A list of modifications to the ANA note and our analysis since the start of the review

- The title has been changed to ' Measurement of the \pt and η dependences of \Lb production, and \BF(\LbLcPi), using hadronic decays'
- We have made the note more self-contained
- We will no longer measure the total yield ratio, we now propose to rescale to the semileptonic fl/fd and measure the BF by using the pt-binned fits only. As such all the integrated efficiencies have been removed from the ANA. This new strategy is described in section 1.1 in the new ANA.
    - This change was done because we realised that the MC would not describe the PT distribution of the Lb very well, because this would be distorted by the PT dependence of f_lambda/fd, which is not described in the MC.
    - By binning in PT and eta, we remove our reliance on the MC to describe these variables well. Appendix C shows that the P and eta distributions of the proton, which would and eta bins factor, as opposed to using linear fits in the previous ANA, this is more correct because we know the PT dependence is not linear from our ratio fits.
    - This strategy also removes the need to extract a semi-leptonic f_lambda value at a certain PT to get the scale-factor.
- The parts of the analysis associated with the semileptonic f_lambda measurement have yet to be completed, due to a substantial reworking of our strategy on this
    - Our strategy for completing the analysis is outlined in sections 9.1 and 9.2
    - If the referees deem our approach to be valid, we will proceed and complete the analysis, measuring BF(Lb->LcPi)
- Section 1 has been modified so that it states our analysis strategy more clearly and explicitly, section 1.1 describes how we measure the pt/eta dependence of f_lambda, the BF of LcPi respectively, and how we use the fs/fd analysis in our present analysis
- Added new section 4.5 'Total combined efficiencies', showing the combined efficiencies and ratios for the two signal modes
- The BDT systematic has been completed, it is decribed in section 7.1.4
- The following systematic uncertainties are no longer included in the final result:
    - The LcK fraction in the LcPi fit: This uncertainty is already covered implicitly because the gaussian constraint allows this fraction to vary around its uncertainties.
    - The 'combfree' systematic. In this the exponential coefficient of the exponential combinatoric background PDF is left free in the fit. The exponential coefficient is found to show large variations from bin to bin which we believe is due to the limited number of events per bin. Also, the uncertainties on this parameter are of the order ~30%, which we deem to be too much to see an underlying trend. Therefore we think it is more realistic to use the [+50%,-50%] method to evaluate the systematic error.
- Section 7 has been substantially modified to explain our uncertainties more clearly.
    - Section 7.1 describes each individual binned uncertainty.
    - Section 7.2 Shows tables of the binned uncertainties
    - Section 7.3 Describes and shows how we use the binned systematic uncertainties to get the uncertainties on the F_lambda vs PT, eta fits and the LcPi BF calculation.
- The fl/fd vs. PT and eta plots, now figures 19 and 20, have been modified:
    - The central values of the datapoints have been re-scaled to the semileptonic fl/fd values, using the scale factor defined in (2)
    - The error bars shown are the systematic errors added in quadrature to the statistical errors. The resulting chi2/ndf values are now consistent with the fit being good.
    - The linear and flat fits have been removed in the pt fits, the flat fit has been removed in the eta fit
    - The red lines show the upper and lower bounds of the uncertainty of the scale-factor, for example, the upper line is the fit that would result if the scale-factor is increased by its positive uncertainty. This allows the reader to see the uncertainty from the semileptonic fl/fd

without increasing the error-bars of the data-points.

Olaf Steinkampfs comments

Section 2.1: Trigger?

Answer: Could you clarify the question please.

Sections 2.2: Data and MC have different values of mu

Answer: At the start of 2011 data-taking in march the mu was set to 2.5, the MC11 value was also set to 2.5 accordingly. The mu was reduced to ~1.5 in the subsequent bulk of the data taking in order to level the luminosity to 3 − 3.5 × 10^32 in the 50 ns bunch spacing scheme (the average mu per fill is shown in lhcb-operationsplots.web.cern.ch/lhcb-operationsplots/index_files/2011AvgMu.png). These different mu values would result in different track multiplicity distributions, which are corrected for in the proton PID reweighting scheme.

---

line 72: is the MC B* value relevant?

Answer: No, it has now been removed from the ANA note.

---

lines 75-77: Define 'particles of interest' and 'trigger pass-through mode'

Answer: 'particles of interest' means the final state particles of the generated decay. 'Pass-through mode' means that the event gets recorded regardless of the trigger decision, this is done in the MC so that trigger efficiencies can be calculated.

---

lines 84-93: If the Lc resonance cocktail MC is the default for the signal, why not use it for the background?

Answer: The background MC requests were submitted before the 'cocktail' MC was designed. There is essentially no difference between the cocktail and phase space samples (see App. A). The part-reco background MC samples are not used in the final fit because their shapes did not resemble the data, as they do not model the spin-structure of the baryon decays.

---

line 96: Give more details on the interferences between the submodes of the D and Ds decays

Answer: Details have been added to the ANA note in lines 92-95

Table 2: Why are the Lb and Bd mass ranges different?

Answer: We initially chose the same size mass window for both the Bd and the Lb fits, but we found that in the Lb case there were not enough combinatorial background events at high masses to reliably fit the combinatorial background. Therefore we decided to make the mass window smaller in the Lb case. As the B fit is an exact copy of the fsfd analysis, we prefer to not touch this fit.

Table 2: Do the different FDCHI2 cuts used for the Lb and Bd modes introduce a systematic effect?

Answer: There is good agreement between data and MC for the charm-daughter FDCHI2 variable for both modes, as can be seen in: diffLcPi_lab2_FDCHI2_ORIVX.pdf where the data (black points) and MC (red points) are compared after full application of the selection criteria and a +/- 40 MeV mass window around the Bd/Lb. Because of this good agreement we can conclude that no systematic effect is introduced by the FDCHI2 cut.

---

line 123: Can nothing be done about the poor statistics of the proton PIDCalib sample in the high P and low ETA regions?

Answer: Unfortunately not, the lambda -> p pi decay, which provides the proton PIDCalib sample, produces protons that have a relatively low PT. This is why we only apply proton PID cuts in the (P,ETA) space where there is enough statistics to calculate the PID cut efficiency.

Section 4: Why is the trigger efficiency not mentioned?

Answer: The trigger requirement is included in the stripping selection (see line 147)

---

line 131-132: Is the 'DaughtersinLHCb' cut the 10-400 mrad cut mentioned in L 75-76?

Answer: yes

---

line 135: Is the PT and eta binning done in 2D?

Answer: no

Table 4: How are uncertainties determined?

Answer: The uncertainties are based on MC sample size, and are taken as the binomial error. The relative errors for the efficiencies for the BdDPi and the LbLcPi samples are added in quadrature to get the error on the ratio of efficiencies.

Table 4: Show individual efficiencies as well as the ratio?

Answer: These are now shown

Figure 4: The Bd sample is x2 larger than the Lb sample, but have x2 events in right fig than left?

Answer: The Bd sample actually consists of 1M events, not 4M, so it is in fact half the size of the Lb sample. Table 1 in the ANA note has been amended accordingly.

---

line 165: **Quantify the small data-MC differences that were observed**

Answer: We expect the main differences to be in the PT distributions of the Lb, as the PT-dependence of F-lambda is not modelled in the MC, this will have a knock-on effect on the PT of all the other final state particles. By binning in PT and ETA we minimise these expected discrepancies, for example, appendix C shows that the binned proton P and ETA distributions have good data-MC agreement.

The BDT systematic, described in section 7.1.4, quantifies the effects as the PT and IPCHI2 of all the final state particles and the reconstructed Lc/D and Lb/Bd as input variables, as well as the lifetime of Bd/Lb (these are the input variables of the BDT). This systematic influences the binned LcPI/DPi ratios by ~2%, the effect on the final fits is larger, where the maximum variation is 11.3% on the b variable in the exponential fit, because the BDT discrepancy shows a trend in PT.

---

line 165: Is it true that we are not directly sensitive to data-MC differences, given that the pion PT distributions of the Lc and D are different?

Answer: See above

---

line 182: Other efficiencies use (PT,eta)

Answer: Can you clarify this statement? We are not aware of other efficiencies or analyses that bin in (PT,eta)

- In the FsFd analysis the efficiencies were binned in (p,pt). We do the same to be consistent.
- For our proton PID cuts, we select special kinematic region in (p,eta) space, therefore we also give this efficiency in bins of (p,eta). Besides, the correlation between (p,eta) is smaller then between (p,pt) therefore this is the preferred combination.
- ntracks distribution is different for the proton calib sample and our signal sample. The ntracks influences the efficiencies quite a lot. We take this into account by also binning in ntracks.

---

line 182: Is there a motivation for why we bin in (P,PT) for DLLK and (P,eta) for DLLp?

Answer: We bin in (P,PT) for cuts applied to kaons and pions because to be consistent with the fs/fd analysis, which used this scheme to calculate the PID efficiencies of the B->DPi decay. The proton PID cut efficiencies are binned in (P,eta) because this cut is applied only in the (P,eta) region described in table 3.

---

line 187: The nTracks distributions for the D->KPi PIDCalib sample are very similar to the Lb and Bd nTracks distributions, therefore we do not bin in nTracks when calculating the efficiency of PID cuts on kaons and pions, is this a good argument?

Answer: Because the nTracks distributions are very similar for the K & Pi PIDCalib sample and our signal, weighting in nTracks would not change the efficiency, as reweighting one distribution to another identical distribution results in no change in the distribution.

---

line 192: Are the overall PID efficiencies used in the analysis or for reference only?

Answer: The overall PID efficiencies are used for reference only. When calculating the Lb->LcPi branching fraction we combine the binned efficiency-corrected yields to get the total ratio.

---

line 192: How do our PID efficiencies compare to other analyses?

Answer: In LHCb-ANA-2012-096 the Lb->LcPi decay is selected with the same criteria as ours, except that they apply a bachelor pion DLLK<5 cut (which is looser than our <0 cut), and their proton PID cut is applied for all protons in the (P,ETA) range. Their combined PID efficiency is 78.5 +/- 0.1%, ours is 69.3 +/- 0.2%, their efficiency without the bachelor cut is 81.1 +/- 0.1%, ours is 82.0 +/- 0.2% (table 11 in our ANA note), the slight increase in our efficiency is because our proton PID cut efficiency is 100% outside the (P,ETA) region defined in Table 3, whilst theirs would be less than 100%.

---

line 200 and table 12: Define misidentification probability

Answer: The fraction of misidentified background candidates that pass the defined selection criteria. i.e. In table 12 D+ -> Lc+ misId rate of 4% means that 4% of D+ decays pass our combined mass window and Lc daughter PID selection criteria.

Section 4.4.3: Are the binned PID efficiencies used in the analysis?

Answer: Yes, the binned PID efficiencies are used to calculate the efficiency corrected yields, i.e. the datapoints in Fig. 16 and 17. These are also used to extract the total yield by summing the binned efficiency-corrected yields.

---

line 215-216: Explain better why the accuracy of the proton PID efficiency is dependent on the proton PT and Eta distributions being accurately modelled in the MC

Answer: Note: There was a typo in the sentence, PT should have read P. The ANA note has been amended in this section to state: 'The accuracy of the proton PID efficiency is highly dependent on the P and η distributions of the proton being modelled precisely in the MC11 \LbLcPi sample, because these variables define the kinematic region within which the proton PID cut is applied, events outside of the regions boundary are assigned an efficiency of 100\% and as such the fraction of events which reside within this boundary has to be accurately modelled in the simulation.'

---

line 238: define DCB

- see below

---

line 239: What do we mean by 'The mean and sigma are shared between the two gaussians'?

Answer: The DCB shape is composed of two superimposed Crystal Ball functions, both functions have the same mean and width. The ANA note has been amended to provide a more concise description of the DCB funtion.

---

line 240: does fixing 'fracSg' to 0.5 affect the tail parameters?

Answer: The choice of fracSg is arbitrary, choosing a value different 0.5 would result in the same fitted shape, but with different tail parameters compensating for the change in fracSg.

---

line 250: Limited statistics is not a good argument for MC

Answer: The reference to 'limited statistics' has been removed. The purpose of the study is to see if there is any variations in the tail fit parameters, which are fixed from the MC, in different bins of PT and ETA. We see no difference between the 1.5-6.5 GeV and 12.5-40 GeV bins so we conclude that there is no broad dependence of the tail parameters on PT (or ETA). This section has been amended to state this conclusion.

---

line 254: What do we mean by the sigma variable floating in the fit? Don't all parameters 'float'?

Answer: The tail parameters are fixed to the MC, only the mean and width are allowed to float in the data fit. This sentence has been amended to state 'A trend of increasing DCB width σ with \pt and η is observed, this is accounted for in the fit to the data because σ is not fixed from the MC but is left free in the fit.'

---

line 264: Quantify 'a clean sample of Bd->DPi events'

Answer: This section has been re-worded to make this clear (lines 312-314)

---

line 266: are the PID cuts and selection in general the same as for the analysis

Answer : Yes, this section has been re-worded to make it clearer. (lines 312-314)

---

lines 264-275: what about mass constraints on the D/Lc?

Answer: A D-mass constraint is applied to the BdDPi data sample. After the clean sample of BdDPi events is selected, the mass hypothesis of the high momentum pion is changed to that of a proton and an Lc-mass constraint is applied. The ANA note has been amended to describe this.

---

line 274-275: What does this sentence mean?

Answer: The pion to proton mis-identification depends on the p and eta of the pion, and therefore alters the shape of the BdDPi mass distributions under the LbLcPi signal. To take this into account the BdDPi mass distribution is reweighted according to the (pion -> proton) misidentification probability.

---

line 284: Explain how the gaussian constraint is used to account for the uncertainty in the yield

Answer: The ANA note has been amended to provide a more detailed description of how the yield is calculated.

---

footnote in p21: 0.4 -> 4.0%?

Answer: Yes, 0.4 should be 4.0%

---

footnote in p21: 52725(72865) multiplied by 4.0% yields 2109(2914), not 2116(2934)

Answer: Correct, 2116(2934) are obtained by multiplying the yields with a higher precision misID rates, which are 4.0133%(4.0266%). The value of 4.0% is a rounded value of these numbers, shown for presentational purposes. This footnote has been removed and replaced by a more detailed description in the main text body.

---

line 297: 'The yield of the LcK contribution is too small to leave free in the fit' - does that make sense?

Answer: The Lb->LcK yield is ~1% of the Lb->LcPi yield, which is comparable to the fit uncertainty on the Lb->LcPi yield (see table 22), this means the LcK yield is vulnerable to statistical fluctuations in the LcPi peak, which is why it has to be constrained.

---

line 303: 'As a systematic check the fraction is varied by one sigma' - fixed or with gaussian constraint?

Answer: We have decided to remove this systematic because it is already covered implicitly because the gaussian constraint allows this fraction to vary around its uncertainties. This has no effect on our combined systematics because the effect was very small.

---

line 312: ' A gaussian constraint is used to account for the uncertainties' - quantify?

Answer: The values of the constraints used in the integrated signal fits are shown in table 21.

---

line 315: 'the yield is allowed to float' - why is the Lb->LcPi under B->DPi allowed to float, but B->DPi under Lb->LcPi is not?

Answer: The Lb->LcPi shape in the Bd->DPi fit peaks above the DPi signal peak, apart from combinatorial background there are no other peaking background contributions in this part of the mass range, this makes is possible to fit the LbLcPi under the BdDPi without a constraint. However, the Bd->DPi shape in the Lb->LcPi fit co-incides with the part-reco backgrounds, the yields and shape parameters of which are unknown and left free in the fit, as such the Bd->DPi yield needs to be constrained to preserve the stability of the fit.

---

section 5.2.4: Is the procedure the same as detailed in section 5.2.1?

Answer: No, the procedure is not exactly the same as detailed in section 5.2.1, the difference being that the shape of the Lb->LcPi under the Bd->DPi is taken from simulated and reconstructed events, whereas the shape of the Bd->DPi under the Lb->LcPi is taken from reconstructed events in data. Only step 3 and 4 of the list in 5.2.1 are applied to the Lb->LcPi under the Bd->DPi, because for simulated events one has a clean sample per definition.

---

line 320: quantify how DK in DPi is constrained

Answer: The procedure is the same one used to contrain the LcK background in the LcPi fit. The subsections on the DK and LcK backgrounds have been unified, in section 5.2.2.

---

section 5.3.1: Motivate the choice of bifurcated gaussian to fit the part-reco

Answer: The bifurcated gaussian is chosen because it provides the best fit to the background. The choice of shape has little influence on our signal yield because the part-reco peaks at a much lower mass than the signal, this is shown by the systematic check entitled 'part reco shapes in Lb->LcPi', where the bifurcated gaussian is replaced by phase space MC samples of the Lb->Sigma_c pi and Lb->Lc Rho decays, the result is a 0.1% relative change in the signal yield, despite the shapes providing a poor fit to the background.

---

section 5.3.1: Why not apply gaussian constraints on the part-reco shape in the binned fit?

Answer: In the fs/fd analysis we performed a simulation study of the part-reco shapes in the Bd->DPi fit, detailed in appendix P of the fs/fd ANA note (ANA-2012-070), where we show that the background shapes had no dependence on pt or eta. We expect this to be the case for the Lb->LcPi backgrounds as well, because these are essentially the baryonic equivalents of the DPi part-reco backgrounds. As a result we do not apply a gaussian constraint because this would allow the part-reco shape to change from bin to bin.

---

line 530: why are the part-reco MC's generated with the phase space Lc decay, not cocktail?

Answer: The part-reco MC was generated before the cocktail was designed. For LbLcPi events it has been shown that there are no significant differences between the cocktail and the phase space MC, so we didn't think it was necessary to also generate cocktail MC for the partially reconstructed backgrounds.

---

section 5.4: why not apply a gaussian constraint to exponential coefficient in binned fit?

Answer: The error on the exponential is rather small and we do not think this would make a big difference. We also believe that any change resulting from this is already covered in our systematic uncertainties regarding the combinatorial background.

---

line 353: 'a strong dependence of the proton PID cuts on the momentum and the pseudorapidity of the particles' - same reason as described in lines 362-364?

Answer: The reason for using different templates in each bin for the BdDPi under the LbLcPi is that for each bin a different fraction of events falls into this special region where the proton PID criteria are applied. Therefore the shapes of the BdDPi background varies a lot more from bin to bin, than for example, the shapes of LbLcK background under the LbLcPi, where the proton PID has a lesser effect.

Table 21: 'Values showed for the integrated case (calculated per bin in the binned fit).' - what does this mean? What are the 'values'?

Answer: Values means yields. The sentence has been amended to state 'The yields are shown for the integrated fit (in the binned fit the yields are calculated separately for each bin).'

Figure 7: fit not perfect in the indicated regions

Answer: The pull isn't perfect in two regions: the high mass sideband of 5700-5800 MeV and below the signal peak at ~5560 MeV. The high-mass sideband deviation affects the combinatorial coefficient fit, this is more than adequately covered by our combinatorial systematic, where we vary the coefficient by +/- 50%. The 5560 MeV deviation is caused by the LcK yield, this is dealt with in the systematics section by varying the mean of the gaussian constraint on the yield. In general, we fix background yields using gaussian constraints, rather than letting them float, the latter would make a better looking pull-plots than the former because there are more free parameters in the fit, but the fitted background yields would be wrong compared to those in the former.

Table 23: Show MagUp/MagDown fractions?

We have checked that these are consistent across bins, but have yet to add them to the tables, we can do this for the next draft.

Table 24: Are these copied from fs/fd?

Answer: Yes, these tables are exact copies of the ones in the fsfd ANA note

---

line 379-387: I don't understand the logic here

Answer: This section has been removed from the ANA note.

Complete Table 27

Answer: The systematics tables have been completed, they are now tables 35 and 36 in the ANA note.

Line 393: "Two possible sources of systematic uncertainty are common between the fit to the LcPi and DPi data samples" - but the effect is different!?!

Answer: Table 28 shows the effects on both fits. Using the DCB2Sigmas shape has exactly the same effect for LcPi and DPi. The combinatoric background systematic is different because this shape is different for the two modes, and its effect on the signal yield can be transmitted by proxy effects which are not the same for the two modes. For example, varying the exponential in the DPi fit will adjust the LcPi under DPi yield, which will in turn influence the signal yield, whereas for the LcPi fit this would not happen because there is no high-mass background.

---

line 399: "For the B->DPi sample, there is a potential uncertainty due to the modeling of the B->D*Pi; background." - Is something missing here

Answer: This uncertainty is described in lines 479-485

---

section 7.1: How are the systematic variation values motivated? i.e. the +/- 10% variation of the tail parameters

Answer: The ANA note has been amended such that the motivation for all variation of systematics is justified, for example, in lines 438-446: 'the tail parameters are varied by ±10% relative to their nominal values, with exception of n2, which is varied by ±20% because the fit is less sensitive to this parameter. These values are chosen because when these parameters are left free in the fit, they are seen to vary by up to 10% (except for n2 , as this is highly correlated with 2 and as such is not well defined). These variations are at least partially caused by the signal fitting the backgrounds above and below the Lb->LcPi mass peak.

---

section 7.1: How is the 50% variation of the exponent of the combinatorial background motivated?

Answer: This is now described in detail in lines 452-466 in the ANA note

---

line 402: the maximum variation in what?

Answer: The fitted LcPi/DPi yield ratio, the ANA note has been amended to state this.

---

line 403: Does this mean FracSg is left free?

Answer: Yes, FracSg is left free in the fit with the DCB2sigmas signal shape, as can also be seen from the tables in appendix F.

---

line 407: 'As a check the shapes are modelled using simulated signal events,and a varation of 0.1% has been found on the signal yield." - Is this a cross-check or does it lead to a systematic?

Answer: It is a systematic, denoted as 'part reco shapes in Lb->LcPi' in tables 33-34. The ANA note has been amended to state explicitly which check lead to a systematic.

---

line 409: 'A variation of this constraint with ±1sigma has no effect on the signal yield' - Explain better, is this justified?

Answer: We have decided to remove this systematic because it is already covered implicitly because the gaussian constraint allows this fraction to vary around its uncertainties. This has no effect on our combined systematics because the effect was very small.

---

line 416: 'distance between the two peaks.', 'The widths of the two crystal ball function are the same.' - define properly

Answer: The B02DstarPi background exhibits a typical double peak shape. From a study on simulated events, it has been shown that this background can be modelled with a double crystal ball function, instead of the non parametric function. This second fit strategy is used to assign a systematic uncertainty. The distance between the two peaks is fixed to the value found on simulated events, whereas the width of the peaks, which they share a common, is left free in the fit. The tail parameters are fixed from simulation.

---

line 418: What do we mean by 'maximum discrepancy'?

Answer: This simply means the signal yield changes by X% as a result of the systematic, the ANA note has been amended to make this clear.

---

section 7.1: Why do we not consider systematics associated with the other backgrounds, i.e. DPi under LcPi?

Answer: We define systematics for all the major backgrounds, namely the D*Pi in the DPi fit, the part-reco and the DPi in the LcPi fits. Other backgrounds are accounted for with gaussian constraints. The exceptions are the DRho and LcPi backgrounds in the DPi fits, but these do not overlap with backgrounds of similarly shaped distributions that are also left free, so they do not require special systematic treatments.

---

section 7.2: Describe this in more detail, what binning is used?

Answer: The binning is the same as that used in the data. The section has been amended to give a more thorough explanation of this systematic.

---

lines 444-446: Don't understand this sentence

Answer: This sentence has been re-worded

---

line 448: "(as a proxy for the offline selection)" - what does this mean?

Answer: This has been removed from the new ANA note, as part of the rewording above

---

Complete the BDT systematic study

Answer: This has now been completed, it is described in section 7.1.4 of the new ANA note

---

line 454: why are these the 'extreme' cases? Why do you want to assign a systematic based on the extreme case here?

Answer: These values are chosen as they lie at each end of the plateau of the significance curve from the BDT testing (see Fig. 1).

---

line 459-461: Not sure I understand this sentence

Answer: This section has been rephrased in the ANA note to make things more clear.

---

line 462-364: 'the L0 hadron e ciency depends strongly on the pT of the track, it is natural to assume that the L0 systematic is uncorrelated across the di erent bins' - is that correct?

Answer: Yes, we cannot think of a mechanism by which such a correlation might arise.

Decide on value to be used for PID systematic

- already done, syst is -1.4%

Ref [21] : Why reference the twiki page? ***Answer:*** The tables showing the binned L0Hadron efficiencies can be found in the twiki page

---

section 7.6.3: **explain better** ***Answer:*** The L0Hadron systematic is described in more detail in section 7.1.5

---

line 488: "It is conservatively assumed that the di erence between the proton and kaon L0 hadron e ciencies is not greater than ±5%" - how is this motivated?

Answer: The maximum pion-kaon efficiency difference is ~2%, and it is conservatively assumed that the difference between the proton and kaon L0 hadron efficiencies is not greater than ±5%, given that the only difference between a kaon and proton in terms of the calorimeter is that the proton mass is roughly twice that of the kaon.

---

line 496: "(2 is about 1.5× larger than 1)" - give the exact number

Answer: It is 1.47 times larger

---

line 496: "as an extra check" - is this assigned as a systematic?

Answer: Yes

---

lines 501-502: "every datapoint is shifted with the amount listed in this table and the variation of the slope is measured" explain better ***Answer:*** This is described in more detail now in section 7.3

Table 33,34: **complete table**

Answer: Done

Figure 16: why show 30-40 GeV if you have no data points? Are the statistical errors added in quadrature? Can't see the horizontal error bars?

Answer: The last bin ranges from 20200-40000 MeV, so I think it is fair to show in the plot the range until 40000 MeV. The statistical errors are added in quadrature. The horizontal error bars are too small to be seen.

---

lines 513-517: chi2 values quite bad

Answer: These were calculated with the statistical errors only, after adding all the systematic errors the chi2 values are now 15.81/17 and 9.07/8 for the pt and eta fits, their corresponding p-values are 0.537 and 0.336, perfectly consistent with being a good fit

---

lines 525-528: Is using the MC11 gen to map PT(LcMu)->PT(Lb) the correct thing to do?

Answer: Yes. The bin centres are chosen as the centre of gravity before any selection or generator level cuts. So the mapping should also happen at the generator level. In the present ANA note the semileptonic treatment isn't shown because we decided to change our strategy, explained in section 9. We still intend to do the same remapping for the new strategy.

---

lines 541-542: make equations more clear

Answer: We no longer intend to fit the semileptonic plot with a free fit (see section 9), any future equations will of course be written more clearly.

---

lines 549-552: This is a rather handwaving argument

Answer: As mentioned above, we have decided to change our strategy, so this section is no longer present in the ANA note.

Write conclusions ***Answer:*** We will do this when we have got our final results

---

Calculate BF(Lb->LcPi) ***Answer:*** We will do this when our new semileptonic strategy has been verified

---

line 611: "agree to within 1%" - absolute or relative? ***Answer:*** * Relative

---

Table 36: large errors on n2 ***Answer:*** this variable is highly correlated with alpha2 and as such is not well defined

---

Lines 641-642: Surprising that adding parameters should make the fit worse?

Answer: Adding more parameters, indeed make the fit to the MC look even better. However, the fit in data (in bins) becomes more unstable by the additional freedom introduced. Hence we prefer to use the DCB function with the two sigmas in common as our standard signal description.

Complete table 39

Answer: This will be done in the next iteration of the ANA

Figure 32: plots not very clear, is there a clear shift in some bins?

> In Fig 33-34 the shapes are given for each bin separately. I do not see a clear shift in some bins, but I do see a clear trend at higher pt where the shape broadens.

Tim Heads comments

---

line 22: for the conclusion: can we show a plot of f_LB/f_d before and after this new measurement to show how much more precise things are now?

Answer: We have made a plot that shows our results on the same plot as the points on the existing HFAG plot. The data points are not exactly equivalent though, since the HFAG xaxis is pT(LcMu) and ours is pT(Lb).

---

line 67: What check can you do to show that you have exactly the same integrated lumi in both your samples?

Answer: Using the luminosity info provided by DaVinci, we have checked that all input files were ran over, and that the lumi is the same in both samples.

---

line 79: have your trigger lines changed cuts over the data taking period?

Answer: This has been double-checked with a trigger expert, and the answer is no, the trigger lines did not change.

Table 2: Please give a reference for the BDTG, this seems to do a large part of your selection but there are no details to be found.

Answer: Info on the BDT (including ref back to DsK TD ANA note) has been added.

---

line 124: Can you quantify how much sensitivity is lost because of not being able to use proton PID?

- In the analysis we apply PID cuts on protons within the kinematic regions shown in Table 3. No cut is applied to protons outside this region, for these the ID and misID rates are both 100%. The proton PID cut can affect the sensitivity through the statistical uncertainty on the fitted signal yield. This can be investigated by performing a fit where we apply proton PID to all candidates, instead of using the partial PID cut described in the ANA note. The change in sensitivity would be greatest in the highest PT bin (20.2 < PT(Lb) < 40 GeV), where 85% of the events in a mass window of +/- 40 MeV around the Lb mass fall outside of the kinematic region where proton PID is applied.
- For the total fit, the signal yield with proton PID applied to all candidates is 44024 +/- 213. By comparison the yield with the partial proton PID cut is 44852 +/- 228. Both yields have a statistical uncertainty of 0.5%.
- In the highest PT bin (20.2 < PT(Lb) < 40 GeV) the fitted yield with proton PID applied to all candidates is 1089 +/- 35, compared to 1454 +/- 43 for when the partial proton PID cuts are applied. The statistical uncertainty is 3.2% for the former and 3.0% for the latter, suggesting that the reduction of sensitivity from the increased background is compensated for by the increase in the signal yield.

---

line 164: how do you do this? Same method in both channels?

Answer: The most thorough data-MC comparison is done in ANA-2010-010, where both Bd and Lb modes are compared using the same method.

---

line 182: Can you show that the calibration and signal samples have similar distributions in the variables which you exclude? Or that the eta dependence is taken care of by using pT

Answer: See answer to Olaf's question on line 182

---

line 274: should this be point 3) instead of 2)?

Answer: This part has been reworded (see answers to line 264 etc from Olaf).

---

line 310: Lc/D+ misid probability is the product of the misid of the children?

Answer: It is the product of the probability to misID (from the PID) the relevant child, and the probability for the misID D_s mass distribution to fall in the D (or Lc) mass window. Added a reference back to the Table showing this (Table 15).

---

line 320: to what value?

Answer: See response to Olaf on line 320.

---

section 5.3.1: Maybe a better way to estimate the systematic due to fixing the parameters is to show that in the MC there is no dependence of these on pT/eta. Or if there is used that to estimate a systematic. Though section 5.5 makes me believe you already tested this assumption?

Answer: In fs/fd no dependence was seen for the part-reco Bd backgrounds, and (since the Lb MC uses phase-space Lb decay) this should also be the case for the Lb part-reco backgrounds.

---

line 338: what are non parametric functions?

Answer: Changed to say it's RooKeysPDF.

---

table 22: Why the large difference in Nsig?

Answer: In 2011 LHCb collected significantly more MagDown than MagUp data. Our Up/Down ratio for Bd->Dpi is 72.2 +/- 0.5, consistent with 70.6 +/- 0.7 for Lb->LcPi

---

Figure 16: is there any theory guidance on the shape of this distribution? The y=a and straight line fits are clearly incompatible, so why do them? Once you have the systematic uncertainties can you add them as errorbars on this plot please?

Answer: We shall remove the flat fits, and the linear pt fit from the distributions

---

Figure 17: The flat model is clearly not the right one so why show it? Add the systematic uncertainties once you have them

Answer: Same as Fig. 16, we will remove the fits that don't describe the data.

Figure 18: can you produce your pT dependent plot in the same bins of eta as here?

Answer: This would require re-doing all of the Bd->DPi mass fits and efficiencies, which are to be untouched as they have already been reviewed.

This topic: Sandbox > B2OCfLbfdRef1Nov2013
Topic revision: r2 - 2013-11-05 - RoseKoopman