

THE STATUS OF AUGER

Peter L. Biermann^{1,2,3,4}

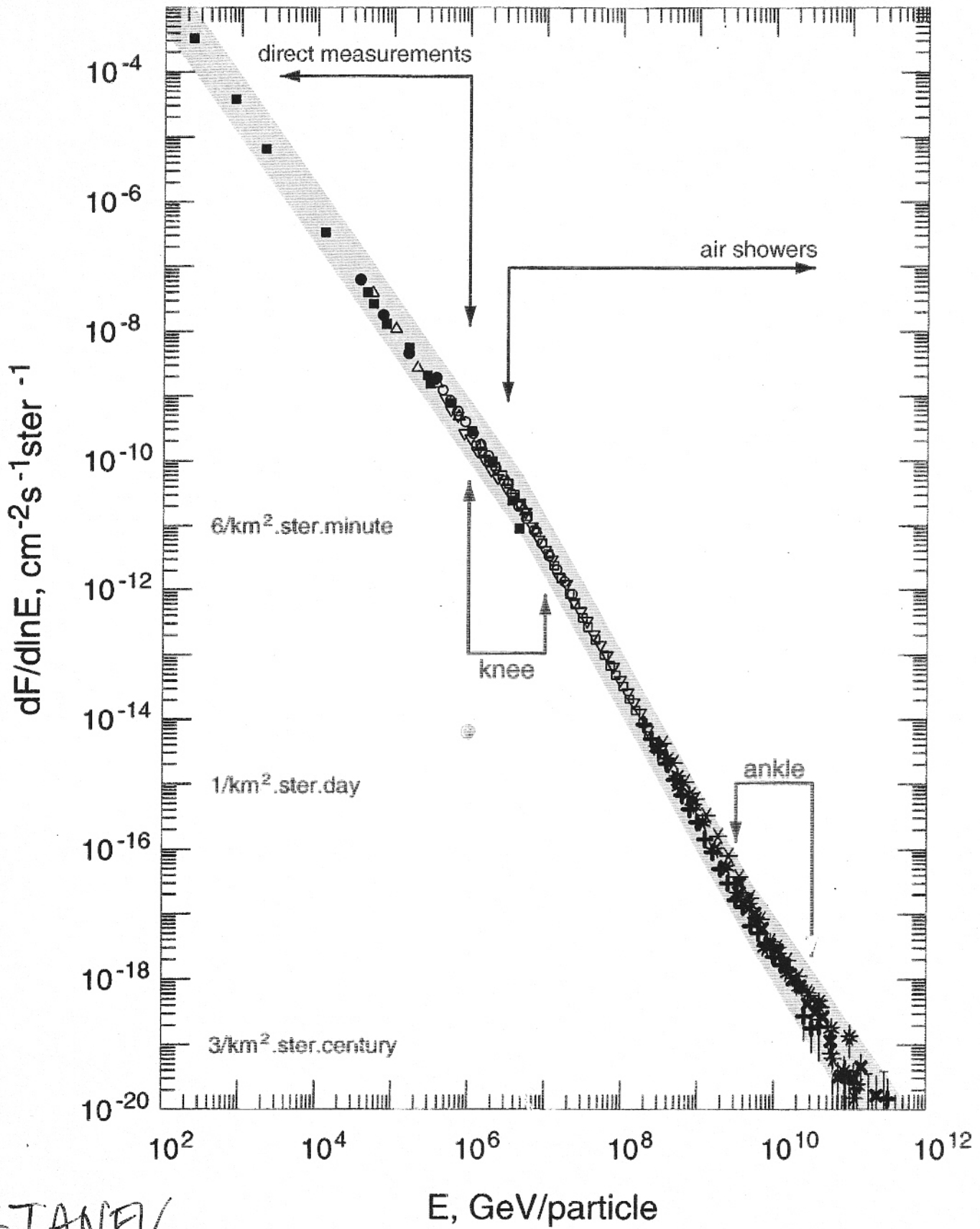
¹ Member of the AUGER collaboration

²MPI for Radioastronomy, Bonn

³Dep. of Phys. & Astron., Univ. of Bonn

⁴Dep. of Phys. & Astr., Univ. of Alabama,
Tuscaloosa, AL

www.mpifr-bonn.mpg.de/div/theory



STANEV

Sources: Radio galaxies XI

- Using Jokipii's picture of transverse shocks

$$\gamma_{p,max} \simeq (\nu_e^*)^{1/2} \left(\frac{16e}{3Bcr_0} \right)^{1/2} \frac{m_p}{m_e} \quad (39)$$

- This in turn translates to

$$\gamma_{p,max} \simeq 1.6 \cdot 10^{11} \left(\frac{\nu_e^*}{3 \cdot 10^{14} \text{ Hz}} \right)^{1/2} B^{-1/2} \quad (40)$$

which is the same as the second case.

- This means that we are independent of all the detailed assumptions about the intensity of the turbulence (b), and the exact shock speed ($\frac{U_{sh}}{c}$)

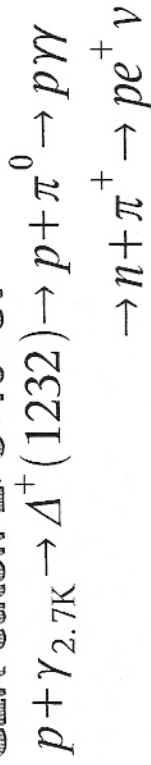
Science Objectives

Fundamental questions

- **Primaries of energies $> 10^{20}$ eV exist**
Standard astrophysical models cannot account for such energies *for many sources*

- **Complication ($d > 20$ Mpc):**

GZK cutoff $E > 5 \cdot 10^{19}$ eV

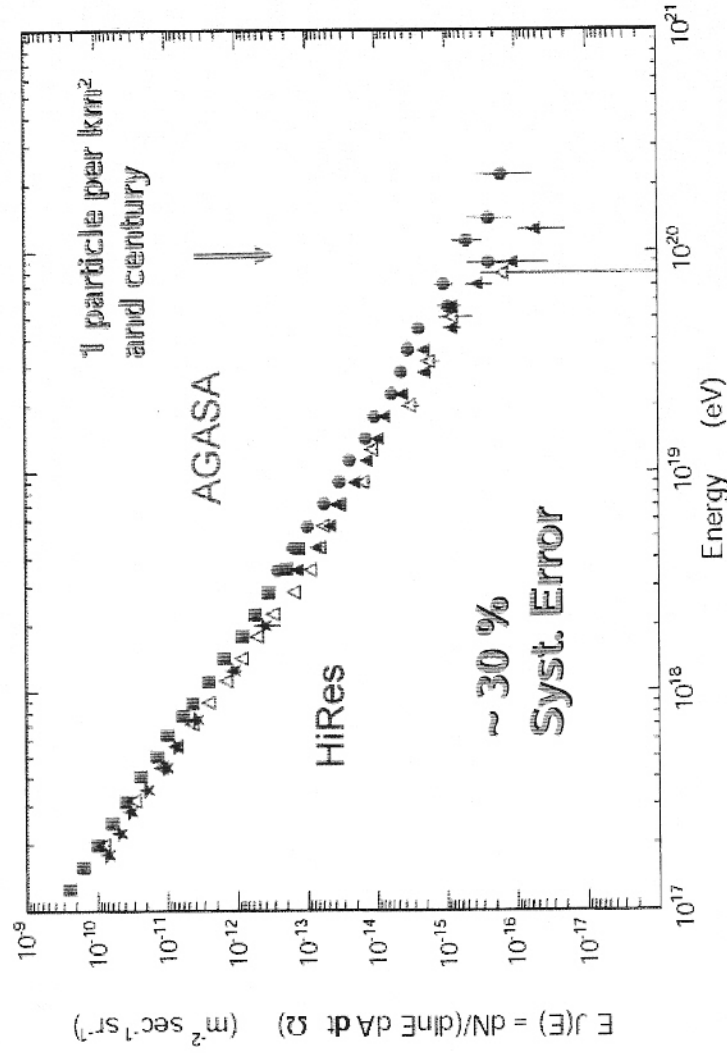


- **If no GZK:**

- **Nearby sources:**
GUT fossils (TD, DM, ...)
- **Propagation effects:**
violation of Lorentz invariance,
Z-Bursts, ... *if in v/c*

- **Near sources should be identified by point source astronomy**
High magnetic rigidity of the primaries (charged particle astronomy)

Contradicting measurements

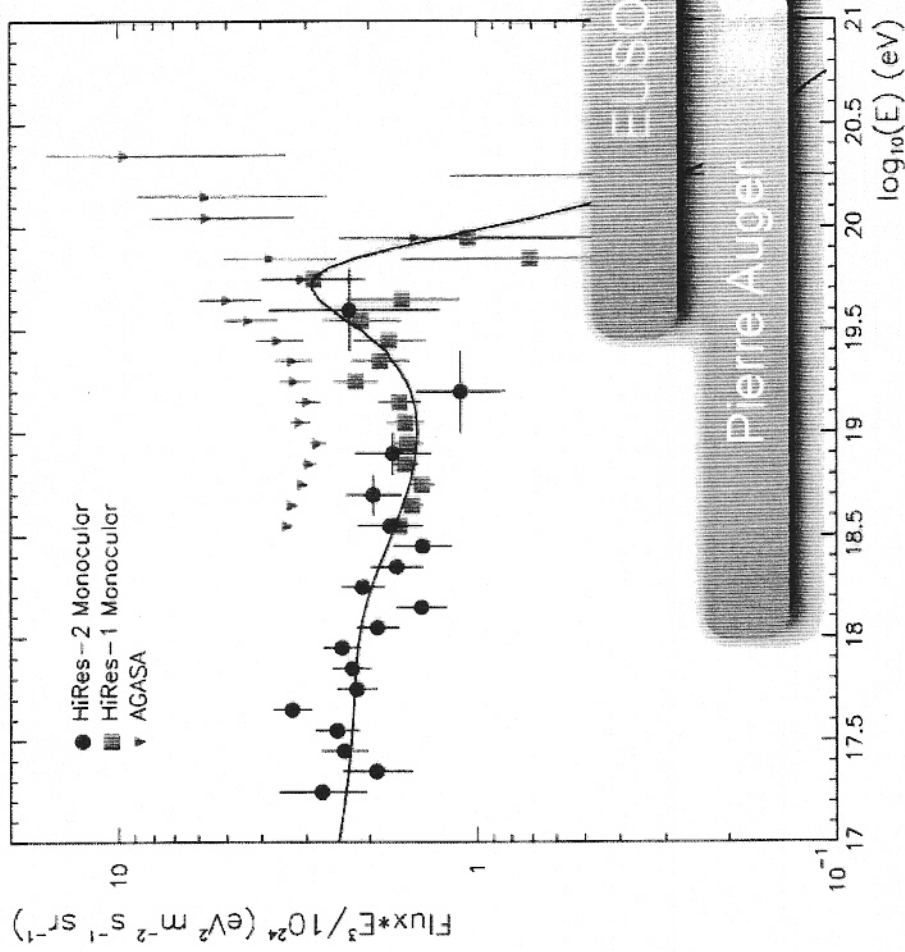


Newest HIRES stereo data give even more contradicting results (W. Springer et al.; ICRC05)

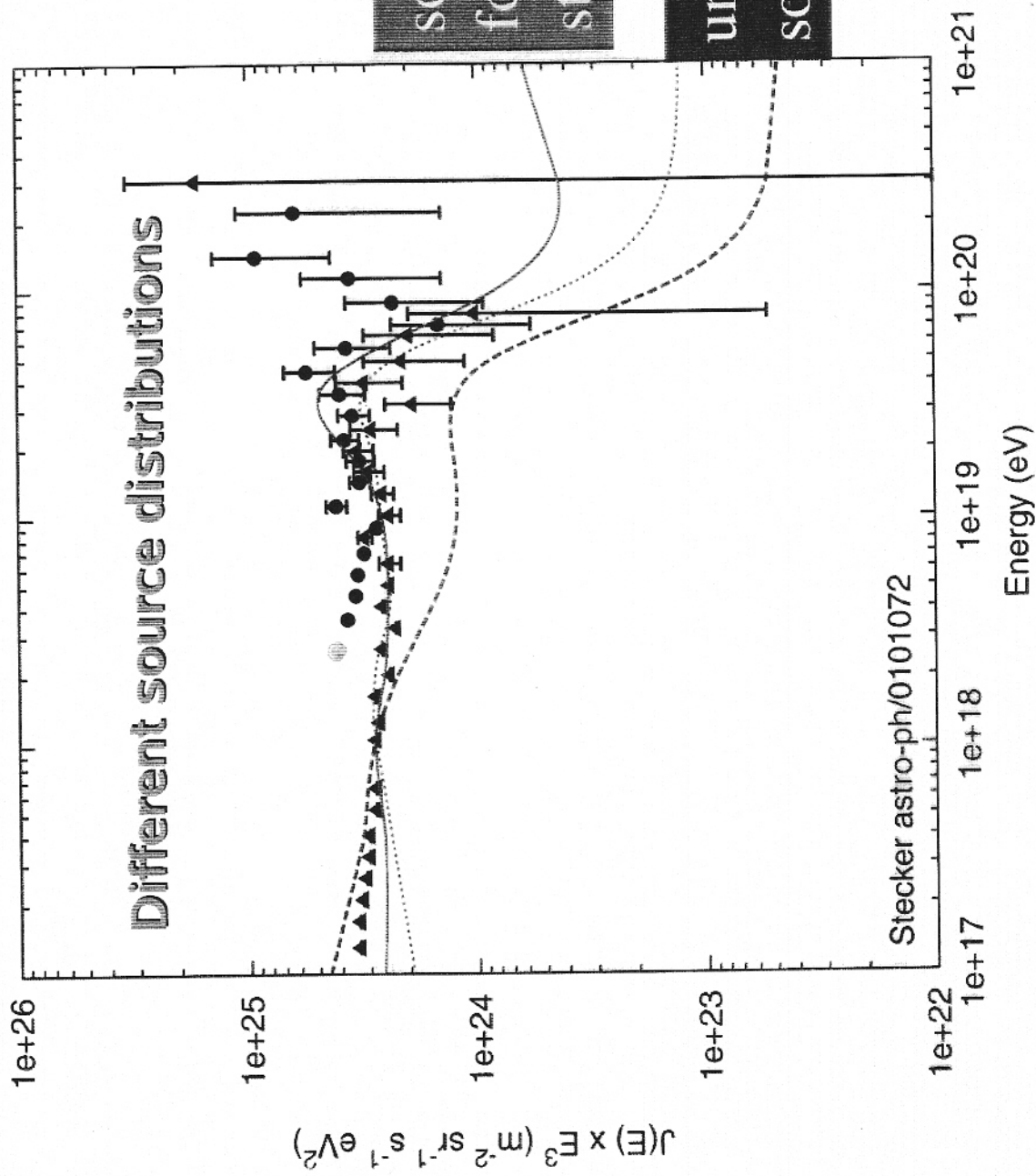
differs from galactic cosmic

Experimental Approach

1. **Cosmic ray spectrum above 10^{19} eV:**
Shape of the spectrum in the region of the GZK cutoff
2. **Arrival direction distribution:**
Search for departure from isotropy, point sources
3. **Composition:**
Light or heavy nuclei, photons, neutrinos, exotics(?)



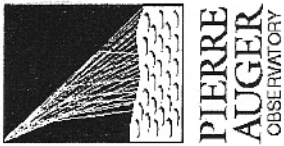
Study of GZK-Cutoff Requires Much Higher Statistics



source distribution
following
star-formation

uniform $E^{-2.75}$
source distributions

different source leads
different E_{max}
to modifications



The Pierre Auger Project

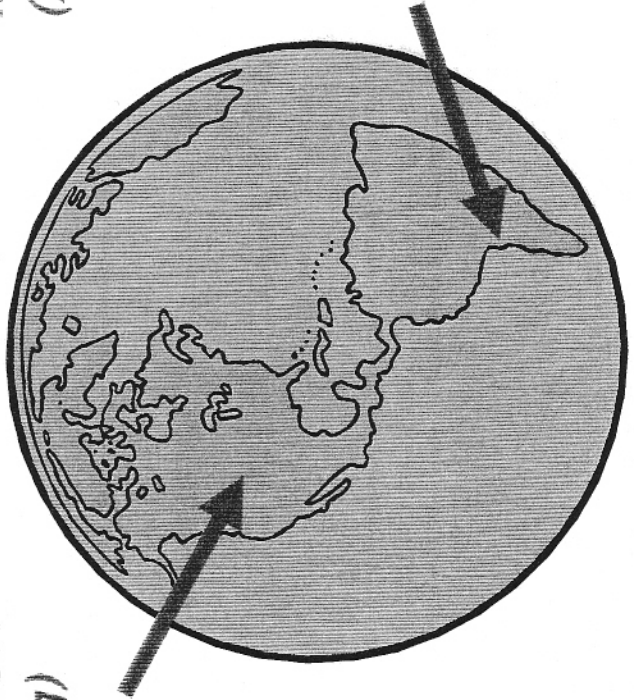
A new cosmic ray observatory designed for a high statistics study of the

The Highest Energy Cosmic Rays

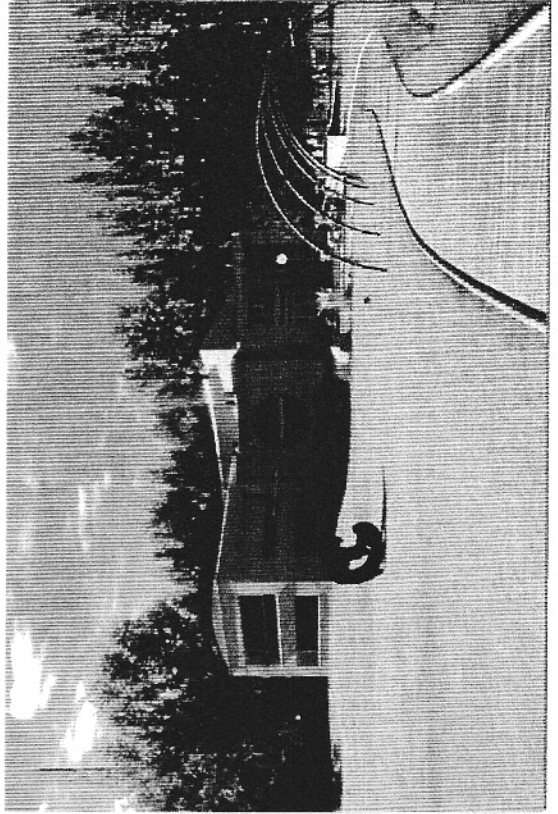
Using

Two Large Air Shower Detectors

Colorado, USA
(in planning)



Mendoza, Argentina
(Auger South)



Auger Energy Spectrum

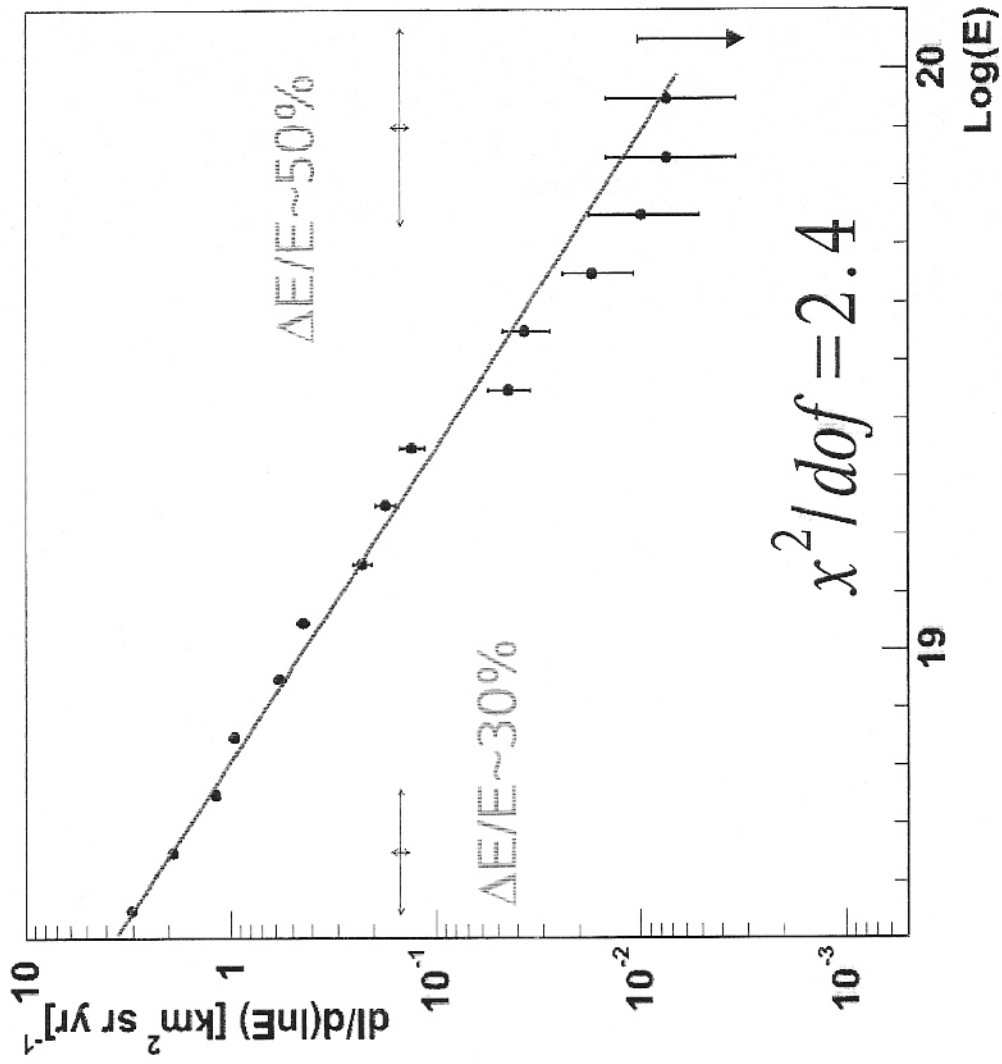
$$\frac{dI}{d \ln(E)} \equiv E \frac{dI}{dE} \quad \text{vs. } \text{Lg}(E)$$

• Error bars on points indicate Poisson statistical uncertainty (or 95% CL upper limit) based on the number of events.

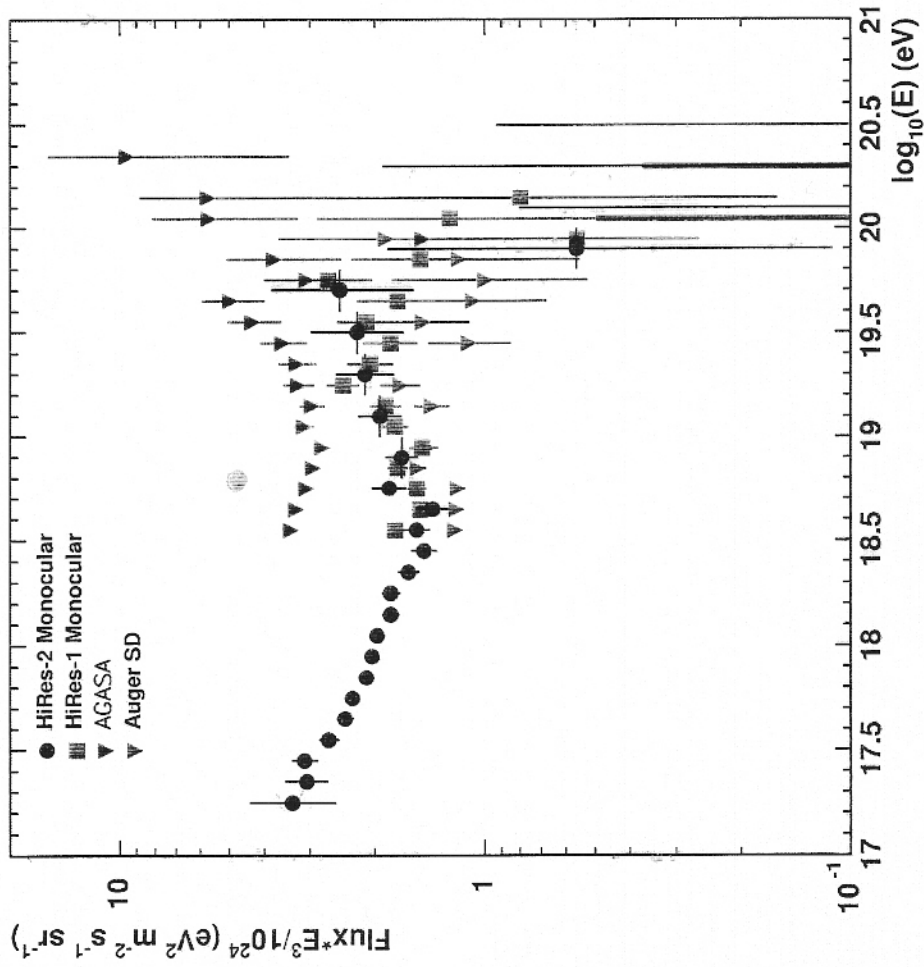
Systematic uncertainty is indicated by double arrows at two different energies.

Horizontal: Systematic ΔE .

Vertical: Exposure uncertainty.



Comparison with HIRES, AGASA



AUGER: Energy scale
uncertainty still large
~50 % at 100 EeV

Summary and Outlook:

Pierre Auger Observatory

Status:

- Southern Observatory over half finished
- With 25% of a full Auger-year exposure, we have:
 - First estimate of an FD-calibrated spectrum
 - First studies of anisotropies in the sky
 - Limits on photon primaries

Future plans:

- Completion by mid 2006
 - Full understanding of our instruments
 - Usage of rapidly expanding data set (x7 in two years)
 - Measure spectrum around 10^{20} eV with unprecedented precision
 - Solve AGASA/HIRES dispute
 - Composition studies with SD, FD and HYBRID
 - Large/small scale anisotropies
 - Search for neutrinos and exotics (horizontal showers)
 - Begin working on Auger North
 - R&D for radio, ...
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