Groups in Kyushu University and the University of Tokyo are working in together on Silicon-Tungsten ECAL (SiECAL) R&D in collaboration with French groups in a framework of the CALICE collaboration. We performed three test beam experiments for a SiECAL technological prototype at DESY. We have also working on a study to determine the design of the silicon sensors. In addition, we are working on a study of Hybrid ECAL which has "Si sensor "and "Scintillator and photo sensor "Active layers as an optimization of ECAL in few of the performance and the cost.

SiECAL test beam experiments were carried out in Jul. 2012, Feb. and Jul. 2013 to test the SiECAL technological prototype. The front-end electronics of the prototype was integrated into an active layer to realize a highly granular calorimeter. In the 2012 test beam, we operated six layers under a continuous current mode. The achieved signal to noise ratio was greater than 10 with SKIROC2 ASICs. In the 2013 test beams, we successfully operated and took data with the prototype under a power pulsing mode. At the same time, we found several issues related to the power pulsing operation. Digital lines on the front-end electronics disrupts analog signals. We had to wait 600 μs for the electronics to stably take the data. We measured pedestal signals in a magnetic field, and confirmed that active channels were working in stable up to 2 T.

As for the R&D of silicon sensors, we measured several new samples with different guard ring types. It is known that a Si sensor makes small fake signals along with its sensor edge when a large amount of current is generated by an electromagnetic shower in a calorimeter. If the fake signal is reasonably small, we can use the Si sensor for the ILD. To test the fake signal, we introduced an infra-red laser system in Kyushu University to measure the Si sensor response with a similar condition of beam test in a labratory scale. We are setting up a multipixel readout system without SKIROC2 ASIC. We can then measure the intrinsic Si sensor properties with the IR laser system.

Studies on the SiECAL optimization have been performed with full ILD detector simulation. We performed simulation studies with different setting of PCB thickness, dead volume related the sensor edge, and fraction of dead channels. We found:

- The PCB thickness does not change the performance of the jet energy resolution.
- The dead volume proportionally degrades the perfomance, but the current Si sensor design is acceptable.
- The fraction of dead channels does not much degrade the jet energy resolution up to the fraction of $\sim$5%.

The electromagnetic calorimeter is, together with the solenoid magnet, a cost driver of the ILD detector. Therefore the study of Hybrid ECAL is important to reduce the overall cost of the detector while keeping the performance. Many configulations of Hybrid ECAL have been studied with the full ILD detector simulation. As a preliminary result, the jet energy resolution is gradually degraded by increasing the Scintillator ratio but the effect is small up to the ratio of sillicon : scintillator $\sim$ 1 : 1.

Detector R&D plan in comming years are shown below.

- Test beam experiments with long SiECAL slabs using new front-end electronics with SKIROC2 ASICs,
- Combined test beam experiments with ScECAL and AHCAL,
- Development a DAQ system (set up of hardwares, development of software and firmware) for the combined tests.
- Further R&D of silicon sensors, using the IR laser system, to determine the final design.
- Irradiation test with several types of Si sensors.
- Looking for Japanese companies which can produce SiECAL front-end electronics in prospect of mass production.
- Further optimization of SiECAL and Hybrid ECAL with full ILD detector simulation.