Experiment SuperB at Cabibbo Lab.

L. Cappelli[1,2], P. Creti[3], F. Grancagnolo[3], A. L'Erario[3,4], A. Maffezzoli[3,4], A. Pepino[3], S. Rella[3,4], G. Zavarise[3,4].

[1]Istituto Nazionale di Fisica Nucleare, Laboratori Nazionali di Frascati, Italy

[2]Dip. di Ingegneria Elettrica e dell'Informazione, Università di Cassino e del Lazio Meridionale, Italy

[3]Istituto Nazionale di Fisica Nucleare, Sezione di Lecce, Italy

[4]Dipartimento di Ingegneria dell'Innovazione, Università del Salento, Italy

1. Introduction

The SuperB experiment [1] is an approved high luminosity flavour physics experiment that will perform detailed studies of the decays of B, D, Υ mesons and τ leptons with billions of events. Using these events it will be possible to start reconstructing the Lagrangian for any physics beyond the Standard Model that may be encountered, and precise tests of the Standard Model of particle physics. The experiment will be built at the newly created Cabibbo Laboratory in Tor Vergata (Rome).

The contribution of the Lecce group is concentrated on the implementation of the Cluster Counting/Timing methodology to the readout of the drift chamber of the SuperB apparatus.

The drift chamber (DCH) is the main tracking and momentum-measuring system. It provides precision momentum measurements, as well as good particle identification for low momentum tracks (those below DIRC threshold) and for tracks in the forward direction, outside the DIRC acceptance. The DCH design is based on the BABAR drift chamber, described in detail in the original BABAR detector publication [2].

2. Drift Chambers Fast Readout Cluster Counting/Timing algorithm implementation and test on a FPGA Board

A fast readout algorithm [3,4] for Cluster Counting and Timing purposes has been implemented and tested on a Virtex 6 core FPGA board. The algorithm analyzes and stores data coming from a Helium based drift tube instrumented by 1 Gsample/s ADC; the algorithm represents the outcome of balancing between efficiency and high speed performances, resulting in high efficiency peak data extraction on simulated signals as well as on experimental ones. A relative efficiency evaluation using commercial peak finder software (i.e. PeakFit) has been carried out too (shown in Fig.1). Based on last results, the developed algorithm (described in Fig.2) can be

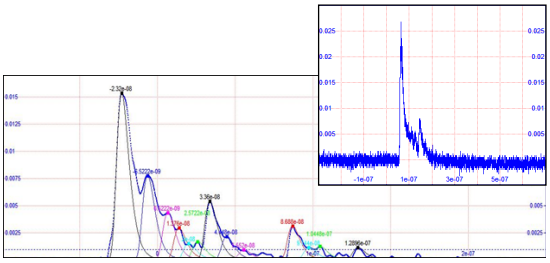
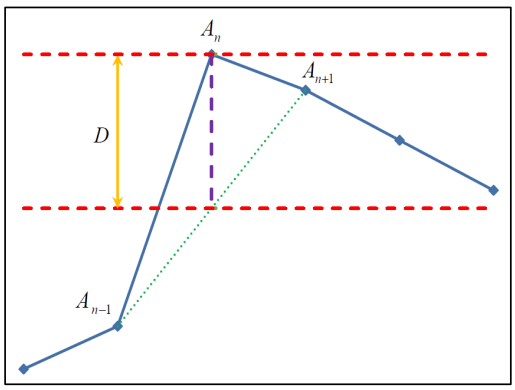


Figure 1. Reconstructed peaks in a typical pulse (in the inset) generated by a m.i.p. in a drift tube, $8mm$ diameter, $90\%He - 10\%iC_4H_{10}$, gas gain 10^5, sampled with a $8GHz$, $12GSa/s$, $8bit$ oscilloscope. In these conditions, one expects of the order of 10 clusters total.



$$D = A_n - \left(\frac{A_{n-1} + A_{n+1}}{2}\right) \geq 3\sigma_d$$

$$\sigma_d^2 = \sigma_{A_n}^2 + \frac{1}{4}\sigma_{A_{n-1}}^2 + \frac{1}{4}\sigma_{A_{n+1}}^2 = \frac{3}{2}\sigma^2$$

Figure 2. A brief description of the fast numeric algorithm developed for the FPGA.

adopted in order to build a VME electronic board that should serve, initially, at least 4 fADC channels and it can be used as on-line preprocessing stage for signals coming from the SuperB DCH.

REFERENCES

1. SuperB - A High-Luminosity Heavy Flavour Factory - Conceptual Design Report, INFN/AE - 07/2, SLAC-R-856, LAL 07-15 March, 2007. Available at http://www.pi.infn.it/SuperB/?q=CDR
2. B. Aubert et al. [BABAR Collaboration], The BaBar detector, Nucl. Instr. Methods Phys. Res., Sect. A 479, 1 (2002).
3. L. Cappelli, "Drift Chambers readout Electronics and Cluster Timing Algorithm for Mu2e Experiment at Fermilab". Tesi di Laurea Magistrale in Ingegneria Elettrica, Facoltà di Ingegneria, Università di Cassino, 2011.
4. L. Cappelli, P. Creti and F. Grancagnolo, "A Cluster Timing Algorithm for drift chambers readout electronics", 4th IEEE International Workshop on Advances in Sensors and Interfaces (IWASI), Savelletri di Fasano, Italy, 28-29 June 2011.