Present Status of LEP

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The LEP at CERN started its operation on 14 July 1989 and the first Z^0 events were recorded on 13 August. We report on the status of LEP and the OPAL detector in which we are participating.

1) Short Description of LEP

Machine Parameters

Circumference	27 km
Number of bunches	4/beam
Beam size	$\sigma_x \sim 300\ \mu m$
	$\sigma_y \sim 12\ \mu m$
	$\sigma_z \sim 13$ mm
Beam energy	nominal 50 GeV
	(will be upgraded to 100 GeV)
Beam energy spread	$0.7 * 10^{-3}$
Beam energy accuracy	$5 * 10^{-4}$
Luminosity	$1.7 * 10^{31}\ /cm^2/sec$
	(3 mA / beam)

4 experiments ;

ALEPH	Apparatus for LEP Physics
DELPHI	Detector with Lepton, Photon and Hadron Identification
L3	3-rd experiment in the Letter of Intent
OPAL	Omni Purpose Apparatus for LEP

2) Machine start-up and the Pilot run

On 14 July 1989 (the 200-th anniversary of French Revolution), 20 GeV positrons were injected from SPS to LEP and the beam turned a full circle immediately. Machine studies such as RF trapping , energy ramping to 45.5 GeV etc. were performed with positron beam for 2 weeks. And the electrons were circulated on 25 July.

The pilot run was carried out 13 - 18 August to investigate the detector performance. The typical current was 0.3 mA/beam during the pilot run and the estimated luminosity was ~ 10^{28} /cm^2/sec. About 10 minutes after the collision started, the first Z^0 event at LEP was recorded by OPAL (Fig. 1) !! The so-called lego plot of this first event is shown in Fig.2 based on the cluster energies measured by the lead glass array, indicating a typical 2-jet structure.

The number of collected Z^0 events during the pilot run for each experiment is listed below;

experiment	# of Z^0
ALEPH	12 MH
	2 e^+e^-
	1 $\tau^+\tau^-$
DELPHI	4 MH
	1 $\mu^+\mu^-$
	1 $\tau^+\tau^-$
L3	13 MH
	1 $\mu^+\mu^-(\gamma)$
OPAL	18 MH
	2 e^+e^-
	1 $\tau^+\tau^-$

where MH stands for "Multihadronic event".

3) Some Analysis Results (very preliminary)

Event shape analyses were performed to the 18 multihadronic events of OPAL. Only the cluster information from the electromagnetic calorimeter (lead glass array) was used in the analysis, because the high voltages of the tracking chambers were not switched on for some events due to high background. The distributions of sphericity and thrust are compared with the expectations from MC simulations in Fig. 3. Also the distributions of P_t(in) and P_t(out), the transverse momenta relative to the event axis inside and out of the event plane respectively, are shown in Fig. 4. Nice agreement was obtained between data and MC simulation.

Based on the observed number of MH events (18) and the luminosity measured by the forward detector (L = 0.37 ± 0.08 (stat) ± 0.08 (sys) /nb), the hadronic cross-section at 91 GeV was derived;

$$\sigma_{had} = 48 \pm 19 \text{ nb} .$$

4) Schedule after the pilot run

* Short term

11-18 Sep. Machine development
& access for L3

18 Sep. - end Dec. Physics run
I = 1.0 - 1.5 mA/beam
mini-beta operation expected
Luminosity ~ 10^{30} /cm^2/sec (hopefully)

8-18 Oct. Shut down.

Latest News

Physics run started on 20 Sep.
Luminosity ~ a few * 10^{29} /cm^2/sec
OPAL collected ~ 970 Z^0 events until 25 Sep.

Scan strategy
a) 24 hours at 91.25 GeV (arbitrarily defined peak energy), including luminosity optimization.
b) 1 fill or at least 6 hours of run per point, for the following energies;

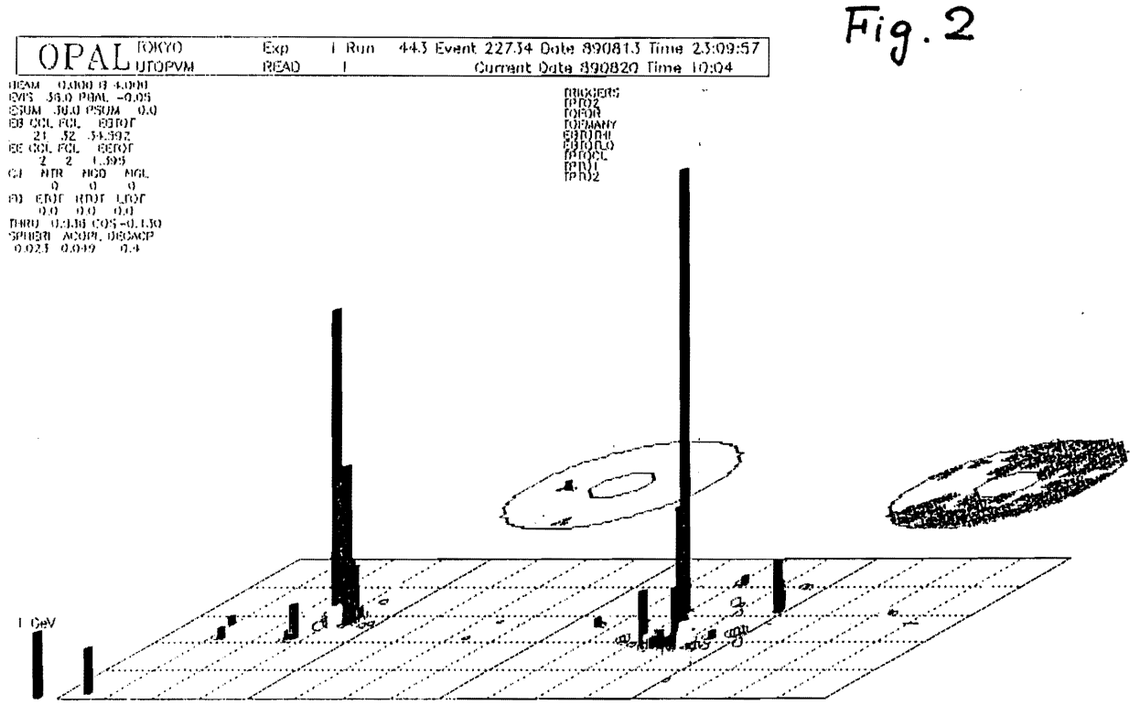
90.25 GeV
92.25
91.25
89.25
93.25
91.25 until 2 Oct. 1989

* long term

1989	L ~ 2 * 10^{30} /cm^2/sec	I ~ 1.0 mA/beam
1990,91	L ~ 1.7 * 10^{31} /cm^2/sec	I ~ 3.0 mA/beam
~ 1991	beam energy ~ 64-67 GeV	SC cavity installation
end of 1993	W+W- threshold will be surpassed.	
	L ~ 5 * 10^{31} /cm^2/sec	I ~ 5.0 mA/beam

Now we can enjoy physics at LEP
after a long painstaking construction time !!!

Fig. 2



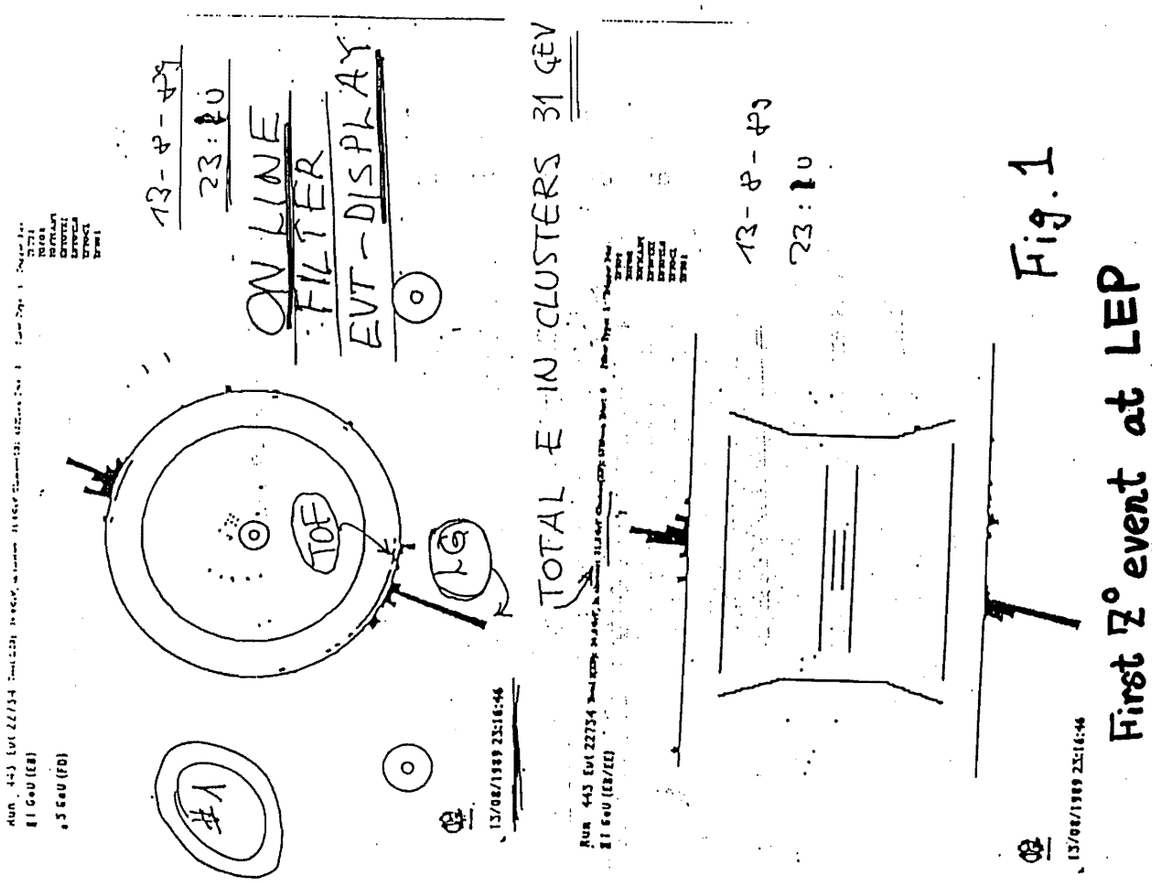


Fig. 1

First Z° event at LEP
seen by OPAL !!

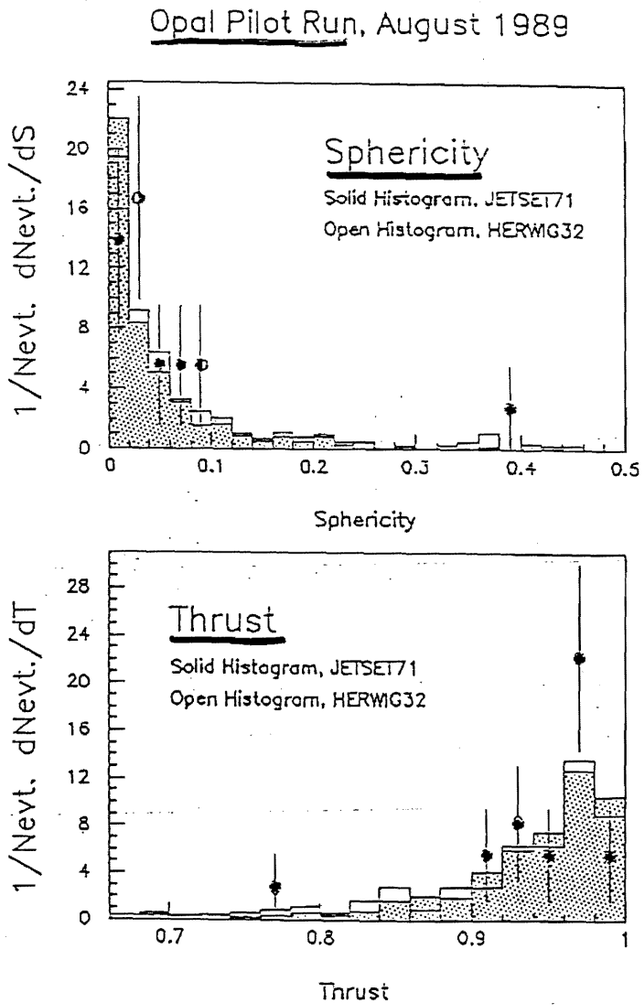

Opal Pilot Run, August 1989
Sphericity
Solid Histogram, JETSET71
Open Histogram, HERWIG32
1/Nevt. dNevt./dS
Sphericity
Thrust
Solid Histogram, JETSET71
Open Histogram, HERWIG32
1/Nevt. dNevt./dT
Thrust

Fig. 3

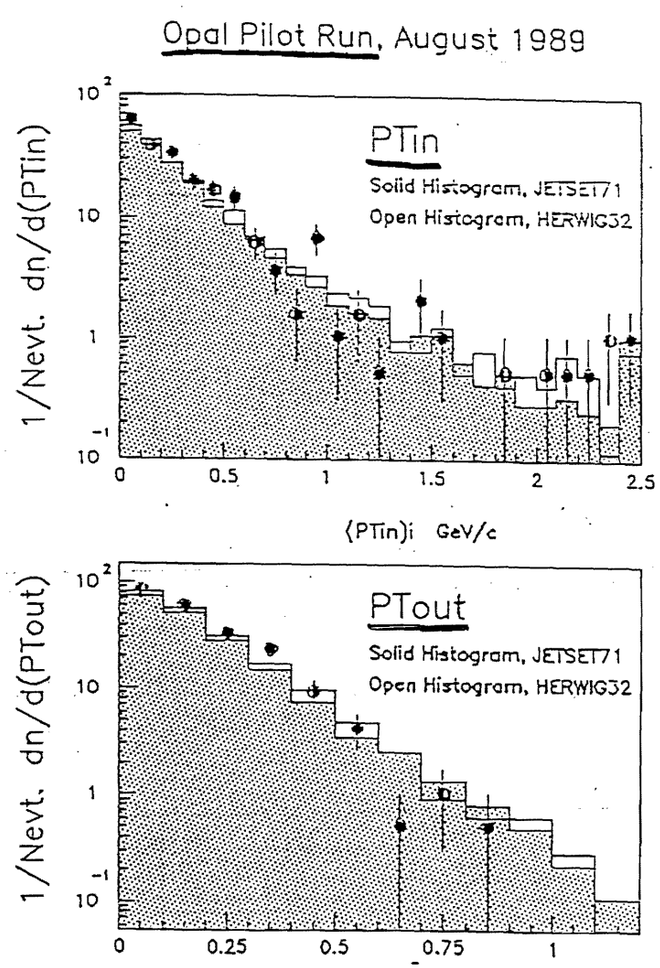

Opal Pilot Run, August 1989
PTin
Solid Histogram, JETSET71
Open Histogram, HERWIG32
1/Nevt. dn/d(PTin)
⟨PTin⟩i GeV/c
PTout
Solid Histogram, JETSET71
Open Histogram, HERWIG32
1/Nevt. dn/d(PTout)

Fig. 4