Imaging camera electronics for MACE telescope

A gamma ray telescope named as MACE (Major Atmospheric Cherenkov Experiment) telescope is set up at the high altitude astronomical site at Hanle (32.7N, 78.9E, 4200 m asl) in the Ladakh region of North India for exploring the gamma-ray sky at energies down to 20 GeV . DAPS section has designed and developed the 1088 PMT based imaging camera for MACE Telescope. The entire camera electronics is mounted on the camera with only the power and communication cables connected to ground station. The instrumentation has been custom designed with innovative techniques to achieve low power, small size, light weight and high performance in terms of low noise, high bandwidth and high event rates. Cherenkov pulses of 5-10 nanoseconds from PMT are digitized and data processing is carried out in the CIM using FPGA technology. The camera electronics consists of front-end electronics consisting of sixty eight Camera Integrated modules (CIM), a Data Concentrator (DC), a Central Camera Controller (CCC) and a Second level trigger generator (SLTG). Each CIM houses 16 Photo-Multiplier Tubes (PMT) and the front-end electronics consisting of VDN, HV supply, Preamplifier, main amplifiers, threshold discriminator, scalar, First Level Trigger (FLT), analog memory and pulse profile digitizer for sixteen pixels. The main function of the camera is to recognize an event of interest and acquire it.

A control room located at ground station near the Telescope, has a control console to coordinate all activities related to an observation. Data Acquisition and Run Control (**DARC**) Software for MACE camera has been designed as a distributed control and monitoring software residing at Data Concentrator (DC), Central Camera Controller (CCC) of MACE Camera and MACE Operator Console at ground station. MACE imaging camera consists of 1088 PMT based pixels. Along with the PMTs, the entire instrumentation for the camera is mounted in the focal plane of the telescope. MACE Operator Console is designed to provide complete support for Control of operations and Monitoring of various subsystems including: Telescope Control Unit (TCU), Camera Electronics (Embedded system), Sky Monitoring System (SkMS), Mirror Alignment System, Weather Monitoring System (WMS), Data Archiving System (DArS) and the MACE Operator Workstation. Salient features of the software are:

- 1. Management of schedule of the experiments, Configuration of Camera Parameters and Observation Run
- 2. Display of event data, telemetry data, Camera parameters.
- 3. Orchestrate execution of data acquisition through Data Concentrator and Camera Integrated Module (CIM) and continuous data archival at 20 MB/sec data rate.
- 4. Initiate LED and Sky calibration.
- 5. Remote control and status monitoring.





Power supply unit



MACE Camera Front side view



MACE Camera backside view





PMT pulse profile of events acquired in a CIM of MACE Camera (Time = 31 nS)



