Monte Carlo background simulation in a boron loaded scintillator for the OLVE-HERO detector

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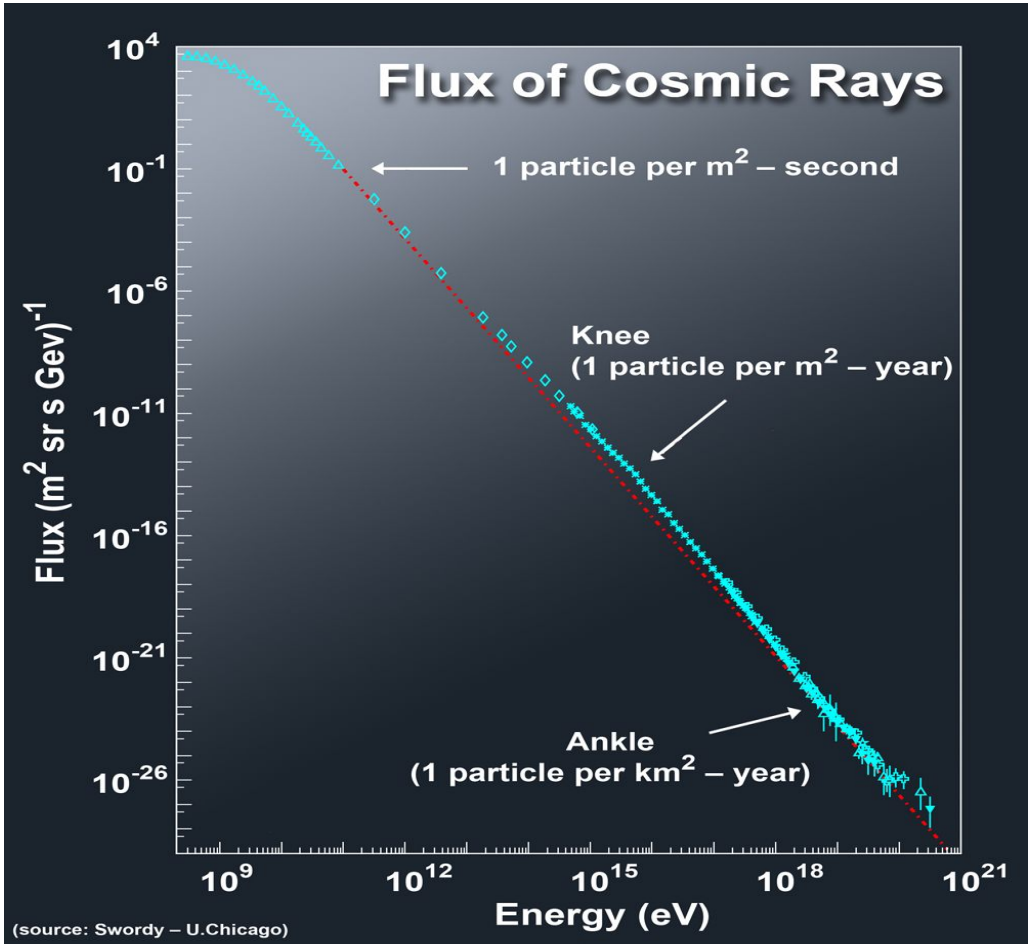


- on Earth orbit until 2030
- The main goal of the HERO mission is to get direct measurements of cosmic rays params in the **10^{12} –10^{16} eV** energy region

  -Energy

  -Direction arrival

  -Type of the particle
- Wight ~ 10 tons
- Geom-factor ~ 16 m^2sr
- Scintillator + ^{10}B

A "breakthrough" experiment is needed, which will turn high-energy astroparticle physics into an exact science!

That is

HERO

"High Energy Rays Observatory"

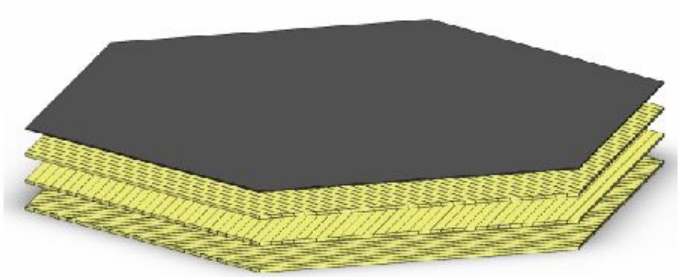
supported by the Russian Academy of Sciences and included in the Russian Federal Space Program

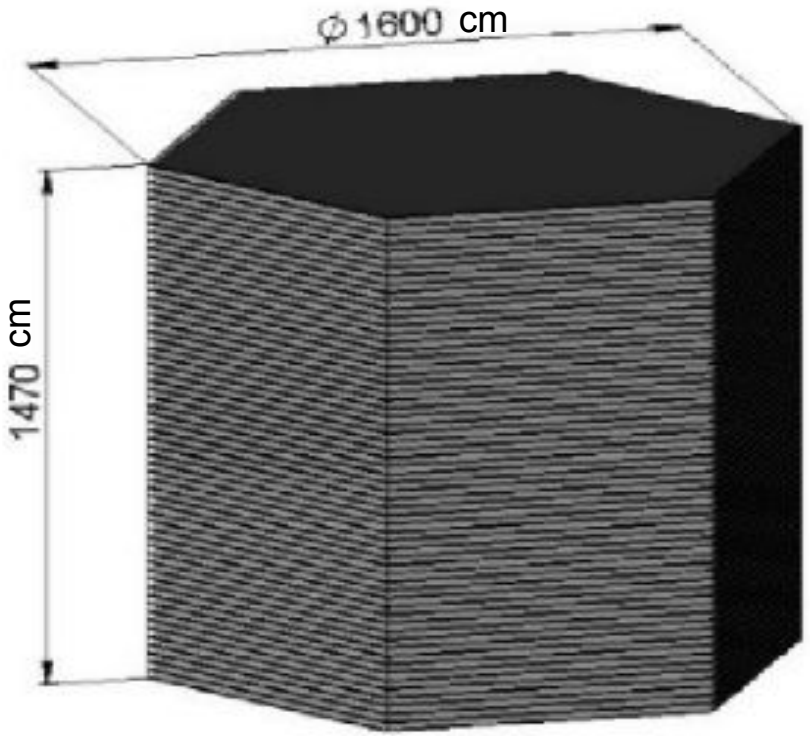
Main Requirements:

- Effective exposure factor >120 m^2 sr year
- Energy resolution
  - for Protons at 10^{15}-10^{16} eV < 30%
  - at 10^{12}-10^{15} eV < 20%
  - for Nuclei at 10^{12}-10^{16} eV < 15-20%
  - for Leptons at $3*10^{11}$-10^{13} eV < 1%
- Charge resolution < 0.2 ch. u. for all Nuclei in full energy range

Total mass is about 10-12 ton

HERO geometry scheme





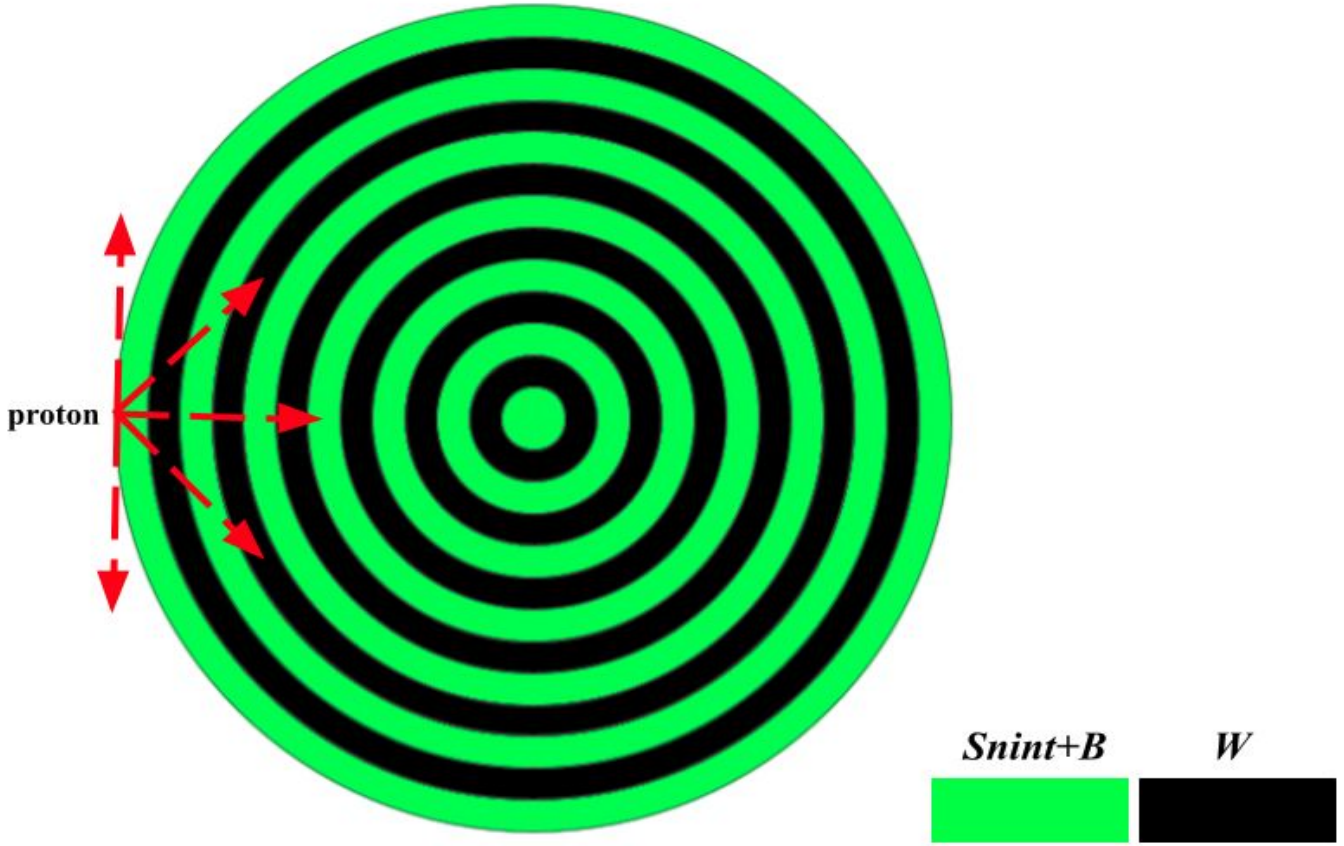
Why do we need a boron loaded scintillator?

- hadrons number is GCRs is 10 000 times greater than electro - part.
- hadrons produce a larger number of neutrons by interacting matter
- $n + B^{10} \rightarrow \alpha + Li^{7}$. α takes almost all the energy
- It will improve the rejection power between electromagnetic and hadron components of CRs

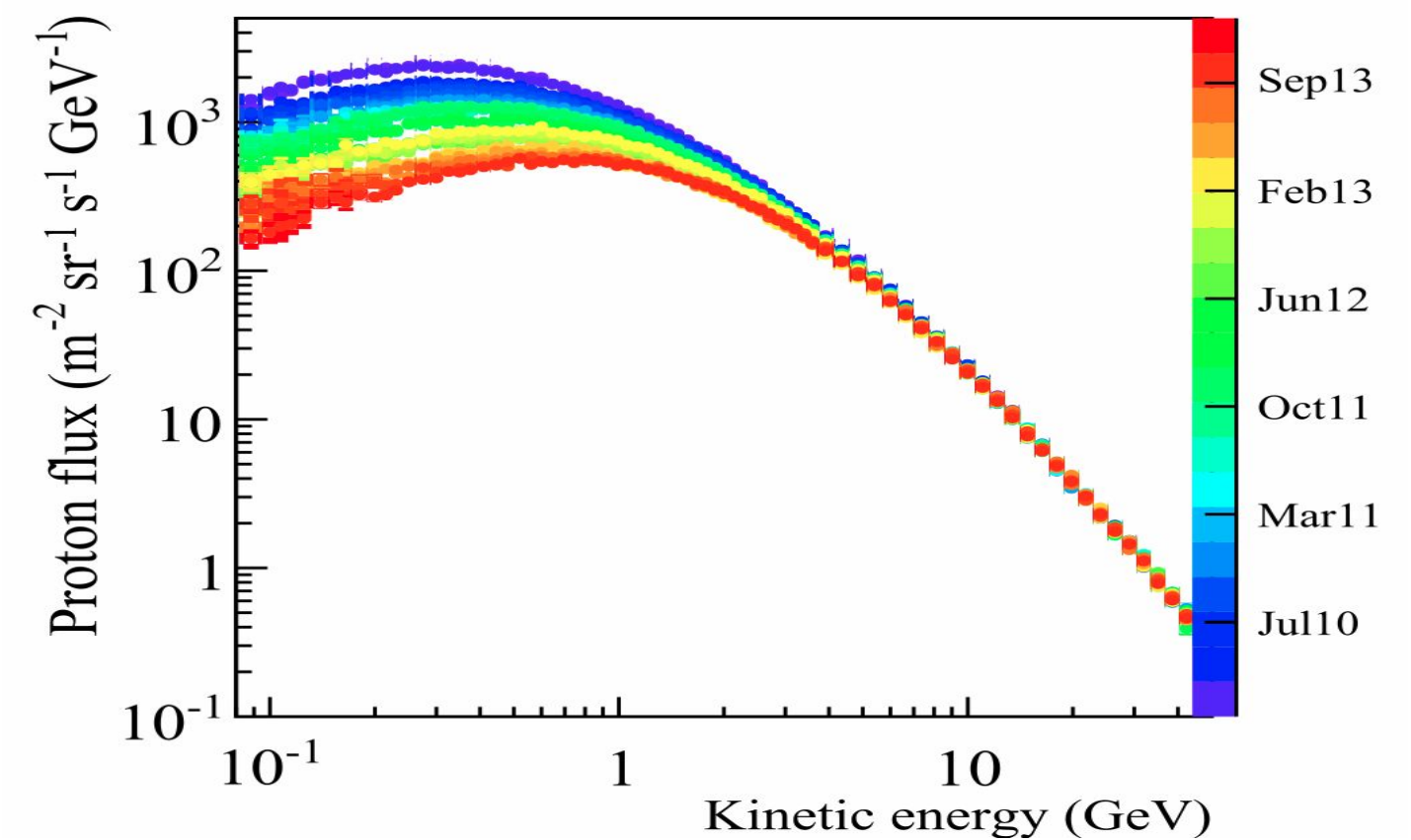
Monte-Carlo simulation

- to study background alpha counts level from cosmic protons in a boron loaded scintillator
- to estimate energy thresholds for different primary particles
- MC engine is **Geant4**

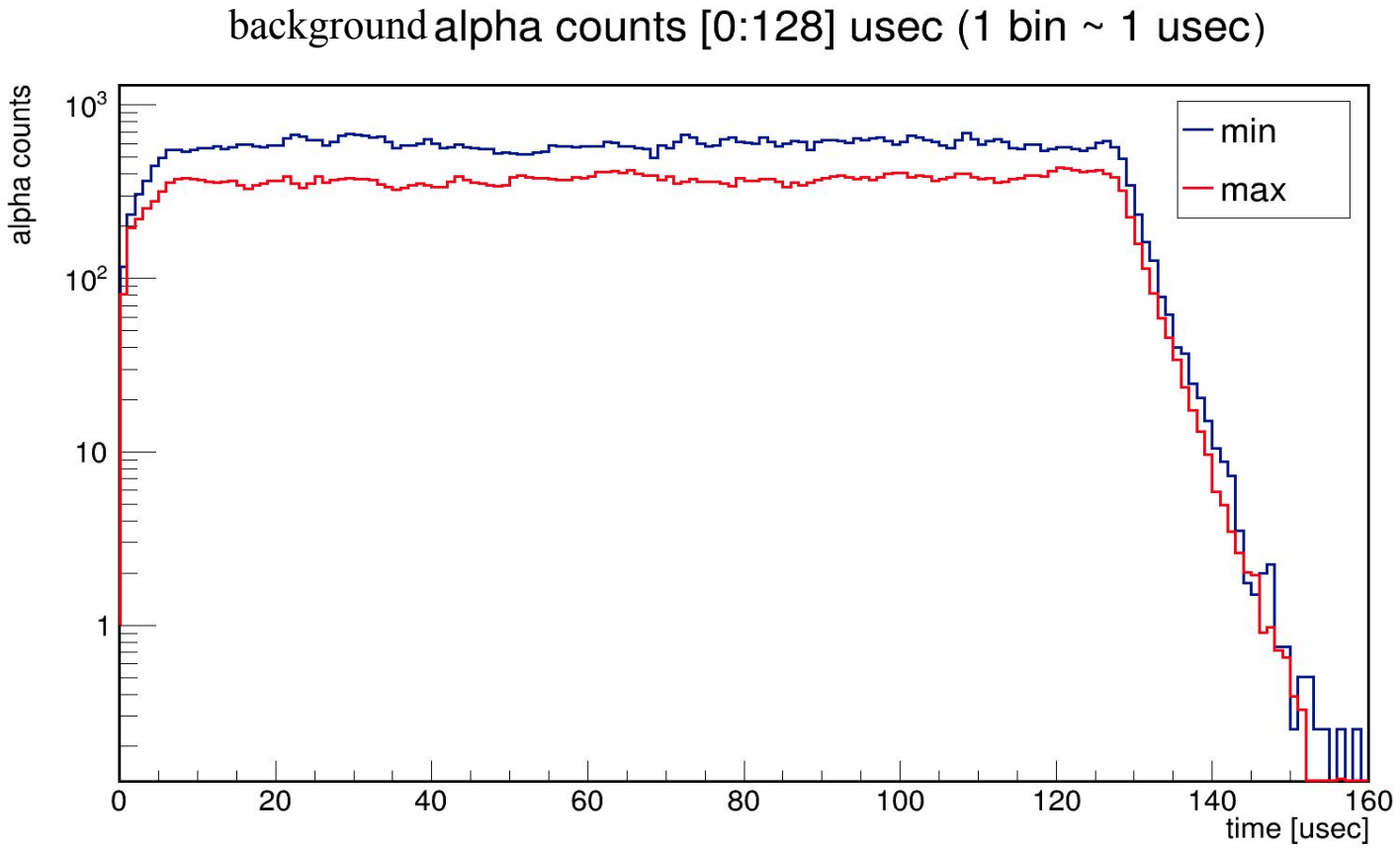
Monte-Carlo model of the OLVE-HERO



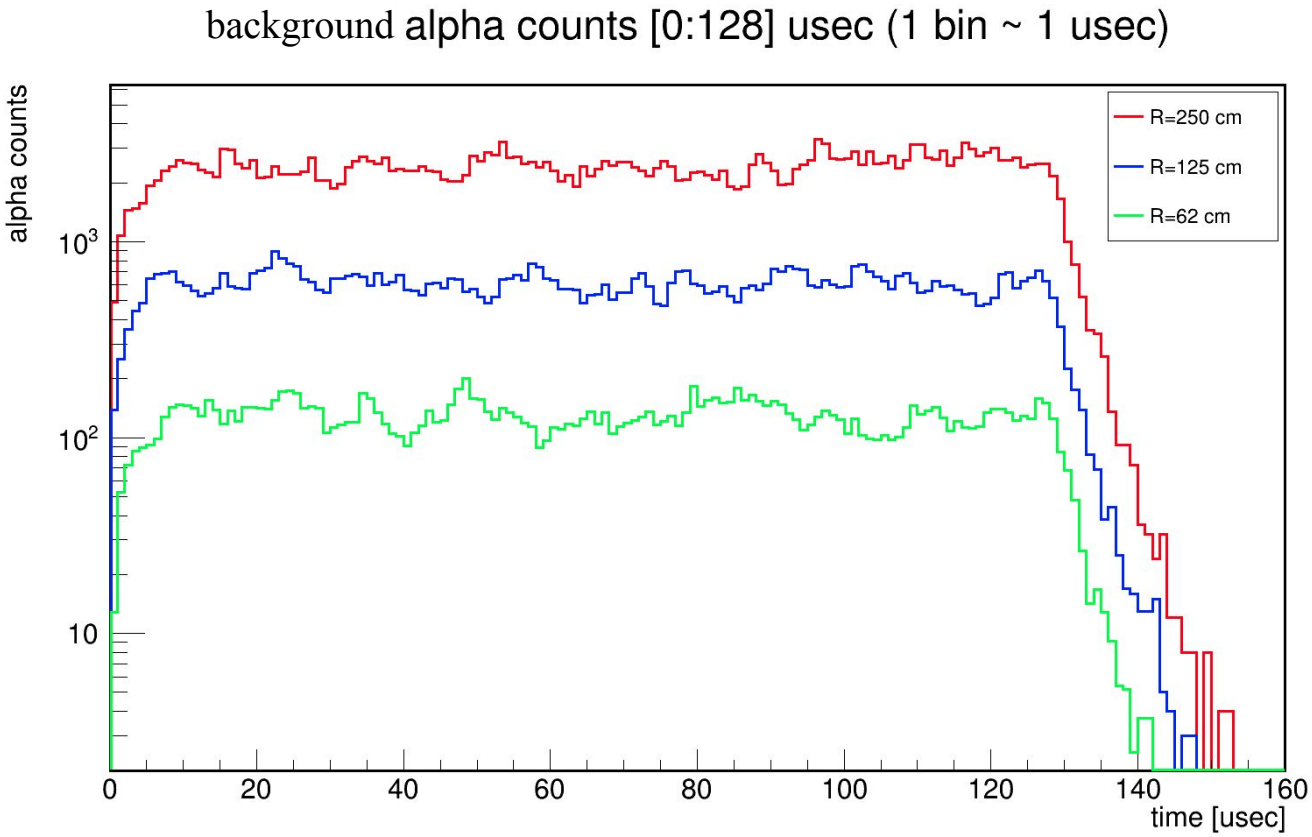
Cosmic proton flux from PAMELA experiment



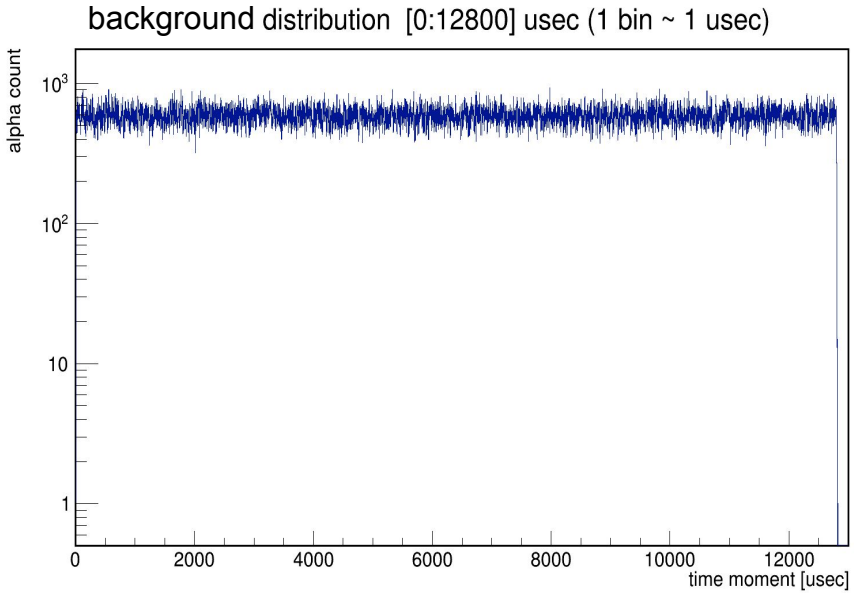
Monte-Carlo alpha counts from CP for min / max SA

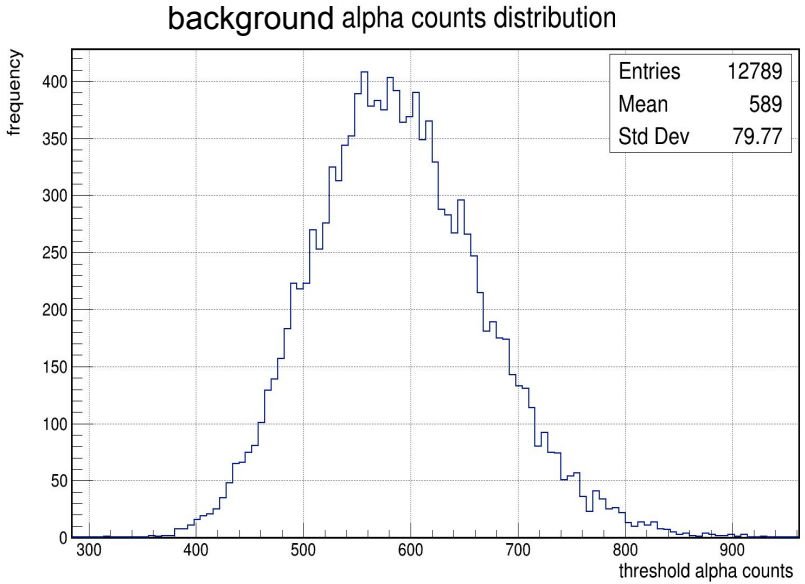


for different detector sizes

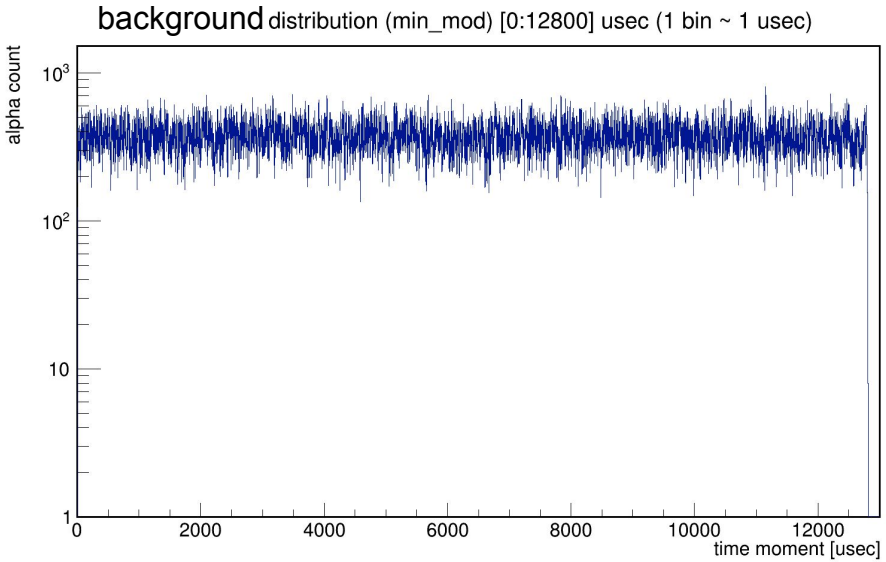


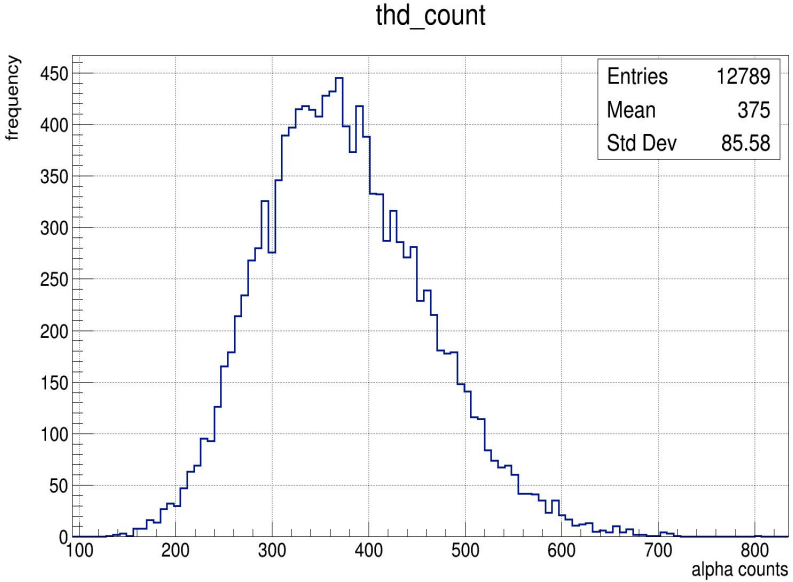
Minimum solar activity



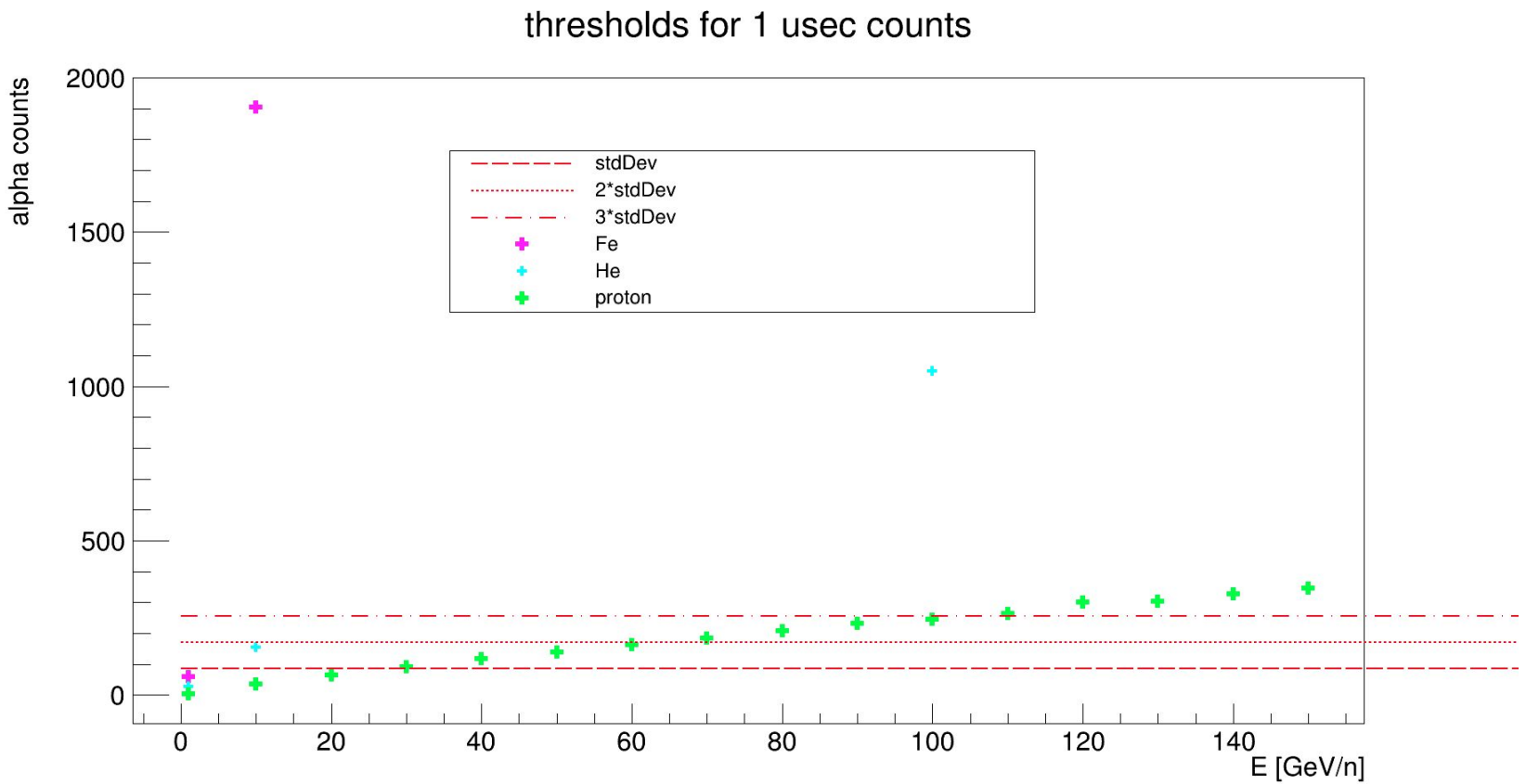


Maximum solar activity





Estimation of energy thresholds

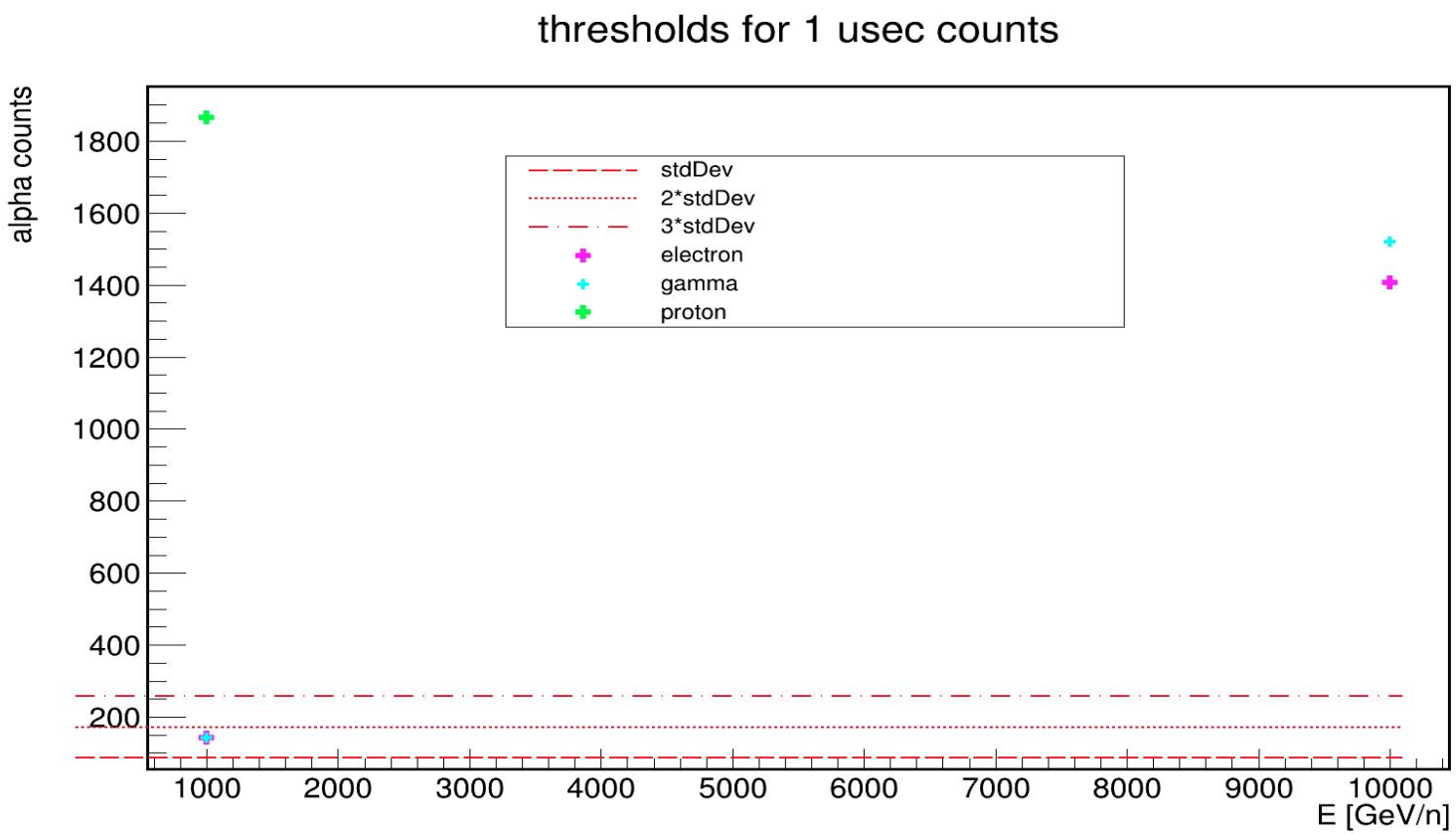


Conclusion of Monte-Carlo estimates

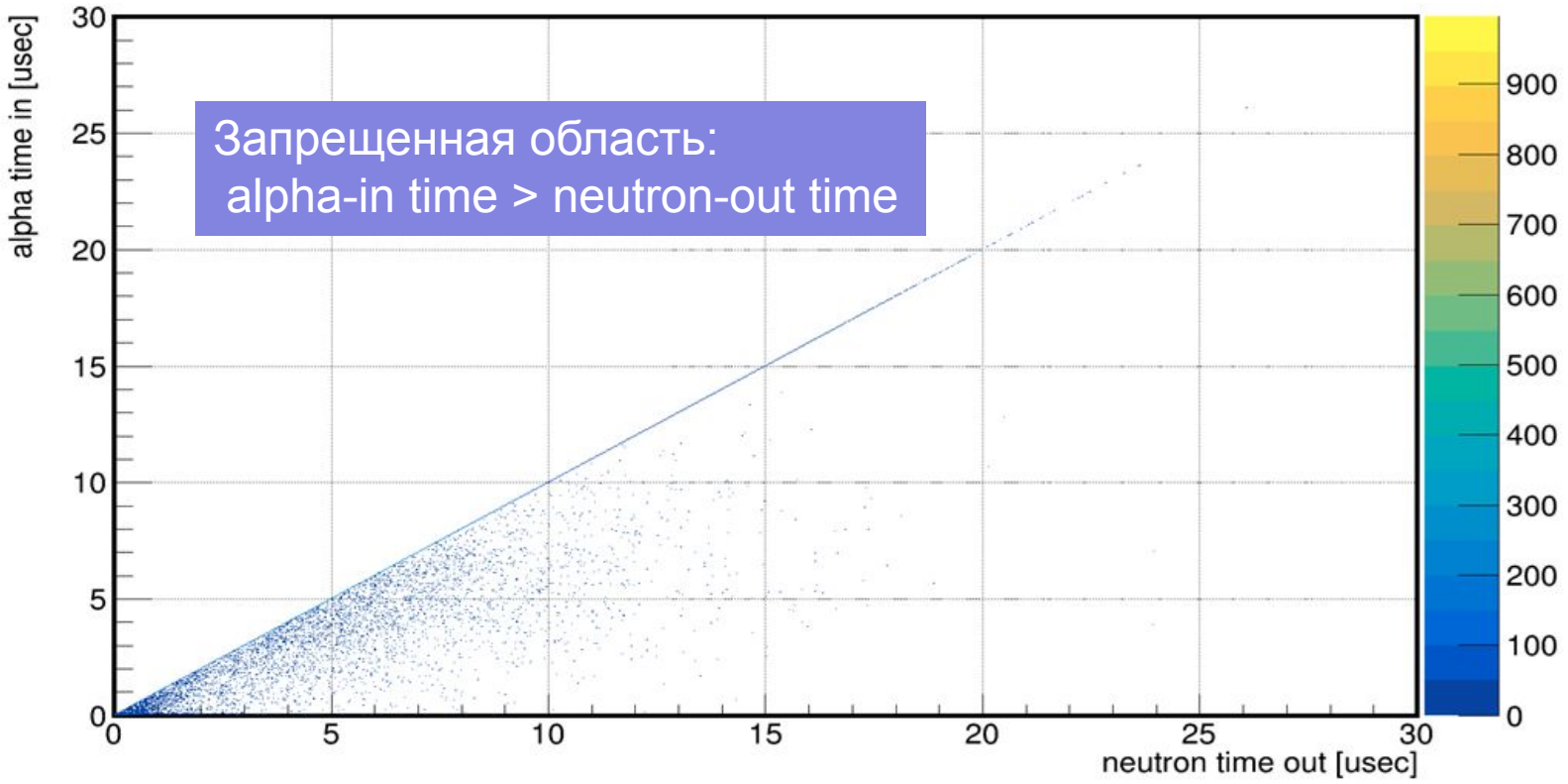
- background level of alpha particles from cosmic protons:
  - ~ 600 particles/microsecond at min solar. activity
  - ~ 400 particles/microsecond at max solar. activity
- thresholds: Fe ~ 10 GeV, He ~ 100 GeV, p ~ 100 GeV (95%)
- threshold: e- and gamma ~ 10 TeV

Thank you for your attention!

Estimation of energy thresholds



Результаты моделирования детектора ОЛВЭ-HERO



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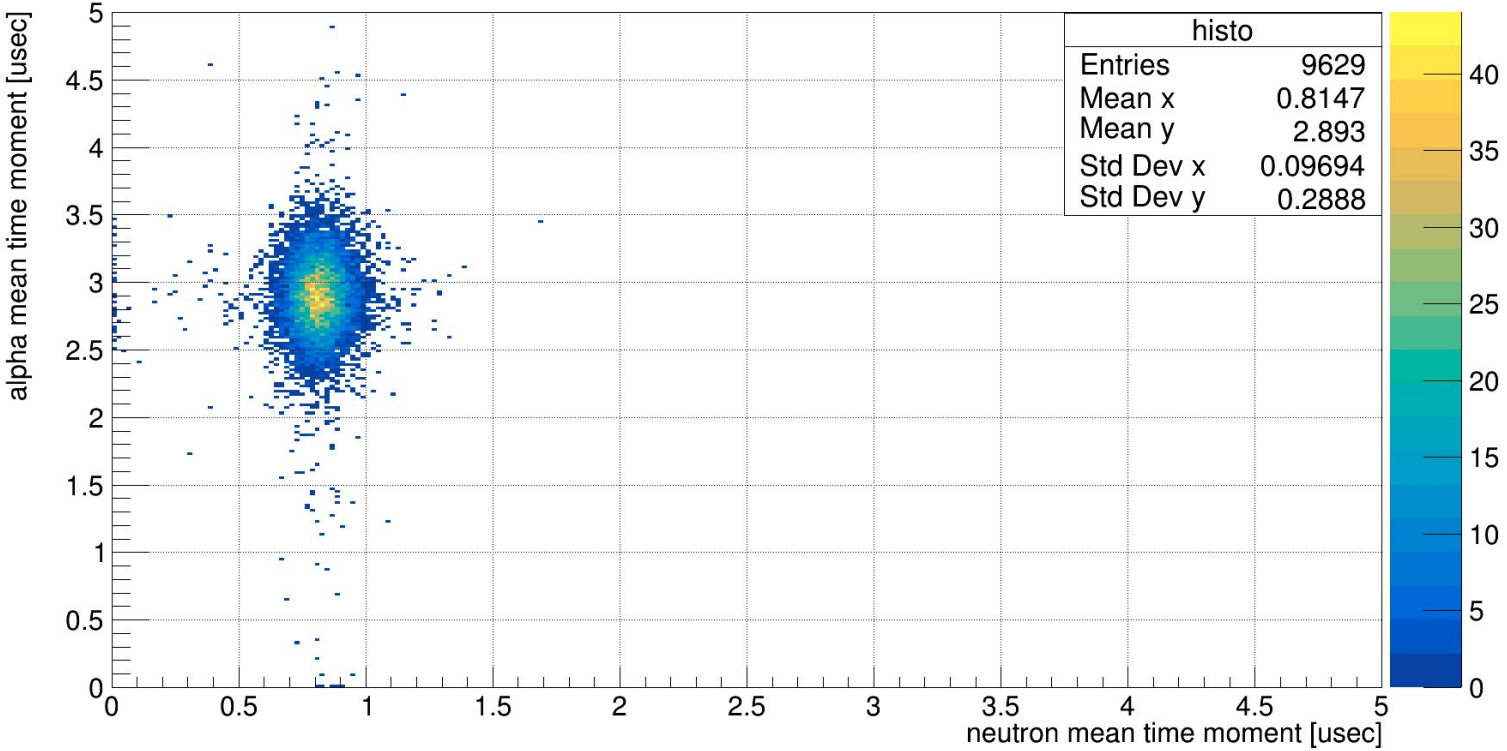

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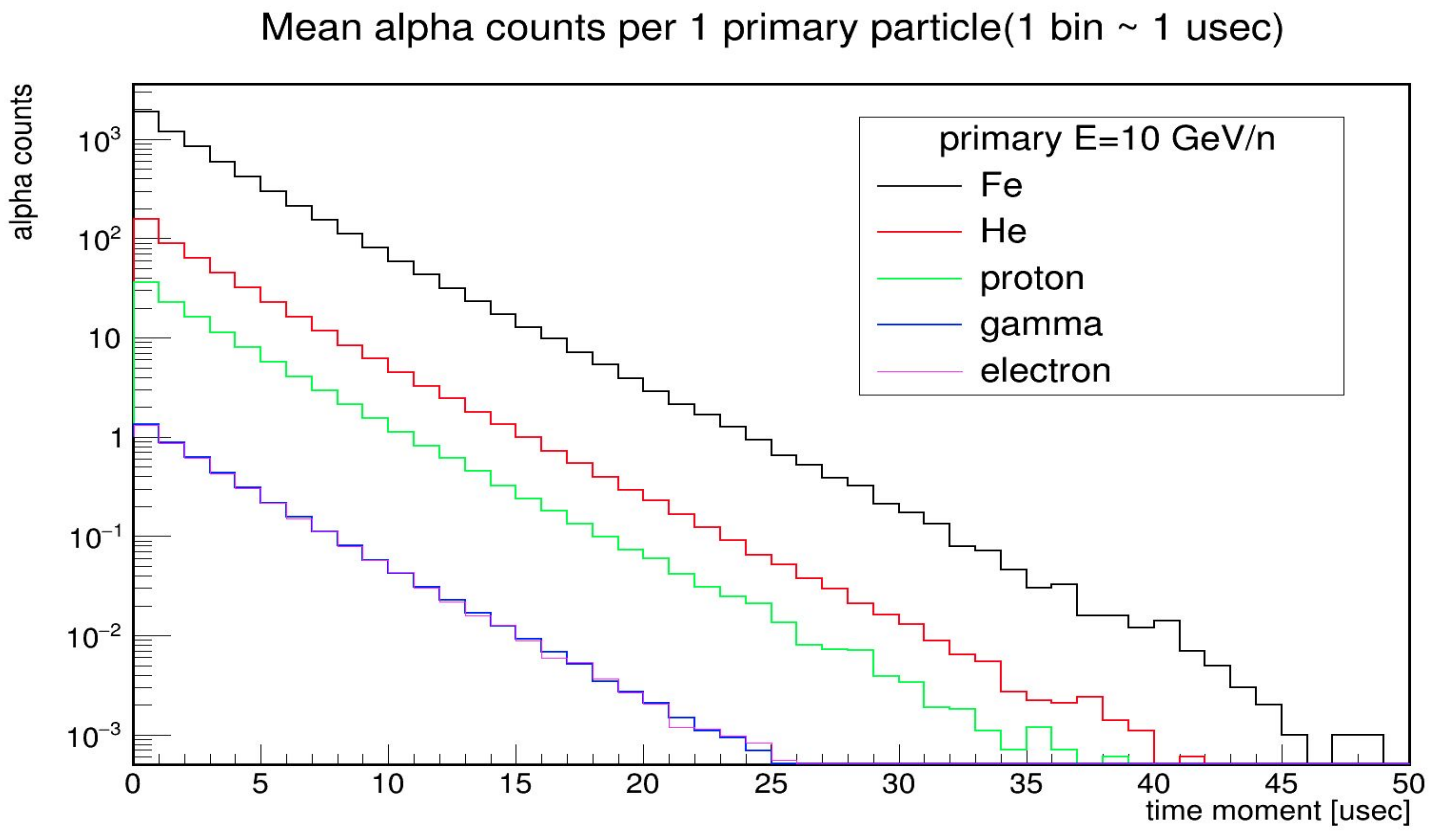
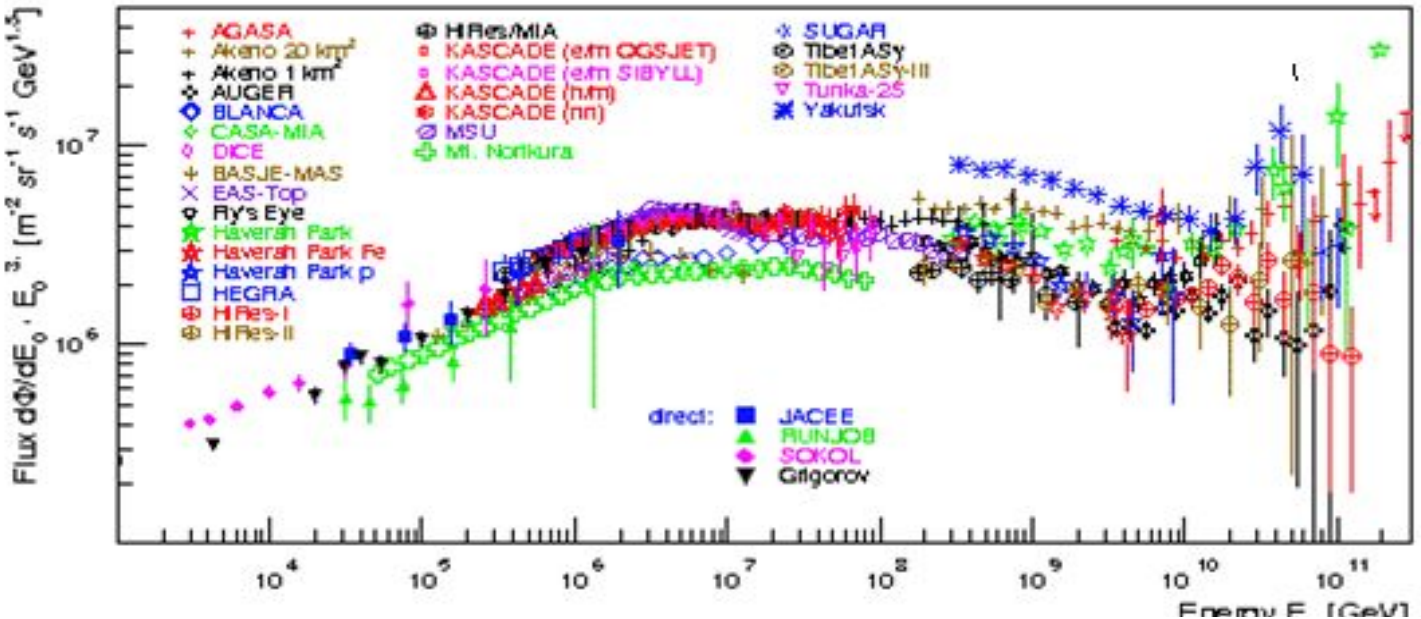


There is a large difference in data for the CR nuclear component flux and composition around of the knee region



Galactic CR

- The total energy density of CR particles is about 1 eV / cm^3
- About 1% of energy from SN required to sustain CR abundance
- At 1 TeV, B~1uG, Gyro-Radius ~ 200 AU, 0.001 pc → **Highly isotropic**

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