CERBEROS: a beam tracker system for HADES *

L. Fabbietti[1], W. Koenig[2], R. Lalik[1], R. Münzer[1], J. Pietraszko[3], and the HADES Collaboration

[1]Excellence Cluster Universe Technische Universität München, Germany; [2]GSI, Helmholtz Gesellschaftt für Schwerionenforschung, Darmstadt, Germany; [3]Institut für Kernphysik, Goethe-Universität Frankfurt, Germany

Cerberos[1] is a new development for pion-beam trackers to be employed in future experiments with HADES at GSI. This system is composed of three large area silicon detectors distributed along the pion beam chicane and a diamond-based start detector [1] close to the HADES spectrometer. The position sensitive silicon detectors have been provided by Micron Semiconductor Ltd. They are 2x128 strips, 10 cm width (760 μm strip width) and 300 μm thick double-sided silicon detectors with high radiation hardness. The mono-crystallin diamond device provides a time resolution of about 100 psec. Due to the large momentum spread (around 8%) of the secondary pion beam, it is necessary to measure exactly the positions along the chicane and time of flight of each incoming pion to determine the momentum precisely. The first two silicons of Cerberos are located about 5 m behind the pion production target, The third silicon is placed in the HADES spectrometer just in front of the start detector. Currently we are developing the readout of the silicon detectors. Each device is connected to a front-end electronics (FEE) composed of two parts. First DC and AC (AC decoupling due to high voltage potential on the detector) preamplifiers with 32-channels, respectively for the ohmic and junction detector sides, are present on the board. The preamplifier architecture is a combination of a charge sensitive amplifier (CSA) and current amplifier and can work with both signal polarities. Due to low energy consumption and power dissipation the preamplifier can be used in vacuum, a key-feature for our application. The second part of front-end electronics

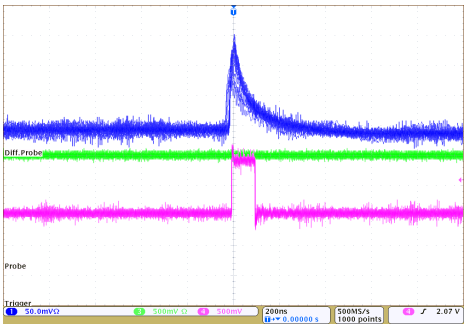

Figure 1: Screenshot of 5.5 MeV α particle hit registered on detector ohmic side. The blue curve shows the pulse obtained after the booster stage on input of discriminator, the pink signal shows LVDS output of the discriminator. This signal is then sent to a TDC on TRB.

consists of a 32-channels booster serving for shaping and

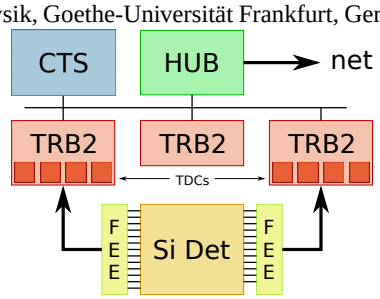

Figure 2: DAQ scheme

time-over-threshold (TOT) processing. The discriminator used for the TOT determination is sensitive only to positive input pulses, thus two different booster boards, with two inverting and only one transistor stages respectively, are used to process the positive and negative input pulses. Due to high power dissipation the booster can not work in the vacuum and must be actively cooled. Figure 1 shows an example of the signal delivered by the booster board. The blue curve shows the output of the booster stage with the signal by an α source as input. The pink signal corresponds to the LVDS (Low Voltage Differential Signal) output of the discriminator. We are currently working on the optimization of the system to minimize the electronic noise and tune the discriminator threshold in the MIP regime. The Cerberos DAQ is based on the standard HADES TRB (TDC Readout Board) boards equipped with four TDC[2] devices for data readout and with additional HUB (data transfer) and CTS[3] addons as well as HADES software for system control. Fig. 2 shows a scheme of the acquisition chain. Cerberos can work inside HADES system or separately after providing a valid trigger for its own CTS. The Cerberos offline software is also fully compatible with HADES thus they can be later easily integrated with the rest of the system. In the future our efforts will concentrate on improving the booster shaping stage which should give a better TOT signal, reducing discriminator output latching to have the opportunity to measure signals induced by MIPs and to reduce noise level to decrease discriminator output jitter. In the future we will also test the possibility to use a n-XYTER ASIC as a front-end integrated readout.

References

[1] J. Pietraszko et al. (HADES), Nucl. Instr. Meth, A 618 121 (2010)

[2] Jahrebericht Hades Upgrade

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[1]Cerberos stands for *CEntRal BEam tRacker for piOnS*

[2]Time-to-Digital Converter

[3]Central Trigger System