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# ASIC design in the KM3NeT Detector

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In the KM3NeT project, the electronics required to control the PMTs and collect the signals is integrated in two ASICs: 1. Front-end mixed signal ASIC (PROMiS) and 2. Analog ASIC (CoCo) to control the feedback of the high voltage (HV) circuit. We discuss the two integrated circuits and their test results. The read out ASIC amplifies converts input charge to pulse width and delivers the information via LVDS signals. PROMiS communicates with the control electronics via an I2C bus. CoCo contains a low power regulator and the feedback of the High voltage generator.

## Summary

About PROMiS : The pre-amplifier boosts the input signal from a PMT and a comparator discriminates against a pre-determined threshold level. The ToT determines how long the signal is above the threshold value and is transmitted in the form of LVDS signals. The functionality of the chip also includes two 8-bit DACs: 1. to control the threshold level of the comparator 2. To control the reference voltage of the High Voltage generation part. An analog output buffer is added to monitor the pre-amplified signal for qualification of the complete PMT module.(test purpose only).
An I2C slave configuration is implemented to communicate with the subsequent electronics. A 24 bit (potentially identify 16 million PMTs)one-time programmable memory is integrated to uniquely identify each chip. The ASIC is designed in 0.35u CMOS technology and consumes <30 mW power and has an area of 1.7mm x 1.25mm in silicon. Improvements and changes made on the previous version will be discussed.
About CoCo :
A very stable High voltage is needed to operate the PMT. This high voltage is generated by a CW circuit and is designed using discrete components on a small PCB. Originally, the CW circuit was controlled using a discrete COTS component. The component issued pulses of a predetermined width at a fixed frequency. The pulses charged the CW multiplier to the required HV, whose value was determined by the DAC setting on PROMiS. The feedback from the CW circuit shut on or off the fixed-frequency pulses from the COTS. The disadvantages of the COTS were: cost, higher power and the risk of the part being obsolete in the future. CoCo is designed to control the feedback of the HV and issue a more stable HV supply for the PMT. Advantages include : stable HV, lesser area, cost, power and external component count on the board. The CoCo comprises of a current controlled oscillator, a monostable circuit to define the pulse width and over current protection for the transformer. It controls the frequency of the pulses, with feedback from the CW. The feedback voltage from the CW is converted to current and used to charge and discharge a fixed capacitor on board. The change in feedback voltage, means a change in current and hence change in the frequency of the pulses, which results in the smooth operation of the regulator. The ASIC is designed in 0.35u CMOS technology and consumes <2 mW power and has an area of 1mm x 1mm in silicon. Test results of both ASIC's (the final prototypes) will be discussed together with the performance of the complete PMT module.

**Primary author:** GAJANANA, Deepak (NIKHEF)

**Co-authors:** TIMMER, Paul (Nikhef); GROMOV, Vladimir (NIKHEF (NL))

**Presenter:** GAJANANA, Deepak (NIKHEF)

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