# THE FTC DETECTOR IN THE L3 EXPERIMENT AT LEP, CERN

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## General Description of the Detector

The FTC (Forward Tracking Chamber) is a tracker designed to detect charged particles emitted at polar angles ranging from 14 to 35 degrees. The two FTC blocks are installed in the gaps between the Central Detector (TEC) and the Electromagnetic Calorimeter (BGO) in the L3 experimental setup, as shown in Fig.1.

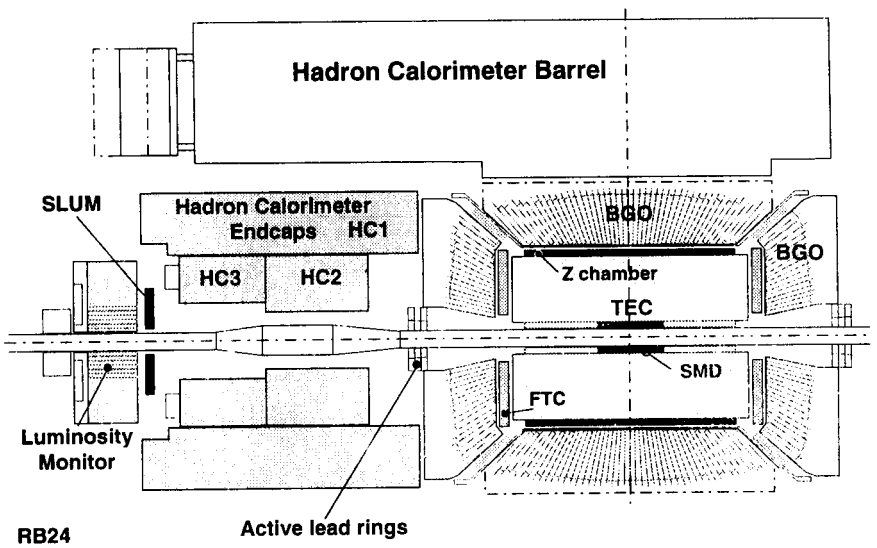


**Fig.1.** Cross section view of L3 endcaps

The basic elements of the FTC are rectangular Drift Cells (DC) of various lengths. Each DC is an independent module containing four sensitive wires. It allows to measure by drift times one coordinate (X or Y) of the track as well as its projection angle ($\theta_x$ or $\theta_y$) and gives also a rough measurement of the orthogonal coordinate (X or Y) by the charge division method.

The DCs are grouped mechanically into Half-Disks (HD). Each HD contains 13 DCs. Two HDs are joint together to form a Disk. Each block of FTC contains two Disks (H-Disk and V-Disk) oriented by 90 degrees with respect to each other.

The positions of 26 reference points (one point on each side of the DC) have been measured on each HD before its installation using a precision measuring table. During the installation the X,Y,Z coordinates of several reference points from each HD were determined in the global coordinate system by a geometry survey. These data were used later as a first approximation in the FTC alignment with physical tracks.

According to the technical parameters of the FTC DCs, the detector was expected to have the coordinate resolution not worse that 150 $\mu$m, and the angular one – not worse than $10^o$ (see [1,2] for details).

## The FTC Calibration and Alignment

The FTC calibration and alignment in the L3 experimental setup, as well as the evaluation of the detector performance, were carried out using the experimental data obtained in 1992 – 1994. Out of the whole bulk of the registered events, only those with the hits registered by at least three out of four wires of an FTC Cell were selected, the tracks segments reconstructed, and the correspondence found between them and the TEC–reconstructed tracks.

The efficiency and space resolution were found for each of the FTC wires using only FTC data. Having excluded the influence of the 'geometric' inefficiency of the first and fourth wires in each DC (a three-hit segment may be reconstructed with any *one* of these wires, while *both* the second and the third wires always participate in it), we obtained the average wire efficiency of approximately 98%. The wire space resolution was determined from the residuals to a straight line fit for the events with the four active wires. Fig.2 shows an example of the FTC single wire resolution as a function of the drift time. The mean value of the resolution does not exceed 150 $\mu$m.

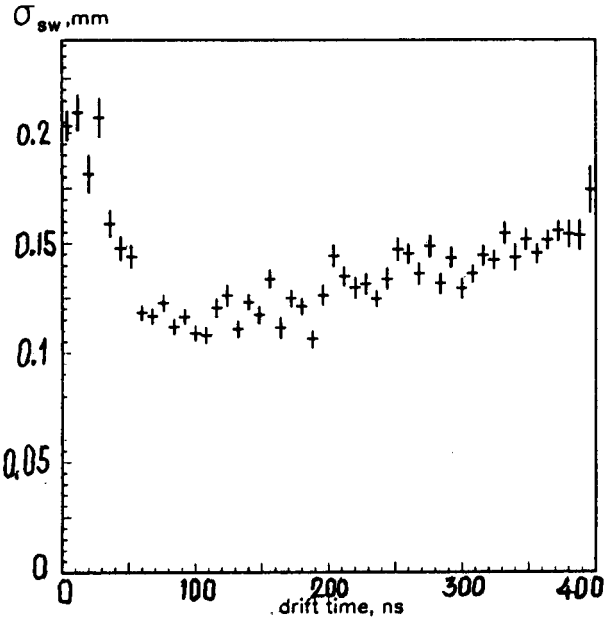


**Fig.2.** A single wire resolution (wire No.25) as a function of the drift time

The FTC alignment in the L3 setup resulted in the calculation of the coordinate corrections stored later in the L3 database. Namely, the values of X(Y)-shifts and turn angles in the XY-plane were calculated for each DC and each HD; the values of Z-shifts were also found for the latters.

The results of the FTC alignment throughout the three years showed a fairly good agreement both among themselves and with the alignment corrections obtained with the preliminary version of the 1995 experimental data.

## An Example of the FTC Use

As a tracking device covering the area of small polar angles, FTC provides a valuable, and often unique in the framework of the L3 experiment, information. For instance, in about 14% cases the TEC software fails to reconstruct the polar angle of the track. Presently, this information gap may only be filled with the FTC data.

Another striking opportunity for using the FTC information, as well as an independent test of the quality of the FTC alignment, offers itself in the investigation of dimuon events $Z \rightarrow \mu\mu$ (see [3] for a detailed discussion). Fig.3 shows the distribution of the azimuthal angles difference for the dimuon tracks determined from the FTC information.

Two peaks in Fig.3 correspond to two possibilities – when a positively charged muon is detected in one or the other of the two endcaps. The probability to assign the wrong muon charge sign estimated from this figure is less than 5%. This is much better than in the barrel region. The peak width of about 1 mrad corresponds to the FTC accuracy of ~380 $\mu$m in determining the XY-point of the trajectory. Taking into account the vertex position uncertainty and the intrinsic FTC resolution, it gives us the alignment precision in the range of 100 $\mu$m.

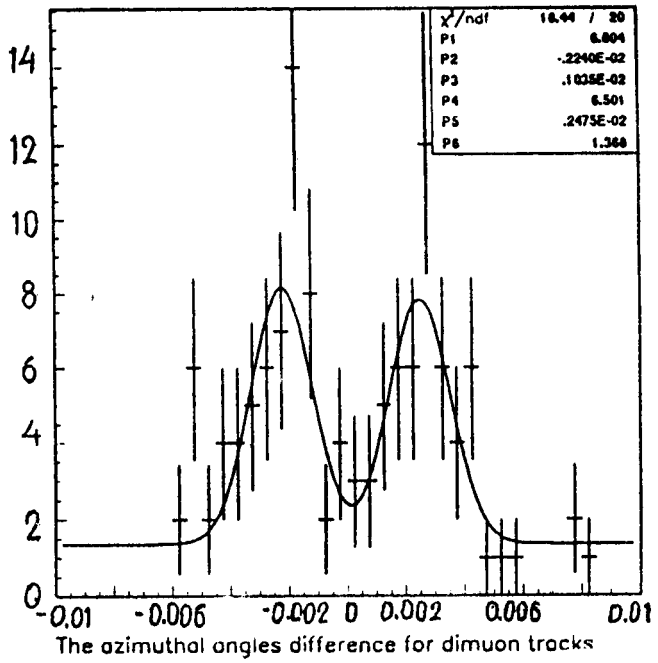


**Fig.3.** The azimuthal angles difference for the dimuon tracks determined from the FTC information only

## REFERENCES


1. *Gavrilov G. et al.* //Nucl.Instr.Meth., 1995. V.356. P.189.
2. *Alkhazov G. et al.* L3/Internal Note No.1862, 1995. 23 p.
3. *Prokofiev D. et al.* L3/Internal Note No.1895, 1995. 74 p.