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Martino Questions 290615

Dear Martino, Many thanks for your questions and comments. Here are our answers.

1a) L189-190 (see also L410-412 and caption of figure 14):
Your statement is that you do not need an efficiency correction due to
the flatness of the efficiency above your cut at PDL>0.02 cm.
However, there is a discrepancy of 4.7+-1.4 um between the generated and fitted lifetime if you use a trigger unbiased method, and a difference of ~5+-2 um between the results you get if you perform the PDL cut or not.

Answer: We can not conclude what you say. Plots at the center and right confirm that after all selection requirements (triggers, 200 microns cut, etc) results are unbiased (and Appendix D shows that the efficiency is flat). The left plot, in which we did not choose trigger (neither apply triggers cuts) includes the prompt region (<200 microns), where the efficency might not be flat (due to various effects). Including the prompt data would be a different analysis. We could study the efficiency in this region but we will not use it.

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I agree with you that the result of the fit using the displaced trigger and the lambda cut is in agreement with the generted value. But at lines 403-405 you write: "In the first we choose all MC events regardless of whether they fired or not any trigger, and avoid to apply those
selection requirements that can produce a PDL efficiency, such as Lxy and pointing angle cuts". From this statement I understand that the result of the fit using this sample shoud be unbiased wrt the generated number, instead you find 455.8 ± 1.4 μm (caption of figure 14, plot on the left). In the answer to my comment you write instead that in the prompt region there could be a not flat efficiency. So please change the text in order to avoid confusion.

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Reply: Yes. this text was changed In the last AN version

1b) L281, (see also L433-436 and equations (27) and (28)):
Your fit to beta gives 0.010+-0.131, therefore you have a large statistical error on the (possible) dependence of the efficiency on the PDL (lambda).
In the systematic error computation, you quote the difference between
the result you get with no correction and the one you obtain using the
numbers as in eq. (27) and (28). In my opinion, due to the large statistical error on beta, you may instead quote the difference between the nominal result (with no correction) and the results obtained using the correction with beta+-1 sigma. In my opinion, the large statistical error on beta tells you that your statistics is not enough to state that the efficiency does not depend on lambda.

Answer: The problem with your suggestion is that we would be including the effect of the low statistics in MC, which is not a good estimate of the underlying systematic uncertainty. For that reason we take the central value of the parameters obtained from the fit of the efficiency using the available MC. ToyMC studies in Appendix D.1 confirms the flatness of the efficiency for PDL > 200 microns.

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*Could you add to the AN the values of the errors on the fitted parameters reported in figure 20 and 21? You could use these errors for the determintion of the systematic on the efficiency flatness.

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Reply: We have included this information in the last AN. We also performed the test you suggest and the difference on the lifetime measurements is found to be 0.8 microns. However Nuno suggested a different way to normalized the effciency which further reduces these errors, so the difference in lifetime will also decrese.

2) Equation (3):
Are lambda and sigma(lamdba) uncorrelated?
In my opinion it could be better to use a 2D PDF instead of the product
of the two PDFs T and E describing the two variables.

Answer: The Lambda PDF already depends on the per-event sigma(lambda). Punzi (http://arxiv.org/abs/physics/0401045) showed that, in addition, the uncertainty distribution must be multiplied if signal and background distributions are different, otherwise results might be biased.

3) L206 and formula (2):
-Could you quantify what is the fraction of the BB BKG wrt the combinatorial BKG from non B decays?

Answer: The parameters for each fraction are in Tables (2-7). For example, for Bs to Jf0 Table 5 shows that fc is the fracion of combinatorial background and, hence, 1-fc would the fraction of the BB (left Gaussian). Please note that the combinatorial background could also include B decays but that **do not peak** in the selected mass window.

-Do they have the same shape?

Answer: BB was modeled only for the B to jpsif0 channel, which is clearly peaking in the low mass sideband. These studies can be seen in Figure 22, Appendix E.
Shapes of the combinatorial background (1st order polynomial) and BB (Gaussians) are of course different.

-Is the BB BKG important only for the f0 channel?

Answer: Yes. This is mainly due to the larger production of B0 with respect to Bs, and that almost any B0 decaying to Jpsi pipi is reconstructed in the low mass sideband as shown in Figure 22.

-What is the subcomponent of the BB BKG coming from the signal channel (i.e. from events wrongly reconstructed from the same channel you are selecting) wrt the other B decay channels?

Answer: This question is not clear to us. Could you rephrase your question?

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*I meant if you know how many BB BKG events in the f0 channel are true f0 channel events with a wrong reconstruction, and how many are instead from other BB channels (not f0 events).

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Reply: No, we don't know that, and is very difficult to determine. The
main idea was to show that other B decay channels when reconstructed as
Bs->J/psi pipi are outside of the Bs signal region, with exception of the
B+ case. The description of each background is then done as a
phenomenological model and the fraction allowed to float and to be
determined by the fit.
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4) L408-410:
"in the MC the background (if present) can be removed by matching".
-Do you require fs=1 (matching) in the MC fit or not? If not, what is the fit result for fs?

Answer: We always require matching and therefore fs is always 1. Hence, we do not need to include the background PDF in the MC fit.

-What about the combinatorial BKG from signal events (see comment 4)?
If you have events wrongly reconstructed, you can have in principle combinatorial background with fs=1.

Answer: The MC matching associates the generated particles with the reconstructed particles and, therefore, no combinatorial is left after the matching process.

5) Eq. (8):
-do you use the same resolution for signal and BKG events?

Answer: Yes. However, remember that we use event per event uncertainties.

-In this case, did you verify on MC this is a good assumption?

Answer: No, we do not have inclusive MC to test the bkg case. However, we expect equal resolutions for signal and background. We confirmed this hypothesis using events in data sidebands.

6) L215: what is the number of the eponentials in equation (8) for the different channels?

Answer: depends on the channel and it could be see in the tables (2-7), for example: they are 4 for B+ (Table 2), 1 for Bd to jpsiK* (table 3), etc.

7) Section 4.4:
Could you show the plot of the error distribution?

Answer: Yes. We will add these plots in the next version of the note.

8) L240-244: do you take into account the error on the fixed parameters in the evaluation of the systematic uncertainties?

Answer: No, but we can do it. We expect them to be very small. We will include these numbers in the next version of the note (using the reprocessed data).

9) L254-259: do you take into account the errors on NB+ and tauB+ from the fit described in Appendix F (figure 25) in the systematics?

Answer: No, but we can do it. We expect them to be very small. We will include these numbers in the next version of the note (using the reprocessed data).

10) Table 2 and figure 3: you quote signal fraction=69%: in what range? From the figure it seems
to be larger.

Answer: The plot was wrong. We will fix that in the note. But the number is correct, the signal fraction is 69%.

11) Table 5: what is the "BB PDL"?

Answer: It is the lifetime of the exponential component of the BB, which in mass corresponds to the Gaussian on the left sideband (magenta in the note).

- Is it an additional sample other than the B+ one?

Answer: Yes, it is an additional component.

- What is its fraction in the BB BKG sample?

Answer: The fraction of BB is 1-fc.

12) L313-316: how do you compute the error for the bias reported in the table from the toy results?

Answer: This is explained in detail in Appendix I. The bias b is calculated making the difference of the fitted lifetime obtained for each sample (ToyMC samples) with respect to input value, as shown in Figs. 26-28 (left). This difference is a distribution centered at the value b, obtained by performing a chi2 fit of a Gaussian to this distribution.

13) L376-382: How do you implement the BS constrain in the likelihood?
What error do you use?

Answer: The BS constraint is implemented in the calculation of the position of the primary vertex (used to calculate the lxy event by event and uncertainty), not in the likelihood.

14) Figure 24: what is the difference between this plot and the green one in the last picture of figure 23?

Answer: The green plot in Figure 23 represents the events in the Jpsif0 sample 3 sigmas around the peak shown in Figure 24.

15) L493-494: could you add some plot or just give a link to some study?

Answer: Please look at Figure 14, bottom-left plot.

16) L140-141: You use only the J/Psi mass constrain in the K* and f0 channels due to the natural widhts of these states. In principle it is possible to perform a kinematic fit including a requirement on the width of the fitted state.

Answer: For the f0, the width is not well known (the PDG reports a range). In the case of K*, we could in principle apply the constrain, but we want to follow the same procedure as in the f0 since this is our crosscheck channel.

17) L153-154: How did you chose the thresholds (7 and 26) for the chi2 cuts?

Answer: Seven is used in the dimuon trigger, so we apply the same cut for all two track vertices. On the other hand, 26 is really a soft cut, just to check that the vertex fit converged. It has to be large enough to avoid biasing the lifetime (as observed if one chooses a candidate per event using this variable).

18) L172-177: It could be interesting to see the distributions you looked at to decide these cuts.

Answer: Ok, we will produce them and include them in the next version note.

-- JhovannyMejia - 2015-07-07

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