Detection of emission from Cygnus Cocoon above 100TeV with LHAASO

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LHAASO Collaboration

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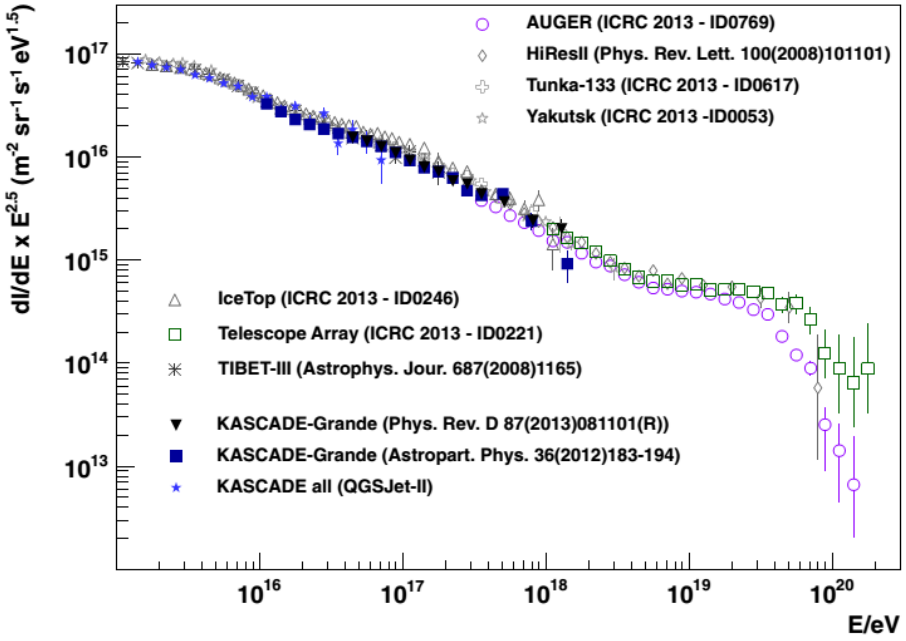
Outline

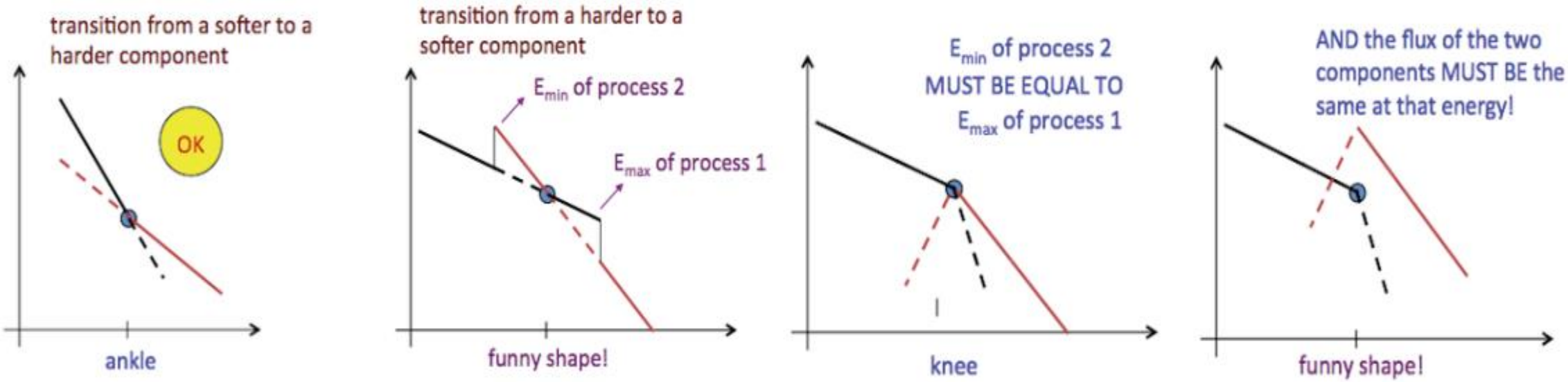
- Introduction
- Recent results about Cygnus region
- Conclusion

Introduction



Where is the transition from galactic to ex-galactic cosmic rays?

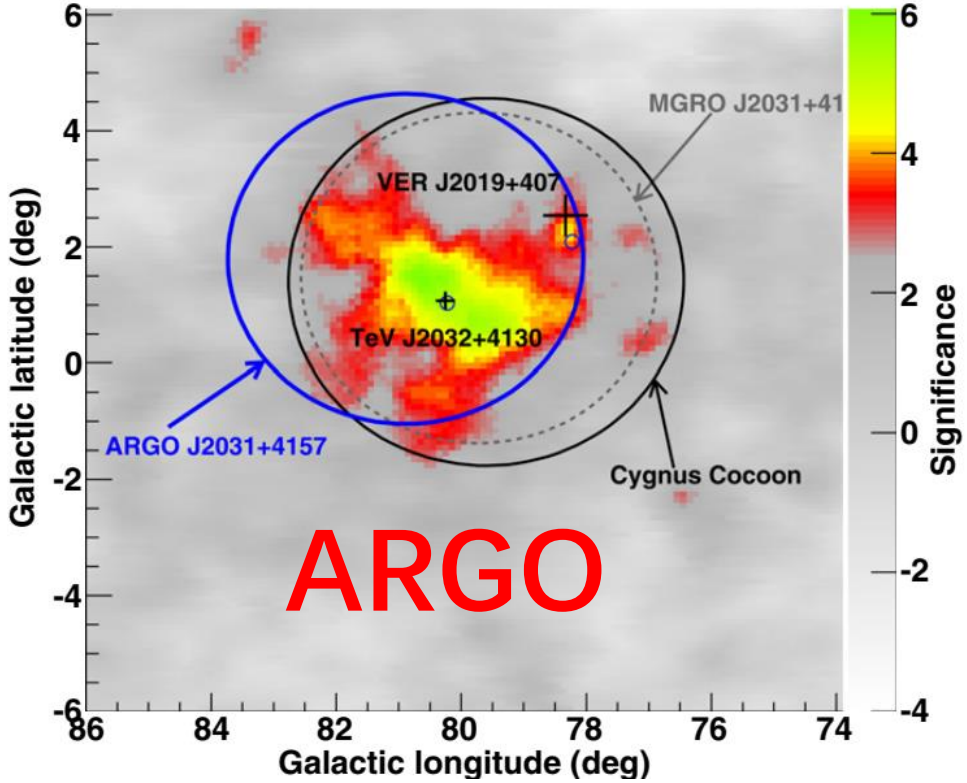
"Ankle" is the most probable energy range, cosmic rays can be accelerated to EeV?



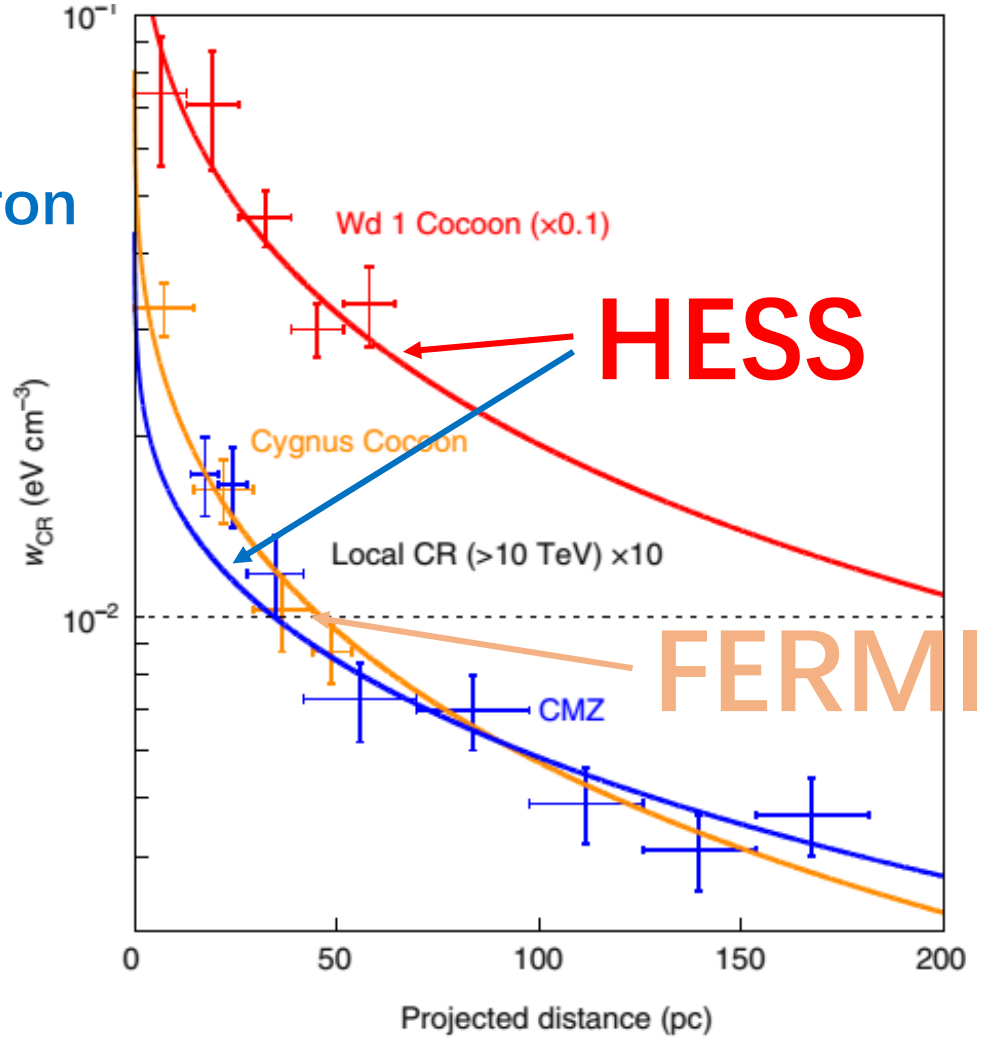
Nuclear Physics B - Proceedings Supplements Volumes 256–257, November–December 2014, Pages 197-212

Cygnus Cocoon

Massive star cluster is an ideal candidate for PeVatron



- The Astrophysical Journal, 790:152 (5pp), 2014 August 1

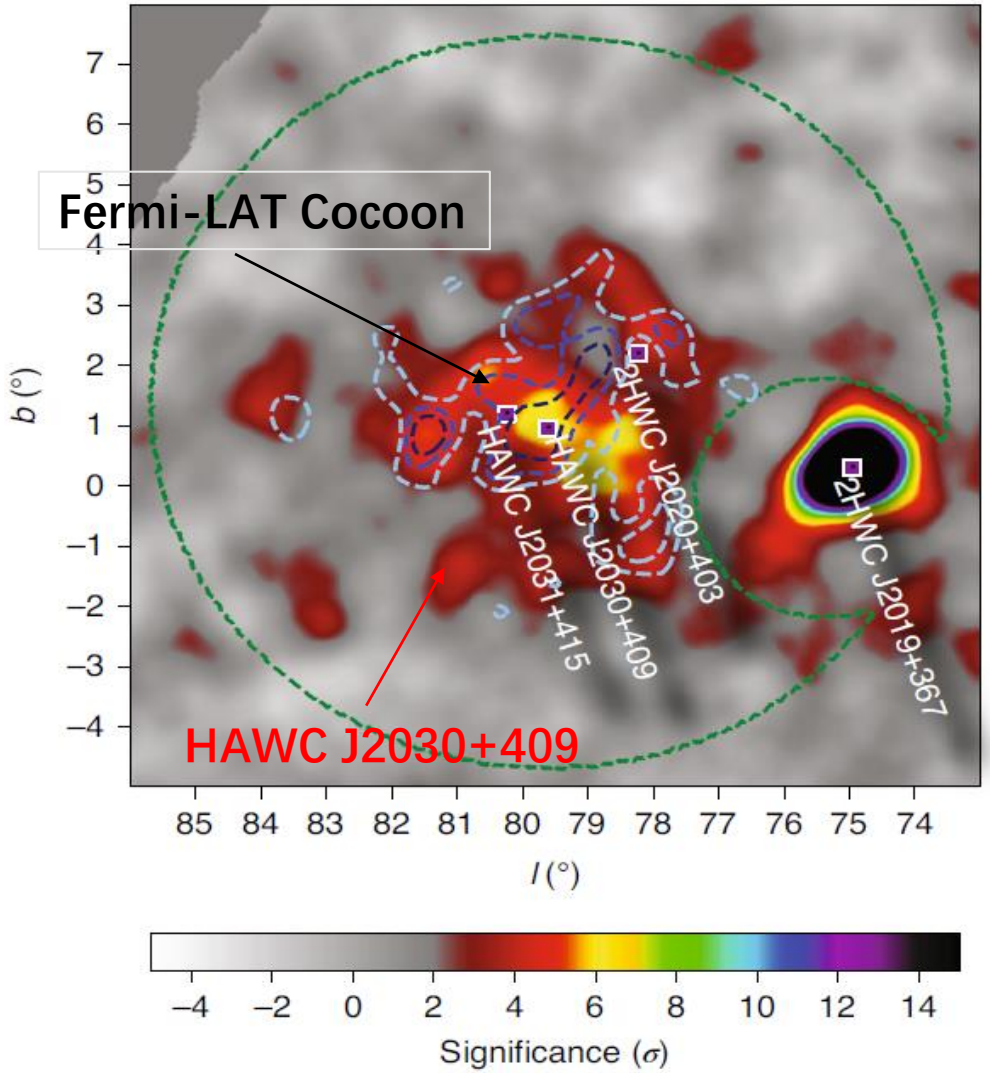


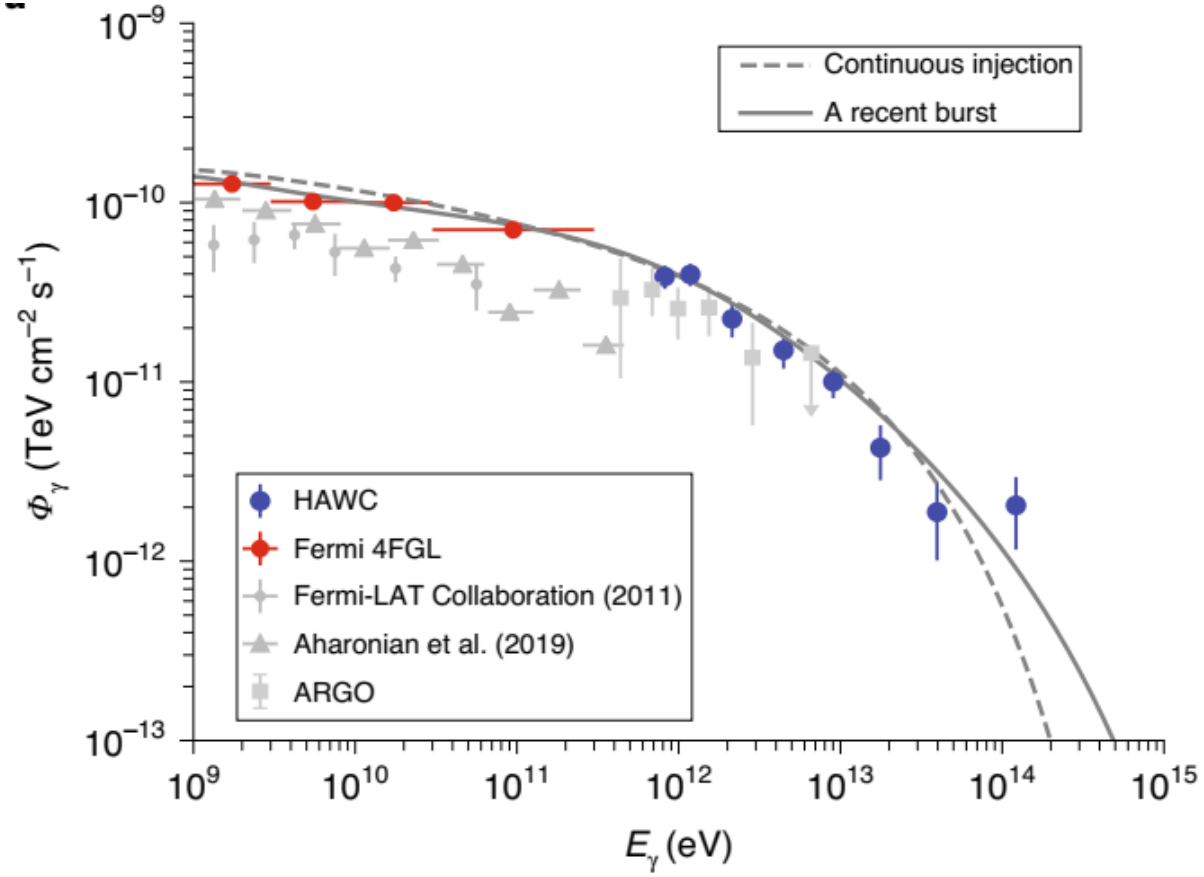
NAtuRE AstRONOMY | VOL 3 | JUNE 2019 | 561–567 |

◆Morphology from GeV to TeV is consistent with cosmic ray propagation;

◆The spectrum can extend above 10TeV;

New progress in 2021





HAWC 2021 result

LHAASO-KM2A

Most sensitive detector above tens of TeV!

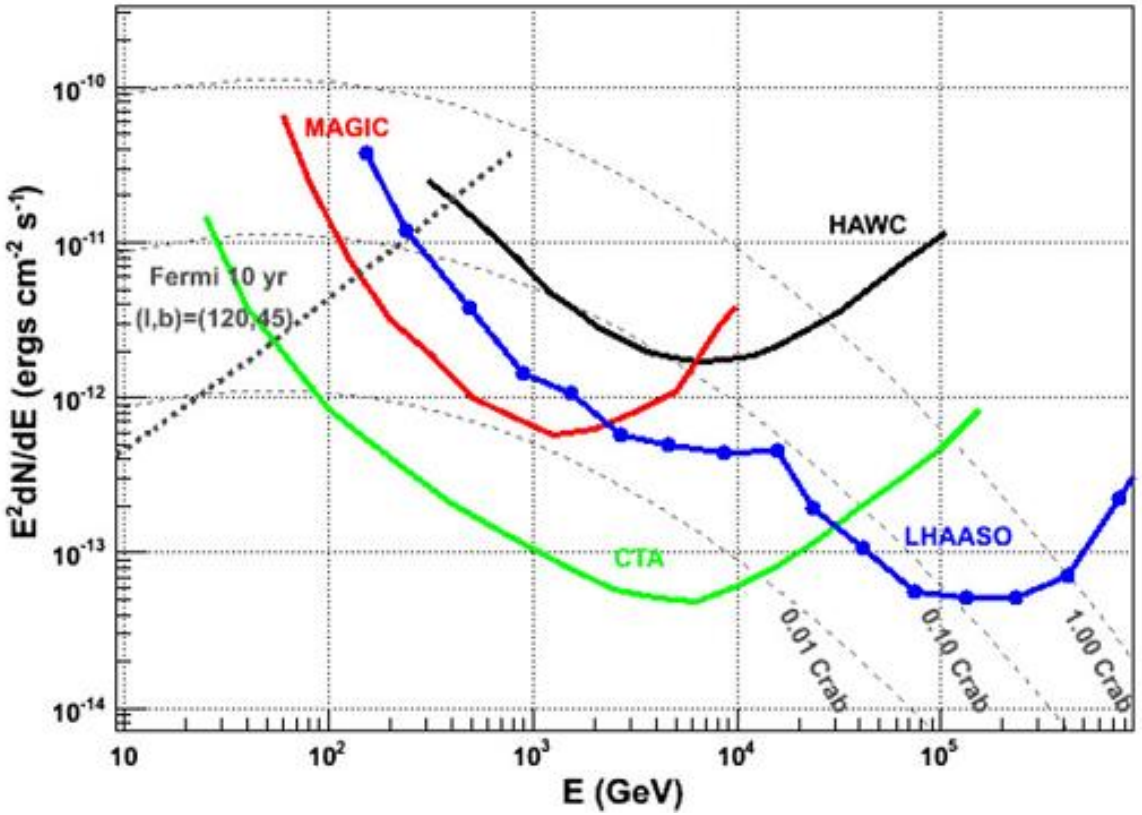
Above 100TeV:

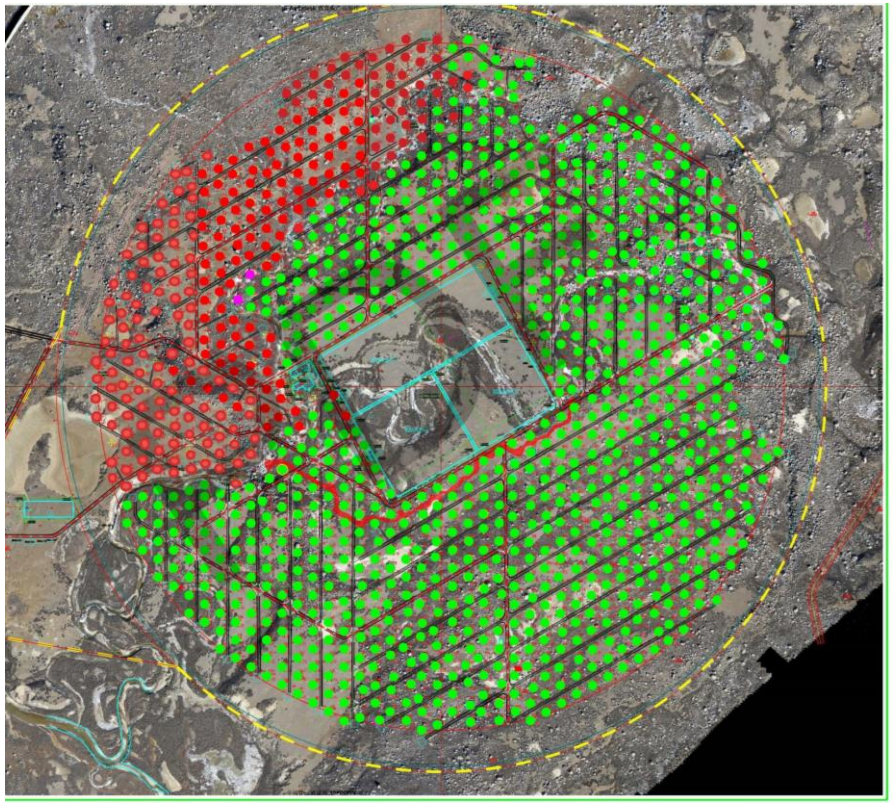
Sensitivity: 1% crab;

Psf: ~0.3 degree;

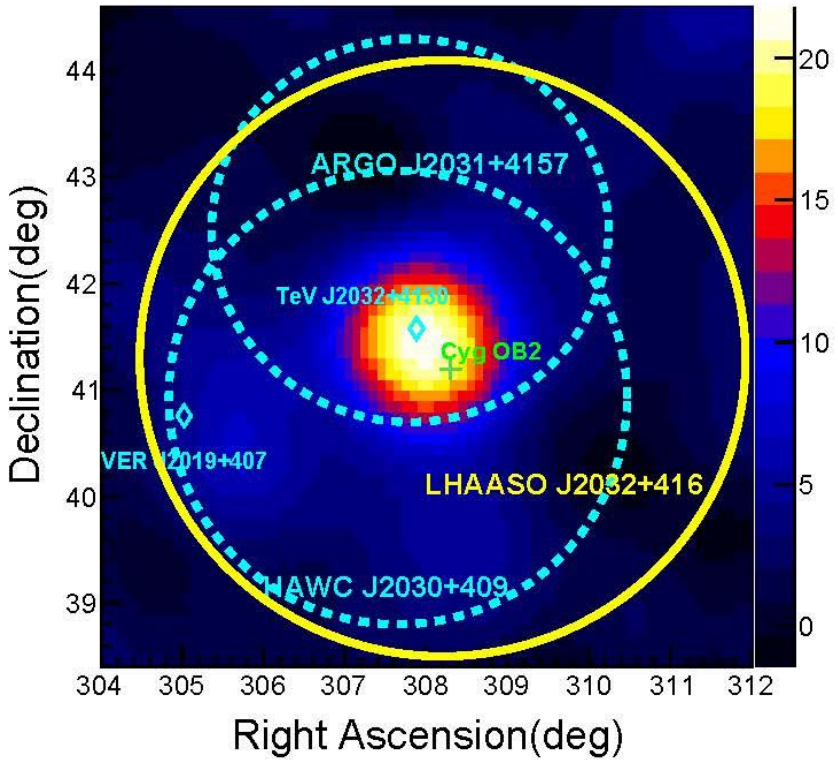
Energy resolution: <20%;

Rejection power : 2×10^4&&60%;

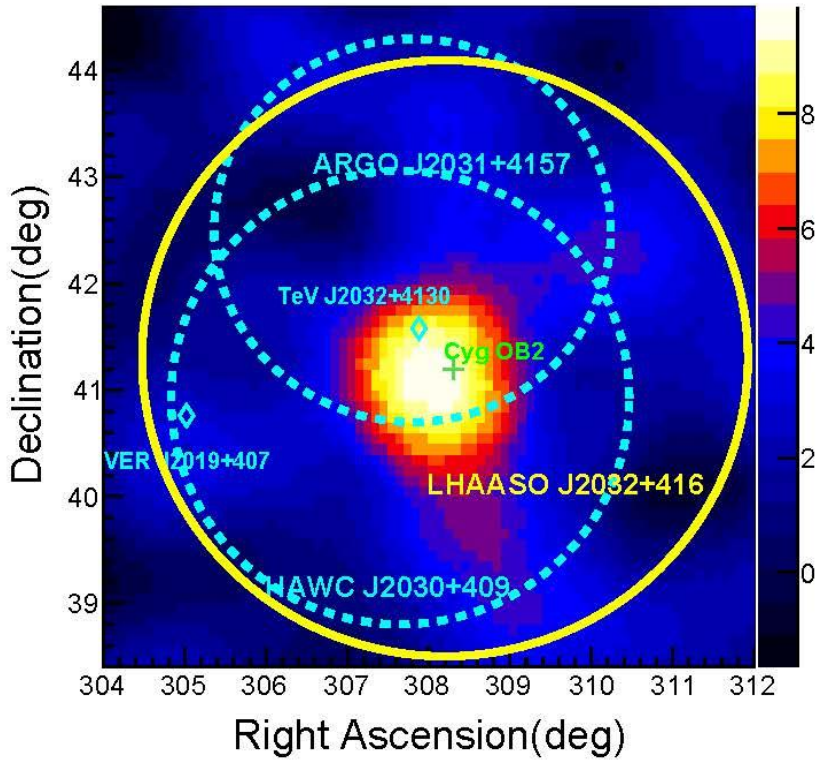




Significance map



Above 25TeV

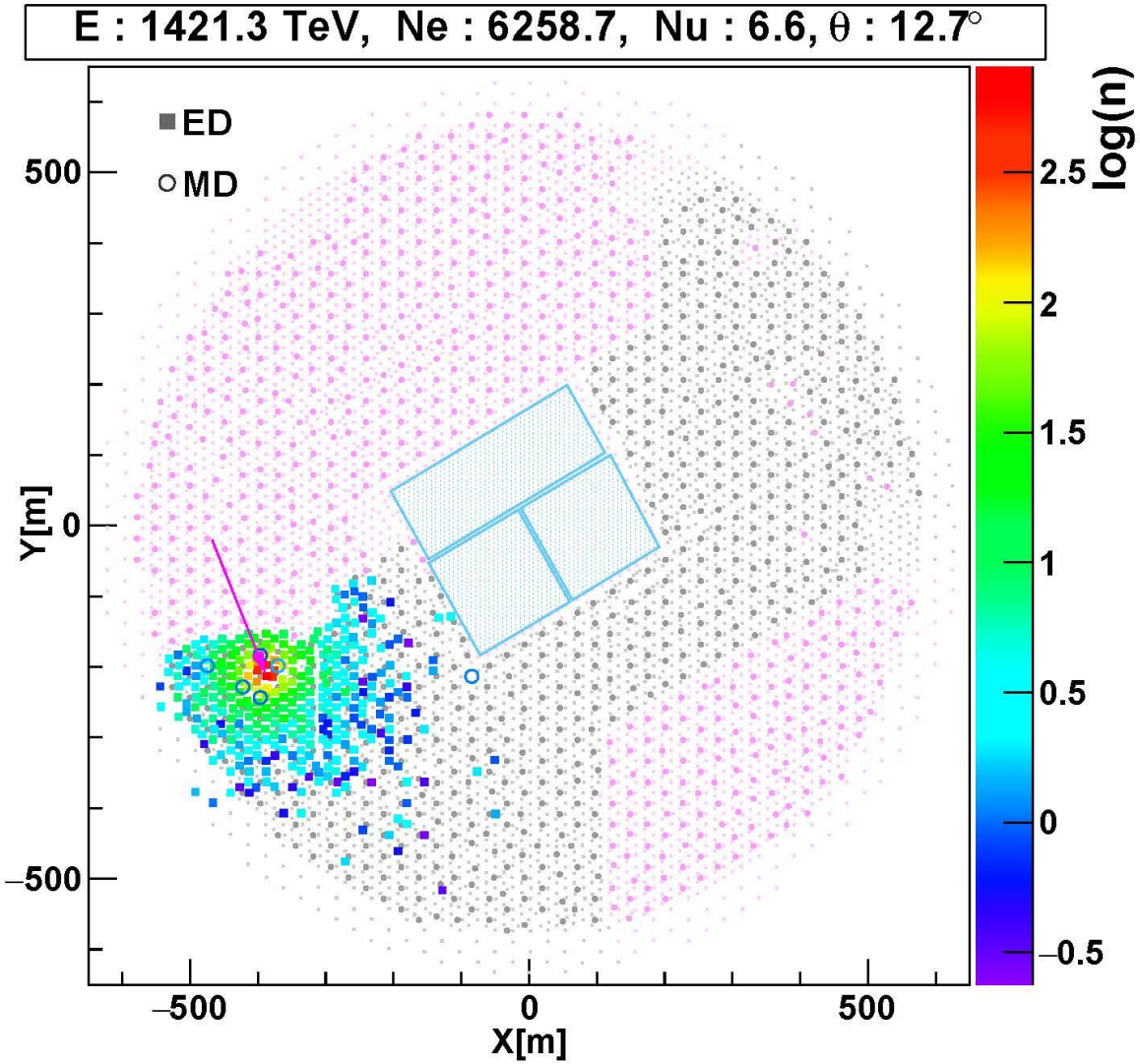


Above 100TeV

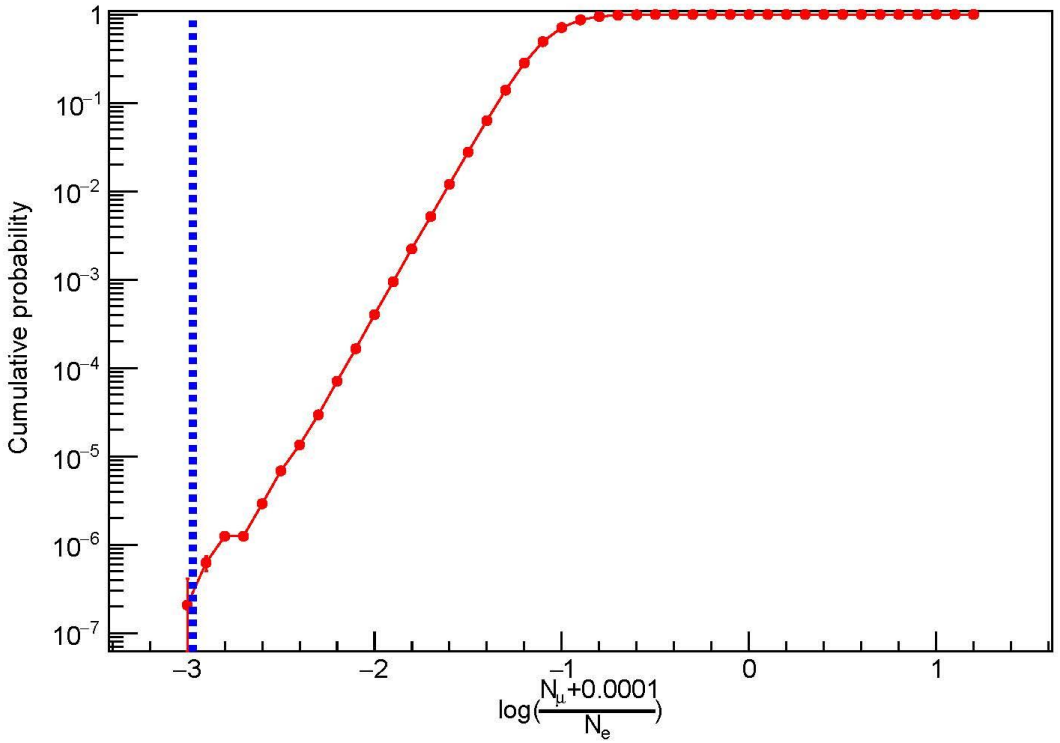
- **The maximum significance is about 10sigma;**
- **Clear extended emission around Cygnus OB2;**
- **The center of the emission is apart from PWN;**

The emission above 100TeV may be dominated by Cygnus Cocoon!

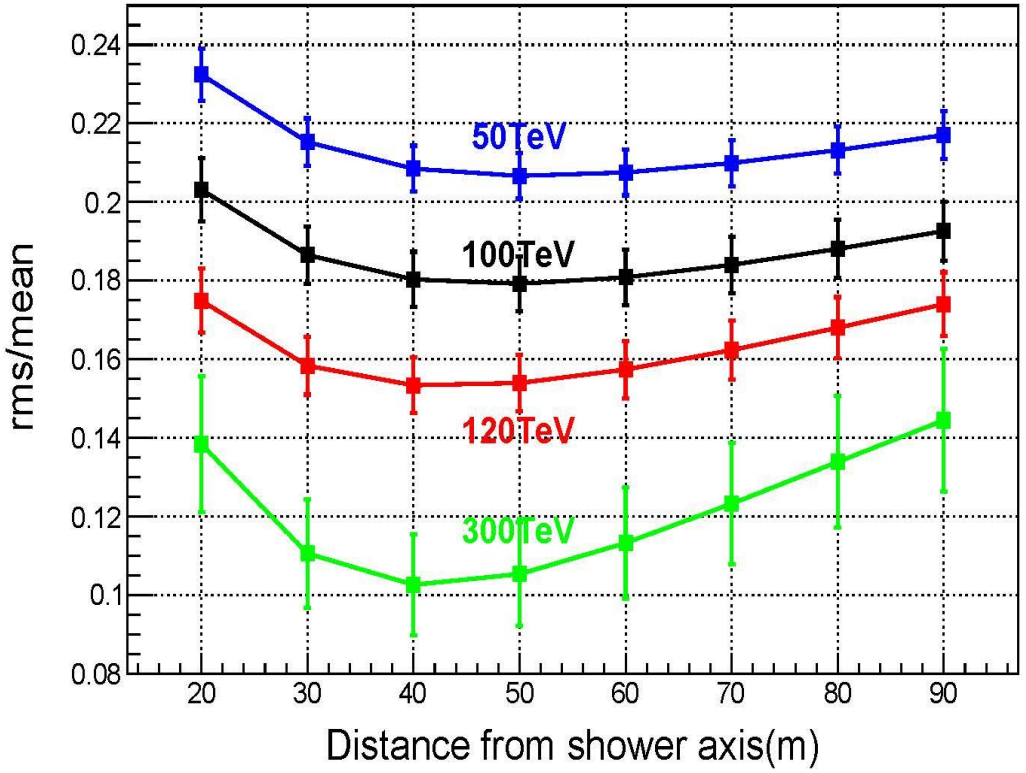
PeV photo from Cygnus Region

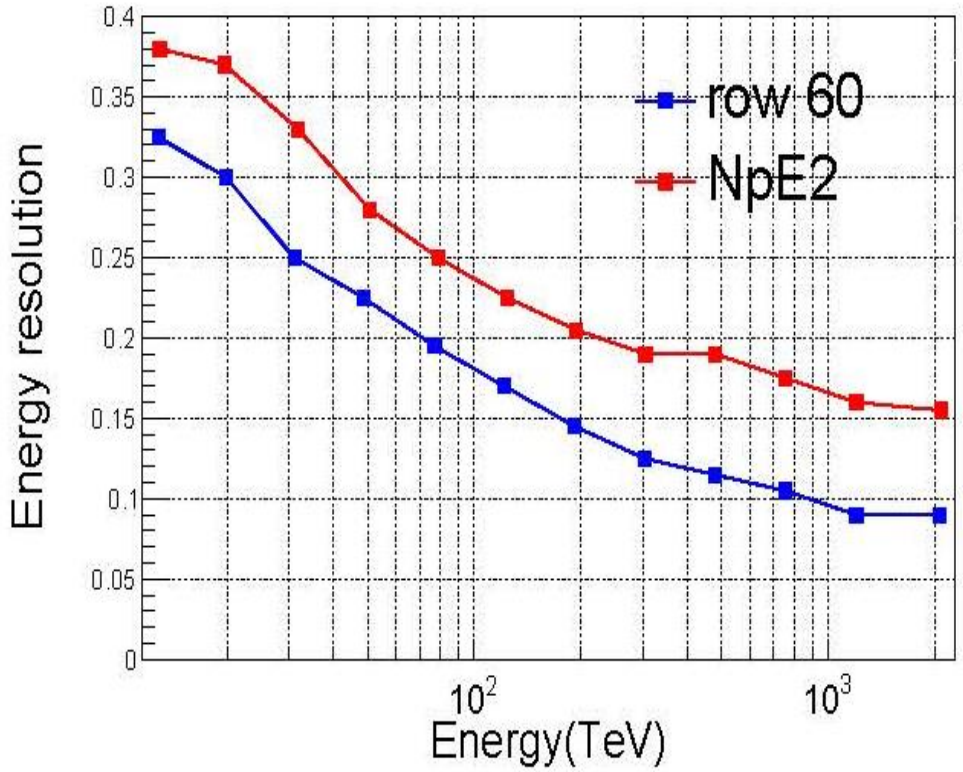


- The energy of this PeV photo is :
  $1.42 \pm 0.13\ PeV$
- The ratio of Nu/Ne is:
  $N_u/N_e = 1./941$
- The chance possibility is:
  0.028%



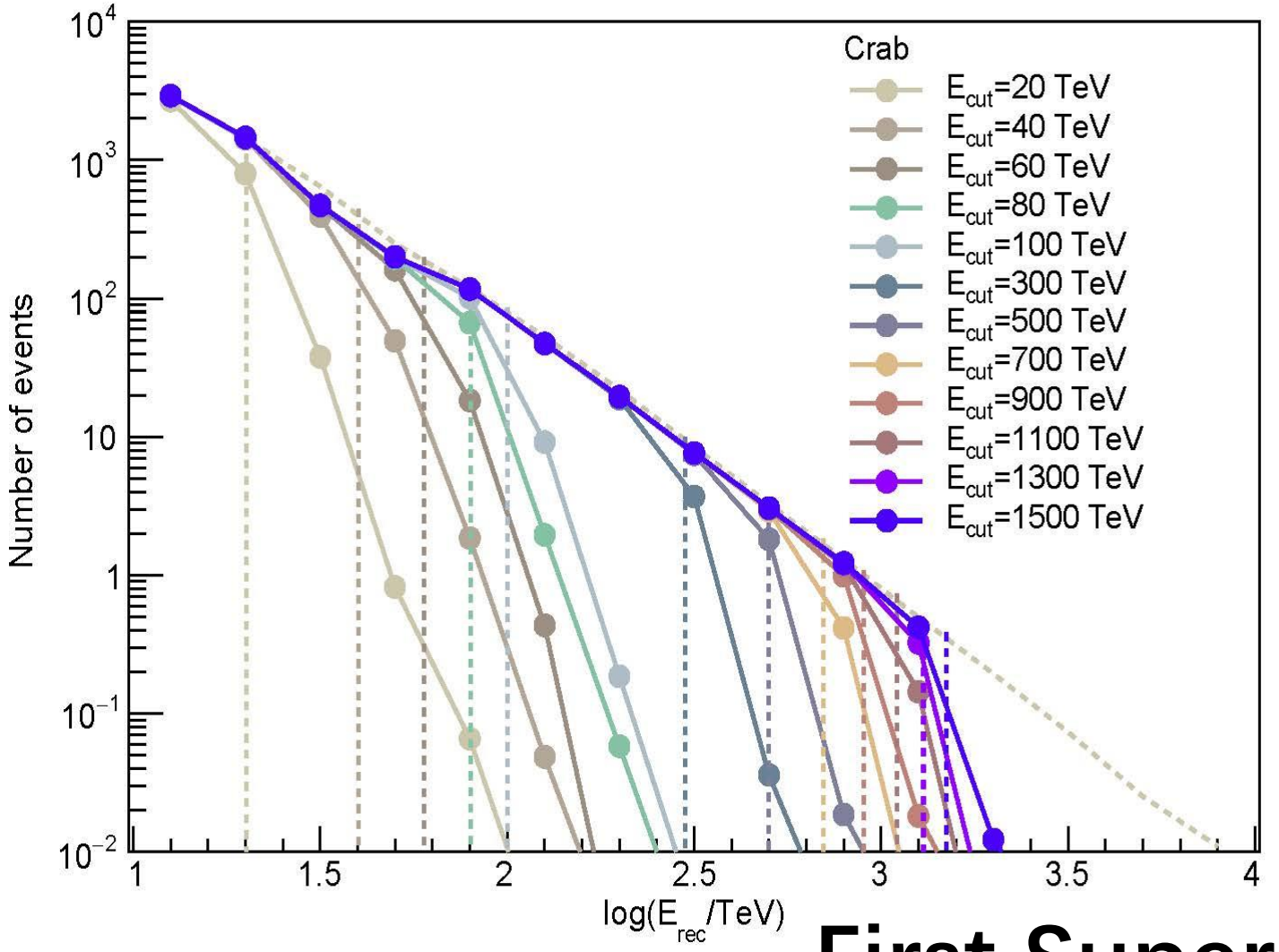
Energy reconstruction





This energy estimator can not only improve the energy resolution, but also enlarge the effective area!

Spillover effect



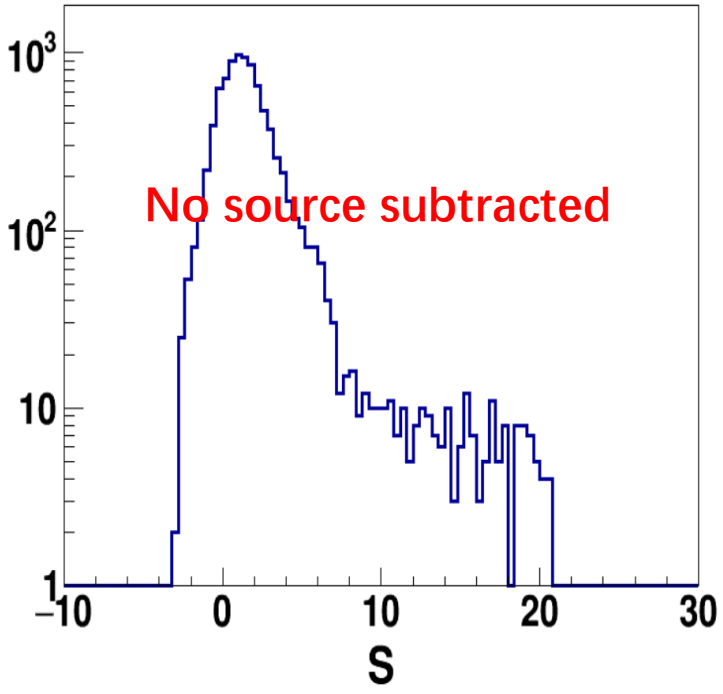
- Benefiting from the excellent energy resolution 14%@>100TeV&&theta< 35°, the spillover effect is small;
- The PeV photo indicates that the energy spectrum beyond PeV at least in the center region!

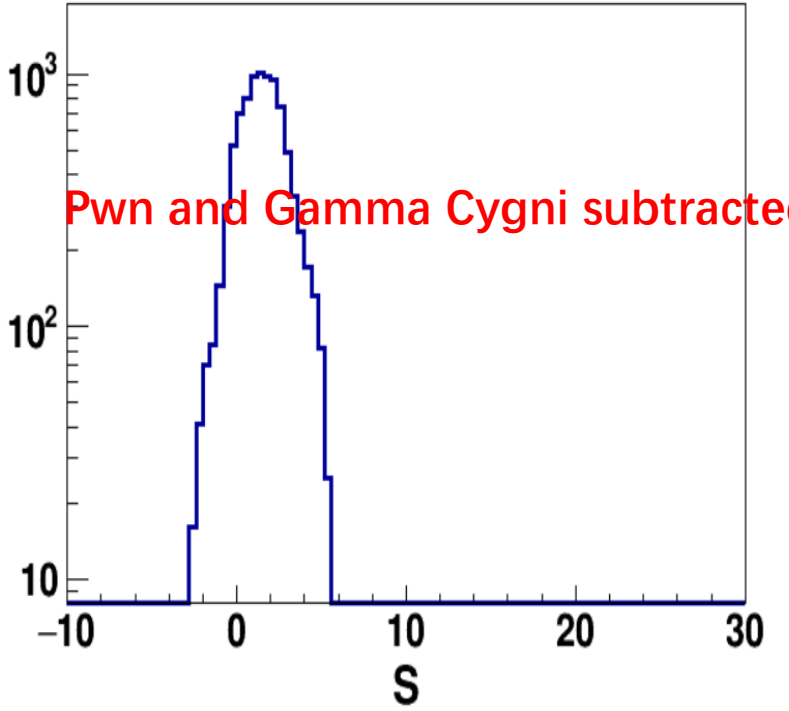
First Super-PeVatron(>10PeV)?

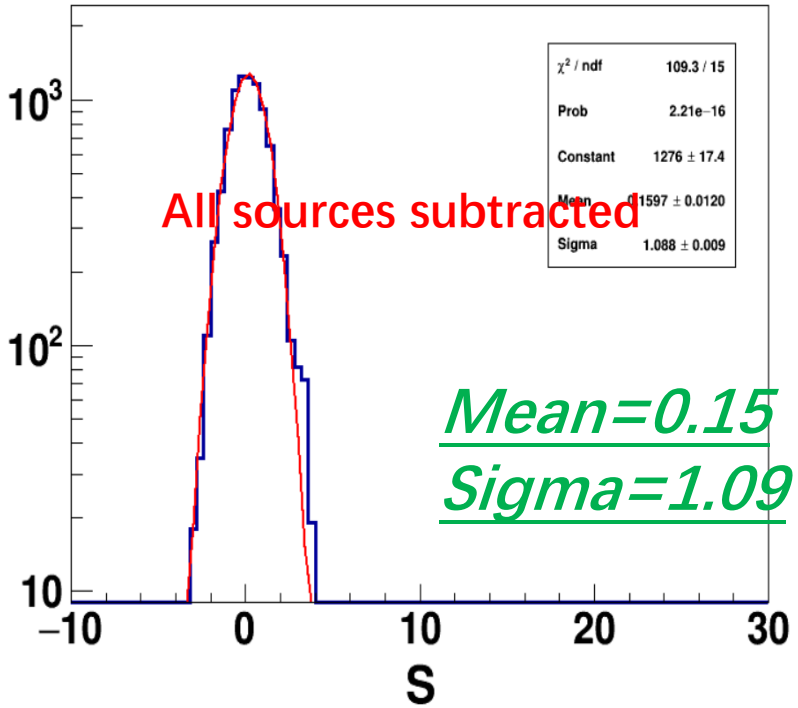
Multi-source fitting

Source Name	RA	DEC	SIGMA
LHAASO J2031+4126	307.98±0.03	41.42±0.03	0.24±0.03
LHAASO J2032+416(Cocoon)	308.2±0.4	41.3±0.3	2.8±0.3
LHAASO J2021+4030(SNR Cygni)	305.5±0.2	40.4±0.1	0.3±0.1

Preliminary







Conclusion

- A very extended emission was detected above 100TeV by LHAASO-KM2A;
- The center of the emission is apart from PWN, indicating the emission may dominated by Cygnus Cocoon;
- A PeV photo is detected in the center. The spectrum can extend beyond PeV at least in the center region.

Next Work

- Detailed spectral and morphological analysis for individual sources;
- Analysis of the correlation with Molecular cloud distribution;
- Joint analysis with multi-wavelength data;

Thanks !