

Performance study of SKIROC2/A ASIC for ILD Si-W ECAL

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The International Large Detector (ILD) is one of two detector concepts of International Linear Collider (ILC). The ILD silicon-tungsten electromagnetic calorimeter (ILD Si-W ECAL) is a sampling calorimeter with tungsten absorber and highly segmented silicon layers to achieve precise jet energy measurements by particle flow concept. Readout ASICs should be embedded between absorber and detector layers.

SKIROC2 is the ASIC for the ILD SiW-ECAL, developed by IN2P3/Omega group. It consists of 64 input channels, preamplifier and two gain slow shapers, a fast shaper for triggering, 15 analog memory cells to accumulate multiple events with up to 2625 bunches colliding in a beam train. It has 12-bit ADC and TDC outputs, multiplexed and sent via a daisy-chained digital bus line. One of the specific characteristics of the ASIC is the power-pulsing capability, to switch off unnecessary part (for example, amplifiers are only powered at acquisition stage) to reduce the power consumption and dissipation.

We produced prototype sensor layers equipped with SKIROC2 and conducted test beams since 2012. We found several issues related either ASIC or PCB. For example, we suffered from multiple fake triggering occurred just after the right trigger (which we called retriggering), which improves at the second prototype at 2014 but still exists. To investigate the issues, we prepared dedicated ASIC evaluation boards with either BGA sockets or directly soldered SKIROC2. The evaluation boards have an analog probe to check the amplifier outputs, and investigate various features of SKIROC2 including TDC, external triggers and so on.

We will report the performance study with the evaluation boards, including signal-to-noise ratio, TDC performance, and investigating the retriggering issues. We also present the comparison of performance with the prototype on the test beam. In addition, the new ASIC, SKIROC2A, has been prepared recently with improved features such as more dynamic range for individual trigger threshold control and TDC dead time. The comparison of features and performance between SKIROC2 and SKIROC2A with the evaluation board is presented as well.

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