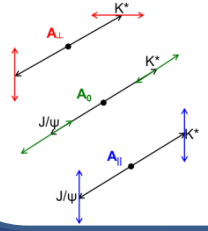
Measurement of the polarisation amplitudes of the decay $B_d \to J/\psi\, K^*$ with LHCb

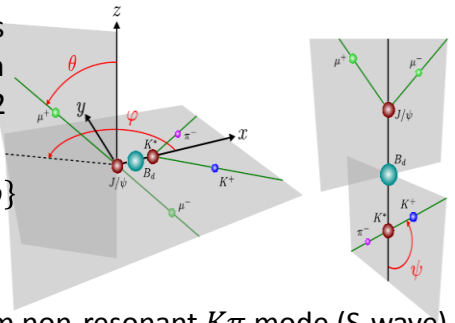
Alexander Bien, Heidelberg University

Theoretical Background

B_d has spin 0, J/ψ and K^* vector mesons
→ final state admixture of 3 states with relative angular momentum L = 0,1,2

Final state products described by three transversity angles $\Omega = \{\cos\psi, \cos\theta, \varphi\}$
3 complex amplitudes: $\boldsymbol{A_0}$, $\boldsymbol{A_{||}}$, $\boldsymbol{A_\perp}$

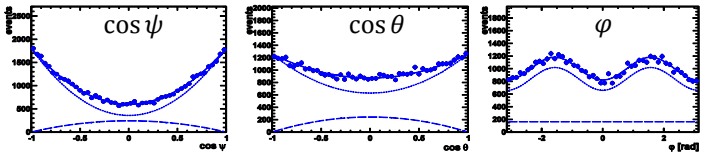




Contribution from non-resonant $K\pi$ mode (S-wave), described by additional amplitude $\boldsymbol{A_s}$

Physics parameters:
$|A_{||}|^2$, $|A_\perp|^2$, $|A_s|^2$, $\delta_{||}$, $\delta_\perp$, δ_s

Analysis strategy

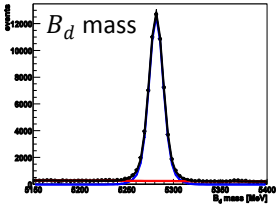


•••••• Toy MC
Angular momentum:
····· L = 0, 2
-------- L = 1

L	Amplitude
0	A_0, $A_{||}$
1	$A_\perp$
2	A_0, $A_{||}$

To disentangle angular momentum states perform maximum likelihood fit, simultaneously in mass and 3 transversity angles

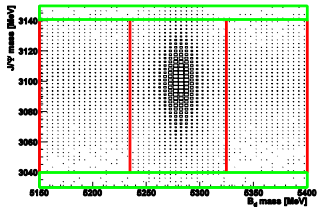
Event sample:
$\mathcal{L}_{\text{int}} \approx 1\ \text{fb}^{-1}$ (LHC 2011 run)
77285 candidates used in analysis
61132 ± 274 signal events



Background studies

Main background components to be considered:
- Combinatorial background of random tracks
- $B \to J/\psi\, X$ events (true J/ψ)
- Muons from fake J/ψ (negligible)

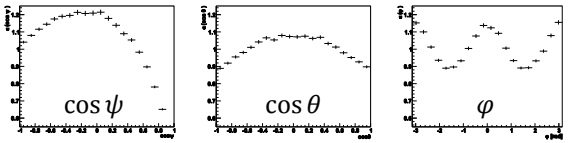
Scatter plot: J/Ψ vs. B_d mass



B_d sidebands
J/Ψ sidebands

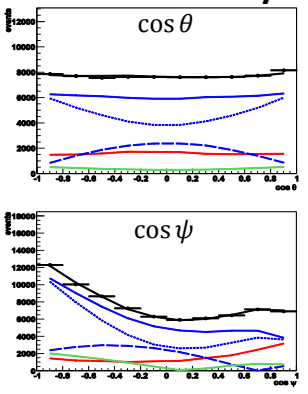
Angular acceptance

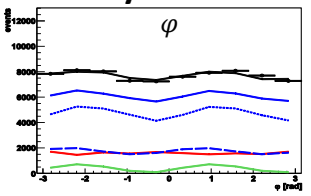
Acceptance corrections are taken from Monte Carlo:
- Angular coverage of the detector (10mrad < ϑ < 400mrad)
- Implicit momentum cuts (reconstruction)



➢ In general good agreement between data and Monte Carlo for all kinematic variables
➢ Only discrepancy: pion momentum distribution for low momenta (this is currently under study)

Very Preliminary results





Systematics:
- Data/MC difference
- Background description
- Acceptance treatment
- Mass model

Consistent with previous results

$\lvert A_{\lvert\rvert}\rvert^2$	0.228 ± 0.004 ± 0.003
$\lvert A_\perp\rvert^2$	0.203 ± 0.004 ± 0.003
$\lvert A_s\rvert^2$	0.044 ± 0.004 ± 0.013
$\delta_{\lvert\rvert}$	-2.98 ± 0.02 ± 0.04
$\delta_\perp$	2.93 ± 0.02 ± 0.02
δ_s	2.19 ± 0.03 ± 0.16