A Test of the Feynman Scaling in the Fragmentation Region at $\sqrt{s}$ = 630 GeV

T. Doke[5)], V. Innocente[1)#], K. Kasahara[2)], J. Kikuchi[5)], T. Kashiwagi[5)], S. Lanzano[1)], K. Masuda[5)], H. Murakami[3)], Y. Muraki[2)], T. Nakada[4)], A. Nakamoto[3)], T. Yuda[2)] and M. Haguenauer[6)#]

1) Instituto di Fisica, Univ. of Naples, Naples, Italy
2) ICRR, Univ. of Tokyo, Tanashi, Tokyo, Japan
3) Dep. of Physics, Rikkyo Univ, Toshima, Tokyo, Japan
4) SIN, Villingen, Switzerland
5) Sci. Eng. Lab, Waseda Univ., Shinjuku, Tokyo, Japan
6) CERN UA-4 collaboration
#) Ecole Polytechnique, Palaiseau, Paris, France

(CERN UA-7 collaboration)

abstract

The result of the direct measurement of the fragmentation region will be presented. The result will be obtained at the CERN $p\bar{p}$ collider, being exposured the Silicon calorimeters inside beam pipe. This experiment clarifies a long riddle of cosmic ray physics, " whether the Feynman scaling does violate at the fragmentation region or the Iron component is increasing at 10^{15} eV".

1. Introduction

This experiment aims to measure the inclusive cross-section of neutral pions emitted into the very forward region in $p\bar{p}$ collision at $\sqrt{s}$ = 630 GeV. Fig. 1 represents an experimental result[1)] which predicts the primary composition of cosmic rays is <u>either</u> proton dominat and Feynman scaling violates <u>or</u> iron dominant and scaling valid.

Until now, no direct measurement inside beam pipe of colliders was made due to a technical difficulty. We have developed a very compact silicon calorimeter with the tungsten target and they will be installed in the Roman pot of UA-4 at CERN

$p\bar{p}$ collider. The direct observation of the energy of the secondary particles with $X_F = 0.05 - 0.5$ gives rise to the final conclusion to a long riddle of cosmic ray physics and also gives a good data for the understanding of the forthcoming cosmic ray phenomena.

2. Geometry

The shower calorimeter consists of 20 layer of silicon wafers with diameter of 10 cm alternating with tungsten converters of thickness 3.5 mm and 7 mm. The total thickness of the calorimeter amounts to 21 radiation lengths.

All electrodes are segmented at the front and rear side of the silicon wafer into x and y electrodes with 5 mm pitch. The first layer of the silicon wafer is used to identify whether the incident particles are charged or photons. At the 8 radiation length from the front, 45° oriented u-chamber is installed to resolve the multi-hit events. Total number of electronics channel is 90 for one detector. The signal is recorded by Le Croy ADC 2281.

One chamber is located at 13 m from the interaction vertex and outside of beam pipe, while the other detector will be installed at 22 m away from the vertex inside the Roman pot (Fig. 2) . The tracking chamber is also located to obtain the interaction vertex,which covers $\eta = 4.4 - 5.6$,in front of the silicon detector at 13 m. The properties of the silicon calorimeter has been published elsewhere[2).

3. Trigger and Detector resolution

The trigger is made by UA-4 trigger logic[3). The identification of the interaction vertex with use of tracking chamber is necessary for the single arm trigger (=single diffractive trigger) selects beam-beam collisions with 75 % probability. Even if the background rate becomes of the same order as the beam-beam collision for the triggered events, we could clearly find the pinote peak as in Fig. 3. For the double arm trigger (double diffractive trigger)($3.0<|\eta|<5.6$), the beam-gas collision is selected with a rate of 2 %.

Under a typical low-β run with a luminosity of L = 1×10^{28} $cm^{-2}sec^{-1}$, and the exposure time of 2 minutes, 60,000 minimum bias events will be obtained which is already sufficient to measure the inclusive $\pi°$ and η production spectra but in order to obtain K°_{s} and η' , we need further 20 minutes.

4. Energy calibration and Detection efficiency

The $\pi°$-mass distribution can be determined with the accuracy of $\Delta M \simeq 8$ MeV. The double photon mapping technique provides a good energy calibration for the photon detector with an accuracy of ±3 % of its absolute value.

Fig. 4 represents the detectable region of photons by the present detector. Former UA-5 experiments observe the polar angle region greater than 30 m rad. Present experiment covers the polar angle between 0.5 and 17 m rad. Fig. 5 represents the detection efficiency of $\pi°$ by each chamber located at 13 m and 22 m.

5. Schedule

The test exposure will be made on Jul. 10 - 16th with the use of 3" silicon calorimeter. The preliminary results will be presented at this conference. The experiments with the use of two 4" Si-calorimeters will start this September.

Acknowledgements

The authors would like to express their sincere thanks to Prof. G. Matthiae, sporksman of UA-4 collaboration, for his warm support and valuable suggestions.

We also thank to Prof. A. Staude for valuable discussions.

References

1) Mt. Fuji emulsion chamber collaboration: Phys. Rev.D24(81)2353.
2) A. Nakamoto et al.: N.I.M. (1985).
3) CERN UA-4 collaboration : N.I.M. (1985) and CERN EP 84-156.

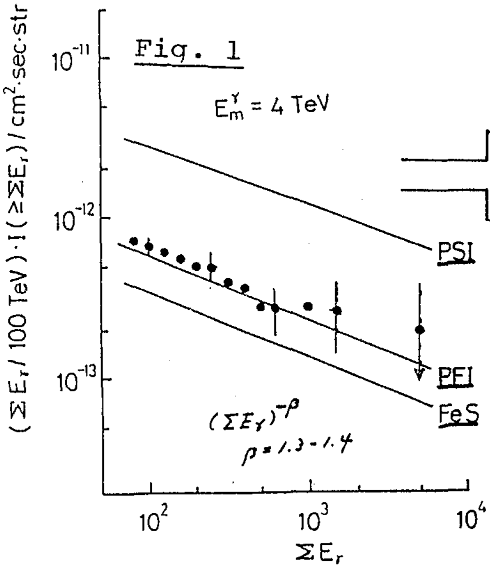

Fig. 1

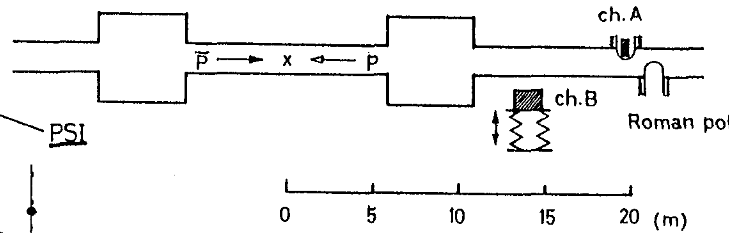

Fig. 2

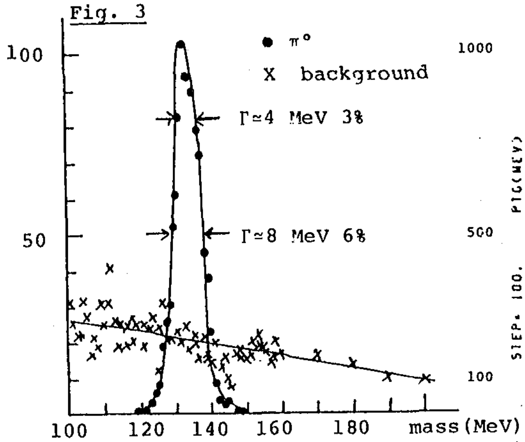

Fig. 3

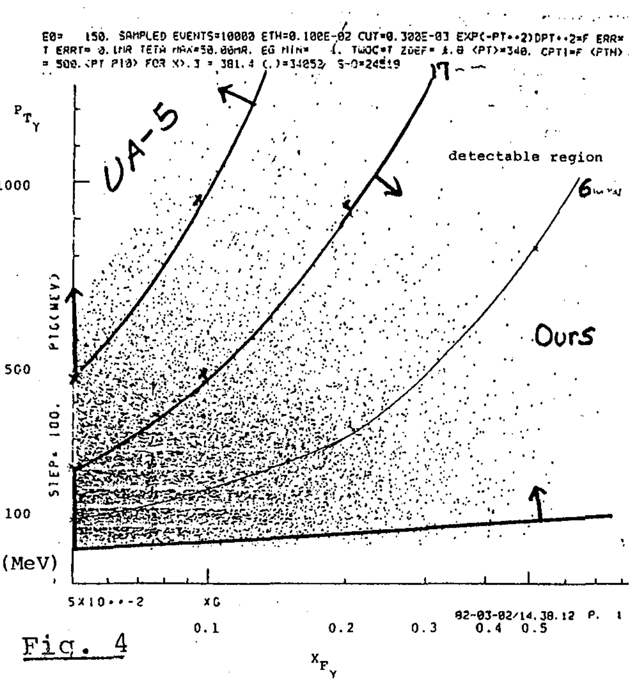

Fig. 4

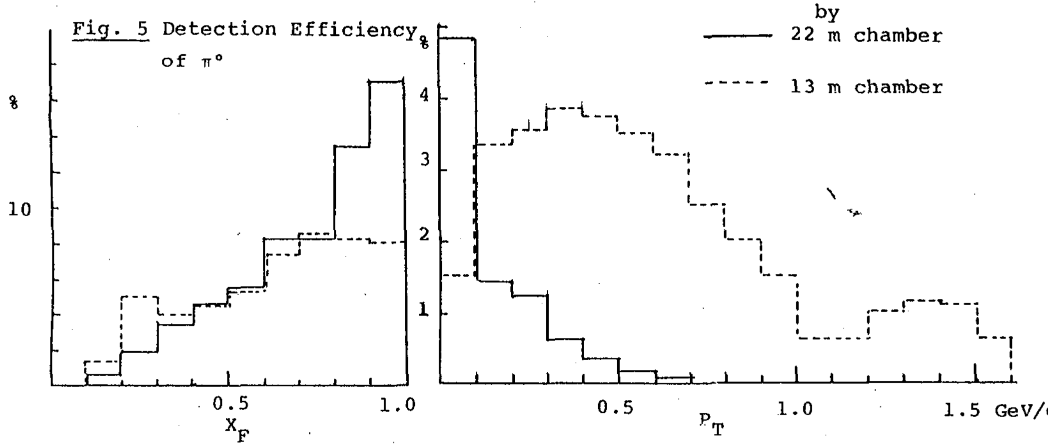

Fig. 5 Detection Efficiency of π^0