

Power Pulsing Results for the Calorimeters

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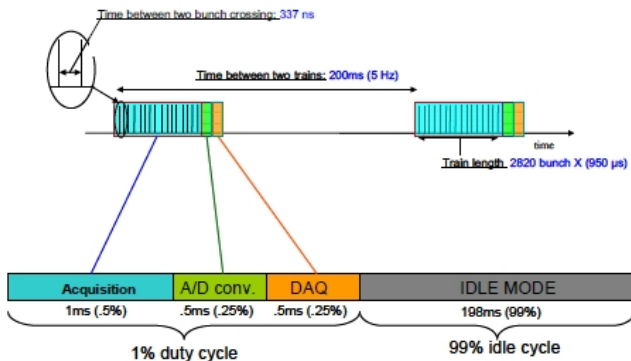


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Outline

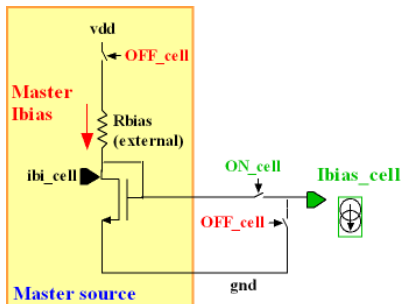
- 1 Introduction
- 2 Power Pulsing Results with the SDHCAL
- 3 Power Pulsing Results with the SiW-ECAL
- 4 Conclusion and Outlook

Why the Power Pulsing



- Reduce the power consumption by taking advantage of the ILC bunch train structure.
- Switch on parts of the electronics only when they are needed.

Principle of the Power Pulsing



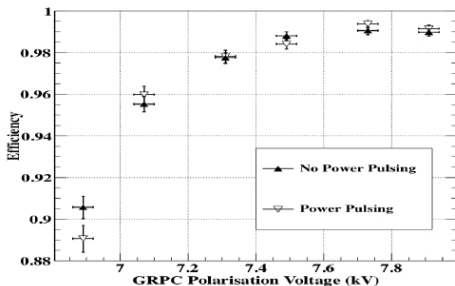
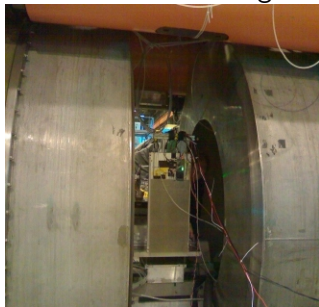
- Power Pulsing is not a simple ON/OFF of the tension.
- Shut down bias currents with v_{dd} always ON.
- 4 Power Pulsing lines : analog, conversion, dac, digital.
- The requirement is $25 \mu W/ch$ with 0.5% duty cycle.

Current situation for SKIROC2

Without Power Pulsing: 40 mW for the all chip \rightarrow 0.6 mW/ch.

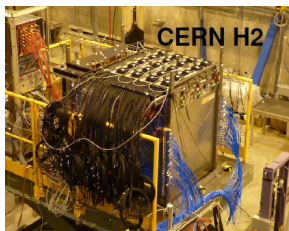
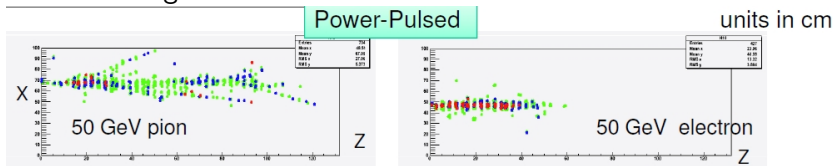
With Power Pulsing: 1.7 mW for the all chip \rightarrow $27 \mu W/ch$.

Test of Power Pulsing in a Magnetic Field of 3 Tesla



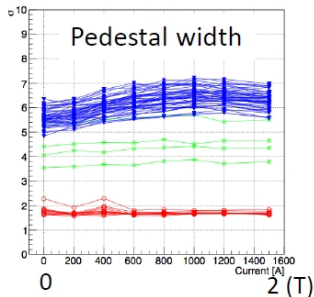
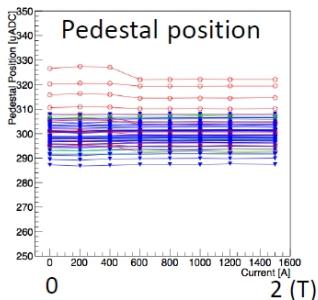
- The Power-Pulsing mode was applied on a GRPC in a 3 Tesla field at H2-CERN (2 ms every 10 ms rather than 200 ms for the ILC).
- No effect on the detector efficiency coming from the Power Pulsing or the magnetic field.

Power Pulsing in SDHCAL test beam

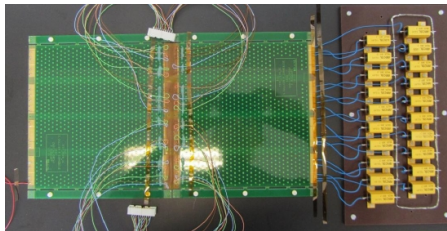


- Power Pulsing was tested in test beam at CERN in 2012.
- Power Pulsing was adapted to the PS and SPS spill duration: 300 ms (PS) and 9 s (SPS) every ≈ 45 s.
- It has applied with a great benefit on the detector behaviour (heating, noise, ...).

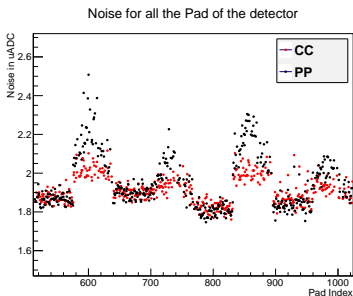
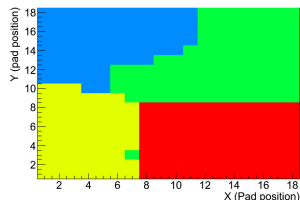
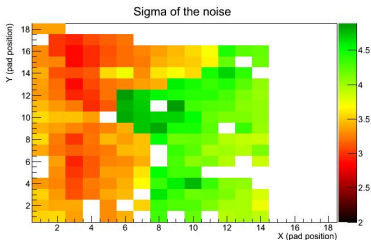
Test of Power Pulsing in a Magnetic Field



- Power Pulsing under magnetic field was tested with 2 Tesla field at DESY.
- Pedestal is stable up to 2 Tesla.
- Also no hardware damages with magnetic field (pcb, interconnections, ...).

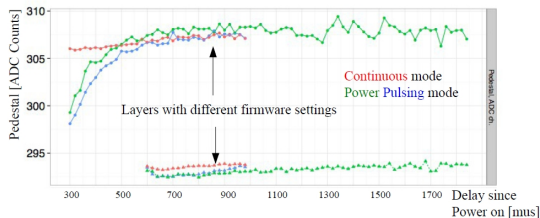


Test Beam Results of the SiW-ECAL: Pedestal

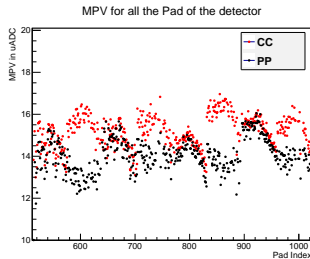
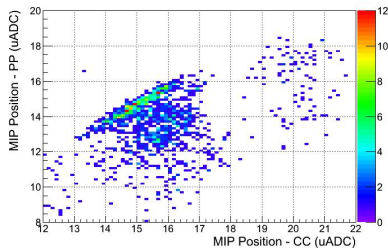


- Two test beam at DESY in 2013: comparison Power Pulsing/Continuous mode .
- For low noise chips: still good with Power Pulsing.
- For high noise chips: the behavior, due to PCB routing, seen in continuous mode is even amplified by Power Pulsing.

Test Beam Results of the SiW-ECAL: Energy calibration



- Stabilisation of the pedestal after $\approx 600 \mu\text{s}$.



- Also different behavior between high/low noise chips for energy calibration.

Conclusion and Outlook

- ① Since two years the Power Pulsing have started to be tested by the calorimeters teams.
- ② The main result for all the calorimeters is: it's works.
- ③ Successful test beam for the SDHCAL operating with power pulsing.
- ④ Highlights of the SiW-ECAL test beam: electronics have to be even more attentive to details with the Power Pulsing.