

# Angular resolution in $B_s^0 \rightarrow J/\psi\phi$

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- Performed toy studies to evaluate the systematic due to ignoring angular resolution in the fit.
- Previous study done by Gerhard, Tristan in LHCb-2009-024.

# Parameterising the angular resolutions

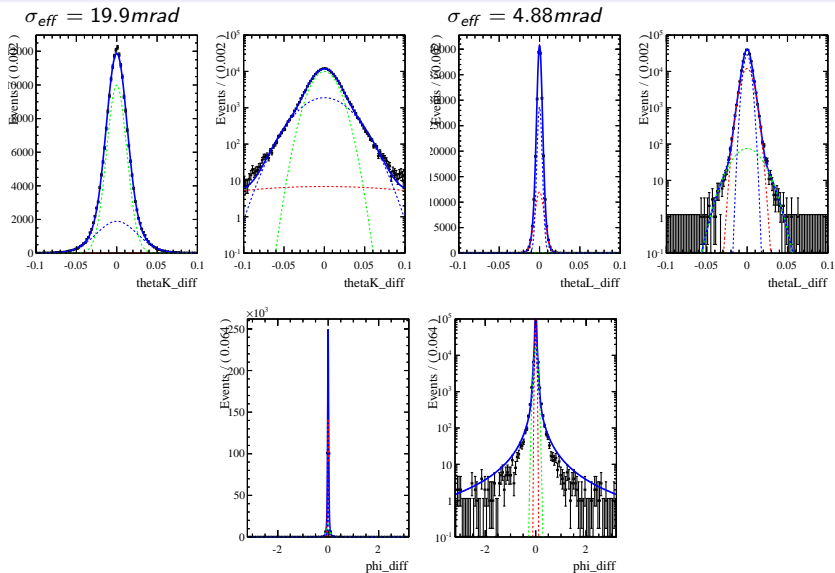


Figure 1 : Plot showing the fit to  $(\text{angle\_true} - \text{angle\_reco})$  for each of the three helicity angles. The right hand side shows the log scale plot.

## 2D plots of the helicity angle resolutions.

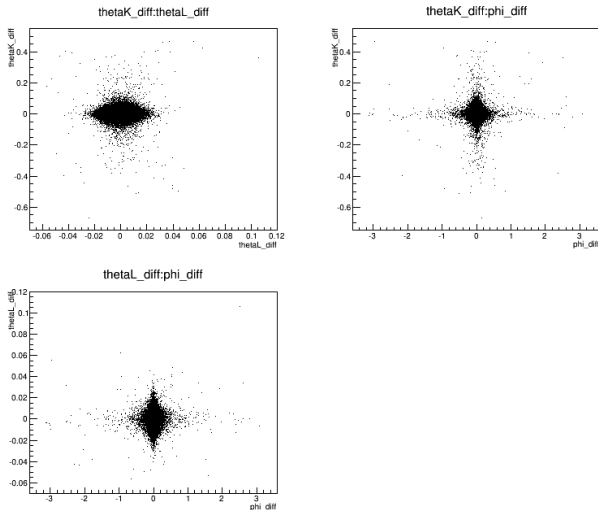


Figure 2 : 2-dimensional plots of the helicity angle resolutions. No obvious correlations.

# Fit results to the helicity resolutions

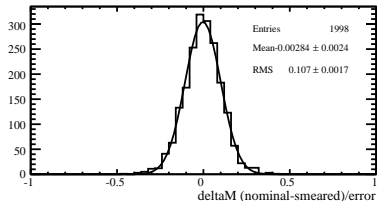
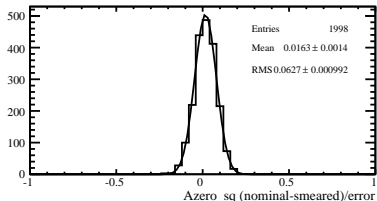
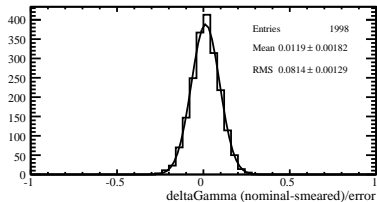
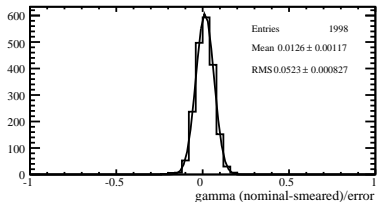
Parameter	3 Gaussian $\theta_K$	3 Gaussian $\theta_\mu$	2 Gaussian+Breit-Wigner $\phi$
$\sigma_1$ (mrad)	$12.60 \pm 0.04$	$6.03 \pm 0.08$	$22.09 \pm 0.19$
$\sigma_2$ (mrad)	$25.4 \pm 0.1$	$3.531 \pm 0.044$	$58.11 \pm 0.84$
$\sigma_3$ (mrad)	$139.0 \pm 4.0$	$15.5 \pm 0.7$	$25.88 \pm 0.41$
$f_1$	$0.719 \pm 0.003$	$0.414 \pm 0.021$	$0.561 \pm 0.006$
$f_2$	$0.275 \pm 0.003$	$0.58 \pm 0.02$	$0.178 \pm 0.005$
$f_3$	$0.005 \pm 0.004$	$0.007 \pm 0.0213$	$0.261 \pm 0.008$
$\sigma_{eff}$ (mrad)	$19.9 \pm 0.07$	$4.88 \pm 0.05$	—

**Table 1 :** Fit results to the angular resolution distributions for each of the helicity angles taken from  $B_s^0 \rightarrow J/\psi \phi$  simulated signal sample.

# Toy studies

- 2000 toy datasets, of 90k events (70k untagged, 20k tagged).
- No angular acceptance or decay time efficiency.

- 1 Generate toy datasets.
- 2 Shift the helicity angles of these datasets using the resolutions found in MC data.
- 3 Fit the unsmeared and smeared datasets.
- 4 Take the difference between fit results for each pair of datasets.



- Repeat procedure for different scalings ( $n$ ).
- Take  $n = 1$  case as estimate for systematic uncertainty.
- This only really affects  $|A_{\perp}|^2$  and  $\delta_{\parallel}$ .
- A new section has been added to the ANA note with the details.

Parameter	(nominal – smeared)/ $\sigma$	
	$n = 1$	$n = 3$
$\Gamma_s$	0.01	0.07
$\Delta\Gamma_s$	0.01	0.06
$ A_{\perp} ^2$	0.13	0.67
$ A_0 ^2$	0.02	0.05
$\delta_{\parallel}$	-0.24	-1.47
$\delta_{\perp}$	-0.07	-0.30
$F_S$	-0.05	-0.28
$\delta_S$	0.08	0.34
$\Delta m_s$	0.00	-0.01
$\phi_s$	0.00	0.00
$ \lambda $	0.00	0.00

# All the plots. . .

