The Alignment of the BESIII Drift Chamber Using Cosmic-ray Data
Wu Linghui
On behalf of BESIII Software Group

**BESIII Experiment**
- Physical goal
  - Precision measurement of CSM matrix
  - Precise test of Standard Model

**Drift Chamber**
- 2.6 m long cylindrical chamber
  - Inner section consists of outer sections, stepped sections.
  - The stepped section is assembled with a total of 12 subendplates.
  - The overlap and radial dimensions are measured in detail.

**Misalignment**
- Displacement of sub-endplates caused bad momentum resolution.
- Alignment with tracks is the only possible strategy to estimate positions and orientations of each component with sufficiently high precision.

**Software Alignment**
- Use cosmic-ray data to do preliminary alignment
- Alignment parameters
  - Inner section: $r_{\text{mean}} = c_0 - c_1 \sin \phi + c_2 \cos \phi$
  - Outer section: $r_{\text{mean}} = c_0 - c_1 \cos \phi + c_2 \sin \phi$
  - For each component, $3$ alignment parameters are considered
  - $\delta_x$: Translation in x direction
  - $\delta_y$: Rotation in y direction
  - $\delta_z$: Rotation around z axis

**Impact of Misalignment on Residuals**
- Translation in x causes dependence of residual on $\sin \phi$
- Translation in y causes dependence of residual on $\cos \phi$
- Rotation in z causes shift of residuals which are independent of $\phi$

**Alignment Results**
- The shift of the east sub-endplates in x direction is very large.

**Conclusion and Outlook**
- Use cosmic tracks to do preliminary alignment for the BESIII drift chamber. Estimate alignment parameters from the residual fits.
- Momentum resolution is improved significantly after alignment. But misalignment still exists.
- Begin to do alignment with high precision:
  - Use other alignment method: Millepede matrix method
  - Use other data samples: dimuon