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CALICE Prototype Calorimeters for Linear Collider detectors

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For several years, CALICE has been testing highly granular calorimeter prototypes using analogue readout. These devices are envisaged for particle flow application in a future linear collider detector. A novel alternative, especially interesting for the hadron calorimeter, is to use digital readout, with a very small cell size. In the past year the first large scale (1m¬≥) digital HCAL has been operated by CALICE in test beams at Fermilab. This detector uses glass RPCs for readout within an iron absorber structure. The RPCs are read out through 1x1 cm¬≤ pads with a single threshold, providing a digital image of the shower with high spatial resolution. Including a similarly equipped tail catcher, the system contains almost 500,000 readout channels. We report on the technical performance of this calorimeter, and show first physics results on shower reconstruction.

A related approach is to use RPCs with two-bit readout, providing three threshold values, referred to as a "semi-digital" HCAL. This approach is being pursued under the aegis of EUDET. Already in 2010 a full 1m¬≤ plane was tested in a beam, and a full 1m¬≥ is being tested at CERN in 2011. The current status is reported. In addition, tests in 2010 demonstrated the performance of these RPCs in a 3T magnetic field, and also showed that there was no degradation of performance when the electronics was "power pulsed", a technique which is envisaged to reduce power dissipation in an ILC detector. Alternative technologies for a digital HCAL are also being studied, both Micromegas, for which 1m¬≤ planes have already been tested in beams, and GEMs for which 30x30 cm¬≤ units are currently being tested.

Second generation analogue devices are also under construction, and we report progress here. The focus of this work is to develop technical solutions which could be scaled up to a full-sized detector.
The development of a highly segmented electromagnetic calorimeter based on silicon sensors with 5x5 mm¬≤ segmentation will be described, covering developments in sensor design, readout electronics and the mechanical and thermal issues of detector integration. The plan is to test one full-length module along with a fully instrumented 18x18 cm¬≤ tower. Modules are also being constructed using an alternative technology based on scintillator-strip sensors.
The second generation analogue HCAL is based on scintillating tiles that are individually read out by silicon photomultipliers. The prototype will contain about 2500 detector channels, corresponding to one calorimeter layer and aims at demonstrating the feasibility of building a detector with fully integrated front-end electronics.

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Classification de Session: Detector R & D and Data Handling

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