

Silicon Detector Development in Kyushu University

Junji Tojo

Kyushu University

Workshop on Silicon Detectors
for g-2/EDM and COMET Experiments

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Introduction to Kyushu Group

- Our group recently started the collaborations with J-PARC muon $g-2$ /EDM and COMET experiments.
- Tsutomu asked me to introduce Kyushu group in this workshop, especially related to silicon detectors.
- In this talk, I will try showing our current and future projects.

Introduction to Kyushu Group

- Kyushu group for experimental particle physics
 - Experimental Particle Physics Group was established in April 2011.
 - Research Center for Advanced Particle Physics was established in October 2012.
 - This center includes the theory group.
 - Members as of now
 - 6 faculty members + 2 postdocs
 - 9 graduate students (+8 from April 2014)

Projects

- ILC
 - ILC project planning
 - Si-W EM calorimeter for ILD (CALICE collaboration)
- ATLAS
 - Operation of Semi-Conductor Tracker (SCT)
 - Future development/construction of the planned pixel detector for the ATLAS upgrade
- COMET
 - Scintillating crystal EM calorimeter
 - Interests in Active Silicon Pixel target
- J-PARC muon g-2/EDM
 - Silicon strip tracker development
- NOP (Neutron Optics and Physics in J-PARC)
 - Neutron EDM measurement
 - Precise Neutron lifetime measurement
 - New interaction search

Projects – Sorted out by Silicon Detector Technology

- Silicon-pad
 - Si-W EM calorimeter
- Silicon strip
 - ATLAS SCT operation
 - J-PARC muon g-2/EMD
- Silicon pixel
 - ATLAS upgrade
 - Interests in COMET Active target

Current Situation

- Since our group is relatively new, there has not been so much infrastructure
 - Always got the significant supports from KEK g-2 and COMET groups.
- We have been working to get the budget for the basic infrastructure for the silicon detectors.
- The budget was recently approved.
- In the following slides, our current plan is shown, targeting in the next half year.

Clean Room

- A clean room (or most likely clean “booth”) will be built.
- All the infrastructure (to be shown later) will be installed here.
- To be safe (from my experience), the class required is 1000.
 - This is a sort of over-specified, but is fine.

Wire-Bonder

- Aluminum thin wire (normally 1 mil) wire-bonding is a basic method for the development/construction.
- This is used mainly for the silicon strip/pixel detectors.
 - Whenever necessary for the other types of the detectors and electronics.
- Both automatic and manual wire-bonders will be prepared.
 - Manual for R&Ds and/or small-scale fabrication.
 - Automatic for the production and/or huge number of wires.

Prober

- Manual prober, which can accommodate 8” wafers.
 - The prober will be in a dark box for the sensor studies.
- Usage
 - Property measurement of Silicon Pad/pixel/strip sensors.
 - Electrical tests of ASICs on wafers

Scanner System

- A scanner system to measure IV/CV of the multi-channel silicon detectors.
- The scanner system is configured to handle 128 channels for IV/CV measurements.
- The pico-anmmeter, LCR meter and others related to IV/CV measurements are also included.

Equipment for Measurement/Evaluation

- DAQ systems
 - VME-based DAQ system for the general usage.
 - ATCA-based DAQ system for the ATLAS upgrade
- All the general devices related to the DAQ system as much as possible
 - Its cost is rather significant if we sum up all of them.
 - To be selected depending on the priority/phase of the projects.

A Small Scale Computing

- A computing resource is always better to have to work on the design including a significant detector and physics simulation.
- The current plan is to have a resource of 200 cores + 100 TB disk space + batch system.

The Other Infrastructure

- Due to the budgetary constraint, the following items might or might not be introduced, although we will try including those as much as possible.
 - 3D measuring machine
 - Bond tester
 - Glue potting machine

Summary

- Our group is going to prepare for the significant infrastructure for the general silicon detector developments and construction by this summer.
- Although there is budgetary constraint, advice/suggestion from the silicon detector experts are very welcome, especially towards for the future collaboration of g-2/COMET and also ILD/ATLAS.