

2 The event plane calibration in the MBD in the 2023 commissioning data

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4 Abstract

5 This is a short approval note in support of the event plane calibration process of the MBD  
6 event plane during Run 2023.

## 7 Introduction

8 The event plane is used in many physics analyses of interest to the collaboration. We refer the  
 9 reader to our previous note linked [\[here\]](#), which describes the event plane determination and first  
 10 order correction by recentering the flow vectors. In the previous note, the event plane shifting  
 11 procedure is implemented for the plots shown in the result section. In this note, we explicitly  
 12 describe the event plane shifting procedure and extract the  $\Psi_n$  distributions employing calibration  
 13 steps described in the previous and current note. The event-by-event shifting of the planes requires  
 14 that one fits the non-flat distribution of the event planes summed over all events to a Fourier  
 15 expansion and devise the shift necessary to force a flat distribution.

16 The equation for the shift is [1]:

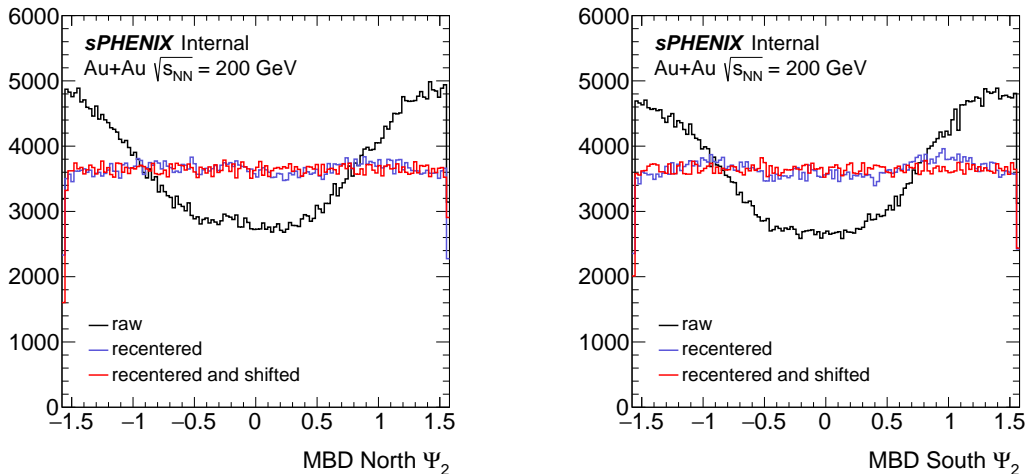
$$n\Delta\Psi_n = \sum_i^{i_{max}} = \frac{2}{i}(-\langle\sin(in\Psi_n)\rangle\cos(in\Psi_n) + \langle\cos(in\Psi_n)\rangle\sin(in\Psi_n)) \quad (1)$$

17 The value of  $i_{max}$  used in this analysis is 6.

## 18 Run selection and code

19 The code used for this analysis is linked [\[here\]](#). The plots in this note use 500k events from run  
 20 21813 and production build DST\_ana395\_2023p007.

## 21 Results



**Figure 1:** Event plane calibration steps of the second order event plane angle using the MBD north arm (left); showing the raw, recentered, and the recentered and shifted distributions in black, blue, and red respectively. The right figure shows the corresponding distributions using the MBD south arm.

22 The one dimensional second order event plane distributions shown in this section do not contain  
23 a z-vertex cut. The event plane is calibrated in bins of MBD total charge with a width of 5. The  
24 maximum order of 6 used in the angle shift in this note is the same as in the previous note.

## 25 References

- 26 1. Arthur M. Poskanzer and S. A. Voloshin. Methods for analyzing anisotropic flow in relativistic  
27 nuclear collisions. *Z. Phys. Rev. C*, 58:1671–1678,1998. doi:10.1103/PhysRevC.58.1671.