Investigation of the Multi-Degree-Long Outflow Towards the Scutum Supershell

Rami Alsulami, Sabrina Einecke, Gavin Rowell, Miroslav Filipovic, Ivo Seitenzahl, and Tiffany Collins

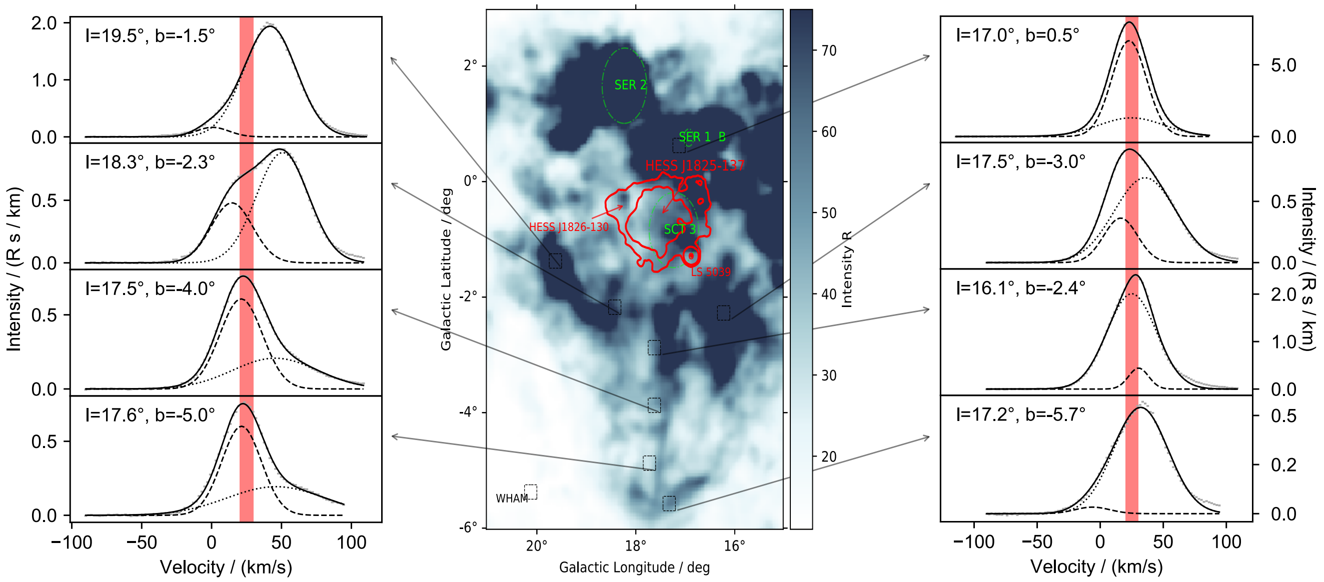


Fig 1. Hα image from Finkbeiner (2003) towards this outflow and some energetic sources such as HESS J1825−137 and LS 5039 with gamma–ray emission (red contours of 5σ, 10σ and 50σ). The red shaded area in the WHAM velocity spectra are from 20—30 km/s . The OB associations are noted in lime dashed circle.

H I & MAXI Observations towards this Outflow

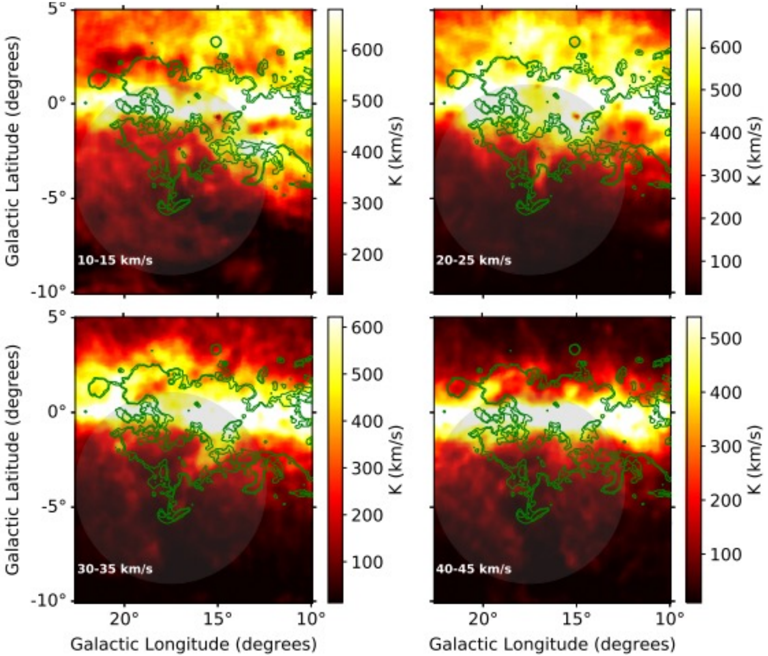


Figure: Velocity band from SGPS H I observation and Hα contours(green). Scutum supershell is in shaded area.

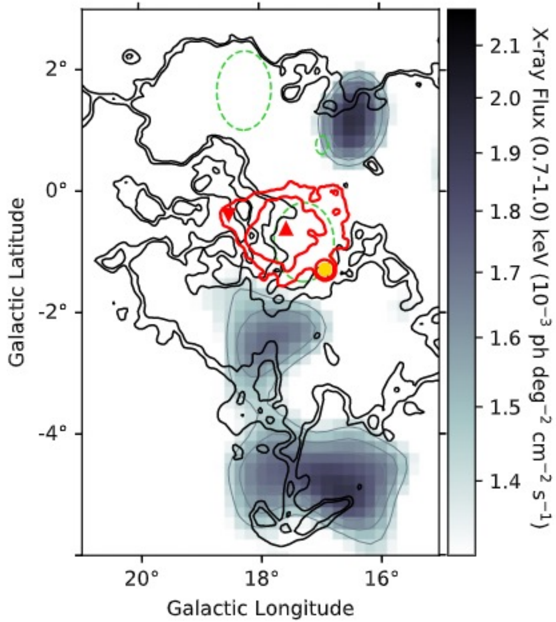


Figure 3. MAXI SSC X-ray (0.7-1.0 keV) image from Nakahira et al. (2020) with the Hα contours (black) of 40 and 50 R, gamma-ray HESS contours (red) of 5 and 10σ, and MAXI contours of 7, 8 and 9σ. The OB associations are indicated as green dashed circles.

Potential Origins

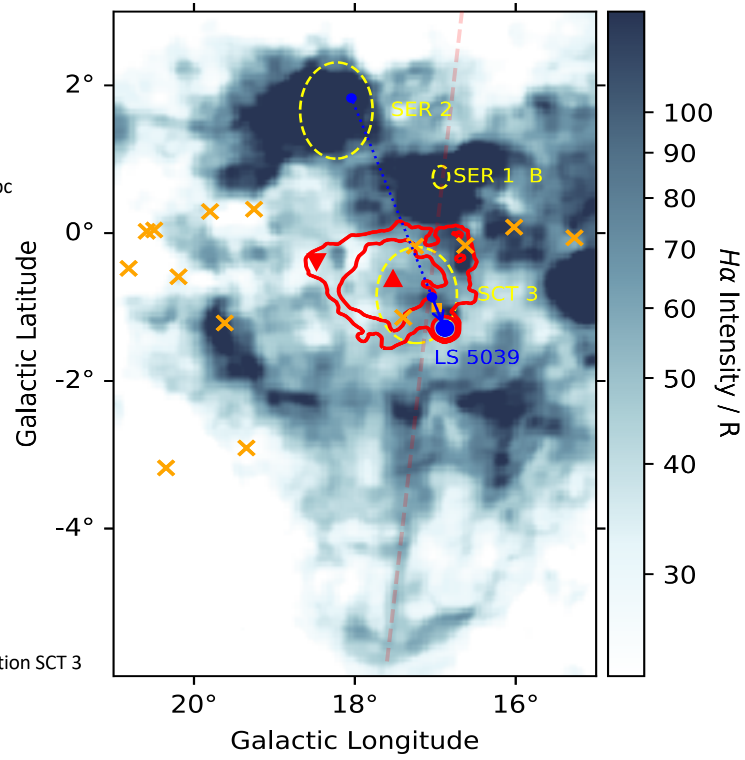
Young Stellar Objects (YSOs)
- Produce small outflows extending to about 1pc
- Implies a very nearby YSO (~30pc)
- No nearby YSOs in this region

Pulsars
- Pulsar's proper motion faster than speed of sound in ISM produce small outflow of about 1pc
- Pulsar's rotation produce small outflows
- Implies a very nearby pulsar
- No nearby pulsars in this region

Stellar Winds of OB Stars
- Generate bow shocks when interacting with ISM
- No OB stars or OB associations near the bow shock

Supernovae
- Produce outflows of large extents
- Search for compact objects left behind
- No irregular pulsars with distance < 5kpc and age < 10Myr
- Extreme outflow by regular pulsar unlikely

Long Gamma-Ray Burst related to LS 5039
- One of LS 5039's possible birth locations (Moldon et al. 2012) aligns with jet (related to OB association SCT 3 and an age of ~0.1Myr)
- LS 5039 is most energetic point source in this region
- Presence of massive stars in final stage supported by Wolf-Rayet star WR 115 in OB association SCT 3



Outflow Parameters

Outflow parameters for 2°-long jet		Outflow parameters for LS 5039	
Hα Luminosity	10^{36} erg/s	Length of outflow	5°
WHAM Velocity	23 km/s	Distance of LS 5039	2 kpc
Upper Limit of Age	4.5 Myr	Physical length of outflow	170 pc
Lower Limit of length	70 pc	Total Hα energy	10^{49} erg

Conclusion

- This feature is most likely related to energetic supernova
- LS 5039 is best candidate to be related to supernova and suggested to be magnetar
- This work is to be submitted to PASA

Understanding the TeV Cosmic-Ray “Sea”

Peter Marinos

November 2021

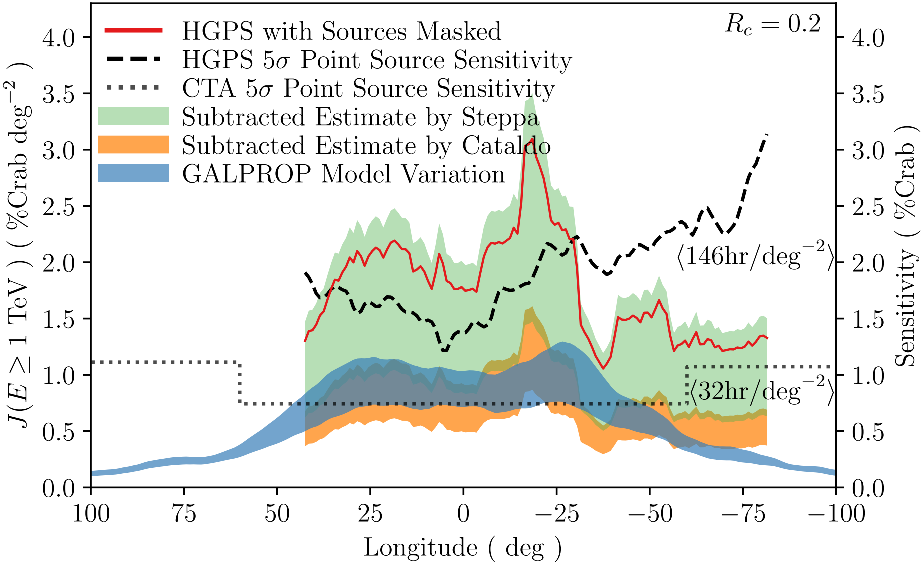
The University of Adelaide
Peter D. Marinos, Prof. Gavin P. Rowell, and Dr. Troy A. Porter

The TeV Diffuse Emission

THE UNIVERSITY of ADELAIDE

- The H.E.S.S. Galactic Plane Survey (HGPS) comprises 2673 hours of γ-ray observations above 1 TeV, covering $250° \leq l \leq 65°$ and $b \leq |3°|$. They observed a large-scale emission along the Galactic plane.
- Accurate models of the sea are required to discern extended and faint sources from the background emission
- GALPROP propagates CRs though the Galaxy and creates γ-ray skymaps (Porter et al. 2020)
- We compare the HGPS diffuse emission to the GALPROP simulations, where we have changed Galactic distributions to find a range of results
- Created a longitudinal profile of both data sets using a sliding averaging window of width $15°$, including latitudes $-1.5° < b < +1.0°$

Current Results



HESS J1804–216:

Modelling The Gamma Ray Emission from Two SNRs in the Hadronic Scenario

Kirsty Feijen, Sabrina Einecke and Gavin Rowell

CTA-Oz meeting – November 2021

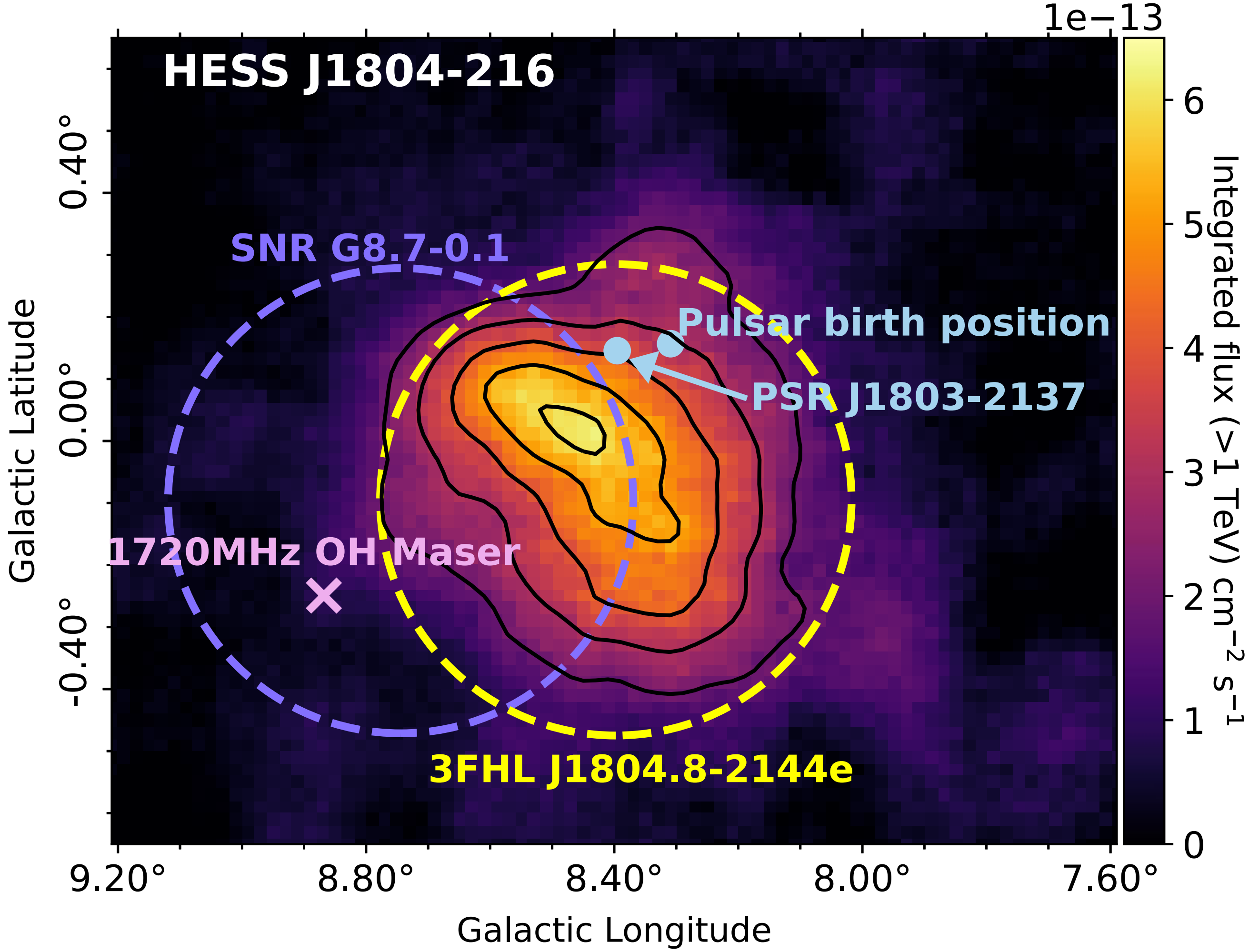
THE UNIVERSITY of ADELAIDE
High Energy Astrophysics Group

Most plausible candidates:

- SNR G8.7–0.1
- PSR J1803–2137

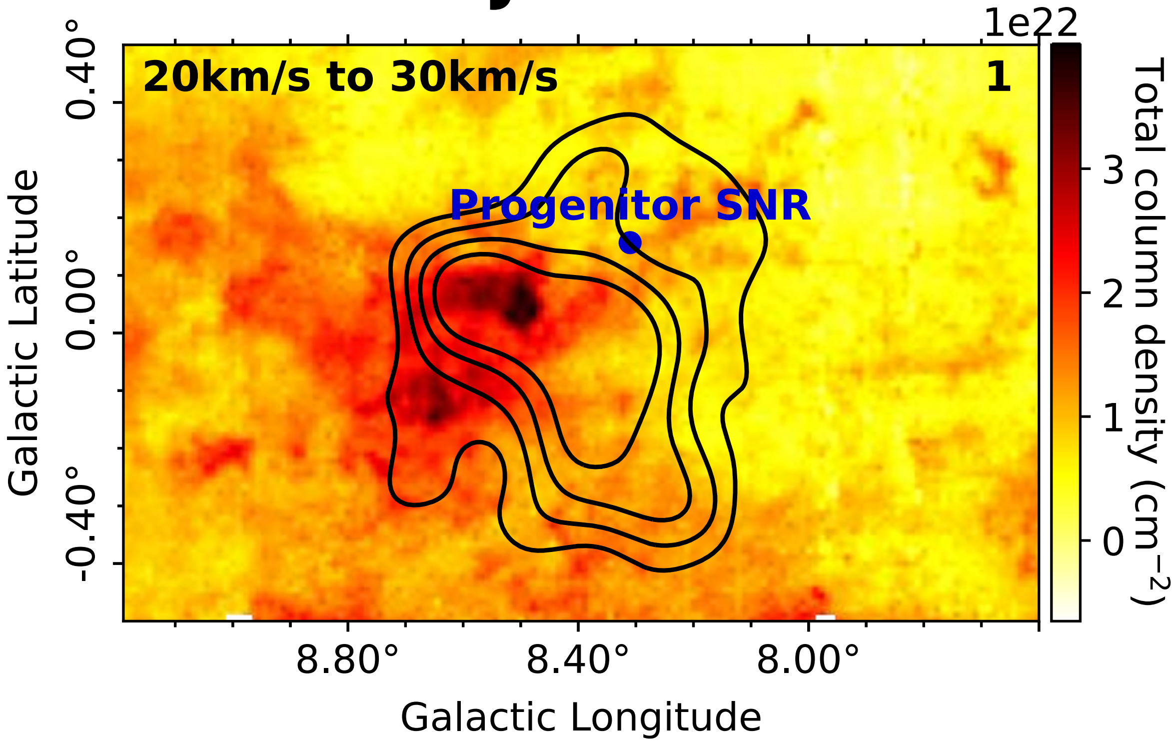
As identified in Feijen et al 2020

arXiV:2011.09021



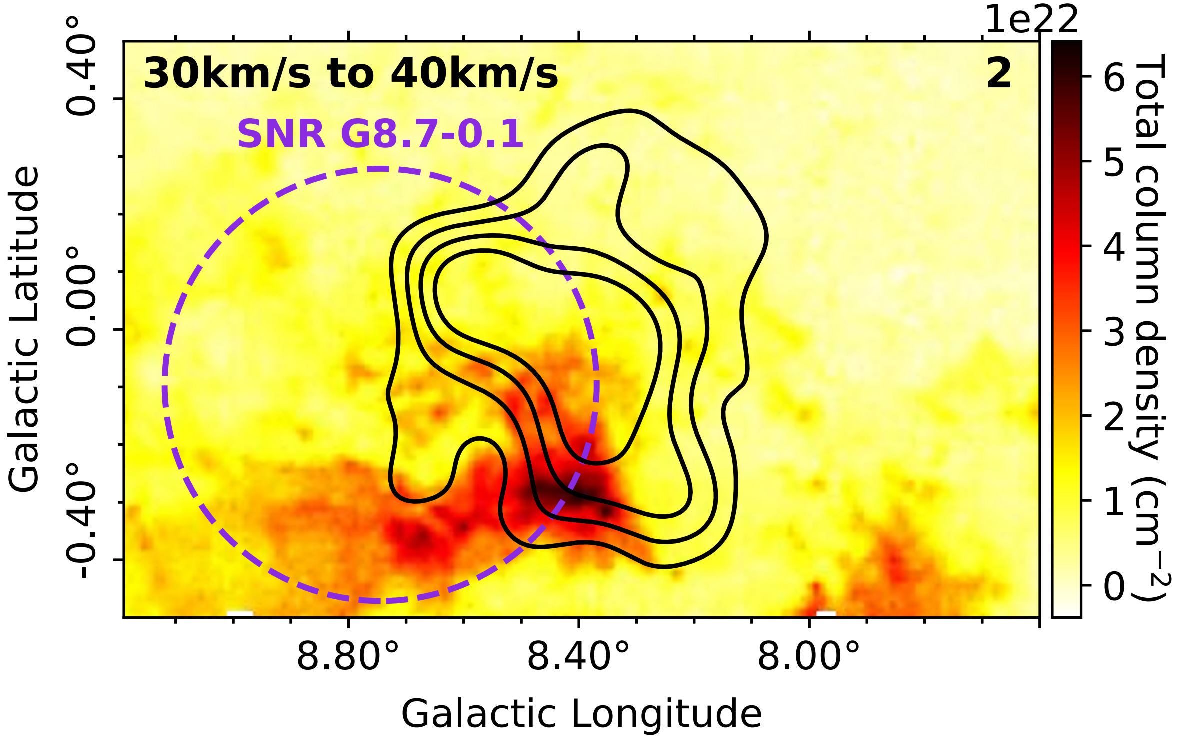
ISM towards Candidates

Progenitor SNR of PSR J1803–2137



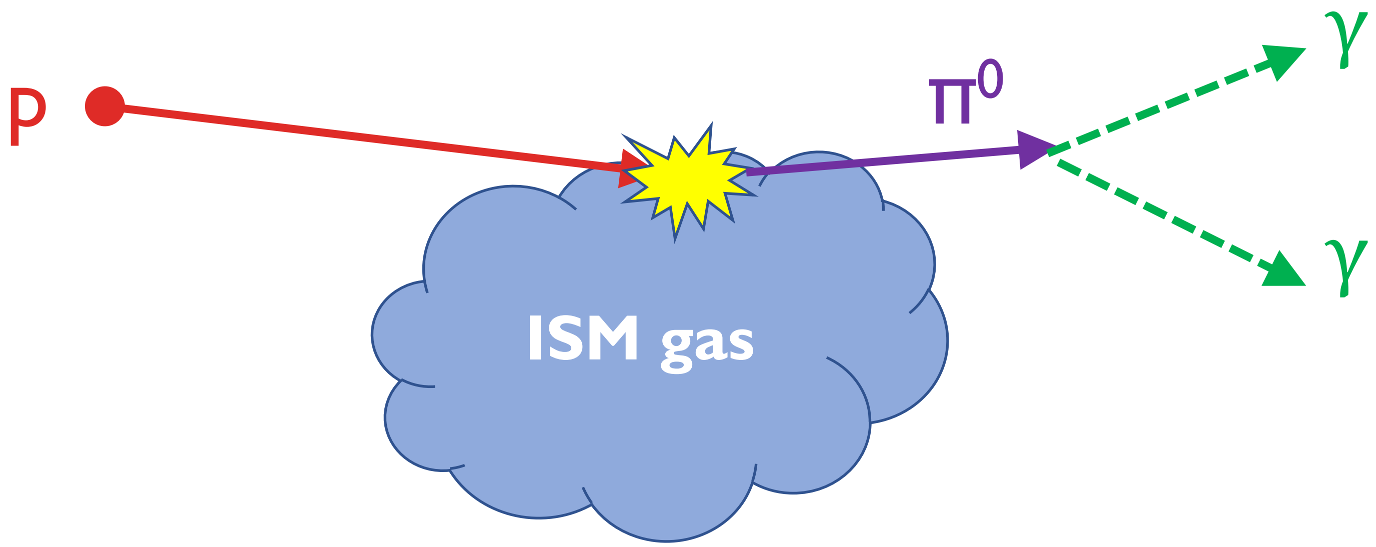
- Distance: 3.8 kpc
- Age: 16 kyr

SNR G8.7–0.1



- Distance 4.5 kpc
- Age: 15-28 kyr

Hadronic Scenario



Proton map

(Aharonian + Atoyan, 1996)

+

Gas map

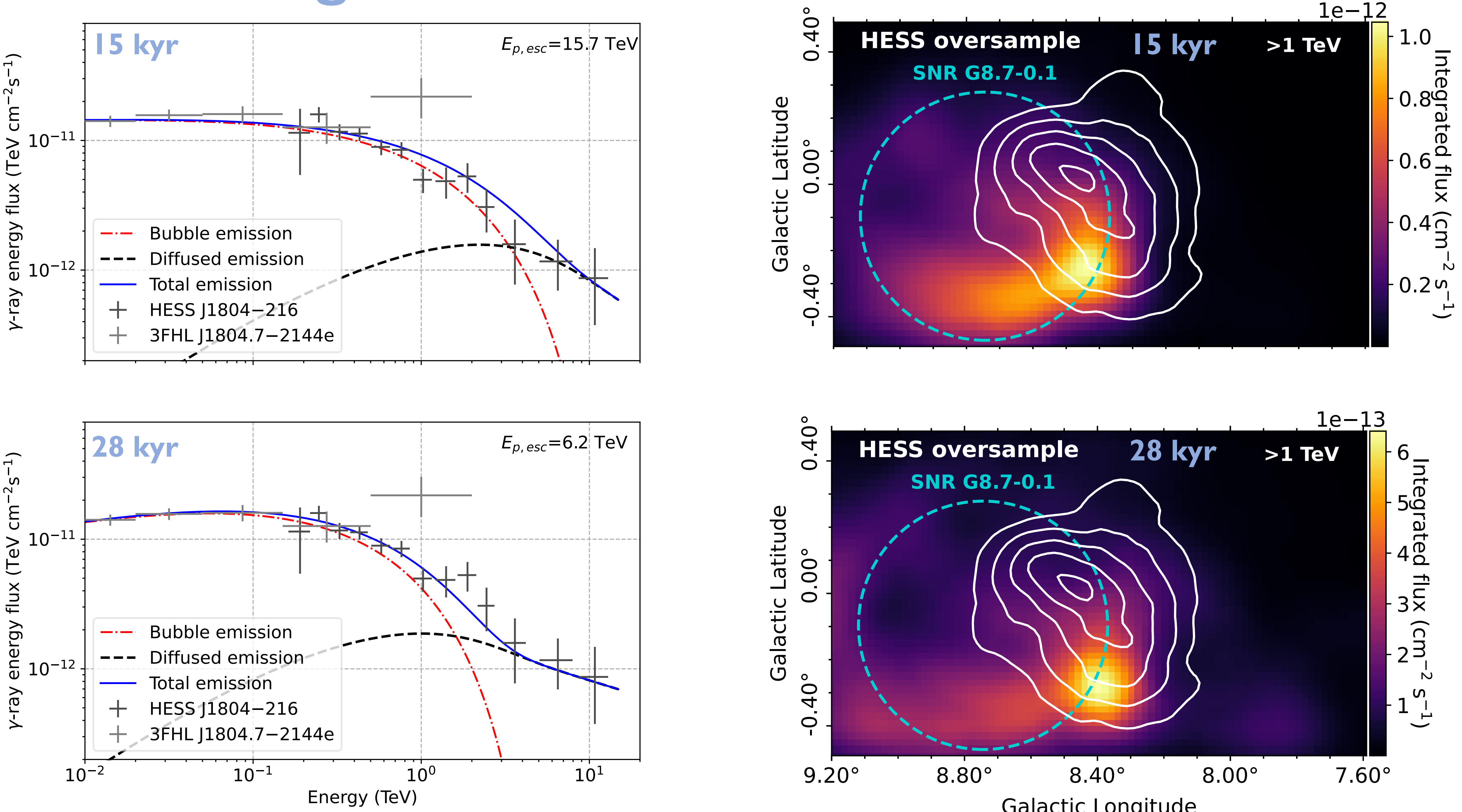
(Total column density from Mopra CO and SGPS HI)

=

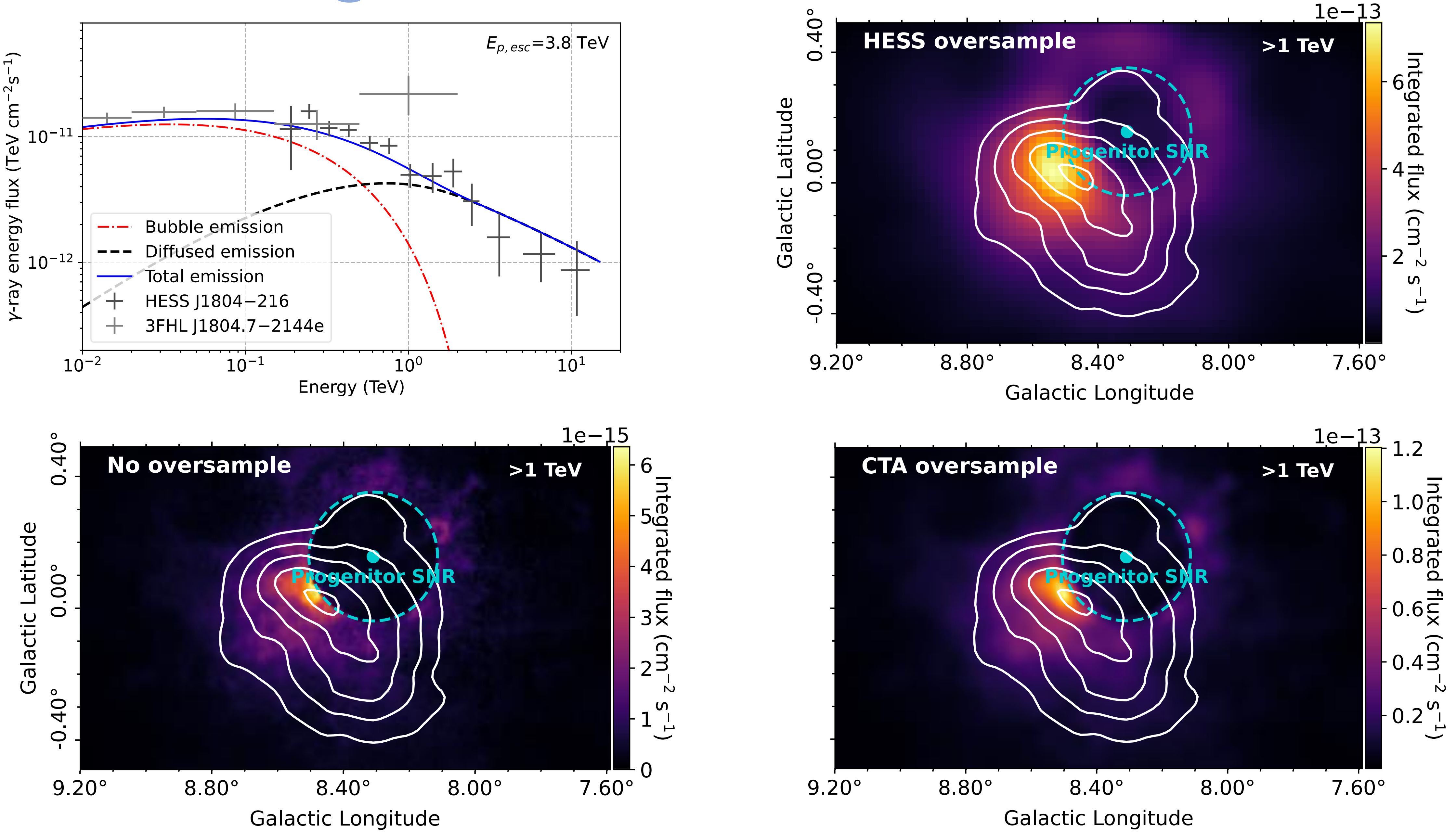
Gamma-ray map

(Kelner et al, 2006)

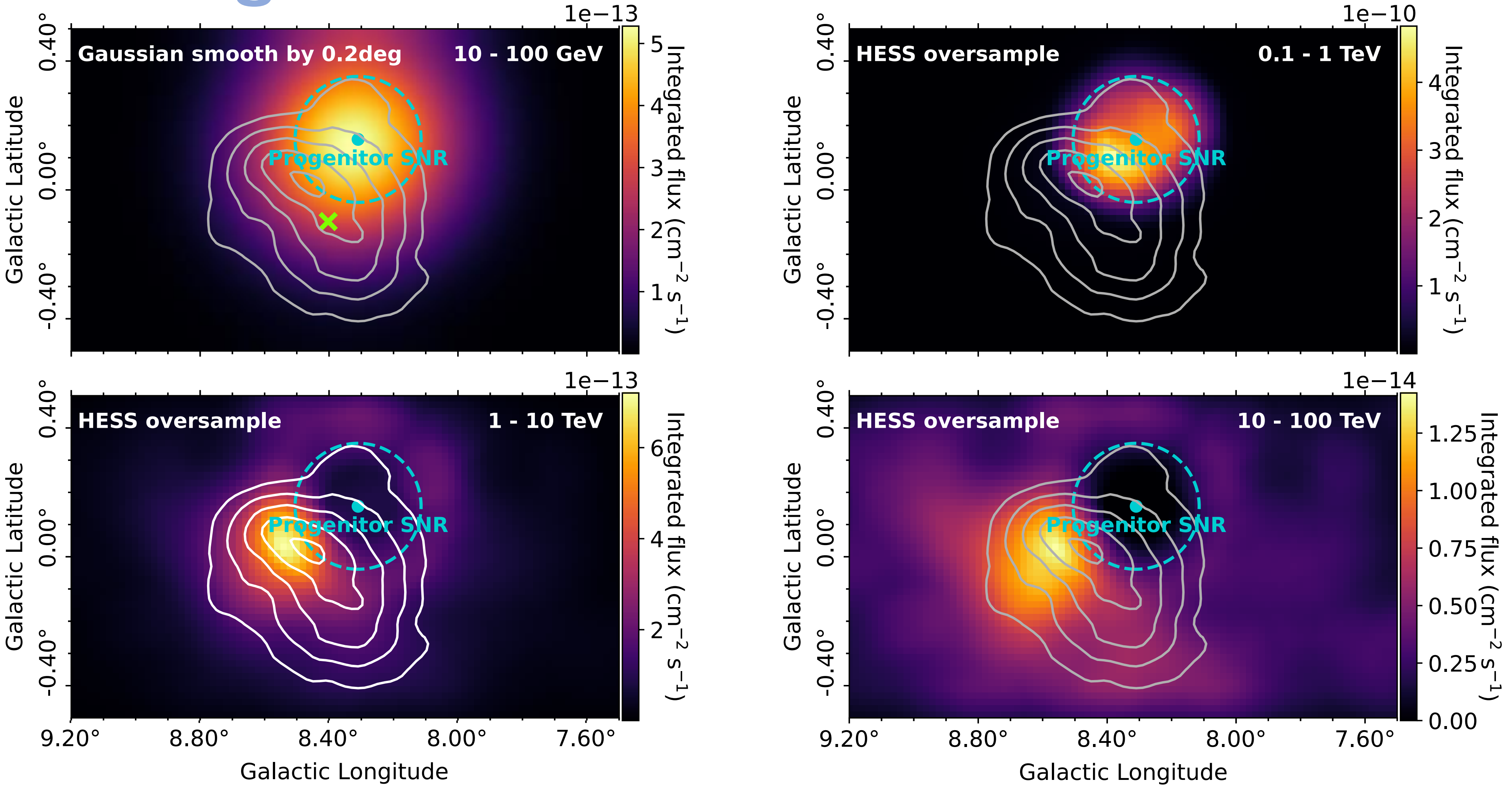
Best Matching Model – SNR G8.7-0.1



Best Matching Model – Progenitor SNR of PSR J1803-2137



Best Matching Model – Progenitor SNR of PSR J1803-2137



These results will be presented in the upcoming paper:

Modelling the Gamma-Ray Morphology of HESS J1804−216 from Two Supernova Remnants in a Hadronic Scenario

K. Feijen[1★], S. Einecke[1], G. Rowell[1], C. Braiding[2], M. G. Burton[2,3], G. F. Wong[4,2]

OBSERVATIONS OF IONISED CARBON TOWARDS SNR RXJ1713.7-3946

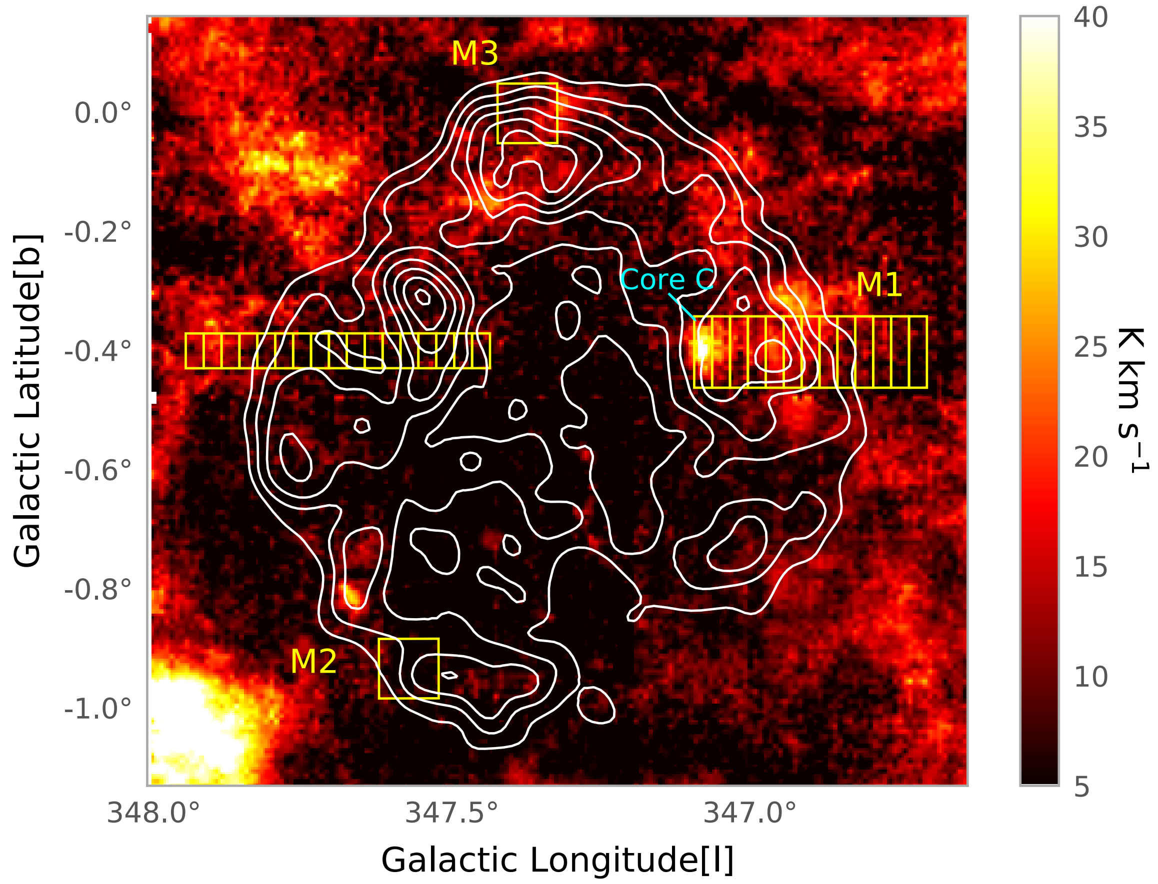
ADNAAN THAKUR

SUPERVISORS:

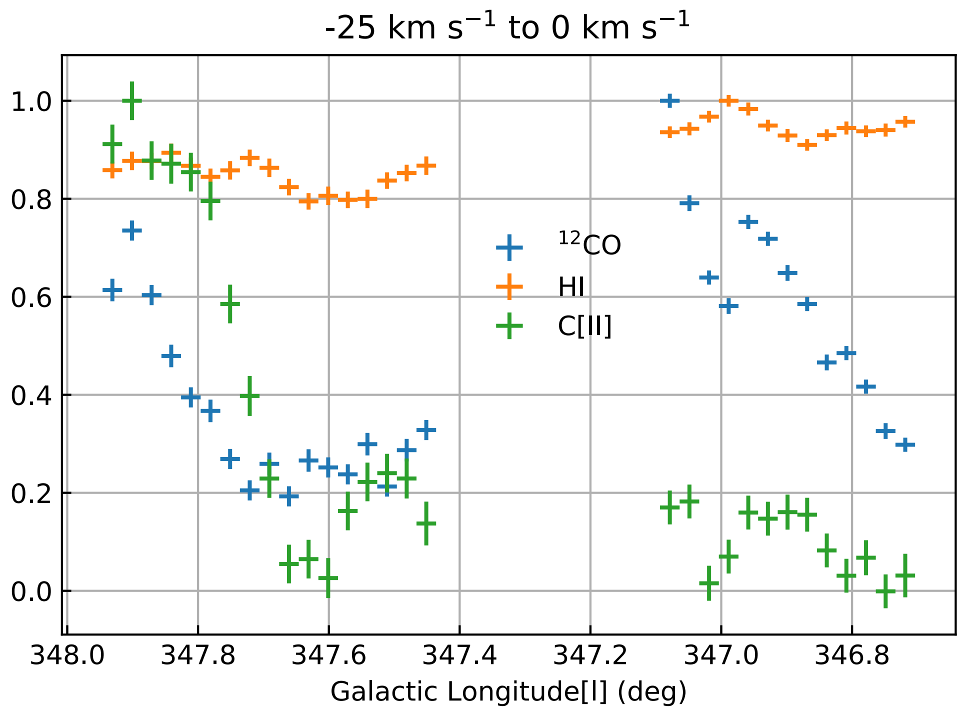
PROF. GAVIN ROWELL

DR. SABRINA EINECKE

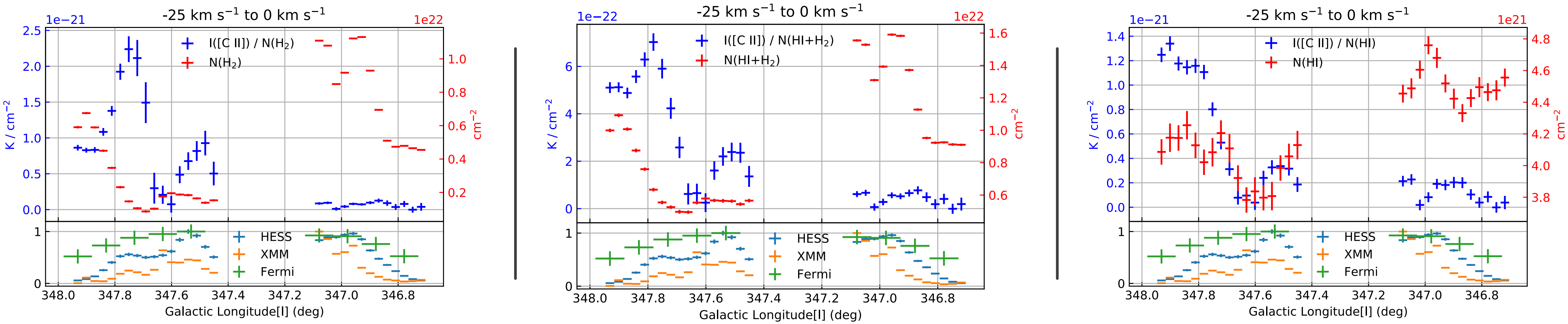
- C+ can be used as a tracer for ionisation.
- We are looking for locations and potential sources of ionisation.
- Our primary source of interest is cosmic rays.



OBSERVATIONAL DATA



- C[II] emission follows the molecular gas well on the left side of the remnant, and the atomic HI on the right.
- The atomic gas seems to stay relatively constant across the SNR.
- The molecular gas peaks around Core C, shown in the previous slide, and around the far left edge, outside the SNR shell.



C[II], HI AND H_2 EMISSION

- Gas clouds across the centre of the remnant are primarily molecular.
- Excess C[II] emission comes from the left of the remnant.