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A Fast UV-LED QRdriver for Calibration System for SiPM Based Scintillator HCAL Detector

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We report on electronic design of new calibration and monitoring system developed for the scintillator tiles calorimeter (AHCAL) for the ILC. System is based on original fast (3 ns pulsewidth) and precise LED driver called QMB. LED driver uses unique Quasi-Resonant circuit with embedded toroidal inductor. The QR-LED driver creates sinusoidal pulse to drive the LED. It has high dynamic range of precise a few nanosecond pulses. This sinus waveform significantly reduced EMC problems in the detector. System of one UV-LED can illuminates 72 scintillating tiles with SiPM using notched fibres. The system is flexible to all necessary task monitoring and calibration of SiPM detector.

Summary

The system based on QR-LED driver is flexible to all necessary task monitoring and calibration of SiPM detector. It has high dynamic range of precise a few nanosecond pulses. Low intensity LED pulses are needed to obtain nice SiPM single photoelectron spectra. A routine monitoring of all SiPMs during test beam operations is achieved with mid-range a fixed-intensity light pulse. The full SiPM response function is cross-checked by varying the light intensity from zero to the saturation level. In calibration systems we developed, we concentrate especially on the aspect a high dynamic range of precise a few nanosecond pulses. Calibration system has been tested with 2.2m long slab of engineering AHCAL prototype uses 864 SiPM embedded in 3 by 3cm scintillator tiles and represents a part of the biggest planned detector using SiPMs. During last two years, we developed the distribution of UV flashes to scintillator tiles. Instead of using one fiber for each tile, a series of notches cut on a single optical fiber illuminates a row of tiles below the fiber. The challenge is to make the light flashes equal with the same amount of light for each tile. We achieved the spread of light better than 20%.

We can get a nice single photoelectron spectra taken by SiPM illuminated by UV LED at QMB1. The SiPM response of quasi-resonant UV LED driver and the light distribution system to the low intensity light will be discussed at presentation. We can conclude that the system meets requirements for the calibration of the engineering hadron calorimeter prototype [2]. We also performed measurements of the amplitude dependence of the QRLED driver on the intensity of the magnetic field in the range 0 –4 T. The strength of the magnetic field is close to the field in the future ILD detector. We conclude that the relative change of the amplitude of the QRLED driver with embedded toroidal inductor do not exceed level of -3 per mille at 1 Tesla change. If we assume that the relative time stability of the magnetic field of the ILD solenoid will be at the level of 5E-4, then the amplitude time stability of the calibration light is better than 2E-6.

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