Contribution ID: **156** Type: **Poster**

The PaDiWa-AMPS2 TDC and QDC front-end electronics for the HADES Electromagnetic Calorimeter

Thursday, 20 September 2018 18:15 (15 minutes)

The second generation of the 8 channel PaDiWa-AMPS front-end board was recently assembled at the GSI department for Experiment Electronics (GSI EE). The board implements precise TDC and QDC measurements optimized to read out the 978 PMTs of the HADES electromagnetic calorimeter (ECAL). The HADES ECAL detector is currently under commissioning. In this contribution the read-out scheme of the ECAL and first results of a production beam time with the HADES will be presented.

Work supported by the DFG through GRK 2128 and VH-NG-823.

Summary

The second generation of the 8 channel PaDiWa-AMPS front-end board was assembled at the GSI department for Experiment Electronics (GSI EE). The board implements precise TDC and QDC measurements optimized to read out the 978 PMTs of the HADES-electromagnetic calorimeter (ECAL). The measurement principle is to integrate the signals and to encode the results in the width of the digital output pulses. High precision is achieved by implementing a modified Wilkinson-ADC method, so actively discharging the integrated signal results in a fast crossing of the threshold. The lengths of the digital pulses are measured by the well-established TRB3 (General Purpose Trigger and Readout Board - version 3) platform.

The circuitry of the front-end board is based on the Come&Kiss principle, where analogue electronics is used only for the amplification stage and integration, while other tasks, e.g. discrimination, threshold settings, delay generation for discharging and the LVDS drivers are implemented in a field-programmable gate array (FPGA).

Because of the new layout in combination with a smaller package size, the routing of the signal lines have been optimized for better timing precision and reduced crosstalk. The concept of using a transformer in the input stage in order to galvanically isolate the ground was carefully tested. In laboratory measurements it has been shown that the transformer improved the signal to noise ratio. The charge measurement precision (resolution of the system defined as sigma/mean of the charge distribution) as a function of the measured charge has been determined with a pulse-generator. A time precision of 20 ps and a relative charge precision below 0.5% (for ECAL PMT pulses >1 V) was reached.

The HADES ECAL detector is currently under construction. The mass production of 150 PaDiWa-AMPS2 front-end boards was done by the GSI EE. The read-out electronics will be installed by end of spring 2018 and fully commissioned with cosmic muons and LED signals. A production beam time with the HADES spectrometer is planned in August 2018. Four sectors of the ECAL will be in place for the 2018 beam time to enable the photon measurement.

Work supported by the DFG through GRK 2128 and VH-NG-823.

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Session Classification: Posters

Track Classification: Systems, Planning, Installation, Commissioning and Running Experience