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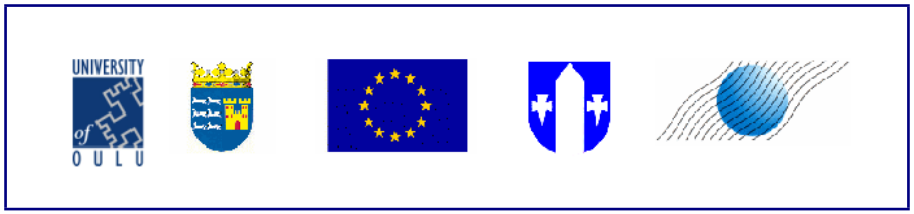
UNDERGROUND MULTIMUON EXPERIMENT IN THE PYHÄSALMI MINE



Pylos, Sep 10, 2004

Introduction

The purpose of the underground multimuon experiment is

- **To study the composition (and origin) of cosmic rays at the knee region (10^{15} – 10^{16} eV)**
- **To observe with high statistic high-energy multimuon events having very high multiplicity**

The setup and the depth are optimised for the primary composition on the knee region

Cosmic-ray experiments have not yet been performed in the same way

Experimental Setup

Total area intended to be 100 – 300 m^2

(1) DELPHI Barrel Muon Chambers (MUB)

- one planck consists of seven chambers
- active volume: 3.65 m long $\times$ 20 cm wide $\times$ 1.6 cm high (one chamber)
- 'normal' gas mixture: Ar:CH_4:CO_2 (88:7:5) (for DELPHI)
  CORAL-test-setup gas mixture: Ar:CH_4:CO_2 (90:5:5)
- our mixture: Ar:CO_2 (95:5)
- ten planks tested
  - ☞ eight works well
  - ☞ position resolution obtained better than 5 mm in both directions
  - ☞ efficiency measured better than 95% for voltage interval of 5.9 – 6.2 kV

(2) Plastic scintillators

Surface array

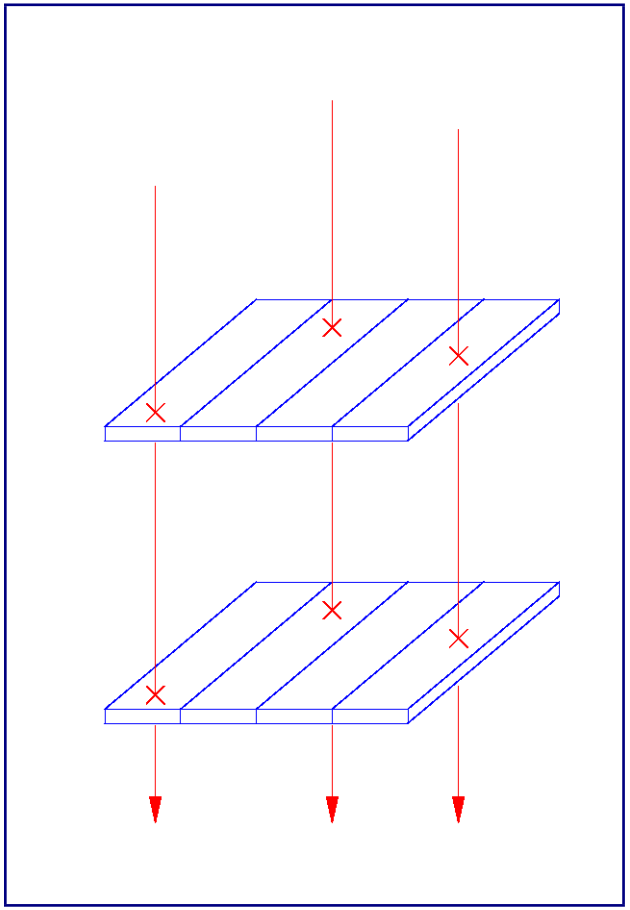
- small surface EAS-array will be set up for measuring the direction and the energy using plastic scintillators

Experimental Setup / Prototype

Before setting up the full-size detector, a prototype detector is constructed

Prototype Detector (MUB)

- **consists of 6 or 8 planks in two layers**
  ☞ **area about 9 m^2 or 12 m^2**
- **situates 210 metres underground (∼600 mwe)**
- **Does not contain methane; the mixture is: Ar:CO_2 ∼(95:5)**
- **under construction**
  ☞ **will be placed underground during the first quarter of the next year**



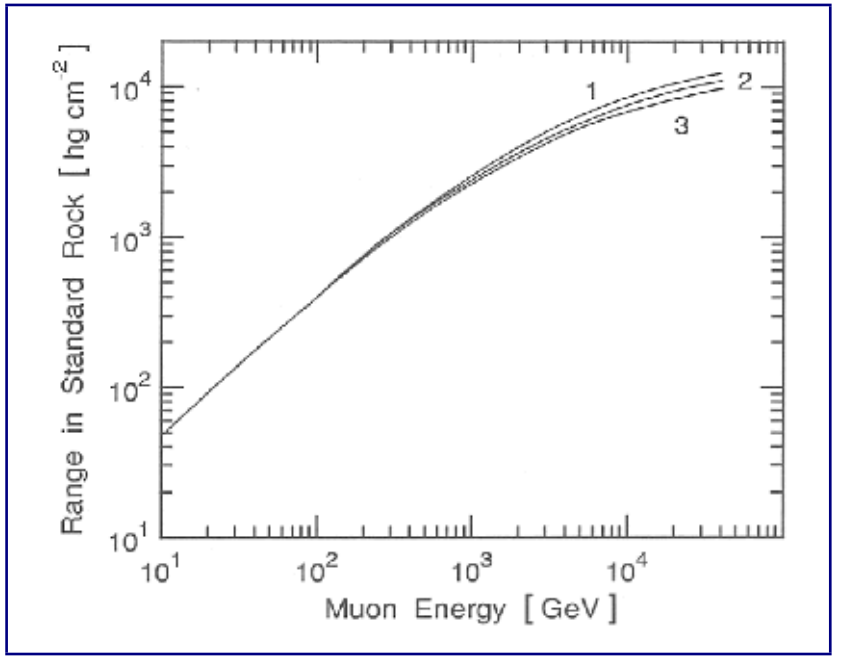
The Depth

The most interesting energy range of muons is between 50 GeV and 100 GeV

- **at higher energies the statistics gets smaller**
- **at lower energies muons could not be confidently detected (too many muons)**

Requiring muon cut-off energy of 50 GeV
☞ the minimum depth is ∼200 mwe (70 metres vertical)
Respectively, the cut-off for 100 GeV muon
☞ the maximum depth is ∼400 mwe (150 metres vertical)
The range in vertical depth: 50 – 150 metres

In reality, there are no caverns for large-size detectors at these depths

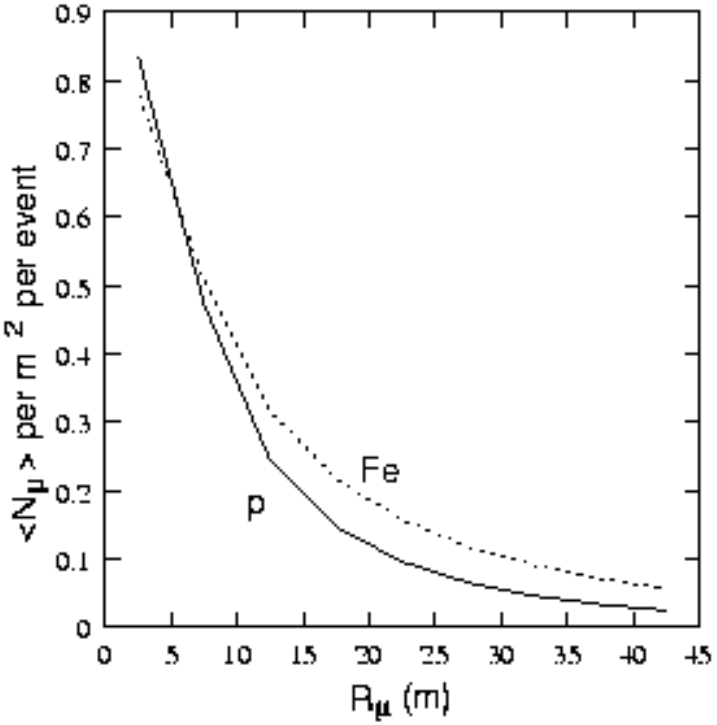


Detectors will be setup at 210 metres underground (∼600 mwe) (∼150 GeV)

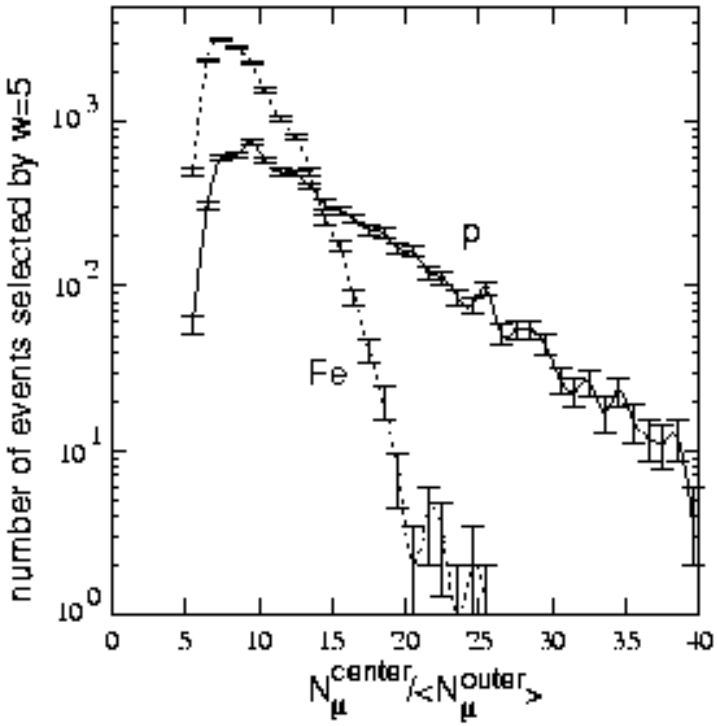
Some Expected Results

Result of a simulation (by L. Ding *et al.*, ICRC1999)

Lateral distribution of multimuon events with energy higher than 100 GeV, originating from proton- and iron-initiated showers with initial energy of 5000 TeV



The distribution of the ratios for the number of muons of the 'central' detector over the average of 'outer' detectors in each event



Conclusions

The prototype detector of the underground multimuon experiment is under construction

Prototype detector starts running underground around april/may 2005

IF full-size detector ($\sim$200 m^2) can be constructed,

- ☞ **about three-year running could give some new information on the composition of cosmic rays in the knee region**

Collaboration

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