

BESIII Oxford Group Meeting

Martin Tat

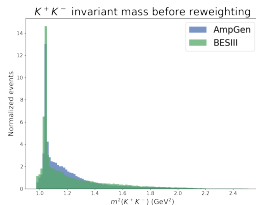
Oxford LHCb

28th April 2022

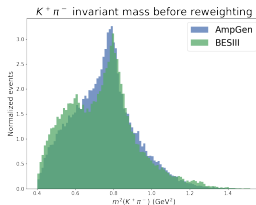


- Previously:
 - F_+ measurement of $D \rightarrow KK\pi\pi$
 - 10 CP tags and $K_{S,L}\pi\pi$ tags
 - Peaking backgrounds
- What has happened since?
 - Presentation in Charm group 15th March 2022
 - Reweighting of $KK\pi\pi$ model
 - Toy studies
 - Systematic uncertainties

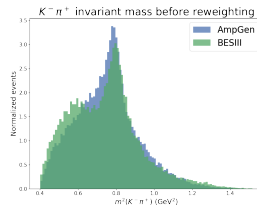
Reweighting of $KK\pi\pi$ model



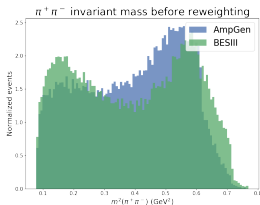
(a) K^+K^-



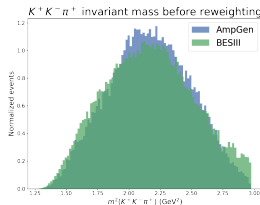
(b) $K^+\pi^-$



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



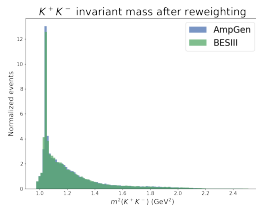
(d) $\pi^+\pi^-$



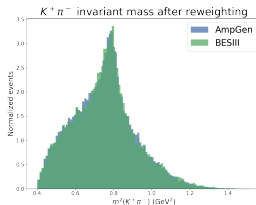
(e) $K^+K^-\pi^+$

Figure 1: Before reweighting

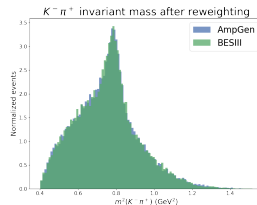
Reweighting of $KK\pi\pi$ model



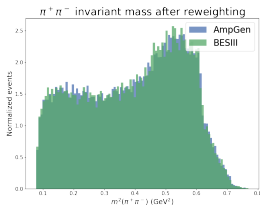
(a) K^+K^-



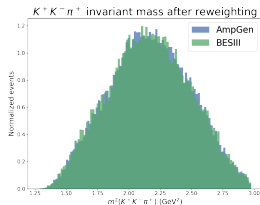
(b) $K^+\pi^-$



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



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



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

Figure 2: After reweighting

Toy studies

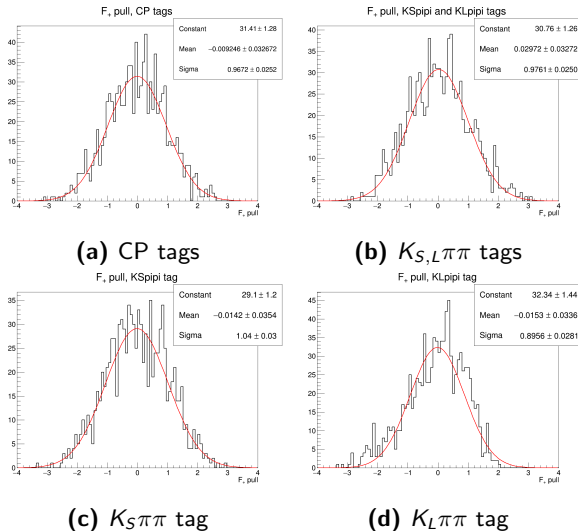
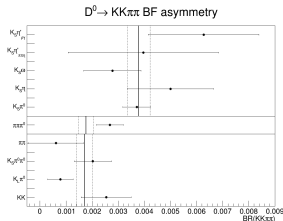
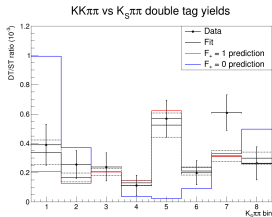


Figure 3: F_+ pull distributions

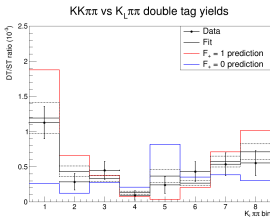
Final fit results



(a) CP tags, $\chi^2 = 1.4$



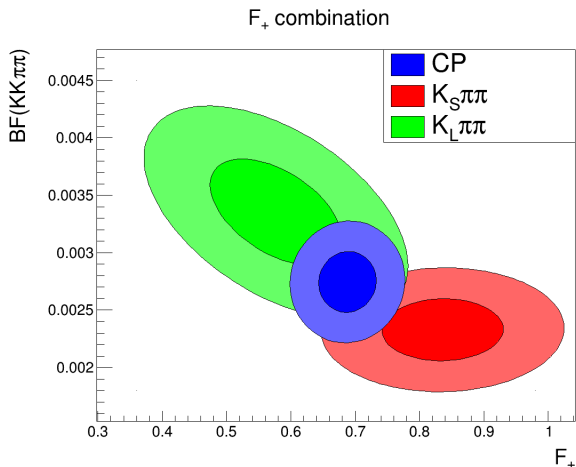
(b) $K_S\pi\pi$ tags, $\chi^2 = 1.2$



(c) $K_L\pi\pi$ tag, $\chi^2 = 1.0$

Figure 4: F_+ fit projections

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 0.8×10^{-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
External inputs	0.3	0.8	0.8	0.8
Peaking backgrounds	0.3	1.0	0.4	1.8
$K_L^0\pi^0$ ST yield	2.1	N/A	N/A	N/A
Efficiency factorisation	0.6	N/A	N/A	N/A
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