System uncertainty for cross section measurement

$$\sigma^{B}_{\Lambda\bar{\Lambda}}(M_{\Lambda\bar{\Lambda}}) = \frac{(dN_{sig}/dM_{\Lambda\bar{\Lambda}})_{corr}}{\varepsilon \cdot BR(\Lambda \to p\pi^-) \cdot BR(\bar{\Lambda} \to \bar{p}\pi^+) \cdot d\mathcal{L}_{int}/dM_{\Lambda\bar{\Lambda}}},$$

1. **$\Lambda/\bar{\Lambda}$ reconstruction (including tracking, PID, vertex fit and mass window cut)**:
   The uncertainty of $\Lambda/\bar{\Lambda}$ reconstruction is referred to PRD107, 072005 (2023)
2. **U_{miss} and $|\cos\theta_{miss}|$ cut:** via $e^+e^- \to \gamma_{ISR} J/\psi \to \gamma_{ISR}\Lambda\bar{\Lambda}$
3. **Background uncertainty:**

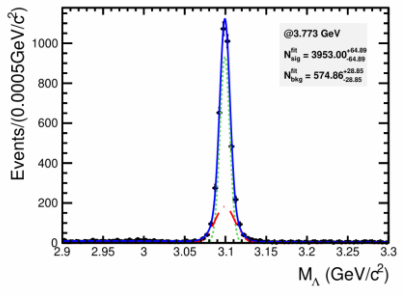
$e^+e^- \to \gamma_{ISR}(\Lambda\bar{\Sigma}^0 + c.c.)$	line shape $\pm\sigma$
$e^+e^- \to \gamma_{ISR} J/\psi \to \gamma_{ISR}\Sigma\bar{\Sigma}^0$	Angle Sum MC generator
$e^+e^- \to \gamma_{ISR}\Sigma\bar{\Sigma}^0$	Ignore
$e^+e^- \to \gamma_{ISR} J/\psi \to \gamma_{ISR}\gamma\Lambda\bar{\Lambda}$	Ignore
$e^+e^- \to \pi^0\Lambda\bar{\Lambda}$	Ignore
Non-$\Lambda\bar{\Lambda}$	Ignore
neglected bkg	0.5%

4. **Angular distribution, spin correction and polarization:**
   use the parameters we measured to generate DIY signal MC samples
5. **Signal MC model:** another MC generator PHOKHARA 10.0 is used
6. **Branching ratio of $\Lambda(\bar{\Lambda}) \to p\pi^-(\bar{p}\pi^+)$:** 1.6% from PDG
7. **Luminosity uncertainty:** including 0.5% ISR uncertainty

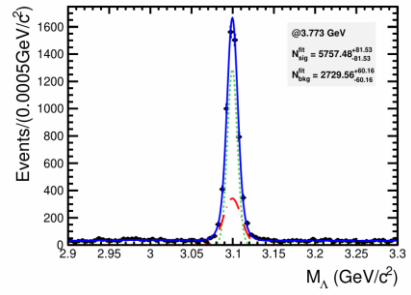
System uncertainty for cross section measurement

U_{miss} and $|\cos\theta_{miss}|$ uncertainty: Data: $\psi(3770)$ MC: $e^+e^- \to \gamma J/\psi \to \gamma\Lambda\bar{\Lambda}$

Data with 2 cut

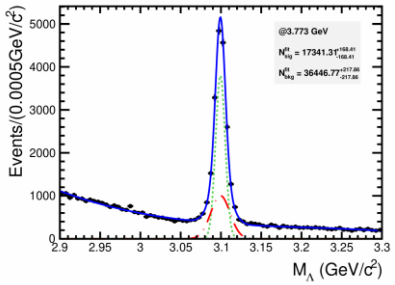


Data without θ cut



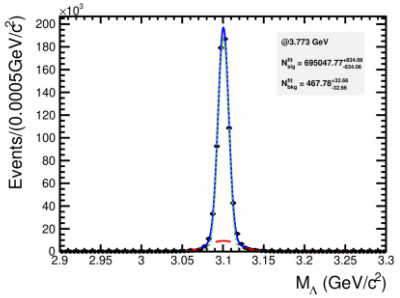
$$\varepsilon_{data} = \frac{N^{with}_{data}}{N^{without}_{data}} = 68.66\%$$

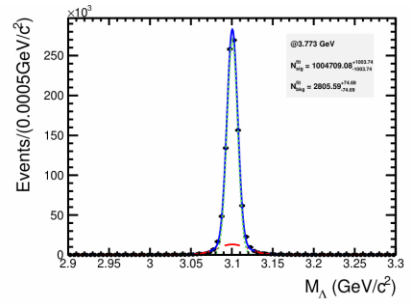
Data without cut



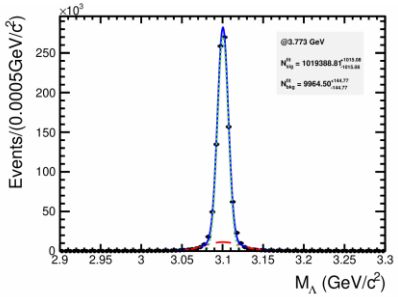
$$\varepsilon_{data} = \frac{N^{with}_{data}}{N^{without}_{data}} = 22.80\%$$

MC



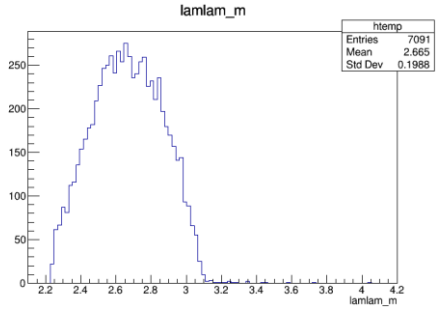


$$\varepsilon_{mc} = \frac{N^{with}_{mc}}{N^{without}_{mc}} = 69.18\%$$



$$\varepsilon_{mc} = \frac{N^{with}_{mc}}{N^{without}_{mc}} = 68.18\%$$

- The uncertainty of $|\cos\theta_{miss}|$ can be determined in this process.
- We can't find $e^+e^- \to \gamma J/\psi \to \gamma\gamma\Lambda\bar{\Lambda}$ signal in $\psi(3770)$ data.



- $\Psi(3686) \to \gamma\chi_{c0} \to \gamma\Lambda\bar{\Lambda}$

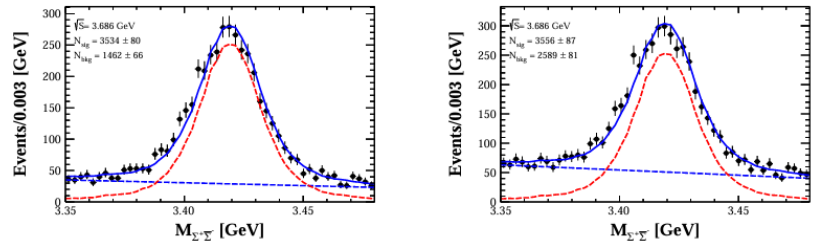
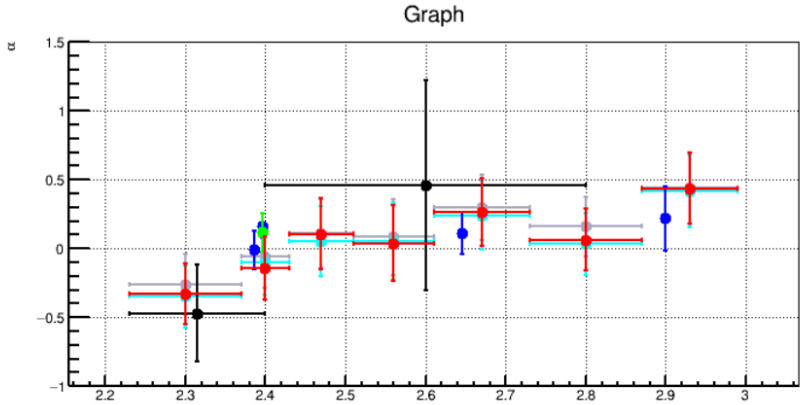


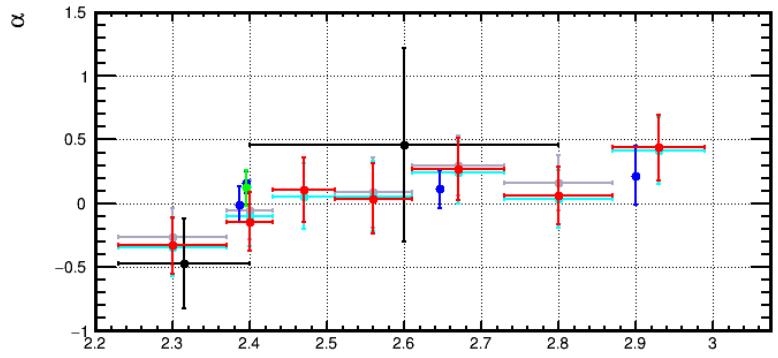
Fig. 28: The invariant mass of $\Sigma^+\bar{\Sigma}^-$ distributions in real data at $\sqrt{s}$ = 3.686 GeV. The left one with the U_{miss} requirement ($U_{miss} \in [-0.06, 0.06]$ GeV) and the right one without this requirement.

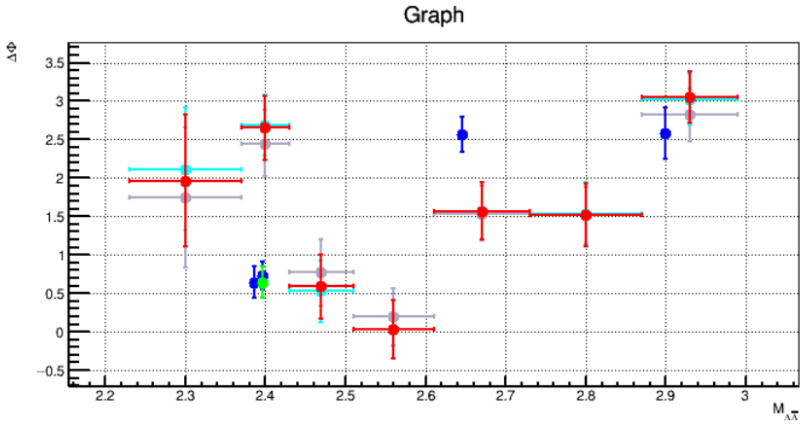
System uncertainty for $|G_E/G_M|$ and phase measurement

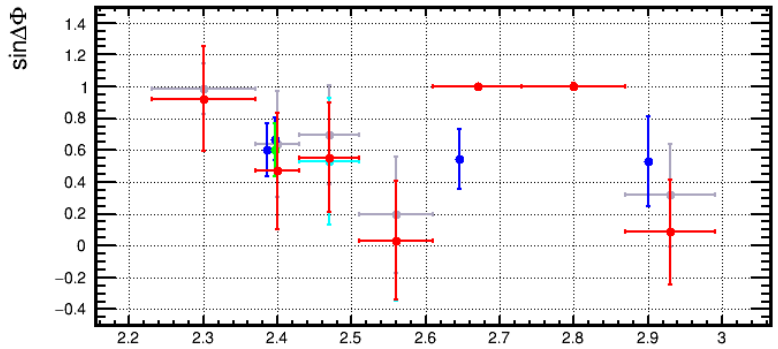
- Objects detection efficiency uncertainties
  - The correction factors of efficiencies are applied in MC integral MC sample. (5-d?)
- Event level selection uncertainties
  - $\Lambda/\bar{\Lambda}$ mass window (associate with detection efficiency)
  - U_{miss} and $|\cos\theta_{miss}|$
- Barlow test for signal mass window
  - Change the mass window, then fit the deviation
- Fit related uncertainties
  - Pull distribution

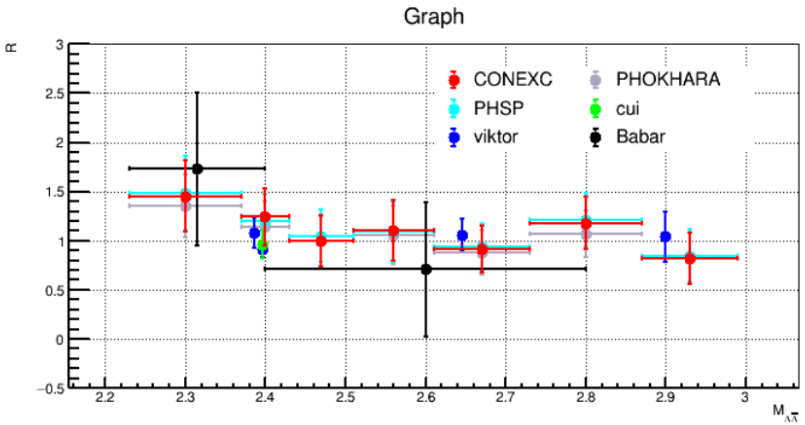
Fit result

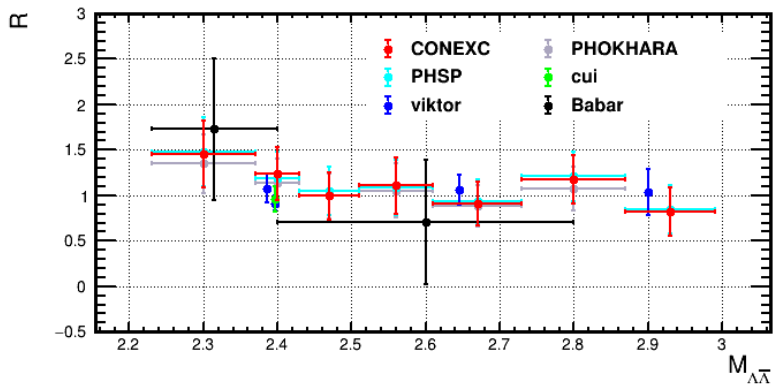

Graph
α


α


Graph
ΔΦ
$M_{\Lambda\bar{\Lambda}}$

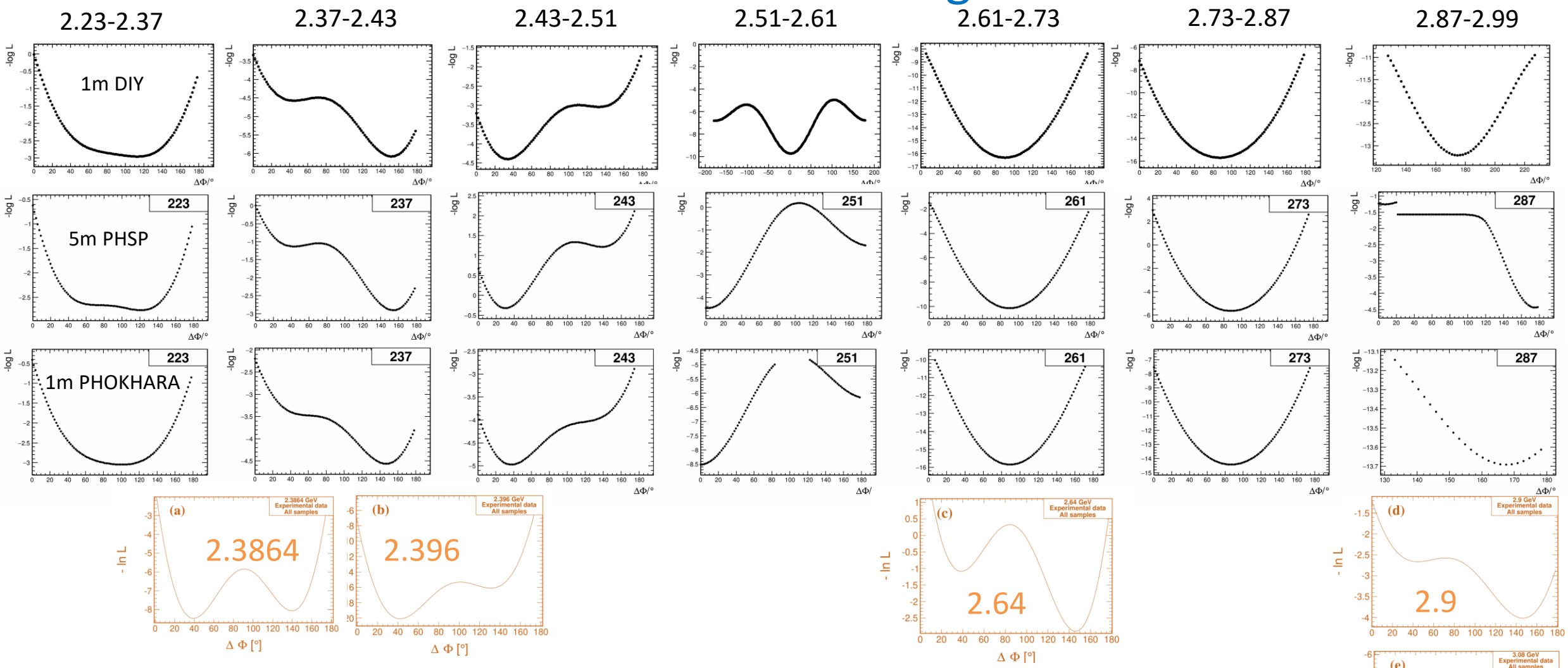

sinΔΦ


Graph
R
CONEXC
PHSP
viktor
PHOKHARA
cui
Babar
$M_{\Lambda\bar{\Lambda}}$


R
CONEXC
PHSP
viktor
PHOKHARA
cui
Babar
$M_{\Lambda\bar{\Lambda}}$

Likelihood scan-ΔΦ for different MC integral

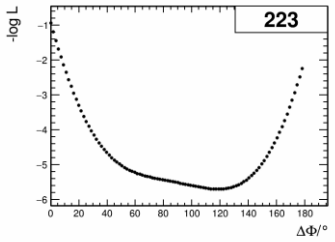
- Black: ISR data
- Orange: scan data BAM-629(2024)



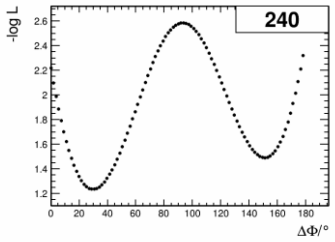
- For ISR data, the scan plots of ΔΦ are consistent with different MC integral.
- There is a significant shift of more than 100° between bin(2.37-2.43) and bin(2.43-2.51).
- The results of the ISR data do not match well with those of the scan data.

Likelihood scan-ΔΦ for different MC integral

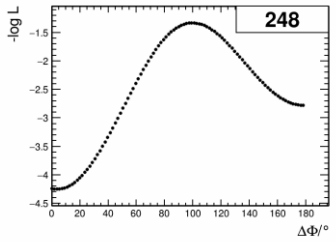
2.23-2.4



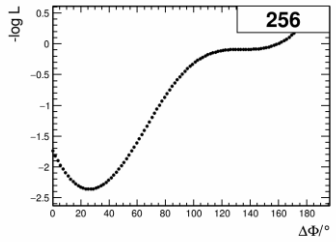
2.4-2.48



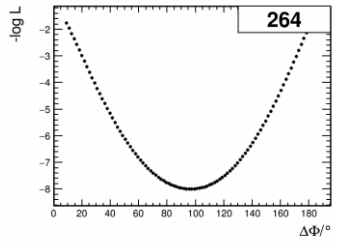
2.48-2.56



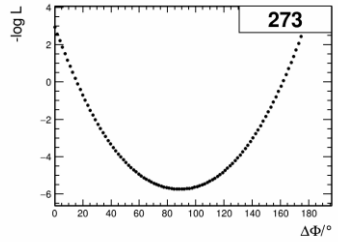
2.56-2.64



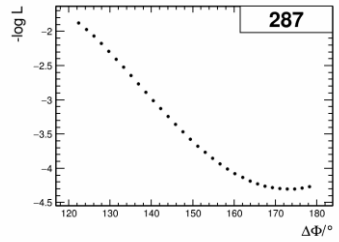
2.64-2.73



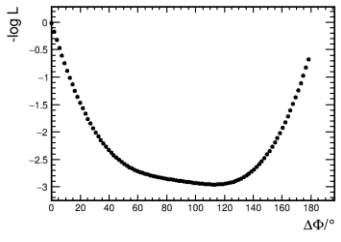
2.73-2.87



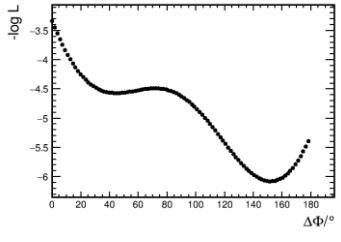
2.87-2.99



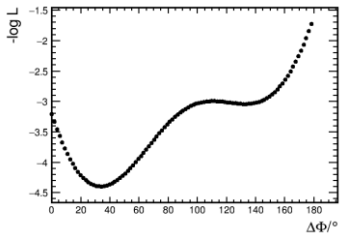
2.23-2.37



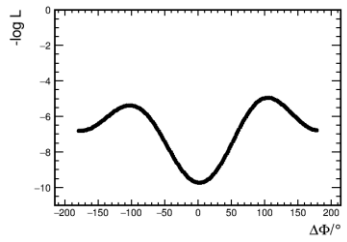
2.37-2.43



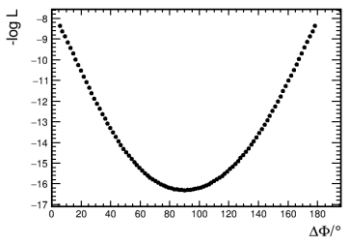
2.43-2.51



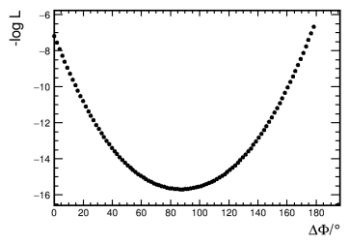
2.51-2.61



2.61-2.73



2.73-2.87



2.87-2.99