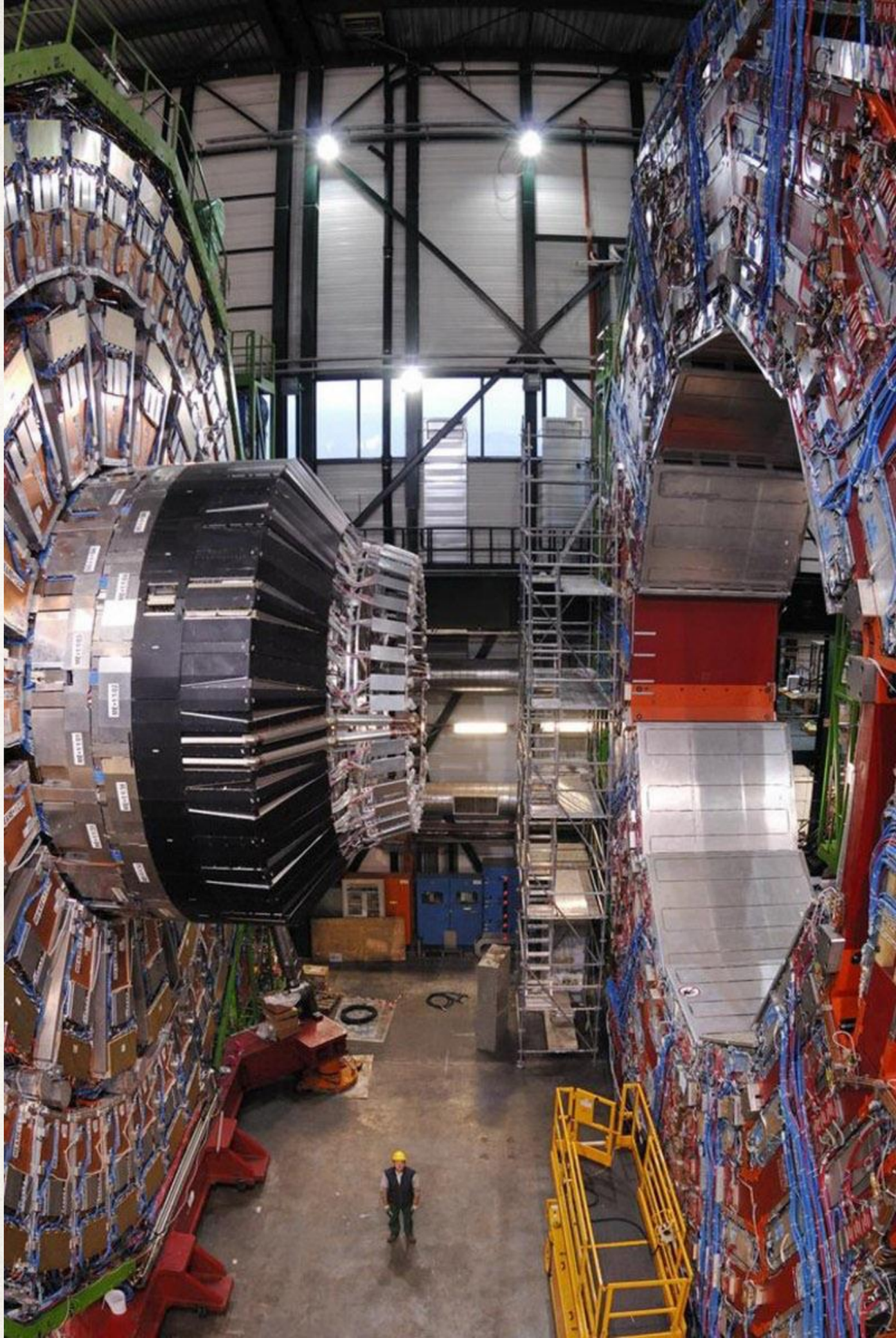
Cosmic Rays

Germán Gomez-Vargas, PontifÍcia Universidad Católica de Chile

Mayo 03, 2018

What are the most energetic particles in nature?

The LHC can accelerate protons up to an energy of 7 TeV. Each proton has the same kinetic energy as a mosquito in flight: 1.1×10^{-6} Joules.



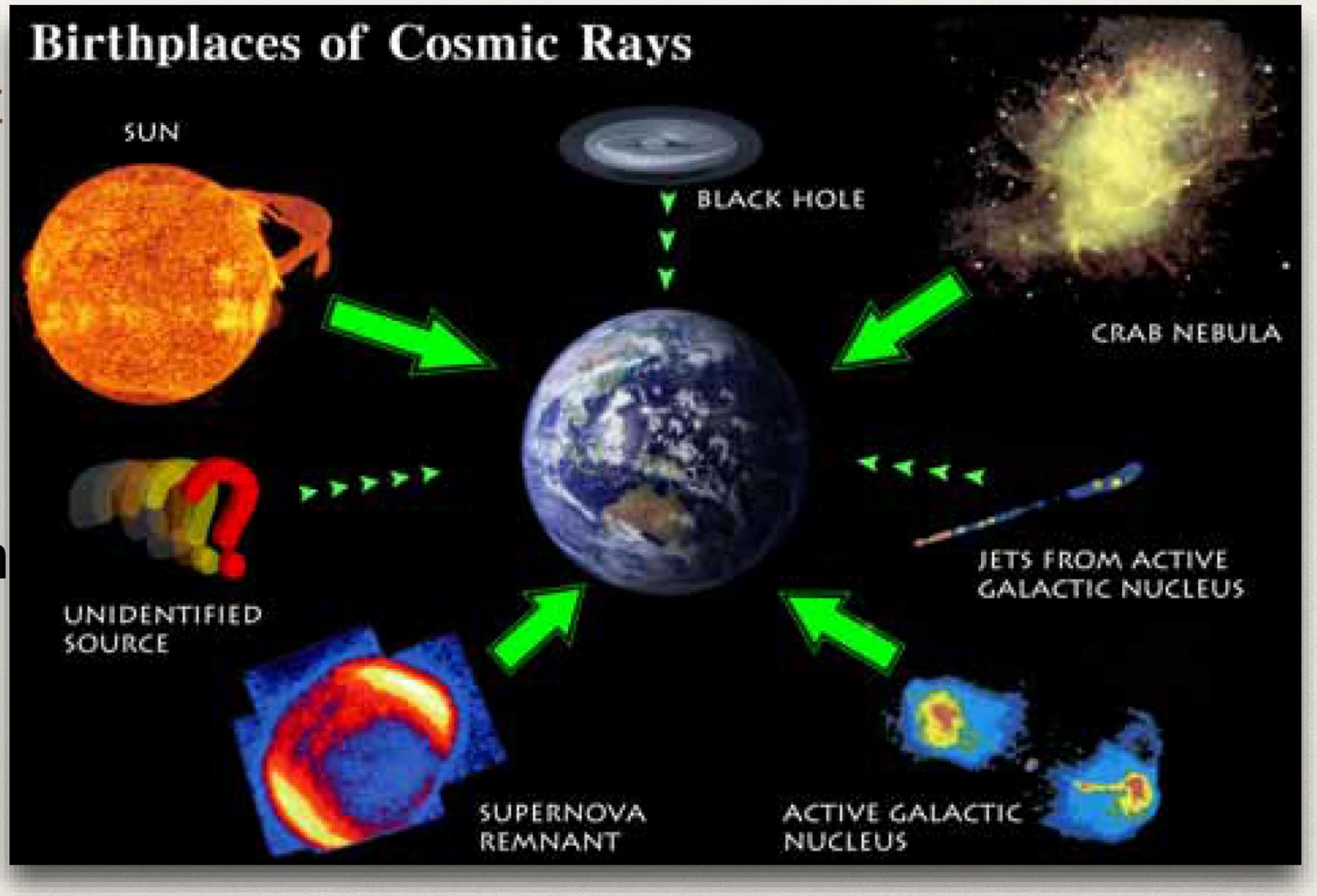
What are the most energetic particles in nature?

Some cosmic rays arrive at the earth with the same energy (10^8 TeV) that is given to a tennis ball in flight: 50 Joules.

What are these cosmic rays?

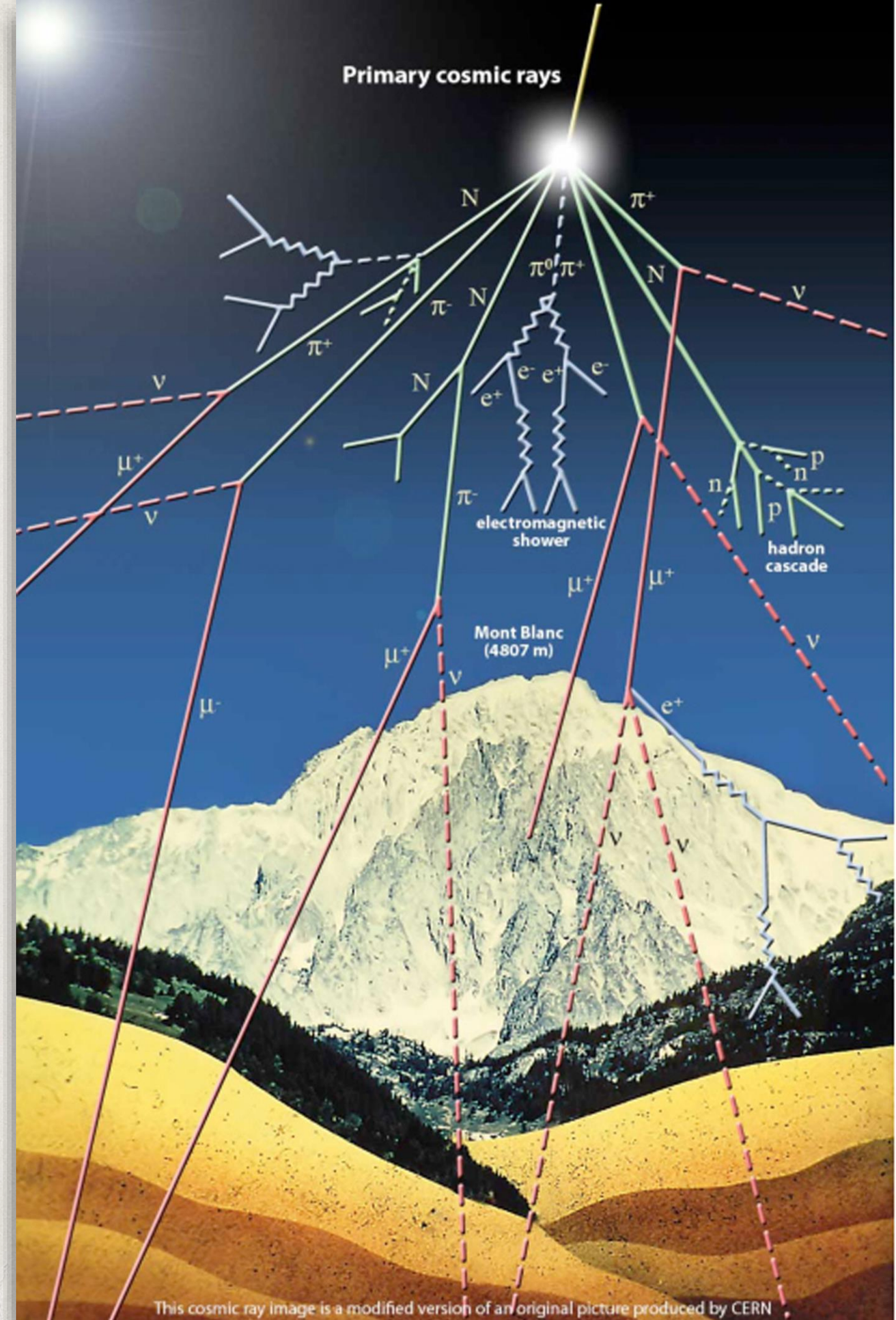
- Cosmic rays are not really rays; they are subatomic particles which are found in outer space.

- They have very high energies as a result of their very high velocities.



What do cosmic rays consist of?

- Primary cosmic rays: these exist in outer space and are mostly protons, but also electrons, positrons, atomic nuclei and gamma rays (photons).
- They hit the atmosphere of earth and the collisions produce secondary cosmic rays.
- These secondary cosmic rays can be pions, muons, and neutrinos.
- Most cosmic rays that we see are secondary, in particular muons.



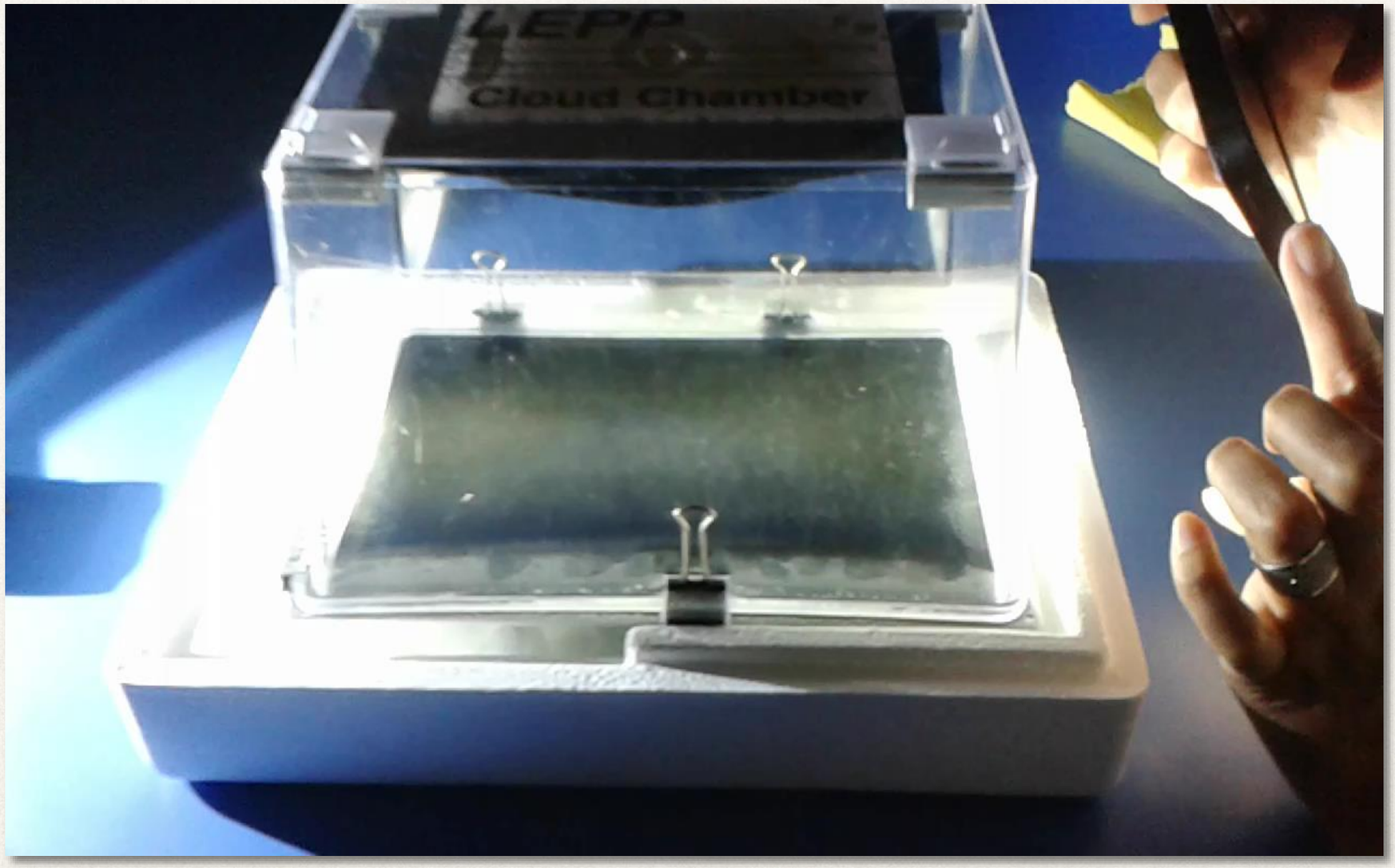
Particle showers produced in Earth's atmosphere by gamma-ray, proton, and carbon-13

- Initial particle energy: 400 GeV
- Animation time: Shower reaching ground
- **Charged particles: Red dots**
- **Cherenkov light: Blue dots**

Visit http://veritas.sao.arizona.edu

VERITAS & Harvard Smithsonian Center for Astrophysics

Something you may have seen or will see…

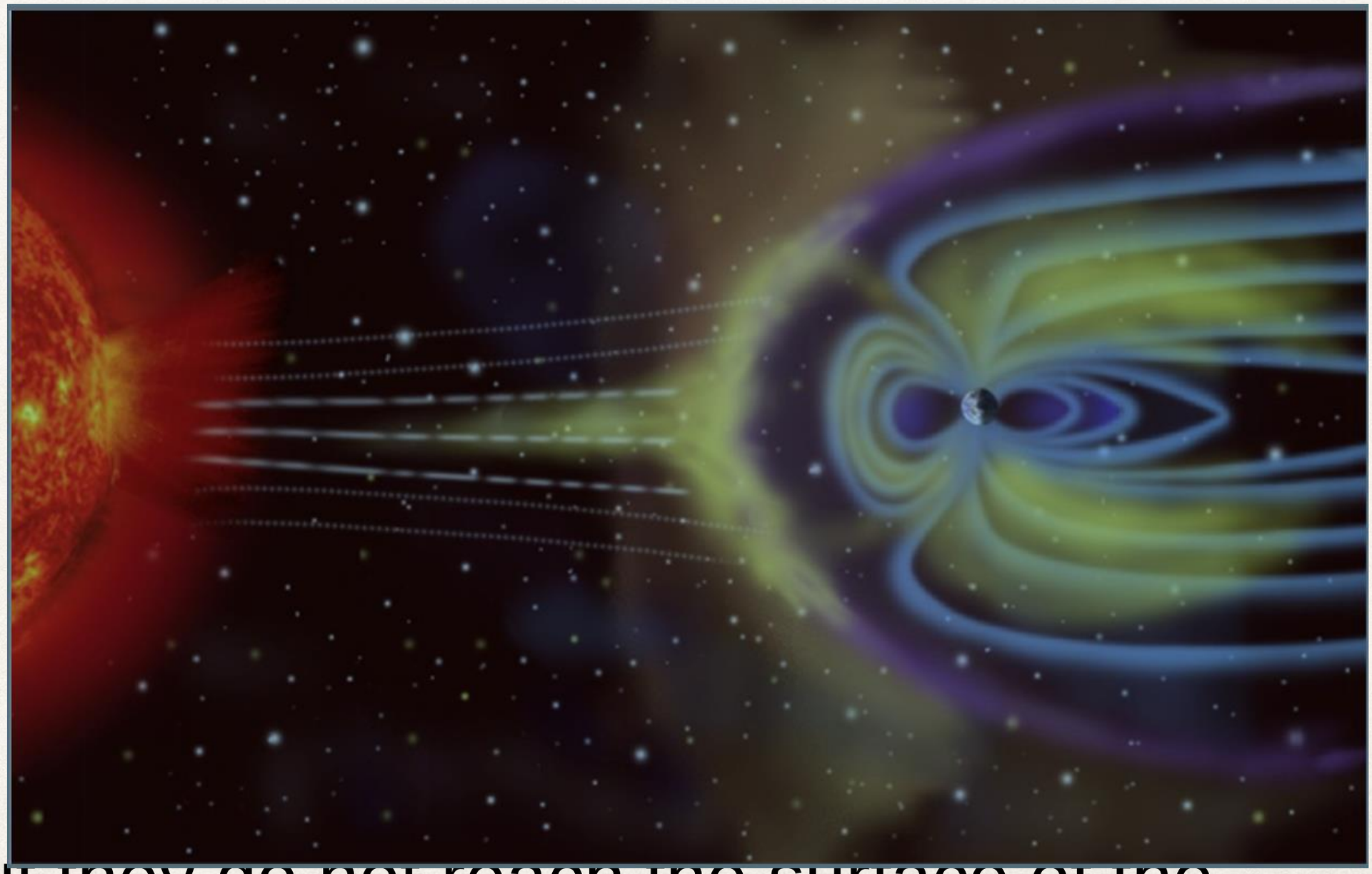


Interesting fact:

- Cosmic rays from the sun are responsible for auroras!

Interesting fact:

- Cosmic rays from the sun are responsible for auroras!*



*But they do not reach the surface of the earth!