A Large Area Cosmic Muon Detector located at Ōhya stone mine

N. Nii
Dep. of Physics, Ashikaga Kogyo Univ., Ashikaga, Tochigi
K. Mizutzni
Dep. of Physics, Saitama Univ., Urawa, Saitama
T.Aoki, T.Kitamura, K.Mitsui, S.Matsuno, Y.Muraki, Y.Ohashi,A.Okada
Inst. for Cosmic Rays, Univ. of Tokyo, Tanashi, Tokyo, 188
Y. Kamiya, I. Nakmura, S. Shibata
Dep. of Physics, Nagoya Univ., Chikusa, Nagoya
H. Kojima
Dep. of Physics., Nagoya Medical College, Toyoake, Aichi
S. Higashi, T. Takahashi,H. Umeda,T. Sato,N. Hiraoka,T.Suwada
S. Chang, H. Kujirai
Dep. of Phys., Osaka City Univ., Sumiyoshi, Osaka
S. Minorikawa
Dep. of Phys., Kinki Univ., Higashi-Osaka, Osaka
K. Kobayakawa, H. Inazawa
Dep. of Phys., Fac. of Art.,Kobe Univ., Kobe
K. Mizushima
Dep. of Physics, Kobe Womans College, Kobe
H. Shibata
Dep. of Phys., Okayama Univ., Okayama

1. The Experimental Aims of Ōhya project

The experimental aims of Ōhya project[1] are

(1) Search for the ultra high-energy gamma-rays,
(2) Search for the GUT monopole created at Big Bang,
(3) Search for the muon bundle,
(4) Determination of the chemical composition of the primary cosmic rays between 10^{15}eV and 10^{18}eV.

For such a sake, a large number of muon chambers will be installed at the shallow underground near Nikko (∿100 Km north of Tokyo, situated at Ōhya-town, Utsunomiya-city). At the surface of the mine, a very fast 100 channel scintillation counters will be equipped in order to measure the direction of air showers. These air shower array will be operated at the same time , together with the underground muon chamber.

Surface is almost flat and the underground room is distributed in the area 2 Km X 3 Km. The depth of the underground room distributes from a few meters to ∿100 m. We can select any place according to the experimental purposes. The temperature is fixed in 2-9 C° in a year. The experimental equipment will be arranged to be easily removed by the purpose of the experiments. We use a large number of muon chambers as a"cosmic"accelerator. The schematic view of Ōhya project is given in Fig. 1.

2. the Detector Characteristics

The angular resolution of the surface telescope has been measured with use of real air shower events (the trigger rate was 0.6/min). We have got the angular resolution in the determination of the air shower direction as to be 0.5°(Fig.2).[2] The time jittering of the phtomultipliers(R329) and the electronics are 1 ns and 250 ps respectively. A combination of the good resolution air shower telescope with the large number of muon chamber underground will be powerful probe to the universe especially search for the UHE gamma-ray point source[3].

The muon chamber is made of the pillared iron pipe with a dimension 10 cm X 10 cm X 10 m(length) (Fig. 3). The energy resolution of the counter is given in Fig. 4 as a function of distance. In case of the observation of the magnetic - monopole created at the Big Bang, the internal gas of the counter is exchanged to the mixed gas of 90%He + 10%CH_4 . The proto-type experiment to use the Drell-mechanism has been published in Ref. 4.

As a powerful device to determine the primary composition between 10^{15}eV to 10^{16}eV, a 100 m^2 solid iron Mutron magnet will be used in the underground. The magnet has a thickness of 1 m and the maximum detectable momentum of 3.5 TeV/c when we use the drift chamber with the position resolution of 0.5 mm. The wire of the drift chamber will be spanned with the accuracy of 0.3 mm. The both corner of the wire will be measured by the optical telescope. Typical height of the underground is 10 m but it is easy to find the place with the height of 20 m.

3. the Budget and Size

We present the scale of the detector and the budget in Table I. The detector will be operated after three years later of the approval by the Ministry of Education.

Table I

Station	Number	Total area	Budget
air shower scintillator	100 (1 m^2)	150x150 m^2	6,500 man Yen = 260K$
muon chamber	5760 (1 m^2)	5760 m^2	20,160 man Yen = 800K$
muon chamber	2250 (0.2 m^2)	450 m^2	7,800 man Yen = 310K$
read-out			10,380 man Yen = 415K$
drift cahmber	3360	2000 m^2	10,720 man Yen = 430K$
Mutron removal		100 m^2	3,840 man Yen = 150K$
Total Sum			59,400 man Yen = 2365K$

References

1) Proceed. 18th ICRC, 7(1983),58.
2) This conference Proceed. OG 9.4-3(1985).
3) Proceed. 17th ICRC, 7(1983), 54.
4) Phys. Rev. Lett., 52 (1984), 1373.

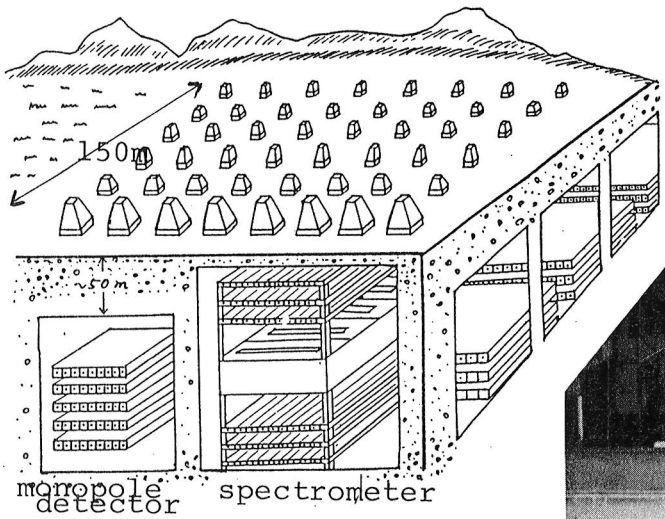

Fig. 1 Schematic View of Ōhya project

Fig. 3

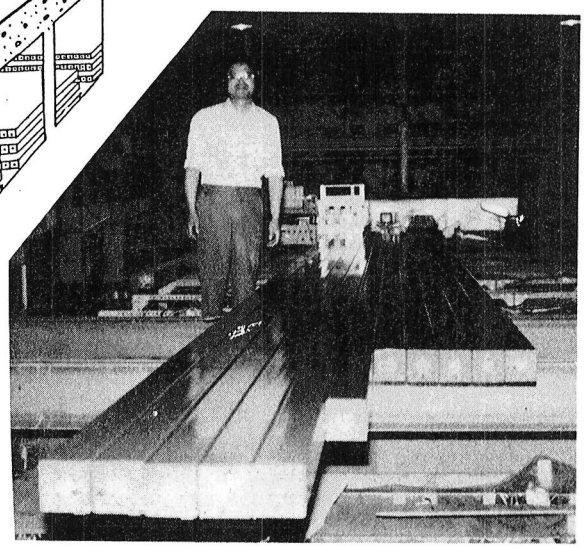

Photo of 10 m muon chambers

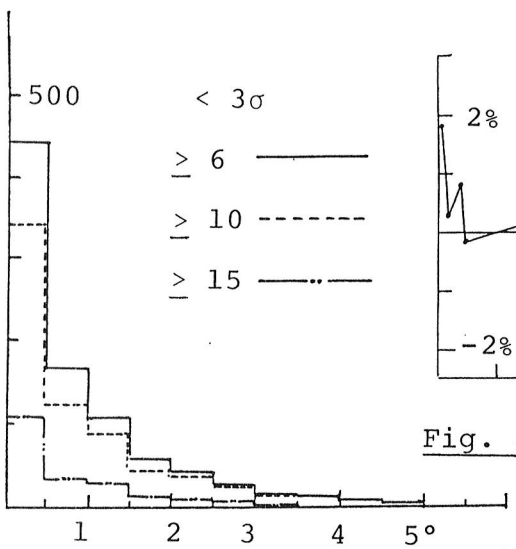

Fig. 2 Angular resolution

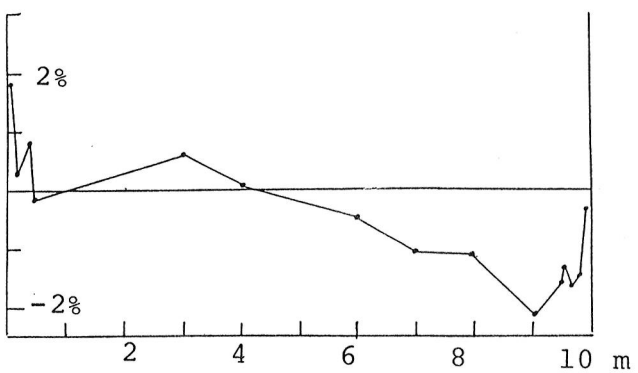

Fig. 4 Position dependency of chamber resolution