

# Deep H.E.S.S. Observations of SNR W44 and Its Surroundings

**Wenjuan Zhong**, Emma de Oña Wilhelmi, Robert Daniel Parsons, Rowan Batzofin, Brian Reville

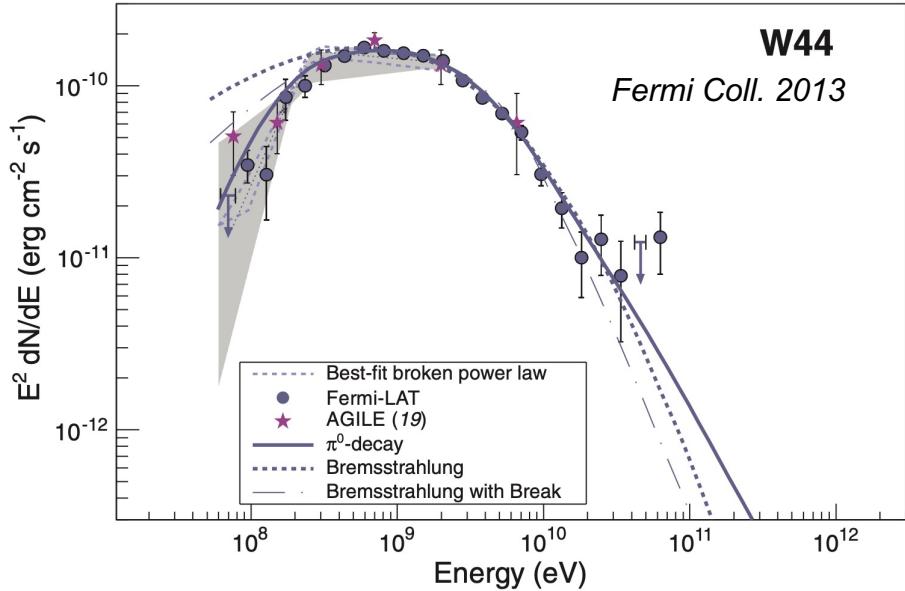
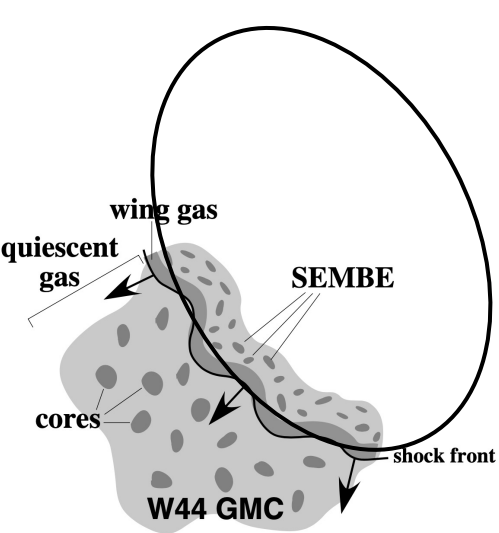
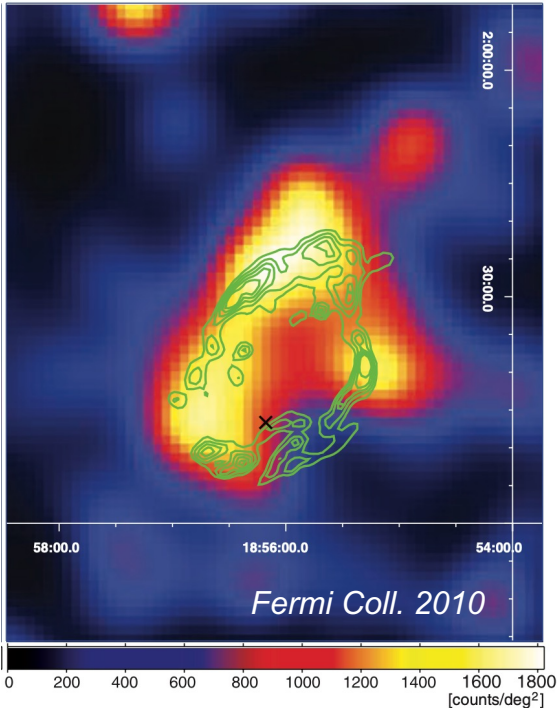
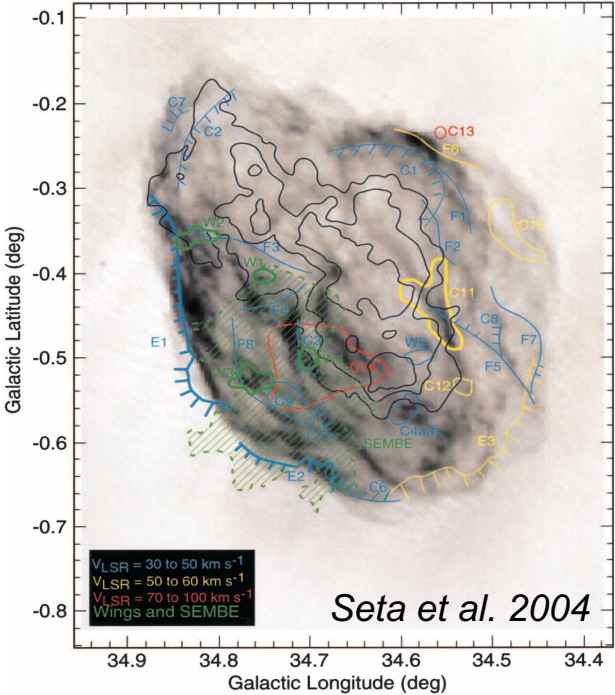
*On behalf of the H.E.S.S. Collaboration*

Nov 3, 2025

# SNR W44

- **Type:** mixed-morphology
- **Distance:** 2.1–3.3 kpc (2.2 kpc)
- **Middle-aged**  
Shell: 7.9–8.9 kyr  
PSR B1853+01: 20 kyr
- **Shocked molecular gas**
- **GeV detection:** shell, pion bump
- **TeV:**

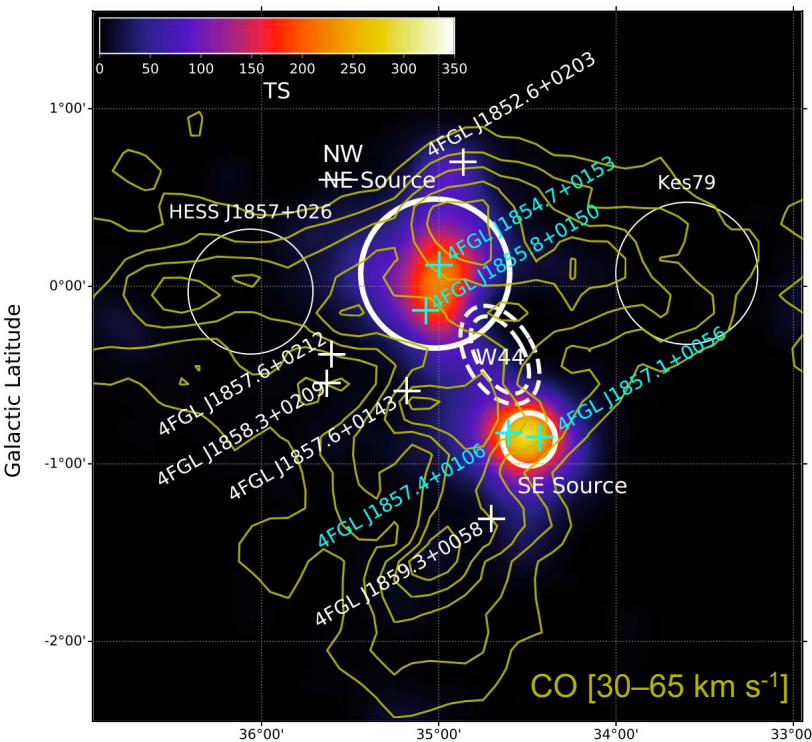
174 h 14 h  
Non-detection by MAGIC and VERITAS  
Extended emission detected by LHAASO  
in the vicinity



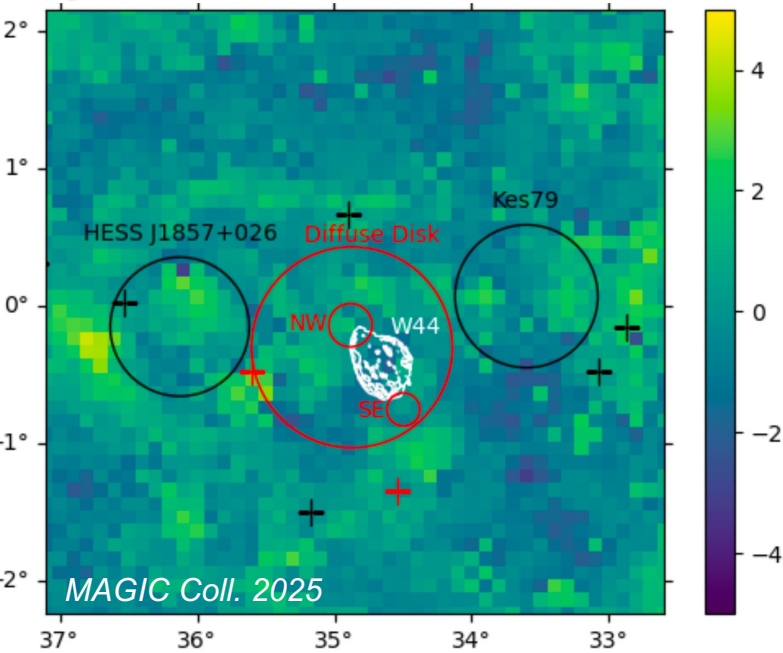
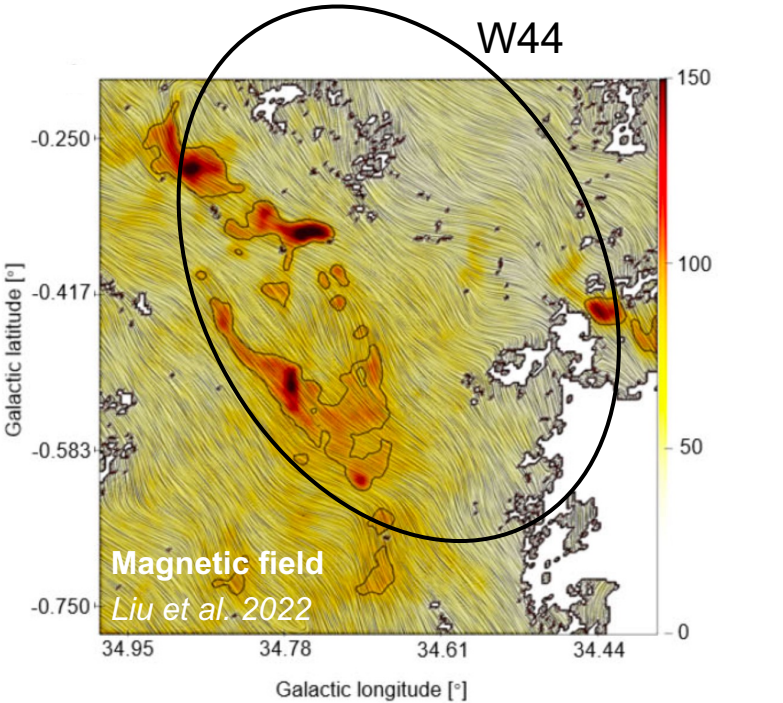
# SNR W44

Escape of high-energy particles

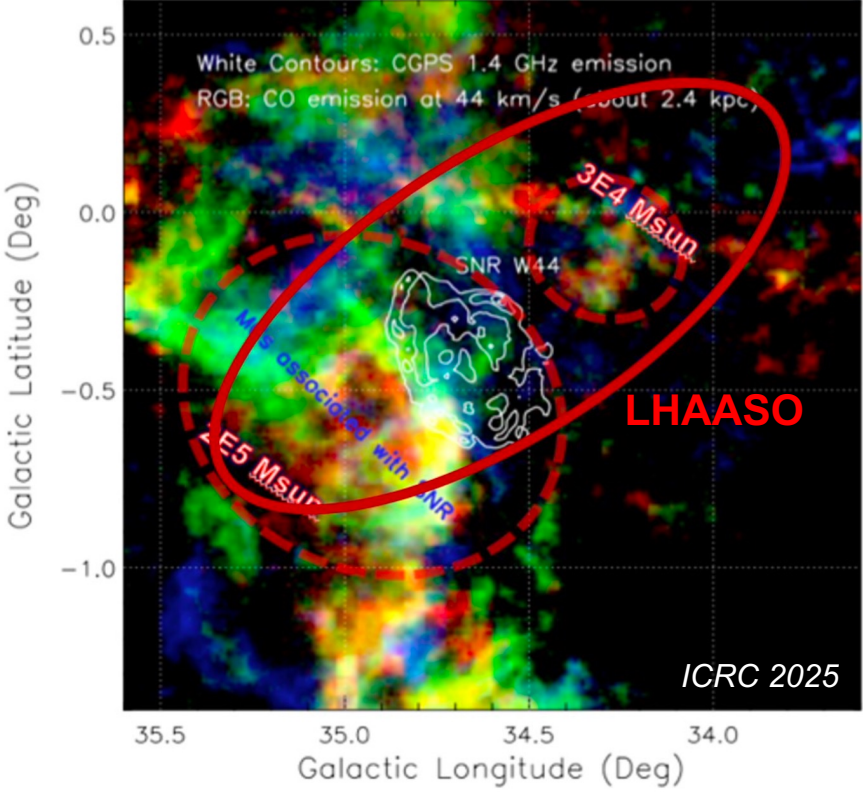
GeV (*Fermi*-LAT)



Peron et al. 2020



TeV (LHAASO)



an elliptical Gaussian,  
exponential cut-off power-law

# High Energy Stereoscopic System (H.E.S.S.)

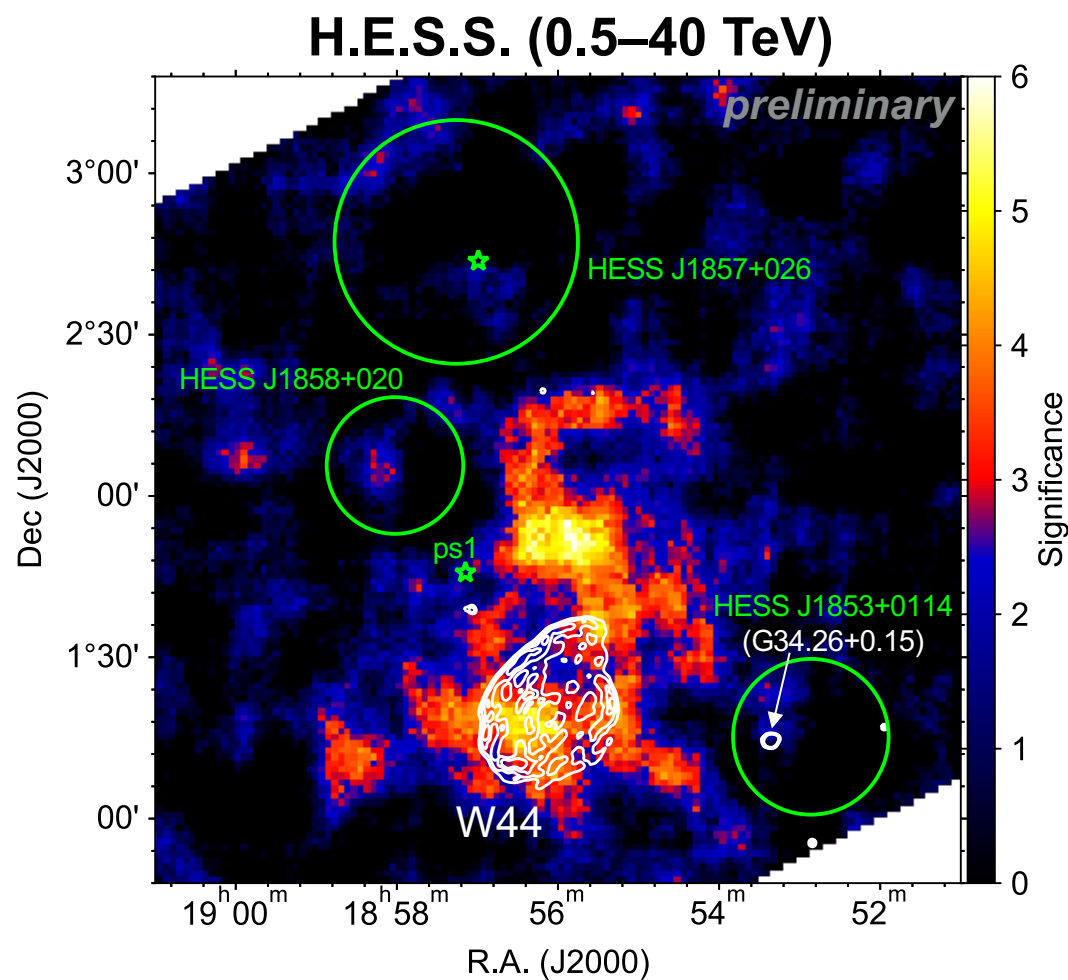
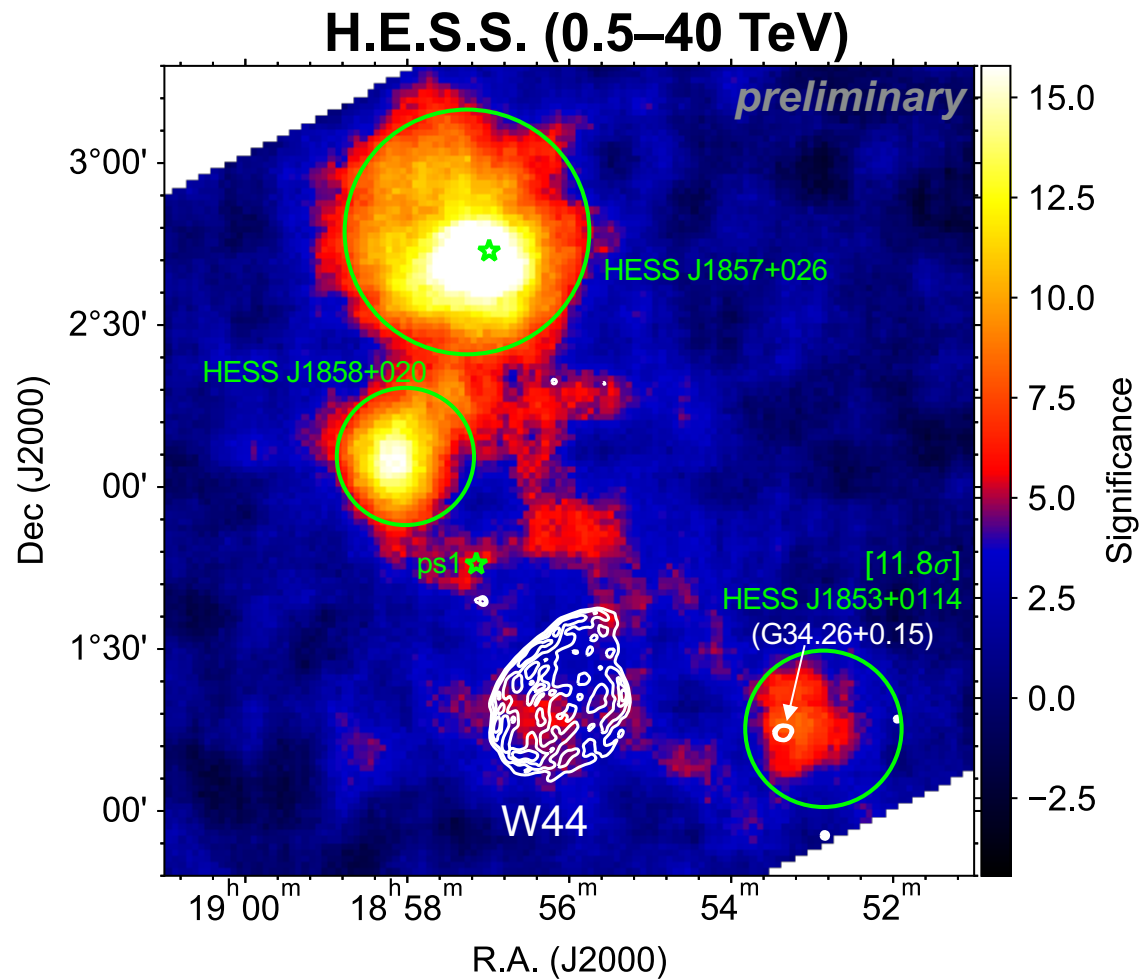
Imaging Atmospheric Cherenkov Telescope



Dataset: **205 h**

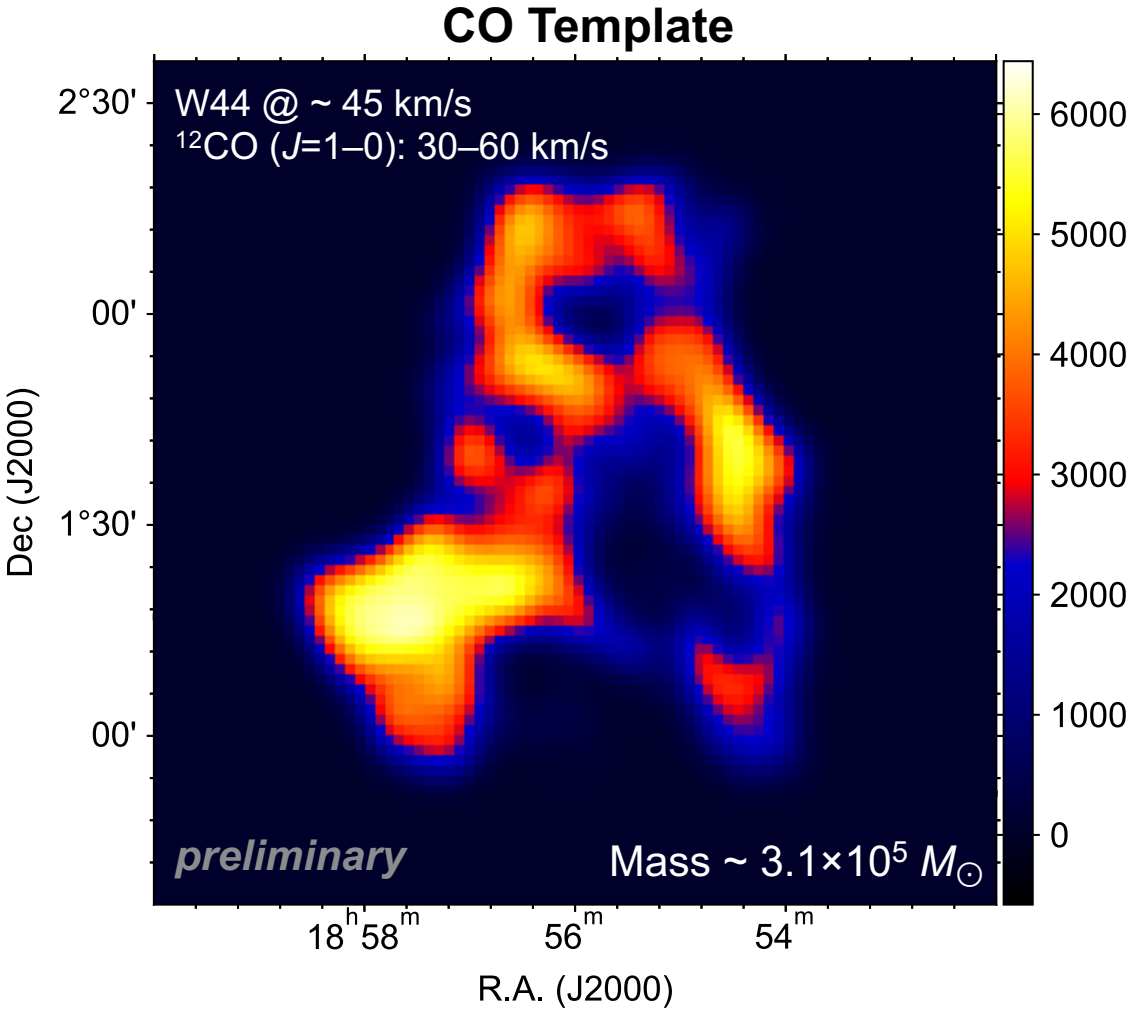
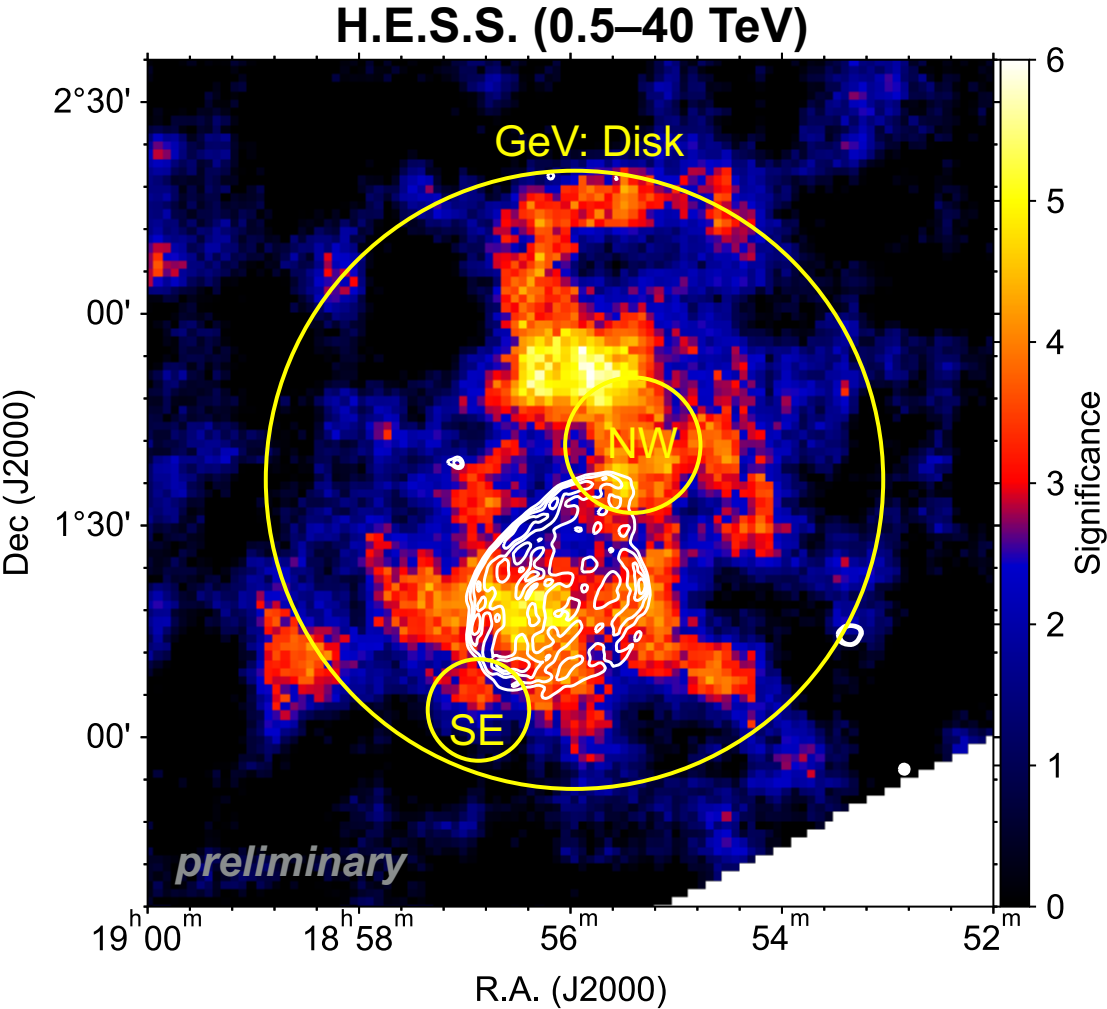
# Remove other sources

New source: HESS J1853+0114 (G34.26+0.15?)



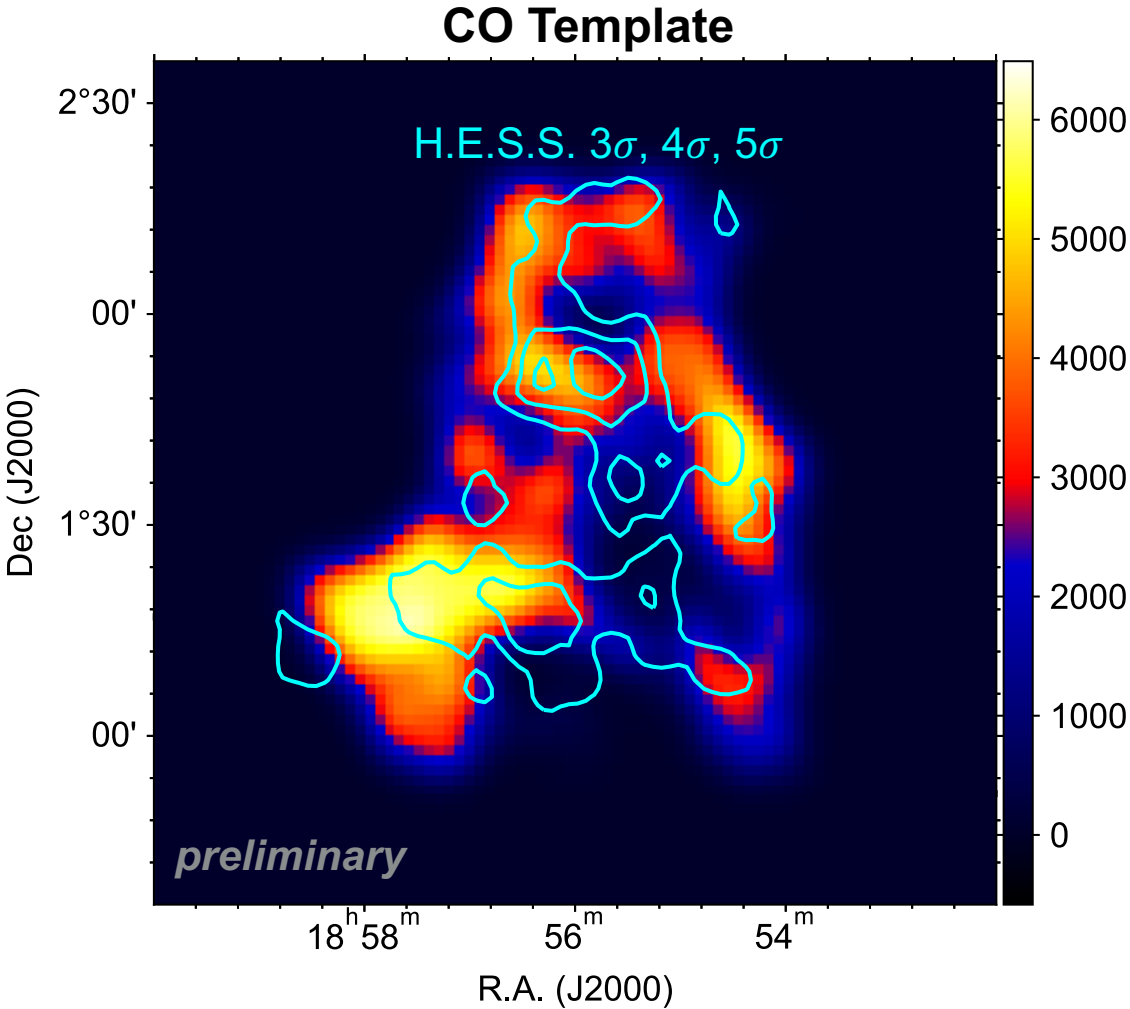
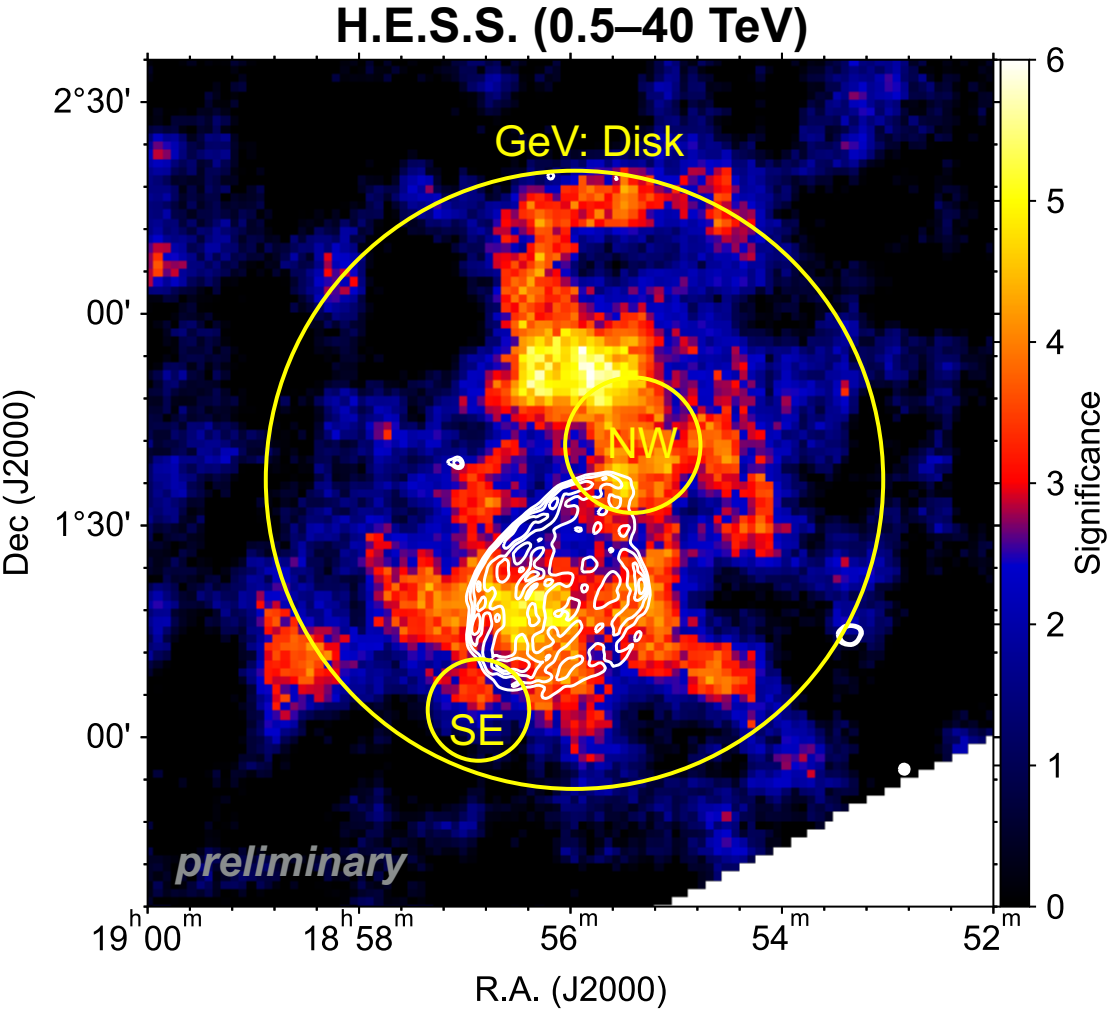
# Morphology

## CO Template



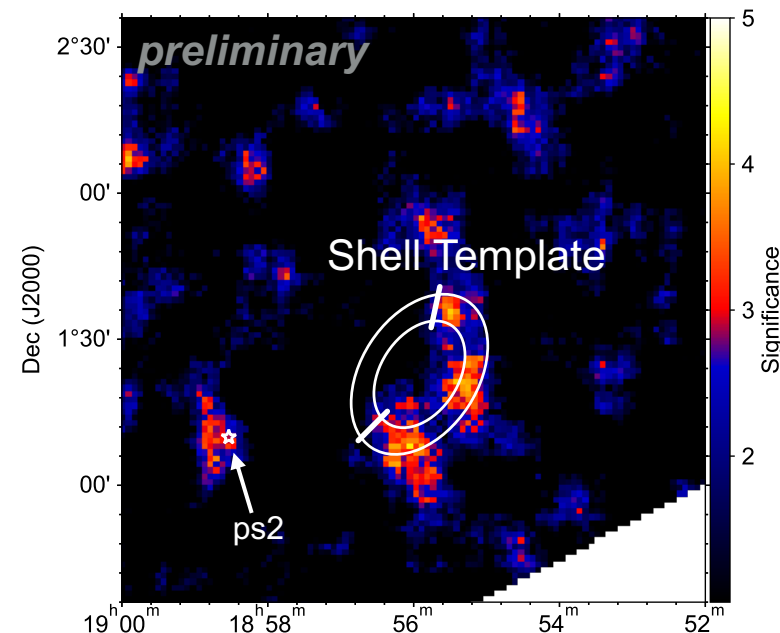
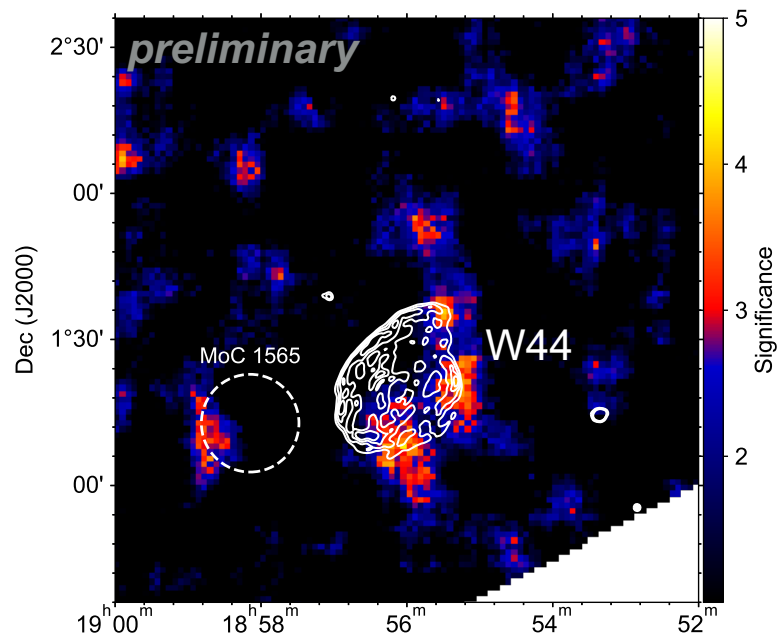
# Morphology

## CO Template

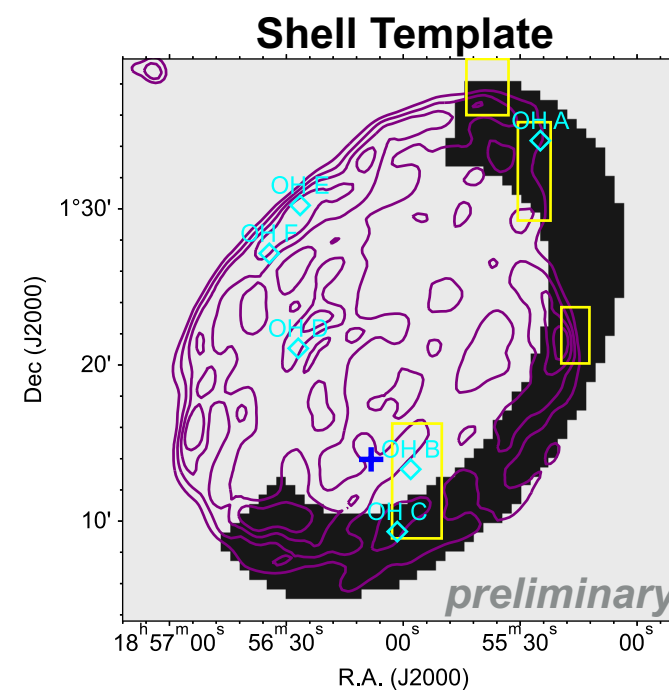
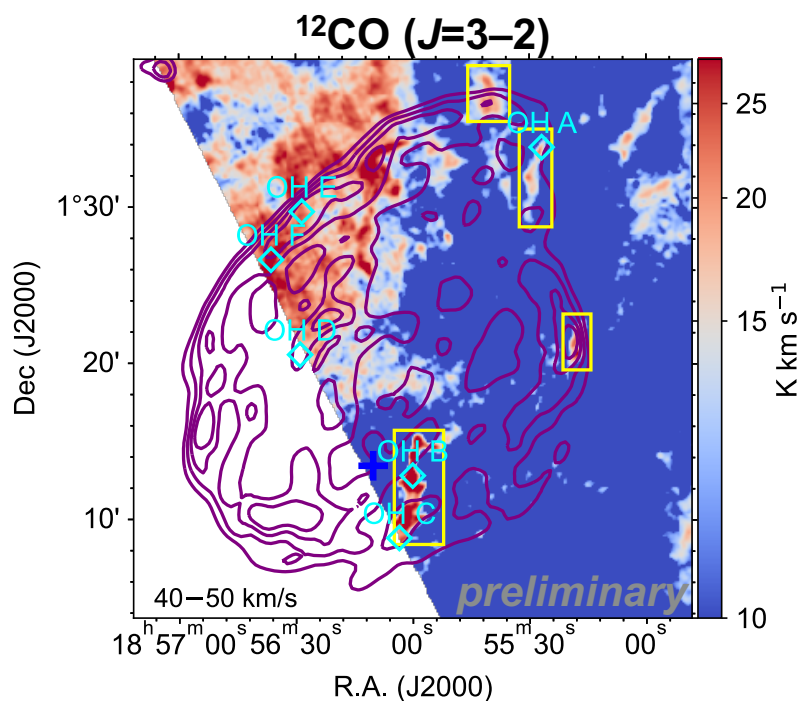


## SNR-Shell Template

## Residuals after subtracting CO template:



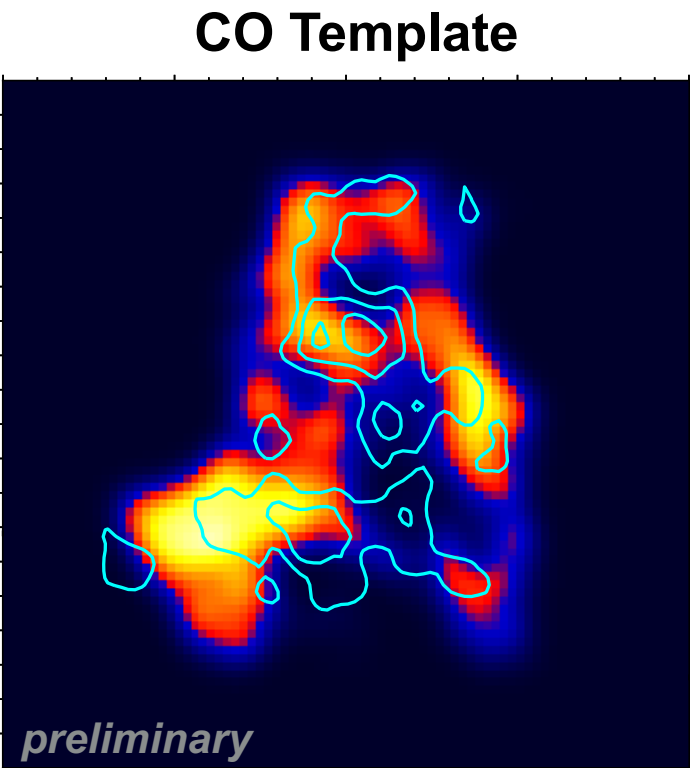
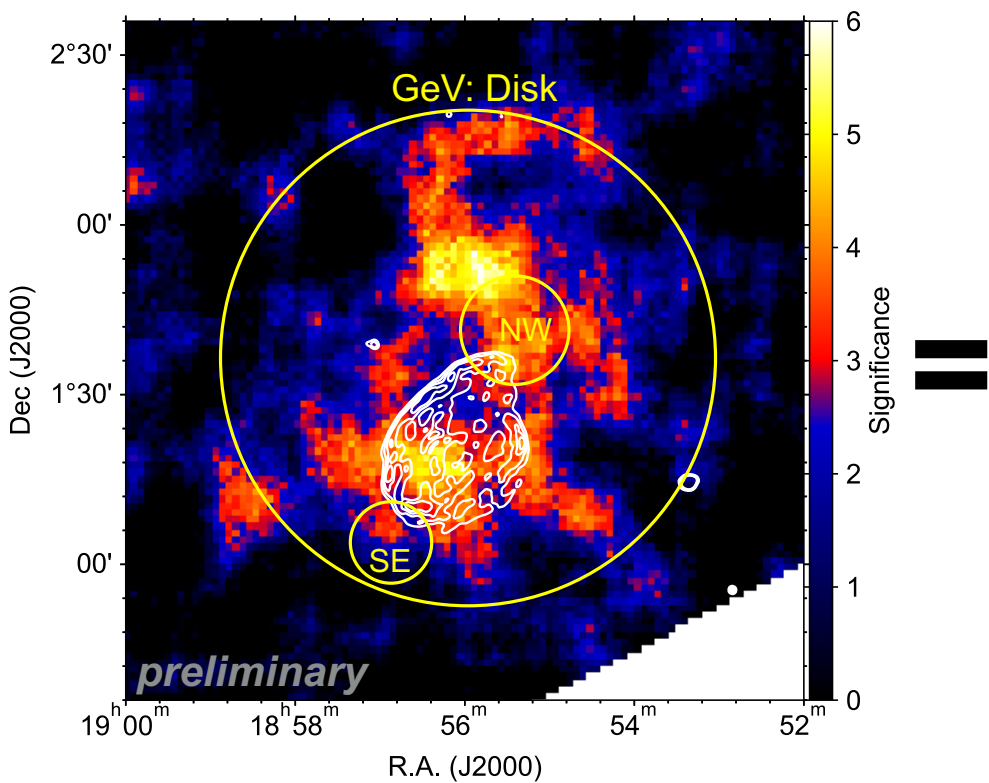
## Insights from MWL Observations:



radio, half-radio,  
shell, half-shell,  
**sector-shell**  
(ring)

# Morphology

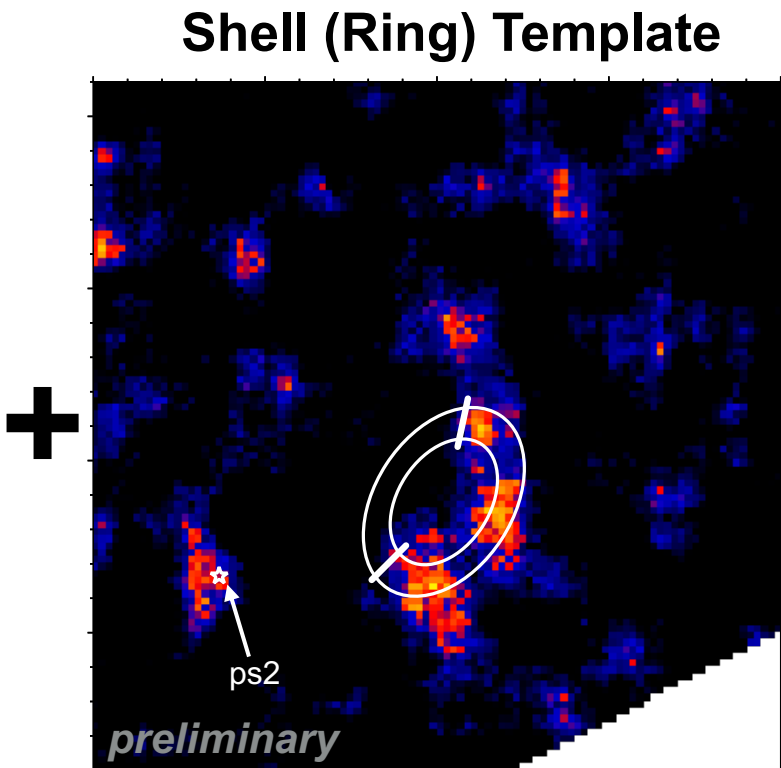
Summary: CO + Shell



CO Template

LogParabola

$17.7\sigma$

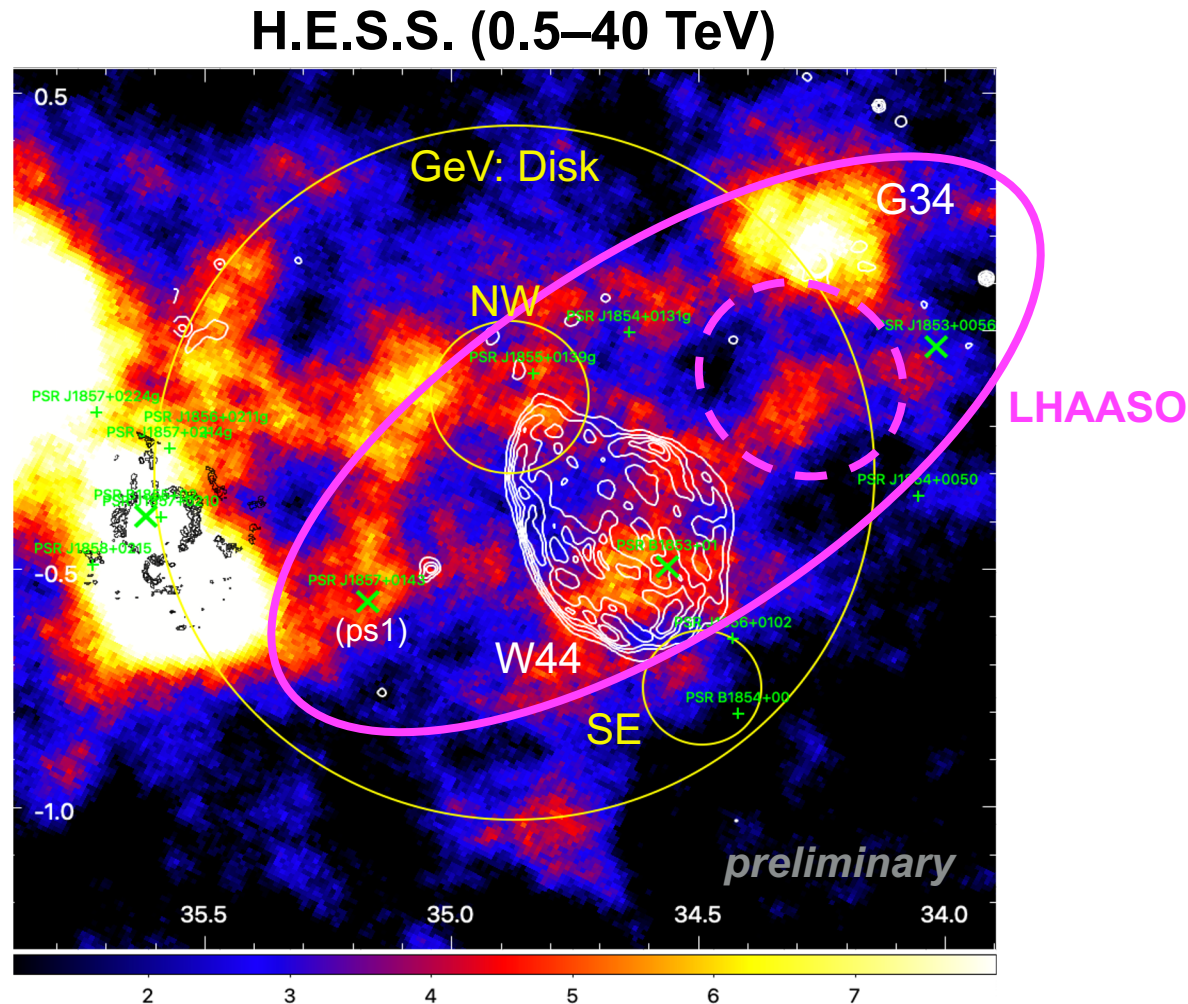
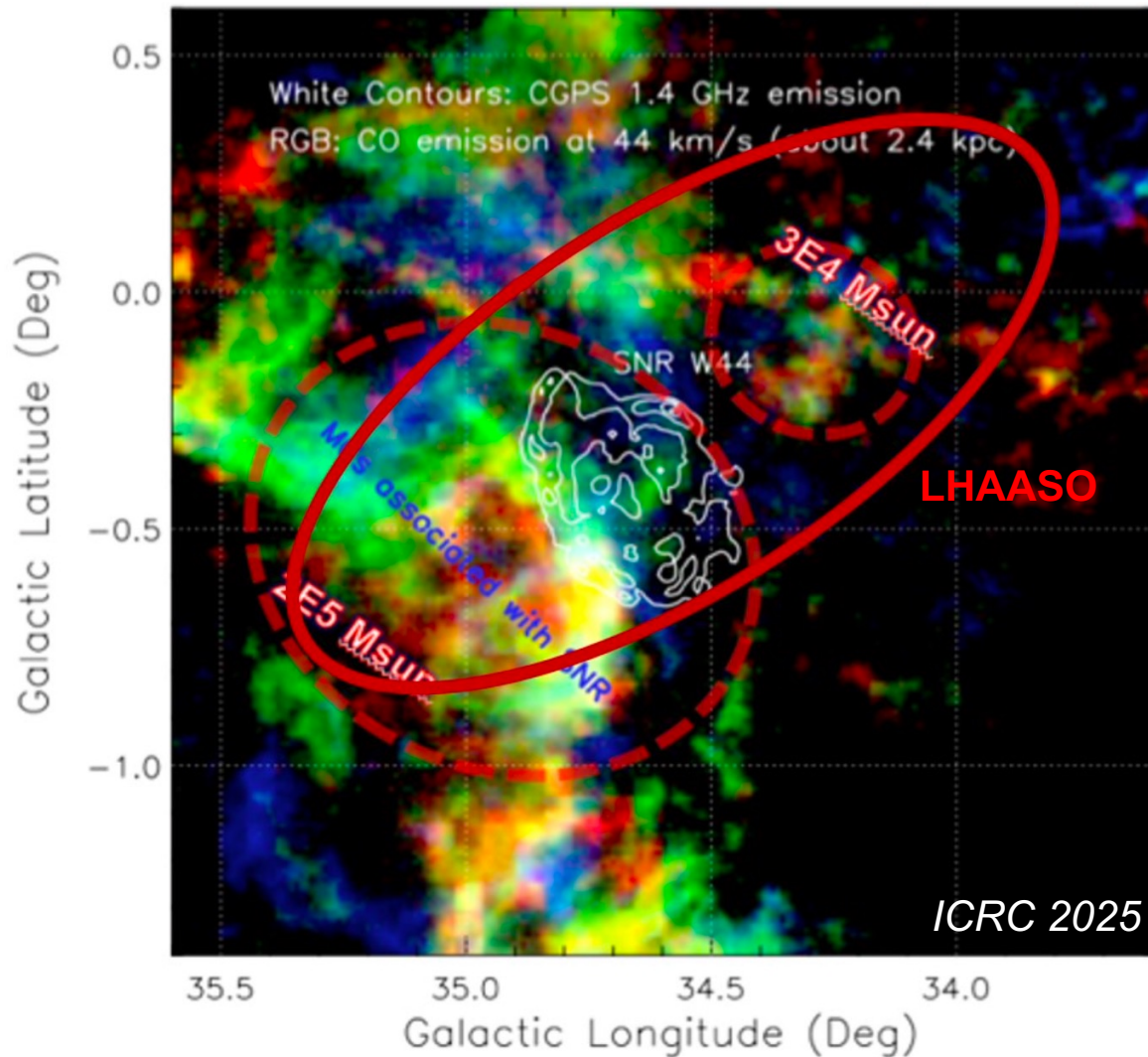


Shell (Ring) Template

Power-Law

$6.7\sigma$

# GeV-TeV Morphology



**LHAASO source ~ W44-CO + W44-shell + G34 (+ ps1)**

*Preliminary results, removed in this public version*

# Interpretation

Hadronic

**Shell:** SNR-MC interaction

*A test, not finalized*

**Surroundings:** escaped protons + MCs

*(Gabici et al. 2009, Ohira et al. 2011)*

*Preliminary results, removed in this public version*

# Summary

## 1. TeV emission detected in the W44 region

**W44-CO** [17.7 $\sigma$ ], **W44-Shell** [6.7 $\sigma$ ], **HESS J1853+0114** [11.8 $\sigma$ ] (SFR G34.26+0.15?)

## 2. W44 Surroundings [CO template, LogParabola]

TeV emission shows an overlap with the surrounding molecular clouds

CR density is **enhanced** above the CR sea at >1 TeV

A size-compatible disk as the GeV counterpart

**Hadronic:** protons **escaping at different times** interact with nearby molecular clouds

## 3. W44 itself [sector-shell template, Power-law]

TeV emission is detected from the **southwest shell** of W44 itself

A clear correspondence with the **dense CO clumps** and **OH masers**

The **spectrum hardens** significantly with a clear break

**Hadronic:** SNR-MC interaction

*Thanks!*