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## Development of the photomultiplier tube readout system for the first Large-Sized Telescope of the Cherenkov Telescope Array

*Tuesday 4 August 2015 16:00 (1 hour)*

The Cherenkov Telescope Array (CTA) is the next generation ground-based very high energy gamma-ray observatory. The Large-Sized Telescope (LST) of CTA targets 20 GeV – 1 TeV gamma rays and has 1855 photomultiplier tubes (PMTs) installed in the focal plane camera. With the 23 m mirror dish, the night sky background rate amounts to ~200 MHz per pixel. In order to record clean images of gamma-ray showers with minimal NSB contamination, a fast sampling of the signal waveform is required so that the signal integration time can be as short as the Cherenkov light flash duration (a few ns). We have developed a readout board which samples waveforms of seven PMTs per board at a GHz rate. Since a GHz FADC has a high power consumption, leading to large heat dissipation, we adopted the analog memory ASIC “DRS4”. The sampler has 1024 capacitors per channel and can sample the waveform at a GHz rate. Four channels of a chip are cascaded to obtain deeper sampling depth with 4096 capacitors. After a trigger is generated in a mezzanine on the board, the waveform stored in the capacitor array is subsequently digitized with a low speed (33 MHz) ADC and transferred via the FPGA-based Gigabit Ethernet to a data acquisition system. Both a low power consumption (~2.7 W per channel) and high speed sampling with a bandwidth of >300 MHz have been achieved. In addition, in order to increase the dynamic range of the readout we adopted a two gain system achieving up to 2000 photoelectrons in total. We finalized the board design for the first LST and proceeded to mass production. Performance of produced boards are being checked with a series of quality control (QC) tests. We report the readout board specifications and QC results.

### Collaboration

CTA

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