Energy spectra of protons and helium nuclei measured by the cosmic ray NUCLEON experiment

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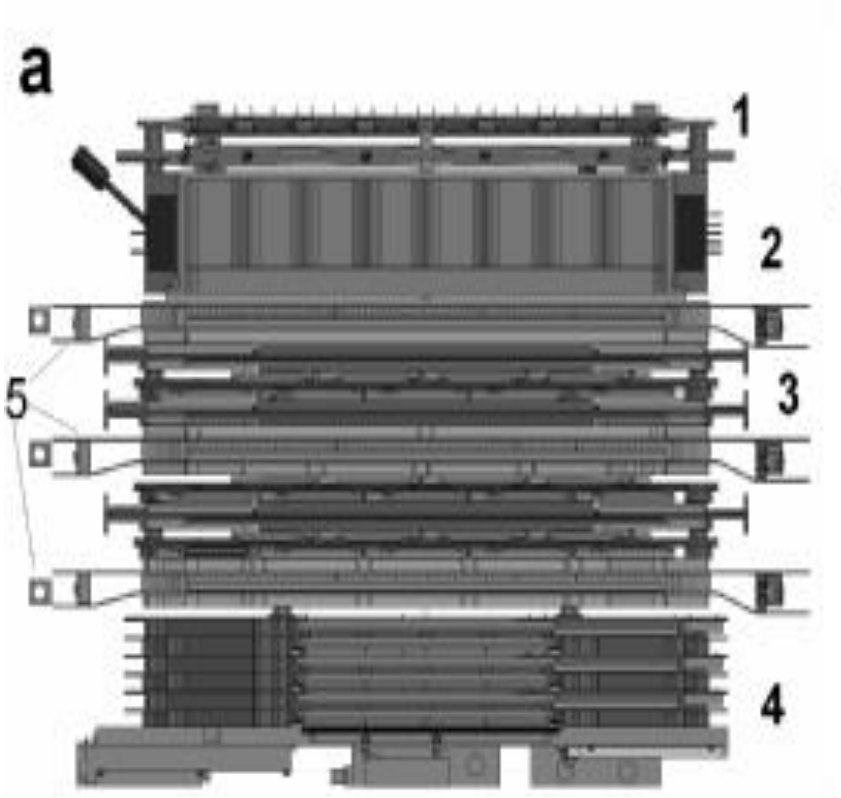
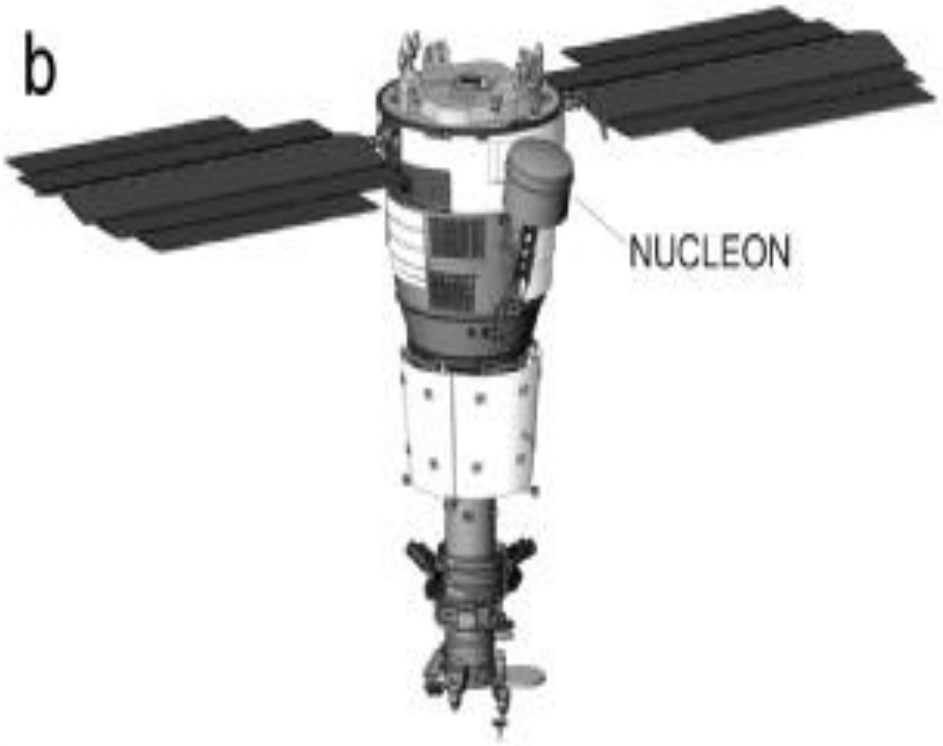
Abstract

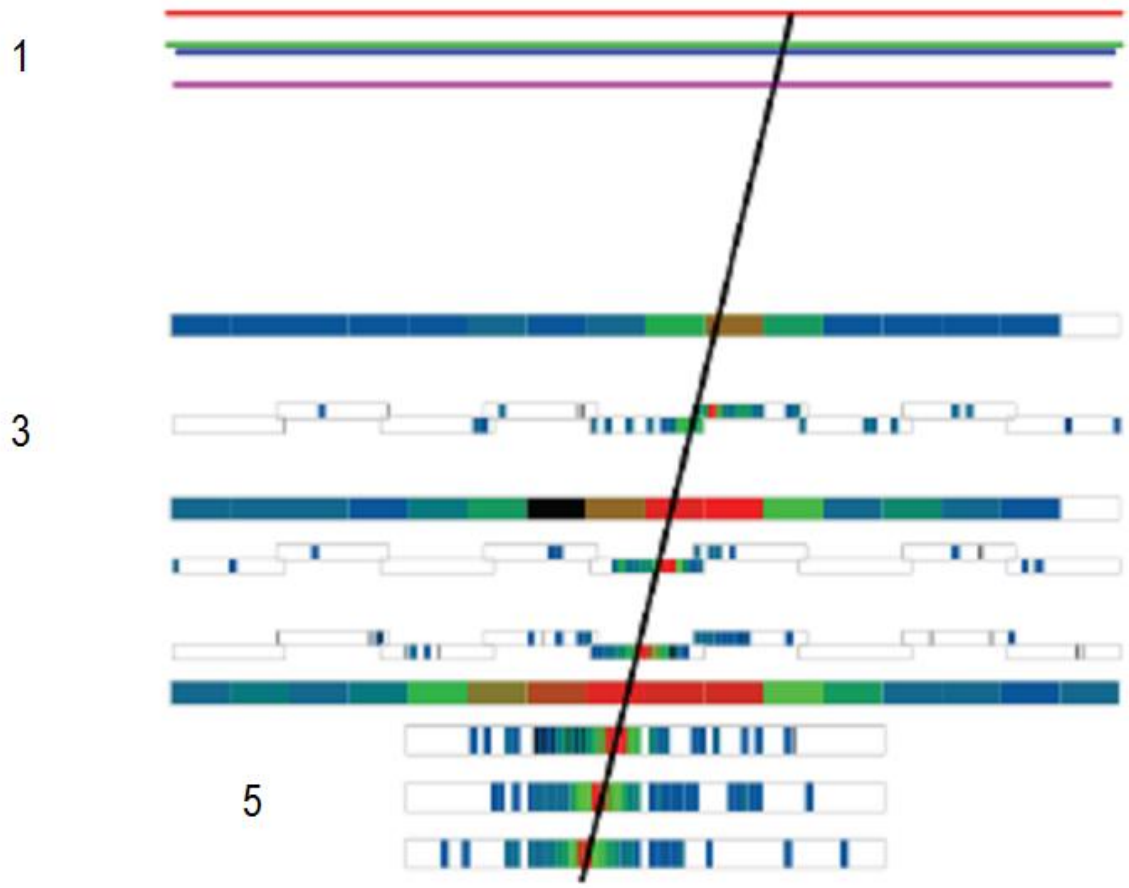
The NUCLEON satellite experiment is designed for direct measurements of the energy spectra of cosmic-ray nuclei and the chemical composition (Z=1-30) at an energy range up to 1000 TeV. The energy spectra of protons and helium nuclei are presented. Some spectral peculiarities were found. The differences of protons and helium spectra are investigated.

NUCLEON



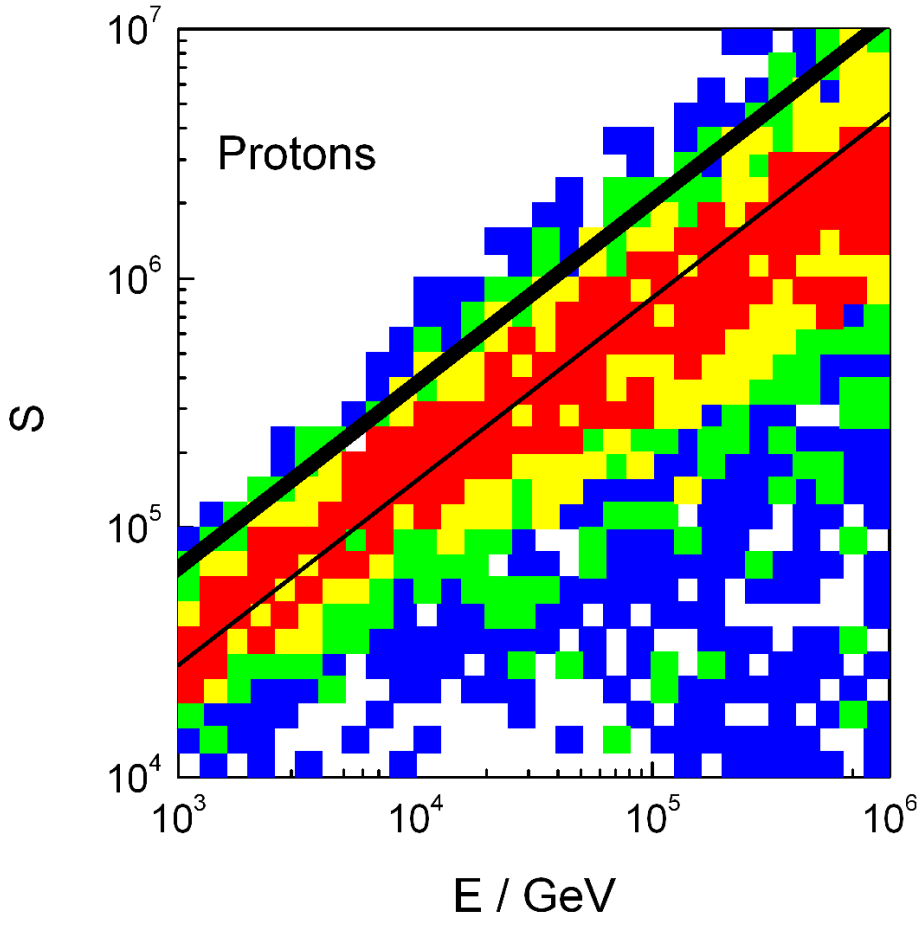


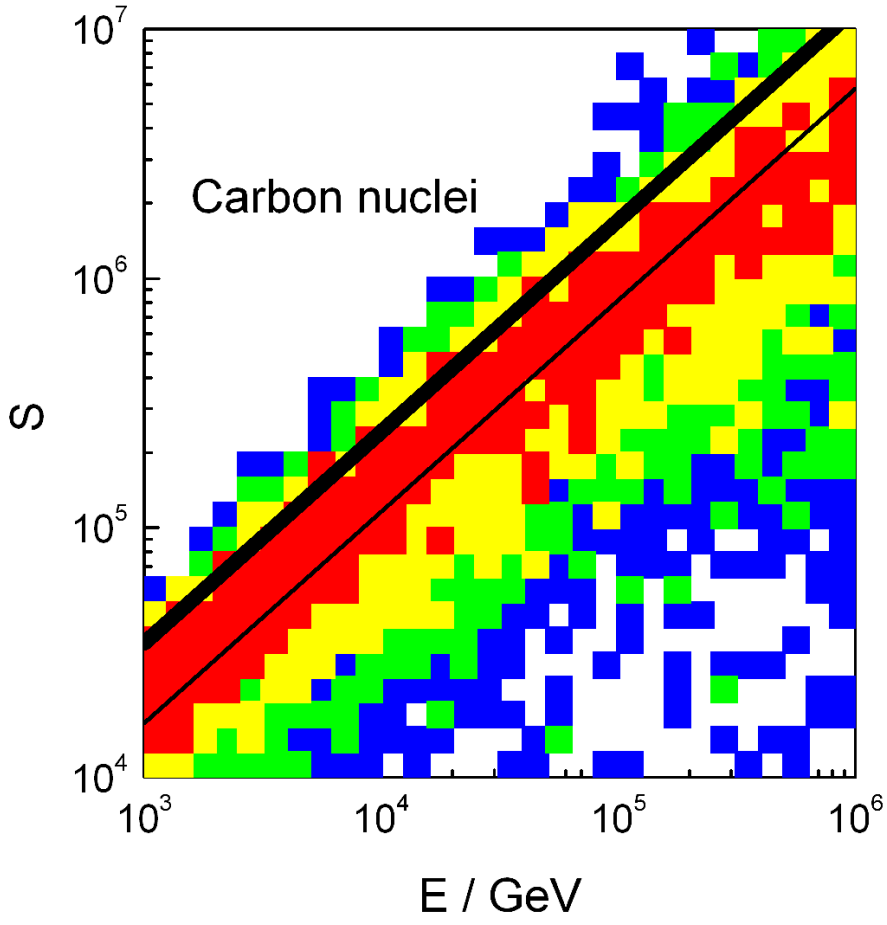
The image of the event. The nucleus initialized the shower. (1) - two pairs of charge measurement system planes; (3) - 6 planes of energy measurement system utilizing the KLEM technique; (5) - calorimeter



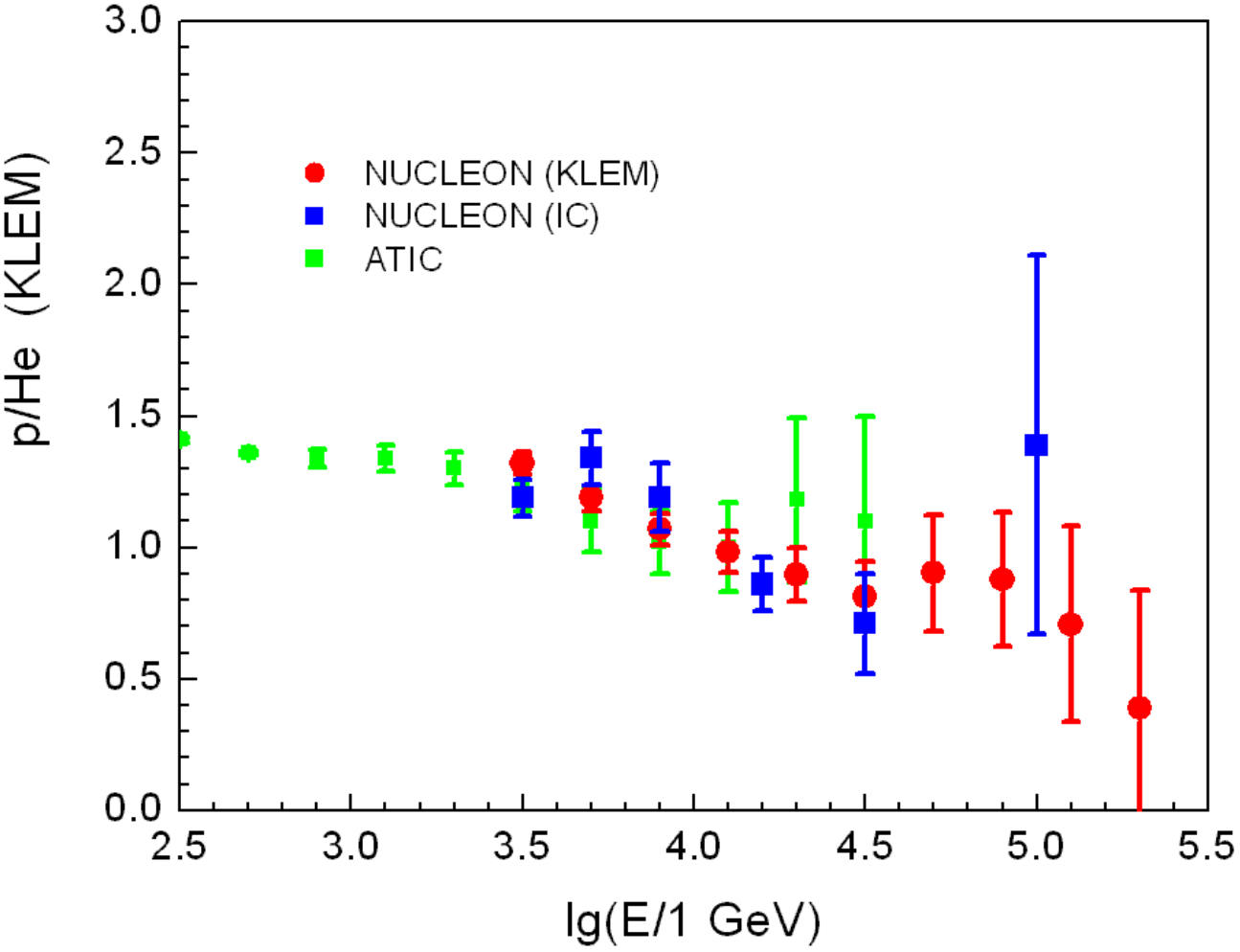
The S-estimator is defined as:

$$S=\Sigma I_k \ln^2(2H/x_k)$$

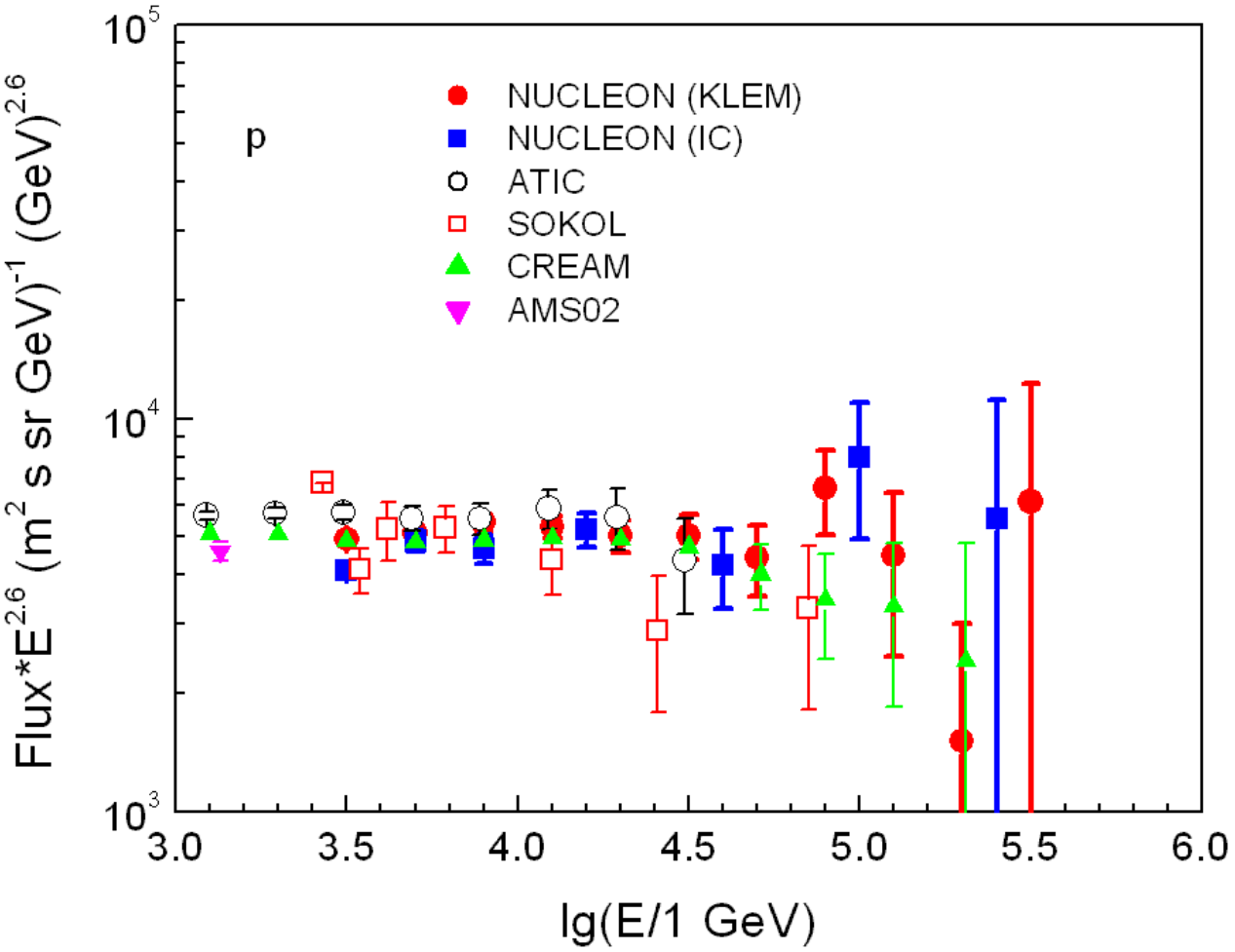




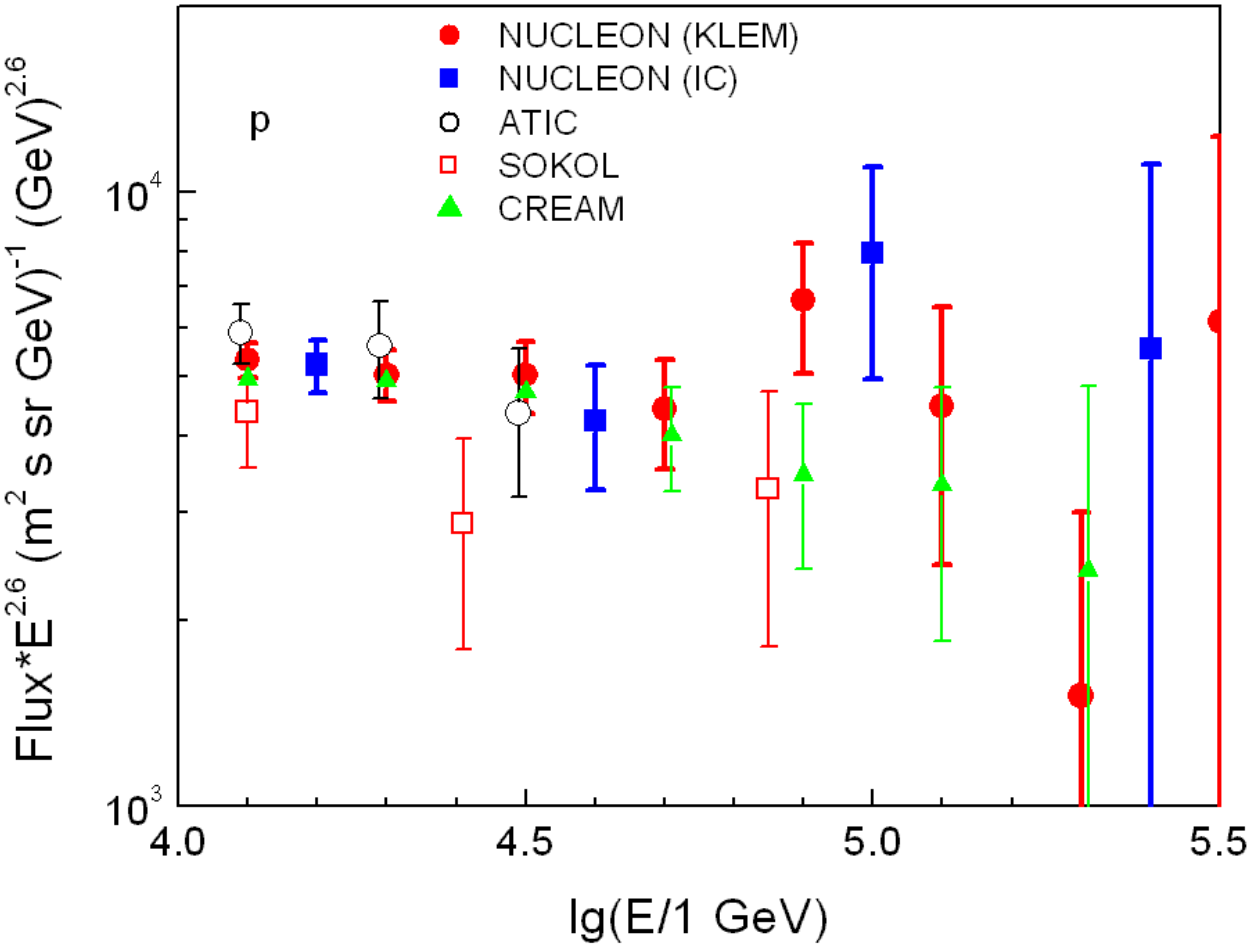
p/He ratio


NUCLEON (KLEM)
NUCLEON (IC)
ATIC
p/He (KLEM)
lg(E/1 GeV)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5

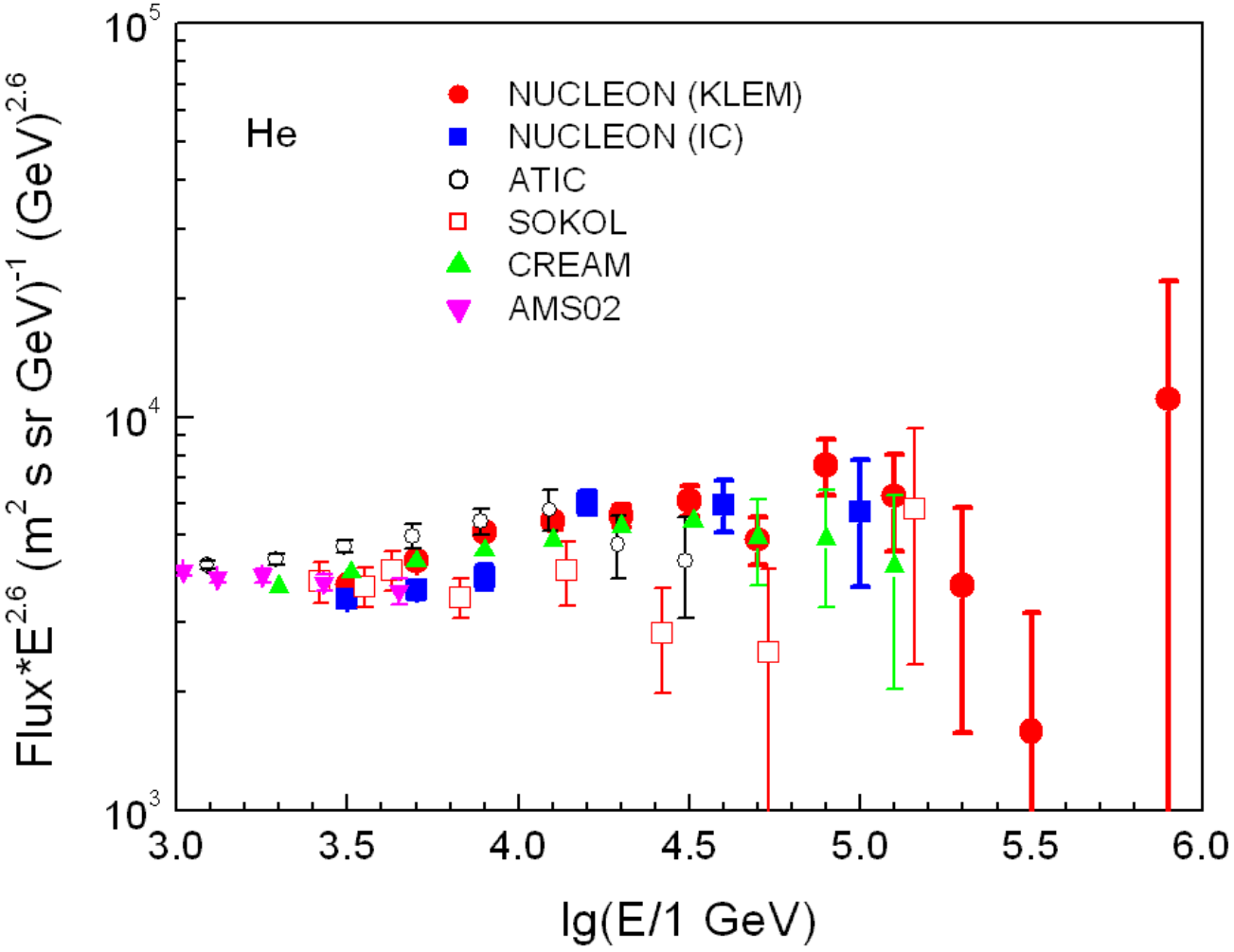
Proton spectra



Proton spectrum peculiarity



Helium spectra



Main results

- The obtained energy spectra show good consensus on two different techniques of energy measurements. Thus, operability of a new KLEM technique in the wide energy range is confirmed.
- There are peculiarities of protons and light nuclei spectra at 30-50 TeV/particle or near 3 TeV/nucleon. A remarkable hardening of spectra is observed; this can possibly be explained by the presence of a few local sources of cosmic rays

Summary

- There are spectral peculiarities (“bird”).
- The proton and helium spectra are different.
- This difference can be explained by the role of hydrogen-deficient Wolf-Rayet stars as cosmic-ray sources.