

Integration of the Pion-Beam Tracker into the HADES DAQ*

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In the 2014 HADES campaign with secondary pion beams, tracking detectors will be mounted into the chicane following the production target. They will provide the pion momentum with a resolution of 0.3 %, i.e. a factor 2 better than the momentum spread of the secondary beam, enabling exclusive analyses of reaction channels. To guarantee fast tracking, silicon sensors read out with the n-XYTER chip are employed. Due to its self-triggering architecture and local storage capability, the n-XYTER chip enables on-line tracking of each individual pion. The read-out of the tracker data is realized with the TRB3 board [1].

The tracking capability of CERBEROS¹ and its integration into the HADES data acquisition system has been tested with proton beams at COSY in Juelich. A diamond-based device has been used as start detector acting as trigger for data taking, like it is planned for the campaign with pion beams. As the start detector is located several meters behind the first silicon detector causing a trigger delay of around 800 ns, the self-triggering architecture of the n-XYTER is crucial. All hits registered by the n-XYTER are buffered inside the TRB3 and only the hits correlated in time with the Start detector trigger signal are sent to the DAQ system. Additionally, the 2 GeV proton beam provided by COSY opened up the possibility to study the stability of the whole system under beam condition.

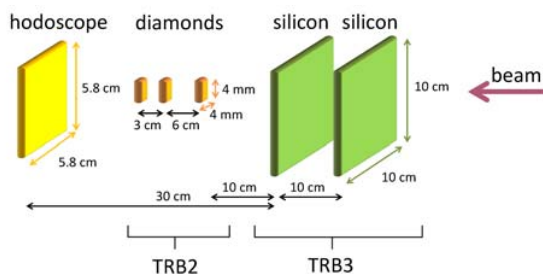


Figure 1: Experimental setup for the beam tests at COSY.

Figure 1 presents the experimental setup consisting of two double-sided silicon detectors of $10 \times 10 \text{ cm}^2$ dimension and 128 strips on each side. The trigger was provided either by the hodoscope or by one of the three diamond detectors placed behind the silicon sensors.

The system was tested with beam rates varying from 2 – 550 KHz measured at the hodoscope, and trigger rates from 2 – 100 kHz as accepted by the CTS. In the beam spot of $16 \times 16 \text{ mm}^2$ (Fig. 2) hit rates of up to

* Supported by VH-Ng-330, TMFABI1012 and BmBf 05P12WOGHH

¹Central Beam Tracker for Pions

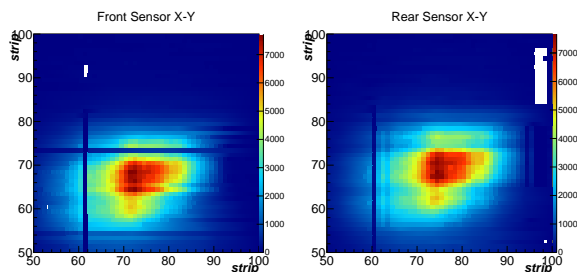


Figure 2: Beam profile as recorded by both silicon sensors using the hodoscope as a trigger.

$2e5/\text{s}/\text{cm}^2$ were achieved. Assuming such hit rates for the full sensor surface when operated in the pion beam experiment the detector will deliver 400 Mbit/s. The registered energy-deposition spectrum of the minimum ionizing protons shows good agreement with the expected energy-loss in $300 \mu\text{m}$ of silicon and the time resolution of the full trigger chain was found to be 30 ns.

In the pion experiments the detector is located in a vacuum chamber (Fig. 3) attached to the accelerator beam pipe. The first chamber close to the pion production target has been already assembled in the NE5 area, and successfully tested. The second chamber is under construction and will be located in the HADES cave.

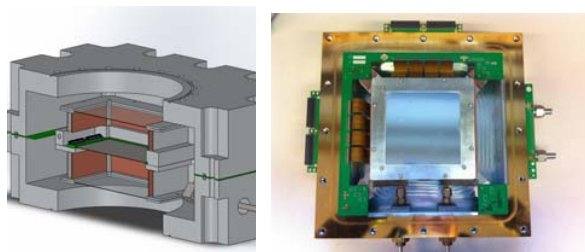


Figure 3: Left: Cross section of the chamber. It consists of two pieces made out of aluminium and with a feed-through PCB sandwiched in between. The Si sensors are located in the middle, covered by mylar foil. Right: One half of the vacuum chamber with a Si sensor covered by its mylar window.

References

- [1] M. Traxler *et al.*, *J. Instrum.*, 6(12), C12004 (2011).