First results of the camera prototype for the Large Size Telescopes of the CTA

D. Hadasch (ICRR)
on behalf of the LST collaboration
Overview

- Camera for the Large Size Telescope (LST) of the Cherenkov Telescope Array (CTA)
- Prototype camera (Mini Camera)
  - Purpose
  - Setup
  - Results

CTA is all sky observatory consisting of two stations in South and North

LST 23m

MST 12m

SST 4.3m

Courtesy of M. Teshima

ASJ 2016 - D. Hadasch
Focus on LST - Camera

- 2.2m diameter
- 265 modules à 7 pixels → 1855 pixels
- 1 module à 7 pixels

Courtesy of D. Nakajima

ASJ 2016 - D. Hadasch
PMT module

Technical Design Report

ASJ 2016 - D. Hadasch

Courtesy of D. Nakajima
Module Control

- **Slow control of the modules** is done through an FPGA on the DRS4 readout board

- **Control** and **Monitoring** of PMT modules

- **Settings** per pixel/cluster/all clusters:
  - High voltage, trigger threshold, sampling rate, readout window, DRS settings, trigger setting (L0 + L1)
  - **Monitor**: Temperatures, currents, voltages, rates
  - **Individual pixel rate control** (IPRC)
Module Control program (ClusCo)

6 ethernet switches

Multi thread programing written in C
1 thread per switch
→ 6 threads ideally running on 6 cores
→ Loop over 48 modules within a thread

One switch = 48 connections

265 modules
1 module = 1855 pixels
7 pixels
1 module = 48 connections

Switch Switch Switch Switch Switch Switch

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Aims and Use of Mini Camera system

- Mini Camera consists of 19 modules
- Mini Camera test (Integration test)
  - Validations of multi-cluster assembly and functionality
  - Mechanics
  - Trigger, Communications, Control
  - DAQ, Power Consumption, etc.
- Module Characterization
  - Compile a database
  - Characterize basic parameters
  - Long term stability
Mini Camera

- 19 Modules inserted in the mini-camera holder
Mini Camera setup at ICRR (schematic view)
Mini Camera setup at ICRR (real view)
Single Photo-Electron Response

Charge distributions of several pixels

HV = 1400V (NOT nominal voltage)
Gain vs. High Voltage

- Long term monitoring for 10hrs with test pulse injection
- #dynodes = 8
- Voltage fixed between Cathode and first Dynode to 350V
- Charge saturates above 1400 V because of dynamic range of the high gain readout. We have Low gain, too (not shown here).
Long term monitoring of gains

- Long term monitoring for 10hrs with test pulse injection

Charge & Charge RMS stable within 2% for high and low gain
Achievements

- **Mechanical validation** of the multi-module assembly: no problem on the mechanical structure

- **Power consumption** of a module is about 800 mA while the DAQ is running with the power of PMTs off

- **Basic functionalities** have been intensively and successfully tested

- **Development of ClusCo** (ClusterControl): 19 clusters can be controlled from ClusCo via multithread program

- **Trigger Propagation test** through L0L1 mezzanine, analog backplane and TIB prototype: No problem

- **Development of DAQ program**: C++ program with basic functionalities, such as the architecture of the program, data format, event reading, event writing, event building, data corruption checks and buffers.
Thank you
ありがとうございます