

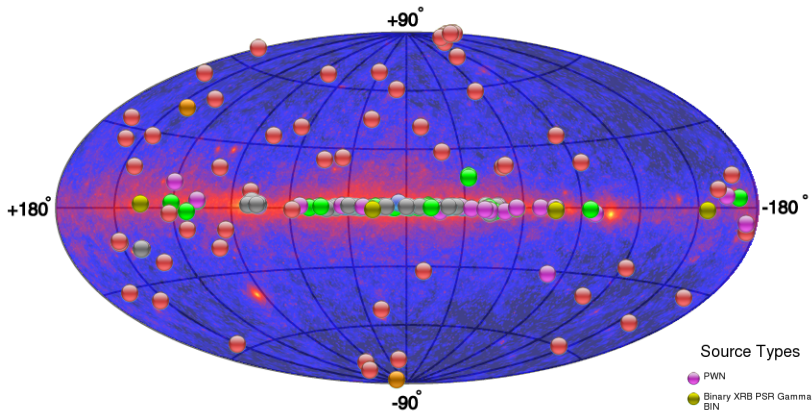


MONTE CARLO STUDIES OF COSMIC RAY BACKGROUND IN IMAGING AIR CHERENKOV TELESCOPES

Uta Menzel

IMPRS Workshop, 11. 11. 2013

The sky in gamma rays



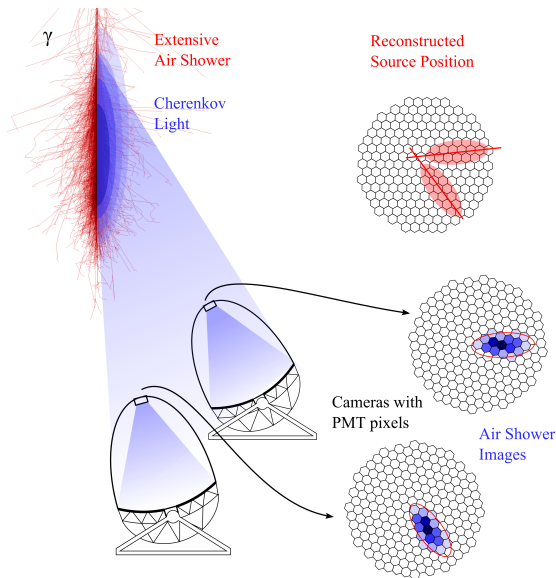
<http://tevcat.uchicago.edu/>

Source Types

- PWN
- Binary XRB PSR Gamma BIN
- HBL IBL FRI FSRQ LBL AGN (unknown type)
- Shell SNR/Molec. Cloud Composite SNR
- Starburst
- DARK UNID Other
- uQuasar Star Forming Region Globular Cluster Cat. Var. Massive Star Cluster BIN BL Lac (class unclear) WR

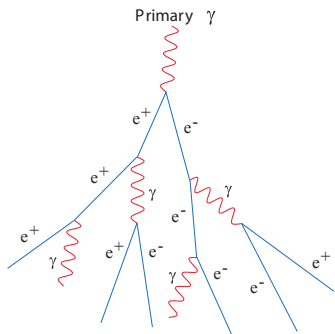
Air Cherenkov telescopes opened new domain of astronomy at very high energies ($E > 100$ GeV)

Imaging Air Cherenkov Technique

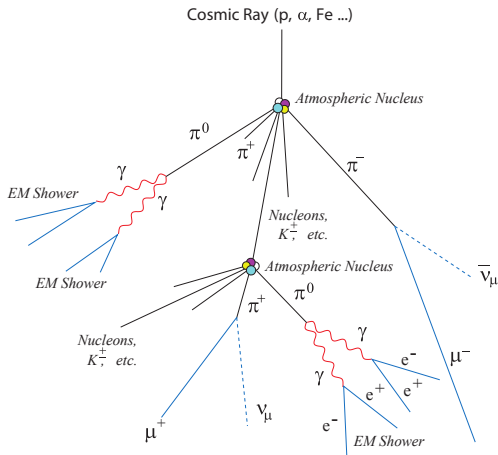


- ▶ image with elliptic shape
- ▶ background from cosmic rays, factor 1000

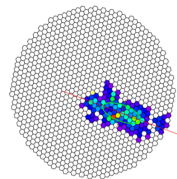
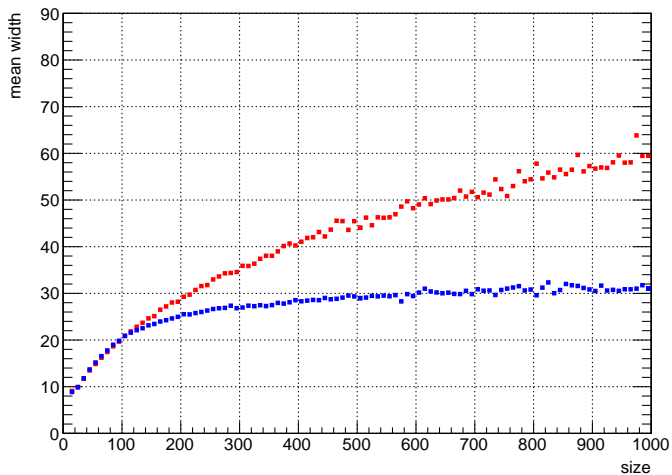
Electromagnetic shower



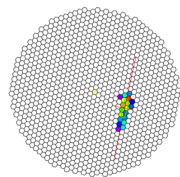
Hadron shower



Gamma-hadron separation

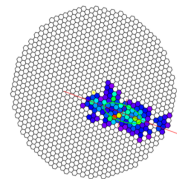
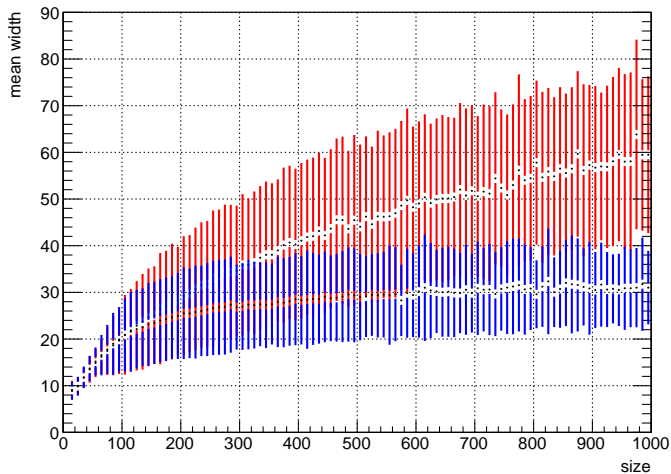


Protons

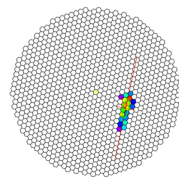


Gammas

Gamma-hadron separation



Protons

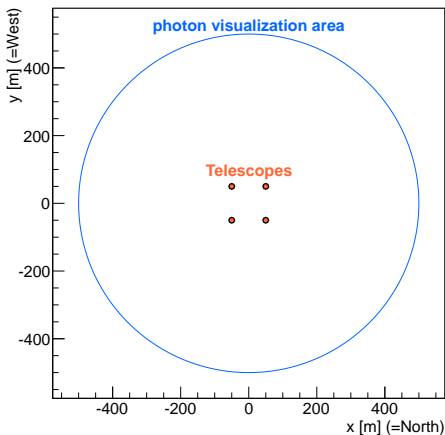


Gammas

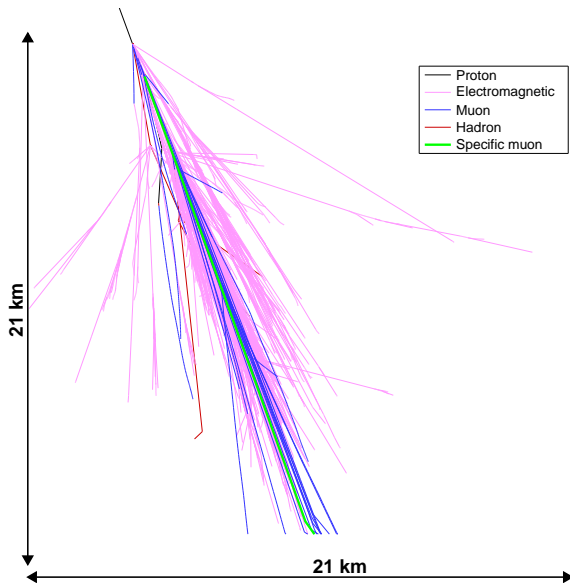
Monte Carlo simulations

- ▶ simulate air showers with modified CORSIKA
 - ▶ possibility to trace back the origin of photons
- ▶ four 17 m telescopes (MAGIC-type)
- ▶ simulated γ showers
 - ▶ $4.5 \cdot 10^6$ simulated
- ▶ simulated proton showers
 - ▶ $6.5 \cdot 10^7$ simulated
 - ▶ $1.5 \cdot 10^5$ triggered
 - ▶ $9.6 \cdot 10^3$ gamma like

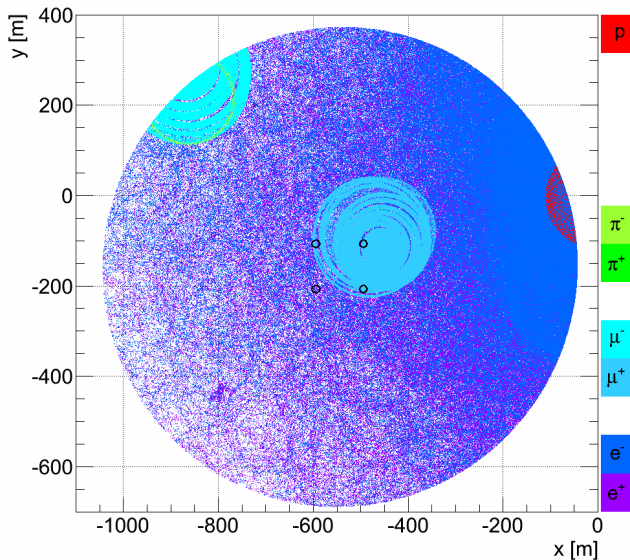
Layout



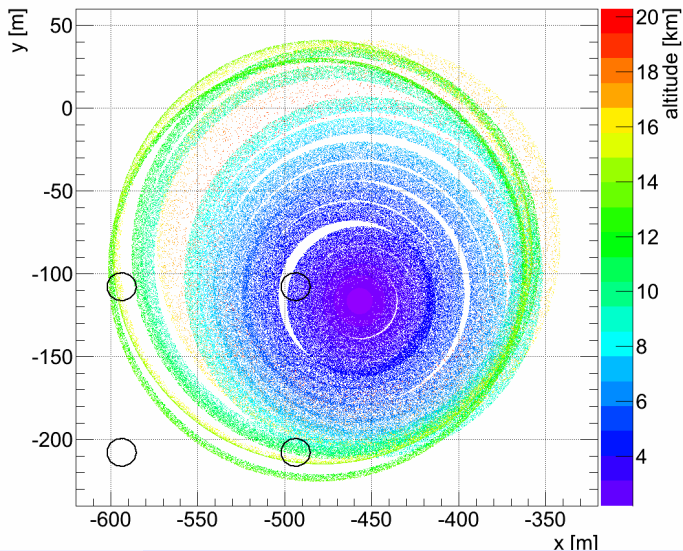
Exemplary proton shower, 445 GeV



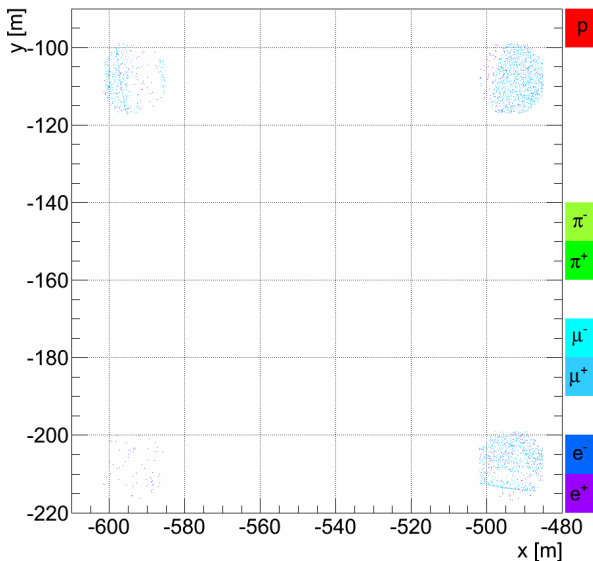
Cherenkov photons on the ground, colour as emitter particle



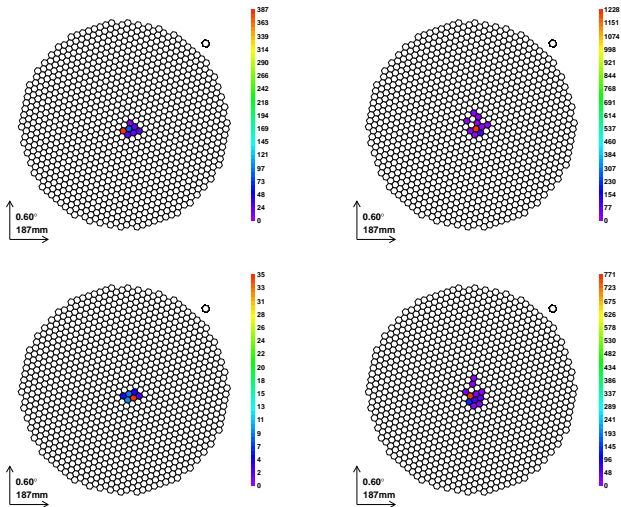
Cherenkov photons from one muon



Cherenkov photons reaching the four telescopes



Shower images in the cameras

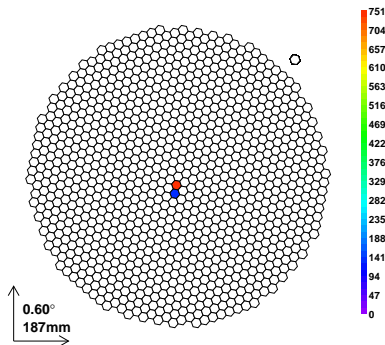
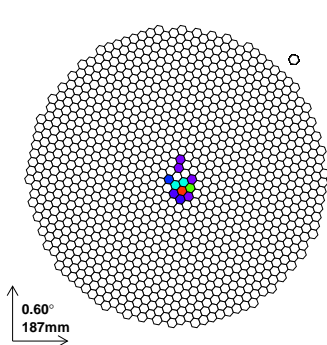


Emitters of the Cherenkov photons

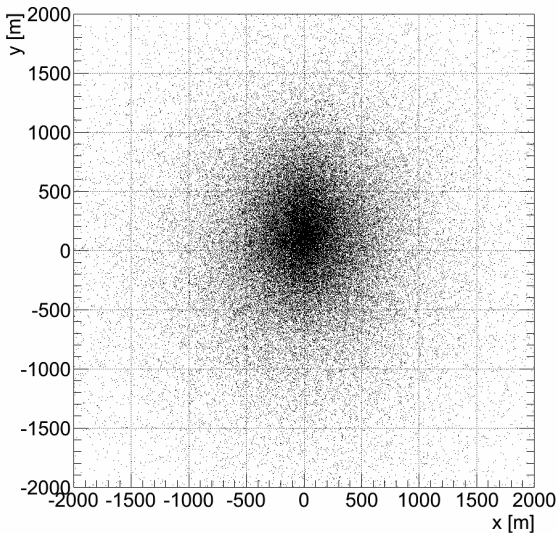
(Camera 4)

photons from e^+/e^-

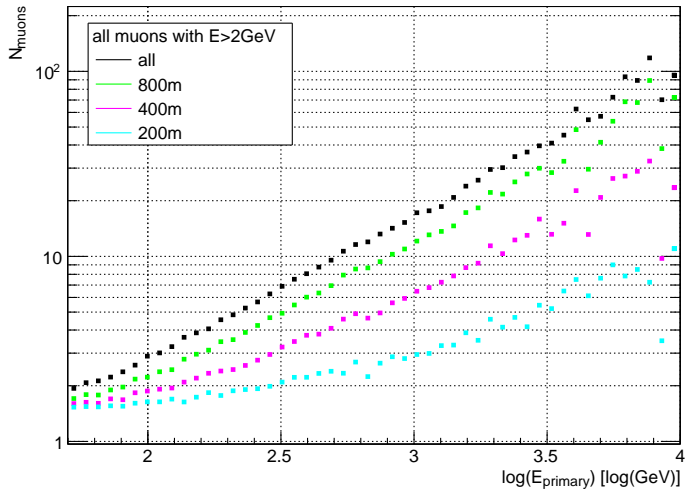
photons from muons



Muon distribution on the ground for all gamma-like showers



Number of muons in a certain radius



SUMMARY

- ▶ changes made in CORSIKA, modified version works
- ▶ possibility to visualize showers on the ground
- ▶ study of further possibilities to reject gamma-like hadron showers
 - ▶ using unexplored features of the Cherenkov images
→ looks promising
 - ▶ using muons on the ground → difficult

PROSPECT

- ▶ implementation of new rejection methods in MAGIC and CTA analysis
- ▶ improvement of Cherenkov telescope sensitivity

Number of muons in a certain radius

