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SUPER-FAMILY P2 C-96-125 OBSERVED BY JAPAN-URSS JOINT EMULSION CHAMBER EXPERIMENT

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1. INTRODUCTION: Since 1969, when it was observed the event 'Andromeda' by Brasil-Japan Emulsion Chamber Collaboration-BJECC, others events, looking like the pionner one, was detected and are turning to be one of the main themas of Cosmic Ray experiments. Nowadays, in 4 mountain stations(Kambala-China, Chacaltaya-Bolivia, Pamir-Soviet Union and Fuji-Japan), huge Cosmic Ray exposed Emulsion Chambers are constructed under name of International Collaborations, and constitute a world-wide effort to catch such type of events.
This paper aims to be a detailed description of the event detected in the second chamber of Japan-Urss Collaboration. A preliminary description was already published(1) and from that time a careful microscopic scanning was carried out.

2. METHODS: Fig.1 is the sketch of the chamber. As the Japanese sensitive X-ray films are inserted only in 4 layers, beeing 2 in the Γ-Block and the other 2 in the H-Block, the usual way of BJECC for energy determination is not applicable, a different method of energy determination was developped by T.Shibata(2), method that was used in the present paper. Japanese and Sovietic groups, using their respective materials and their own methods, made energy determination of this event. A check was recently made, obtaining consistent energy values.

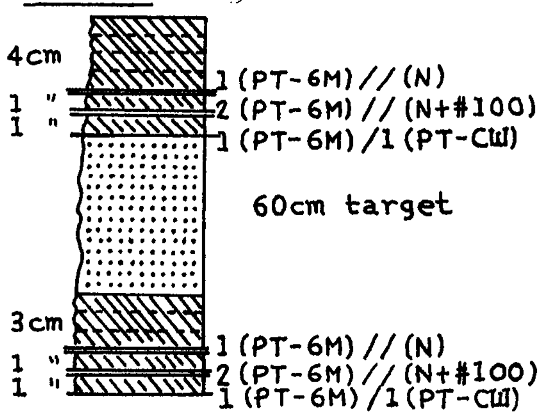

Fig.1 Sketch of the chamber

lead plates

rubber plates

3. RESULTS: Main characteristics of the event are summarized in Table I. From there we see that around half (56%) of the scanned individual showers are inside the central area of $(1.5x1.5)cm^2$. They carries about 76% of the energy ($\Sigma E_\gamma + \Sigma E_h^\gamma$) of the individual showers and the energy inside the central square of $(1.5x1.5)cm^2$ is equal to $2.5x10^3$ TeV, approximately equal to the energy determined by halo measurement ($=2.9x10^3$ TeV). So, the remaining 400 TeV are distributed into many showers with energy less than 1 TeV and that causes the blacked region of the event.

TABLE I

Zenith angle: (18±2) degrees

Detection: e,γ and hadrons (efficiency for hadrons = 80%)

Halo	Radius R_{halo}	= 1.2 cm
	Energy	= 2.9×10^3 TeV
e,γ (E_γ>1 TeV)	Number	177 112 inside central square of $(1.5\times1.5)cm^2$
	Energy ΣE_γ/TeV	2,000 1,651 inside central sq. of $(1.5\times1.5)cm^2$
Hadrons ($E_h^{(\gamma)}$>1 TeV)	Number	35(44) 7(9) inside central sq. of $(1.5\times1.5)cm^2$
	Energy $\Sigma E_h^{(\gamma)}$/TeV	1,254(1,567) 822(1,028) inside sq. of $(1.5\times1.5)cm^2$

Notes: a) the efficiency was calculated as ref.4, i.e. efficiency = $\exp(-4/\lambda_h\cos\theta) - \exp\{-(T-T_o)/\lambda_h\cos\theta)\}$, where the nuclear collision mean free path λ_h was assumed as 30 c.u.Pb, T_o=vertical traverse in lead over which an electron shower develop above the detection threshold (assumed T_o=4 c.u.Pb) and T is the thickness of Pb layers + target.

b) radius of halo, R_{halo} is defined as the distance from the center to the point where the electron density is $10^6/cm^2$.

c) hadrons was identified as shower spots observed only in H-Block(22) + shower spots showing transition curve with 2 peaks(6) + shower spots showing transition curve adjustable to analytical γ transition curve(7).

d) figures in the parentheses gives the value after correction of detection efficiency.

Fig.2 shows the integral fractionary energy spectrum of electrons/gamma-rays. Others events are included and the marks are: Δ for the concerned event, O for Andromeda, X for Ursa Maior, ● for Mini-Andromeda III and the smooth curve is the average of five families with ΣE_γ=(1,000~3,000) TeV of Mt.Fuji experiment(3). Fig.3 shows the same kind of spectrum for hadrons. Marks are the same as Fig.2. From the coments of Table I, it is clear that the number of identified hadrons is the minimum, because it was used a very restrictive criterion. Also, looking for the figures (13 continuing showers from Γ-Block to H-Block and labeled as hadrons) and the 22 hadrons observed only in H-Block, we confirm the above affirmation. Fig.4 is the lateral distribution of energy flow, where R is the distance of shower from the energy weigthed center,center of γ's only. Hatched areas are for identified hadrons.

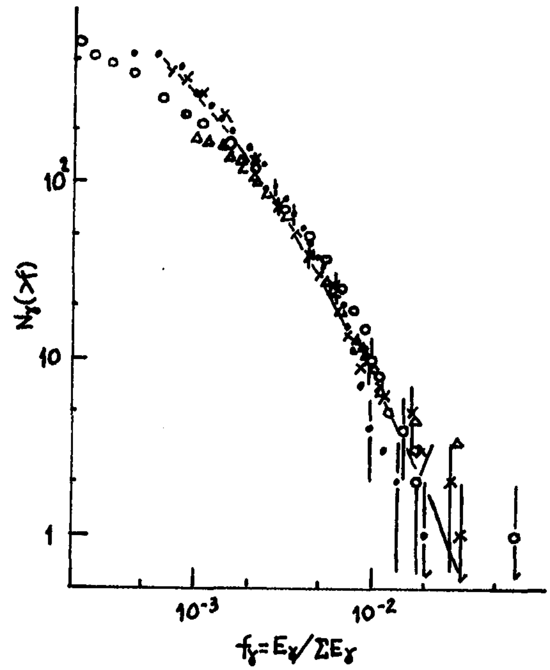

Fig.2

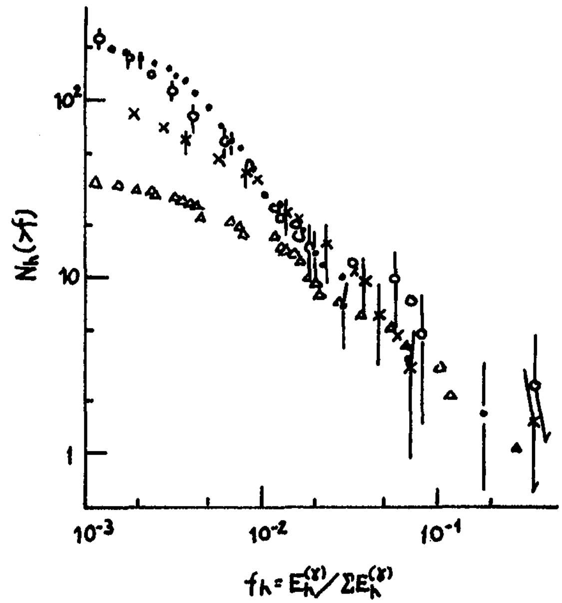

Fig.3

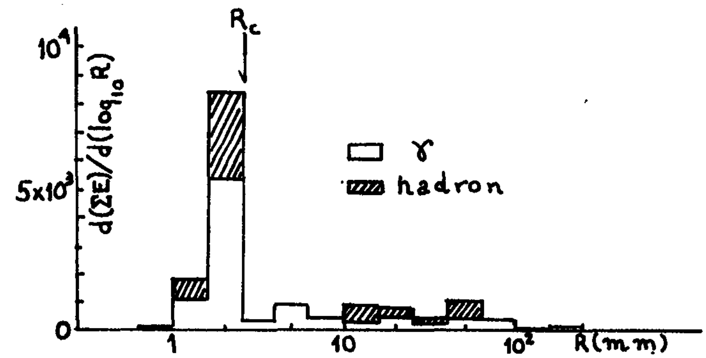

Fig.4

The individual showers was observed in the central (1.5x1.5) cm^2 area, by microscopic scanning in the #100 type Fuji X-ray films(fine grains) added to showers scanned by naked eyes in the N-type Sakura X-ray films(high sensitivity). From this scanning it is clear the existence of two clusters, formed by 76 spots, each one containing γ's and also hadrons. The showers of these two clusters are distributed in the distances smaller than R_c, that characterizes the pronounced pek of Fig.4.

Table II*

event name	lateral spread R_c(mm)*	energy $\sum_{R<R_c} E_\gamma$ (TeV)	energy-normalized lateral spread $R_c X \sum_{R<R_c} E_\gamma$ (GeV.Km)
P2 C-96-125	2.5	1,338(66.9%)**	3.3
Andromeda	1.0	323(7.2%)	0.32
Ursa Maior	4.0	700(52.1%)	2.8
M.A.I	6.3	734(55.0%)	4.6
M.A.II	1.6	390(43.9%)	0.62
M.A.III	2.5	796(31.5%)	2.0

Notes:* For definition of R_c and data of other events see(4)

**Figures in the parentheses are the fraction of energy to the total energy of electromagnetic component

4. SUMMARY AND DISCUSSIONS: Comparison of this event shows similar features with other events. Remarkable difference is the existence of two central clusters carrying 67% of electromagnetic energy and 64% of hadronic energy. Under the same restrictive criterion for hadron identification, from where it was obtained the above figures, it was made a $E_\gamma R_\gamma$ integral distribution(fig.5). Marks are △ for this event considering γ's with $R_\gamma < R_c$(=2.5mm) and ▲ for $R_\gamma < R_{halo}$(=12.0mm). The distribution for event P06 is from article:A Cosmic-Ray Nuclear. ..-Amato,Arata and Maldonado in this issue. Full lines are from ref.5. So, the distribution obtained for this event is similar to that one obtained for events containing the so-called Giant-Mini-Cluster phenomena (see article of BJ ECC in this issue).

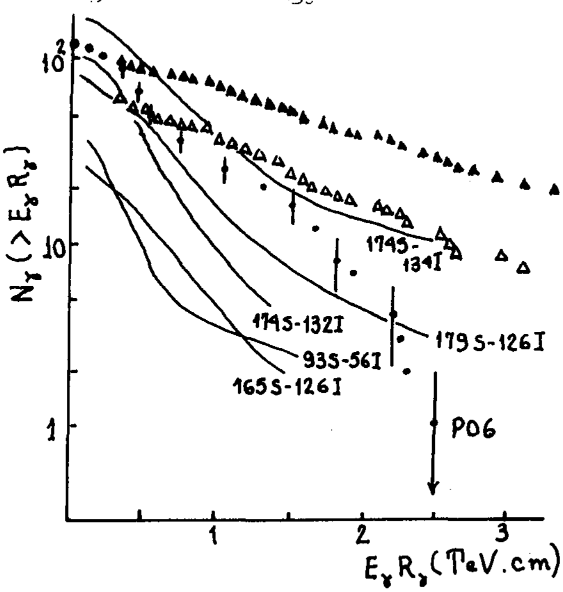

Fig.5

References:
1. Shibuya,E.H.-Proc.Int.Sympo. on Cosmic-Rays and Particle Physics, Tokyo,(1984),127
2. Shibata,T.-Internal Colloquium of Japanese Group of Japan-USSR Collaboration
3. Mt.Fuji Collaboration-Nuovo Cimento Ser.11,67A,(1982),221
4. Yamashita,S.-Jour.Phys.Soc.of Japan,vol.54,nº2,(1985),529
5. Hasegawa,S.-Proc.Int.Sympo. on Cosmic-Rays and Particle Physics, Tokyo,(1984),62

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