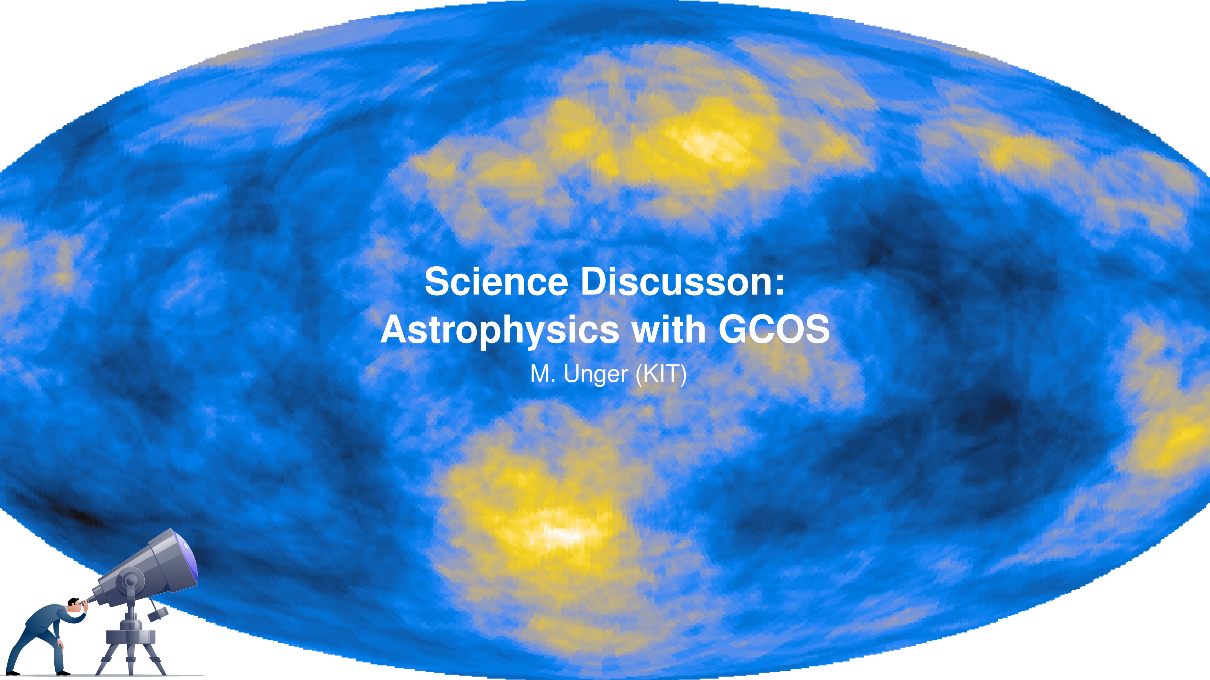

Science Discusson: Astrophysics with GCOS

M. Unger (KIT)

Discussion: Astrophysics with GCOS

By the end of this decade AugerPrime and TAx4 will tell us

- UHE anisotropies at 200 kL* (Auger South)
- UHE composition at 200 kL (WCD+DNN), 60 kL (WCD+SSD), 10 kL (FD)

Probable Scenario at 2030

- Peters Cycle, 1-2 sigificant hot spots, UHE proton-fraction $< 1\%$

*1 L = 1 km^2 sr yr (Linsley)

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Main Science Case for GCOS

- **Discovery of UHE Accelerators with 1ML**

*1 L = 1 km^2 sr yr (Linsley)

Astrophysics with GCOS

Target: UHE Accelerators

- known: local luminosity density $\sim 6 \times 10^{44}$ erg/ (Mpc^3 yr) PRL 126 (2021) 152002
- unknown: source density (but known for source classes!)
- unknown: cosmological evolution (but known for source classes!)

Nuisances:

- GMF $\rightarrow$ learn about Galactic magnetism!
  what we know:
  - coherent and random fields $O(\mu\mathrm{G})$
  - coherence length few pc to tens of pc
  - global GMF models
- EGMF $\rightarrow$ learn about cosmic magnetism!
  what we know:
  - ≤ 1 nG, but filaments, voids etc.
  - coherence length $\leq$ Mpc
  - UHECR charge $\rightarrow$ learn about hadronic interactions!
- UHECR charge
  what we know:
  - $\ln A$ scale known within ~ 1
  - in better shape 2030 (after LHC p+O, AugerPrime)?

Discussion: Astrophysics with GCOS

We are in a good shape to understand the science capabilities of GCOS

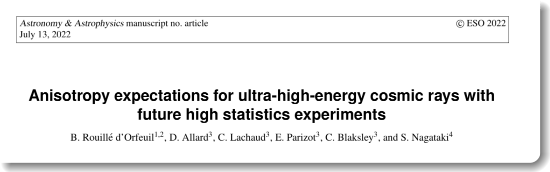
- we (roughly) know the parameters of each source class
- we (roughly) know the interfering nuisances

$\rightarrow$ thoroughly study each source class and predict what to expect

- multiplets, amplitudes, auto-correlation...

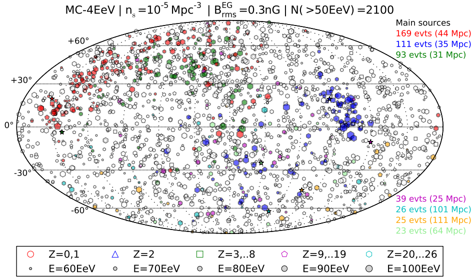
What can we discover with GCOS, what can we exclude?

GCOS must be large enough and precise enough that we expect guaranteed science outcomes (even exclusions are interesting, see IC)
(possible for transient source classes?)

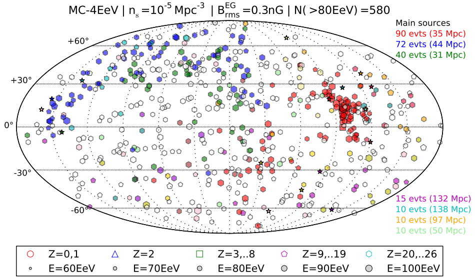

Astronomy & Astrophysics manuscript no. article © ESO 2022
July 13, 2022

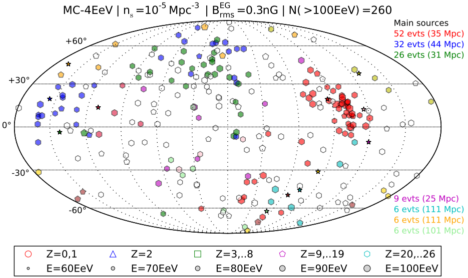
Anisotropy expectations for ultra-high-energy cosmic rays with future high statistics experiments

B. Rouillé d'Orfeuil[1,2], D. Allard[3], C. Lachaud[3], E. Parizot[3], C. Blaksley[3], and S. Nagataki[4]



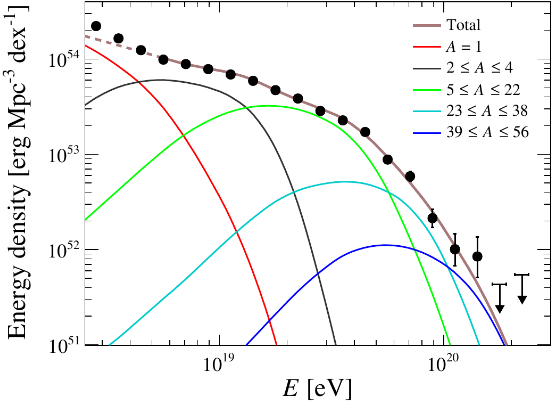
simulations for 0.3 ML

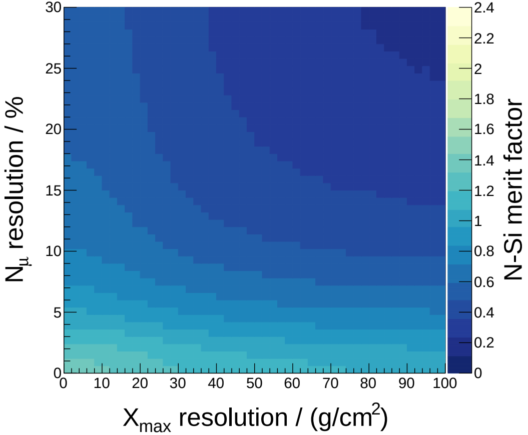




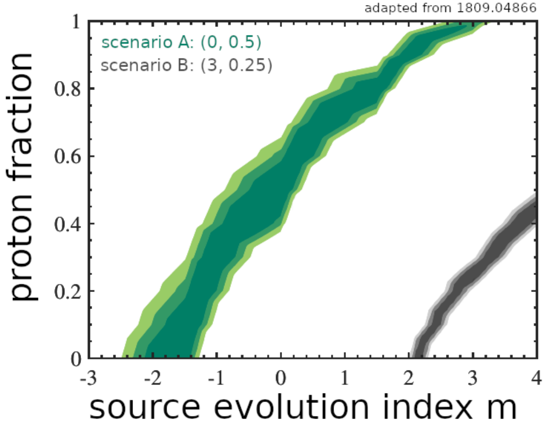
Particle Identification

Need N-Si Separation?



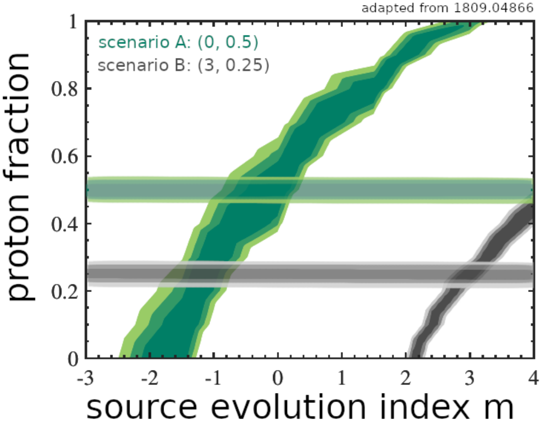


NB: Neutrino Measurements



(redshift evolution of sources $\propto (1+z)^m$)

NB: Multimessenger Constraints!



(redshift evolution of sources $\propto (1+z)^m$)