Results from the Akeno Experiment

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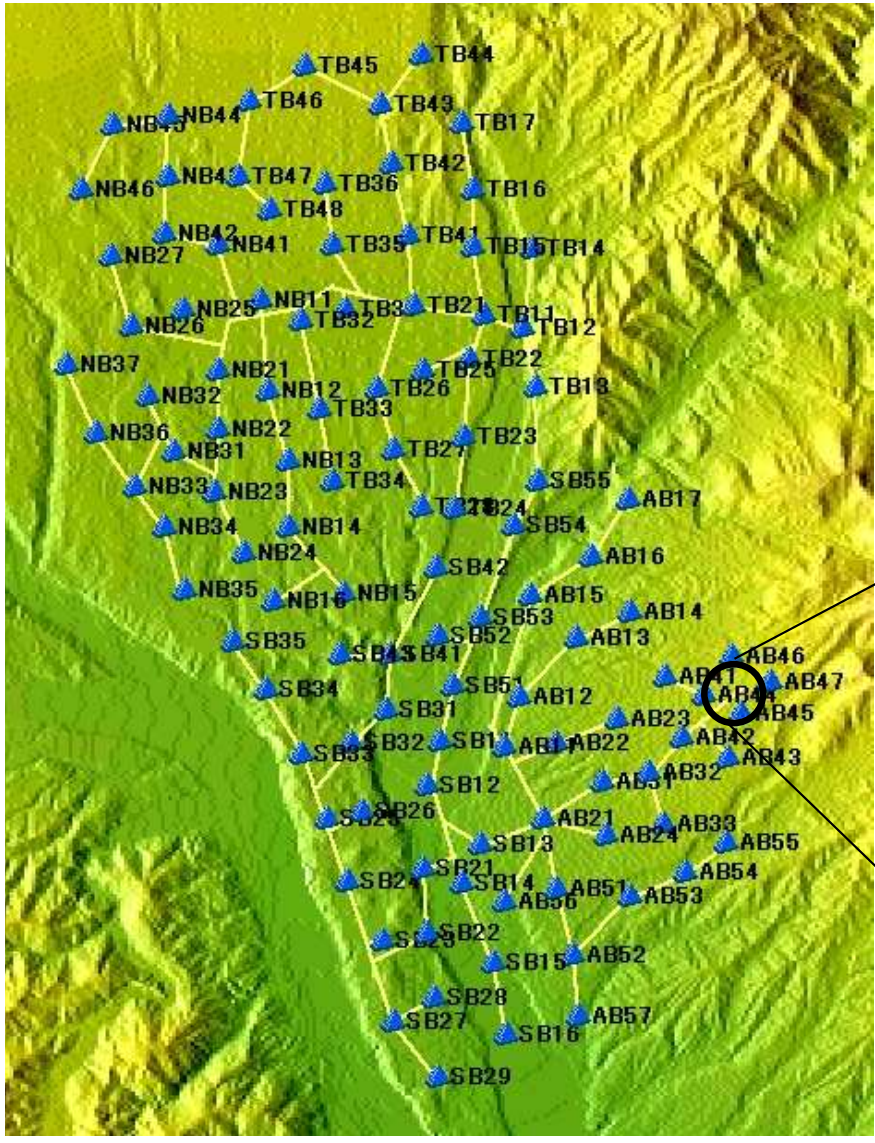
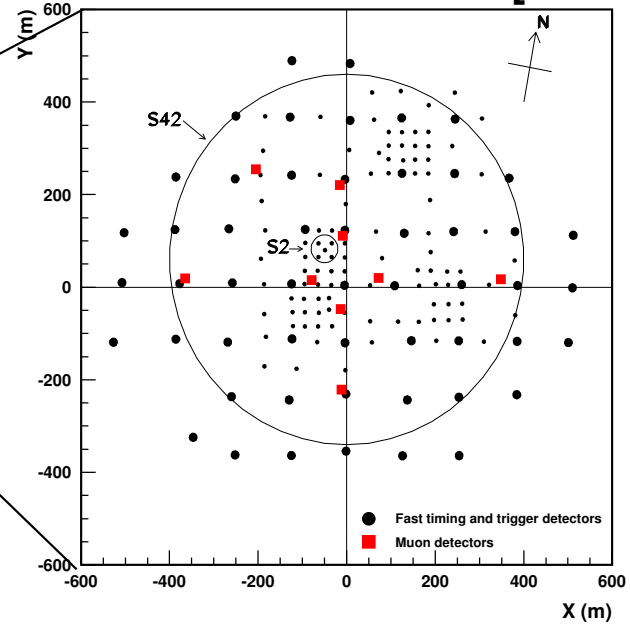
Akeno 1km^2 array

AGASA (Akeno Giant Air Shower Array) [1990–2004]



35° 47’ N
138° 30’ E
900m a.s.l.

Akeno 1km^2 array **[1979–1996**



Detector

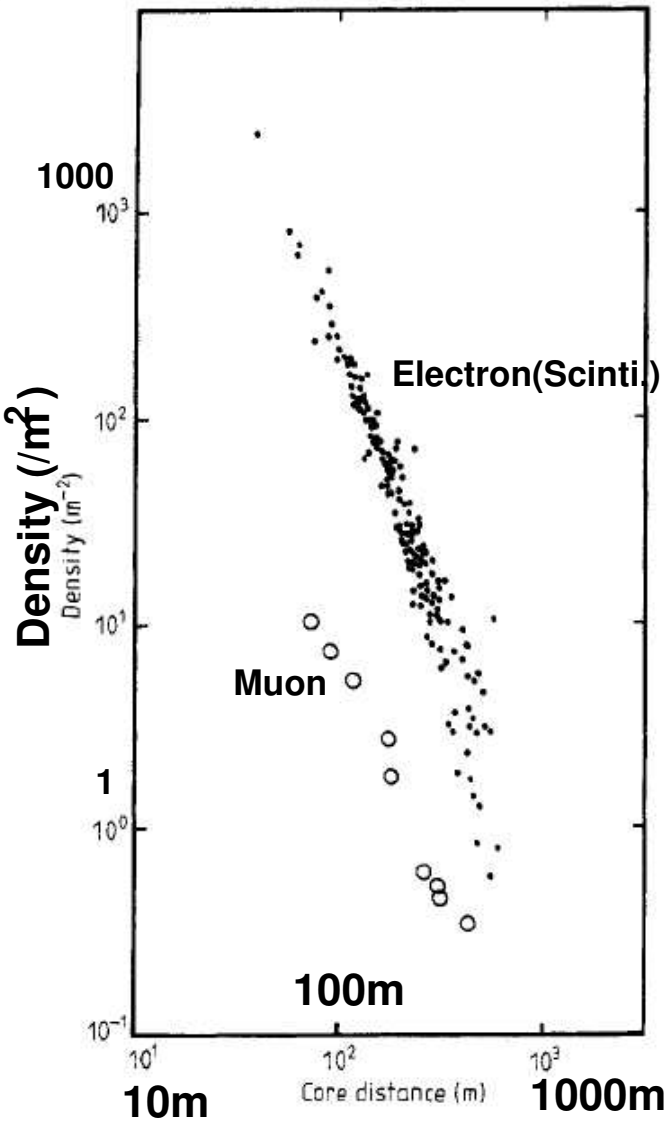
Akeno Observatory

156 scintillation detectors ($1m^2$)

9 muon stations ($25m^2$)

(50 proportional counters are put under the shield (1GeV threshold))

Lateral distribution of Shower particles



Electron

$$\rho_e = \frac{N_e}{2\pi R_M^2} \frac{\Gamma(4.5-s)}{\Gamma(4.5-2s)\Gamma(s)} \left(\frac{r}{R_M}\right)^{s-2.0} \left(1+\frac{r}{R_M}\right)^{(s-4.5}$$

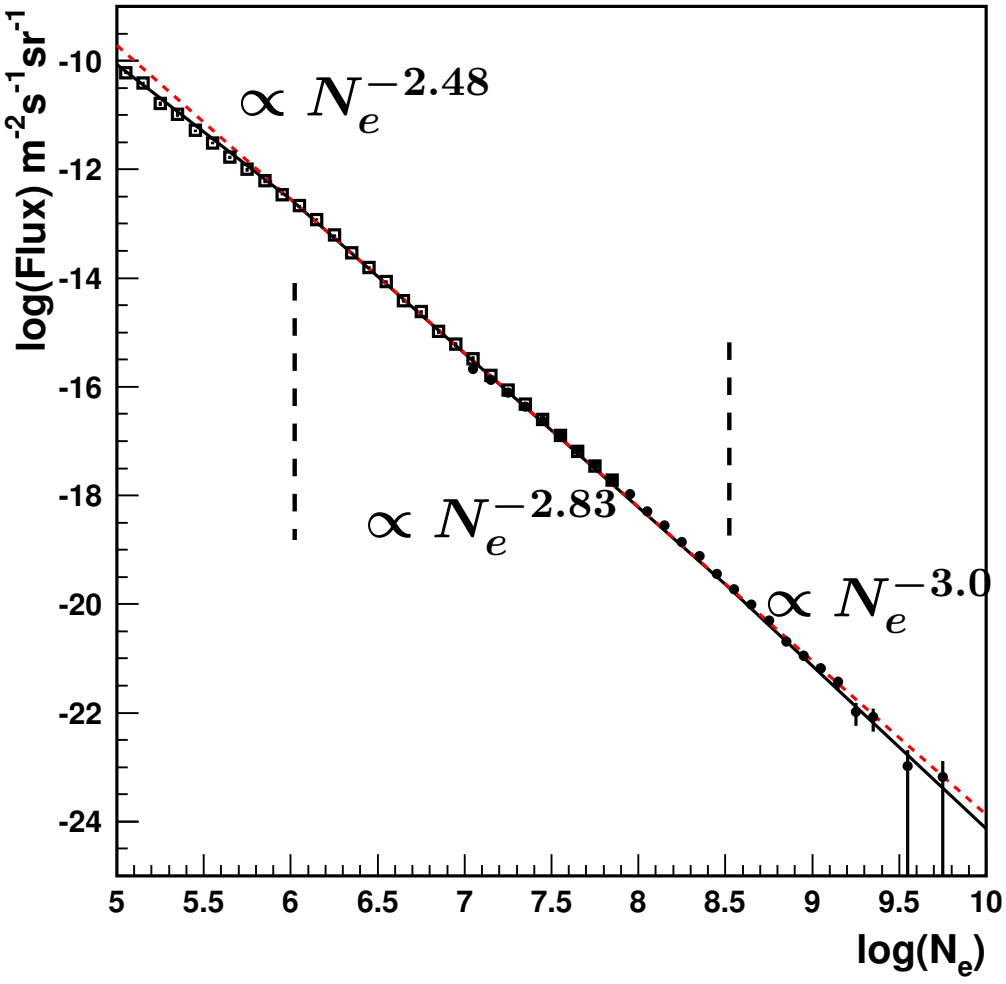
determine core pos., size(N_e),age(s)

Muon

$$\rho_\mu = \frac{0.258}{R_0^2} N_\mu \left(\frac{r}{R_0}\right)^{-0.75} \left(1+\frac{r}{R_0}\right)^{-2.5}$$

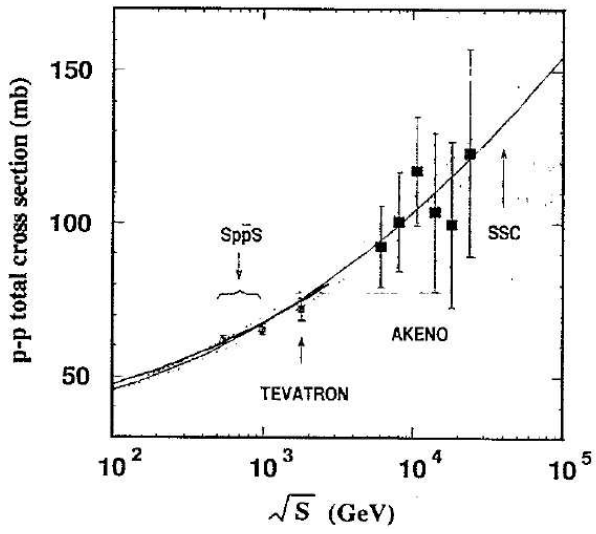
determine Muon size(N_μ)

Electron Size Spectrum

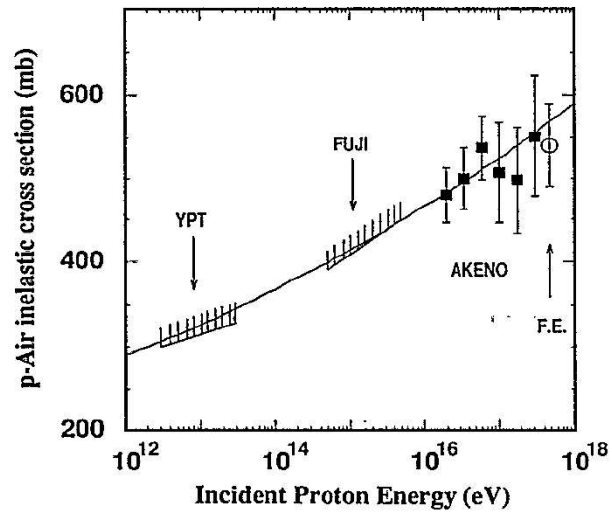


Cross section

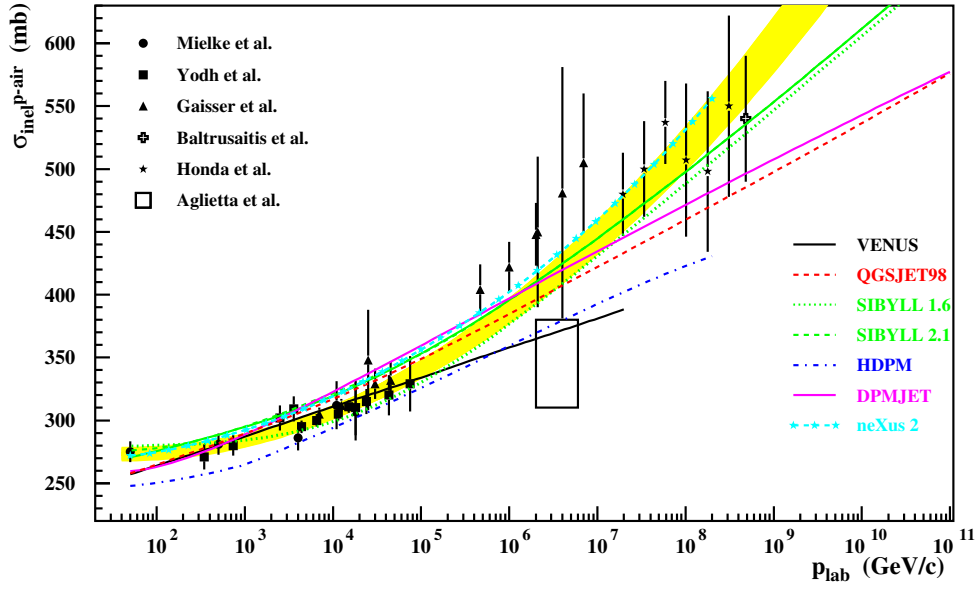
p–p



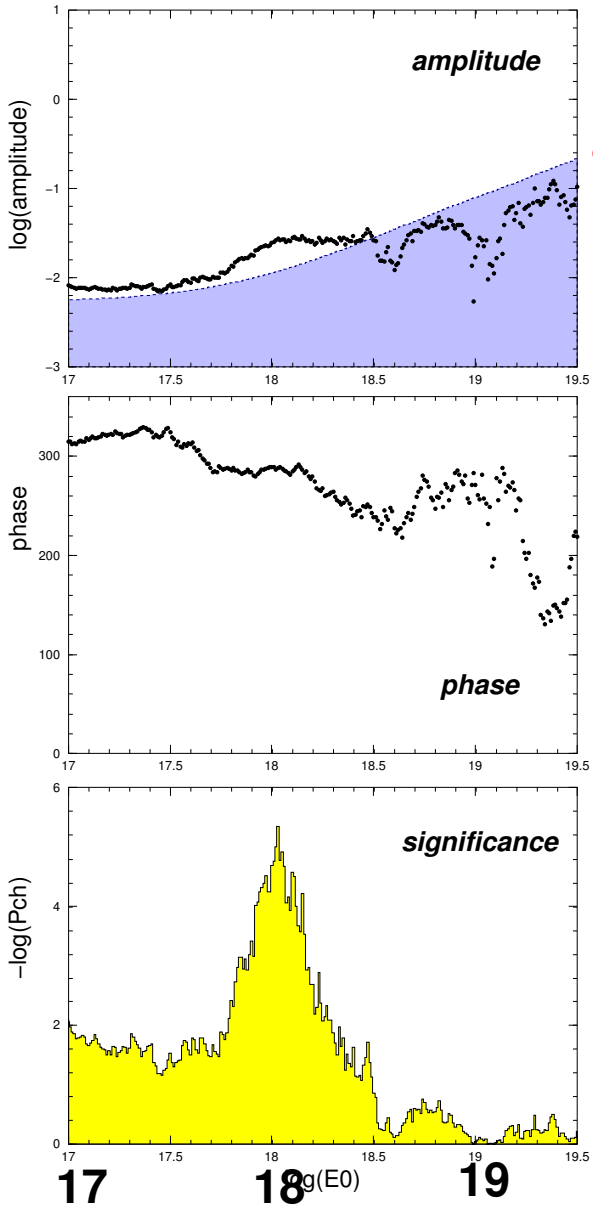
p–Air



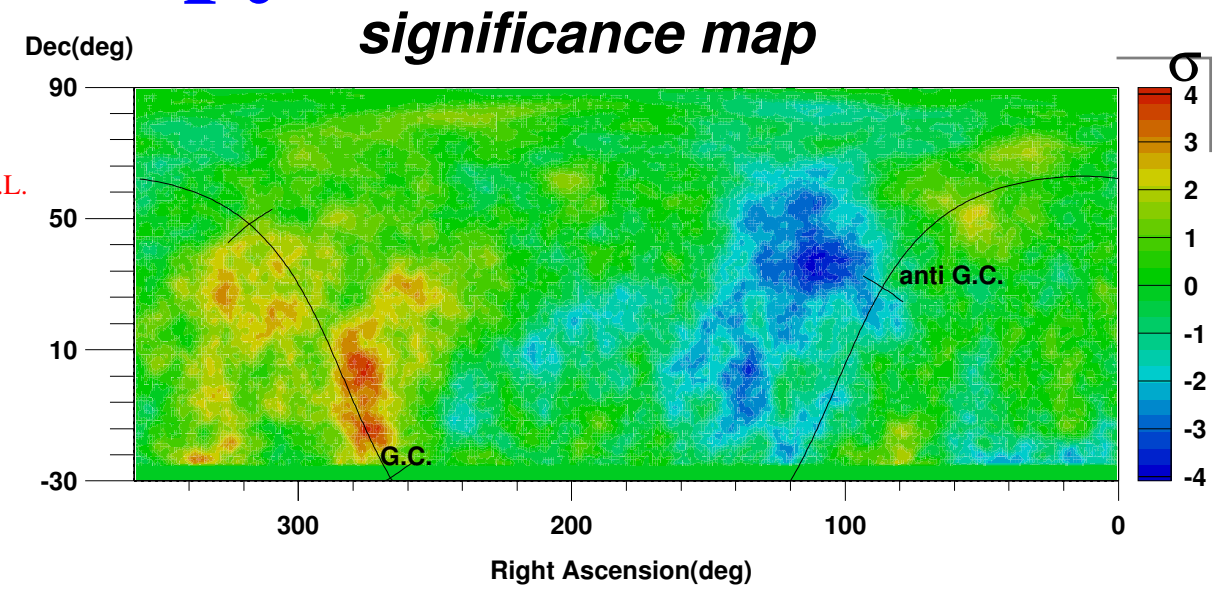
p–Air



AGASA anisotropy around 10^{18}eV

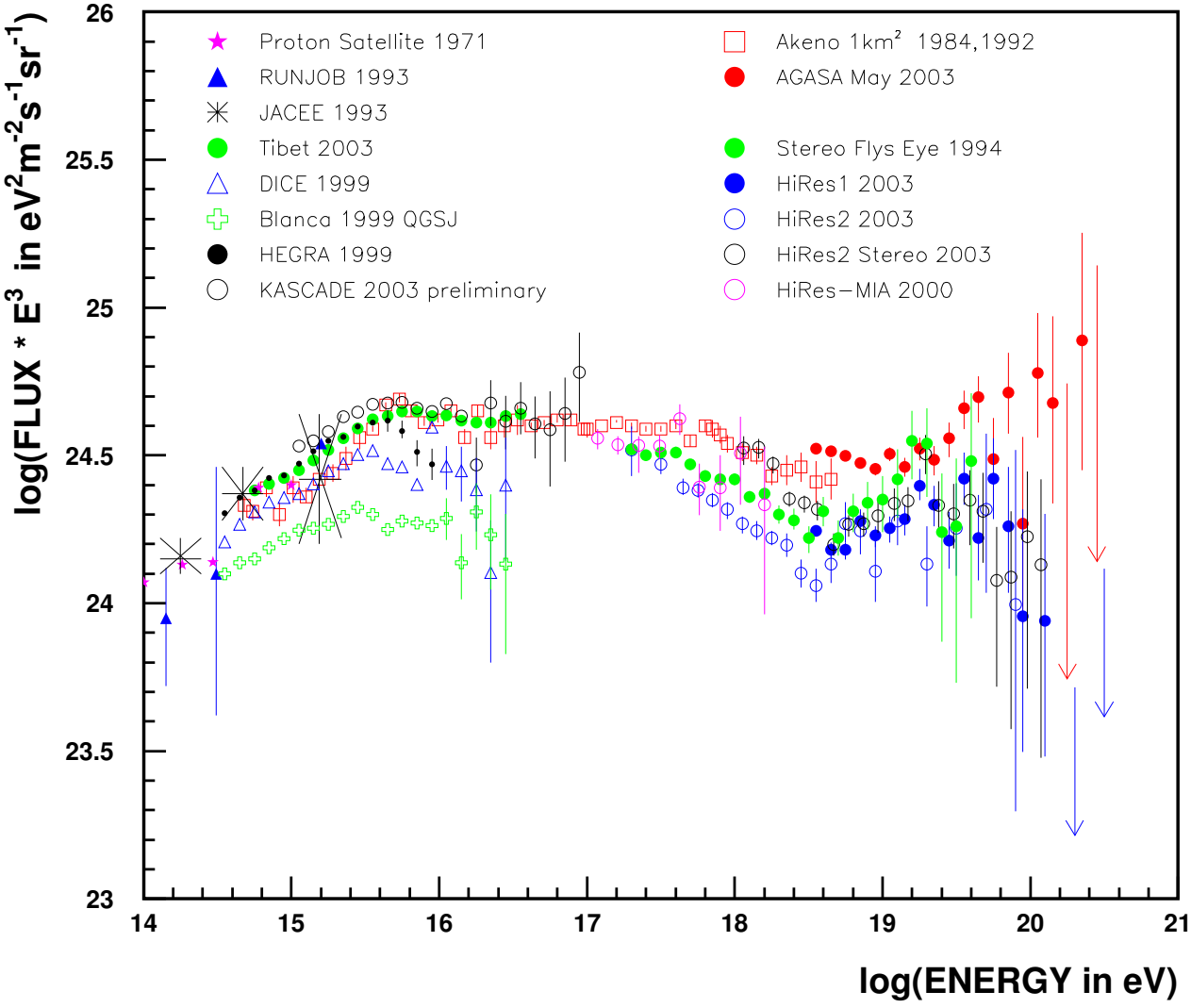


90%C.L.



Clear Evidence for the Galactic Cosmic Rays at 10^{18}eV

Cosmic Ray Energy Spectrum



Analysis

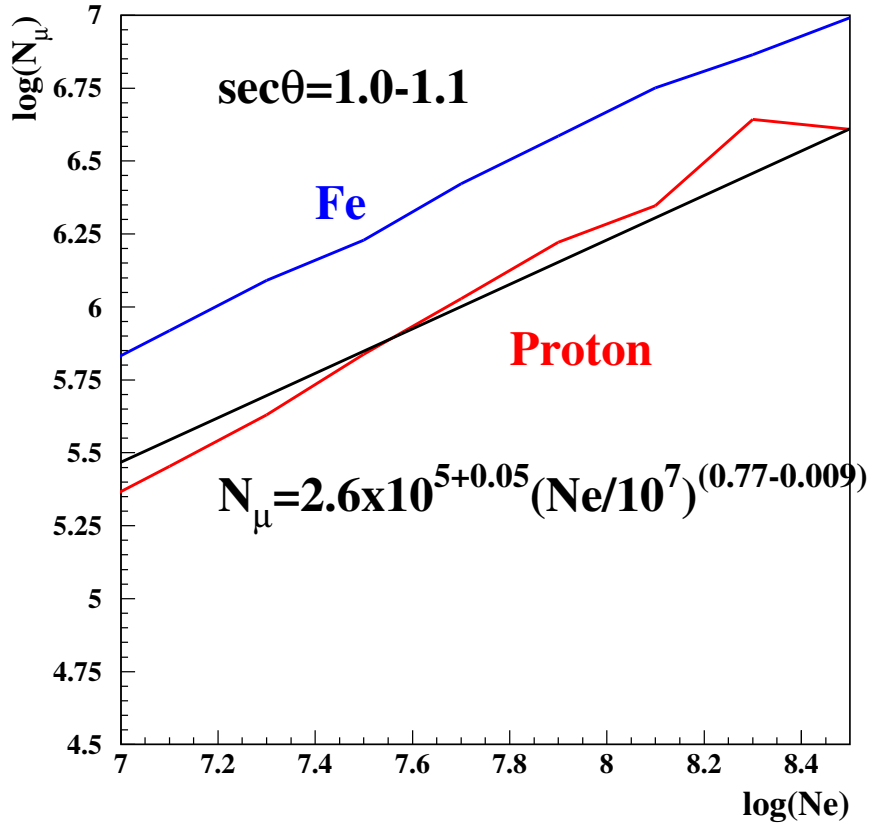
- The data for Oct. 1981 - July, 1992 were used.
- Showers with $\geq$7 hit detectors were triggered.
  (Triggering efficiency is almost uniform at $N_e > 10^{7.0}$.)
- Shower cores hit inside of the circle of 400m radius.
- $\sim$570,000 analysed showers

Simulation

- CORSIKA 6.200 + QGSJET01c + FLUKA2002
- Proton / Fe
- $F \propto E^{-3}$
- Scintillator response is included. (Single particle is determined as done in the experiment.)
- N_μ is the muon number at E> 1GeV$\times \sec\theta$.
- Trigger condition, detector position, reconstruction error etc. have not been implemented yet (will be taken into account in the future).

N_e-N_μ relation

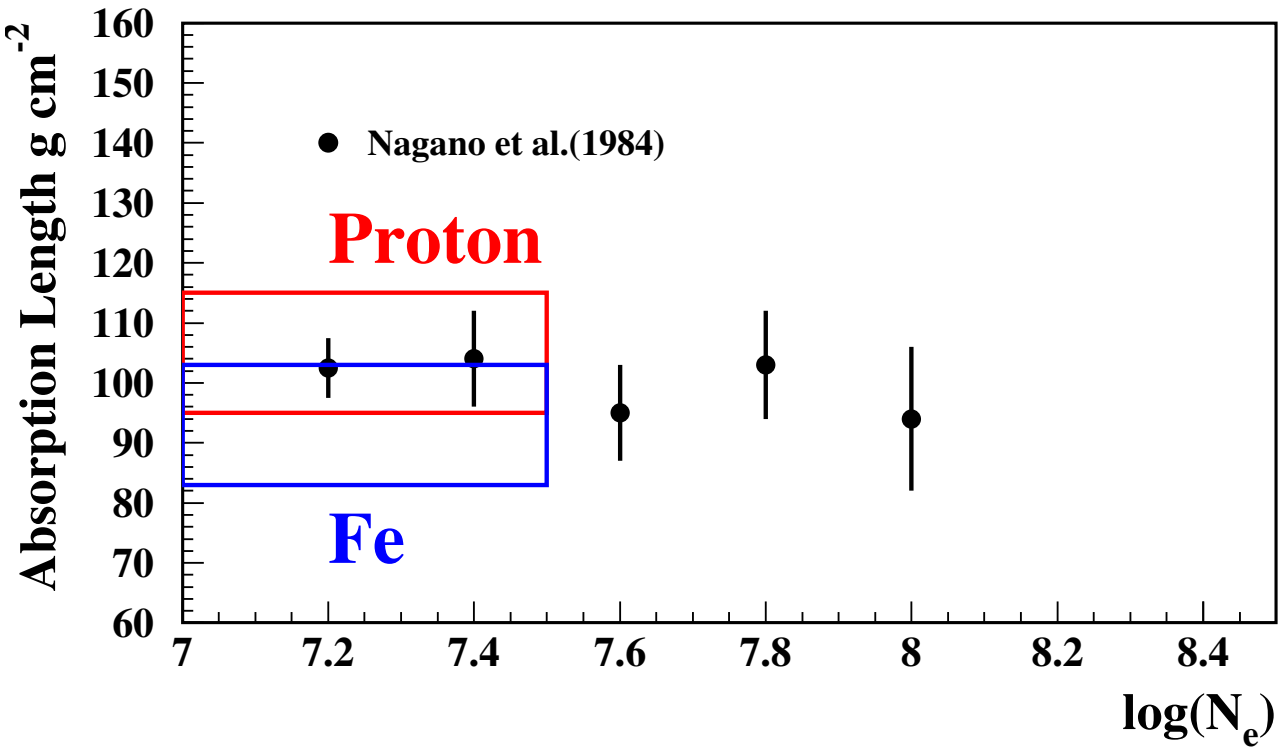
Very Preliminary



Absorption length

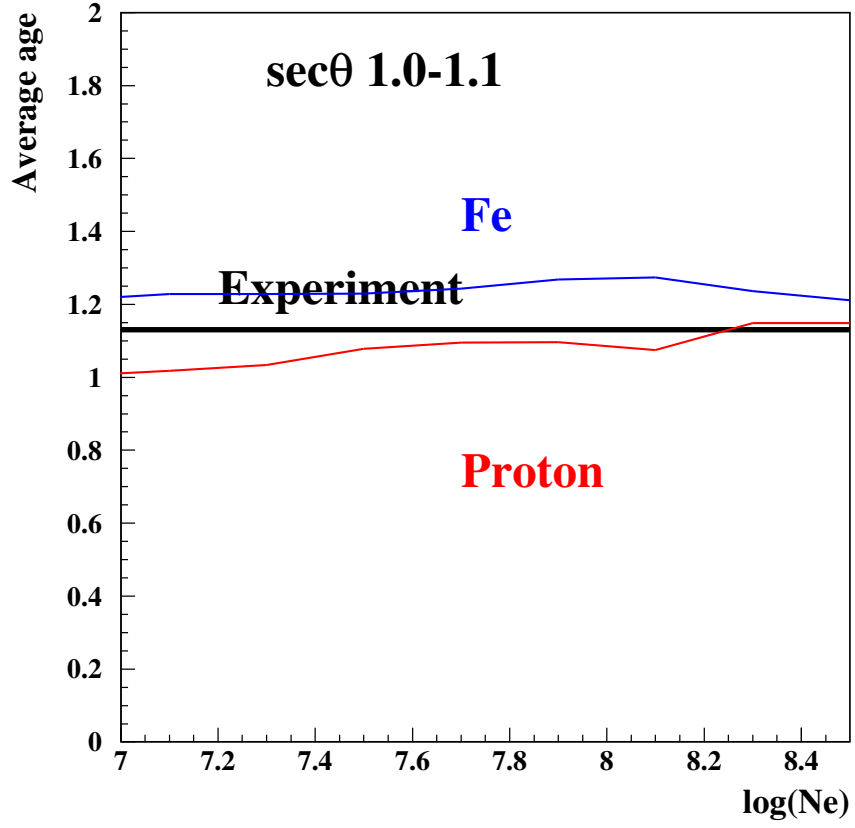
(Flux attenuation with zenith angle)

Very Preliminary



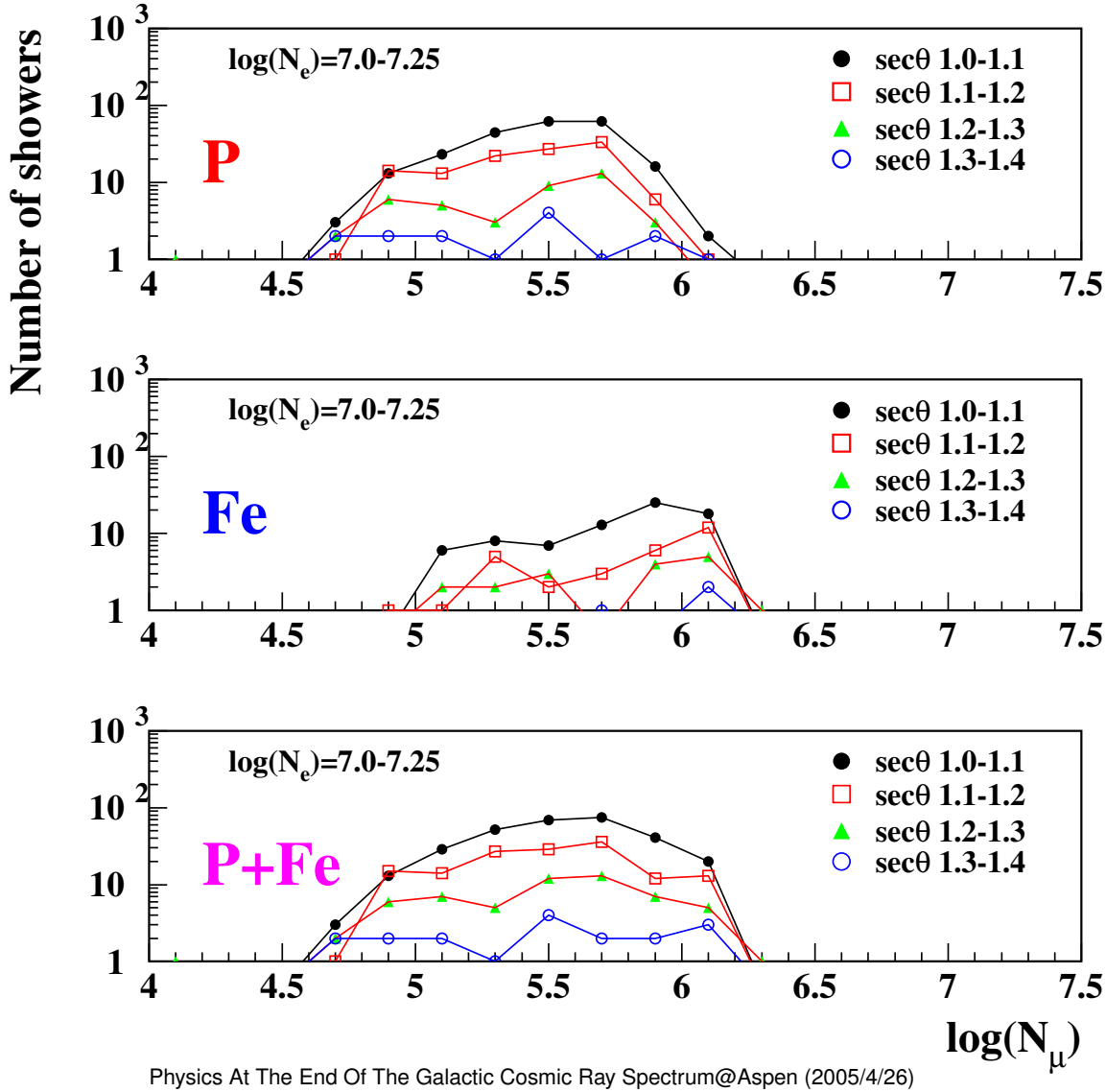
Age (s parameter)

Very Preliminary



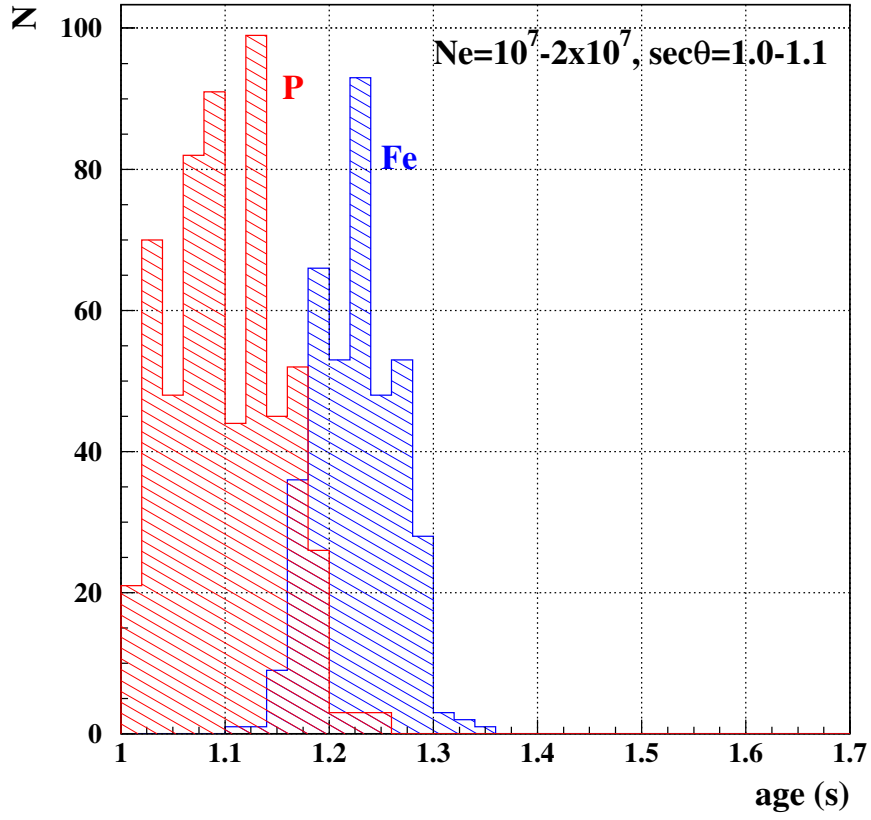
N_μ distribution (simulation)

Very Preliminary



Age fluctuation (simulation)

Very Preliminary



Summary

- Some results of Akeno 1km^2 array are shown. (shower characteristics, size spectra, cross section,...)
- AGASA anisotropy around 10^{18}eV shows the evidence of Galactic cosmic ray existance.
- Only a few experimental results on the chemical composition exist between 10^{16}eV and 10^{18}eV.
  $\Rightarrow$ Interpretation of Akeno 1km^2 data with recent simulation is very important.
- Comparison of Akeno1km^2 data with simulation data is going on to investigate the chemical composition. (in the future ,with different hadronic interaction models (QGSJET, SIBYLL, ...), including trigger condition, reconstruction error)