

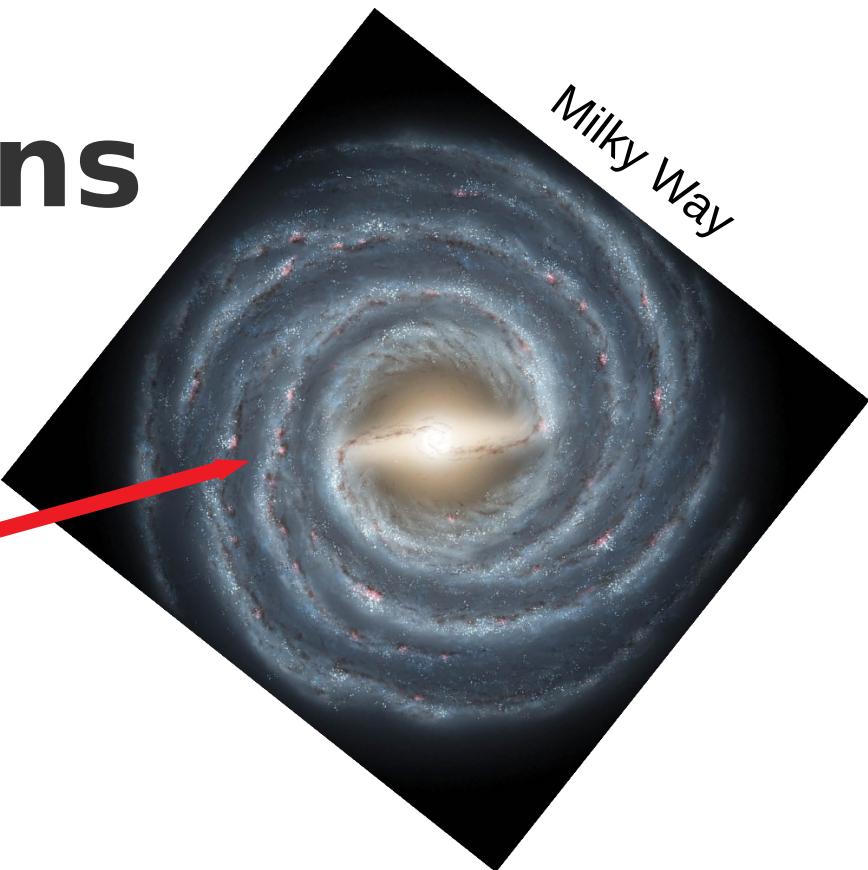
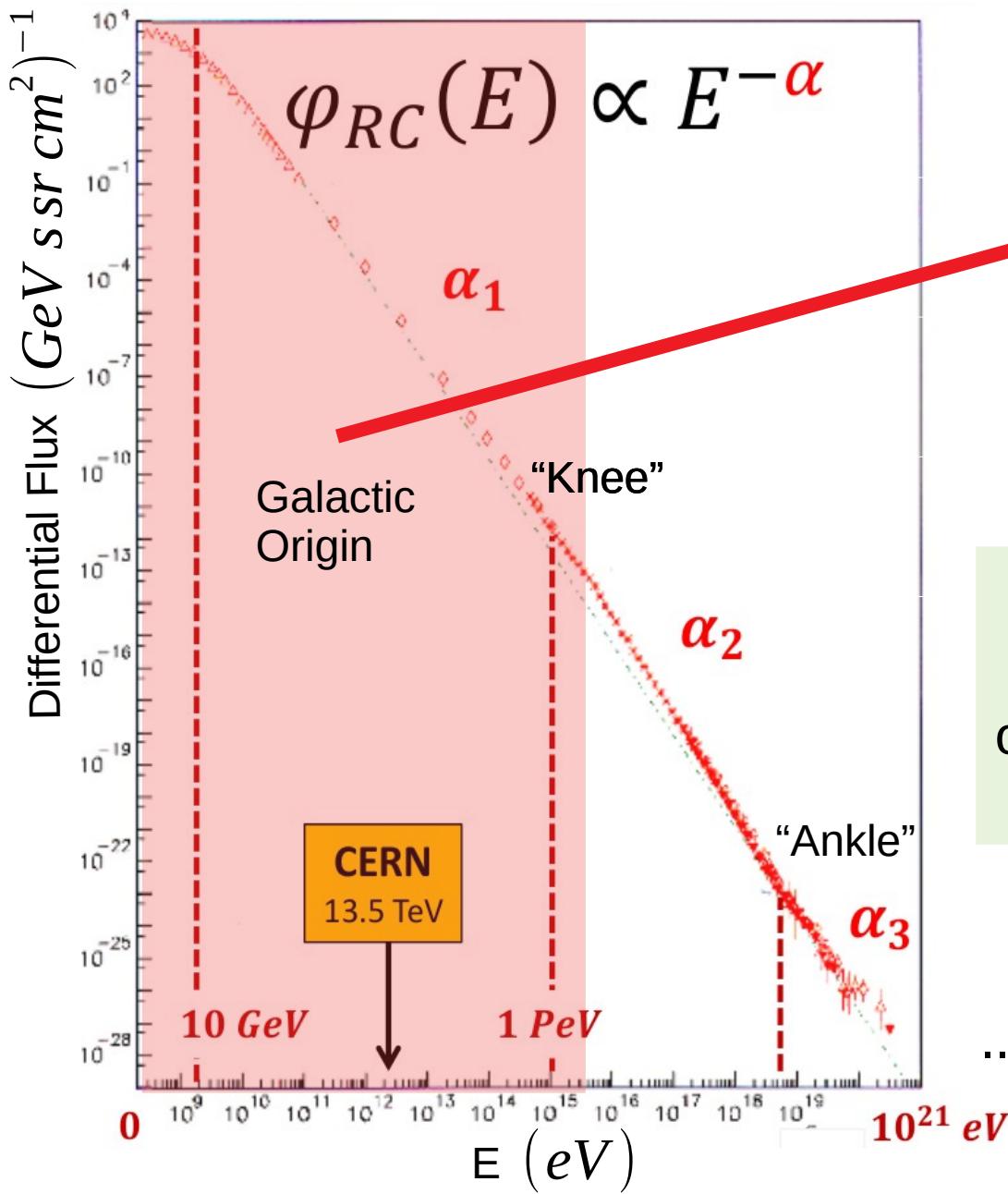


Searching for galactic PeVatrons with CTA

Cosmic Explosions, Cargèse 2019

Galactic PeVatrons

Locally measured Cosmic Rays (CRs)



Milky Way

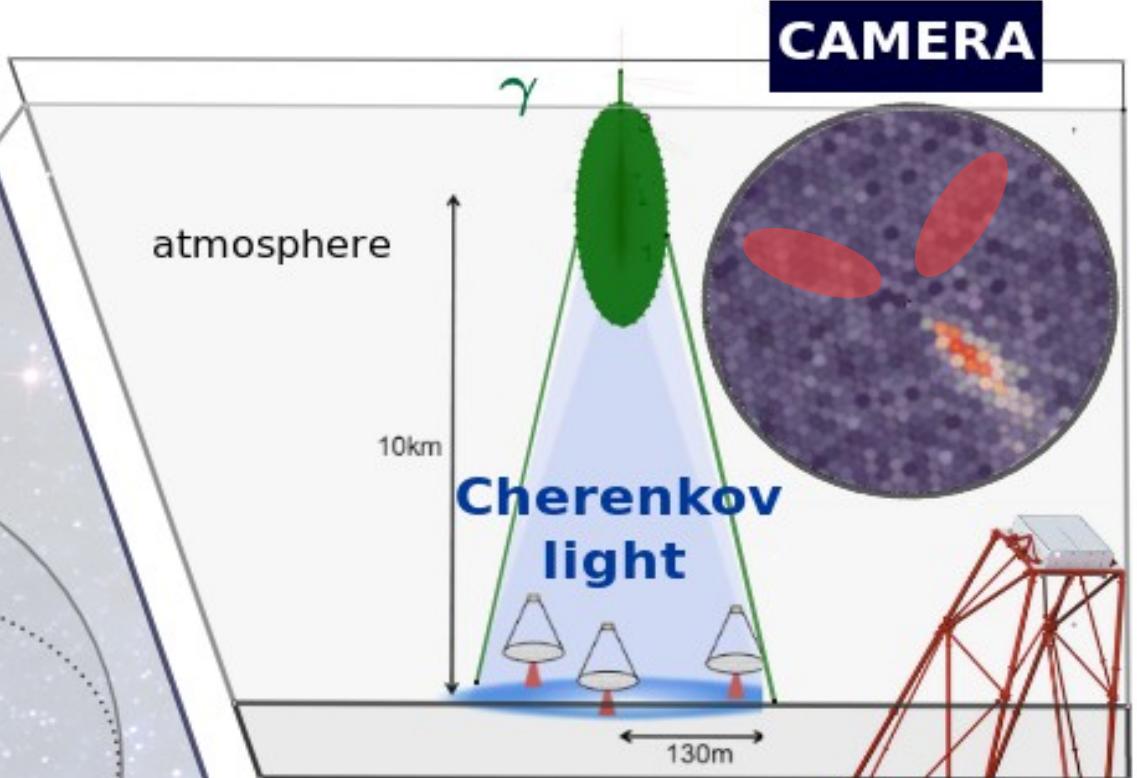
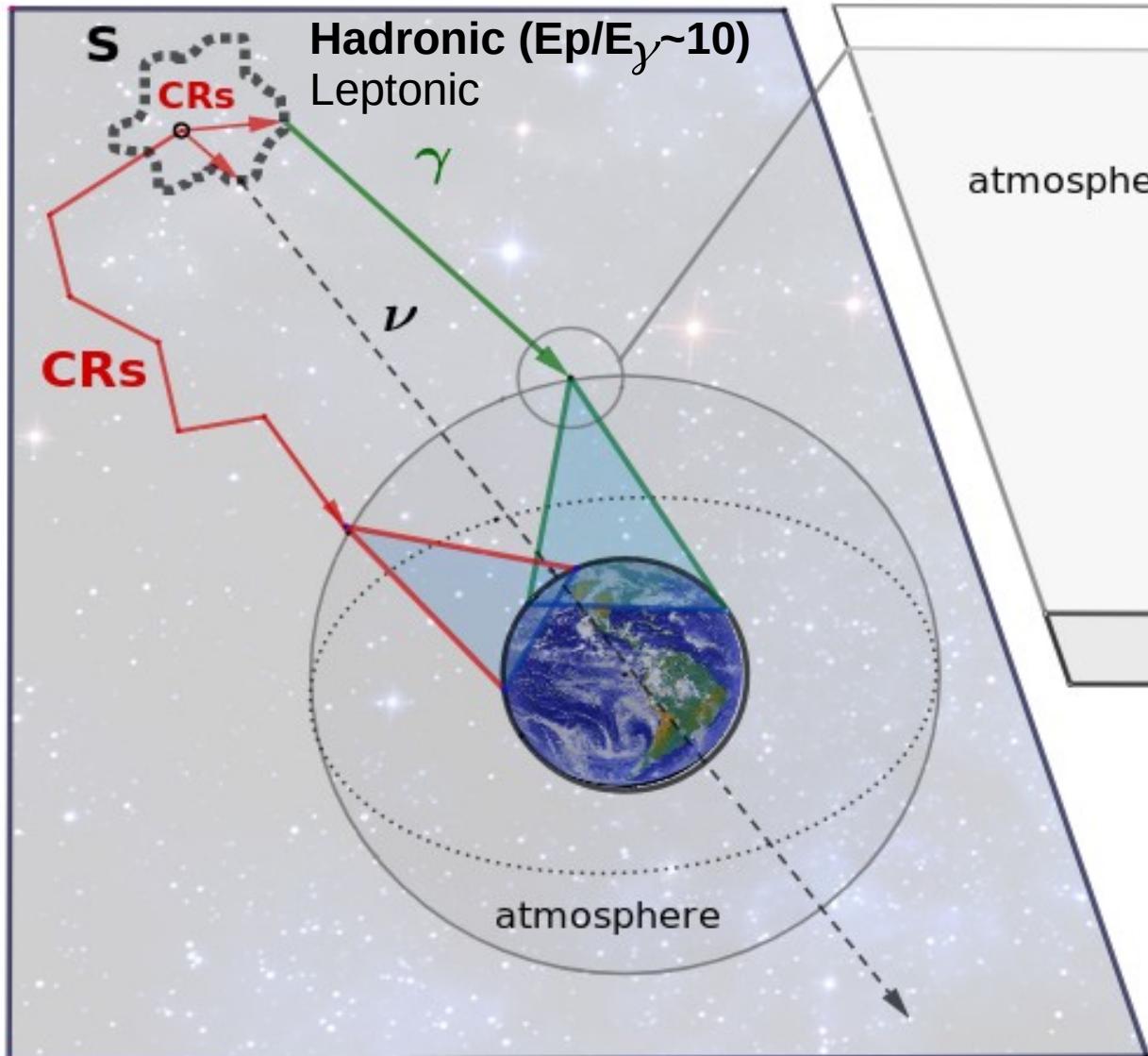
Galactic PeVatrons

Galactic sources of CRs capable of generating particles at least at PeV energies

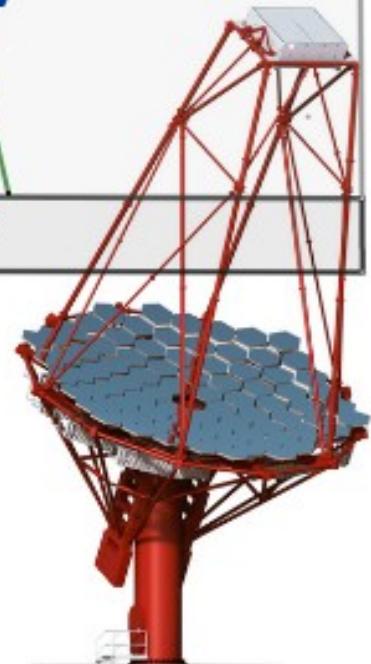
SuperNovae Remnants (SNRs)?

...is still unclear whether or not SNRs can act as CRs PeVatrons.

Galactic PeVatrons and ground based γ -ray astronomy



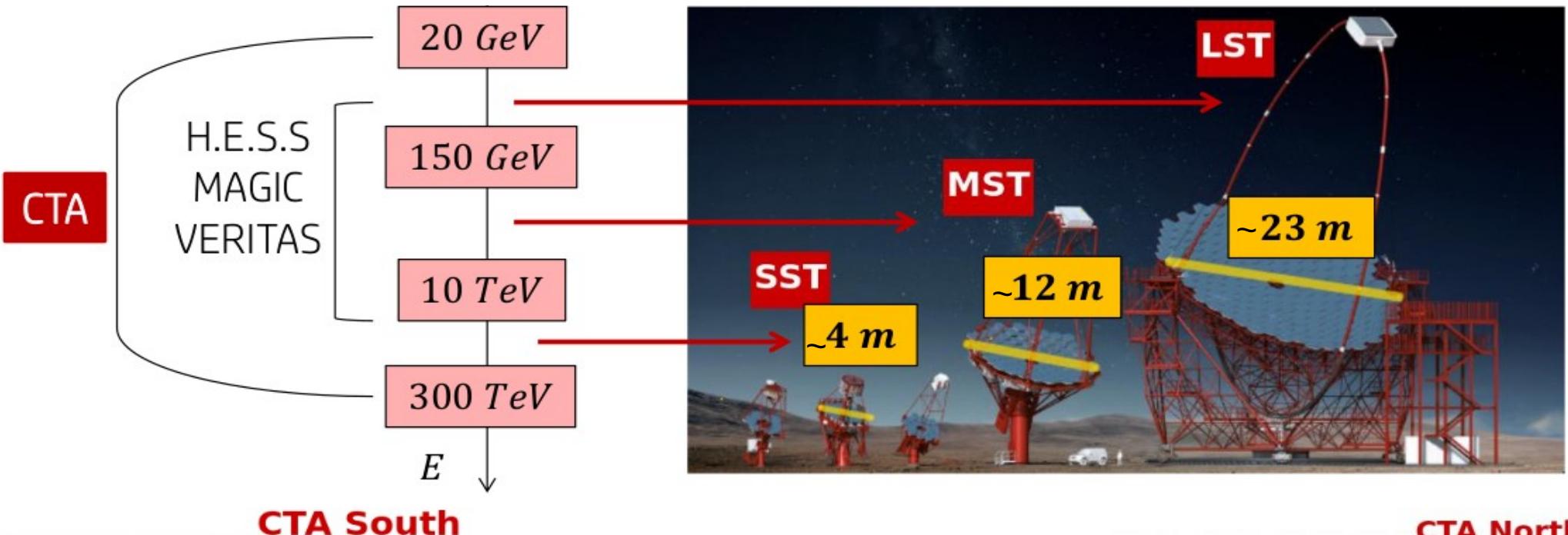
Current IACTs:
- H.E.S.S.
- MAGIC
- VERITAS



IACTs = Imaging Atmospheric Cherenkov Telescopes

CTA:

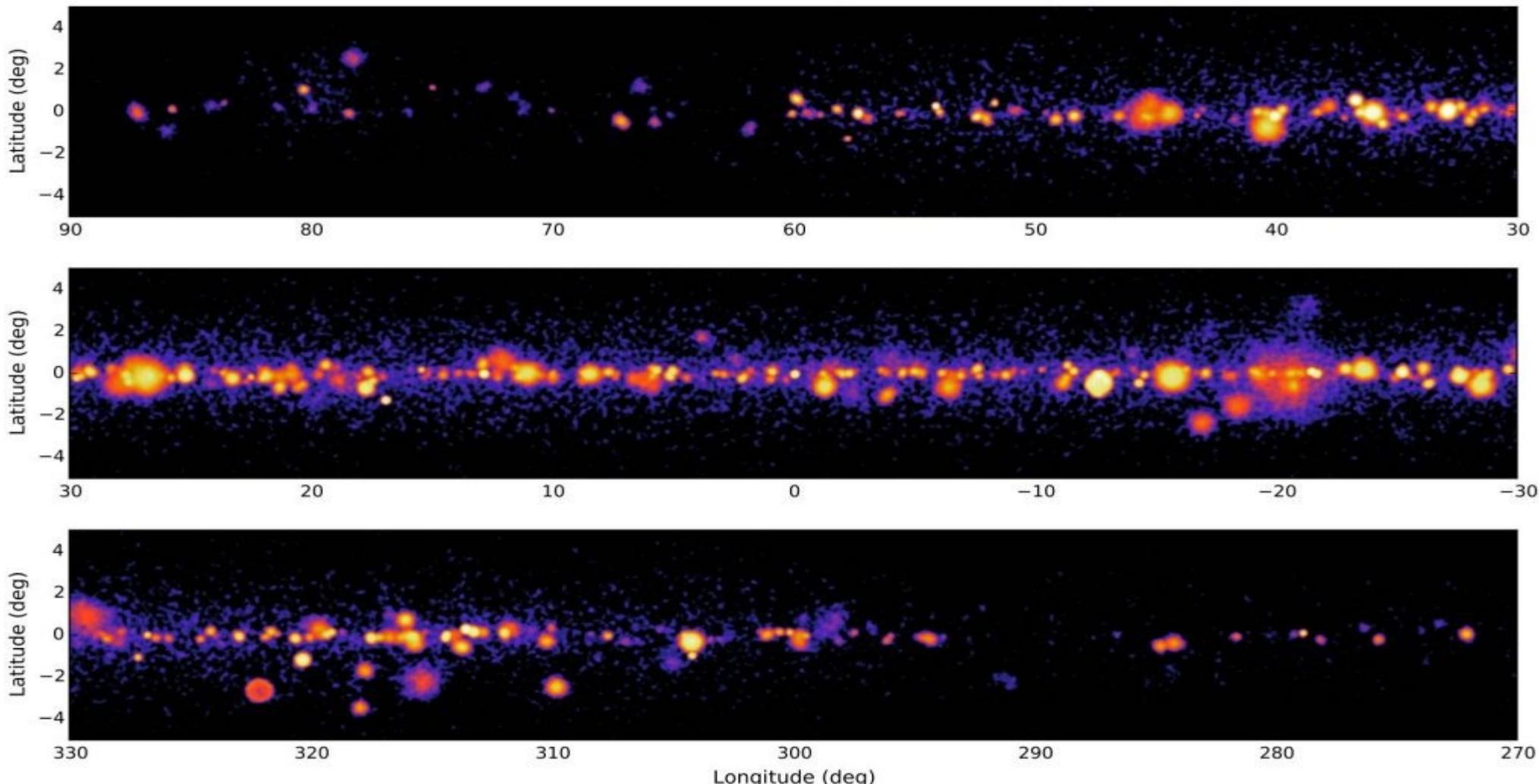
Cherenkov Telescope Array



Galactic PeVatrons

CTA-GPS

Galactic Plane Survey



ctools simulation of the GPS, "Science with the telescope telescope array" (2018)

Galactic PeVatrons

CTA-GPS

Galactic Plane Survey

- general census of particle accelerators in our galaxy (<10h>)
 - +
 - determination of promising targets for deep observations (<40h>)

...How to claim for promising PeVatrons candidates?

- hard power-law spectra that extend up to $E \geq 50\,TeV$ without evidence for a spectral cutoff

Galactic PeVatrons

CTA-GPS

Galactic Plane Survey

- general census of particle accelerators in our galaxy (<10h>)
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...How to claim for promising PeVatrons candidates?

- hard power-law spectra that extend up to $E \geq 50 \text{ TeV}$ without evidence for a spectral cutoff

Study on the sensitivity of CTA in the detection of a cutoff in the γ -ray spectrum

$$H_0 \quad PL \quad \Phi(E) = \Phi_0 \left(\frac{E}{E_0} \right)^{(-\Gamma)}$$

$$H_1 \quad ECPL \quad \Phi(E) = \Phi_0 \left(\frac{E}{E_0} \right)^{(-\Gamma)} e^{\frac{-E}{E_c}}$$

Spectral cutoff sensitivity of CTA

Simulation of 100
ECPL sources:

$$\Gamma \in [-2.3, -1.7]$$

$$\Phi_0 \in [5, 55] mCrab$$

$$E_c = 10/50/100 TeV$$

RANDOM EXTRACTION

Maximum Likelihood Fit
(forward folding method^[1])

$$W = -2 \ln(L)$$

$$PL \rightarrow W_{PL}$$

$$ECPL \rightarrow W_{ECPL}$$

LogLikelihood Ratio test:

$$TS = W_{PL} - W_{ECPL} \quad [2]$$

$$TS \geq 9 \\ ECPL$$

$$TS < 9 \\ PL$$

[1] Piron et al. (2001)

"Temporal and spectral gamma-ray properties of Mkn 421 above 250 GeV from CAT observations between 1996 and 2000"
de Naurois (2012)

"Very High Energy astronomy from H.E.S.S. to CTA. Opening of a new astronomical window on the non-thermal Universe"

[2] H.E.S.S. collaboration (2018)

"The H.E.S.S. Galactic plane survey"

Spectral cutoff sensitivity of CTA

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ECPL sources:
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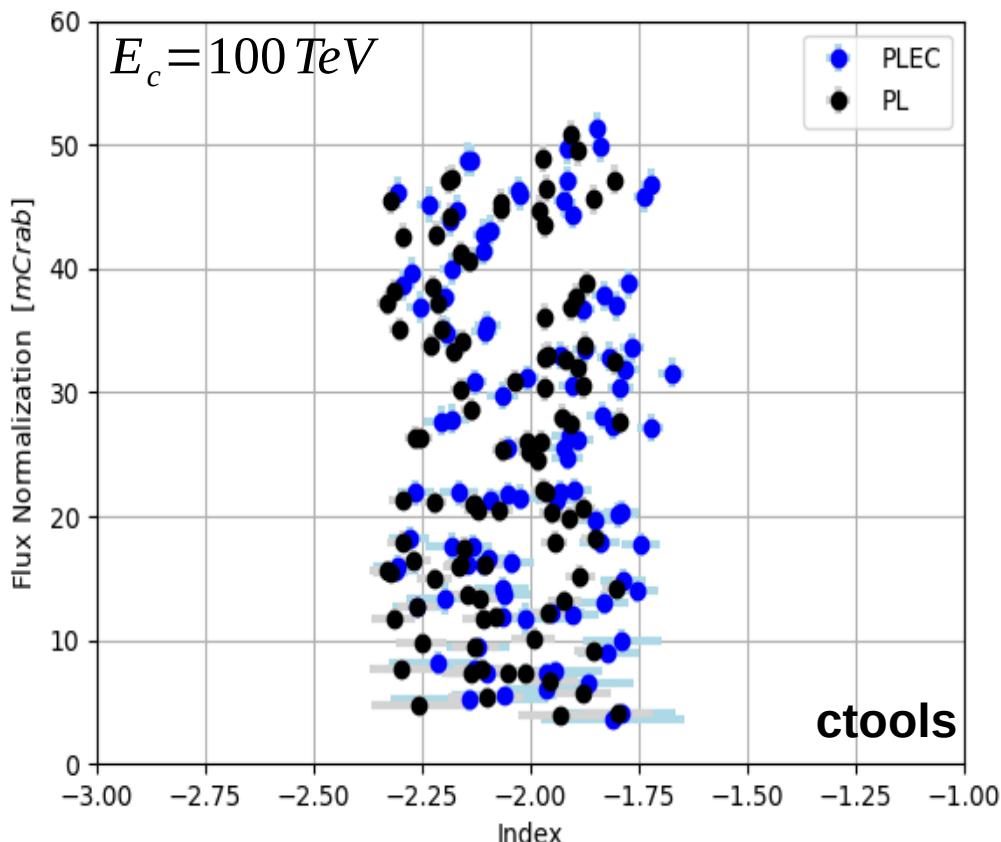
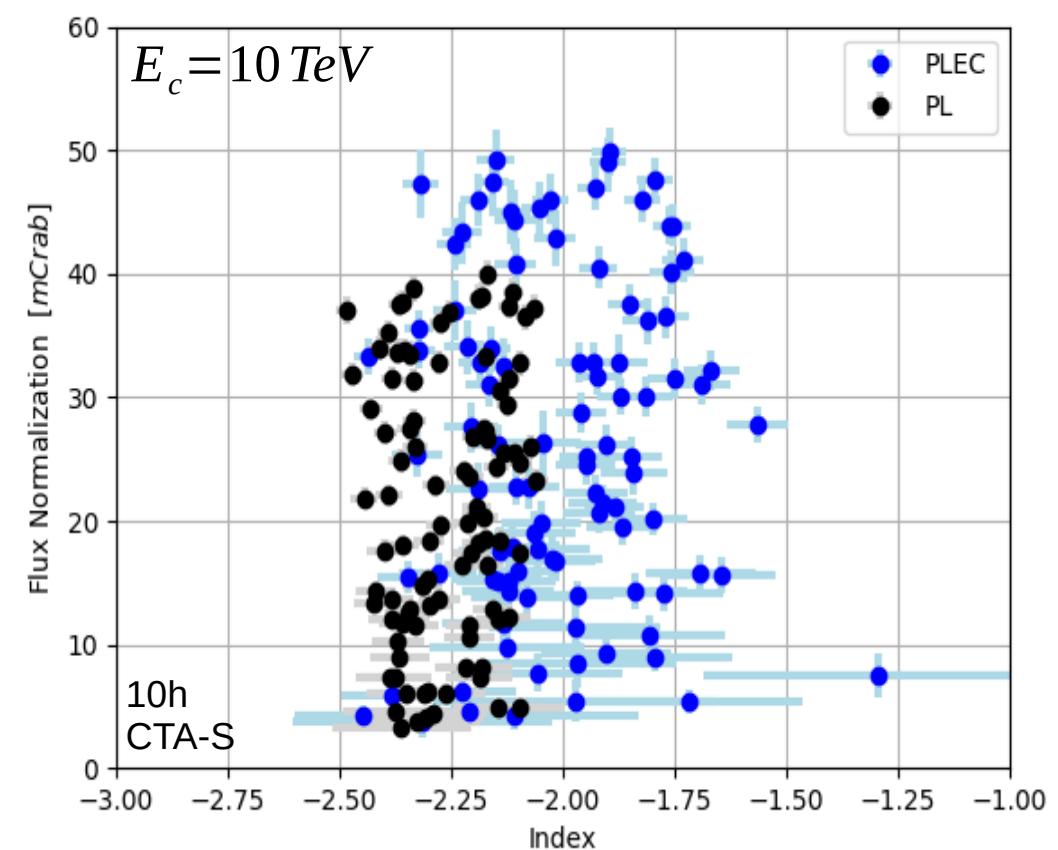
RANDOM EXTRACTION

Maximum Likelihood Fit
(forward folding method)
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 $PL \rightarrow W_{PL}$
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Likelihood Ratio test:
 $TS = W_{PL} - W_{ECPL}$

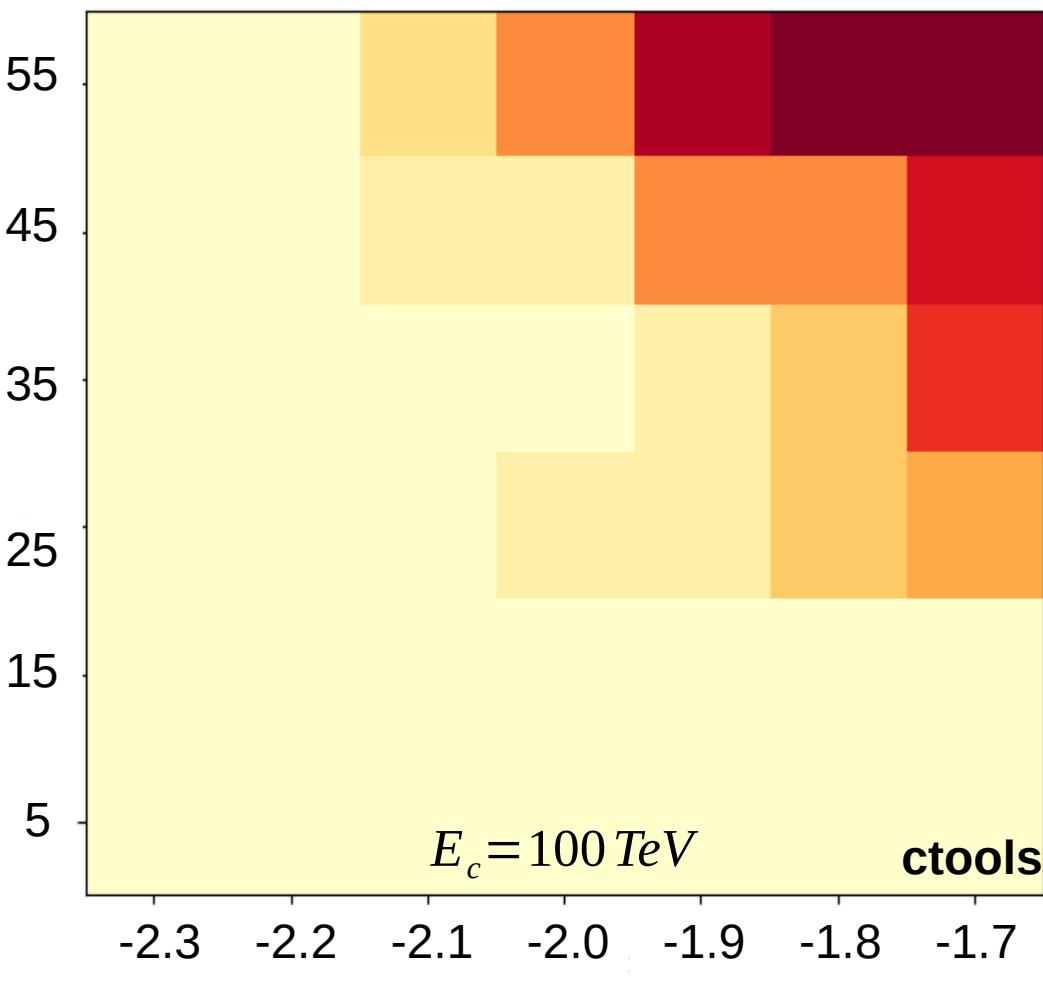
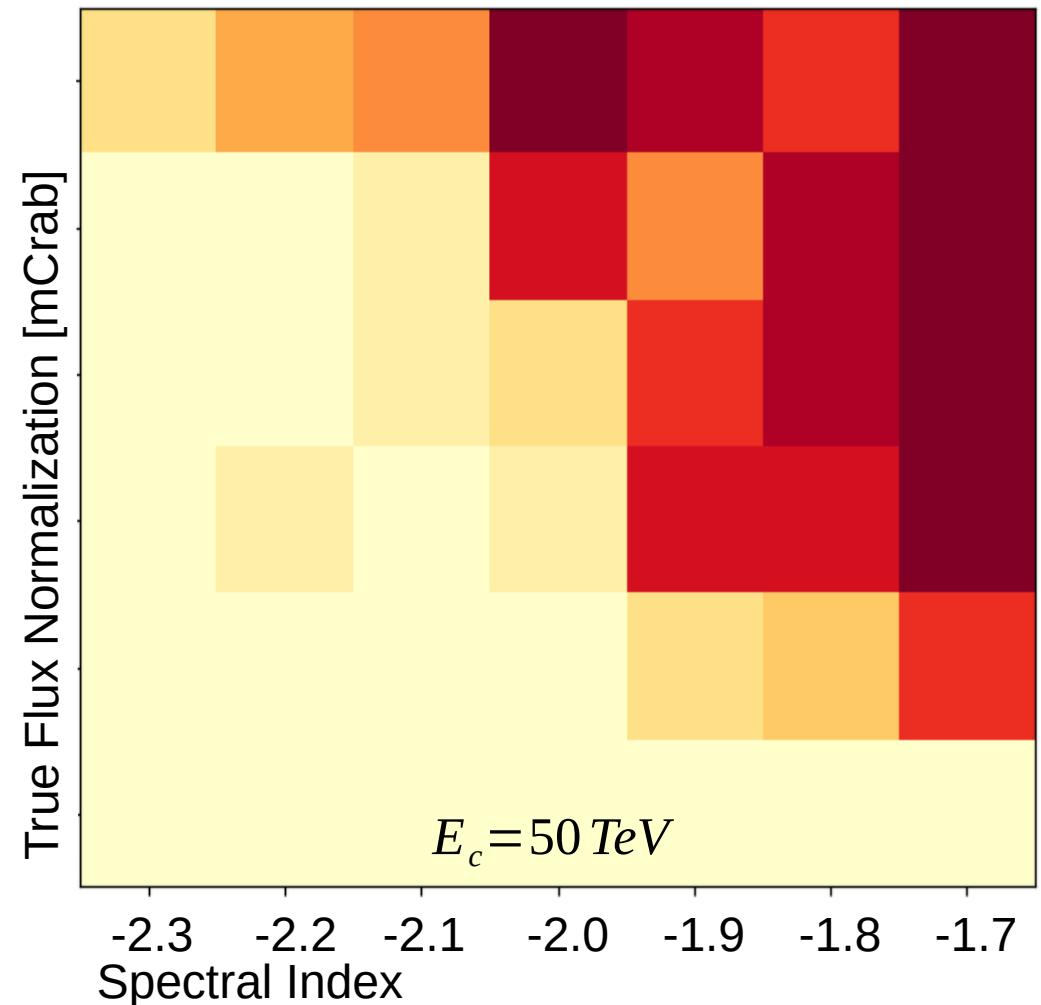
$TS \geq 9$
 $ECPL$

$TS < 9$
 PL



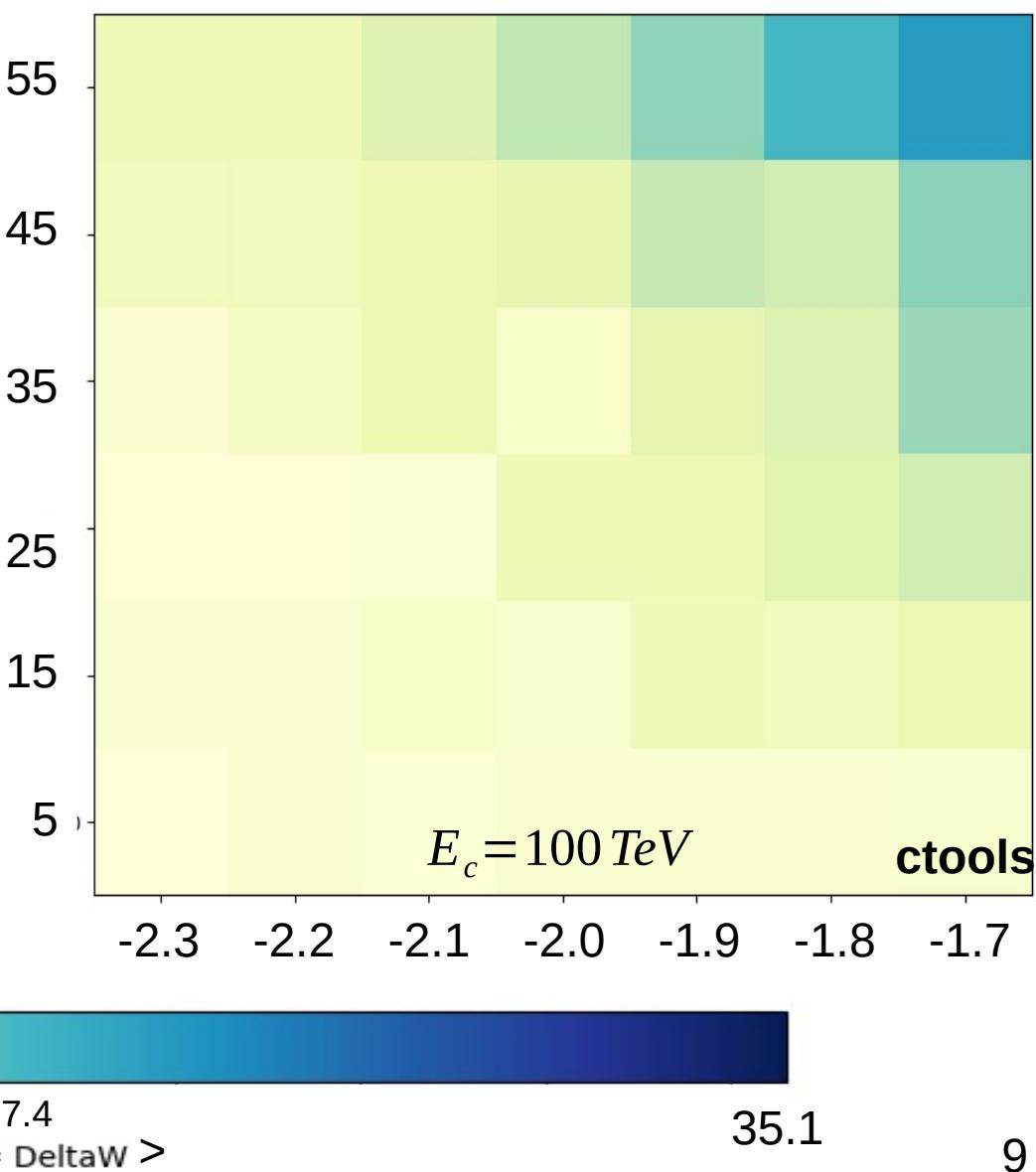
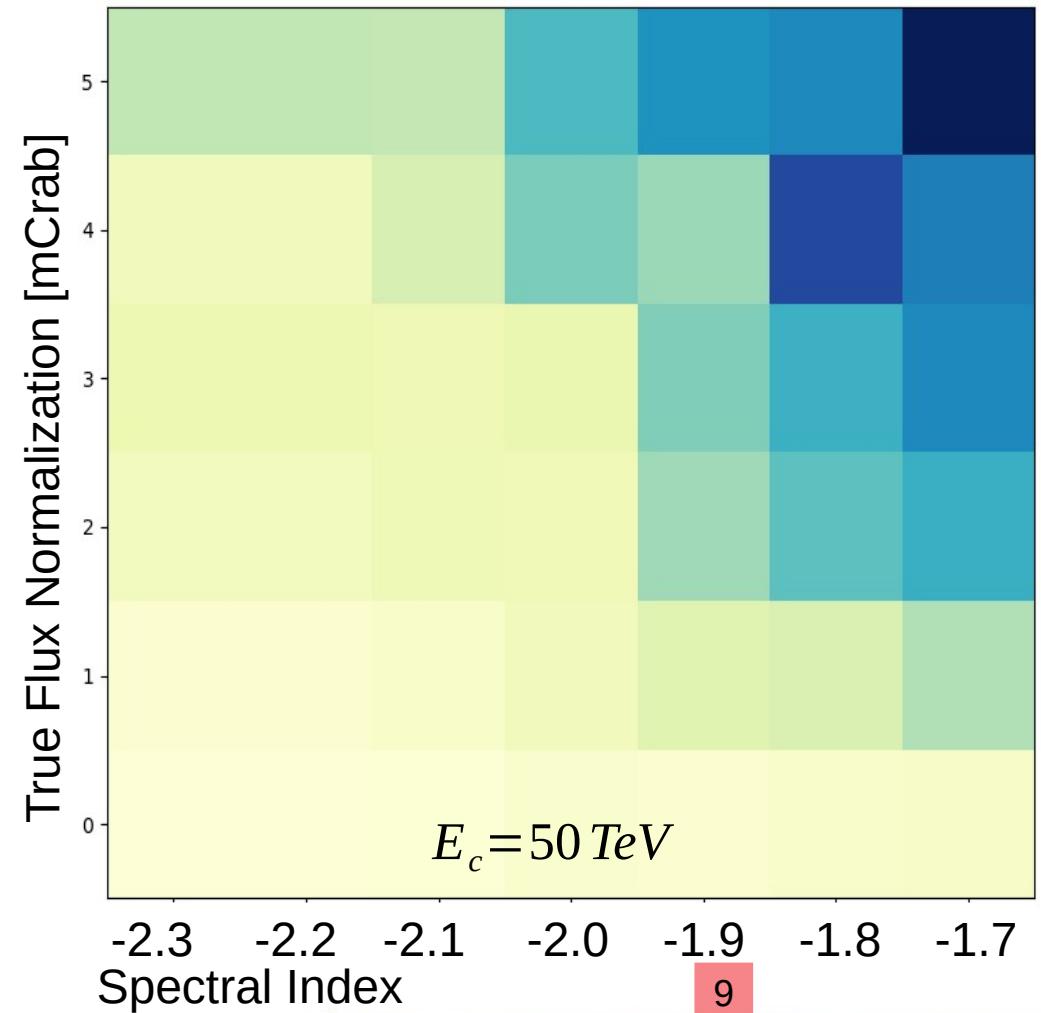
Spectral cutoff sensitivity of CTA

10 OBSERVATIONS PER BIN



Spectral cutoff sensitivity of CTA

10 OBSERVATIONS PER BIN



Summary

- Scientific tools used: Ctools/GammaPy
- ...how to find best PeVatron candidates for follow-up observations in CTA-GPS?
 - study on energy cutoff sensitivity of CTA
 - comparison of Flux, Index, EnergyCutoff lower limit / N_excess(>50TeV) in order have a ranking of possible candidates

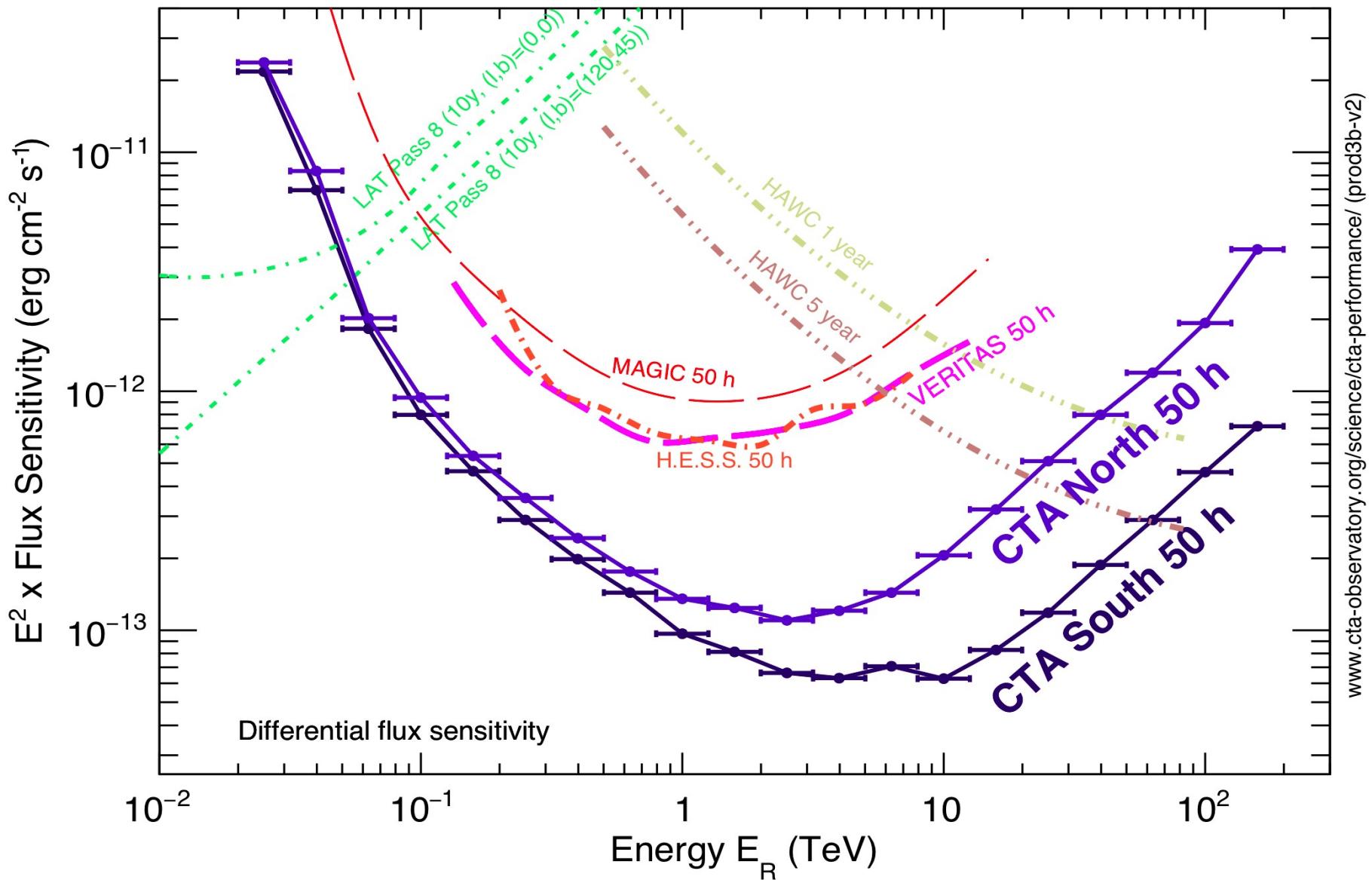


Thanks for your attention!

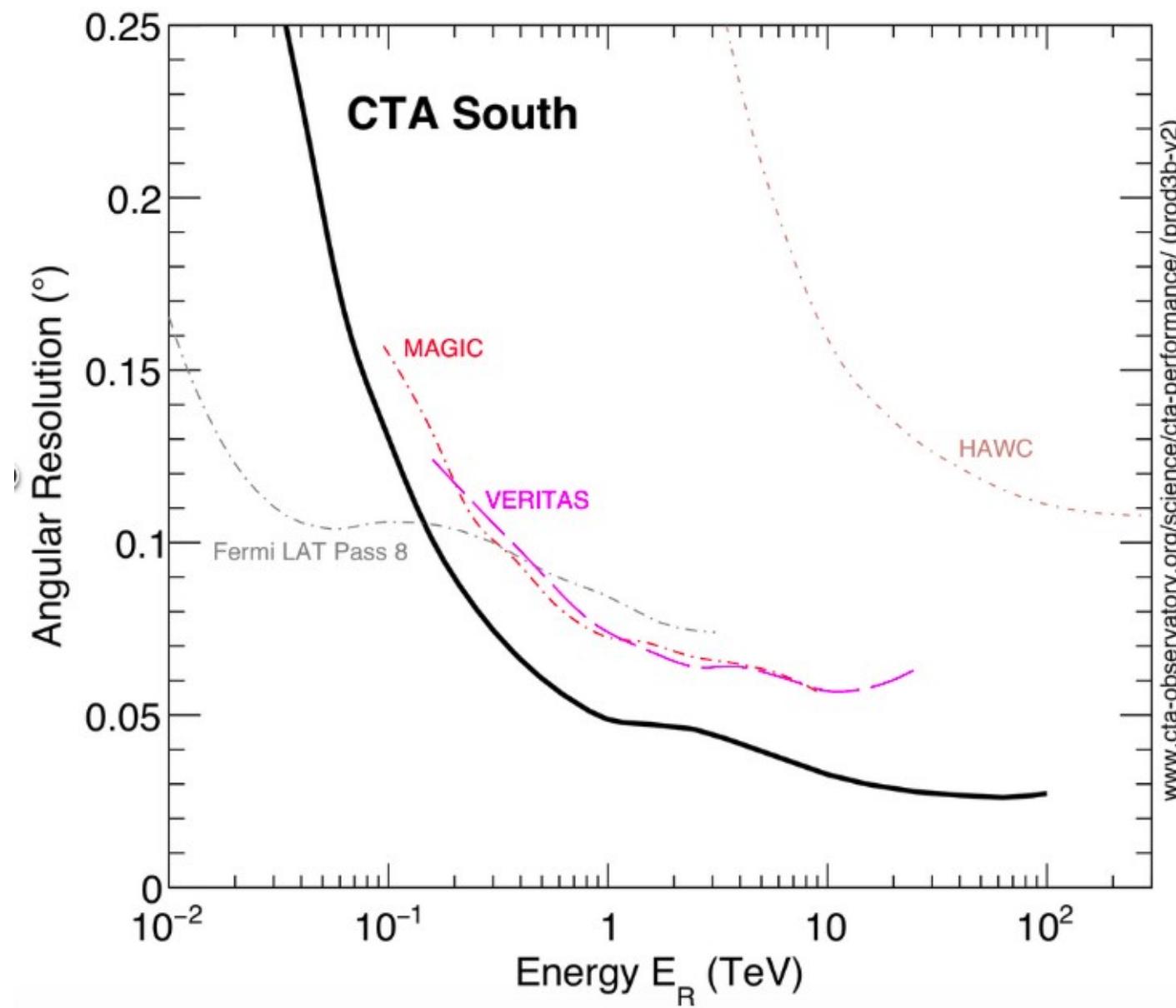
CTA



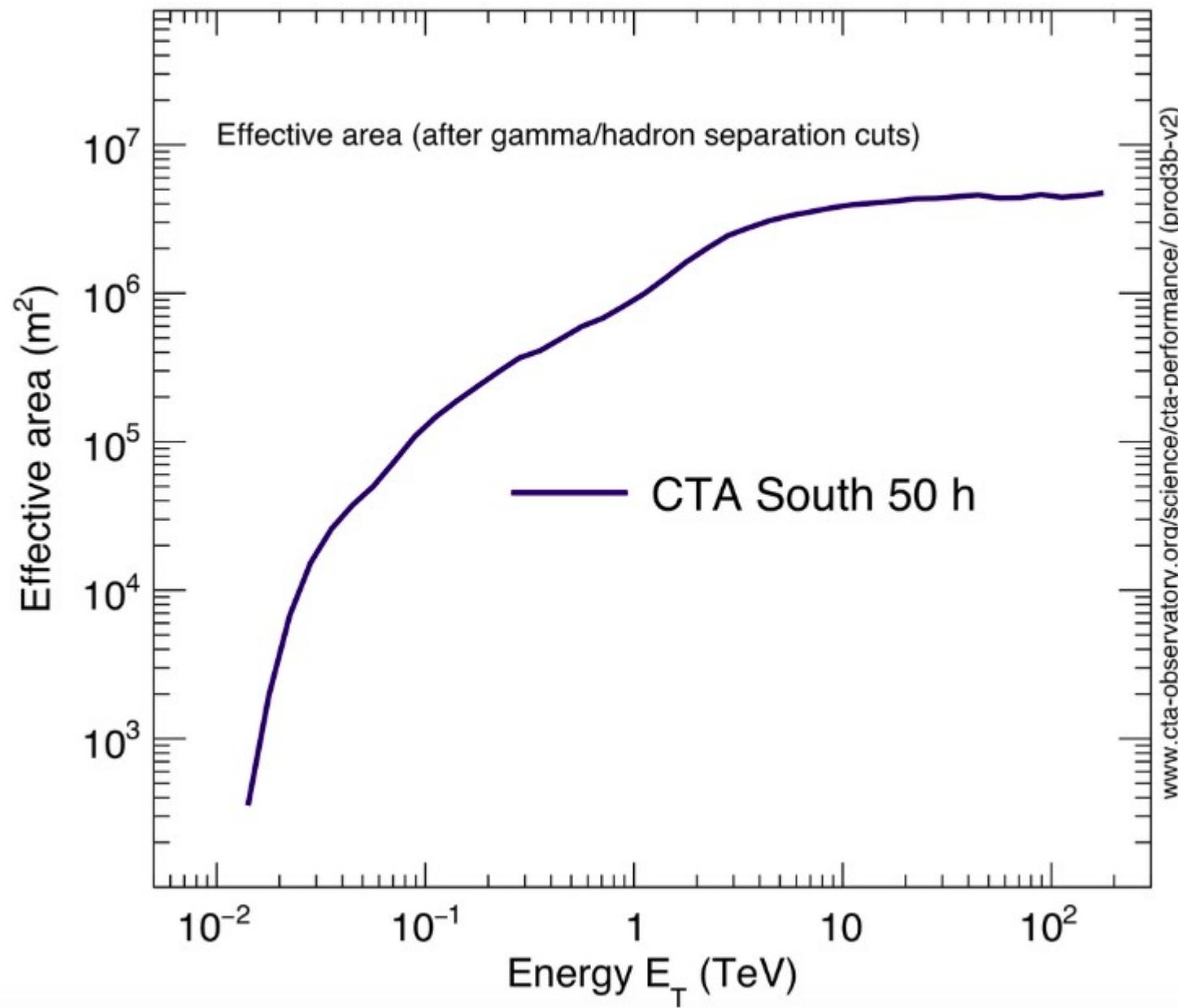
CTA IRFs: Sensitivity



CTA IRFs: Angular Resolution



CTA IRFs: Effective Area



CTA IRFs: Energy Resolution

