

MTCD@NCBJ - MPPC Temperature Compensation Device

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Due to the strong Multi Pixel Photon Counter (MPPC) gain dependence on temperature, a prototype MPPC Temperature Compensation Device (MTCD@NCBJ) was designed and produced at NCBJ. It will be used at the Joint European Torus (JET), with the upgraded detectors during high count rate measurements.

In Fig. 1, the overall scheme of the electronics for the upgraded JET Gamma Camera is shown.

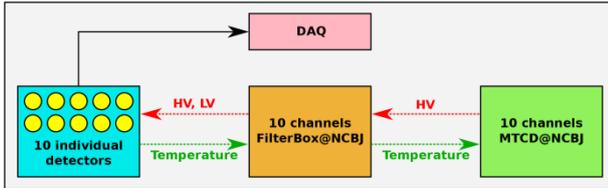


Fig. 1. Overall scheme of the detector system for the upgraded JET Gamma-ray Camera. HV denotes the MPPC voltage, LV – the power supply for temperature sensors and active elements.

The MTCD@NCBJ, with integrated power supplies, uses real-time temperature monitoring to maintain a constant value of the MPPC gain. It comprises two main parts: one connected with the adjustable MPPC voltage channels for each GC channel, the other used to determine an optimum value of the voltage which guarantees a constant gain. Each channel has its own isolated converter to eliminate ground loops, followed by a low-dropout regulator to minimize ripple on the output.

All functions are controlled from a personal computer with a communication based on Ethernet. In Fig. 2, the MTCD@NCBJ board is shown.

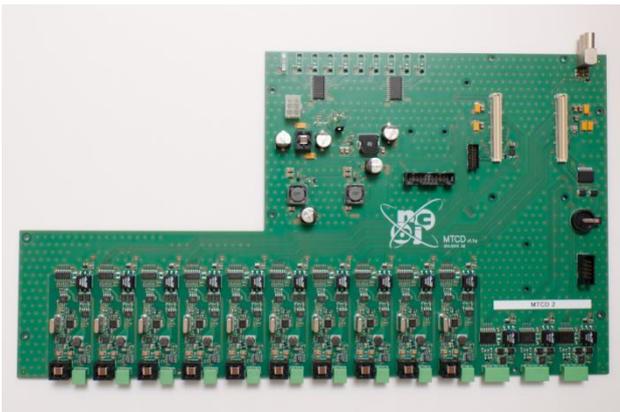


Fig. 2. Photo of MTCD@NCBJ with integrated power supplies.

A protection of overvoltage was implemented in the control part of the program to guarantee that the

detectors will not be destroyed by applying too high a voltage.

A series of measurements was performed at NCBJ with a standard ^{137}Cs source, registered with a $\phi 20 \times 15$ mm cylindrical CeBr_3 scintillator, MPPC from Hamamatsu and an active system based on a transimpedance amplifier (TIA) in order to check the MTCD@NCBJ performance.

The influence of the MPPC temperature change on gamma-ray spectra was checked in the temperature range between 10°C and 34°C as shown in Fig. 3.

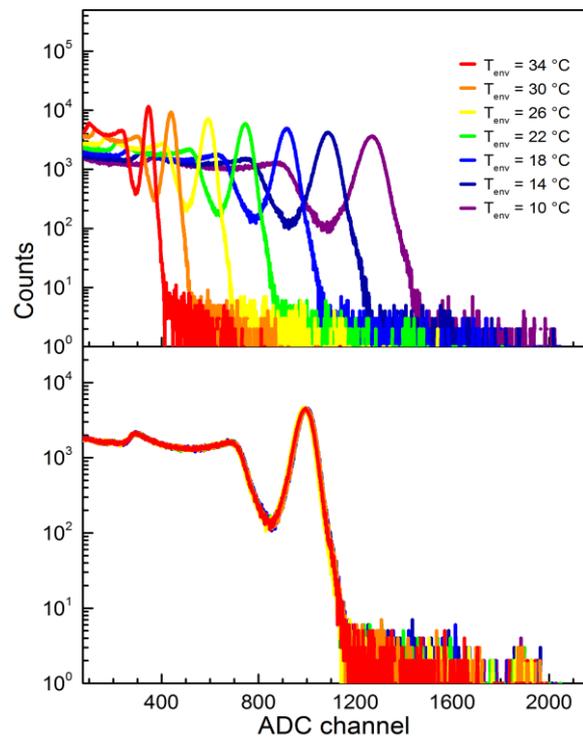


Fig. 3. Peak position as a function of MPPC temperature. Upper: without MTCD@NCBJ. Lower: with MTCD@NCBJ. Operational voltage: 57.5 V.

From the measurements performed we conclude that MTCD@NCBJ is able to maintain a constant value of MPPC gain for both active and passive bases.

Reference

- [1] A. Urban et al., *Detectors with a Compensation for MPPC Gain Dependence on Temperature*, sub. to IEEE Transactions on Nuclear Science (2018).

This work was partly supported by the Polish Ministry of Science and Higher Education within the framework of the scientific financial resources in the years 2015-2018 allocated for the realization of international co-financed projects.