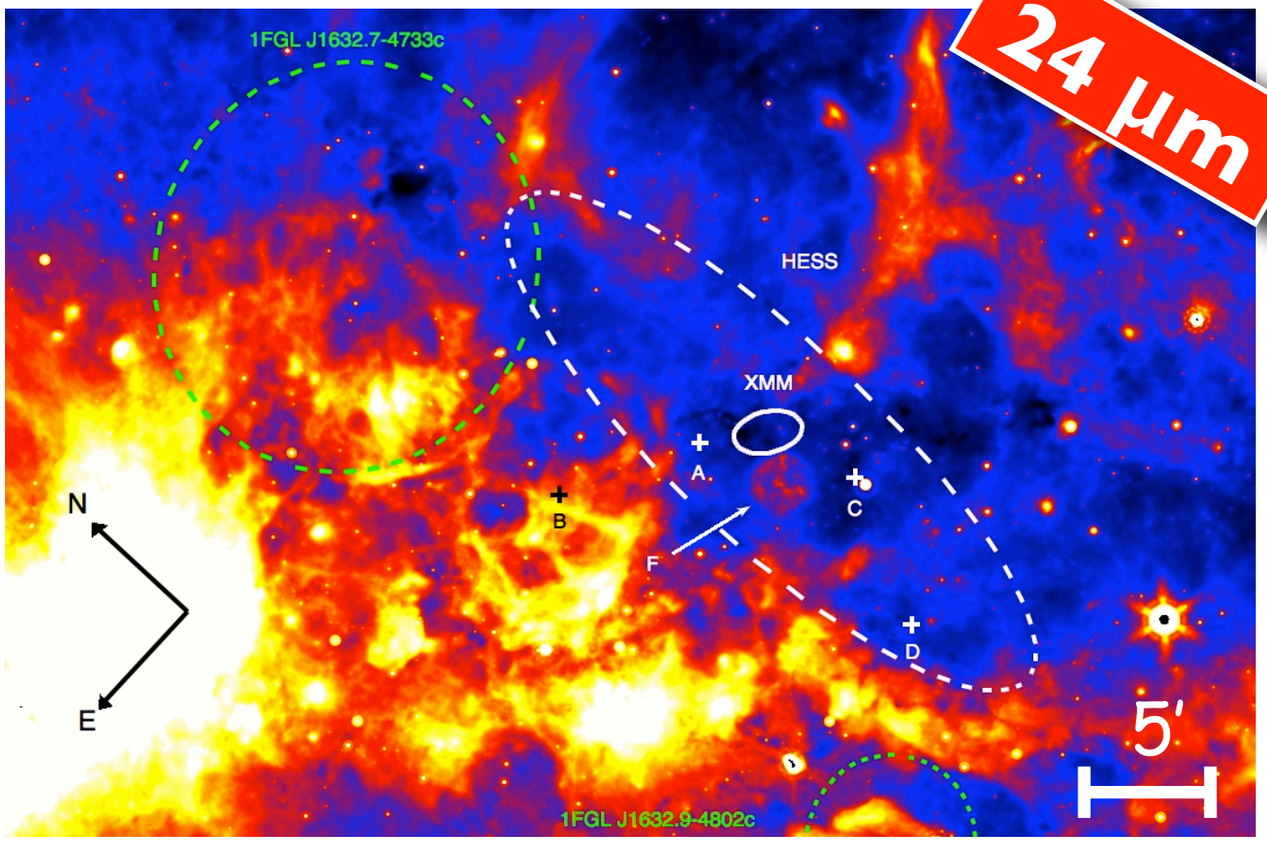
Parkes Survey @ 2.4 GHz

- Rms noise ~ 12 mJy/beam
- Resolution: 10.4’
- Upper limit ~ 100 mJy

(Duncan et al. 1995)

Infrared: GLIMPSE & MIPSGAL

MIPSGAL: MIPS, onboard Spitzer (Carey et al. 2009)



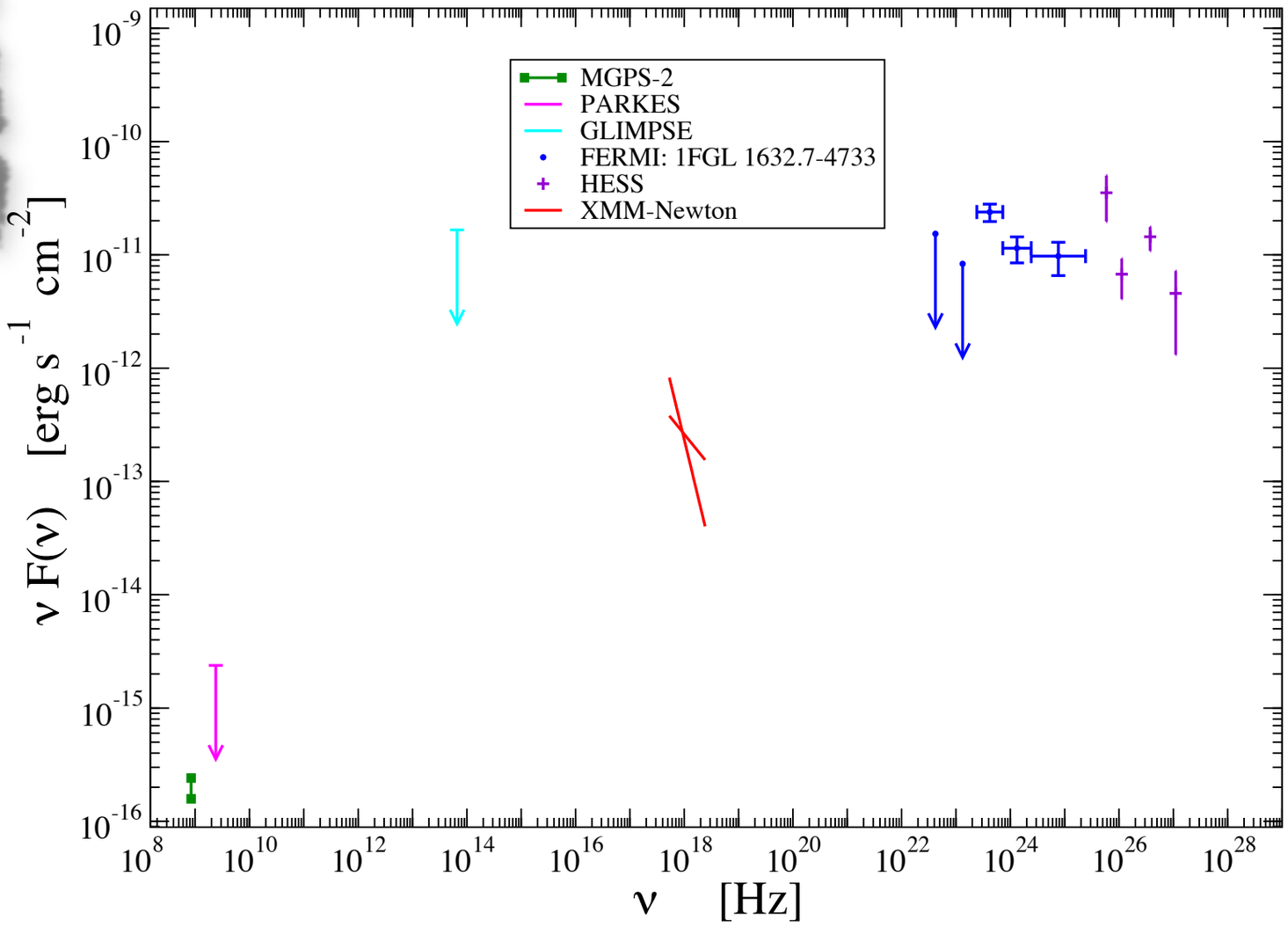
- λ: 24 and 70 μm
- Point source sensitivity ~ 2 and 75 mJy (3σ)
- Resolution ~ 6” and 18”
- No evidence for a diffuse emission corresponding to the diffuse X-ray source

GLIMPSE: (Benjamin et al. 2003)

- IRAC instrument
- λ: 3.6 - 4.5 - 5.8 - 8 μm
- Point source sensitivity ~ 0.2 - 0.4 mJy (5σ)
- Upper limit ~ 25 mJy

Discussion

- **Match** in position between the **radio excess** and the **extended X-ray** source.



- The **TeV centroid** of the HESS source lies within the extended XMM source.

- XMM-Newton + HESS spectra:

  two spectral bumps matching the expected synchrotron and inverse Compton emission of a PWN.

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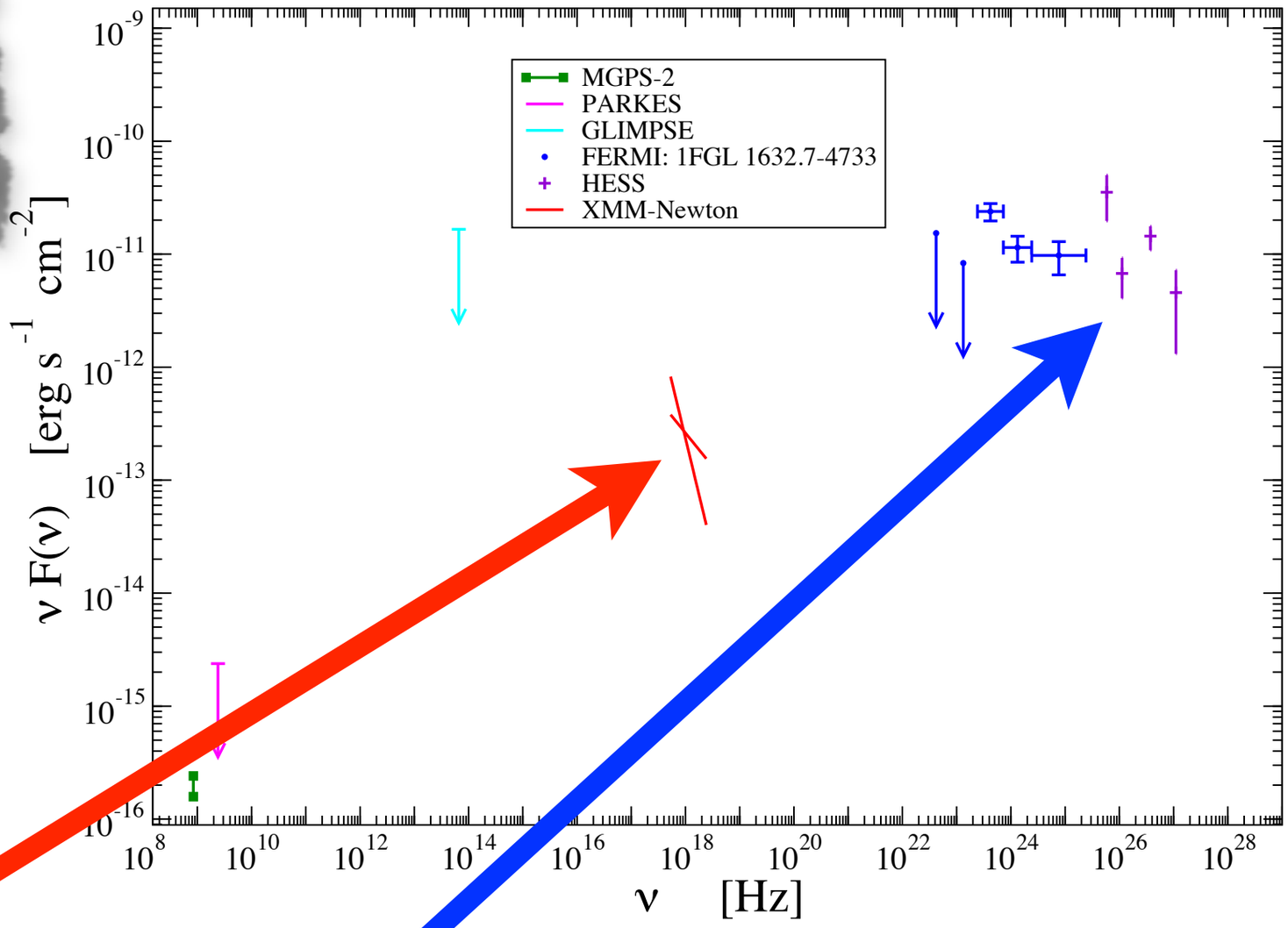

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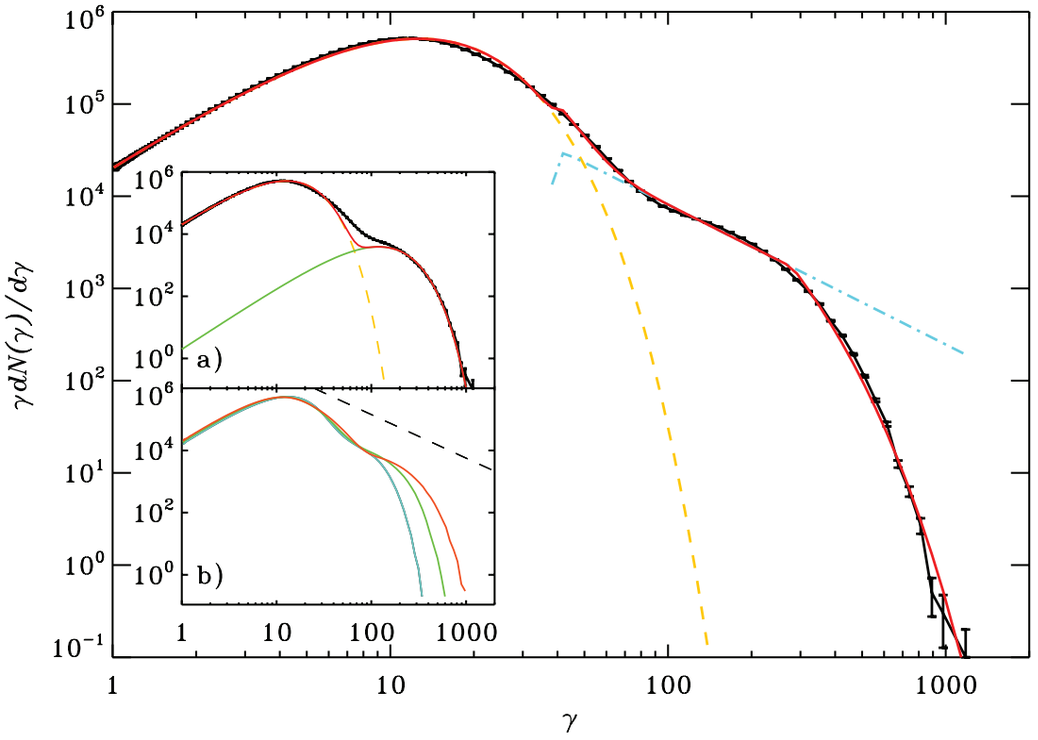
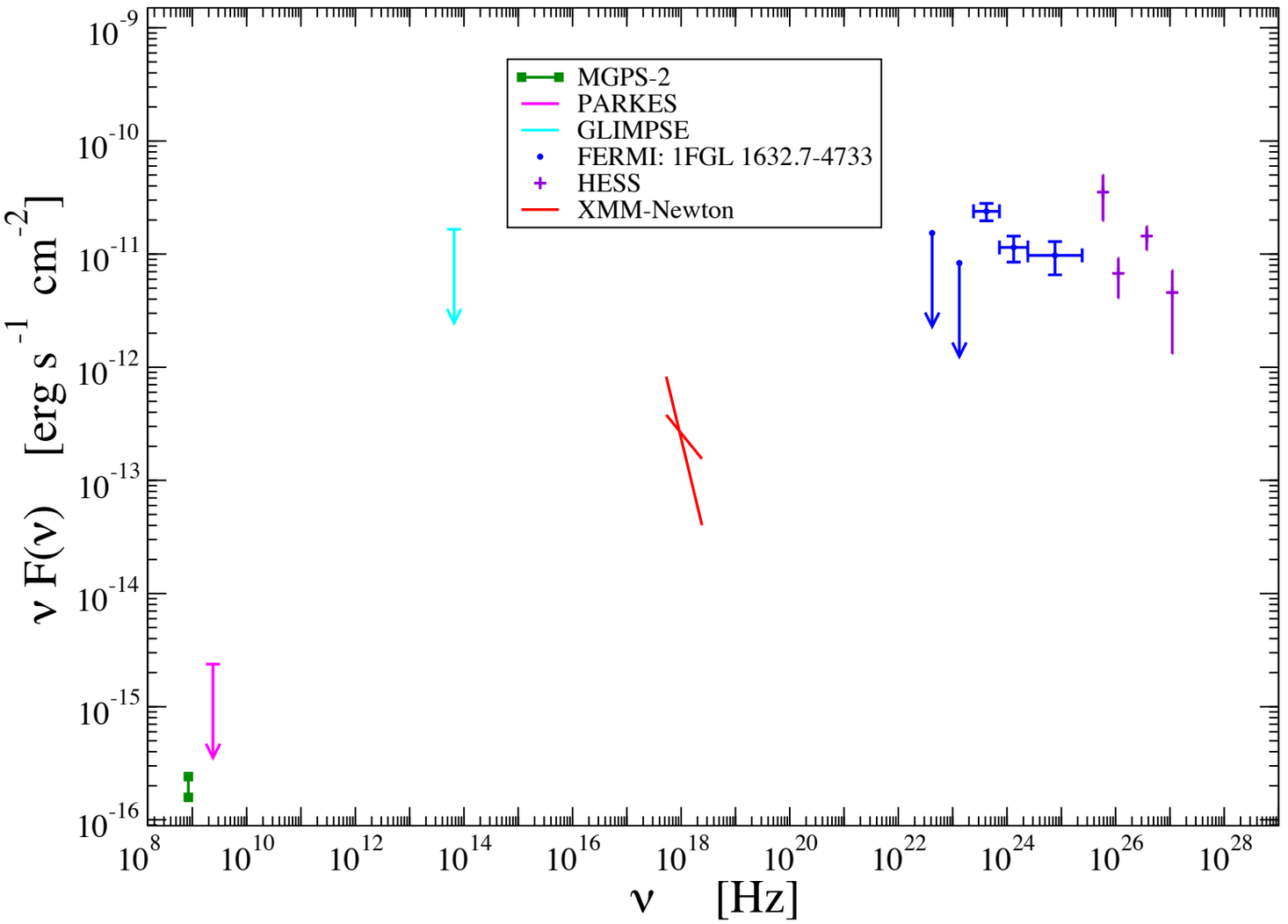
Electron spectrum (Spitkovsky et al. 2008)



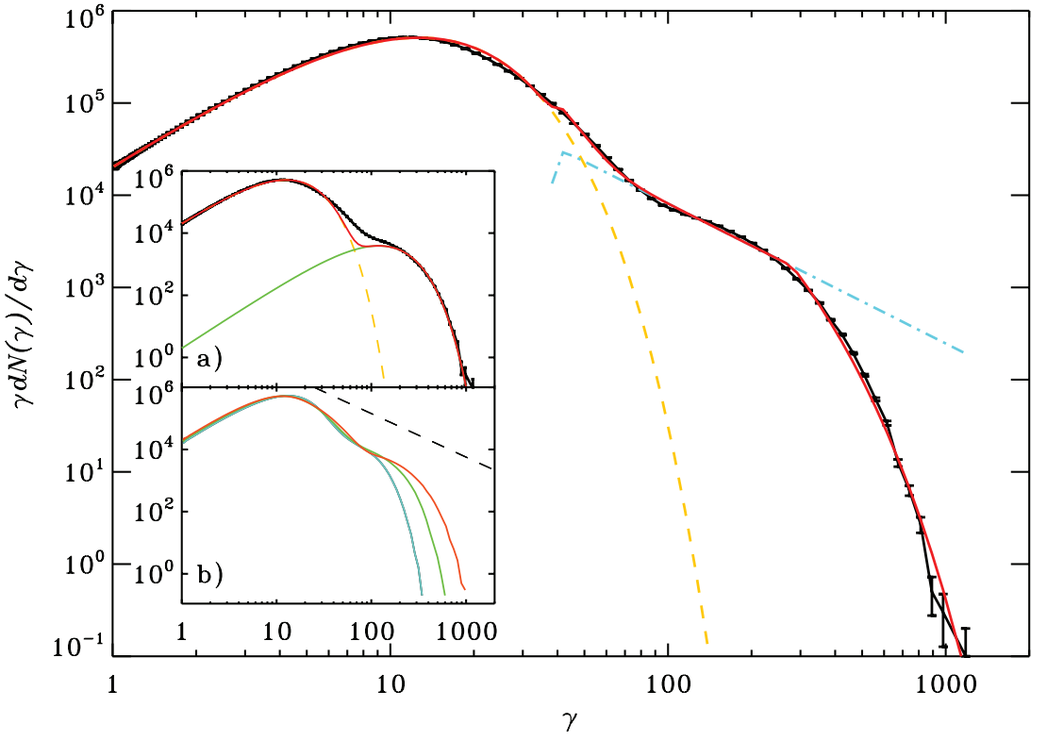


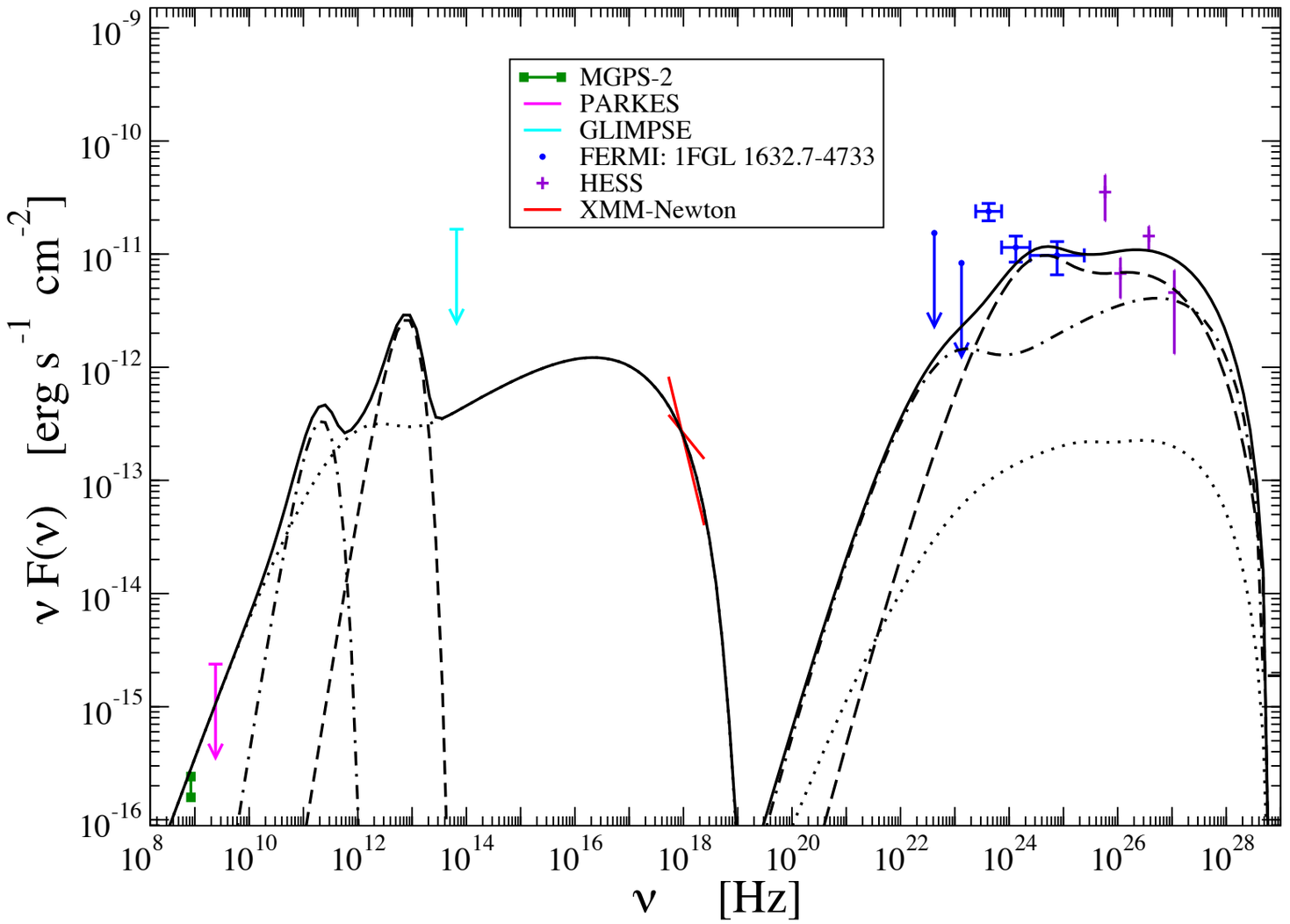
	Parameter	Value	
Electron distribution	γ_c	1.6×10^5	
	γ_{c1}	1.6×10^8	
	α	2.4	
	N	7.0×10^{-8}	e^-/cm^3
	R	1.6×10^{18}	cm
Synchrotron	B	3	μG
External Compton	U_{rad}^{CMB}	0.25	eV/cm^3
	U_{rad}^{IR}	2	eV/cm^3

Emission model

Code (Tramacere et al. 2009)

Electron spectrum (Spitkovsky et al. 2008)





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Emission model

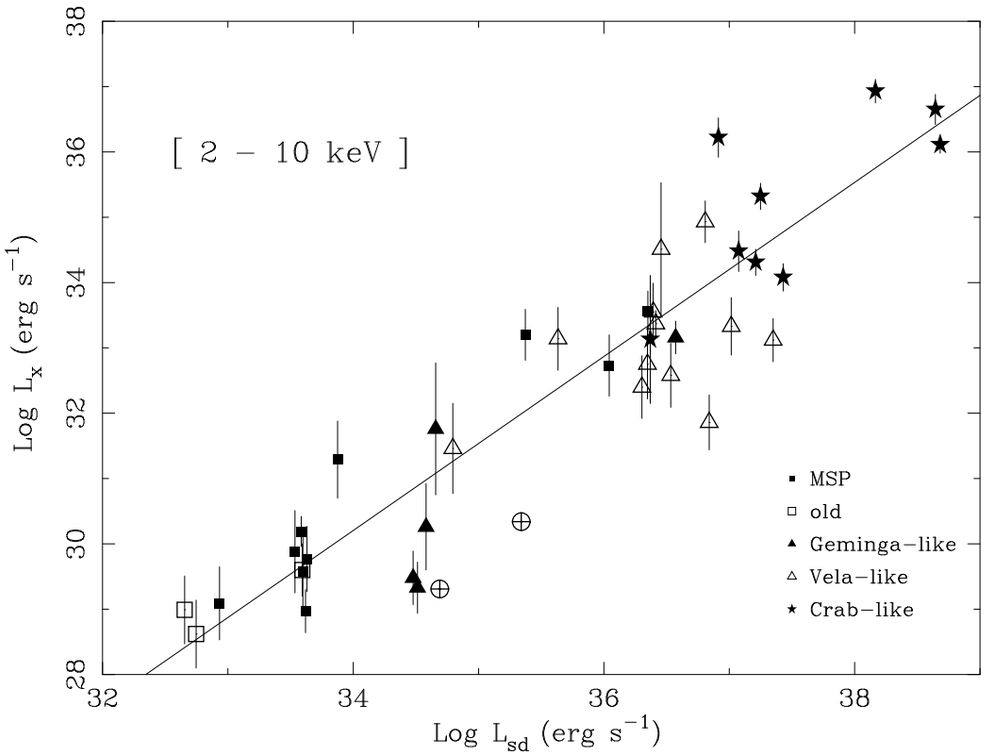
Code (Tramacere et al. 2009)

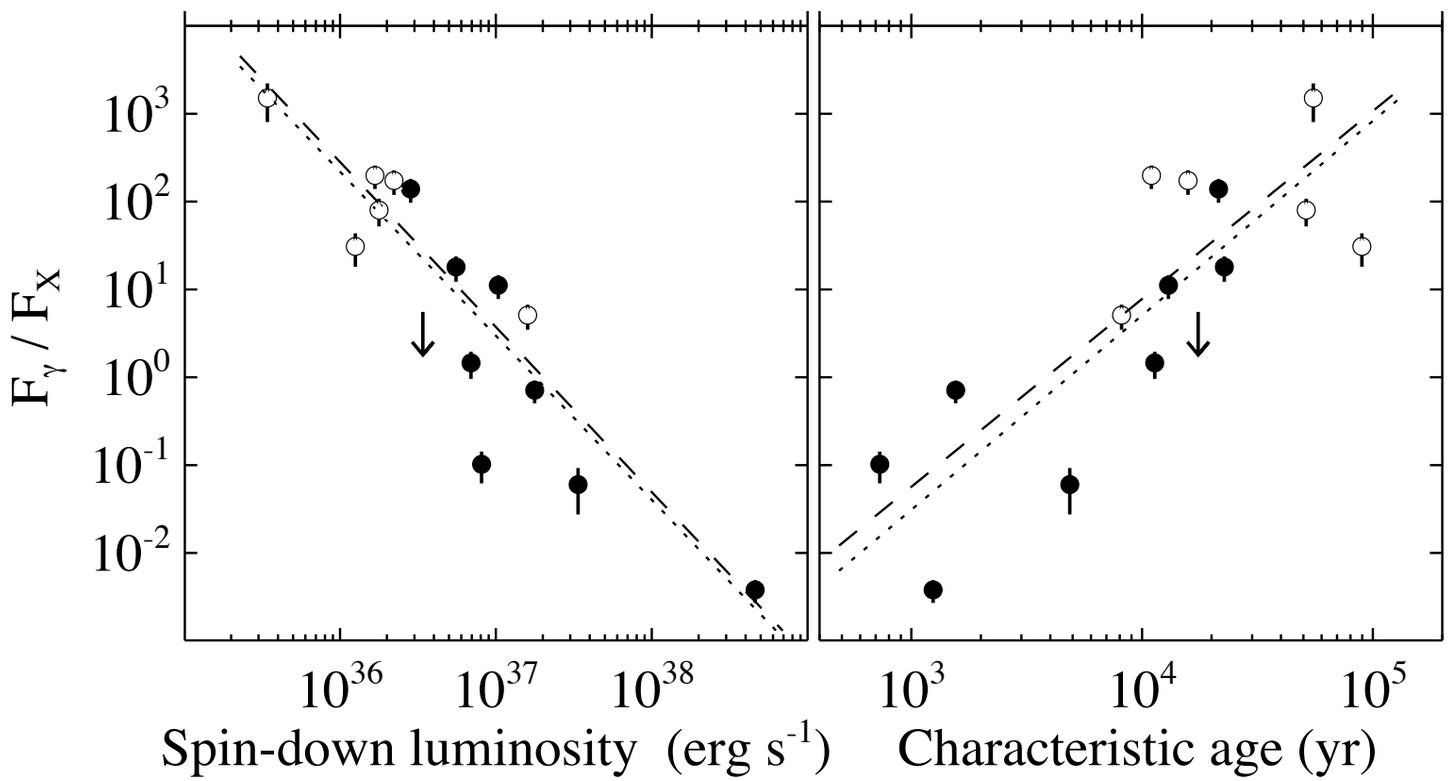
Assuming that the same electron population is responsible for the synchrotron and IC emission: f_{sync} / f_{IC} ➡ B ~ 3 μG

$L_{X,(2\text{-}10keV)}$

$\dot{E} \sim 10^{36} d_3^{1.5}$ erg/s

(Possenti et al. 2002)





F_γ / F_X

$\tau_c \sim 2 \cdot 10^4$ yr

$\dot{E} \sim 3 \cdot 10^{36}$ erg/s

(Mattana et al. 2009)

Unidentified HESS sources:

(Matthew Dalton for the HESS collaboration,
Paris conference 2010: TeV Particle Astrophysics)

- HESS J0632+057
- HESS J1023-575 → WR 20a; Westerlund 2; RCW 49
- HESS J1303-631
- HESS J1427-608
- HESS J1614-518
- HESS J1616-508 → PSR J1617-5055 ?
- HESS J1626-490
- HESS J1632-478 → IGR J16320-4751 ?
- HESS J1634-472 → IGR J16358-4726 ?; G337.2+0.1 ?
- HESS J1640-465 → G338.3-0.0 ?; 3EG J1639-4702 ?
- HESS J1702-420
- HESS J1708-410
- HESS J1713-381 → CTB 37B (G348.7+0.3) ?
- HESS J1714-385 → CTB 37A
- HESS J1718-385 → PSR J1718-3825 ?
- HESS J1745-290 → SgrA*/ChanPWN?
- HESS J1745-303 → 3EG J1744-3011 ?
- HESS J1804-216 → G8.7-0.1 / W30 ?; PSR J1803-2137 ?
- HESS J1809-193 → PSR J1809-1917 ?
- HESS J1813-178 → G12.8-0.02; AX J1813-178
- HESS J1834-087 → G23.3-0.3 / W41?

Unidentified HESS sources:

(Matthew Dalton for the HESS collaboration,
Paris conference 2010: TeV Particle Astrophysics)

- HESS J0632+057
- HESS J1023-575 → WR 20a; Westerlund 2; RCW 49
- HESS J1303-631

- HESS J1503-582 → miss low energy emission
- HESS J1507-622 → miss low energy emission
- HESS J1848-018 → W 43 / MC / WR 121a ?
- HESS J1745-303 → 3EG 1744-3011 ?
- HESS J1741-302 → MC / PWN powered by PSR B1737-30

(Tibolla et al. 2009 Fermi Symposium)

- HESS J1813-178 → G12.8-0.02; AX J1813-178
- HESS J1834-087 → G23.3-0.3 / W41?

Summary & Conclusion

- Broadband studies of HESS J1632-478 have identified this source as a likely PWN, with X-ray observations providing images of an extended nebula as well as the putative pulsar powering the system.

- The models used to reproduce the data require a B~3μG and yield an approximate age of 20 kyr and $\dot{E} \sim 10^{36} d_3^{1.5}$ erg/s, consistent with expectations for the late-phase evolution of a PWN.

- HESS sources lacking clear low energy counterpart could represent ancient PWNs or MCs illuminated by CRs from nearby SNRs.