ULTRA HIGH ENERGY EVENTS IN ECHOS SERIES AND PRIMARY ENERGY SPECTRUM

Capdevielle J.N., lab.Phys.Théorique, Bordeaux, rue du Solarium, 33170 Gradignan, France
Iwai J. and Ogata T., ICR, University of Tokyo, Japan

1.ECHOS series. EMULSION chambers with X-ray film are boarded on the supersonic Concorde Air France liner from October 1978. Since, 6 chambers have been exposed at the highest altitude (about 16Km). The different flights of the French-Japanese collaboration (often quoted as Concorde Collaboration) have been scheduled on Atlantic between Paris and New York as listed in table 1. (ECHOS-Emulsion Chamber On Supersonic).

ECHOS	Altitude g-cm^{-2}	Exposure (hours)	Area m^2	Depth c.u.	Type	Period
1	106	200	0.1	8.5	producer	9-11 78
					no prod.	
2	"	"	0.2	7.5	prod.	1-2 80
3	"	"	0.25	6.5	+spacer	1-2 82
4	"	"	0.2	8.5	+TLS sheet	8-10 82
5	"	500	0.2	8.5		11/84-8/85

Table 1

A description of the different chambers and sensitive materials can be found in previous reports (1,2,3) as well as the collection of remarkable events in ECHOS1,2,3 between 10^6-10^7 GeV; we examine hereafter those events, jets, stratospheric ray family in view to point out some signature of phase transition quark gluon plasma and try from a general review of the data of flying experiments (Concorde, JAL cargo jets, JACEE) to situate the tendancy of primary cosmic ray spectrum.

2.Correlation rapidity density-$\langle p_T \rangle$. A survey of ISR and $\overline{P}$-P data has been taken from Hagedorn's compilation and joined to our data and analysis of cosmic ray jets (2) on Fig.1. The accelerator data suggested a clear increase of $\langle p_T \rangle$ with rapidity density dn/dy and also that $\langle p_T \rangle$ levels off at highest densities (16). The total p_T distribution has been derived from well collimated and localized jets in emulsion chambers like JF1af1 In Concorde (2), Texas Lone Star in stack, C-C and Ca-C collisions in JACEE (5,6) or in Chacaltaya experiment (7). Admitting that $\langle p_T \rangle$ is the same for nucleon-nucleus collision, we can extend the behaviour of $\langle p_T \rangle$ versus dn/dy by one order of magnitude (fig.1). Inside the experimental errors, the prediction of Barshay

$$\langle p_T \rangle = 0.32\exp\left[\frac{1}{7}\ \mathrm{Ln}\left(1+\frac{3}{\exp\left(-0.519\frac{dn}{dy}^2\right)Ei(-0.0516)}\right)\mathrm{Ln}\left(3-\exp\left(0.0516\frac{dn}{dy}^2\right)E_i\left(-0.0516\frac{dn}{dy}^2\right)\right)\right]$$

looks in better agreement than the hybrid model containing thermodynamic coupled with collective motions, which links phase transition and $\langle p_T \rangle$ flattening. (4)

3.Pseudo-rapidity distributions and phase transition.

It was advanced that the bumps occuring in pseudo-rapidity distribution could also be a signature of transition to quark-gluon plasma(8).We have carried out a Monte-Carlo simulation of 1500 p-Aluminium collisions for specific comparison with our typical event JFaf1 produced in Concorde cabin wall.The multicluster phenomenological model(MPM)has been used to extrapolate the collider data(see HE4.1-9,10),assuming simultaneous rise in Lns of height anf width of plateau,random production of small clusters decaying with Gaussian distribution and finally inclination of plateau for nucleon-nucleus collision.The average number $\langle\nu\rangle$ of successive collisionss in Al target has been taken as 2 at low energy.

The pseudo-rapidity distribution plotted on fig.2 for $E_o=2.6\ 10^6$ GeV includes all the possible fluctuations in multiplicity and inelasticity for p-Al collisions(where $\bar{n}_c=73$).If the discrepancy of the left part can be easily explained by the γ-ray threshold of 100 GeV,the simulation cannot explain the large number of γ rays emmitted(about 50%) at very high rapidity.Substracting the forward part of simulated from experimemtal distribution,we obtain superposition of two components,one being consistent with the extrapolation of accelerator data(containing near 80 γ's) ,also for n_c estimated to 45 in JFaf1, and one additive component characterized by a narrow peak with gaussian distribution centered at 2.7 unit of rapidity in CMS with FWHM near 1unit.

This could be the rapidity signature of an explosive decay of phase transition fireball after compression of the projectile fragmentation fireball in the target.(the target fragmentation fireball cannot be seen with γ rays in emulsion chamber).Such procedure rep eated with $E_o=10^6$ GeV lead to similar results even more pronounced.

5.Primary energy spectrum.

Using the relations previously developed between E_o,ΣE_γ,r_γ ,$\langle E_\gamma R_\gamma\rangle$for stratospheric γ ray family with SBM model by Monte-Carlo simulation,we make a first attempt(now repeated with MPM) to estimate the integral primary spectrum from the primary energy E_o of ultra high energy jets in our Concorde and JAL cargo data(table2,3) in "average conditions".

Name	ΣE_γ (TeV)	Comment	E_o (GeV)
JF2f1	1589	1Km above chamber	$0.9\ 10^7$
JF1af1	260	From cabin wall	$1.9\ 10^6$
JF3-1	55	jet	$4\ 10^5$
JF3-2	51	jet	$3.9\ 10^5$
JF1af2	34	600m above	$2.3\ 10^5$
JFa1	18	jet	$1.55\ 10^5$

Table 2.Concorde data.

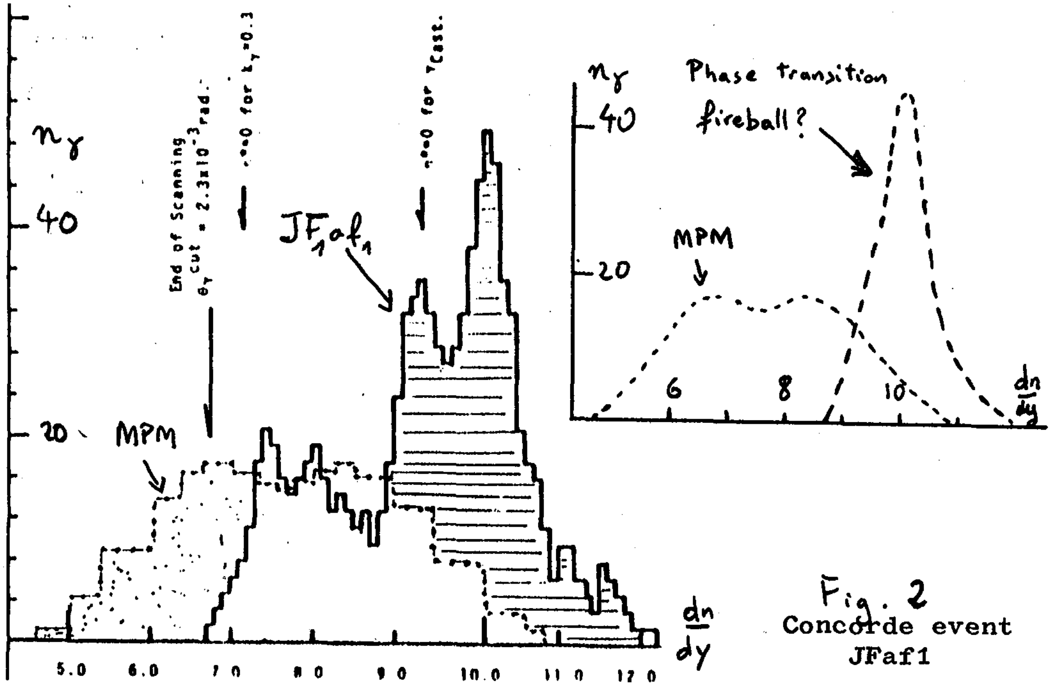

Fig. 2
Concorde event
JFaf1

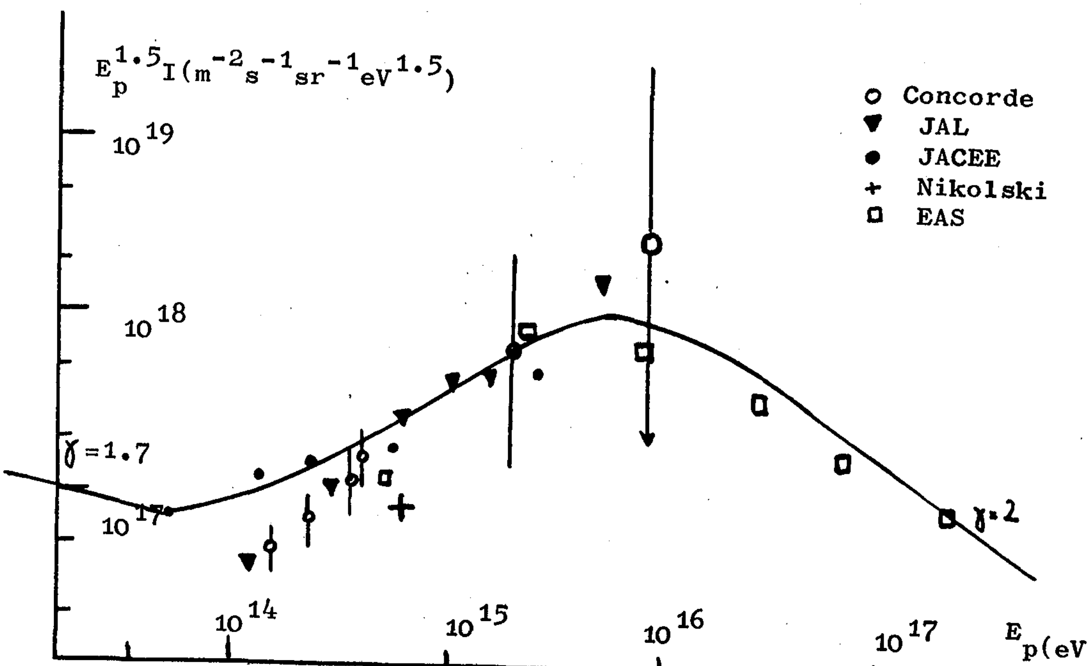

Fig.3

Name	ΣE_γ	Comment	E
O#1	760	770m above	$5\ 10^6$
AJ-c	239		$1.5\ 10^6$
AJ-b	167		10^6
AJ-a	101		$6\ 10^5$
CF1	74	3.2Km	$2.8\ 10^5$
EF1	20.5	1.7Km	$1.2\ 10^5$

Table 3

JAL-cargo data

Taking into account the exposure period and the area of the different chambers,we estimate the integral hadron energy spectrum at 260 G-cm^{-2} and 106 g-cm^{-2} and converted those spectra in total primary spectrum assuming Λ =105g-cm^{-2} for hadron absorption length in air.The situation obtained ,together with JACEE data is shown on fig.3.The total 18 events(6 Concorde+6 JACEE+6 JAL)suggests a tendancy for a bump in primary spectrum near 10^6-10^7GeV.Furthermore,those intensities are close from those obtained by EAS near maximum(9).

6.Conclusion.The compilation of ultra high energy jets suggests at present the existence of a bump in primary energy spectrum(with the standard concept of high energy collisions).The pseudo rapidity distribution exhibits some typical anomalies,more than the $\langle p_t \rangle$ behaviour,which are,may be,the fingerprints of quark gluon plasma transition.The next results of ECHOS Vwill be in both cases determinant to confirm those tendancies,as well as an important effort of the cosmic ray communauty to develop in that sense flying emulsion chamber experiment.

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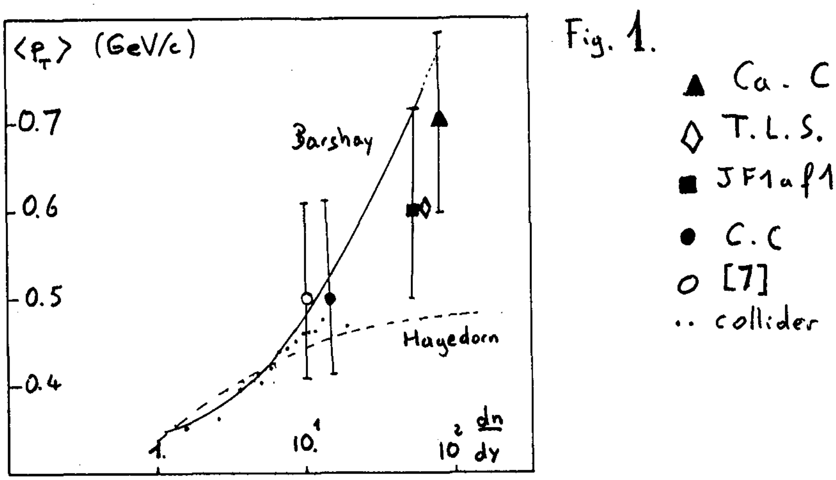

Fig. 1.