N3 (GEP=4)

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 a streaming DAQ system.
(b) 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 into specialists, 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 field should have experience of construction of test bench for detector test. The knowledge will be required 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 plan to analyze the Time-of-Flight (TOF) information from three hodoscopes to evaluate timing resolution. The data on DAQ is binary data and you need to know how to treat those data on memory. Using a simple program written by C/C++, you will learn how to access the data. 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 using Photomultiplier tube (PMT) for photon detection for many years. 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.

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Textbook and References

Progress Schedule

- Day 1
  Basic of data acquisition system (Lecture)
  How to access and control memory on VME modules as an example (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 streaming DAQ system, and performance test by cosmic ray (Experiment).
- Homework
  Data analysis to evaluate timing resolution.

Other Details

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

In Addition

After the test bench is set up, 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