

EAS impact on biological systems

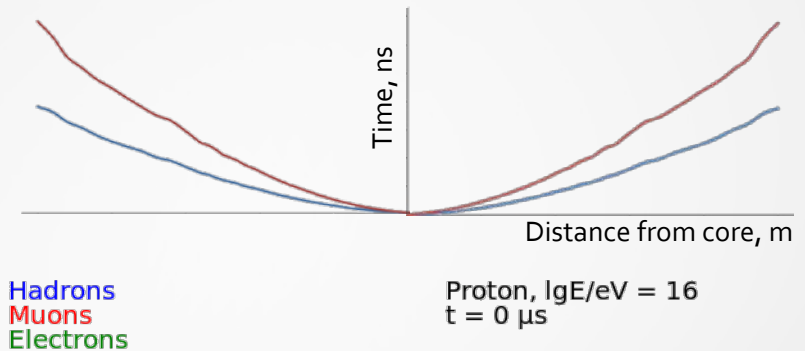
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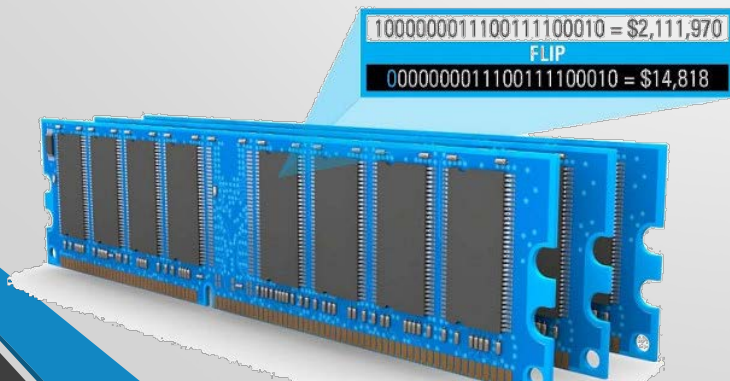
What is EAS

- A particle with ultra-high energy arrives from outer space and enters atmosphere
- In interactions, billions of secondary particles are born
- They form two parts:
 - Core – 1-2 meters wide central area, very dense
 - Extended Air Shower (EAS) – disk of up to few km

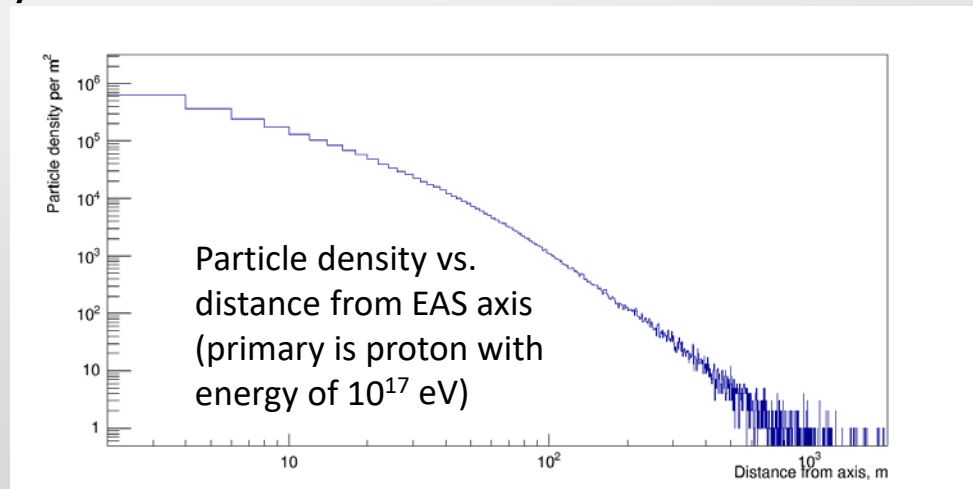


EAS Core

- EAS Core is very dense with very energetic hadronic (those found in a nucleus) particles
- Together, they give lots of radiation to any object they hit
- Error-correcting code memory (*ECC memory*) for computers was invented to correct errors mostly from cosmic rays – small storage cells can flip their value with cosmic rays passage
- If core passes – massive data failure. Can affect Hard drives too in a same way. CREDO as monitor of risk areas.

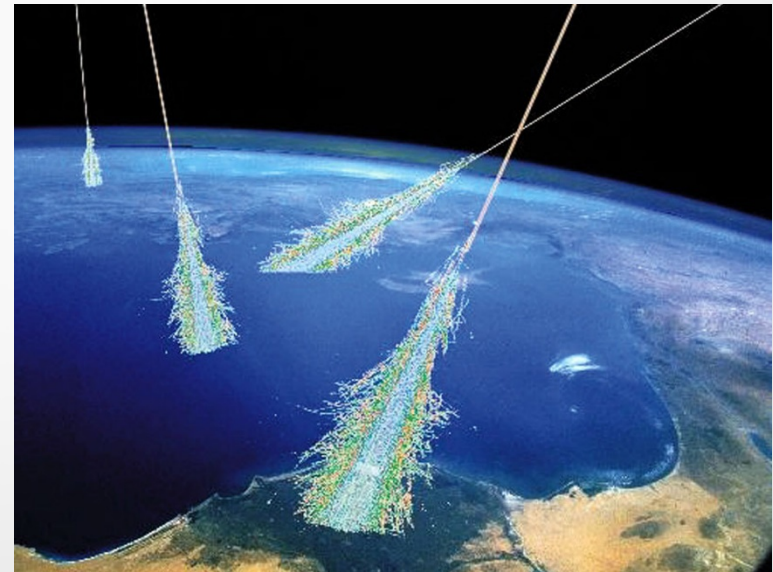


<https://www.makeuseof.com/tag/data-corruption-prevent/>



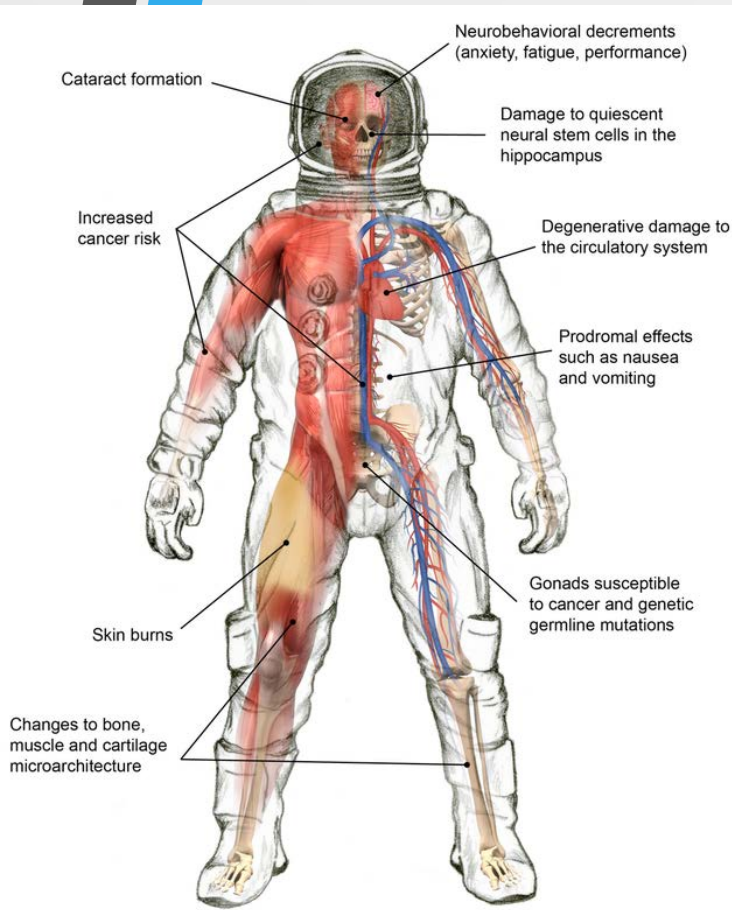
EAS and life

- Primordial Earth – before life
- Separate cosmic rays can only break molecules, not create
- In EAS core – very high dose, many breaks – new combinations, new molecules.
- Origin of life?



<https://www.space.com/32644-cosmic-rays.html>

EAS and Health risks



- EAS – radiation. Core can deposit high dose in human parts (hands, legs, whole body) that can cause different disease (leukemia, cancer, etc...)
- If primary energy very big ($>10^{19}$ eV) and a person is caught standing up in the core, can receive lethal dose (few Sv)
- Ultra-high energy cosmic rays are VERY rare – one a year per km². Core is few meters wide. In a densely populated city, probability is rising.
- Global monitoring (CREDO) and correlation between high energy events and medical database can uncover these correlations, provide doctors information on EAS

https://scienceaid.net/Space_Radiation