Report from the 1^{st} HADES Production Run C + C at 2 AGeV ◇

J. Friese

In the end of 2002 we have performed the first production run with the new Hi Acceptance DiElectron Spectrometer HADES [1,2] at GSI. The run was preceded by a period of intense commissioning of the data acquisition system (DAQ) with strong emphasis on optimization of detector readout speed and second level trigger (LVL2) performance. In the HADES DAQ first level (LVL1) triggered data is transported up to distributed front-end memory and, except for the drift chambers, to so called image processing units which generate a LVL2 decision for events containing the rare $e^{\pm}$ candidates. In the off-line tests with a random pulse generator the data acquisition saturated at an accepted first level trigger (LVL1) rate of 18 kHz, having all installed detectors ($\simeq$ 70.000 channels) integrated. Depending on event size the level 2 triggered data transport saturated typically at rates a factor of 5 to 10 smaller. These rates were more than an order of magnitude larger compared to the run performed in November 2001 [3].

In the production beam time a C beam of typically 10^7 ions/spill at $E = 2$ AGeV was directed and focussed to a twofold segmented C - target of 6% interaction length. The target consisted of two 3 mm thick pellets of 3 mm diameter separated at 20 mm distance. Two diamond (CVD) strip detectors were used to monitor the beam position and to provide excellent time zero information. In addition we installed 20 cm upstream from the target a 4-fold segmented halo detector with a central hole of 0.5 cm diameter for beam focus optimization. The target segmentation and the in-beam detectors are visible in the vertex reconstruction plot shown in figure 1.

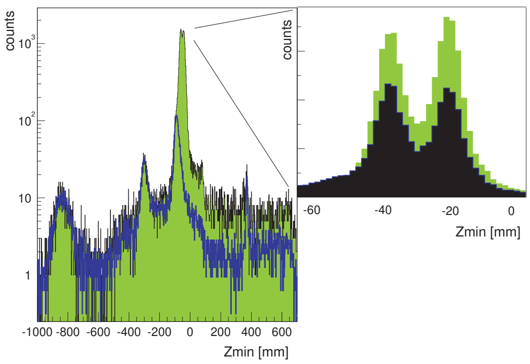

Fig. 1: Reconstruction of interaction points along the beam axis z from single particle hits in MDC I and MDC III chambers for C+C at 2A GeV. In beam start detector and foils are also visible. The empty target measurement shows that $\simeq 15 - 20\%$ of the vertices are located in the target frame. The insert depicts an blow-up of the target region (linear scale). The dark and the pale histograms refer to LVL2 triggered and downscaled events, respectively.

The LVL1 trigger condition was set to charged particle multiplicity $M_{ch.p.} \geq 4$ (measured in the TOF wall) and accounted for about 70% of the geometrical cross section. While the free LVL1 trigger rates were typically 30 - 35 kHz, only about 7-9 kHz were accepted by the data acquisition. These rates are by a factor 2 smaller as compared to the off-line tests and follow partly from larger event sizes and from the micro structure of the extracted carbon beam, which effectively increase the instantaneous rates. The observed LVL2 trigger reduction factor for events containing $e^{\pm}$ candidates was about 8 and governed by the RICH IPU. It was found that the lepton identification by online ring recognition in the RICH was affected by charge particles from reactions in upstream material. These particles induced pad patterns in the photon detector, which led to enlarged fake contributions to ring candidates recognized by the minimum bias algorithm running on the image processing unit.

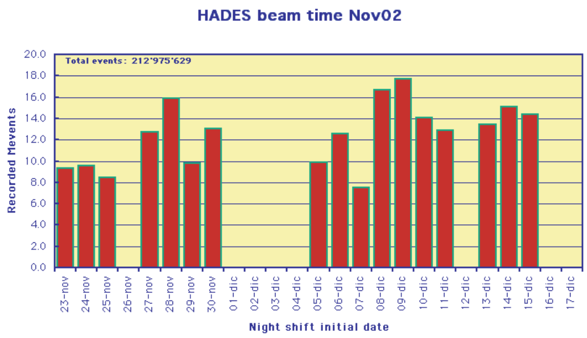

Fig. 2: Number of recorded events per night shift. The experiment was performed during the nights of the routine GSI cancer therapy operation. The break in the middle was caused by an accelerator shut down.

Throughout the beam time all detectors and the DAQ were operated at stable performance. A total of 213 million events were recorded with a yield over time distribution as plotted in Figure 2. About 45% (i.e. 93 M) of the recorded events are LVL2 triggered events, the remaining represent downscaled LVL1 events. The total recorded event statistics (1.2 TByte) corresponds to roughly $1 \cdot 10^9$ collisions with a fraction of about $80 - 85\%$ stemming from C+C interactions (see Fig. 1). The detector performances and the integrity of the data stream was monitored online with a new Go4 based package [4]. Parallel to data taking the recorded files were analyzed with the full HADES analysis code HYDRA to yield data with detector information on particle hit level. Here we could make efficient use of fast and automatic parameter retrieval from the ORACLE data base in which calibration and alignment parameters were stored and updated continuously. One example of this quasi "online" data analysis is given in figure 1 showing the vertex reconstruction of all reaction products measured in 2 of the tracking chambers.

Meanwhile the data analysis has started and the first generation of data summary tapes are produced.

References

[1] P. Salabura *et al.*, Nucl. Phys. **B44** (1995) 701
[2] J. Friese *et al.*, Nucl. Phys. **A654** (1999) 1017c
[3] J. Homolka *et al.*,Annual report 2001, p. 105
[4] H.G. Essel *et al.*, Go4 analysis system; http://go4.gsi.de

◇ work supported by MLL, BMBF and GSI