Electronics plans in LA

Second UK-Latin America
Workshop on
DAQ and data selection.

UNIVERSIDAD
ANTONIO NARIÑO

Task	Description	Due Date
SiPM Number/ Ganging Studies	Establish the effect of different SiPM ganging configurations. Study active vs. Passive	July 2018
Signal to be processed and trigger strategy	Design a readout system which meets physics requirements with maximum data reduction. Optimize channels per board and band width. Claibration system design	July 2018
Design of Readout Electronics	Proposal of a readout system and architecture to be tested. One or two options to be considered. Cabling and grounding scheme presented	October 2018
Initial readout electronics test	Tests of proposed designs based on simulations and small-scale prototype hardware. Final cryostat feedthrough and cabling design	December 2019
Prorotyping	Representative sample of final proposed architecture should be fabricated and tested	March 2019

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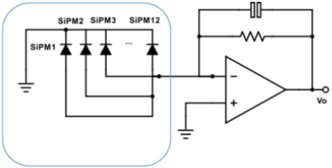
Design of the Active Ganging boards

Esteban Cristaldo, Jorge Molina
Carlos Montiel, Diego Aranda

DUNE-SP Photon Detection System
Conceptual Design Review

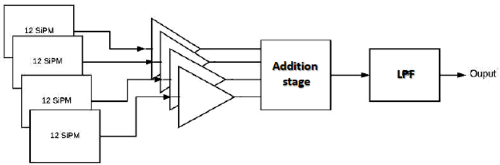
November 12th, 2018

We want to know if we can amplify **12** SiPM in paralell (active *ganging*) with one output channel.



Design scheme

Three stages of the circuit for 48 SiPM:



Charge integrators or transimpedance

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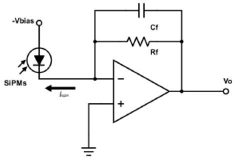
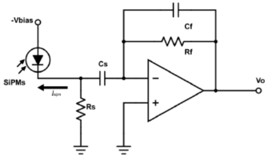
Two preamps models studied





Transimpedance model

- This is a first order low pass filter
- Rf and Cf establish the bandwith and frequency cut point
- Eliminates high frequency noise

Charge integrator model

- This is a second order band pass filter
- Cf and Cs establish the bandwith and frequency cut point
- Eliminates low and high frequency noise

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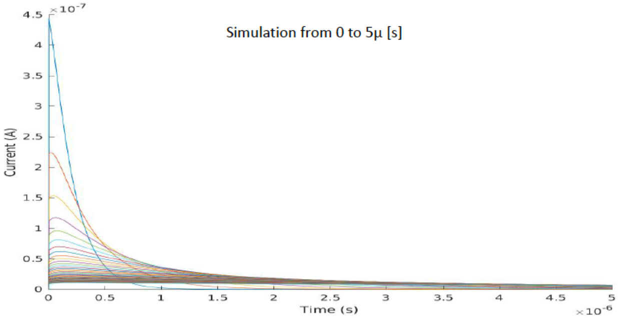
Front-end developement for ARAPUCA TRANSISTOR-BASED VERSION

Presenter: Amaro Lopes

Marcelo Paschoal, Marcelo Lima,
Herman Lima, Rafael Nóbrega

Signals from the SiPMs



4-stage discrete MOSFET operational amplifier - Features

- Very high input resistance (ideally infinity)
- Low output resistance (~35Ω)
- Passive loads (active loads may be used in a next approach)
- Open-loop gain: 87dB
- Open-loop -3dB frequency: ~550 kHz for transistor capacitances = 1pF (commercial transistors may have lower capacitance values)
- Three differential gain stages and one common drain output stage (voltage buffer)

Conclusions

- SiPM model is operational on SPICE
  - Simulated for up to 48 SiPM in parallel (ganging)
  - Implemented using script
- New proposal based on MOSFET
  - Simulated with SiPM model
  - Preliminary simulation tests show reasonable results
- SiPM devices have arrived for testing
- Next steps:
  - components are been selected for purchase
  - Prototyping

ELECTRONICS SIMULATION

Maritza Delgado

Nov. 5 , 2018

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Introduction

Dynamic Range

Goal: Find the maximum number of true photons with different time windows and quantum efficiency.

- Data generated by module **SPCounter_module.cc,** based on SimPhotonCounter_module.cc.

- Sample: Beam Neutrinos
  prodgenie_nu_dune10kt_1x2x6_323_20171227T183346_merged1.root

- The first step was to identify the maximum number of true photons by each Optical Detector per event from PhotonsLite.

- The second step was to do each histogram of maximum number of true photons, considering:

  - Different time Windows:

    + 1ns + 6ns + 12ns + 1μs

  - The scale factors calculation with the quantum efficiency of each effective detector areas of 15, 30, 45, and 60 cm^2.

- The last step was to determine the dynamic range from maximum number of true photons with the scale 10 ADC/PE.

1.Scale factor

The scale factor was determinated using the effective detector areas and QE values.

- 4.05 cm^2 (0.00287) (current standard in vanilla larsoft. Close to the current dip-coated design)
- 5.1 (0.00361) (Close to lowest ARAPUA measurement and potential improved dip-coated design)
- 7.44 (0.005265) (Current double-shift light guide)
- 12.8 (0.009059) (Highest ARAPUCA measurement at TallBo)
- 15 (0.01063) (Potential improved double-shift light guide)
- 23 (0.016277) (Highest ARAPUCA measurement)

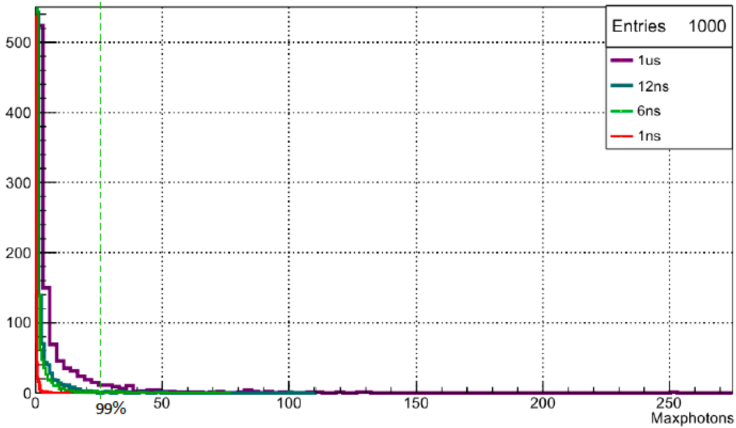
https://indico.fnal.gov/event/16848/contribution/4/material/slides/0.pdf

Area (cm^2)	QE	QE/4
15	0,01063	0,002658
30	0,021231	0,005308
45	0,031847	0,007962
60	0,042462	0,010616

One Optical Detector have 4 Channels.

1000 EVENTS

2. Effective Area: $15cm^2$



Experimental Facilities

1. UAN Detectors Laboratory

- Lab. team with broad experience in optical (SiPMs, PMTs) and Radiation and Particle detectors (MPGDs).
- Expertise gained working at NEXT (Neutrino Experiment with Xenon TPC) and RD51-CERN (Program for MPGDs' R&D) collaborations

- Available to perform R&D and characterization of detectors.
- Possible work on analog and digital electronic devices.
- Data acquisition and data processing studies.

- Laboratory supported by 2 groups of HEP, 1 PhD program in applied science, 2 M.Sc programs in physics and physical Engineering.

Conclusions

1. Intense work is on going to define a dedicated electronics for the PDS.
2. Interest to test different prototypes in small scale facilities like ICEBERG.
3. Integration of the electronics and the DAQ system one of the priorities of this meeting