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Online control of the gain drift with temperature of SiPM arrays used for the readout of LaBr3:Ce crystals

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LaBr3:Ce crystals have been introduced for radiation imaging in medical physics, with photomultiplier or single SiPM readout.
An R&D was pursued with 1/2" and 1" LaBr3:Ce, from different producers, to realize
compact large area detectors (up to some cm2 area) with SiPM array readout, aiming at high light yields, good energy resolution, good detector linearity and fast time response for low-energy X-rays. A natural application was found inside the FAMU project at RIKEN-RAL muon facility, that aims at a precise measure of the proton Zemach radius to solve the so-called "proton radius puzzle", triggered by the recent measure of the proton charge radius at PSI. The goal is the detection of characteristic X-rays around 130 KeV. Other applications may be foreseen in medical physics, such as PET, and gamma-ray astronomy. A limiting factor is the gain drift of SiPM arrays with temperature, that may give a major deterioration of the FWHM detector's energy resolution. To solve this problem a custom NIM module was developed, based on CAEN A7585D digital power supplies, with temperature feedback. Up to eight channels may be powered by a single 2-slots NIM module. The control of this module was implemented via either a FDTI USB-I2C converter or an Arduino Nano chip. Three modules (with which up to 24 channels may be powered) were realized and are linkable in daisy chain, via the I2C protocol. Test results of the correction of gain drift with temperature for SiPM arrays from Advansid, Sensl, Hamamatsu will be presented, together with the ones obtained on energy resolution, detector linearity, ... for the realized LaBr3:Ce detectors.
As an example, at the Cs137 peak, an energy resolution better than 3 % was obtained, using Hamamatsu S13461 arrays , that compares well with best available results obtained with a PMTs.
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