Basic of Data Acquisition, Detector Technique, and Data Analysis

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GPPU Experimental Point (GEP): 4

Goal of Study

In this course, we would like you to acquire the following knowledge and techniques.
(a) Construction of a test bench using NIM and VME modules
(b) Control of VME modules and reading/writing data from/to modules (VME access).
(c) Detector construction and data analysis

Contents

Recent high energy particle physics, like Large Hadron Collider (LHC) experiment at CERN, has a few hundred to a few thousand people in the collaboration. The tasks are separated to specialist, and it is difficult to understand whole system (detectors, data acquisition, trigger, and analysis framework) by one person.
On the other hand, the experimental physicist in elementary particle/nuclear physics filed should have an experience of construction of test bench for detector test. The knowledge will be requisite to design an experiment and to be a group leader.
You will learn the following items in this course.
(1) Construction of a test bench for detector test using cosmic ray.
(2) Assembling of a plastic scintillator hodoscope and silicon photomultiplier (SiPM)
(3) Performance test of timing resolution by cosmic ray.
We plant to analyze the Time-of-Flight (TOF) information from three hodoscopes to evaluate timing resolution. The data on VME module is a binary data and need to know how to treat those data on memory. Using a simple program written by C/C++, you will learn how to access VME memory. ROOT which is a framework for data processing and born at CERN will be used for analyses.
SiPM is a solid-state photomultiplier comprised of a high-density matrix of Geiger-mode-operated avalanche photodiodes. We had been used Photomultiplier tube (PMT) for the photon detection in many years. The normal PMT has a weakness in that it could not operate in a magnetic field. Because of silicon sensor, SiPM can be operated in a magnetic field. Additionally, SiPM has the advantage of being small.

Textbook and References

Progress Schedule

- Day 1
  Basic of data acquisition system (Lecture)
  How to access and control memory on VME modules (Lecture)
  How to get intrinsic timing resolution from TOF information (Lecture).
- Day 2
  Assembly of hodoscope (Experiment)
- Day 3
  Construction of test bench using plastic scintillation counters and NIM/VME modules and Performance test by cosmic ray (Experiment).
- Homework
  Data analysis to evaluate timing resolution.

Other Details

Course Period	In the first/second semester of 2023
Place	Science Complex B, 6F, Rm. 642
Number of Students	1 – 6
Evaluation method	The evaluation method will be based on number of dates attended (30%) and depth of understanding (70%).

In Addition

After construction of the test bench, you need one day to a few days for data taking.
Data analysis will be homework.
Date and time of the course will be decided by discussion with attendants