# $B^0 ightarrow {\cal K}^{0*}({\cal K}\pi) \mu \mu$ full angular analysis Systematics

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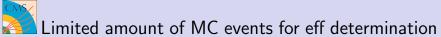
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#### Some thoughts on systematics

- Limited amount of MC events for eff determination
- ernel width for KDE
- efficiency shape
- Simulation mismodeling
- wrong CP assignment
- ø background determination
- Ø MC derived pdf component
- angular resolution



## n C

#### Split MC

- Split MC sample in N(=4) subsample;
- evaluate the efficiency via KDE for each sub sample  $\epsilon_i$ ,  $i = 1, \ldots, N$
- perform N fit on MC and/or control samples  $J/\psi \ \psi'(2s)$  and extract N set of angular parameters for each  $q^2$  bin  $X_i$ ;
- compute spread of parameter X as RMS(X)
- systematics is  $RMS(X)/\sqrt{N}$  (Is that correct, or it should be /N?)

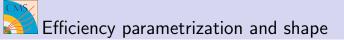


### Limited amount of MC events for eff determination (II)



#### Toy MC

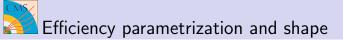
- alternative method
- get pdf for N and D of efficiency  $\epsilon = \frac{N}{D}$  with full MC statistics;
- generate toy MCs for N and D with as many events as in the original MC, following the pdf
- $\bullet$  apply KDE on the toy MC samples, and get back  $\epsilon$
- use these efficiencies to repeat the fit (as before) and take spread of output as systematics
- can be computational heavy





#### Kernel width for KDE

- The KDE use a kernel with a given width
- we tried several, and choose one as an acceptable compromise;
- evaluate the systematics associated to this choice by varying the width up and down and compare the fit results;
- Alternative: we do have adaptive width for some of the bins, we can compare the adaptive with the fixed width and get the syst.





#### Kernel width for KDE

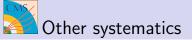
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#### Efficiency shape

 From the control sample fit: compare fit results with PDG values (as in 2D analysis)

#### Simulation mismodeling

- Compare fit result on GEN (w/o efficiency) and RECO (w/ efficiency) (as in 2D analysis)
- Q: how much of this already includes kernel width and eff shape syst?





#### • As in 2D analysis

- wrong CP assignment
  - measure  $B^0$  width with  $K * (K\pi)J/\psi(\mu\mu)$  control sample
  - measure mistag ratio with  $K * (K\pi) J/\psi(\mu\mu)$  control sample
  - fit N times data with mis-tag ratio randomly generated according to gaussian centered at nominal value and with σ from the previous two methods.
- background determination
  - modify the parametrization of background (+1 degree of pol)
- MC derived pdf component
  - $\blacktriangleright$  signal mass shape: use  $J/\psi$  control sample, let mass shape free to float
- angular resolution
  - use generated angles in place of reconstructed ones, and compare.





- First toughts on systematics, starting from those considered in 2D analysis;
- No major show stopper, we can redo most of the work already done for 2D analysis;
- we have a workplan for efficiency related systematics;
- In all cases, we need to perform the fit many many times, as expected
- cannot progress much w/o the fitting code...
- Adding all this to the AN