A NOVEL ENERGY RECONSTRUCTION FOR HIGH-ENERGY GAMMA-RAY WIDE FIELD OF VIEW OBSERVATORIES

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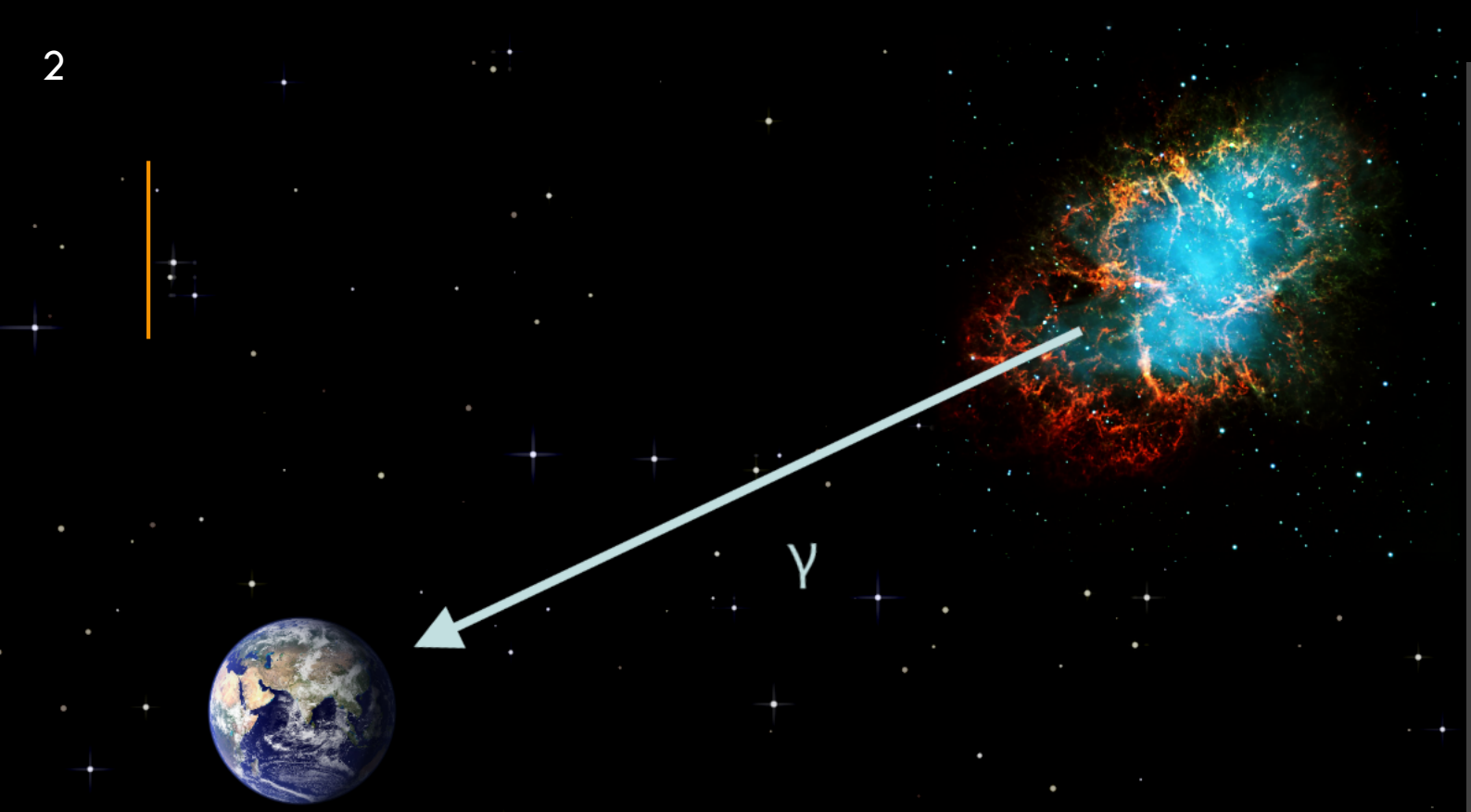


GAMMA-RAYS

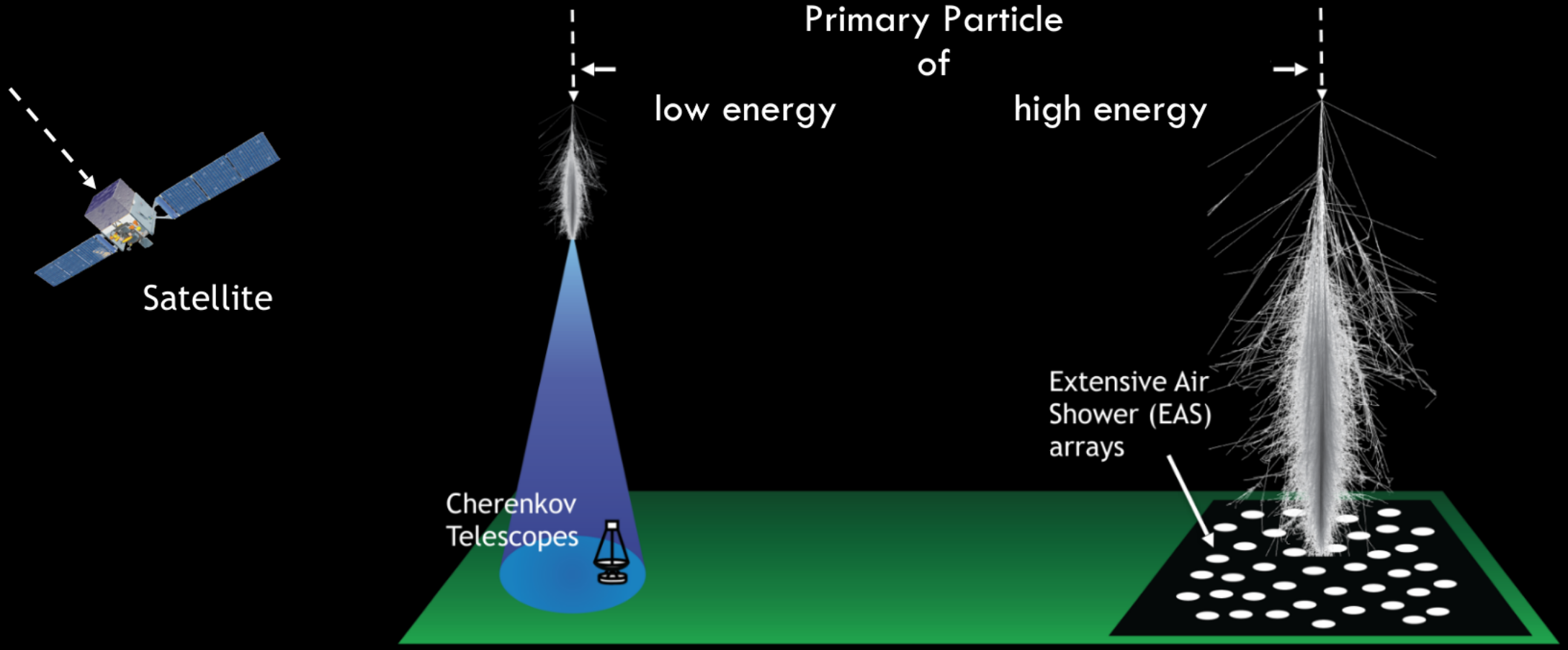
Photons of very high energies – 0.5 x 10^6 eV to 10^{20} eV

The best messenger of the most extreme phenomena in the Universe

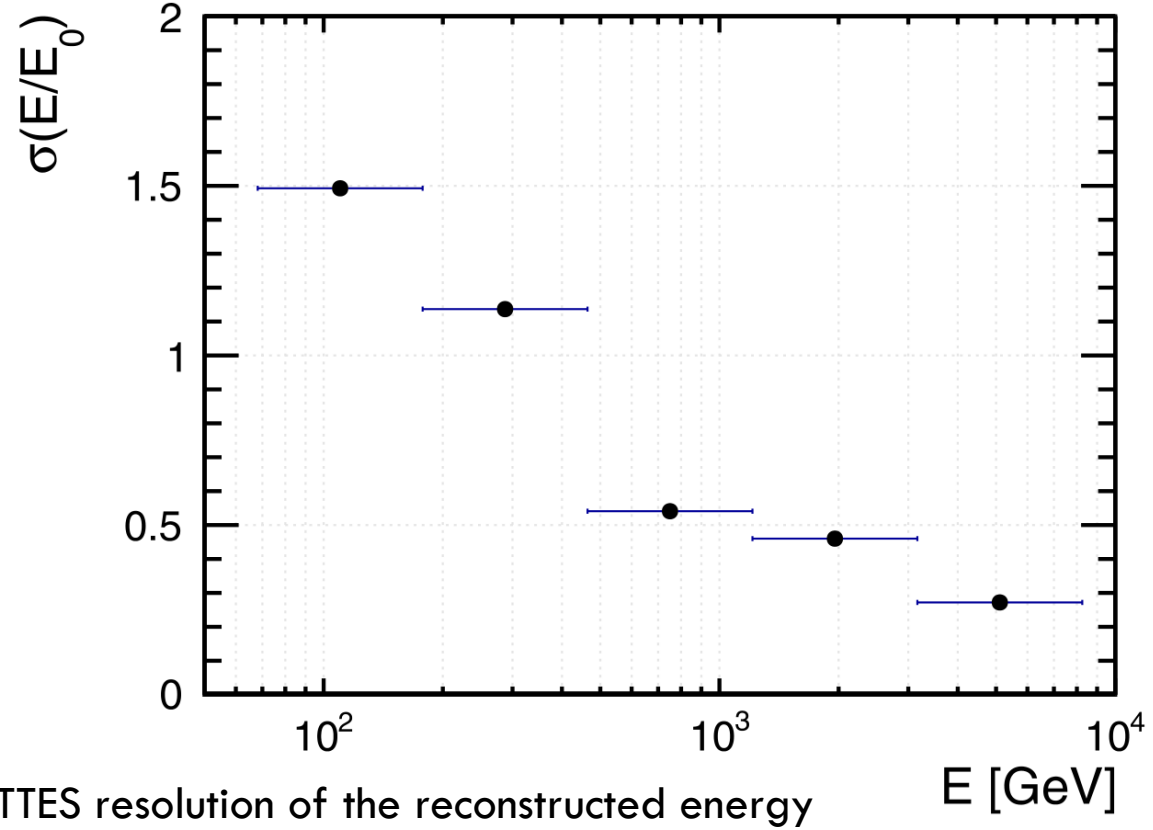
Interest is general astrophysics questions

Very High Energy (VHE) γ-rays → 30 GeV to 30 TeV

DETECTION OF GAMMA-RAYS



Arrays at high-altitude = large field of view + large duty cycle + low energy



LATTES resolution of the reconstructed energy

ENERGY RECONSTRUCTION METHODS

Current methods use the total signal of hit PMTs to reconstruct the energy of the primary photon

Signal ∝ Number particles ∝ Energy

The shower stage is not known → energy reconstruction resolution of 100%

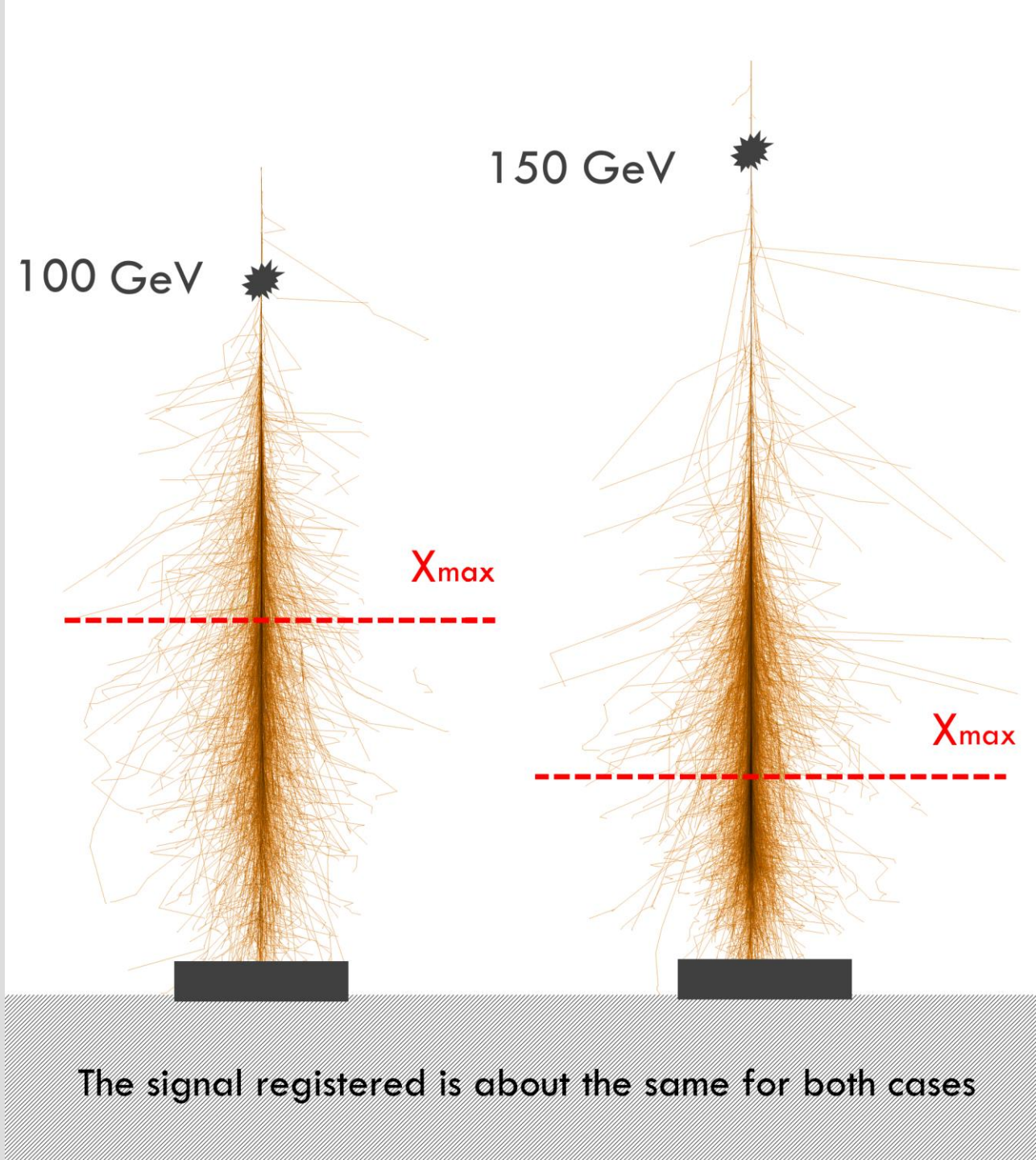
ESTIMATION OF THE SHOWER STAGE

X_{max} is the key to a better energy reconstruction!

$$X_{max} \sim X_0 \ln \frac{E_0}{E_c}$$

X_0 is the radiation length in air

E_c is a value related to the ionization energy loss



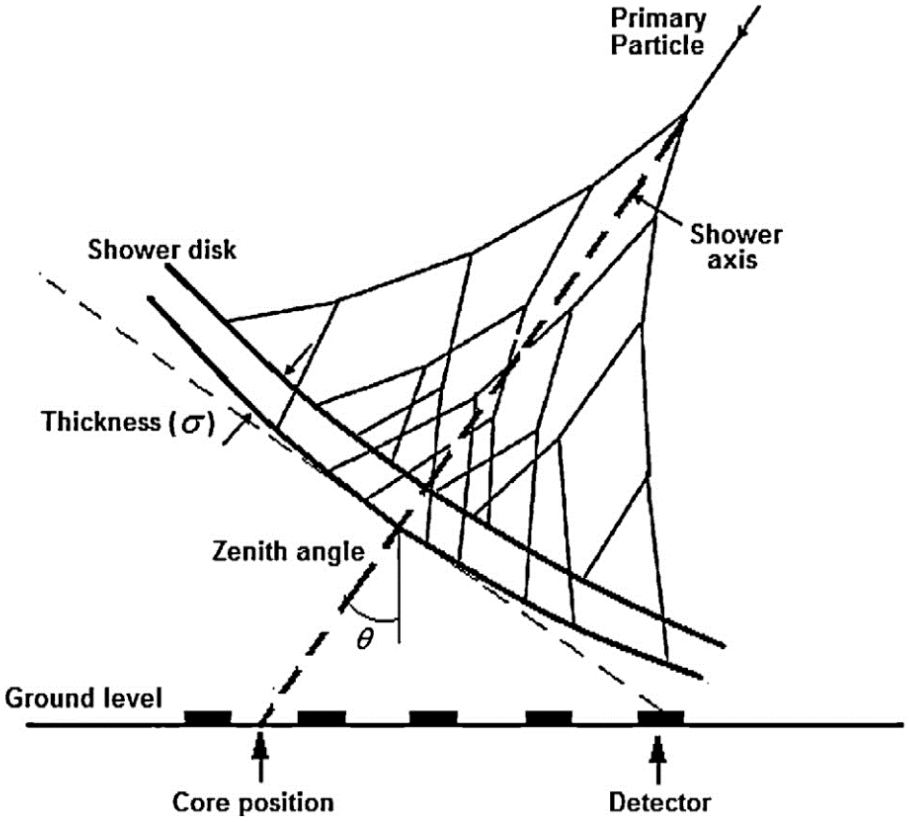
RISETIME AND ⟨Δ⟩ METHOD

Risetime

- Obtained for each of the triggered detectors of an event
- Time taken by the signal to increase from 10% to 50%
- Function of distance, zenith angle and energy – directly related to E_0

⟨Δ⟩

- Combines the risetime value in one observable
- Evaluates how fast or slow the risetime is compared to a benchmark
- Is the average deviation from the benchmark in term of risetime uncertainty – dimensionless parameter



⟨Δ⟩ is transformed in terms of X_{max} so it's possible to use SD-only events.

Correlation of ⟨Δ⟩ with X_{max} increases with the number of detectors.

APPLYING TO GAMMA-RAY WIDE FOV EXPERIMENTS

It's not easy and it comes with problems, but it has the potential to improve the energy reconstruction resolution dramatically.

Problems:

- The difference in energy between VHE γ-rays and UHE cosmic rays.
- The size of the shower – km vs few hundred meters.

However it has an advantage to the UHECRs due to the shower curvature.

This method can be applied to the planned LATTES experiment, providing an opportunity to improve the energy reconstruction resolution in unprecedented ways in a γ-ray wide field of view observatory.