

# BESIII Oxford Group Meeting

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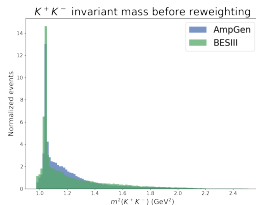
Oxford LHCb

28th April 2022

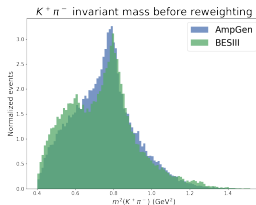


- Previously:
  - $F_+$  measurement of  $D \rightarrow KK\pi\pi$
  - 10 CP tags and  $K_{S,L}\pi\pi$  tags
  - Peaking backgrounds
- What has happened since?
  - Presentation in Charm group 15th March 2022
  - Reweighting of  $KK\pi\pi$  model
  - Toy studies
  - Systematic uncertainties

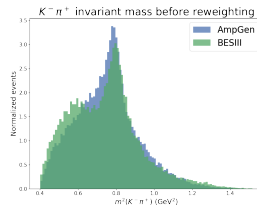
# Reweighting of $KK\pi\pi$ model



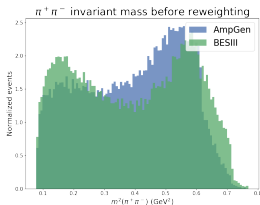
(a)  $K^+K^-$



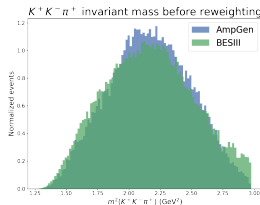
(b)  $K^+\pi^-$



(c)  $K^-\pi^+$



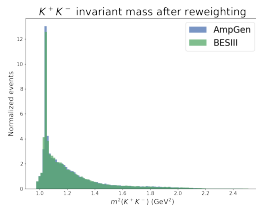
(d)  $\pi^+\pi^-$



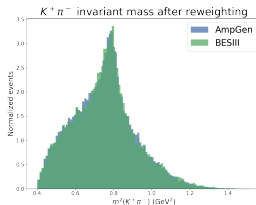
(e)  $K^+K^-\pi^+$

**Figure 1: Before reweighting**

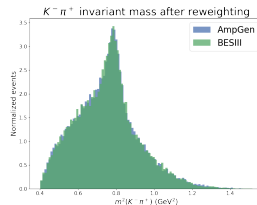
# Reweighting of $KK\pi\pi$ model



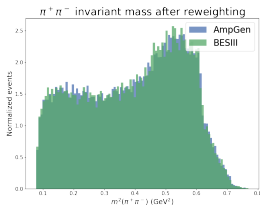
(a)  $K^+K^-$



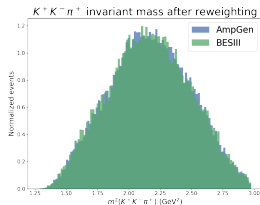
(b)  $K^+\pi^-$



(c)  $K^-\pi^+$



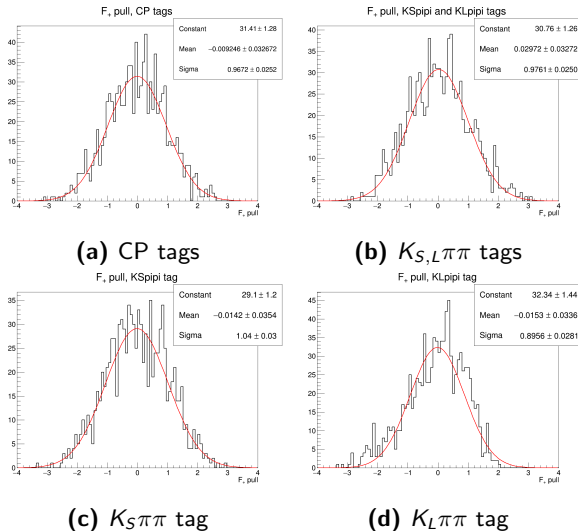
(d)  $\pi^+\pi^-$



(e)  $K^+K^-\pi^+$

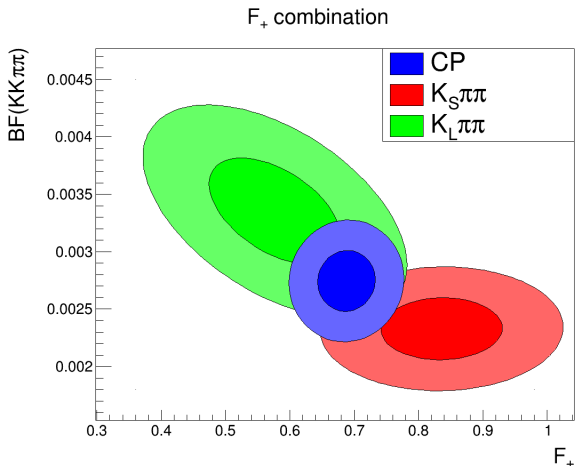
Figure 2: After reweighting

# Toy studies



**Figure 3:**  $F_+$  pull distributions

# Final fit results



- $K_L\pi\pi$  normalisation reduced by 14% because of larger BF
- $K_L\pi\pi$  is potentially biased towards low  $F_+$
- Only statistical uncertainties are shown

# Systematic uncertainties

- ① External parameters:  $F_{+}^{\pi\pi\pi^0}$ ,  $c_i^{(\prime)}$ ,  $K_i^{(\prime)}$ 
  - Do a fit with these Gaussian constrained and subtract in quadrature
  - Correlations between  $c_i^{(\prime)}$  are accounted for
- ② Peaking backgrounds
  - Perform multiple fits to data with peaking background yields smeared
  - In binned  $K_{S,L}\pi\pi$ , correlations are accounted for
- ③ Uncertainties in the efficiencies (finite MC samples)
  - Multiple fits with smearing
- ④  $K_L\pi^0$  single tag yield
  - Uncertainty from  $K_L\pi^0$  BF and  $N_{DD}$
  - Smear ST yield and perform multiple fits
- ⑤ Efficiency factorisation
  - Perform fit with DT efficiencies replaced by product of ST efficiencies and take difference as a systematic
- ⑥  $K_S$  veto
  - Calculate  $F_{+}$  from model with and without  $K_S$  veto and take the difference as a systematic

# Summary of all systematic uncertainties

Sources of  $F_+$  systematics in units of  $10^{-2}$

In addition, there is a  $0.8 \times 10^{-2}$  uncertainty from  $K_S$  veto

Source	CP tags	$K_{S,L}\pi\pi$ tags	$K_S\pi\pi$ tag	$K_L\pi\pi$ tag
Statistical	4.5	8.3	8.4	10.3
Efficiency	0.1	0.4	0.4	0.4
Efficiency factorisation	0.6	N/A	N/A	N/A
External inputs	0.3	0.8	0.8	0.8
$K_L^0\pi^0$ ST yield	2.1	N/A	N/A	N/A
Peaking backgrounds	0.3	1.0	0.4	1.8
Total	2.2	1.3	1.0	2.0



# Summary and conclusion

- Finally finished with:
  - ① Peaking backgrounds
  - ② Toy studies
  - ③ Reweighting
  - ④ Systematics
- Final result:  $F_+ = 0.70 \pm 0.04$
- First draft of MEMO is finished and (hopefully) ready for circulation