
Supplementary information

HAWC observations of the acceleration of very-high-energy cosmic rays in the Cygnus Cocoon

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1 Supplementary Tables

Rings (pc)	Mass ($10^5 M_\odot$)	$L_\gamma(> 1\text{TeV})$ $\text{erg} \cdot \text{s}^{-1}$	$w_{\text{CR}}(> 10\text{TeV})$ eV/cm^3
$0 < r < 15$	0.8	$0.5^{+1.6}_{-0.4}$	$0.012^{+0.037}_{-0.090}$
$15 < r < 29$	2.4	$3.3^{+0.7}_{-0.5}$	$0.025^{+0.005}_{-0.004}$
$29 < r < 44$	4.0	$3.5^{+0.9}_{-0.6}$	$0.016^{+0.004}_{-0.003}$
$44 < r < 55$	3.3	$2.6^{+1.6}_{-0.9}$	$0.014^{+0.009}_{-0.004}$

Supplementary Table 1: **Luminosity and CR Density values in the four rings at the Cocoon region.** The given uncertainties are 1σ statistical errors. The gas mass is quoted from (16).

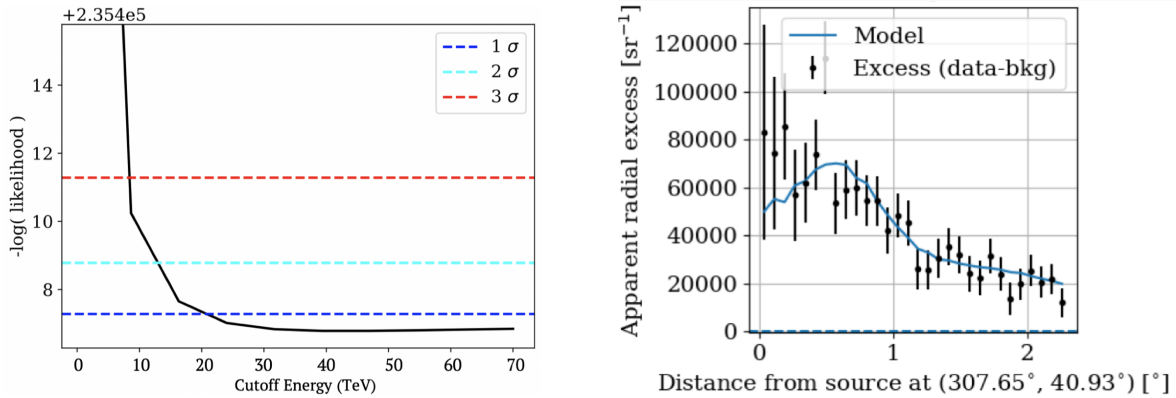
Source	Spectral Model	TS	Spectral Parameters			
			N_0 ($\text{TeV}^{-1}\text{cm}^{-2}\text{s}^{-1}$)	E_0 (TeV)	Γ	E_c (TeV)
HAWC J2030+409	Eq. 2	195.2	$9.3^{+0.9}_{-0.8} \times 10^{-13}$	4.2	$-2.64^{+0.05}_{-0.05}$	
HAWC J2031+415	Eq. 3	298.5	$1.3^{+0.2}_{-0.2} \times 10^{-13}$	4.9	$-1.90^{+0.20}_{-0.16}$	33^{+17}_{-10}
2HWC J2020+403	Eq. 2	53.7	$39^{+6}_{-6} \times 10^{-13}$	1.1	$-2.95^{+0.12}_{-0.13}$	

Supplementary Table 2: **Maximum likelihood fit results for the three sources in the ROI.** All uncertainties quoted are 1σ statistical errors.

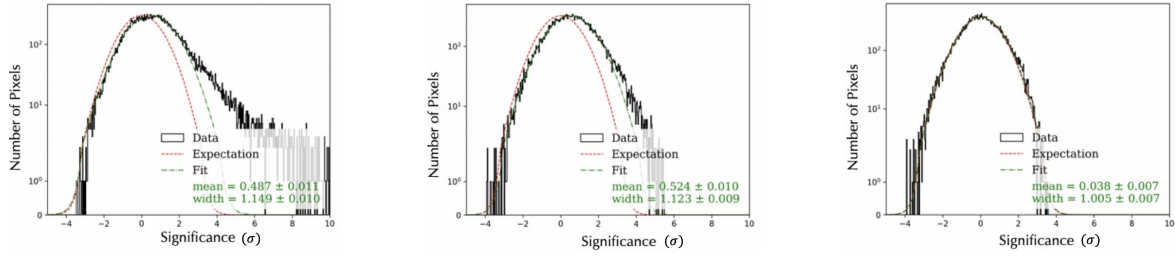
Energy Bins (TeV)	Median Energy (TeV)	TS
1.0 - 1.78	0.83	57.83
1.78 - 3.16	1.20	66.19
3.16 - 5.62	2.18	30.10
5.62 - 10.0	4.50	49.34
10.0 - 17.8	9.08	40.50
17.8 - 31.6	17.73	13.94
31.6 - 100	39.79	11.47
100 - 316	122.18	6.31

Supplementary Table 3: **Test statistics (TS) of the Cocoon in each energy bin.** The median energy quoted here is the HAWC reconstructed energy.

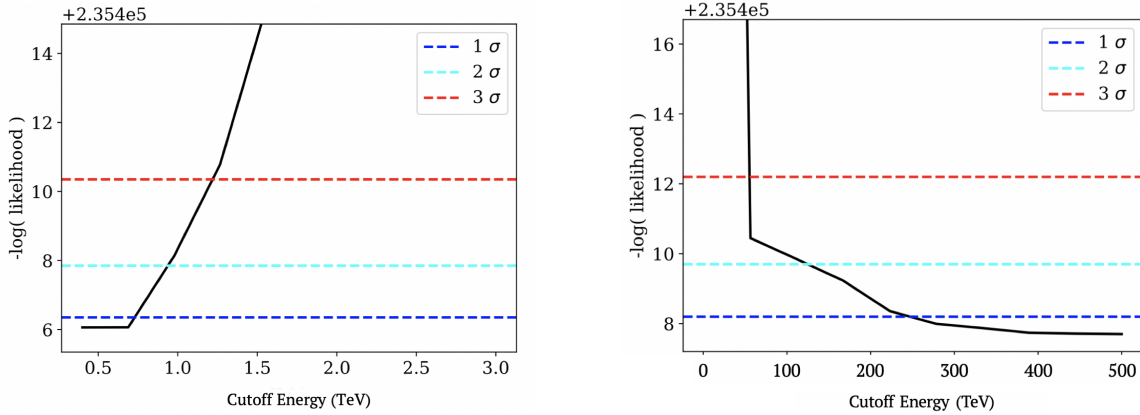
2 Supplementary Figures



Supplementary Figure 1: **Likelihood profile of the Cocoon cutoff energy and radial profile of the Cocoon region.** **Left (a):** Likelihood profile of the cutoff energy for the Cygnus Cocoon assuming a power law spectrum with an exponential cutoff as in equation 3. **Right (b):** Radial profile of the γ -ray emission at ROI region centered at the HAWC Cocoon location. The errors shown are 1σ statistical errors. The blue model curve is the PWN and γ Cygni subtracted from the multi-source model in Extended Data Fig. 2. The initial bump in the blue curve is an artifact of the binning used.



Supplementary Figure 2: **Significance distribution in the analysis region of interest (ROI).** The black curve is the distribution of excess significance in the ROI. The red and the green curves are the expected and the obtained distribution respectively. If there is no significance above the background fluctuations, the significance histogram should follow a normal distribution where the mean of the distribution is close to zero and the width is about 1σ . **Left (a):** Distribution of excess significance before any source subtraction in the given ROI overlaid with the expected and the best fit Gaussian distribution. **Middle (b):** Distribution of excess significance after subtracting PWN & γ Cygni. **Right (c):** Distribution of excess significance after subtracting PWN & γ Cygni and Cocoon.



Supplementary Figure 3: **Likelihood profile of the cutoff energy for the Cocoon energy range estimations** **Left:** Likelihood profile of hard cutoff to calculate the upper limit to the minimum Cocoon energy. **Right:** Likelihood profile of hard cutoff to calculate the lower limit to the maximum Cocoon energy.