



THE QUEST FOR THE UNEXPECTED



INSTYTUT FIZYKI JĄDROWEJ
IM. HENRYKA NIEWODNICZAŃSKIEGO
POLSKIEJ AKADEMII NAUK

Search for Ultra-High Energy Photons through the preshower effect with CTA telescopes

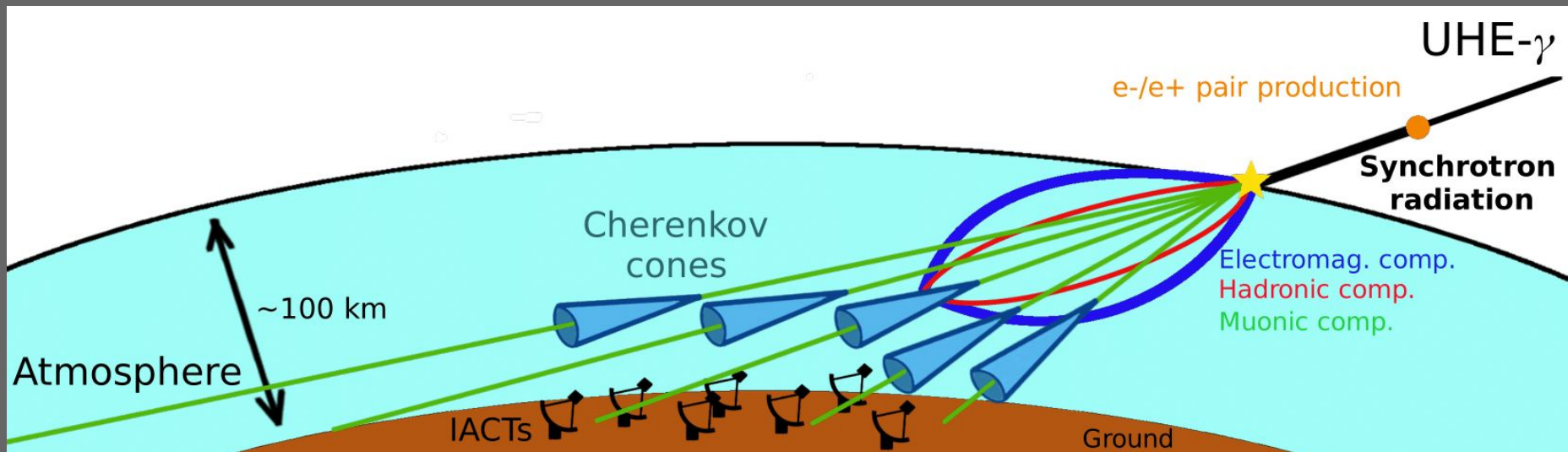
Kévin Almeida Cheminant and Dariusz Gora

Instytut Fizyki Jądrowej PAN, Krakow, Poland

CREDO Visegrad Workshop, May 20th- 21st 2019 Opava, Czech Republic



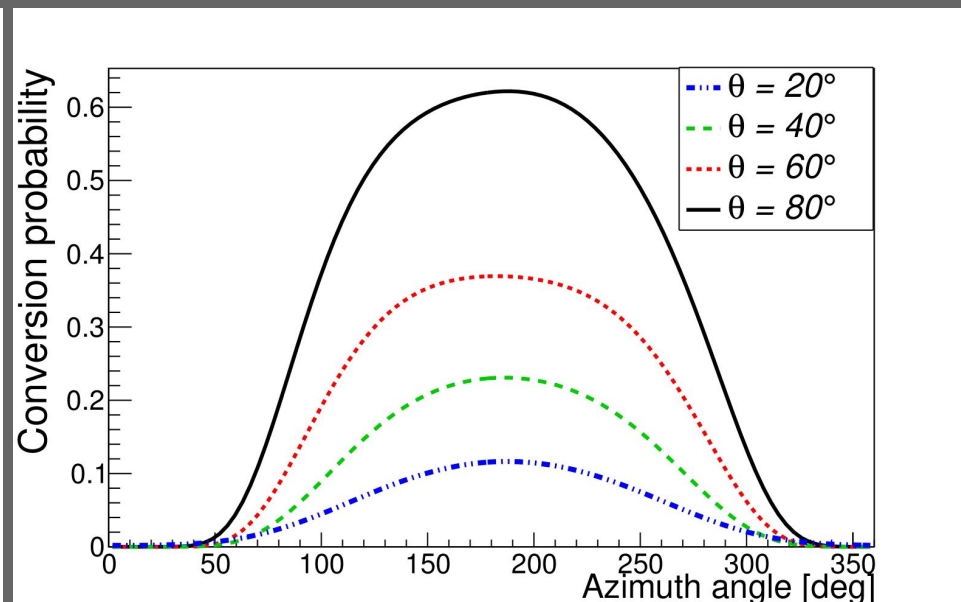
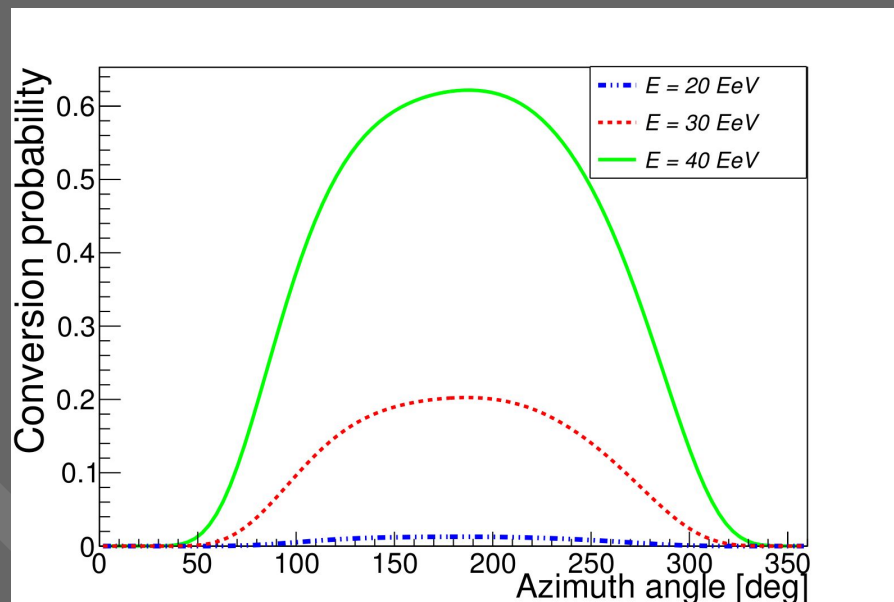
The Preshower Effect





The Preshower Effect

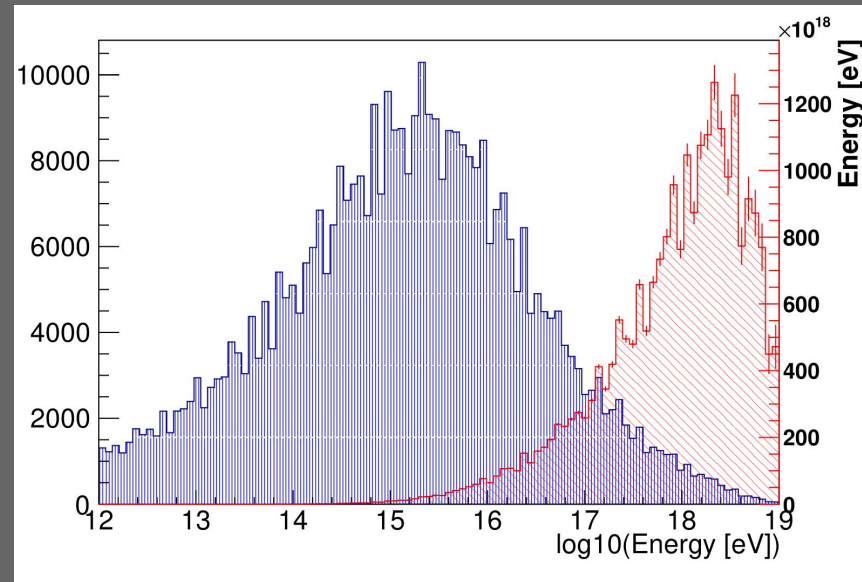
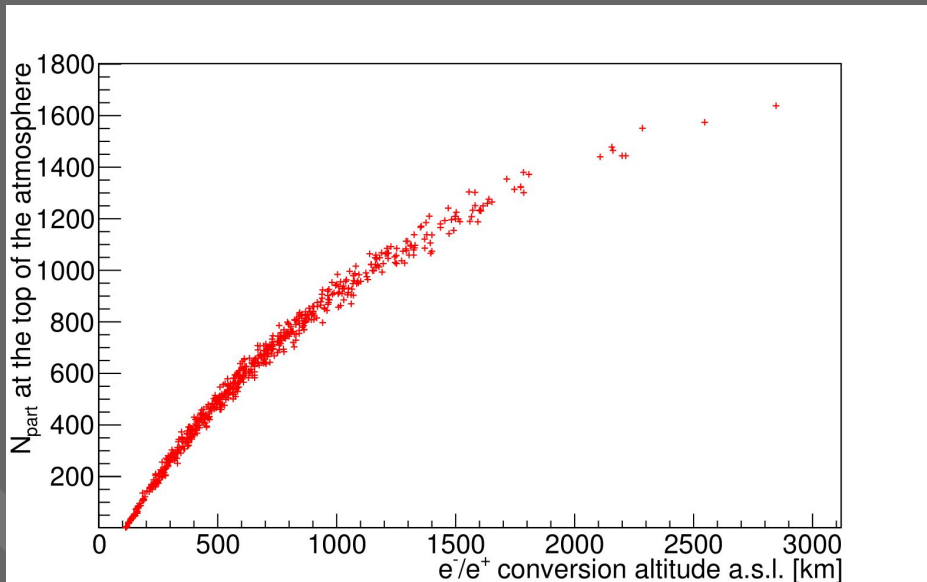
- CTA location: **La Palma (Canary Islands)**





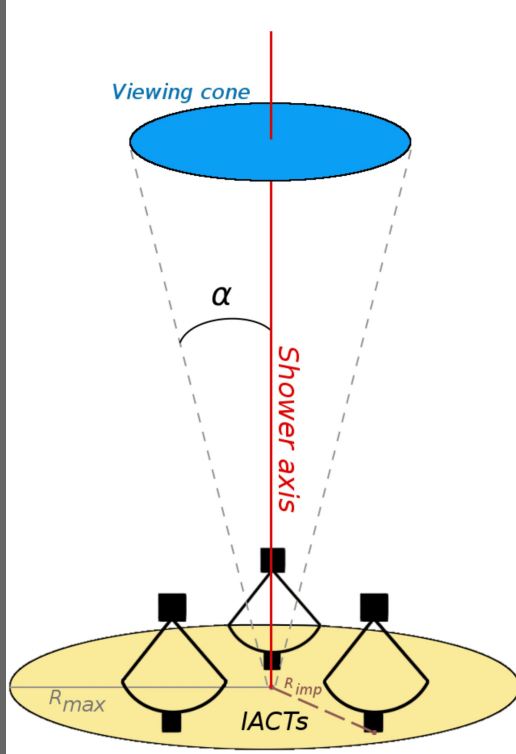
The Preshower Effect

- **Multiple photons** in a wide energy range reaching the atmosphere!





Extensive Air Shower simulations

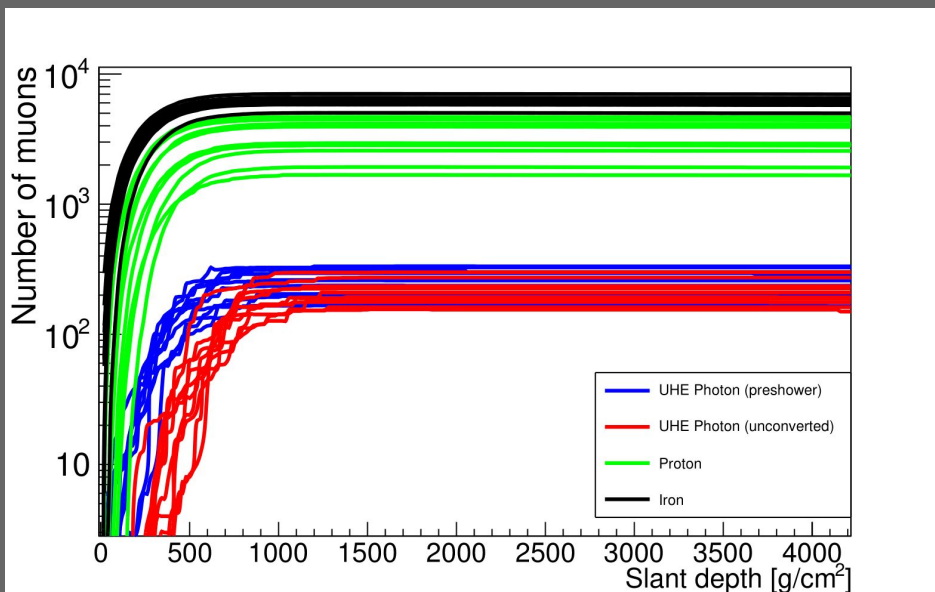
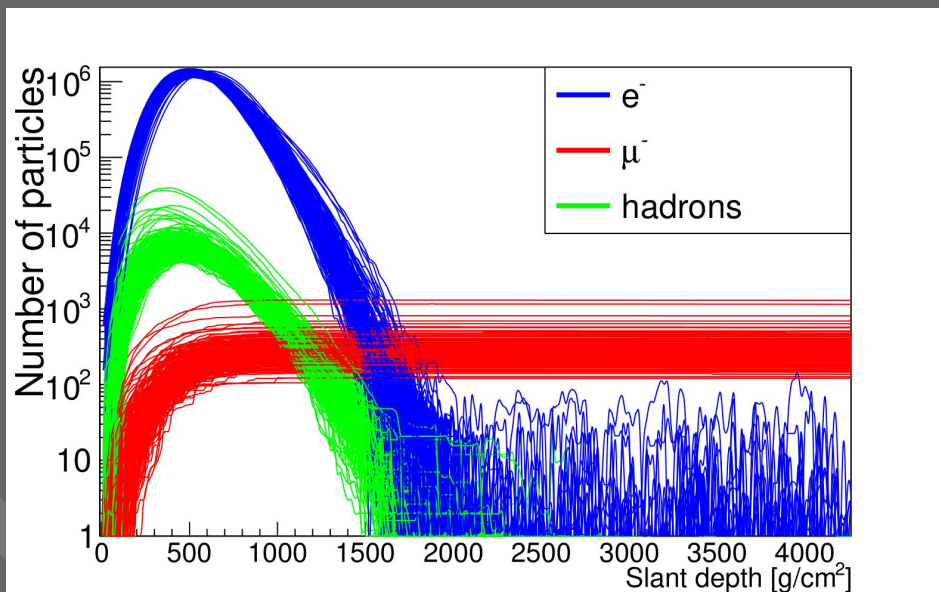


- Multiple options in *CORSIKA* to simulate different scenarios.
 - Point and diffuse sources.
 - Randomization of the impact location.
 - Looking at very inclined air showers from the northern direction.



Extensive Air Shower simulations

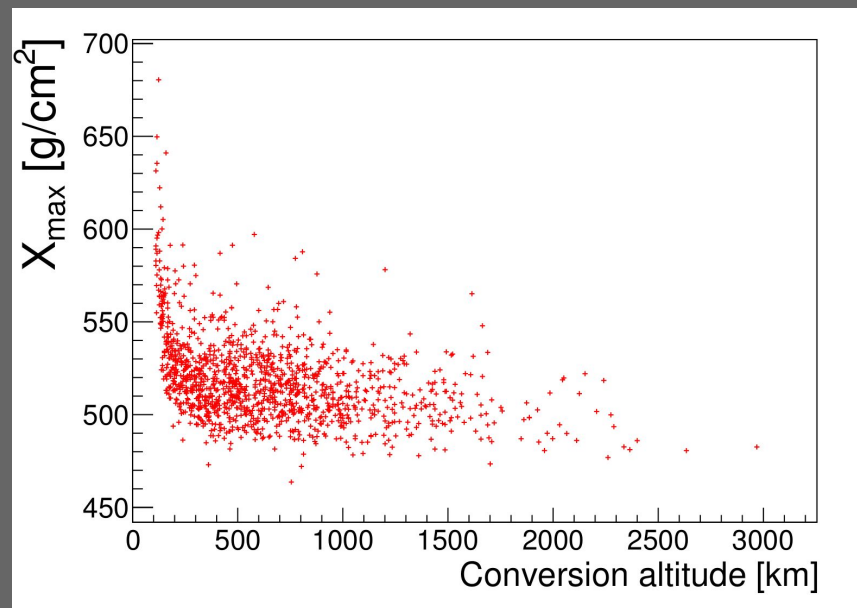
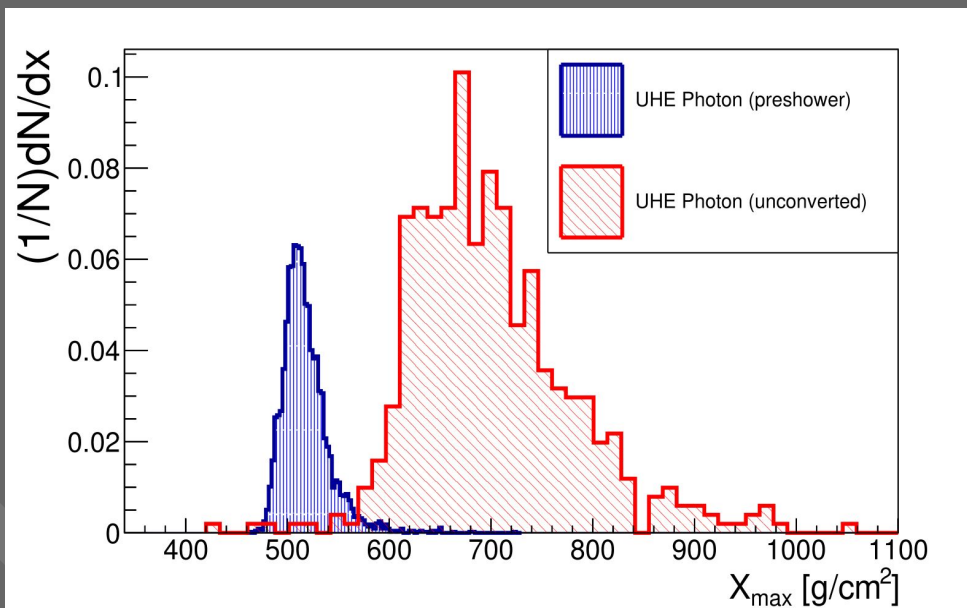
- The **muon component** is dominating.





Extensive Air Shower simulations

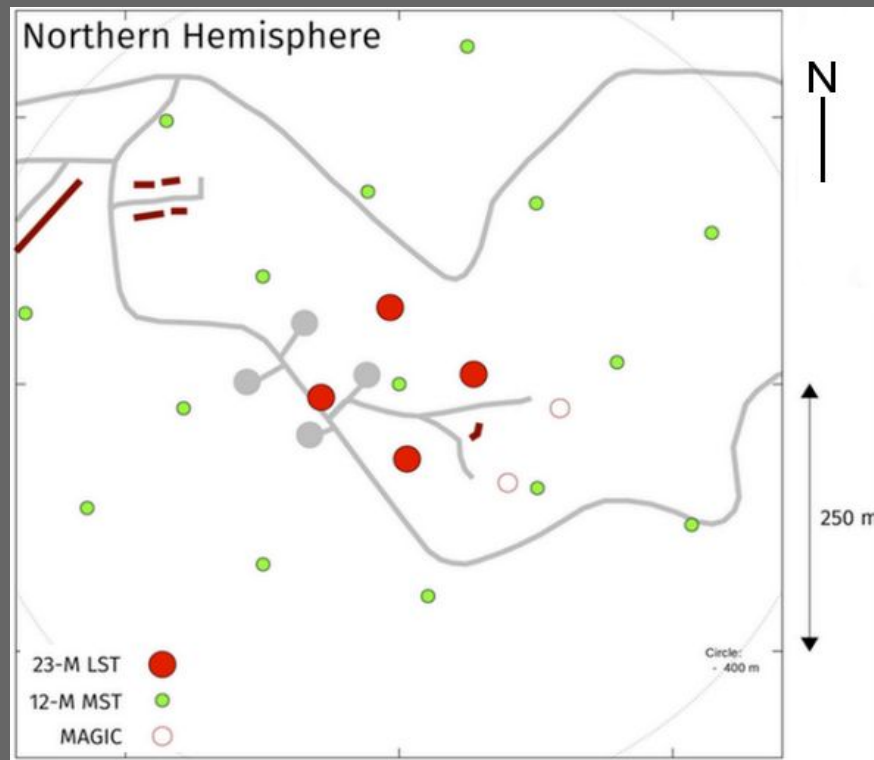
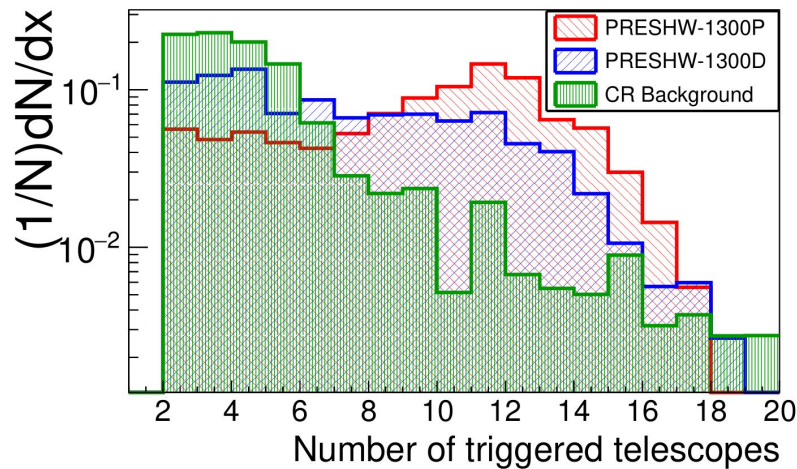
- Higher interaction point → EAS maximum higher in the atmosphere.





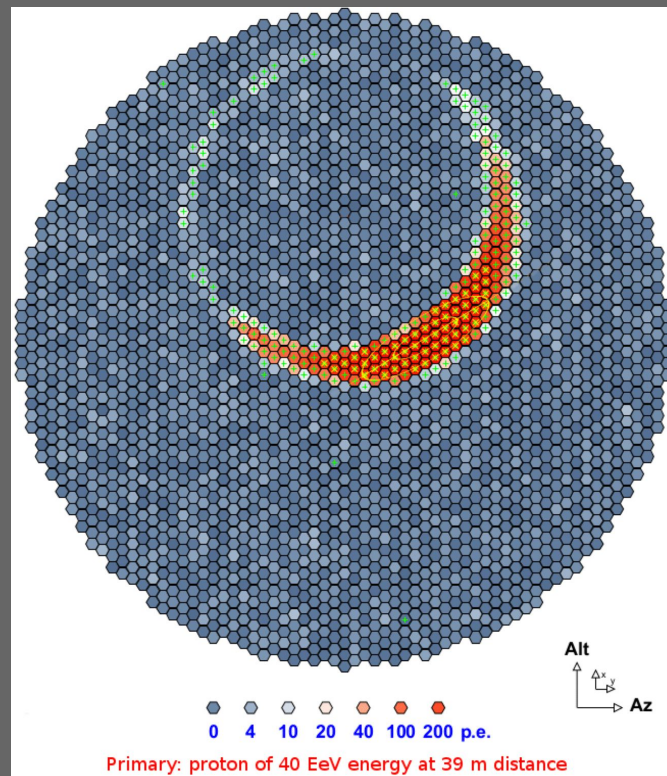
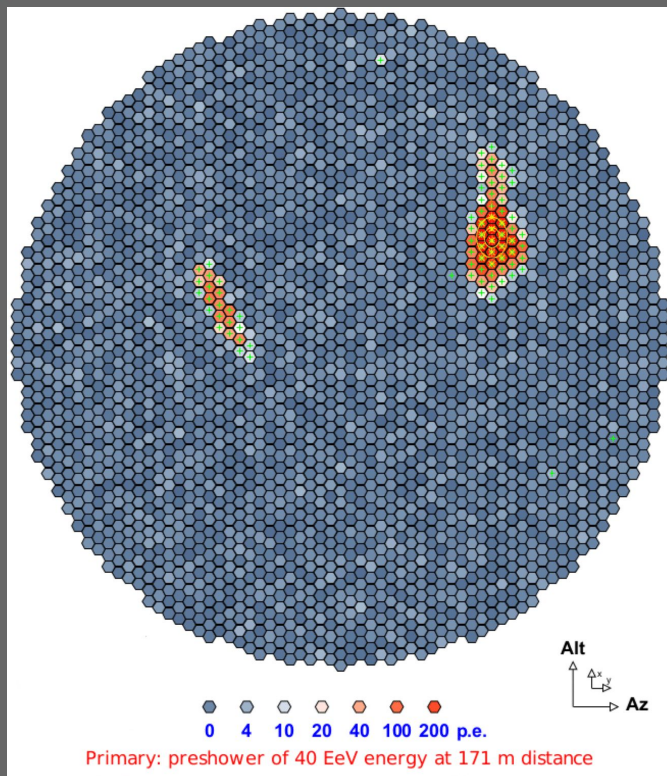
CTA detectors' response

- **19 telescopes** pointing in the direction of the simulated sources.



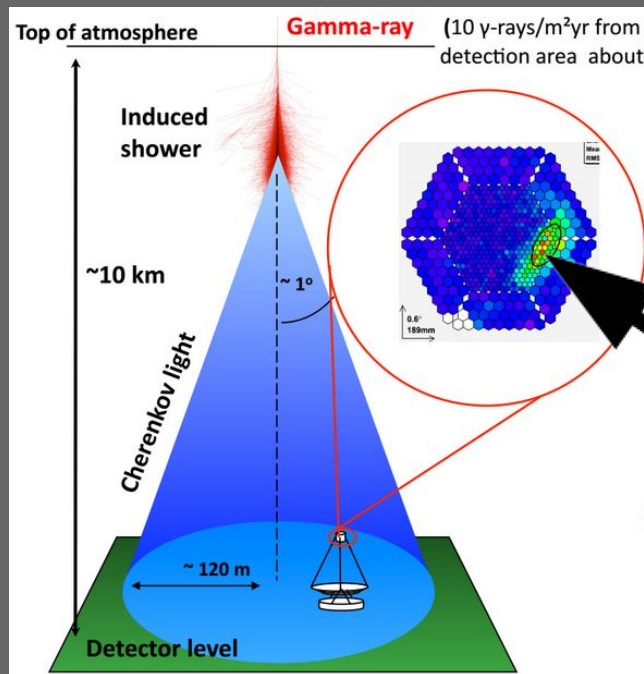


CTA detectors' response

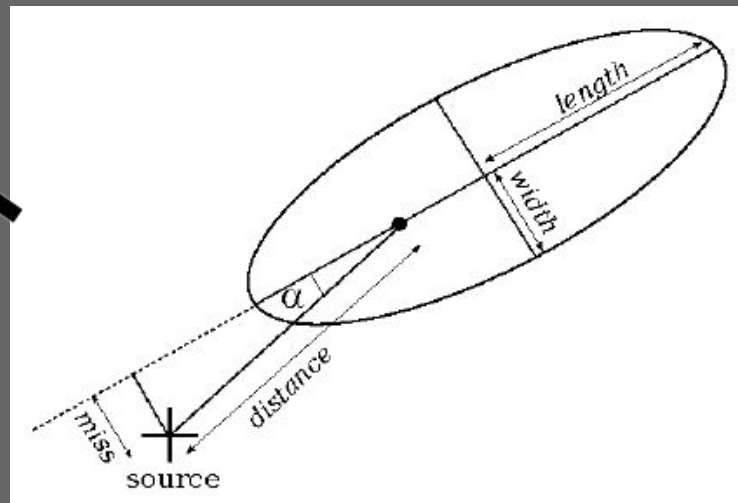




CTA detectors' response

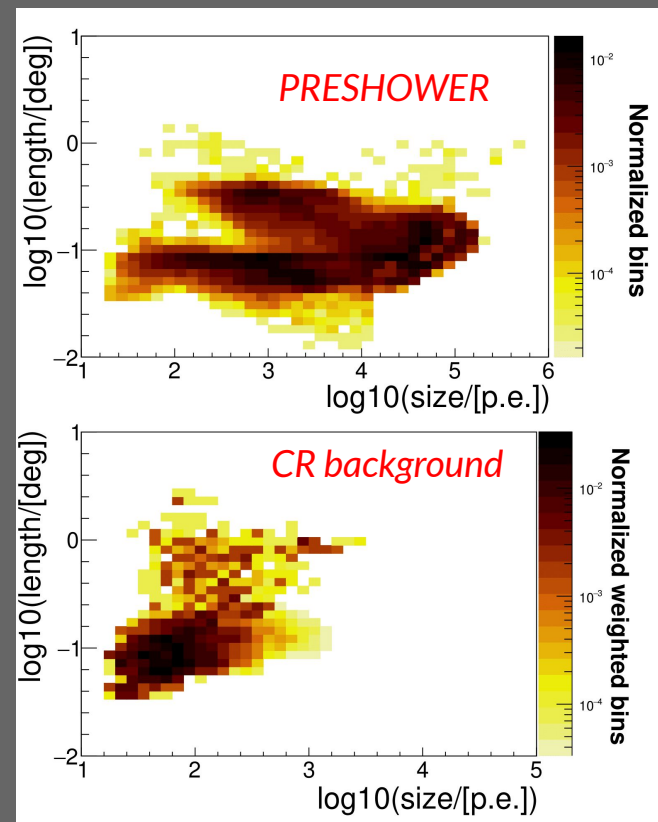
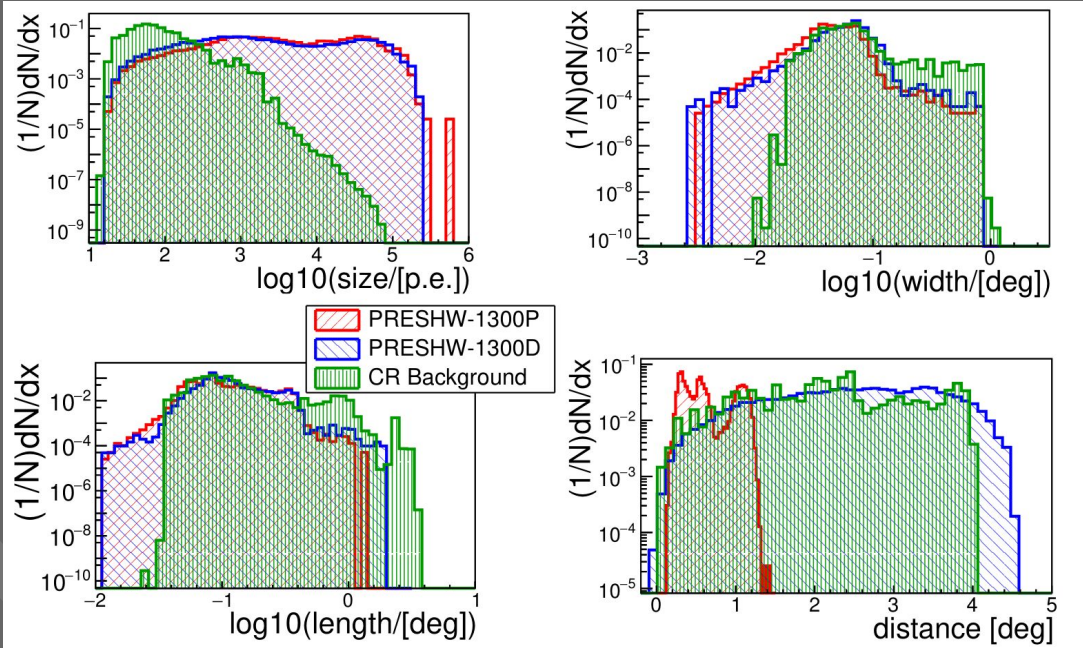


Hillas parameters are used to characterize images formed by EAS from preshower and CR background.





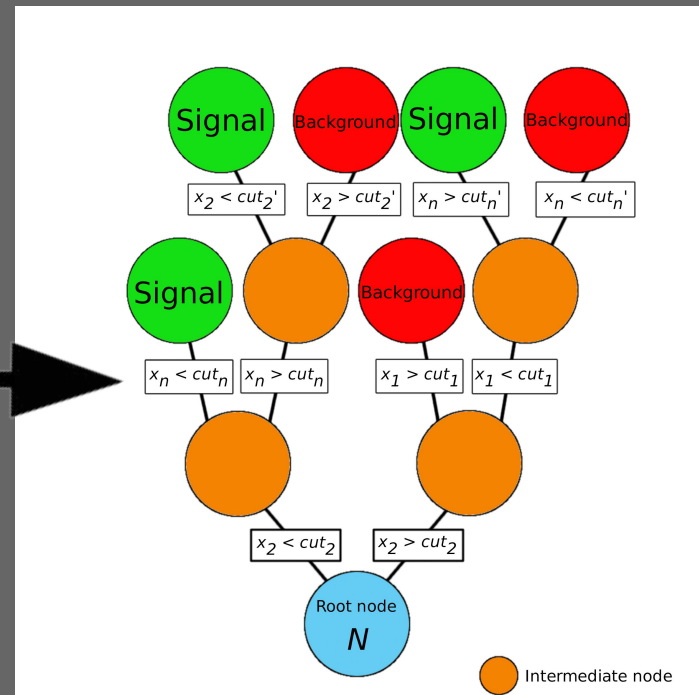
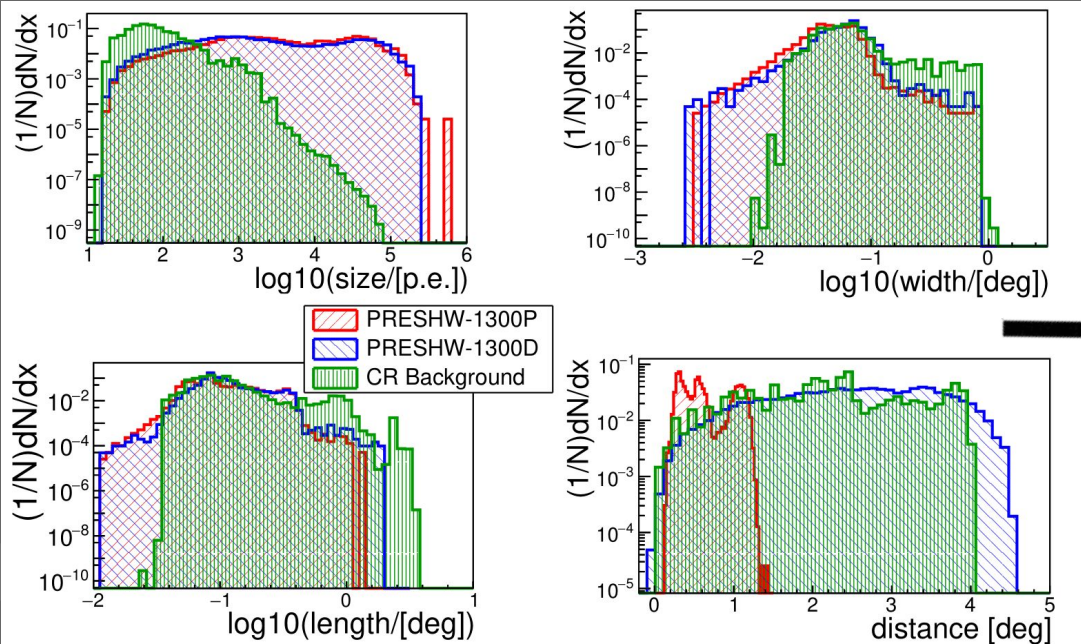
CTA detectors' response





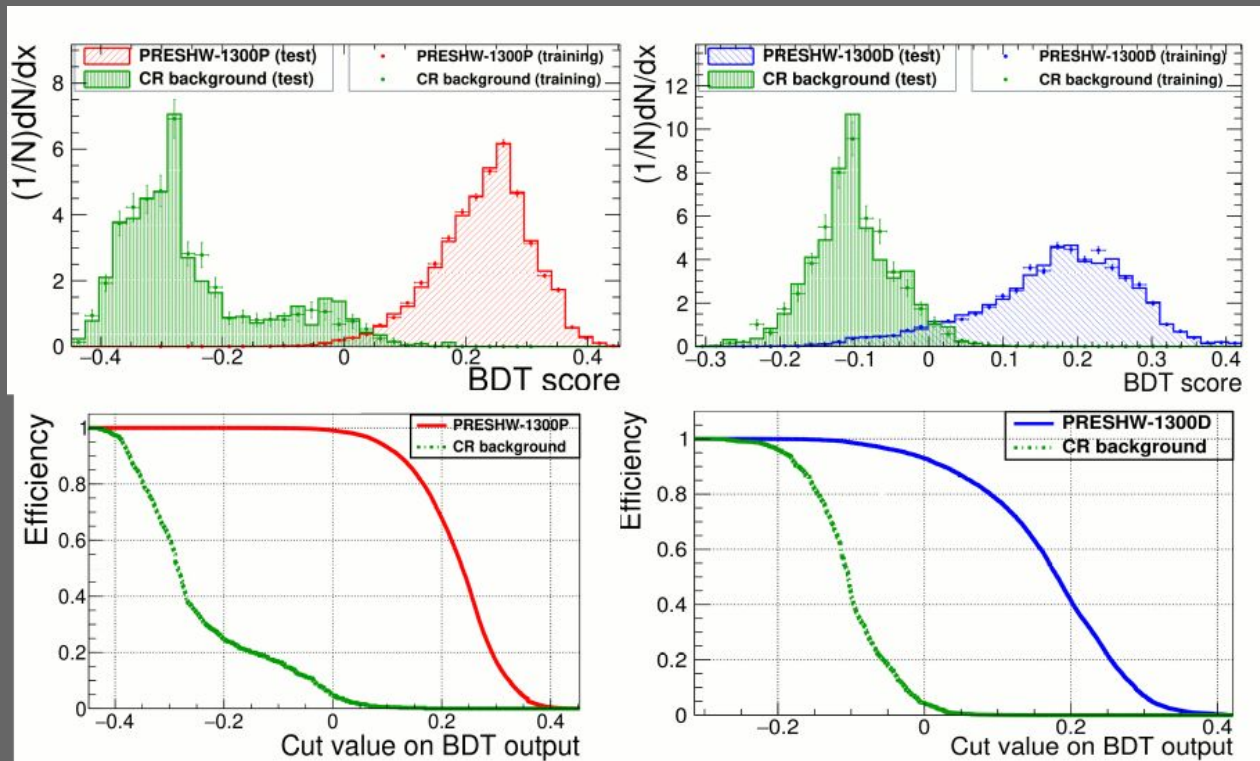
Preshower/CR separation

- Boosted decision trees





Preshower/CR separation





Aperture and number of expected events...

- Various **UHE photon production** models and limits put by AUGER on the integral **UHE photon flux**.

	PRESHW-1300P	PRESHW-1300D	PRESHW-4000P	PRESHW-4000D
Aperture [km ²]	3.40	0.05	3.30	0.06
SHDM	1.01×10^{-4}	1.49×10^{-6}	9.83×10^{-5}	1.79×10^{-6}
AUGER limits	3.82×10^{-6}	5.61×10^{-8}	3.70×10^{-6}	6.74×10^{-8}
GZK	3.50×10^{-6}	5.15×10^{-8}	3.40×10^{-6}	6.19×10^{-9}

Typical 30h observation time.



Conclusion and outlook

