HADES Forward Wall calibration procedure

E. Zherebtsova^{1,2} S. Morozov^{1,2} M. Golubeva¹ F. Guber^{1,3} A. Ivashkin^{1,3}

²National Research Nuclear University MEPhI, Moscow, Russia

¹Institute for Nuclear Research RAS, Moscow, Russia ³Moscow Institute of Physics and Technology, Moscow, Russia

Motivation

The Forward Wall detector (FWall) is one of the detector subsystems in the HADES setup at GSI, which is used to determine the collision centrality and event plane orientation in nucleus-nucleus reactions. The results of the FWall calibration in Ag+Ag collisions at 1.58AGeV and 1.23AGeV is very important for accurate estimation of the event centrality and the event plane. In this work results of the FWall calibration at 1.58AGeV are presented.

HADES experimental setup



- Extraction of Z1 and Z2 positions.
- Determination of the ADC parameters with functions:

$$Slope_{adc} = \frac{100}{ToT_{Z2} - ToT_{Z1}}$$
$$Offset_{adc} = 100 - Slope_{adc} \cdot ToT_{Z1}$$





Results of the FWall calibration

The WC parameters and the TDC offsets were established to have a real particles time of flight from the target to FWall. The ADC parameters were determined to equalize response of all cells for a certain charge of the particles.



Figure 2: Scheme of the Forward Wall Figure 1: HADES experimental setup. detector.

The FWall consists of 288 individual scintillator detectors. It has total transverse size $176 \times 176 \text{ cm}^2$ and is placed at the beam axis at 7mfrom the target. The PMTs are used for light readout from each FWall scintillator detector. The FWall includes 144 small cells $40x40 \text{ mm}^2$, 64 medium cells $80 \times 80 \text{ mm}^2$, 96 large cells $160 \times 160 \text{ mm}^2$.

Calibration procedures

The amplitude and time calibration procedures for each cell of the FWall are used to equalize response of the detectors for a certain charge of the particles (Z=1, 2 etc.) in Ag+Ag collisions at an energy of 1.58 AGeV and 1.23 AGeV. The FWall calibrations are day-wised. Time calibration:

■ Walk Time Correction. Fitting raw time vs amplitude (ToT time over threshold) dependence with function:

$$T_{cal} = T_{raw} \cdot slope_{tdc} - WC1 - \frac{WC2}{\sqrt{ToT}}$$

- Determination of the WC1, WC2 parameters (electronic channel property) to eliminate measured hit time vs hit amplitude dependence.
- Fitting the peak of obtained time distribution by Gauss function and determination of TDC offsets to have a real particles time of flight from the target to the FWall.

Initial 'time - signal width' distribution for cell 0	Calibra
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ated 'time - signal width' distribution for cell 0



Figure 5: Time on cell dependence for Figure 6: Amplitude on cell dependence one day after calibration. for one day after calibration.



Figure 7: Amplitude on cell dependence for one day after calibration.

After calibration procedure, amplitude of particles with Z=1 and Z=2 match the 100 and 200 channel, correspondingly. Small deviations form cell to cell for particles with $Z \geq 3$ are due to nonlinearity of the PMTs response.

Conclusion



Figure 3: Raw time and amplitude dependence of one FWall cell before and after WC parameters estimation and TDC offset correction.

Amplitude calibration:

Raw marks for peaks and multiple gaus fitting.



The implementation of the amplitude and time calibration procedure of FWall detectors based on matching of the recorded signals with a certain charge of the charged spectators was done for Ag+Ag collisions at an energy of 1.58 AGeV and 1.23AGeV for each of the 28 running day. Corrections for beam shifts along the x, y axis for all runs were determined and will be used in further analyses.

References

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