Model-independent measurement of γ in $B^{\pm} \to [h^+h^-\pi^+\pi^-]_D h^{\pm}$ at LHCb and BESIII

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Introduction

Last presentation since starting my PhD journey 1295 days ago!

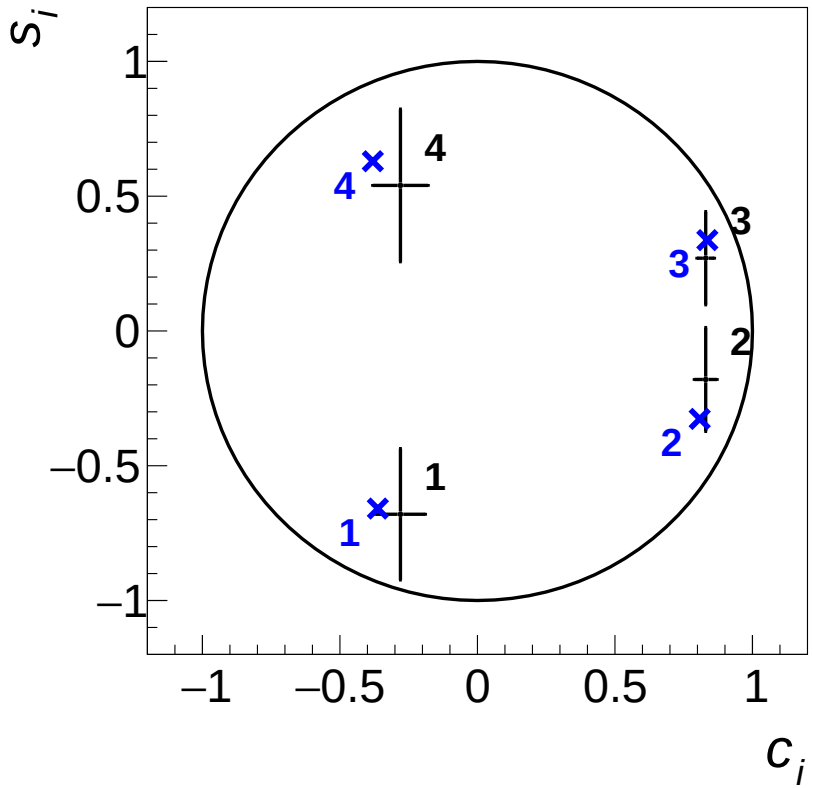
1. October 2020: Sensitivity studies with $B^{\pm} \to [K^+K^-\pi^+\pi^-]_D K^{\pm}$
2. April 2021: First data fit reveals large tension in γ

4. January 2023: Model-dependent γ publication with 3 σ tension
5. March 2024: BESIII c_i/s_i analysis approved by review committee
6. April 2024: Presented $B^{\pm} \to [h^+h^-\pi^+\pi^-]_D h^{\pm}$ to B2OC

Recap of BESIII $D^0 \to K^+K^-\pi^+\pi^-$ strong-phase results

With additional BESIII data ($16\,\text{fb}^{-1}$), c_i/s_i agree perfectly with model
Analysis approved by review committee, paper currently in review

$$c_1 = -0.28 \pm 0.09 \pm 0.01$$
$$s_1 = -0.68 \pm 0.24 \pm 0.04$$
$$c_2 = +0.83 \pm 0.04 \pm 0.01$$
$$s_2 = -0.18 \pm 0.19 \pm 0.03$$
$$c_3 = +0.83 \pm 0.03 \pm 0.01$$
$$s_3 = +0.27 \pm 0.17 \pm 0.03$$
$$c_4 = -0.28 \pm 0.10 \pm 0.01$$
$$s_4 = +0.54 \pm 0.28 \pm 0.04$$



Measured values (black) are consistent and close to LHCb model predictions (blue), so central value of γ is not expected to change much

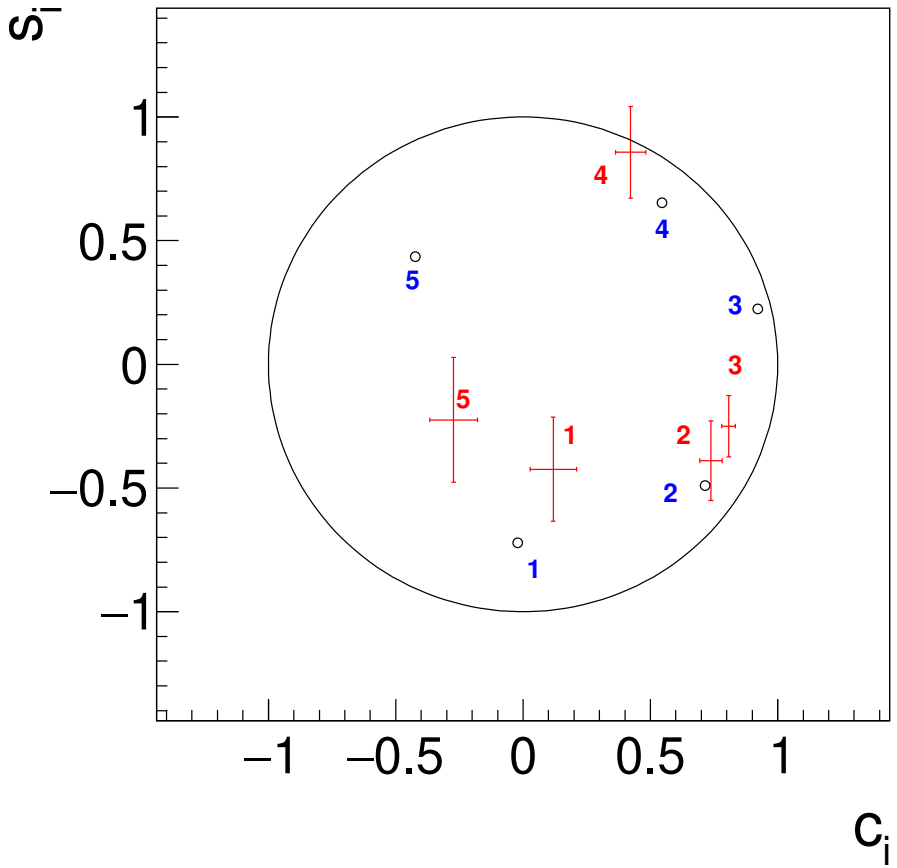
BESIII preliminary $D^0 \to \pi^+\pi^-\pi^+\pi^-$ strong-phase results

- Binned strong-phase analysis of $D^0 \to \pi^+\pi^-\pi^+\pi^-$ uses the 2×5 "optimal" binning scheme with 3 fb^{-1} $\psi(3770)$
- Earlier CLEO-c analysis with 0.8 fb^{-1} JHEP **01** (2018) 144
- New BESIII analysis uses a new binning scheme optimised with a BESIII amplitude model arXiv:2312.02524
  - Amplitude model constructed from a larger data set
  - In principle more sensitive
- Two binning schemes are available:
  - We use the more sensitive "optimal" binning with $Q = 0.85$
  - The other "equal δ" binning has $Q = 0.80$
- Analysis also approved by review committee, currently in paper review

BESIII preliminary $D^0 \to \pi^+\pi^-\pi^+\pi^-$ strong-phase results

Small differences between model prediction and measurement, but data points are generally close to the unit circle

$$c_1 = +0.12 \pm 0.09 \pm 0.02$$
$$s_1 = -0.42 \pm 0.21 \pm 0.04$$
$$c_2 = +0.74 \pm 0.04 \pm 0.02$$
$$s_2 = -0.39 \pm 0.16 \pm 0.06$$
$$s_3 = -0.25 \pm 0.12 \pm 0.03$$
$$c_3 = +0.81 \pm 0.03 \pm 0.01$$
$$c_4 = +0.42 \pm 0.06 \pm 0.02$$
$$s_4 = +0.86 \pm 0.19 \pm 0.07$$
$$c_5 = -0.27 \pm 0.09 \pm 0.03$$
$$s_5 = -0.22 \pm 0.25 \pm 0.08$$



Plan: Publish measurement of γ using both $K^+K^-\pi^+\pi^-$ and $\pi^+\pi^-\pi^+\pi^-$

Summary and next steps

In summary:

1. BESIII results approved, paper in review
2. Model-independent measurement of γ with $B^{\pm} \to [h^+h^-\pi^+\pi^-]_D h^{\pm}$ presented to B2OC, and ANA note circulated to B2OC conveners
3. 3σ tension in $D \to K^+K^-\pi^+\pi^-$ has reduced to less than 2σ due to:
   1. Non-Gaussian uncertainties in $y_{\pm}^{DK}$ originating from s_i uncertainties
   2. Large anti-correlation between γ and δ_B^{DK}
4. Main takeaway: Important to meausure γ model independently!

Summary and next steps

Next steps:

- Aim to finish thesis by the end of June
- Unfortunately I failed to obtain useful TORCH results...
- ...but it was a useful experience with testbeam and RICH work!
- Future plans: Start new postdoc position in Heidelberg in September

Thanks for your attention and thanks for all your support during my PhD!