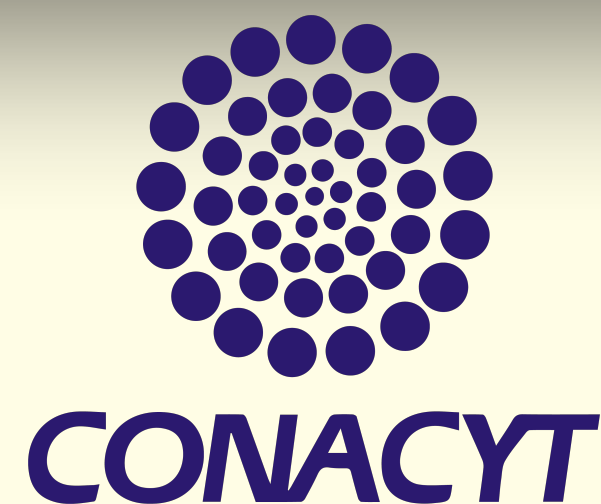


Study the Most Powerful Particle Accelerators

At eHWC J1825-134 with



Dezhi Huang
For the HAWC Collaboration

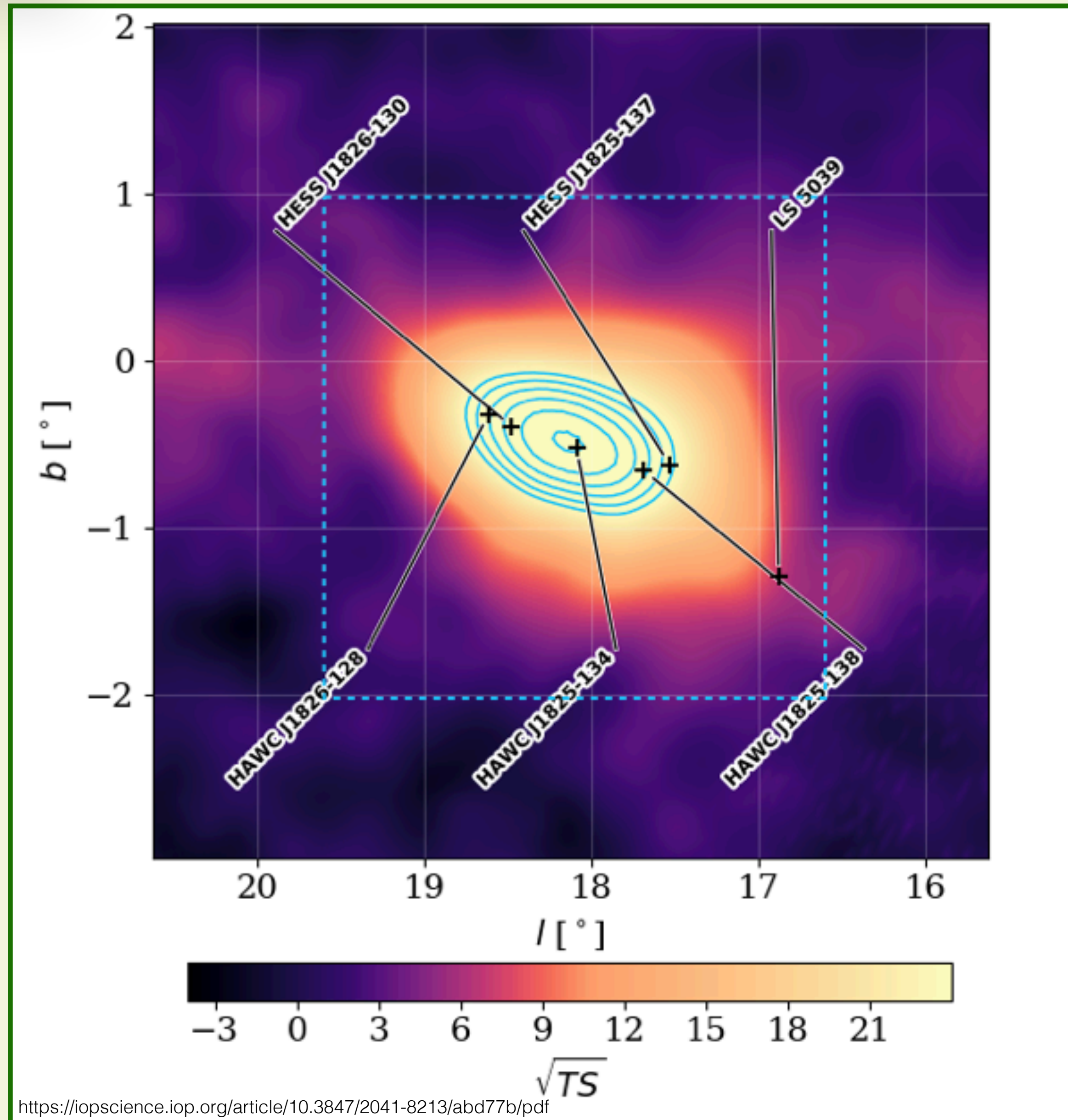


1



Michigan
Technological
University

Previously of J1825 Region



- TeVCat shows three TeV sources in this region (Upper three)

1. HESS J1826-130 (PWN candidate)

2. HESS J1825-137 (PWN)

3. LS 5039 (Microquasar)

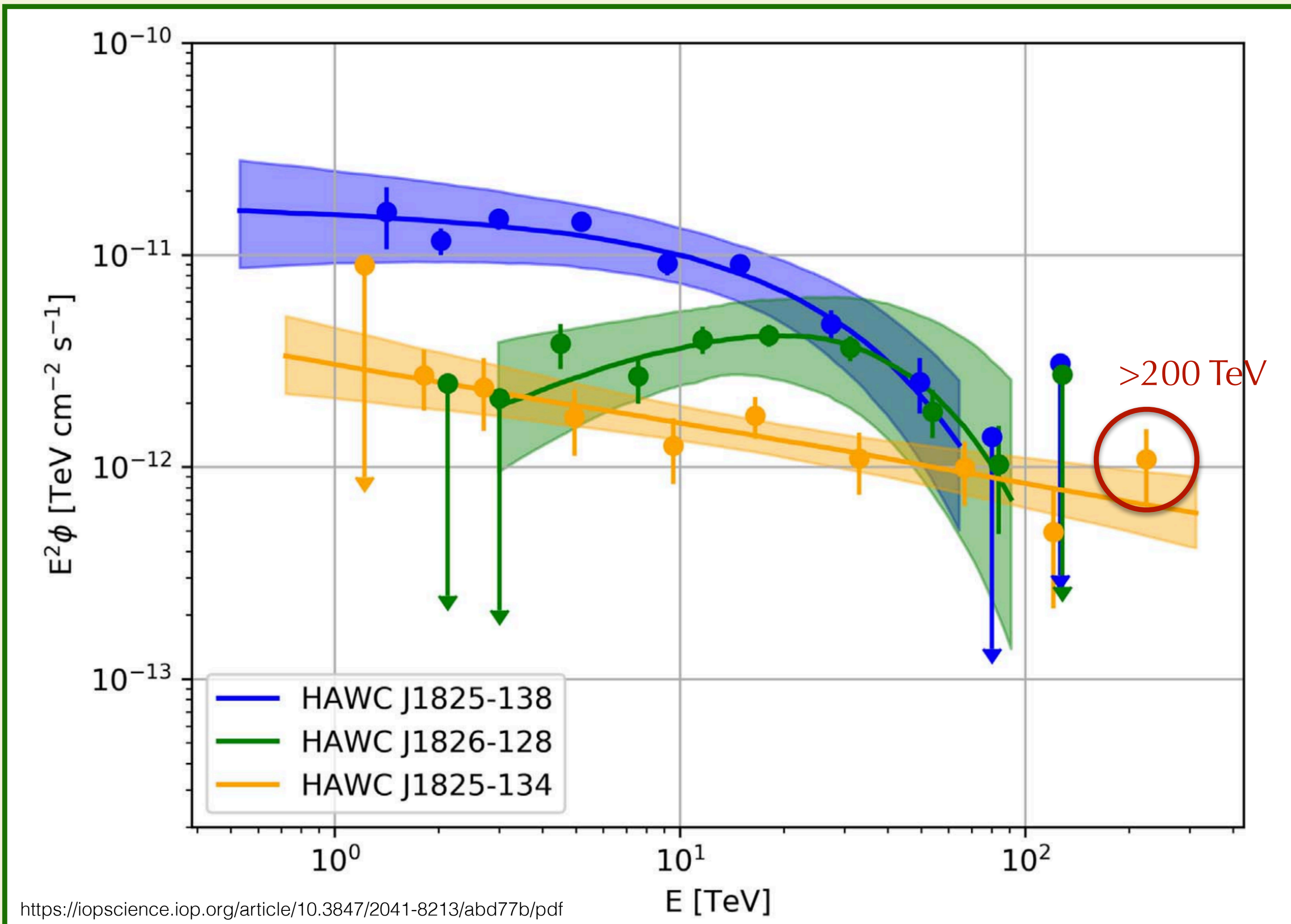
- HAWC analysis (Lower three)

1. HAWC J1826-128 (may associate with HESS J1826-130)

2. HAWC J1825-138 (may associate with HESS J1825-137)

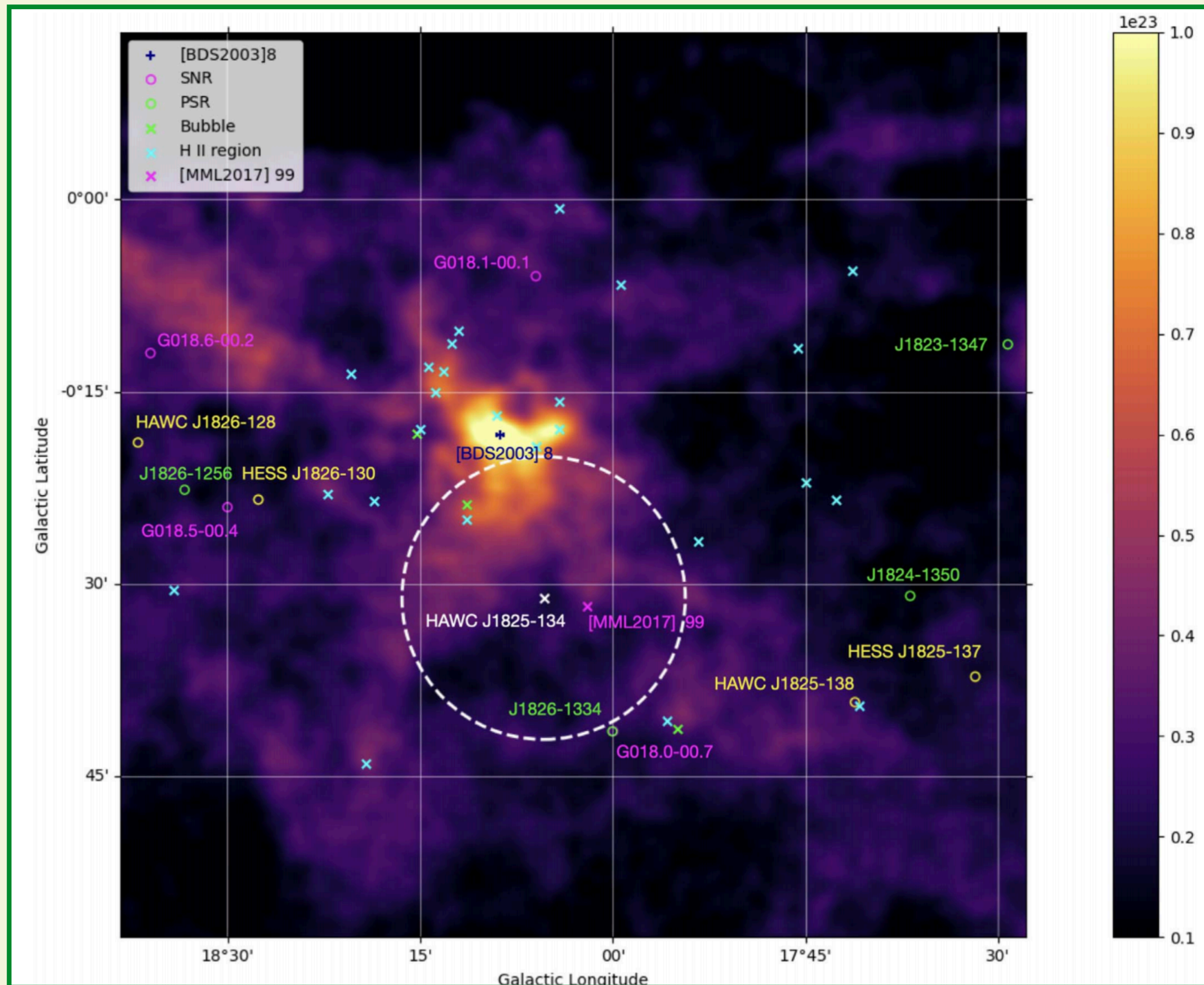
3. New Point like source HAWC J1825-134

Previously of J1825 Region



- Spectral analysis from HAWC data
 1. Extended source HAWC J1826-128 and extended source HAWC J1825-138 both started cutoff around 30 TeV
 2. New Point like source HAWC J1825-134 extend beyond 200 TeV and don't showing any cut off in HAWC data

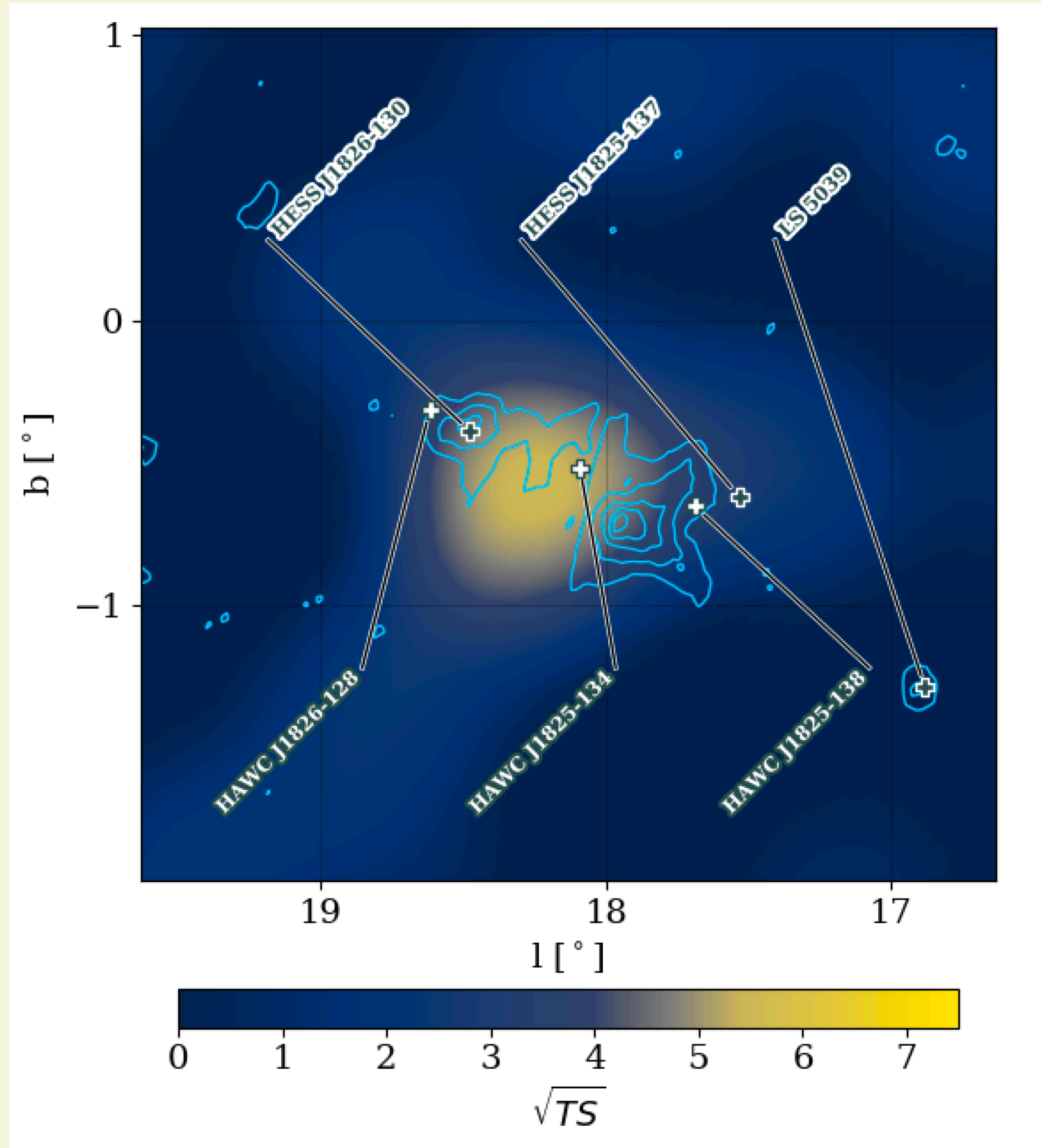
Previously of J1825 Region



- Proton can be accelerated at Young Star Cluster [BDS2003]8
- High energy protons can travel to giant molecular cloud [MML2017]99 and collide with ambient gas to produce π_0
- π_0 can decay to photons, then contribute the emission seen by HAWC

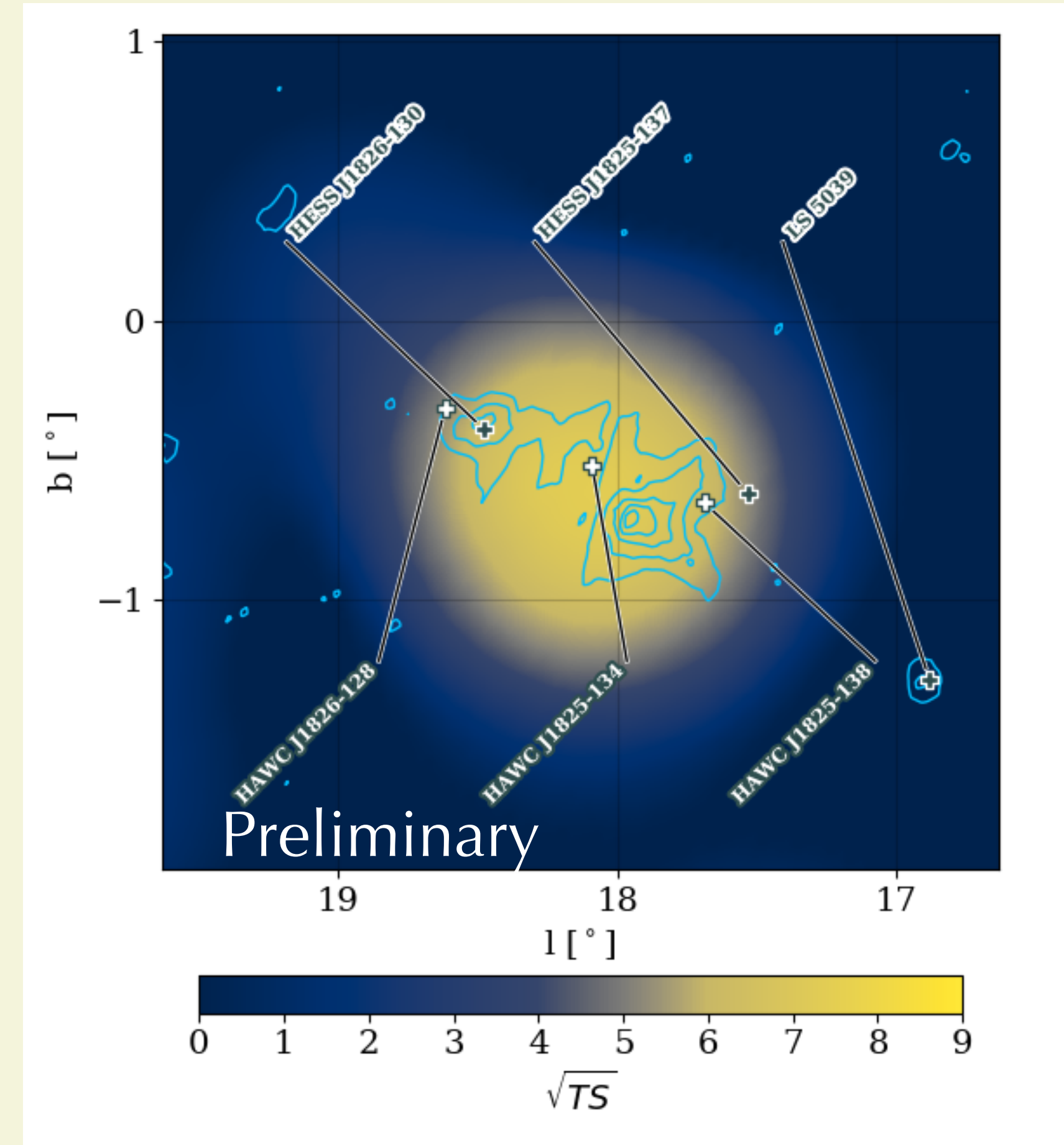
First Look of HAWC New Data >177 TeV Map

Pass4



5.56σ

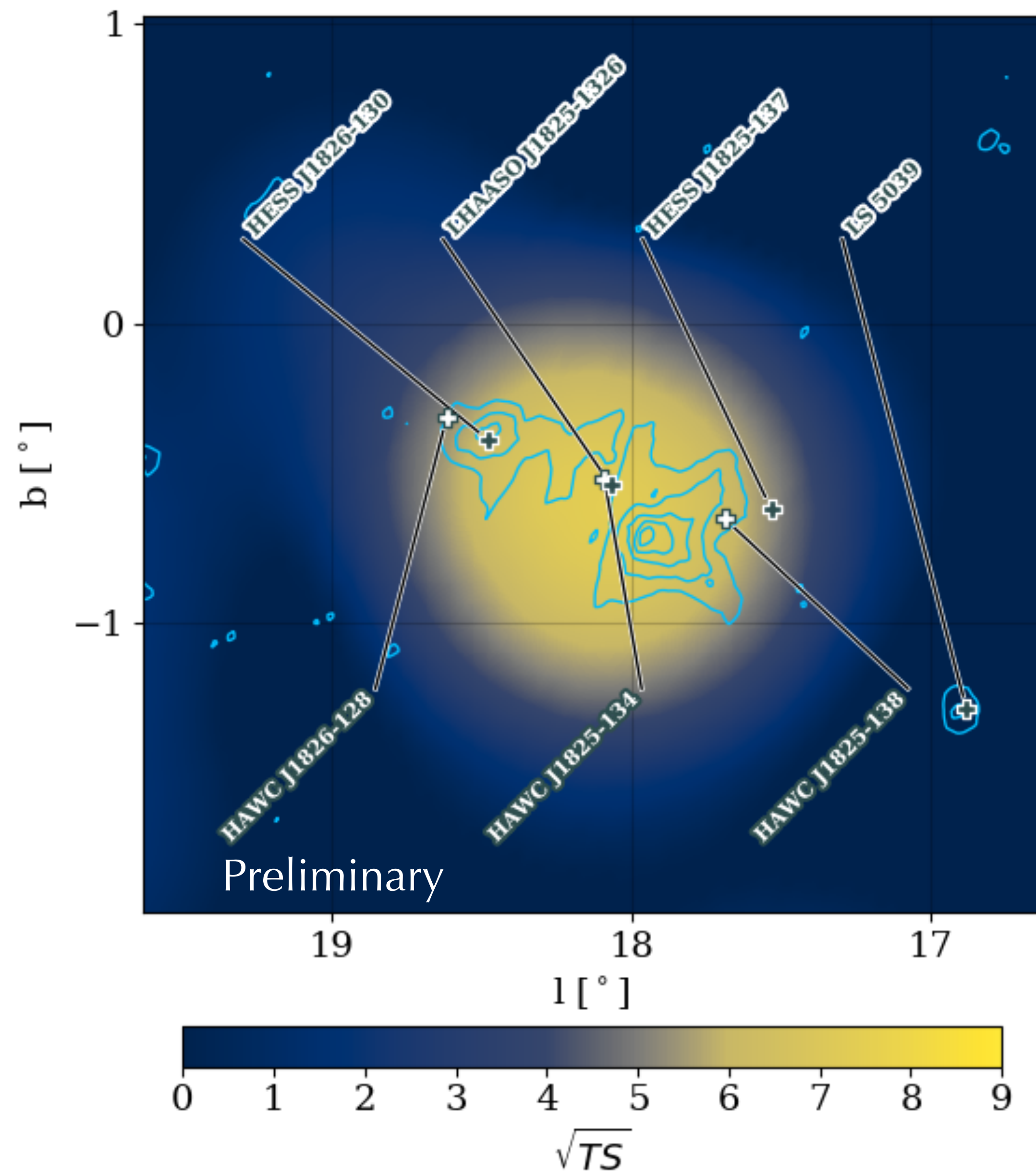
Pass5



7.43σ

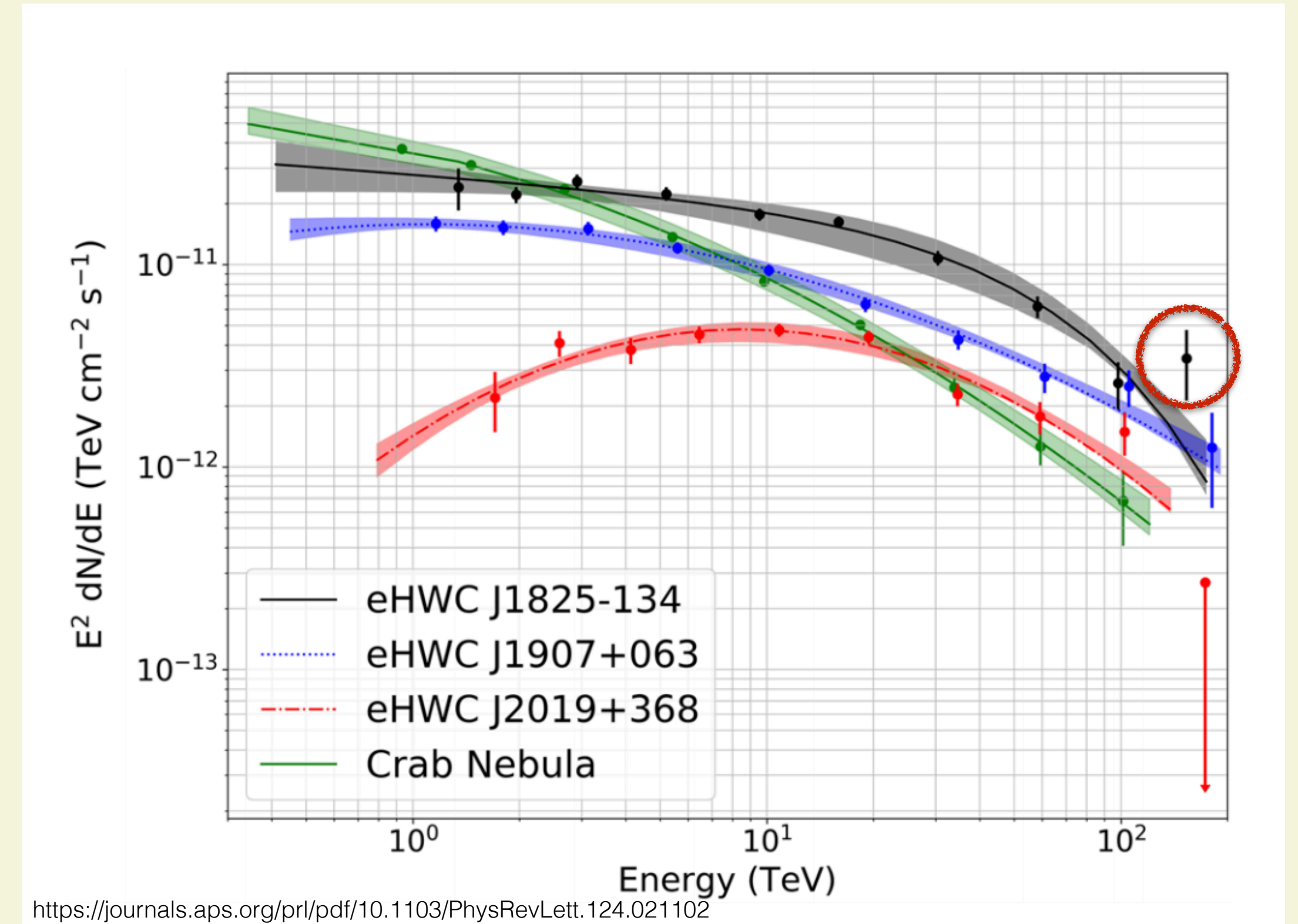
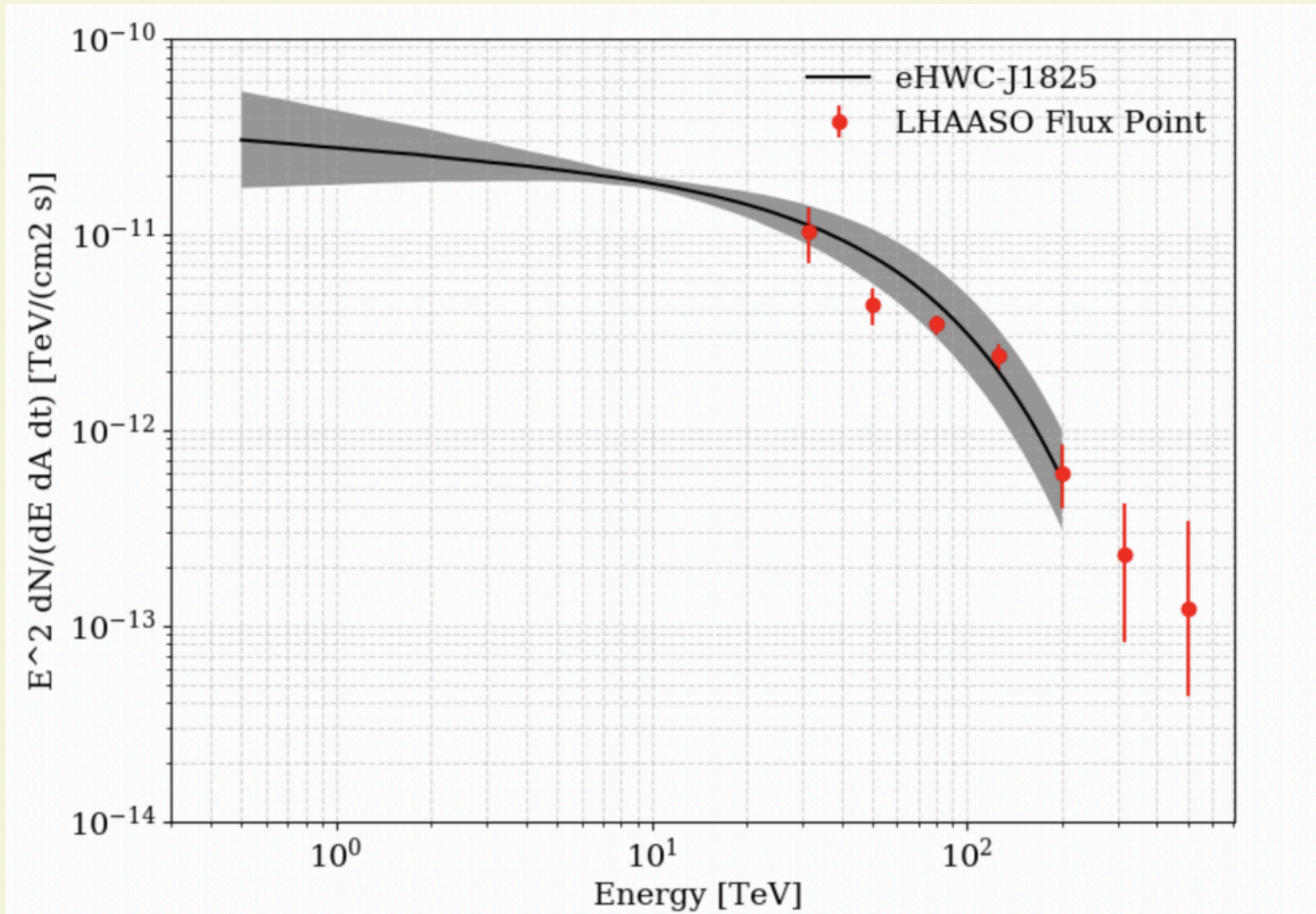
Maximum significance pixel more agree with the best fit location of HAWC J1825-134 in the Pass5 map

How About New Point Source Location



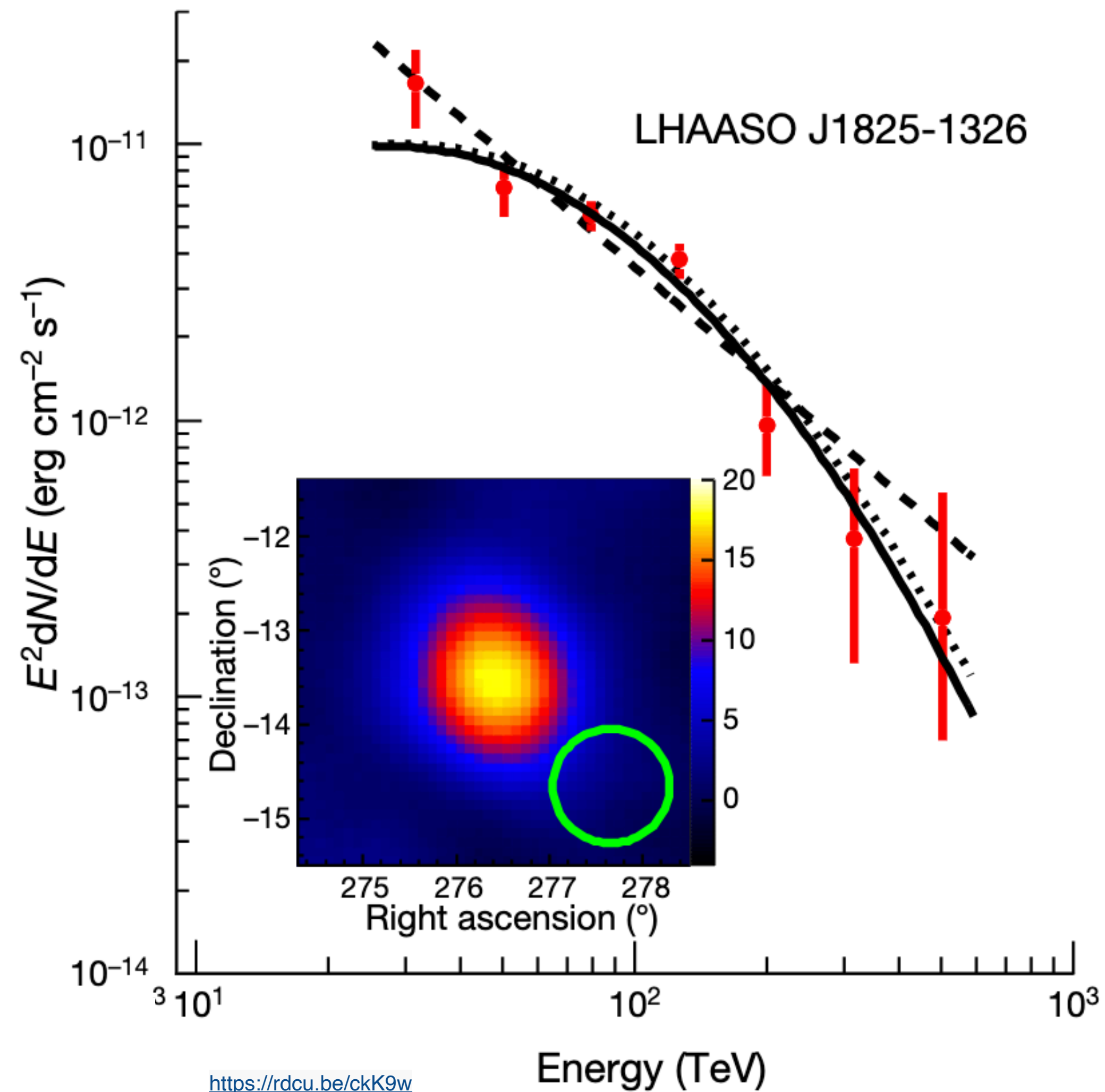
- Location comparison with LHAASO result
 - 1.LHAASO J1825: RA: 276.45° , Dec: -13.45°
 - 2.HAWC J1825-134: RA: 276.44° , Dec: -13.42°
 - 3.eHWC J1825-134: RA: 276.40° , Dec: -13.37°
- LHAASO J1825 location almost overlap with the new point like source we reported in J1825 paper
- There is a $\sim 0.2^\circ$ uncertain for HAWC's pointing will investigate in our newer data set

How About New Point Source Energy



- LHAASO flux points agree with eHWC J1825-134 spectrum

How About New Point Source Energy

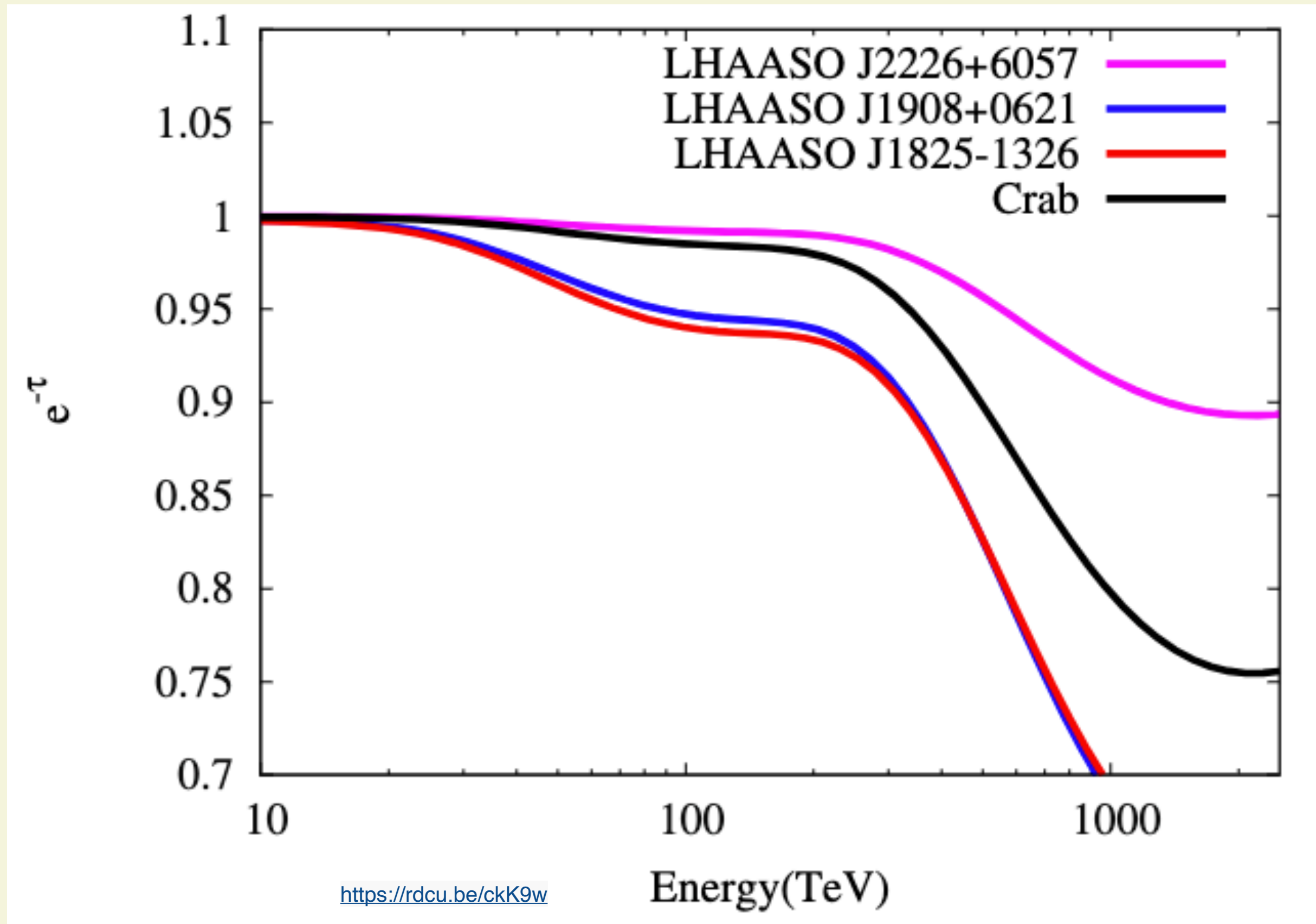


<https://rdcu.be/ckK9w>

- LHAASO reported the gradual steepening of the γ -ray spectrum is partly due to the γ - γ absorption
- Dash line is the power-law spectrum after applied the γ - γ absorption correction
 - The absorption due to both ISRFs and CMB is taken into account

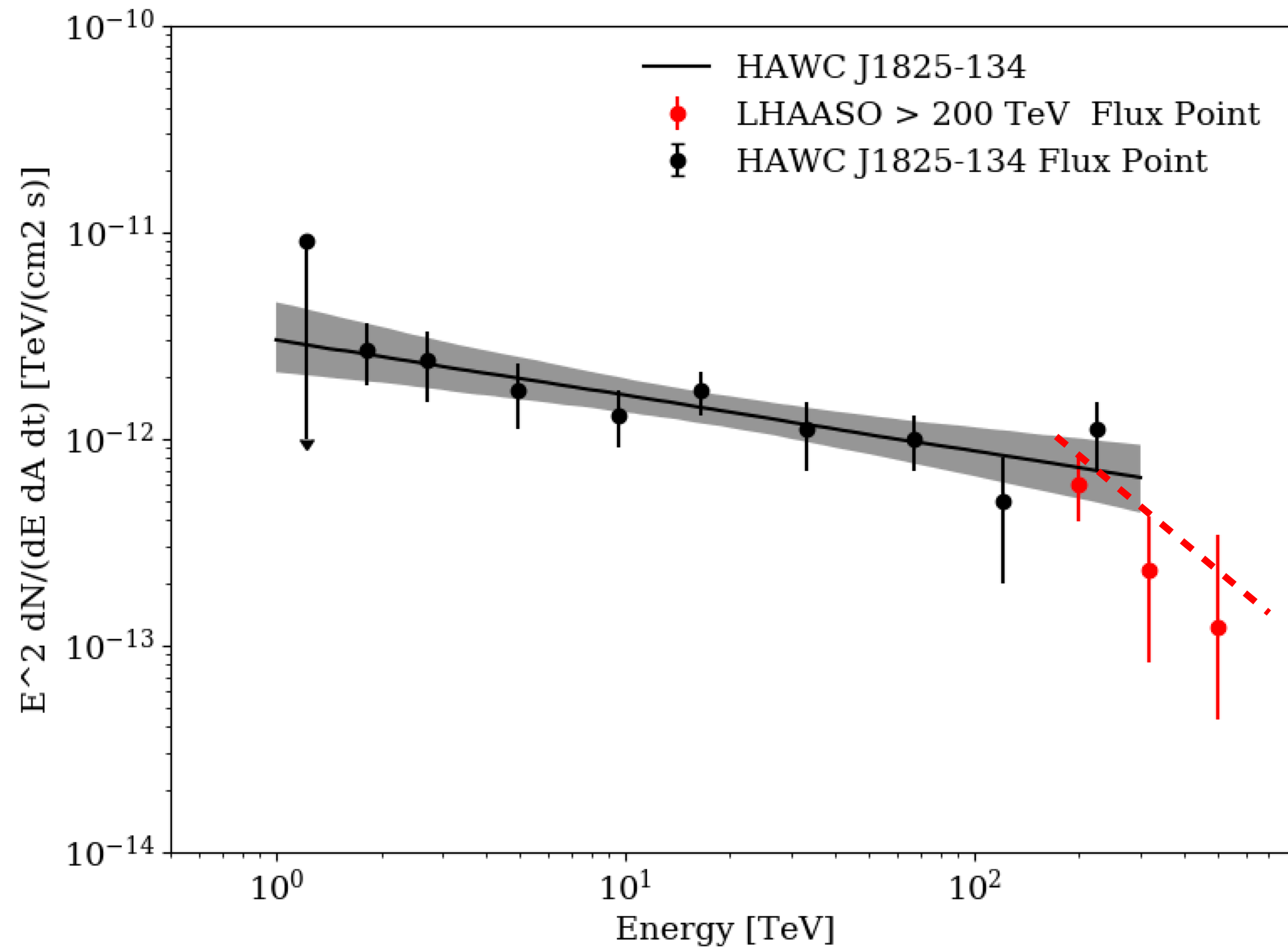
How About New Point Source Energy

Gamma-ray opacities

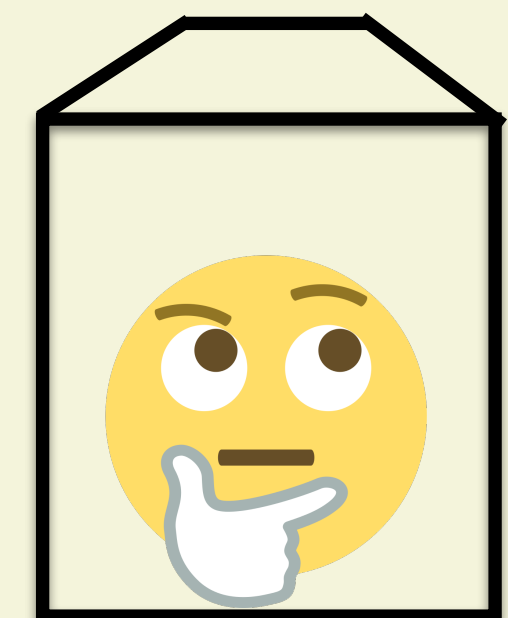


- LHAASO reported the gradual steepening of the γ -ray spectrum is partly due to the γ - γ absorption
- Around 200 TeV the attenuation start to have big impact
- How does this compare to HAWC's result?

How About New Point Source Energy

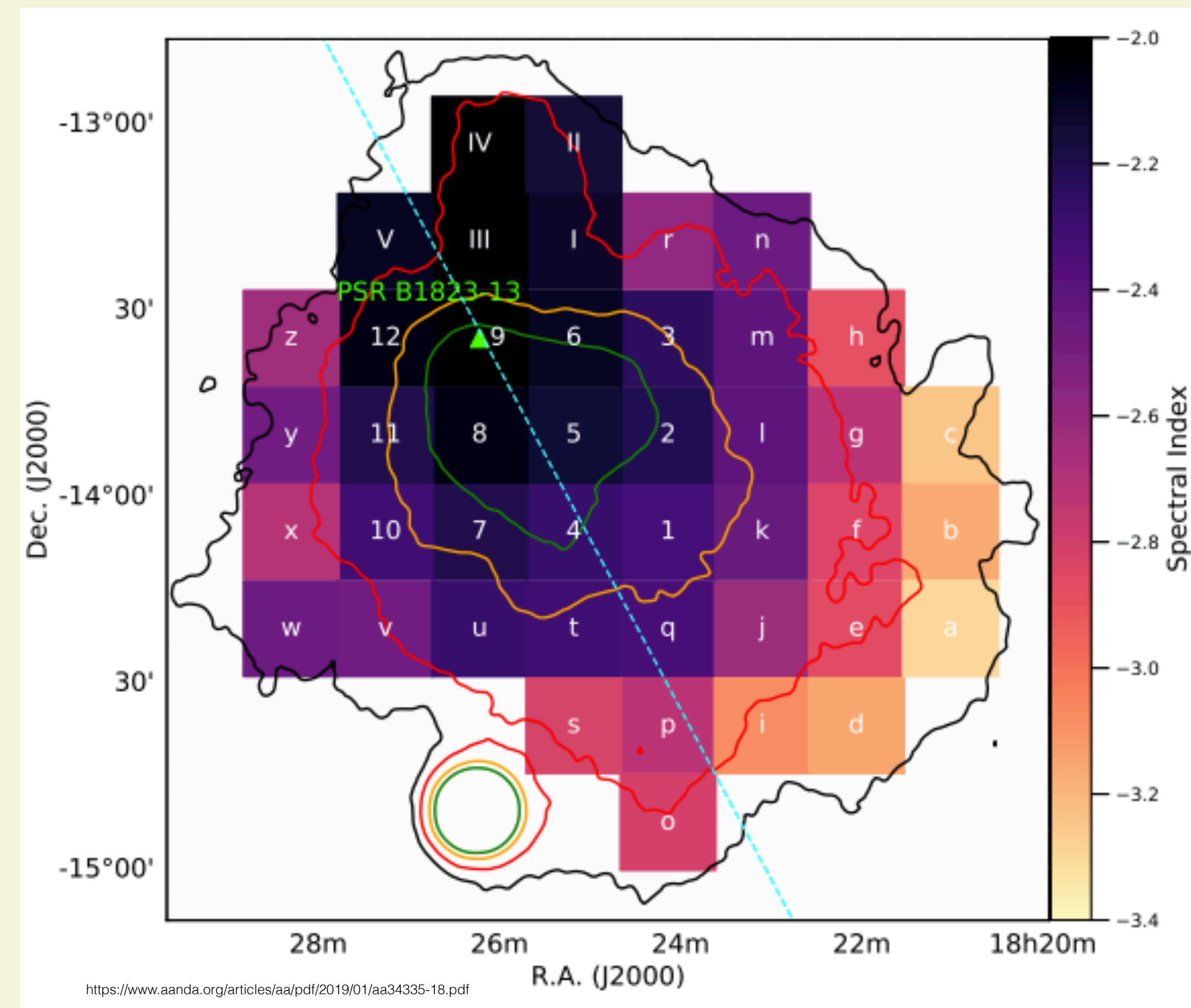


- Assume the LHAASO flux points > 200 TeV are coming from the same origin of HAWC J1825-134
- Flux point at 200 TeV agrees HAWC J1825-134 point source spectrum
- The spectrum become softer beyond 300 TeV
- HAWC Outriggers!



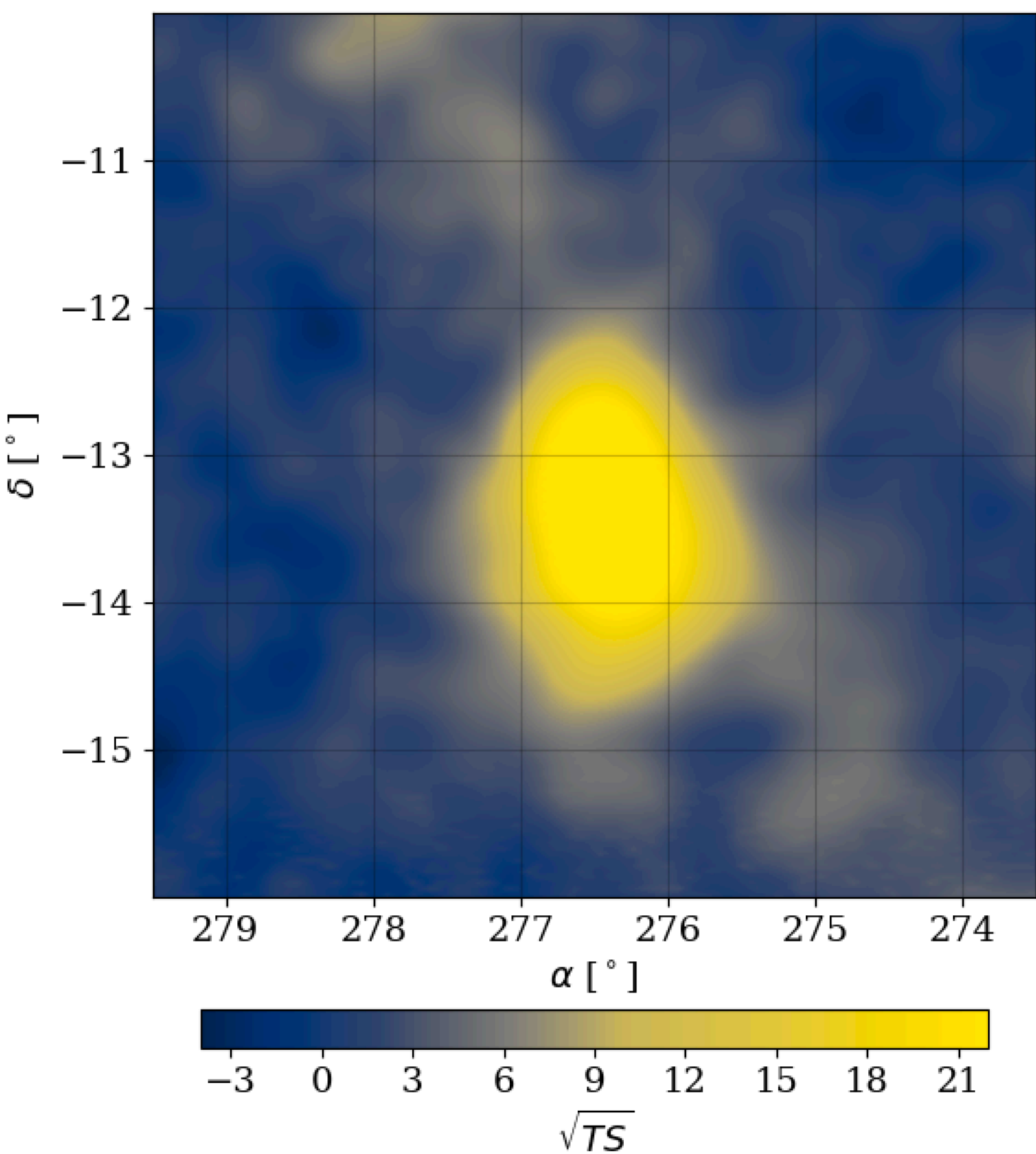
Energy-dependent J1825

- H.E.S.S. reported energy dependent morphology of HESS J1825-137
- Gaussian morphology with 1σ width 0.47° best fitted with HAWC J1825-138
- Looking into potential energy dependent morphology of this extended source in HAWC data

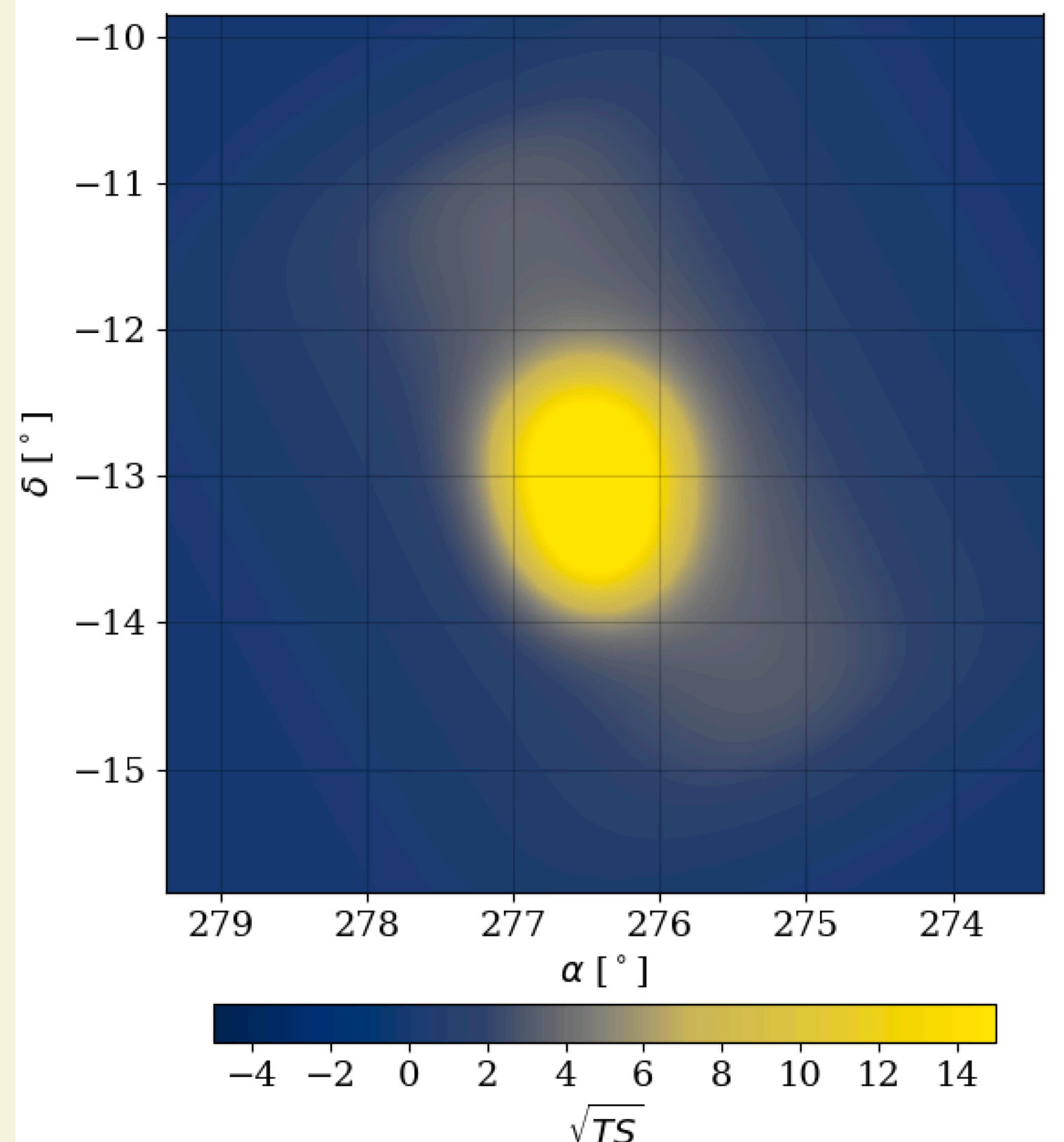


Energy-dependent J1825

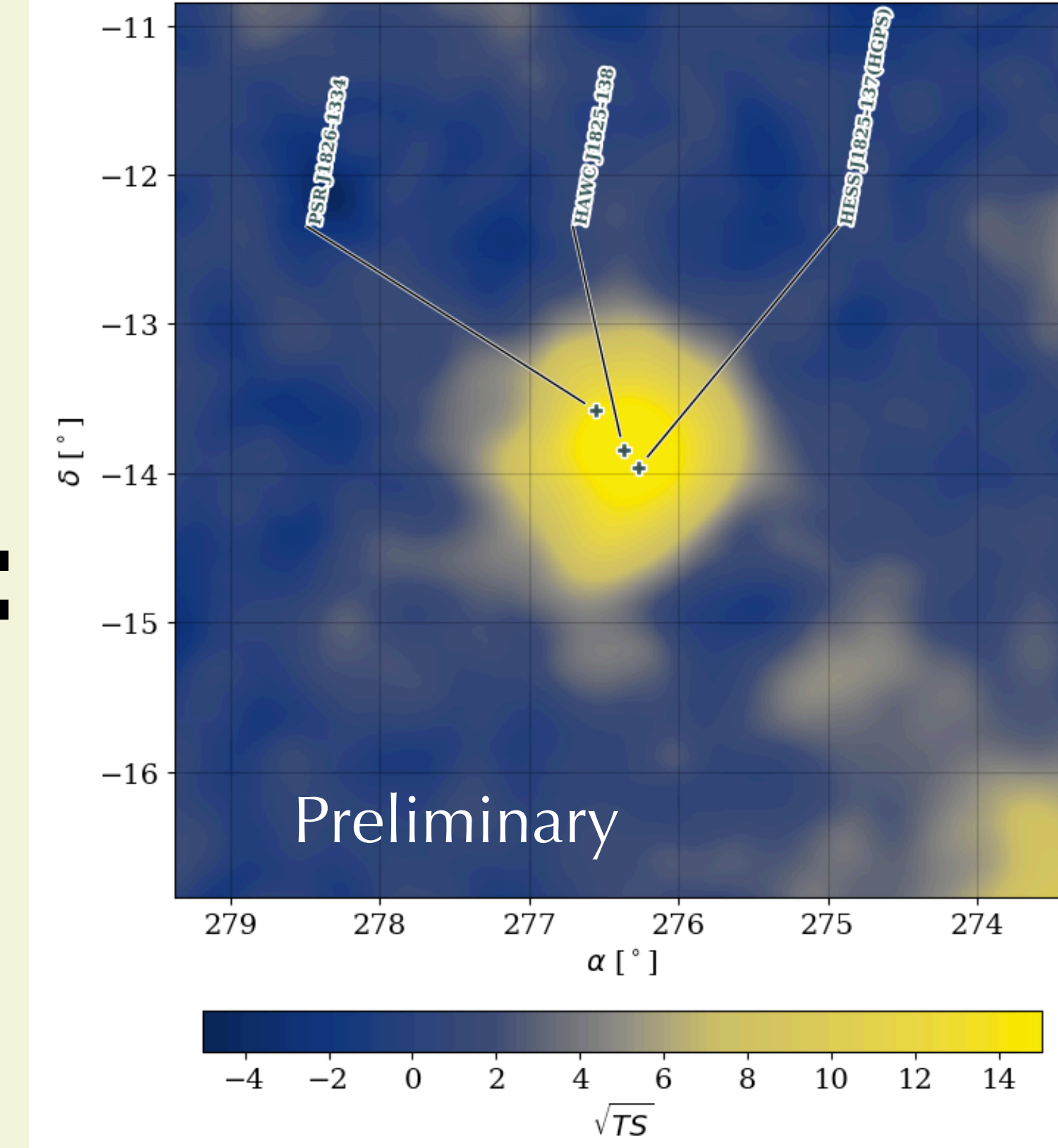
Data Map



Model : J1825 PS + J1826 ES +
GDE

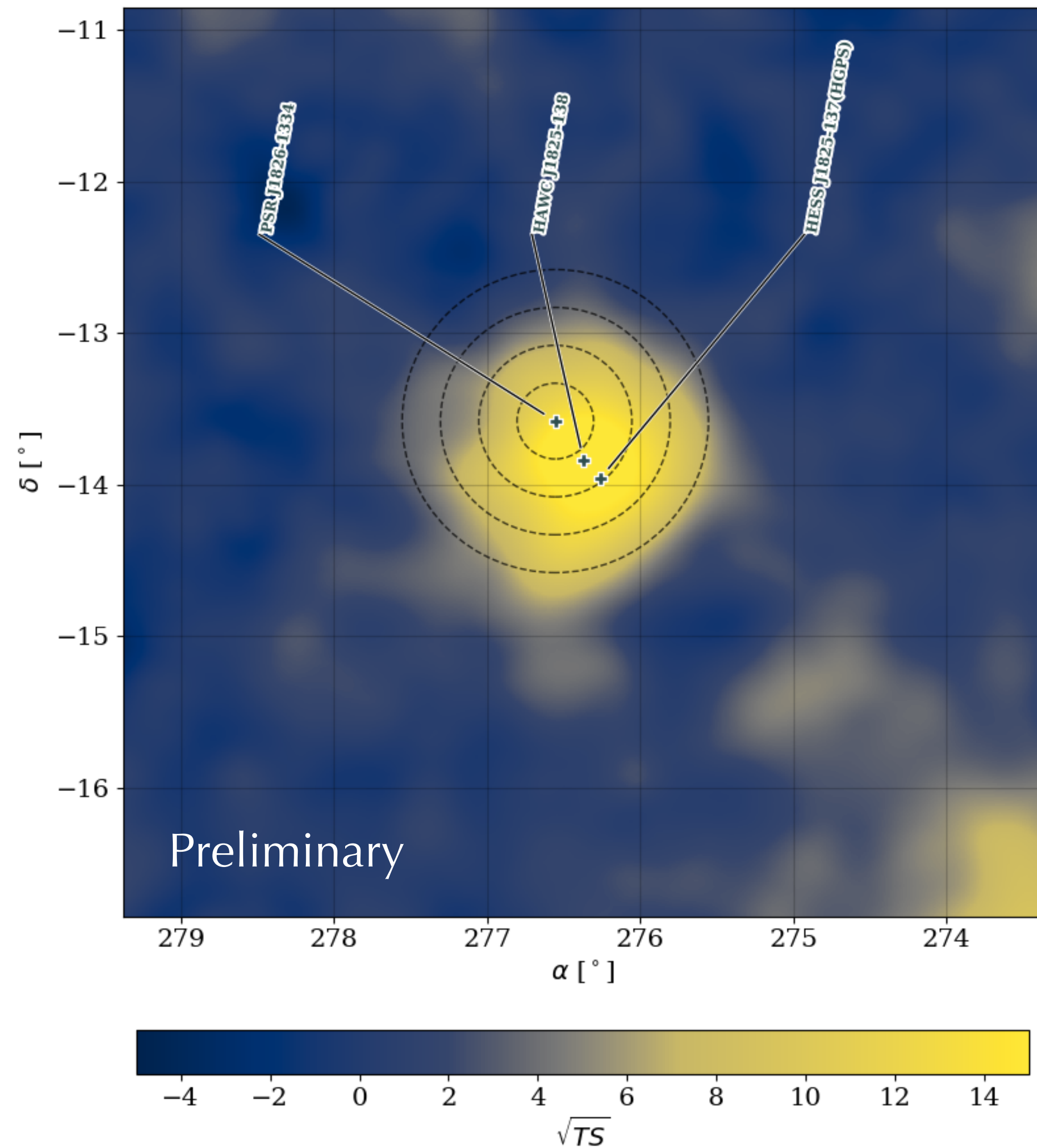


J1825-138 Only Map



- To focus on the J1825-138 we subtract the point like source HAWC J1825-134, extended source HAWC J1826-128 and galactic diffuse emission

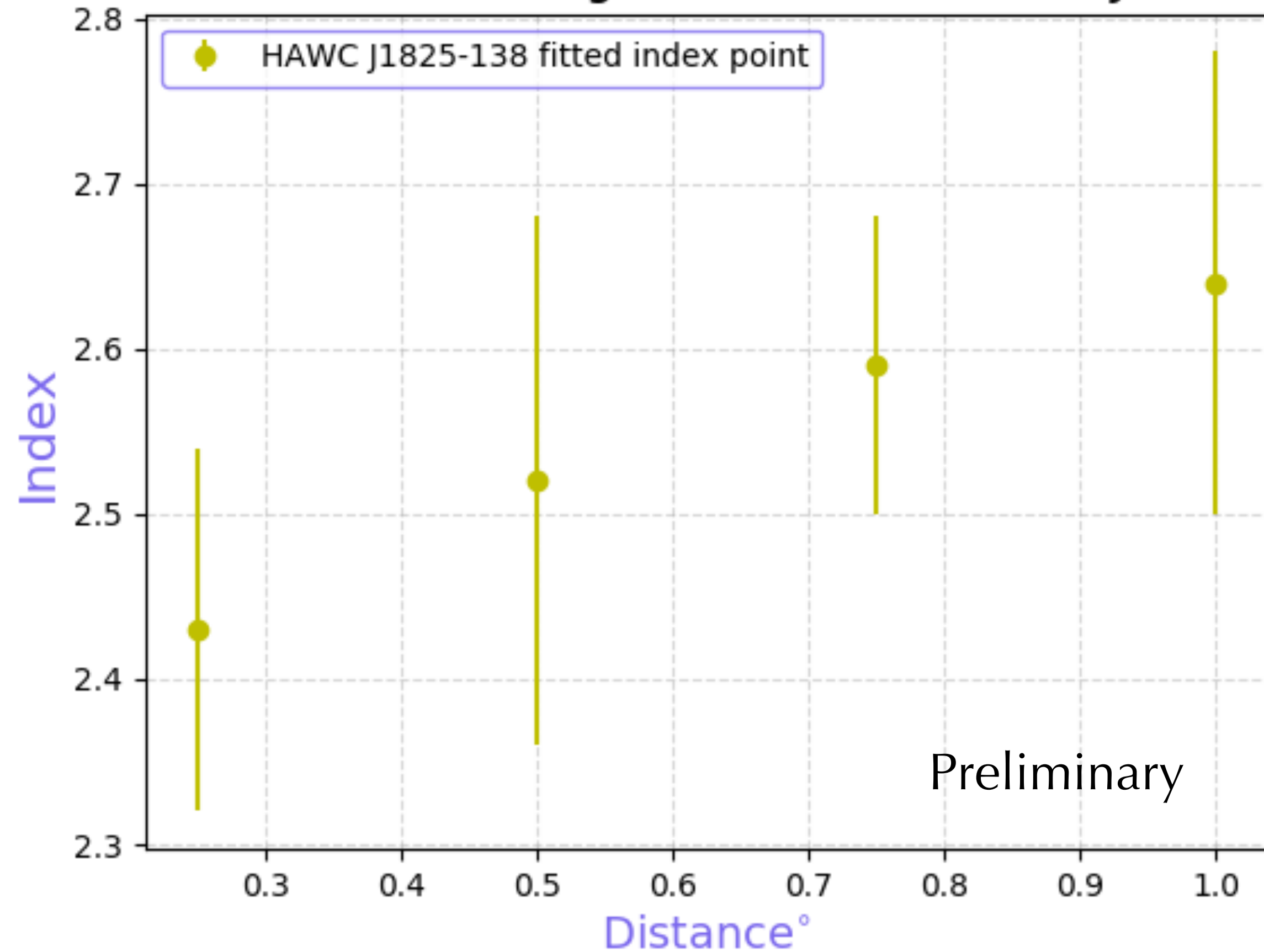
Energy-dependent J1825



- Choose 4 rings centered at the Pulsar location
- Each ring has extra 0.25° radius compare to previously ring
- Using power-law spectrum fit the flux normal and index in each region

Energy-dependent J1825

Index as a function of angular distance from PSR J1825-1334



- We do found the index become softer when move further to the Pulsar
- But we still have “big” error bars
- We may see the some clue about the energy-dependent morphology for the J1825-138 with HAWC data
- More in the future

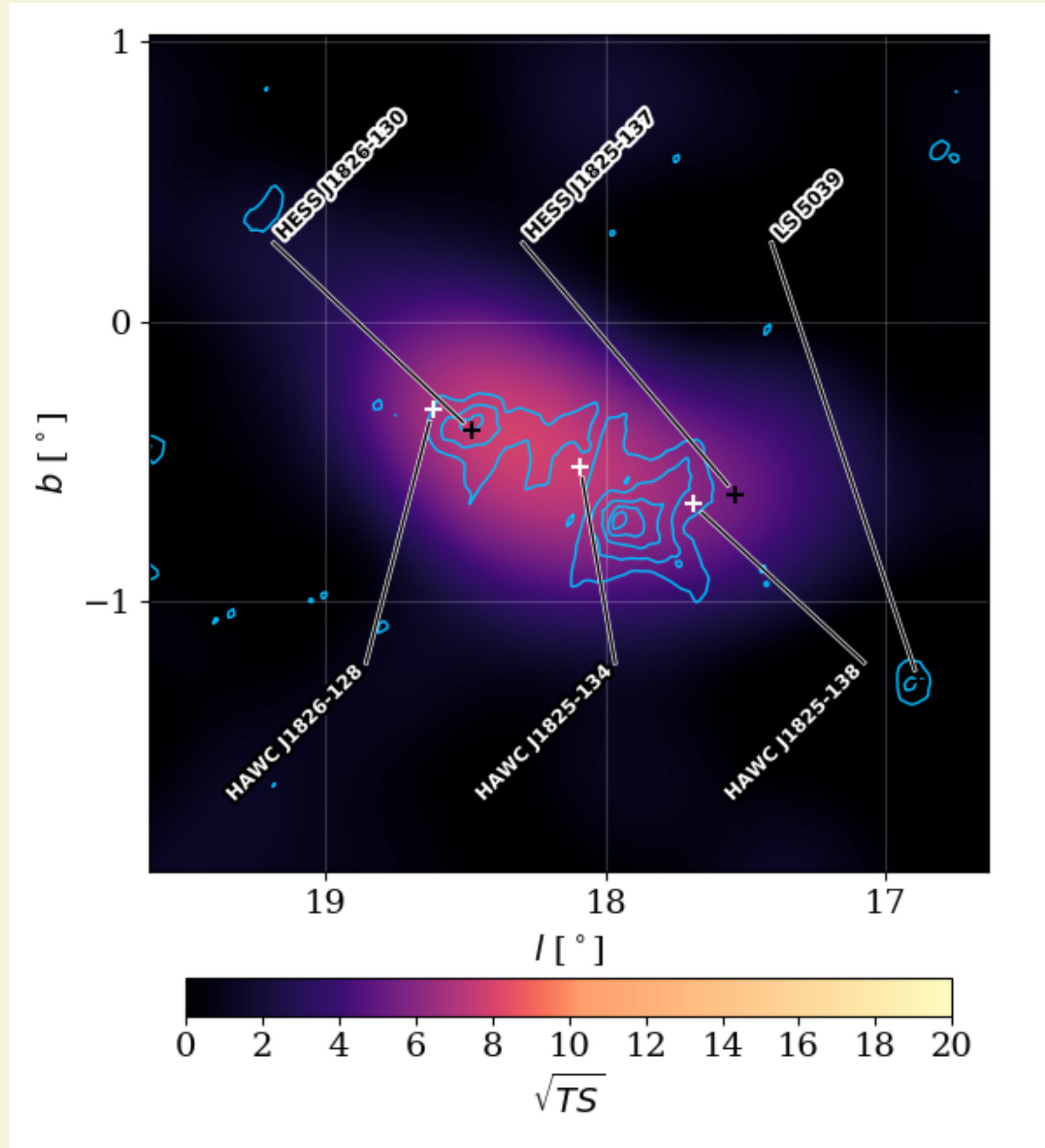
Summary & Outlook

- Young star cluster best candidate for 200 TeV gamma-ray emission origin of eHWC J1825-134
- LHAASO confirm the our detection at even higher energy
- HAWC outrigger and LHAASO will be important to understand this region at the highest energies
- We may see the energy dependent morphology at extended source HAWC J1825-138

Backup

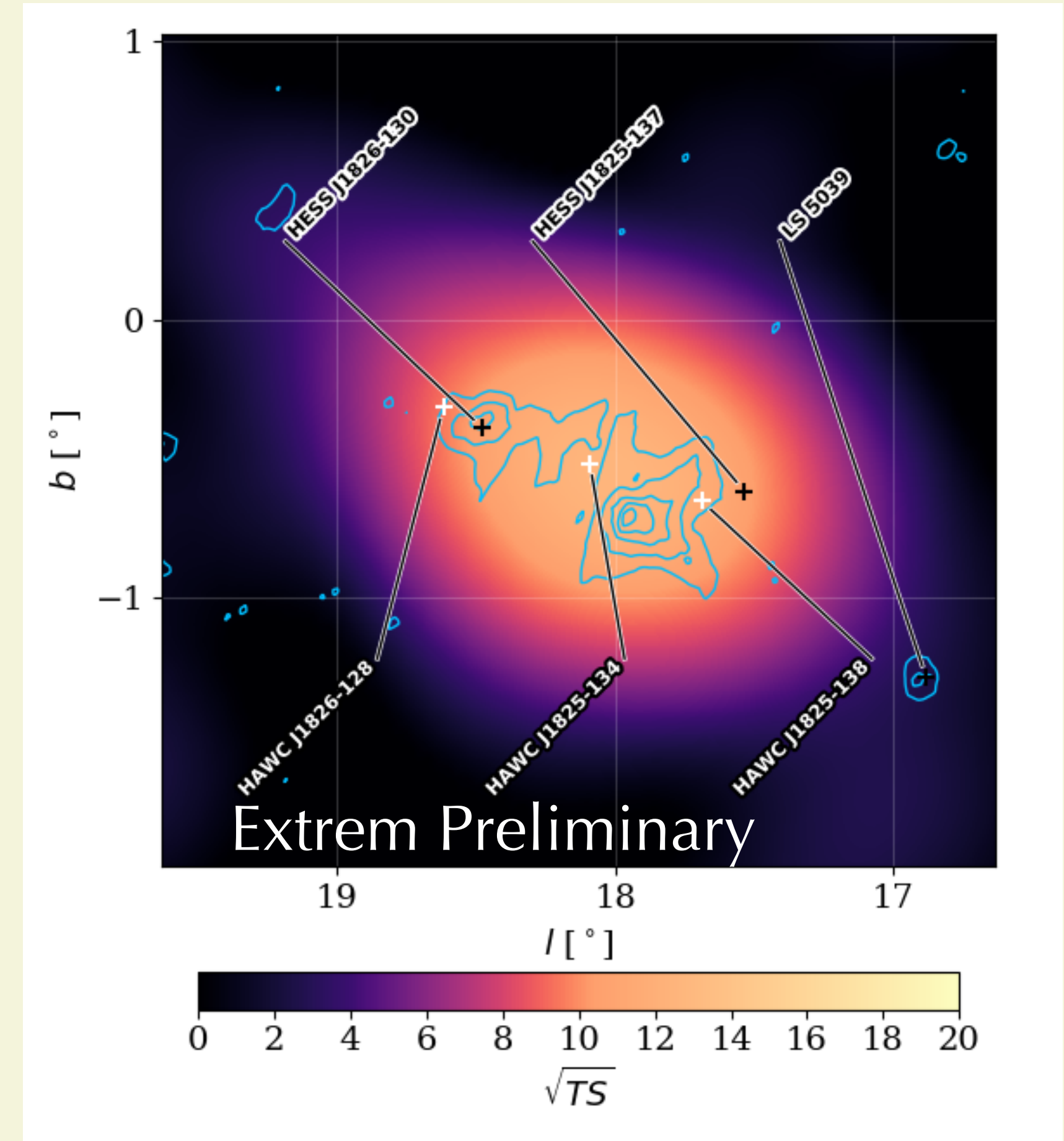
First Look of Pass5 $\rho_{40} > 100$ TeV Map

Pass4



8σ

Pass5



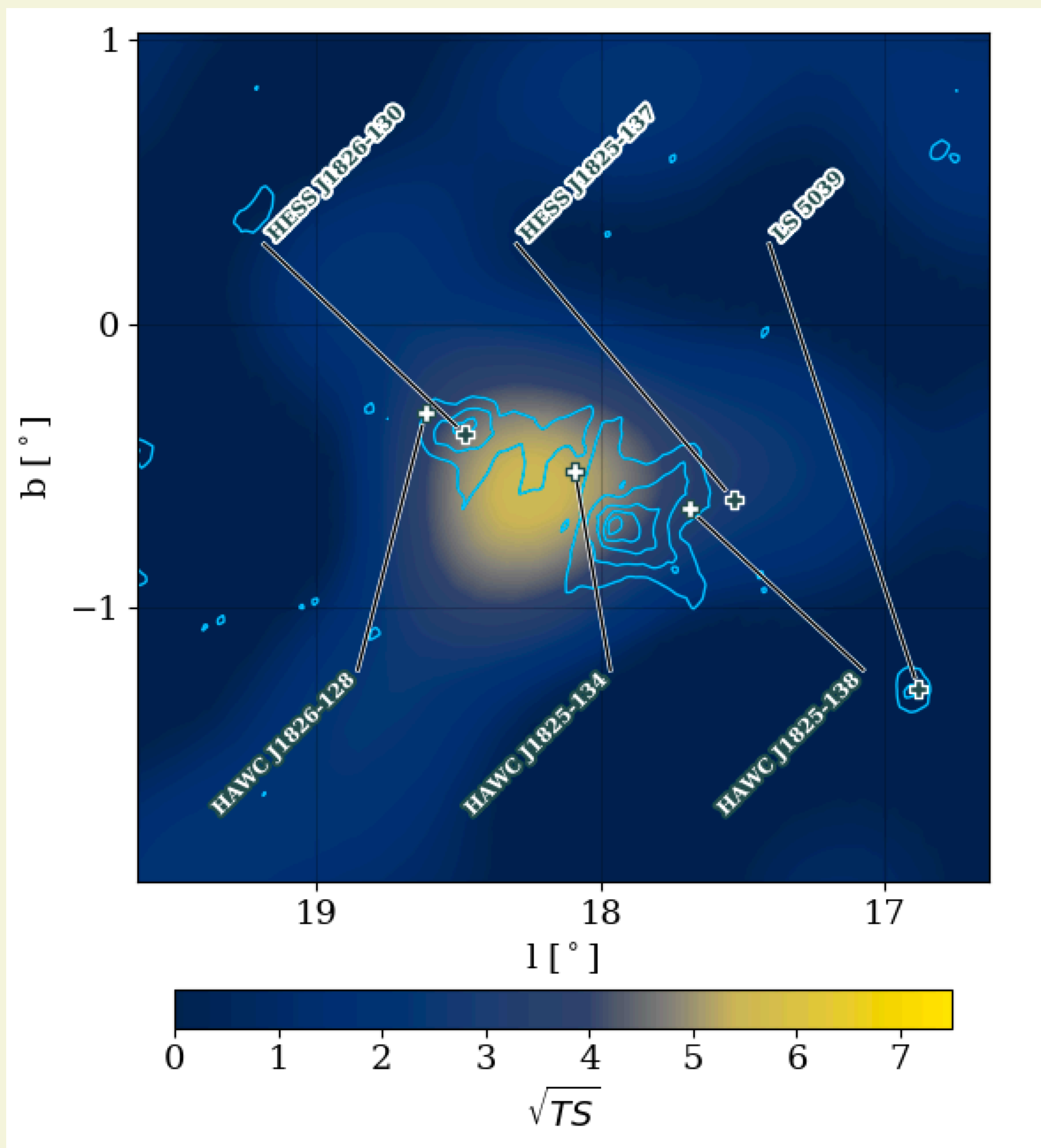
12.7σ

PSF become slight worse than Pass4

First Look of HAWC New Data >177 TeV Map

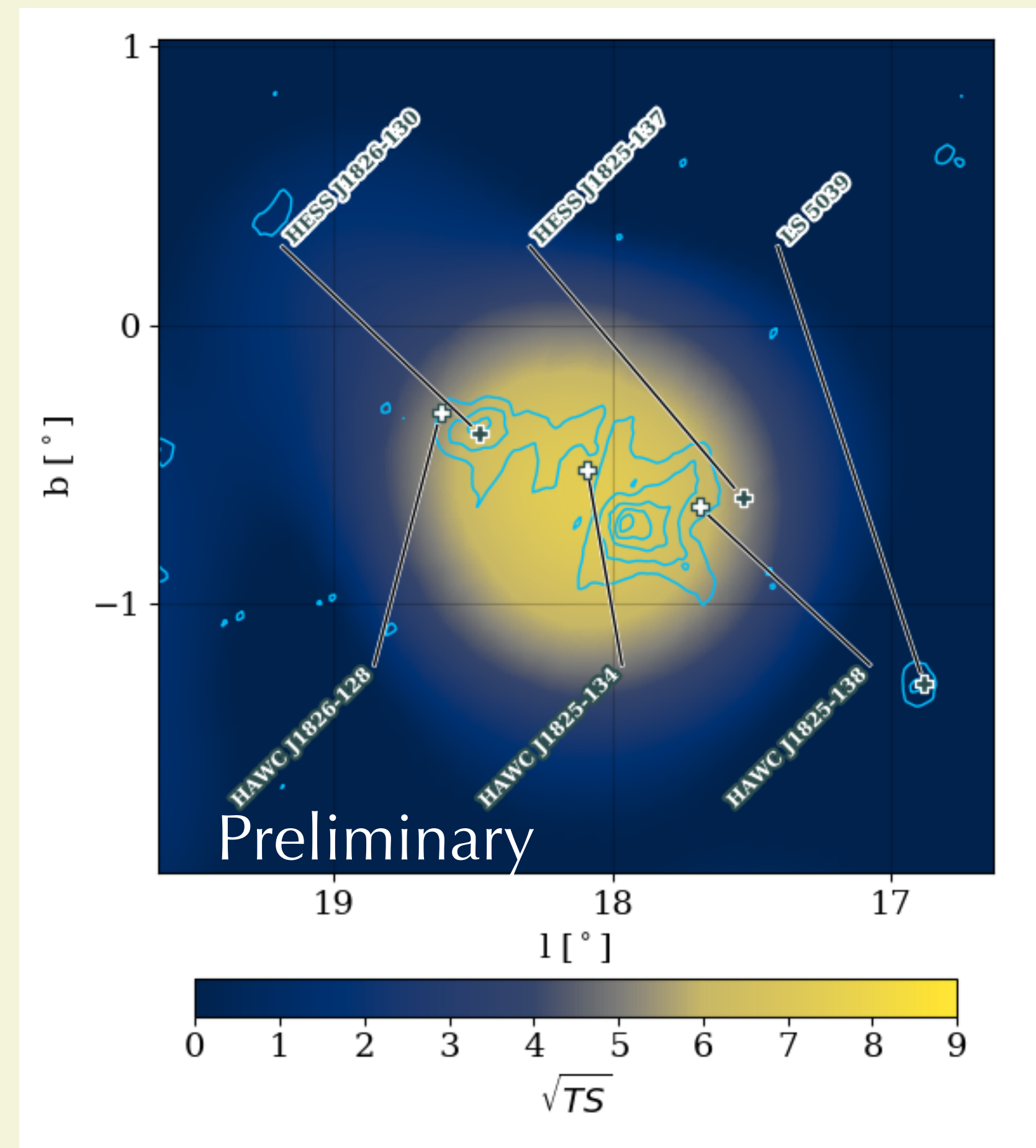
Pass4

Pass5



5.56σ

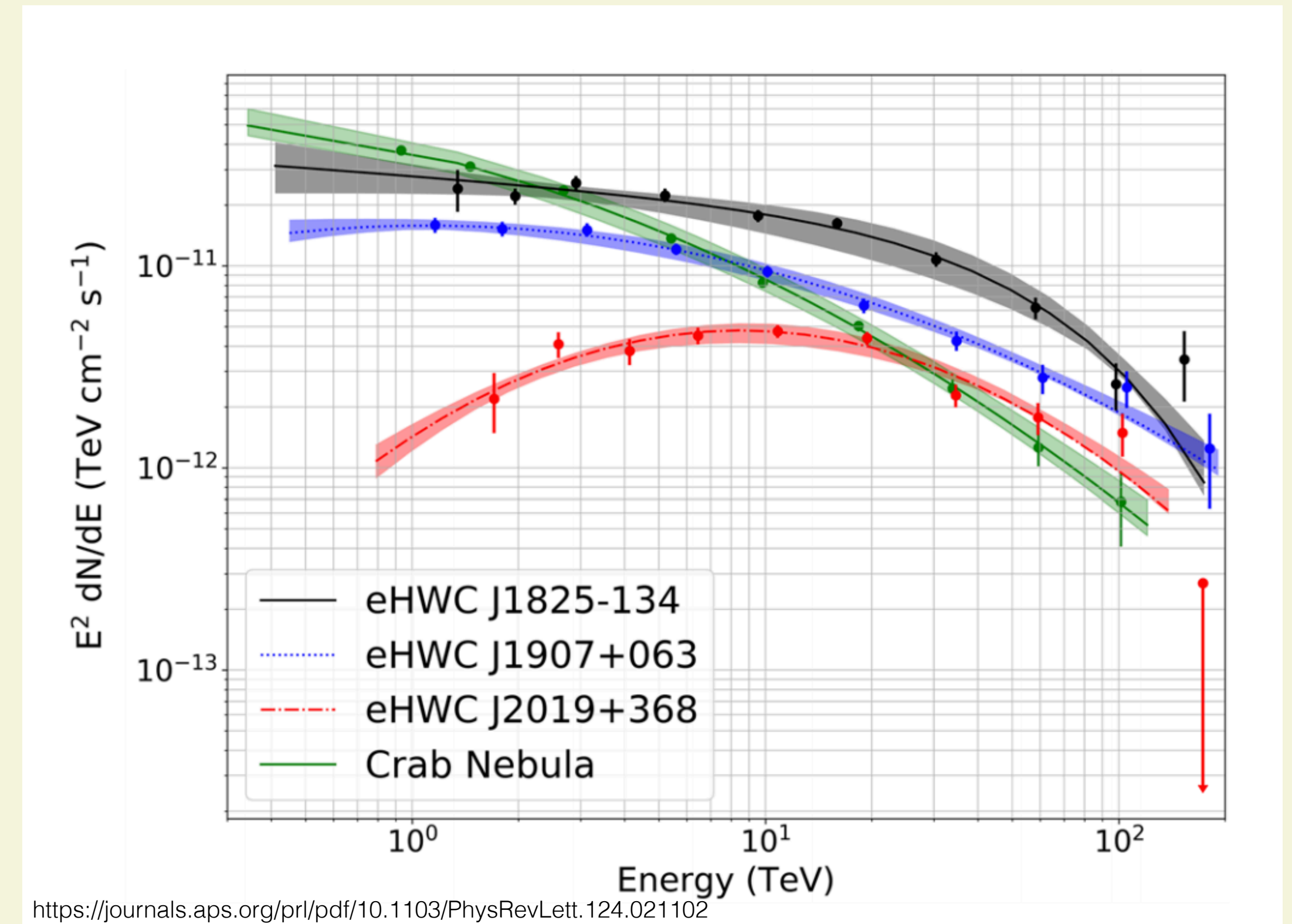
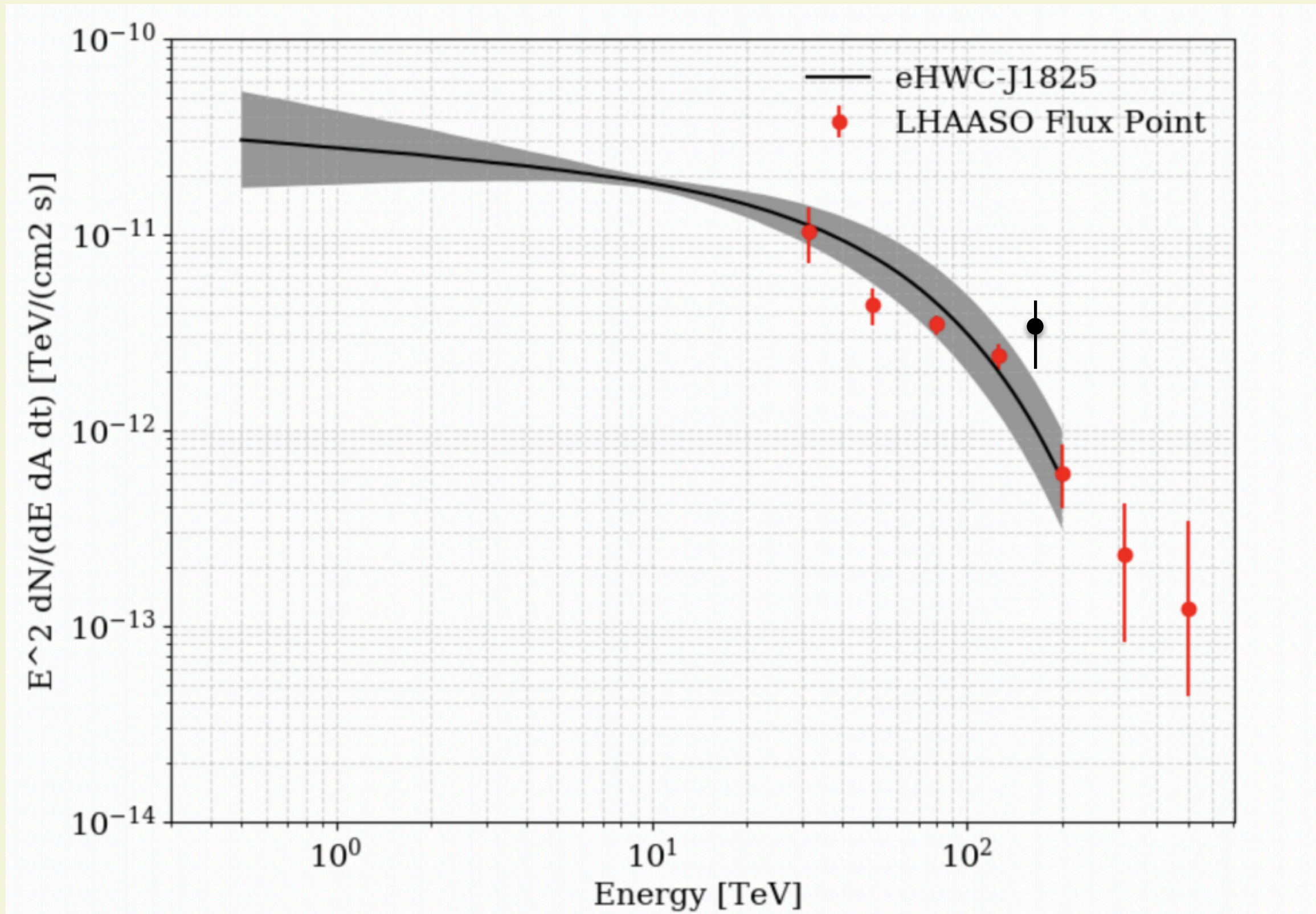
PSF
 $\leftarrow 0.4^\circ$
 $0.43^\circ \rightarrow$



7.43σ

Maximum significance shift towards Point source

How About New Point Source Energy



<https://journals.aps.org/prl/pdf/10.1103/PhysRevLett.124.021102>