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Template for writing LHCb papers

The LHCb collaboration[†]

Abstract

Guidelines for the preparation of LHCb documents are given. This is a "living" document, that should reflect our current practice. It is expected that these guidelines are implemented for papers already before they go into the first collaboration wide review. Please contact the Editorial Board chair if you have suggestions for modifications. This is the title page for journal publications (PAPER). For a CONF note or ANA note, switch to the appropriate template by uncommenting the corresponding line in the file `main.tex`.

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1 Introduction

This is the template for typesetting LHCb notes and journal papers. It should be used for any document in LHCb [1] that is to be publicly available. The format should be used for uploading to preprint servers and only afterwards should specific typesetting required for journals or conference proceedings be applied. The main Latex file contains several options as described in the Latex comment lines.

It is expected that these guidelines are implemented for papers already before they go into the first collaboration wide review.

This template also contains the guidelines for how publications and conference reports should be written. The symbols defined in `lhcb-symbols-def.tex` are compatible LHCb guidelines.

The front page should be adjusted according to what is written. Default versions are available for papers, conference reports and analysis notes. Just comment out what you require in the `main.tex` file.

This directory contains a file called `Makefile`. Typing `make` will apply all Latex and Bibtex commands in the correct order to produce a pdf file of the document. The default Latex compliler is pdflatex, which requires figures to be in pdf format. To change to plain Latex, edit line 9 of `Makefile`. Typing `make clean` will remove all temporary files generated by (pdf)latex.

2 General principles

The main goal is for a paper to be clear. It should be as brief as possible, without sacrificing clarity. For all public documents, special consideration should be given to the fact that the reader will be less familiar with LHCb than the author.

Here follow a list of general principles that should be adhered to:

1. Choices that are made concerning layout and typography should be consistently applied throughout the document.

2. Standard English should be used (British rather than American) for LHCb notes and preprints. Examples: colour, flavour, centre, metre, modelled and aluminium. Words ending on -ise or -isation (polarise, hadronisation) can be written with -ize or -ization ending. The punctuation normally follows the closing quote mark of quoted text, rather than being included before the closing quote. Footnotes come after punctuation. Papers to be submitted to an American journal can be written in American English instead. Under no circumstance should the two be mixed.

3. Use of jargon should be avoided where possible. “Systematics” are “systematic uncertainties”, “L0” is “hardware trigger”, “penguin” diagrams are best introduced with an expression like “electroweak loop (penguin) diagrams”.

4. Avoid using quantities that are internal jargon and/or are impossible to reproduce without the full simulation: instead of 'It is required that $\chi^2_{\text{vtx}} < 3$', say 'A good quality vertex is required'; instead of 'It is required that $\chi^2_{\text{IP}} > 16$', say 'The track is inconsistent with originating from a PV'; instead of 'A DLL greater than 20 is required' say 'Tracks are required to be identified as kaons'.

5. Latex should be used for typesetting. Line numbering should be switched on for drafts that are circulated for comments.

6. The abstract should be concise, and not include citations or numbered equations, and should give the key results from the paper.

7. Apart from descriptions of the detector, the trigger and the simulation, the text should not be cut-and-pasted from other sources that have previously been published.

8. References should usually be made only to publicly accessible documents. References to LHCb conference reports and public notes should be avoided in journal publications, instead including the relevant material in the paper itself.

9. The use of tenses should be consistent. It is recommended to mainly stay in the present tense, for the abstract, the description of the analysis, *etc.*; the past tense is then used where necessary, for example when describing the data taking conditions.

10. It is recommended to use the passive rather than active voice: "the mass is measured", rather than "we measure the mass". Limited use of the active voice is acceptable, in situations where re-writing in the passive form would be cumbersome, such as for the acknowledgements. Some leeway is permitted to accommodate different author's styles, but "we" should not appear excessively in the abstract or the first lines of introduction or conclusion.

11. A sentence should not start with a variable, a particle or an acronym. A title or caption should not start with an article.

3 Layout

1. Unnecessary blank space should be avoided, between paragraphs or around figures and tables.

2. Figure and table captions should be concise and use a somewhat smaller typeface than the main text, to help distinguish them. This is achieved by inserting `\small` at the beginning of the caption. (NB with the latest version of the file `premable.tex` this is automatic) Figure captions go below the figure, table captions go above the table.

3. Captions and footnotes should be punctuated correctly, like normal text. The use of too many footnotes should be avoided: typically they are used for giving commercial details of companies, or standard items like coordinate system definition or the implicit inclusion of charge-conjugate processes.[1,2]

4. Tables should be formatted in a simple fashion, without excessive use of horizontal and vertical lines. See Table 1 for an example.

5. Figures and tables should normally be placed so that they appear on the same page as their first reference, but at the top or bottom of the page; if this is not possible, they should come as soon as possible afterwards. They must all be referred to from the text.

6. If one or more equations are referenced, all equations should be numbered using parentheses as shown in Eq. 1,

$$V_{us}V_{ub}^{*} + V_{cs}V_{cb}^{*} + V_{ts}V_{tb}^{*} = 0\ . \tag{1}$$

7. Displayed results like

$$\mathcal{B}(B_s^0 \to \mu^+\mu^-) < 1.5 \times 10^{-8} \text{ at 95\% CL}$$

   should in general not be numbered.

8. Numbered equations should be avoided in captions and footnotes.

9. Displayed equations are part of the normal grammar of the text. This means that the equation should end in full stop or comma if required when reading aloud. The line after the equation should only be indented if it starts a new paragraph.

10. Sub-sectioning should not be excessive: sections with more than three levels of index (1.1.1) should be avoided.

11. Acronyms should be defined the first time they are used, *e.g.* “Monte Carlo (MC) events containing a doubly Cabibbo-suppressed (DCS) decay have been generated.” The abbreviated words should not be capitalised if it is not naturally written with capitals, *e.g.* quantum chromodynamics (QCD), impact parameter (IP), boosted decision tree (BDT). Avoid acronyms if they are used three times or less. A sentence should never start with an acronym and its better to avoid it as the last word of a sentence as well.

[1] If placed at the end of a sentence, the footnote symbol normally follows the punctuation; if placed in the middle of an equation, take care to avoid any possible confusion with an index.

[2] The standard footnote reads: The inclusion of charge-conjugate processes is implied.

Table 1: Background-to-signal ratio estimated in a $\pm 50\,\mathrm{MeV}/c^2$ mass window for the prompt and long-lived backgrounds, and the minimum bias rate.

Channel	B_{pr}/S	B_{LL}/S	MB rate
$B_s^0 \to J/\psi\,\phi$	1.6 ± 0.6	0.51 ± 0.08	~ 0.3 Hz
$B^0 \to J/\psi\,K^{*0}$	5.2 ± 0.3	1.53 ± 0.08	~ 8.1 Hz
$B^+ \to J/\psi\,K^{*+}$	1.6 ± 0.2	0.29 ± 0.06	~ 1.4 Hz

4 Typography

The use of the Latex typesetting symbols defined in the file `lhcb-symbols-def.tex` and detailed in the appendices of this document is strongly encouraged as it will make it much easier to follow the recommendation set out below.

1. LHCb is typeset with a normal (roman) lowercase b.

2. Titles are in bold face, and usually only the first word is capitalised.

3. Mathematical symbols and particle names should also be typeset in bold when appearing in titles.

4. Units are in roman type, except for constants such as c or h that are italic: GeV, GeV/c^2. The unit should be separated from the value with a thin space (“`\,`”), and they should not be broken over two lines. Correct spacing is automatic when using predefined units inside math mode: `$3.0\gev$` → 3.0 GeV. Spacing goes wrong when using predefined units outside math mode AND forcing extra space: `3.0\,\gev` → 3.0 GeV or worse: `3.0~\gev` → 3.0 GeV.

5. If factors of c are kept, they should be used both for masses and momenta, *e.g.* $p = 5.2\,\mathrm{GeV}/c$ (or $\mathrm{GeV}c^{-1}$), $m = 3.1\,\mathrm{GeV}/c^2$ (or $\mathrm{GeV}c^{-2}$). If they are dropped this should be done consistently throughout, and a note should be added at the first instance to indicate that units are taken with $c = 1$.

6. The % sign should not be separated from the number that precedes it: 5%, not 5 %. A thin space is also acceptable: 5 %, but should be applied consistently throughout the paper.

7. Ranges should be formatted consistently. The recommendend form is to use a dash with no spacing around it: 7–8 GeV, obtained as `7--8\gev`.

8. Italic is preferred for particle names (although roman is acceptable, if applied consistently throughout). Particle Data Group conventions should generally be followed: B^0 (no need for a “d” subscript), $B_s^0 \to J/\psi\,\phi$, $\overline{B}{}_s^0$, (note the long bar,

obtained with `\overline`, in contrast to the discouraged short `\bar{B}` resulting in $\bar{B}$), K^0_{S} (note the uppercase roman type "S"). This is most easily achieved by using the predefined symbols described in Appendix C. Unless there is a good reason not to, the charge of a particle should be specified if there is any possible ambiguity ($m(K^+K^-)$ instead of $m(KK)$, which could refer to neutral kaons).

9. Decay chains can be written in several ways, depending on the complexity and the number of times it occurs. Unless there is a good reason not to, usage of a particular type should be consistent within the paper. Examples are: $D_s^+ \to \phi\pi^+$, with $\phi \to K^+K^-$; $D_s^+ \to \phi\pi^+$ $(\phi \to K^+K^-)$; $D_s^+ \to \phi(\to K^+K^-)\pi^+$; or $D_s^+ \to [K^+K^-]_\phi\pi^+$.

10. Variables are usually italic: V is a voltage (variable), while 1 V is a volt (unit). Also in combined expressions: Q-value, z-scale, R-parity *etc.*

11. Subscripts and superscripts are roman type when they refer to a word (such as T for transverse) and italic when they refer to a variable (such as t for time): p_{T}, Δm_s, t_{rec}.

12. Standard function names are in roman type: *e.g.* cos, sin and exp.

13. Figure, Section, Equation, Chapter and Reference should be abbreviated as Fig., Sect. (or alternatively Sec.), Eq., Chap. and Ref. respectively, when they refer to a particular (numbered) item, except when they start a sentence. Table and Appendix are not abbreviated. The plural form of abbreviation keeps the point after the s, *e.g.* Figs. 1 and 2. Equations may be referred to either with ("Eq. (1)") or without ("Eq. 1") parentheses, but it should be consistent within the paper.

14. Common abbreviations derived from Latin such as "for example" (*e.g.*), "in other words" (*i.e.*), "and so forth" (*etc.*), "and others" (*et al.*), "versus" (*vs.*) can be used, with the typography shown, but not excessively; other more esoteric abbreviations should be avoided.

15. Units, material and particle names are usually lower case if spelled out, but often capitalised if abbreviated: amps (A), gauss (G), lead (Pb), silicon (Si), kaon (K), but proton (p).

16. Counting numbers are usually written in words if they start a sentence or if they have a value of ten or below in descriptive text (*i.e.* not including figure numbers such as "Fig. 4", or values followed by a unit such as "4 cm"). The word 'unity' can be useful to express the special meaning of the number one in expressions such as: "The BDT output takes values between zero and unity".

17. Numbers larger than 9999 have a comma (or a small space, but not both) between the multiples of thousand: *e.g.* 10,000 or 12,345,678. The decimal point is indicated with a point rather than a comma: *e.g.* 3.141.

18. We apply the rounding rules of the PDG [2]. The basic rule states that if the three highest order digits of the uncertainty lie between 100 and 354, we round to two significant digits. If they lie between 355 and 949, we round to one significant digit. Finally, if they lie between 950 and 999, we round up and keep two significant digits. In all cases, the central value is given with a precision that matches that of the uncertainty. So, for example, the result 0.827 ± 0.119 should be written as 0.83 ± 0.12, 0.827 ± 0.367 should turn into 0.8 ± 0.4, and 14.674 ± 0.964 becomes 14.7 ± 1.0. When writing numbers with uncertainty components from different sources, *i.e.* statistical and systematic uncertainties, the rule applies to the uncertainty with the best precision, so $0.827 \pm 0.367\,(\text{stat}) \pm 0.179\,(\text{syst})$ goes to $0.83 \pm 0.37\,(\text{stat}) \pm 0.18\,(\text{syst})$ and $8.943 \pm 0.123\,(\text{stat}) \pm 0.995\,(\text{syst})$ goes to $8.94 \pm 0.12\,(\text{stat}) \pm 1.00\,(\text{syst})$.

19. When rounding numbers, it should be avoided to pad with zeroes at the end. So 51237 ± 4561 should be rounded as $(5.12 \pm 0.46) \times 10^4$ and not 51200 ± 4600.

20. When rounding numbers in a table, some variation of the rounding rules above may be required to achieve uniformity.

21. Hyphenation should be used where necessary to avoid ambiguity, but not excessively. For example: “big-toothed fish” (to indicate that big refers to the teeth, not to the fish), but “big white fish”. A compound modifier often requires hyphenation (*CP*-violating observables, *b*-hadron decays, final-state radiation, second-order polynomial), even if the same combination in an adjective-noun combination does not (direct *CP* violation, heavy *b* hadrons, charmless final state). Adverb-adjective combinations are not hyphenated if the adverb ends with ’ly’: oppositely charged pions, kinematically similar decay. Cross-section, cross-check, and two-dimensional are hyphenated. Semileptonic, pseudorapidity, pseudoexperiment, multivariate, multidimensional, reweighted, preselection, nonresonant, nonzero, nonparametric, nonrelativistic, misreconstructed and misidentified are single words and should not be hyphenated.

22. Minus signs should be in a proper font (-1), not just hyphens (-1); this applies to figure labels as well as the body of the text. In Latex, use math mode (between `$$`’s) or make a dash (“`--`”). In ROOT, use `#font[122]{-}` to get a normal-sized minus sign.

23. Inverted commas (around a title, for example) should be a matching set of left- and right-handed pairs: “Title”. The use of these should be avoided where possible.

24. Single symbols are preferred for variables in equations, *e.g.* $\mathcal{B}$ rather than BF for a branching fraction.

25. Parentheses are not usually required around a value and its uncertainty, before the unit, unless there is possible ambiguity: so $\Delta m_s = 20 \pm 2\,\text{ps}^{-1}$ does not need parentheses, whereas $f_d = (40 \pm 4)\%$ or $x = (1.7 \pm 0.3) \times 10^{-6}$ does. The unit does not need to be repeated in expressions like $1.2 < E < 2.4\,\text{GeV}$.

26. The same number of decimal places should be given for all values in any one expression (*e.g.* $5.20 < m_B < 5.34\,\text{GeV}/c^2$).

27. Apostrophes are best avoided for abbreviations: if the abbreviated term is capitalised or otherwise easily identified then the plural can simply add an s, otherwise it is best to rephrase: *e.g.* HPDs, π^0s, pions, rather than HPD's, π^0's, πs.

28. Particle labels, decay descriptors and mathematical functions are not nouns, and need often to be followed by a noun. Thus "background from $B^0 \to \pi^+\pi^-$ decays" instead of "background from $B^0 \to \pi^+\pi^-$", and "the width of the Gaussian function" instead of "the width of the Gaussian".

29. In equations with multidimensional integrations or differentiations, the differential terms should be separated by a thin space. Thus $\int f(x,y)dx\,dy$ instead $\int f(x,y)dxdy$ and $\frac{d^2\Gamma}{dx\,dQ^2}$ instead of $\frac{d^2\Gamma}{dxdQ^2}$. The d's are allowed in either roman or italic font, but should be consistent throughout the paper.

5 Detector and simulation

The following paragraph can be used for the detector description. Modifications may be required in specific papers to fit within page limits, to enhance particular detector elements or to introduce acronyms used later in the text. Reference to the detector performance papers are marked with a $*$ and should only be included if the analysis described in the paper relies on numbers or methods described in the paper.

The LHCb detector [1, 3] is a single-arm forward spectrometer covering the pseudorapidity range $2 < \eta < 5$, designed for the study of particles containing b or c quarks. The detector includes a high-precision tracking system consisting of a silicon-strip vertex detector surrounding the pp interaction region [4]$*$, a large-area silicon-strip detector located upstream of a dipole magnet with a bending power of about $4\,\text{Tm}$, and three stations of silicon-strip detectors and straw drift tubes [5]$*$ placed downstream of the magnet. The tracking system provides a measurement of momentum, p, of charged particles with a relative uncertainty that varies from 0.5% at low momentum to 1.0% at $200\,\text{GeV}/c$. The minimum distance of a track to a primary vertex, the impact parameter, is measured with a resolution of $(15 + 29/p_{\mathrm{T}})\,\mu\text{m}$, where p_{T} is the component of the momentum transverse to the beam, in GeV/c. Different types of charged hadrons are distinguished using information from two ring-imaging Cherenkov detectors [6]$*$. Photons, electrons and hadrons are identified by a calorimeter system consisting of scintillating-pad and preshower detectors, an electromagnetic calorimeter and a hadronic calorimeter. Muons are identified by a system composed of alternating layers of iron and multiwire proportional chambers [7]$*$. The online event selection is performed by a trigger [8]$*$, which consists of a hardware stage, based on information from the calorimeter and muon systems, followed by a software stage, which applies a full event reconstruction.

A more detailed description of the 'full event reconstruction' could be:

- The trigger [8]* consists of a hardware stage, based on information from the calorimeter and muon systems, followed by a software stage, in which all charged particles with $p_{\mathrm{T}} > 500(300)\,\mathrm{MeV}$ are reconstructed for 2011 (2012) data. For triggers that require neutral particles, energy deposits in the electromagnetic calorimeter are analysed to reconstruct π^0 and γ candidates.

The trigger description has to be specific for the analysis in question. In general, you should not attempt to describe the full trigger system. Below are a few variations that inspiration can be taken from. First from a hadronic analysis, and second from an analysis with muons in the final state. A detailed description of the trigger conditions for Run 1 is available in Ref. [9].

- At the hardware trigger stage, events are required to have a muon with high p_{T} or a hadron, photon or electron with high transverse energy in the calorimeters. For hadrons, the transverse energy threshold is 3.5 GeV. The software trigger requires a two-, three- or four-track secondary vertex with a significant displacement from the primary pp interaction vertices (PVs). At least one charged particle must have a transverse momentum $p_{\mathrm{T}} > 1.7\,\mathrm{GeV}/c$ and be inconsistent with originating from a PV. A multivariate algorithm [10] is used for the identification of secondary vertices consistent with the decay of a b hadron.

- Candidate events are first required to pass the hardware trigger, which selects muons with a transverse momentum $p_{\mathrm{T}} > 1.48\,\mathrm{GeV}/c$ in the 7 TeV data or $p_{\mathrm{T}} > 1.76\,\mathrm{GeV}/c$ in the 8 TeV data. In the subsequent software trigger, at least one of the final-state particles is required to have both $p_{\mathrm{T}} > 0.8\,\mathrm{GeV}/c$ and impact parameter larger than $100\,\mu\mathrm{m}$ with respect to all of the primary pp interaction vertices (PVs) in the event. Finally, the tracks of two or more of the final-state particles are required to form a vertex that is significantly displaced from the PVs.

An example to describe the use of both TOS and TIS events:

- In the offline selection, trigger signals are associated with reconstructed particles. Selection requirements can therefore be made on the trigger selection itself and on whether the decision was due to the signal candidate, other particles produced in the pp collision, or a combination of both.

A good example of a description of long and downstream K^0_{S} is given in Ref. [11]:

- Decays of $K^0_{\mathrm{S}} \to \pi^+\pi^-$ are reconstructed in two different categories: the first involving K^0_{S} mesons that decay early enough for the daughter pions to be reconstructed in the vertex detector; and the second containing K^0_{S} that decay later such that track segments of the pions cannot be formed in the vertex detector. These categories are referred to as *long* and *downstream*, respectively. The long category has better mass, momentum and vertex resolution than the downstream category.

The description of our software stack for simulation is often causing trouble. The following paragraph can act as inspiration but with variations according to the level of detail required and if mentioning of *e.g.* PHOTOS is required.

- In the simulation, pp collisions are generated using PYTHIA [12] (In case only PYTHIA 6 is used, remove `*Sjostrand:2007gs` from this citation) with a specific LHCb configuration [13]. Decays of hadronic particles are described by EVTGEN [14], in which final-state radiation is generated using PHOTOS [15]. The interaction of the generated particles with the detector, and its response, are implemented using the GEANT4 toolkit [16] as described in Ref. [17].

Many analyses depend on boosted decision trees. It is inappropriate to use TMVA as the reference as that is merely an implementation of the BDT algorithm. Rather it is suggested to write

In this paper we use a boosted decision tree (BDT) [18, 19] to separate signal from background.

When describing the integrated luminosity of the data set, do not use expressions like "$1.0\,\mathrm{fb}^{-1}$ of data", but *e.g.* "data corresponding to an integrated luminosity of $1.0\,\mathrm{fb}^{-1}$", or "data obtained from $3\,\mathrm{fb}^{-1}$ of integrated luminosity".

For analyses where the periodical reversal of the magnetic field is crucial, *e.g.* in measurements of direct *CP* violation, the following description can be used as an example phrase: "The polarity of the dipole magnet is reversed periodically throughout data-taking. The configuration with the magnetic field vertically upwards, *MagUp* (downwards, *MagDown*), bends positively (negatively) charged particles in the horizontal plane towards the centre of the LHC." Only use the *MagUp*, *MagDown* symbols if they are used extensively in tables or figures.

6 Figures

A standard LHCb style file for use in production of figures in ROOT is in the URANIA package `RootTools/LHCbStyle` or directly in SVN at `svn+ssh://svn.cern.ch/reps/lhcb/Urania/trunk/RootTools/LHCbStyle`. It is not mandatory to use this style, but it makes it easier to follow the recommendations below.

Figure 1 shows an example of how to include an eps or pdf figure with the `\includegraphics` command (eps figures will not work with `pdflatex`). Note that if the graphics sits in `figs/myfig.pdf`, you can just write `\includegraphics{myfig}` as the `figs` subdirectory is searched automatically and the extension `.pdf` (`.eps`) is automatically added for `pdflatex` (`latex`).

1. Figures should be legible at the size they will appear in the publication, with suitable line width. Their axes should be labelled, and have suitable units (e.g. avoid a mass plot with labels in MeV/c^2 if the region of interest covers a few GeV/c^2 and all the numbers then run together). Spurious background shading and boxes around text should be avoided.

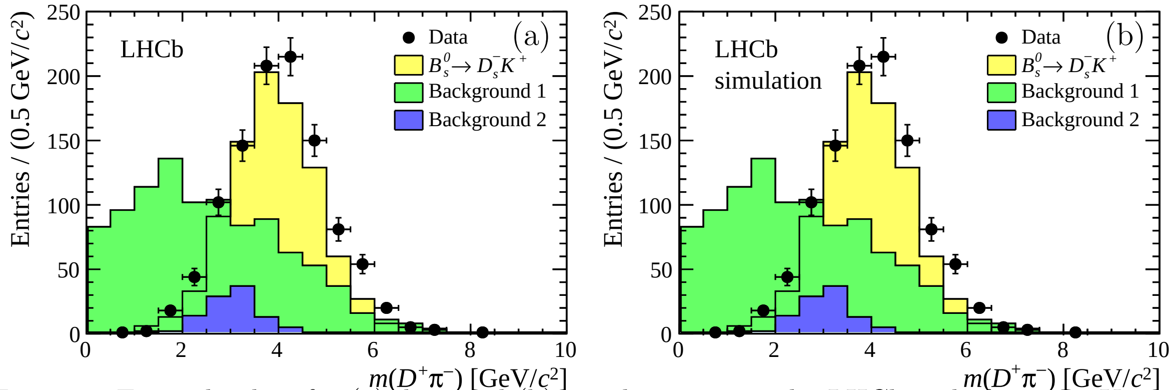

Figure 1: Example plots for (a) data and (b) simulation using the LHCb style from the URANIA package `RootTools/LHCbStyle`. The signal data is shown as points with the signal component as yellow (light shaded), background 1 as green (medium shaded) and background 2 as blue (dark shaded).

2. For the y-axis, "Entries" or "Candidates" is approriate in case no background subtraction has been applied. Otherwise "Yield" or "Decays" may be more appropriate. If the unit on the y-axis corresponds to the yield per bin, indicate so, for example "Entries / (5 MeV/c^2)" or "Entries per 5 MeV/c^2".

3. Fit curves should not obscure the data points, and data points are best (re)drawn over the fit curves.

4. Colour may be used in figures, but the distinction between differently coloured areas or lines should be clear also when the document is printed in black and white, for example through differently dashed lines. The LHCb style mentioned above implements a colour scheme that works well but individual adjustments might be required.

5. Using different hatching styles helps to disinguished filled areas, also in black and white prints. Hatching styles 3001-3025 should be avoided since they behave unpredictably under zooming and scaling. Good styles for "falling hatched" and "rising hatched" are 3345 and 3354.

6. Figures with more than one part should have the parts labelled (a), (b) *etc.*, with a corresponding description in the caption; alternatively they should be clearly referred to by their position, e.g. Fig. 1 (left). In the caption, the labels (a), (b) *etc.* should precede their description. When referencing specific sub-figures, use "see Fig. 1(a)" or "see Figs. 2(b)-(e)".

7. All figures containing LHCb data should have LHCb written on them. For preliminary results, that should be replaced by "LHCb preliminary". Figures that only have simulated data should display "LHCb simulation". Figures that do not depend on LHCb-specific software (*e.g.* only on PYTHIA) should not have any label.

7 References

References should be made using BibTEX [20]. A special style `LHCb.bst` has been created to achieve a uniform style. Independent of the journal the paper is submitted to, the preprint should be created using this style. Where arXiv numbers exist, these should be added even for published articles. In the PDF file, hyperlinks will be created to both the arXiv and the published version.

1. Citations are marked using square brackets, and the corresponding references should be typeset using BibTEX and the official LHCb BibTEX style. An example is in Ref. [12].

2. For references with four or less authors all of the authors' names are listed [21], otherwise the first author is given, followed by *et al.*. The LHCb BibTEX style will take care of this.

3. The order of references should be sequential when reading the document. This is automatic when using BibTEX.

4. The titles of papers should in general be included. To remove them, change `\setboolean{articletitles}{false}` to `true` at the top of this template. Note that the titles in `LHCb-PAPER.bib` are in plain LaTex, in order to correspond to the actual title on the arXiv record. Some differences in style can thus be noticed with respect to the main text, for example particle names that use capital Greek letters are not slanted in the reference titles ($\mathrm{\Lambda}$ vs Λ)

5. Whenever possible, use references from the supplied files `main.bib`, `LHCb-PAPER.bib`, `LHCb-CONF.bib`, and `LHCB-DP.bib`. These are kept up-to-date by the EB. If you see a mistake, do not edit these files, but let the EB know. This way, for every update of the paper, you save yourself the work of updating the references. Instead, you can just copy or check in the latest versions of the `.bib` files from the repository.

6. For those references not provided by the EB, the best is to copy the BibTEX entry directly from `Inspire`. Often these need to be edited to get the correct title, author names and formatting. For authors with multiple initials, add a space between them (change `R.G.C.` to `R. G. C.`), otherwise only the first initial will be taken. Also, make sure to eliminate unnecessary capitalisation. Apart from that, the title should be respected as much as possible (*e.g.* do not change particle names to PDG convention nor introduce/remove factors of c). Check that both the arXiv and the journal index are clickable and point to the right article.

7. The `mciteplus` [22] package is used to enable multiple references to show up as a single item in the reference list. As an example `\cite{Mohapatra:1979ia,*Pascoli:2007qh}` where the `*` indicates that the reference should be merged with the previous one. The result of this can be seen in

Ref. [23]. Be aware that the `mciteplus` package should be included as the very last item before the `\begin{document}` to work correctly.

8. It should be avoided to make references to public notes and conference reports in public documents. Exceptions can be discussed on a case-by-case basis with the review committee for the analysis. In internal reports they are of course welcome and can be referenced as seen in Ref. [24] using the `lhcbreport` category. For conference reports, omit the author field completely in the BibTeX record.

9. To get the typesetting and hyperlinks correct for LHCb reports, the category `lhcbreport` should be used in the BibTeX file. See Refs. [25] for some examples. It can be used for LHCb documents in the series `CONF`, `PAPER`, `PROC`, `THESIS`, `LHCC`, `TDR` and internal LHCb reports. Papers sent for publication, but not published yet, should be referred with their `arXiv` number, so the `PAPER` category should only be used in the rare case of a forward reference to a paper.

10. Proceedings can be used for references to items such as the LHCb simulation [17], where we do not yet have a published paper.

There is a set of standard references to be used in LHCb that are listed in Appendix A.

8 Inclusion of supplementary material

Three types of supplementary material should be distinguised:

- A regular appendix: lengthy equations or long tables are sometimes better put in an appendix in order not to interrupt the main flow of a paper. Appendices will appear in the final paper, on arXiv and on the cds record and should be considered integral part of a paper, and are thus to be reviewed like the rest of the paper. An example of an LHCb paper with an appendix is Ref. [26].

- Supplementary material for cds: plots or tables that would make the paper exceed the page limit or are not appropriate to include in the paper itself, but are desireable to be shown in public should be added to the paper drafts in an appendix, and removed from the paper before submitting to arXiv or the journal. See Appendix D for further instructions. Examples are: comparison plots of the new result with older results, plots that illustrate cross-checks. An example of an LHCb paper with supplementary material for cds is Ref. [27]. Supplementary material for cds cannot be referenced to in the paper.

- Supplementary material for the paper. Most journals allow to submit files along with the paper that will not be part of the text of the article, but will be stored on the journal server. Examples are plain text files with numerical data corresponding to the plots in the paper. The supplementary material should be referenced to in the paper, by including a reference of the type "See supplementary material for [give brief description of material].” The journal will insert a specific link here. For the arXiv record, a specific link to the supplementary material on the arXiv server should be included when the paper gets updated, after it has been published. For the internal reviewing, an appendix should be provided illustrating the format of the file, its purpose and providing a link where the actual files can be found. An example of an LHCb paper with supplementary material is Ref. [28]

Acknowledgements

The text below are the acknowledgements as approved by the collaboration board. Extending the acknowledgements to include individuals from outside the collaboration who have contributed to the analysis should be approved by the EB. The extra acknowledgements are normally placed before the standard acknowledgements, unless it matches better with the text of the standard acknowledgements to put them elsewhere. They should be included in the draft for the first circulation. Except in exceptional circumstances, to be approved by the EB chair, authors of the paper should not be named in extended acknowledgements.

We express our gratitude to our colleagues in the CERN accelerator departments for the excellent performance of the LHC. We thank the technical and administrative staff at the LHCb institutes. We acknowledge support from CERN and from the national agencies: CAPES, CNPq, FAPERJ and FINEP (Brazil); NSFC (China); CNRS/IN2P3 (France); BMBF, DFG and MPG (Germany); INFN (Italy); FOM and NWO (The Netherlands); MNiSW and NCN (Poland); MEN/IFA (Romania); MinES and FANO (Russia); MinECo (Spain); SNSF and SER (Switzerland); NASU (Ukraine); STFC (United Kingdom); NSF (USA). We acknowledge the computing resources that are provided by CERN, IN2P3 (France), KIT and DESY (Germany), INFN (Italy), SURF (The Netherlands), PIC (Spain), GridPP (United Kingdom), RRCKI (Russia), CSCS (Switzerland), IFIN-HH (Romania), CBPF (Brazil), PL-GRID (Poland) and OSC (USA). We are indebted to the communities behind the multiple open source software packages on which we depend. We are also thankful for the computing resources and the access to software R&D tools provided by Yandex LLC (Russia). Individual groups or members have received support from AvH Foundation (Germany), EPLANET, Marie Skłodowska-Curie Actions and ERC (European Union), Conseil Général de Haute-Savoie, Labex ENIGMASS and OCEVU, Région Auvergne (France), RFBR (Russia), GVA, XuntaGal and GENCAT (Spain), The Royal Society and Royal Commission for the Exhibition of 1851 (United Kingdom).

Appendices

A Standard References

Below is a list of common references, as well as a list of all LHCb publications. As they are already in prepared bib files, they can be used as simply as `\cite{Alves:2008zz}` to get the LHCb detector paper. The references are defined in the files `main.bib`, `LHCb-PAPER.bib`, `LHCb-CONF.bib`, `LHCb-DP.bib` `LHCb-TDR.bib` files, with obvious contents. Each of these have their `LHCb-ZZZ-20XX-0YY` number as their cite code. If you believe there is a problem with the formatting or content of one of the entries, then get in contact with the Editorial Board rather than just editing it in your local file, since you are likely to need the latest version just before submiting the article.

Description	`cite` code	Reference
LHCb detector	`Alves:2008zz`	[1]
LHCb simulation	`LHCb-PROC-2011-006`	[17]
PDG 2014	`PDG2014`	[2]
HFAG	`HFAG`	[29]
Pythia	`Sjostrand:2006za, *Sjostrand:2007gs`	[12]
LHCb Pythia tuning	`LHCb-PROC-2010-056`	[13]
Geant4	`Allison:2006ve, *Agostinelli:2002hh`	[16]
EvtGen	`Lange:2001uf`	[14]
Photos	`Golonka:2005pn`	[15]
Dirac	`Tsaregorodtsev:2010zz, *BelleDIRACAmazon`	[30]
Crystal Ball function[3]	`Skwarnicki:1986xj`	[31]
Wilks' theorem	`Wilks:1938dza`	[32]
BDT	`Breiman`	[18]
BDT training	`AdaBoost`	[19]
HLT2 topo	`BBDT`	[10]
DecayTreeFitter	`Hulsbergen:2005pu`	[33]
sPlot	`Pivk:2004ty`	[34]
Punzi's optimization	`Punzi:2003bu`	[35]
f_s/f_d	`fsfd`	[36]

[3]A valid alternative for most papers where the normalisation is not critical is to use the expression"Gaussian function with a low-mass power-law tail" or "Gaussian function with power-law tails". In that case, no citation is needed

LHCb-DP number	Title
LHCb-DP-2014-002 [3]	LHCb detector performance
LHCb-DP-2014-001 [4]	Performance of the LHCb Vertex Locator
LHCb-DP-2013-004 [37]	Performance of the LHCb calorimeters
LHCb-DP-2013-003 [5]	Performance of the LHCb Outer Tracker
LHCb-DP-2013-002 [38]	Measurement of the track reconstruction efficiency at LHCb
LHCb-DP-2013-001 [39]	Performance of the muon identification at LHCb
LHCb-DP-2012-005 [40]	Radiation damage in the LHCb Vertex Locator
LHCb-DP-2012-004 [8]	The LHCb trigger and its performance in 2011
LHCb-DP-2012-003 [6]	Performance of the LHCb RICH detector at the LHC
LHCb-DP-2012-002 [7]	Performance of the LHCb muon system
LHCb-DP-2012-001 [41]	Radiation hardness of the LHCb Outer Tracker
LHCb-DP-2011-002 [42]	Simulation of machine induced background ...
LHCb-DP-2011-001 [43]	Performance of the LHCb muon system with cosmic rays
LHCb-DP-2010-001 [44]	First spatial alignment of the LHCb VELO ...

LHCb-TDR number	Title
LHCb-TDR-016 [45]	Trigger and online upgrade
LHCb-TDR-015 [46]	Tracker upgrade
LHCb-TDR-014 [47]	PID upgrade
LHCb-TDR-013 [48]	VELO upgrade
LHCb-TDR-012 [49]	Framework TDR for the upgrade
LHCb-TDR-011 [50]	Computing
LHCb-TDR-010 [51]	Trigger
LHCb-TDR-009 [52]	Reoptimized detector
LHCb-TDR-008 [53]	Inner Tracker
LHCb-TDR-007 [54]	Online, DAQ, ECS
LHCb-TDR-006 [55]	Outer Tracker
LHCb-TDR-005 [56]	VELO
LHCb-TDR-004 [57]	Muon system
LHCb-TDR-003 [58]	RICH
LHCb-TDR-002 [59]	Calorimeters
LHCb-TDR-001 [60]	Magnet

Table 3: LHCb-PAPERs (which have their identifier as their cite code). Note that LHCb-PAPER-2011-039 does not exist.

LHCb-PAPER-2015-055 [61]	
LHCb-PAPER-2015-054 [62]	LHCb-PAPER-2015-053 [63]
LHCb-PAPER-2015-052 [64]	LHCb-PAPER-2015-051 [65]
LHCb-PAPER-2015-050 [66]	LHCb-PAPER-2015-049 [67]
LHCb-PAPER-2015-048 [68]	LHCb-PAPER-2015-047 [69]
LHCb-PAPER-2015-046 [70]	LHCb-PAPER-2015-045 [71]

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LHCb-PAPER-2015-044 [72]	LHCb-PAPER-2015-043 [73]
LHCb-PAPER-2015-042 [74]	LHCb-PAPER-2015-041 [75]
LHCb-PAPER-2015-040 [76]	LHCb-PAPER-2015-039 [77]
LHCb-PAPER-2015-038 [78]	LHCb-PAPER-2015-037 [79]
LHCb-PAPER-2015-036 [80]	LHCb-PAPER-2015-035 [81]
LHCb-PAPER-2015-034 [82]	LHCb-PAPER-2015-033 [83]
LHCb-PAPER-2015-032 [84]	LHCb-PAPER-2015-031 [85]
LHCb-PAPER-2015-030 [86]	LHCb-PAPER-2015-029 [87]
LHCb-PAPER-2015-028 [88]	LHCb-PAPER-2015-027 [89]
LHCb-PAPER-2015-026 [90]	LHCb-PAPER-2015-025 [91]
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LHCb-PAPER-2015-002 [114]	LHCb-PAPER-2015-001 [115]
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LHCb-PAPER-2014-032 [154]	LHCb-PAPER-2014-031 [155]

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LHCb-PAPER-2013-030 [223]	LHCb-PAPER-2013-029 [224]
LHCb-PAPER-2013-028 [225]	LHCb-PAPER-2013-027 [226]
LHCb-PAPER-2013-026 [227]	LHCb-PAPER-2013-025 [228]
LHCb-PAPER-2013-024 [229]	LHCb-PAPER-2013-023 [230]
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LHCb-PAPER-2013-020 [233]	LHCb-PAPER-2013-019 [234]
LHCb-PAPER-2013-018 [235]	LHCb-PAPER-2013-017 [236]

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LHCb-PAPER-2013-016 [237]	LHCb-PAPER-2013-015 [238]
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LHCb-PAPER-2013-012 [241]	LHCb-PAPER-2013-011 [242]
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LHCb-PAPER-2013-008 [245]	LHCb-PAPER-2013-007 [246]
LHCb-PAPER-2013-006 [247]	LHCb-PAPER-2013-005 [248]
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LHCb-PAPER-2012-054 [256]	LHCb-PAPER-2012-053 [257]
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LHCb-PAPER-2012-022 [288]	LHCb-PAPER-2012-021 [289]
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LHCb-PAPER-2012-002 [308]	LHCb-PAPER-2012-001 [309]
LHCb-PAPER-2011-045 [310]	LHCb-PAPER-2011-044 [311]
LHCb-PAPER-2011-043 [312]	LHCb-PAPER-2011-042 [313]
LHCb-PAPER-2011-041 [314]	LHCb-PAPER-2011-040 [315]
LHCb-PAPER-2011-038 [316]	LHCb-PAPER-2011-037 [317]
LHCb-PAPER-2011-036 [318]	LHCb-PAPER-2011-035 [319]

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LHCb-PAPER-2011-034 [320]	LHCb-PAPER-2011-033 [321]
LHCb-PAPER-2011-032 [322]	LHCb-PAPER-2011-031 [323]
LHCb-PAPER-2011-031 [324]	LHCb-PAPER-2011-029 [325]
LHCb-PAPER-2011-028 [326]	LHCb-PAPER-2011-027 [327]
LHCb-PAPER-2011-026 [328]	LHCb-PAPER-2011-025 [329]
LHCb-PAPER-2011-024 [330]	LHCb-PAPER-2011-023 [331]
LHCb-PAPER-2011-023 [332]	LHCb-PAPER-2011-021 [333]
LHCb-PAPER-2011-020 [28]	LHCb-PAPER-2011-019 [334]
LHCb-PAPER-2011-018 [335]	LHCb-PAPER-2011-017 [336]
LHCb-PAPER-2011-016 [337]	LHCb-PAPER-2011-015 [338]
LHCb-PAPER-2011-014 [339]	LHCb-PAPER-2011-013 [340]
LHCb-PAPER-2011-012 [341]	LHCb-PAPER-2011-011 [342]
LHCb-PAPER-2011-010 [343]	LHCb-PAPER-2011-009 [344]
LHCb-PAPER-2011-008 [345]	LHCb-PAPER-2011-007 [346]
LHCb-PAPER-2011-006 [347]	LHCb-PAPER-2011-005 [348]
LHCb-PAPER-2011-004 [349]	LHCb-PAPER-2011-003 [350]
LHCb-PAPER-2011-002 [351]	LHCb-PAPER-2011-001 [352]
LHCb-PAPER-2010-002 [353]	LHCb-PAPER-2010-001 [354]

Table 4: LHCb-CONFs (which have their identifier as their cite code). Note that LHCb-CONF-2011-032 does not exist.

LHCb-CONF-2015-005 [355]	
LHCb-CONF-2015-004 [356]	LHCb-CONF-2015-003 [357]
LHCb-CONF-2015-002 [358]	LHCb-CONF-2015-001 [359]
LHCb-CONF-2014-004 [360][4]	LHCb-CONF-2014-003 [361]
LHCb-CONF-2014-002 [362]	LHCb-CONF-2014-001 [363]
LHCb-CONF-2013-013 [364]	
LHCb-CONF-2013-012 [365]	LHCb-CONF-2013-011 [366]
LHCb-CONF-2013-010 [367]	LHCb-CONF-2013-009 [368]
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LHCb-CONF-2013-006 [371]	LHCb-CONF-2013-005 [372]
LHCb-CONF-2013-004 [373]	LHCb-CONF-2013-003 [374]
LHCb-CONF-2013-002 [375]	LHCb-CONF-2013-001 [376]
LHCb-CONF-2012-034 [377]	LHCb-CONF-2012-033 [378]
LHCb-CONF-2012-032 [379]	LHCb-CONF-2012-031 [380]
LHCb-CONF-2012-030 [381]	LHCb-CONF-2012-029 [382]

[4] If you cite the gamma combination, always also cite the latest gamma paper as `\cite{LHCb-PAPER-2013-020,*LHCb-CONF-2014-004}` (unless you cite LHCb-PAPER-2013-020 separately too).

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LHCb-CONF-2012-028 [383]	LHCb-CONF-2012-027 [384]
LHCb-CONF-2012-026 [385]	LHCb-CONF-2012-025 [386]
LHCb-CONF-2012-024 [387]	LHCb-CONF-2012-023 [388]
LHCb-CONF-2012-022 [389]	LHCb-CONF-2012-021 [390]
LHCb-CONF-2012-020 [391]	LHCb-CONF-2012-019 [392]
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LHCb-CONF-2012-016 [395]	LHCb-CONF-2012-015 [396]
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LHCb-CONF-2011-034 [439]	LHCb-CONF-2011-033 [440]
LHCb-CONF-2011-031 [441]	
LHCb-CONF-2011-030 [442]	LHCb-CONF-2011-029 [443]
LHCb-CONF-2011-028 [444]	LHCb-CONF-2011-027 [445]
LHCb-CONF-2011-026 [446]	LHCb-CONF-2011-025 [447]
LHCb-CONF-2011-024 [448]	LHCb-CONF-2011-023 [449]
LHCb-CONF-2011-023 [450]	LHCb-CONF-2011-021 [451]
LHCb-CONF-2011-020 [452]	LHCb-CONF-2011-019 [453]
LHCb-CONF-2011-018 [454]	LHCb-CONF-2011-017 [455]
LHCb-CONF-2011-016 [456]	LHCb-CONF-2011-015 [457]
LHCb-CONF-2011-014 [458]	LHCb-CONF-2011-013 [459]
LHCb-CONF-2011-012 [460]	LHCb-CONF-2011-011 [461]
LHCb-CONF-2011-010 [462]	LHCb-CONF-2011-009 [463]
LHCb-CONF-2011-008 [464]	LHCb-CONF-2011-007 [465]

– continued from previous page.

LHCb-CONF-2011-006 [466]	LHCb-CONF-2011-005 [467]
LHCb-CONF-2011-004 [468]	LHCb-CONF-2011-003 [24]
LHCb-CONF-2011-002 [469]	LHCb-CONF-2011-001 [470]
LHCb-CONF-2010-014 [471]	LHCb-CONF-2010-013 [472]
LHCb-CONF-2010-012 [473]	LHCb-CONF-2010-011 [474]
LHCb-CONF-2010-010 [475]	LHCb-CONF-2010-009 [476]
LHCb-CONF-2010-008 [477]	

Some LHCb papers quoted together will look like [346–350]. The combination of CMS and LHCb results on $B^0_{(s)} \to \mu^+\mu^-$ should be cited like [365].

B Standard symbols

As explained in Sect. 4 this appendix contains standard typesetting of symbols, particle names, units etc. in LHCb documents.

In the file `lhcb-symbols-def.tex`, which is included, a large number of symbols is defined. While they can lead to quicker typing, the main reason is to ensure a uniform notation within a document and between different LHCb documents. If a symbol like `\CP` to typeset *CP* violation is available for a unit, particle name, process or whatever, it should be used. If you do not agree with the notation you should ask to get the definition in `lhcb-symbols-def.tex` changed rather than just ignoring it.

All the main particles have been given symbols. The B mesons are thus named B^+, B^0, B^0_s, and B^+_c. There is no need to go into math mode to use particle names, thus saving the typing of many $ signs. By default particle names are typeset in italic type to agree with the PDG preference. To get roman particle names you can just change `\setboolean{uprightparticles}{false}` to `true` at the top of this template.

There is a large number of units typeset that ensures the correct use of fonts, capitals and spacing. As an example we have $m_{B^0_s} = 5366.3 \pm 0.6\,\mathrm{MeV}/c^2$. Note that µm is typeset with an upright µ, even if the particle names have slanted greek letters.

A set of useful symbols are defined for working groups. More of these symbols can be included later. As an example in the Rare Decay group we have several different analyses looking for a measurement of $\mathcal{C}_7^{\prime(\mathrm{eff})}$ and $\mathcal{O}_7^{\prime}$.

478 # C List of all symbols

479 ## C.1 Experiments

	\lhcb	LHCb	\atlas	ATLAS	\cms	CMS
	\alice	ALICE	\babar	BaBar	\belle	Belle
	\cleo	CLEO	\cdf	CDF	\dzero	D0
	\aleph	ALEPH	\delphi	DELPHI	\opal	OPAL
	\lthree	L3	\sld	SLD	\cern	CERN
480	\lhc	LHC	\lep	LEP	\tevatron	Tevatron

481 ### C.1.1 LHCb sub-detectors and sub-systems

	\velo	VELO	\rich	RICH	\richone	RICH1
	\richtwo	RICH2	\ttracker	TT	\intr	IT
	\st	ST	\ot	OT	\spd	SPD
	\presh	PS	\ecal	ECAL	\hcal	HCAL
	\MagUp	*MagUp*	\MagDown	*MagDown*	\ode	ODE
	\daq	DAQ	\tfc	TFC	\ecs	ECS
	\lone	L0	\hlt	HLT	\hltone	HLT1
482	\hlttwo	HLT2				

483 ## C.2 Particles

484 ### C.2.1 Leptons

	\electron	e	\en	e^-	\ep	e^+
	\epm	$e^\pm$	\epem	e^+e^-	\muon	μ
	\mup	μ^+	\mun	μ^-	\mumu	$\mu^+\mu^-$
	\tauon	τ	\taup	τ^+	\taum	τ^-
	\tautau	$\tau^+\tau^-$	\lepton	ℓ	\ellm	ℓ^-
	\ellp	ℓ^+	\neu	ν	\neub	$\overline{\nu}$
	\neue	ν_e	\neueb	$\overline{\nu}_e$	\neum	ν_μ
	\neumb	$\overline{\nu}_\mu$	\neut	ν_τ	\neutb	$\overline{\nu}_\tau$
485	\neul	ν_ℓ	\neulb	$\overline{\nu}_\ell$		

486 ### C.2.2 Gauge bosons and scalars

	\g	γ	\H	H^0	\Hp	H^+
	\Hm	H^-	\Hpm	$H^\pm$	\W	W
	\Wp	W^+	\Wm	W^-	\Wpm	$W^\pm$
487	\Z	Z				

C.2.3 Quarks

`\quark`	q	`\quarkbar`	$\overline{q}$	`\qqbar`	$q\overline{q}$
`\uquark`	u	`\uquarkbar`	$\overline{u}$	`\uubar`	$u\overline{u}$
`\dquark`	d	`\dquarkbar`	$\overline{d}$	`\ddbar`	$d\overline{d}$
`\squark`	s	`\squarkbar`	$\overline{s}$	`\ssbar`	$s\overline{s}$
`\cquark`	c	`\cquarkbar`	$\overline{c}$	`\ccbar`	$c\overline{c}$
`\bquark`	b	`\bquarkbar`	$\overline{b}$	`\bbbar`	$b\overline{b}$
`\tquark`	t	`\tquarkbar`	$\overline{t}$	`\ttbar`	$t\overline{t}$

C.2.4 Light mesons

`\hadron`	h	`\pion`	π	`\piz`	π^0
`\pizs`	$\pi^0\mathrm{s}$	`\pip`	π^+	`\pim`	π^-
`\pipm`	$\pi^\pm$	`\pimp`	$\pi^\mp$	`\rhomeson`	ρ
`\rhoz`	ρ^0	`\rhop`	ρ^+	`\rhom`	ρ^-
`\rhopm`	$\rho^\pm$	`\rhomp`	$\rho^\mp$	`\kaon`	K
`\Kb`	$\overline{K}$	`\KorKbar`	$\overset{(-)}{K}$	`\Kz`	K^0
`\Kzb`	$\overline{K}^0$	`\Kp`	K^+	`\Km`	K^-
`\Kpm`	$K^\pm$	`\Kmp`	$K^\mp$	`\KS`	K^0_{S}
`\KL`	K^0_{L}	`\Kstarz`	K^{*0}	`\Kstarzb`	$\overline{K}^{*0}$
`\Kstar`	K^*	`\Kstarb`	$\overline{K}^*$	`\Kstarp`	K^{*+}
`\Kstarm`	K^{*-}	`\Kstarpm`	$K^{*\pm}$	`\Kstarmp`	$K^{*\mp}$
`\etaz`	η	`\etapr`	η'	`\phiz`	ϕ
`\omegaz`	ω				

492 ### C.2.5 Heavy mesons

`\D`	D	`\Db`	$\overline{D}$	`\DorDbar`	$\overset{(-)}{D}$
`\Dz`	D^0	`\Dzb`	$\overline{D}^0$	`\Dp`	D^+
`\Dm`	D^-	`\Dpm`	$D^\pm$	`\Dmp`	$D^\mp$
`\Dstar`	D^*	`\Dstarb`	$\overline{D}^*$	`\Dstarz`	D^{*0}
`\Dstarzb`	$\overline{D}^{*0}$	`\Dstarp`	D^{*+}	`\Dstarm`	D^{*-}
`\Dstarpm`	$D^{*\pm}$	`\Dstarmp`	$D^{*\mp}$	`\Ds`	D_s^+
`\Dsp`	D_s^+	`\Dsm`	D_s^-	`\Dspm`	$D_s^\pm$
`\Dsmp`	$D_s^\mp$	`\Dss`	D_s^{*+}	`\Dssp`	D_s^{*+}
`\Dssm`	D_s^{*-}	`\Dsspm`	$D_s^{*\pm}$	`\Dssmp`	$D_s^{*\mp}$
`\B`	B	`\Bbar`	$\overline{B}$	`\Bb`	$\overline{B}$
`\BorBbar`	$\overset{(-)}{B}$	`\Bz`	B^0	`\Bzb`	$\overline{B}^0$
`\Bu`	B^+	`\Bub`	B^-	`\Bp`	B^+
`\Bm`	B^-	`\Bpm`	$B^\pm$	`\Bmp`	$B^\mp$
`\Bd`	B^0	`\Bs`	B_s^0	`\Bsb`	$\overline{B}_s^0$
`\Bdb`	$\overline{B}^0$	`\Bc`	B_c^+	`\Bcp`	B_c^+
493 `\Bcm`	B_c^-	`\Bcpm`	$B_c^\pm$		

494 ### C.2.6 Onia

`\jpsi`	J/ψ	`\psitwos`	$\psi(2S)$	`\psiprpr`	$\psi(3770)$
`\etac`	η_c	`\chiczero`	χ_{c0}	`\chicone`	χ_{c1}
`\chictwo`	χ_{c2}	`\OneS`	$\Upsilon(1S)$	`\TwoS`	$\Upsilon(2S)$
`\ThreeS`	$\Upsilon(3S)$	`\FourS`	$\Upsilon(4S)$	`\FiveS`	$\Upsilon(5S)$
495 `\chic`	χ_c				

496 ### C.2.7 Baryons

`\proton`	p	`\antiproton`	$\overline{p}$	`\neutron`	n
`\antineutron`	$\overline{n}$	`\Deltares`	$\varDelta$	`\Deltaresbar`	$\overline{\varDelta}$
`\Xires`	$\varXi$	`\Xiresbar`	$\overline{\varXi}$	`\Lz`	$\varLambda$
`\Lbar`	$\overline{\varLambda}$	`\LorLbar`	$\overset{(-)}{\varLambda}$	`\Lambdares`	$\varLambda$
`\Lambdaresbar`	$\overline{\varLambda}$	`\Sigmares`	$\varSigma$	`\Sigmaresbar`	$\overline{\varSigma}$
`\Omegares`	$\varOmega$	`\Omegaresbar`	$\overline{\varOmega}$	`\Lb`	$\varLambda_b^0$
`\Lbbar`	$\overline{\varLambda}_b^0$	`\Lc`	$\varLambda_c^+$	`\Lcbar`	$\overline{\varLambda}_c^-$
`\Xib`	$\varXi_b$	`\Xibz`	$\varXi_b^0$	`\Xibm`	$\varXi_b^-$
`\Xibbar`	$\overline{\varXi}_b$	`\Xibbarz`	$\overline{\varXi}_b^0$	`\Xibbarp`	$\overline{\varXi}_b^+$
`\Xic`	$\varXi_c$	`\Xicz`	$\varXi_c^0$	`\Xicp`	$\varXi_c^+$
`\Xicbar`	$\overline{\varXi}_c$	`\Xicbarz`	$\overline{\varXi}_c^0$	`\Xicbarm`	$\overline{\varXi}_c^-$
`\Omegac`	$\varOmega_c^0$	`\Omegacbar`	$\overline{\varOmega}_c^0$	`\Omegab`	$\varOmega_b^-$
497 `\Omegabbar`	$\overline{\varOmega}_b^+$				

C.3 Physics symbols

C.3.1 Decays

`\BF`	$\mathcal{B}$	`\BRvis`	$\mathcal{B}_{\text{vis}}$	`\BR`	$\mathcal{B}$
`\decay[2] \decay{a }{b c }`	$a \to bc$	`\ra`	$\rightarrow$	`\to`	$\to$

C.3.2 Lifetimes

`\tauBs`	$\tau_{B^0_s}$	`\tauBd`	τ_{B^0}	`\tauBz`	τ_{B^0}
`\tauBu`	τ_{B^+}	`\tauDp`	τ_{D^+}	`\tauDz`	τ_{D^0}
`\tauL`	τ_{L}	`\tauH`	τ_{H}		

C.3.3 Masses

`\mBd`	m_{B^0}	`\mBp`	m_{B^+}	`\mBs`	$m_{B^0_s}$
`\mBc`	$m_{B_c^+}$	`\mLb`	$m_{\Lambda_b^0}$		

C.3.4 EW theory, groups

`\grpsuthree`	$\mathrm{SU}(3)$	`\grpsutw`	$\mathrm{SU}(2)$	`\grpuone`	$\mathrm{U}(1)$
`\ssqtw`	$\sin^2\theta_{\text{W}}$	`\csqtw`	$\cos^2\theta_{\text{W}}$	`\stw`	$\sin\theta_{\text{W}}$
`\ctw`	$\cos\theta_{\text{W}}$	`\ssqtwef`	$\sin^2\theta_{\text{W}}^{\text{eff}}$	`\csqtwef`	$\cos^2\theta_{\text{W}}^{\text{eff}}$
`\stwef`	$\sin\theta_{\text{W}}^{\text{eff}}$	`\ctwef`	$\cos\theta_{\text{W}}^{\text{eff}}$	`\gv`	g_{V}
`\ga`	g_{A}	`\order`	$\mathcal{O}$	`\ordalph`	$\mathcal{O}(\alpha)$
`\ordalsq`	$\mathcal{O}(\alpha^2)$	`\ordalcb`	$\mathcal{O}(\alpha^3)$		

C.3.5 QCD parameters

`\as`	α_s	`\MSb`	$\overline{\text{MS}}$	`\lqcd`	Λ_{QCD}
`\qsq`	q^2				

C.3.6 CKM, CP violation

`\eps`	ε	`\epsK`	ε_K	`\epsB`	ε_B
`\epsp`	ε'_K	`\CP`	CP	`\CPT`	CPT
`\rhobar`	$\overline{\rho}$	`\etabar`	$\overline{\eta}$	`\Vud`	V_{ud}
`\Vcd`	V_{cd}	`\Vtd`	V_{td}	`\Vus`	V_{us}
`\Vcs`	V_{cs}	`\Vts`	V_{ts}	`\Vub`	V_{ub}
`\Vcb`	V_{cb}	`\Vtb`	V_{tb}	`\Vuds`	V_{ud}^*
`\Vcds`	V_{cd}^*	`\Vtds`	V_{td}^*	`\Vuss`	V_{us}^*
`\Vcss`	V_{cs}^*	`\Vtss`	V_{ts}^*	`\Vubs`	V_{ub}^*
`\Vcbs`	V_{cb}^*	`\Vtbs`	V_{tb}^*		

511 C.3.7 Oscillations

	\dm	Δm	\dms	Δm_s	\dmd	Δm_d
	\DG	$\Delta\Gamma$	\DGs	$\Delta\Gamma_s$	\DGd	$\Delta\Gamma_d$
	\Gs	Γ_s	\Gd	Γ_d	\MBq	M_{B_q}
	\DGq	$\Delta\Gamma_q$	\Gq	Γ_q	\dmq	Δm_q
	\GL	Γ_{L}	\GH	Γ_{H}	\DGsGs	$\Delta\Gamma_s/\Gamma_s$
	\Delm	Δm	\ACP	$\mathcal{A}^{CP}$	\Adir	$\mathcal{A}^{\mathrm{dir}}$
	\Amix	$\mathcal{A}^{\mathrm{mix}}$	\ADelta	$\mathcal{A}^{\Delta}$	\phid	ϕ_d
	\sinphid	$\sin\phi_d$	\phis	ϕ_s	\betas	β_s
	\sbetas	$\sigma(\beta_s)$	\stbetas	$\sigma(2\beta_s)$	\stphis	$\sigma(\phi_s)$
512	\sinphis	$\sin\phi_s$				

513 C.3.8 Tagging

	\edet	$\varepsilon_{\mathrm{det}}$	\erec	$\varepsilon_{\mathrm{rec/det}}$	\esel	$\varepsilon_{\mathrm{sel/rec}}$
	\etrg	$\varepsilon_{\mathrm{trg/sel}}$	\etot	$\varepsilon_{\mathrm{tot}}$	\mistag	ω
	\wcomb	ω^{comb}	\etag	$\varepsilon_{\mathrm{tag}}$	\etagcomb	$\varepsilon_{\mathrm{tag}}^{\mathrm{comb}}$
	\effeff	$\varepsilon_{\mathrm{eff}}$	\effeffcomb	$\varepsilon_{\mathrm{eff}}^{\mathrm{comb}}$	\efftag	$\varepsilon_{\mathrm{tag}}(1-2\omega)^2$
514	\effD	$\varepsilon_{\mathrm{tag}}D^2$	\etagprompt	$\varepsilon_{\mathrm{tag}}^{\mathrm{Pr}}$	\etagLL	$\varepsilon_{\mathrm{tag}}^{\mathrm{LL}}$

515 C.3.9 Key decay channels

	\BdToKstmm	$B^0\to K^{*0}\mu^+\mu^-$	\BdbToKstmm	$\overline{B}^0\to \overline{K}^{*0}\mu^+\mu^-$	\BsToJPsiPhi	$B^0_s\to J/\psi\,\phi$
	\BdToJPsiKst	$B^0\to J/\psi\,K^{*0}$	\BdbToJPsiKst	$\overline{B}^0\to J/\psi\,\overline{K}^{*0}$	\BsPhiGam	$B^0_s\to \phi\gamma$
	\BdKstGam	$B^0\to K^{*0}\gamma$	\BTohh	$B\to h^+h'^-$	\BdTopipi	$B^0\to \pi^+\pi^-$
516	\BdToKpi	$B^0\to K^+\pi^-$	\BsToKK	$B^0_s\to K^+K^-$	\BsTopiK	$B^0_s\to \pi^+K^-$

517 C.3.10 Rare decays

	\BdKstee	$B^0\to K^{*0}e^+e^-$	\BdbKstee	$\overline{B}^0\to \overline{K}^{*0}e^+e^-$	\bsll	$b\to s\ell^+\ell^-$
	\AFB	A_{FB}	\FL	F_{L}	\AT#1 \AT2	A_{T}^2
	\btosgam	$b\to s\gamma$	\btodgam	$b\to d\gamma$	\Bsmm	$B^0_s\to \mu^+\mu^-$
518	\Bdmm	$B^0\to \mu^+\mu^-$	\ctl	$\cos\theta_\ell$	\ctk	$\cos\theta_K$

519 C.3.11 Wilson coefficients and operators

	\C#1 \C9	$\mathcal{C}_9$	\Cp#1 \Cp7	$\mathcal{C}_7'$	\Ceff#1 \Ceff9	$\mathcal{C}_9^{(\mathrm{eff})}$
520	\Cpeff#1 \Cpeff7	$\mathcal{C}_7^{\prime(\mathrm{eff})}$	\Ope#1 \Ope2	$\mathcal{O}_2$	\Opep#1 \Opep7	$\mathcal{O}_7'$

521 C.3.12 Charm

	\xprime	x'	\yprime	y'	\ycp	y_{CP}
522	\agamma	A_Γ	\dkpicf	$D^0\to K^-\pi^+$		

C.3.13 QM

`\bra[1]` `\bra{a}` $\langle a|$ `\ket[1]` `\ket{b}` $|b\rangle$ `\braket[2]` `\braket{a}{b}` $\langle a|b\rangle$

C.4 Units

`\unit[1]` `\unit{kg}` kg

C.4.1 Energy and momentum

`\tev`	TeV	`\gev`	GeV	`\mev`	MeV
`\kev`	keV	`\ev`	eV	`\gevc`	GeV/c
`\mevc`	MeV/c	`\gevcc`	GeV/c^2	`\gevgevcccc`	GeV^2/c^4
`\mevcc`	MeV/c^2				

C.4.2 Distance and area

`\km`	km	`\m`	m	`\ma`	m^2
`\cm`	cm	`\cma`	cm^2	`\mm`	mm
`\mma`	mm^2	`\mum`	µm	`\muma`	µm^2
`\nm`	nm	`\fm`	fm	`\barn`	b
`\mbarn`	mb	`\mub`	µb	`\nb`	nb
`\invnb`	nb^{-1}	`\pb`	pb	`\invpb`	pb^{-1}
`\fb`	fb	`\invfb`	fb^{-1}	`\ab`	ab
`\invab`	ab^{-1}				

C.4.3 Time

`\sec`	s	`\ms`	ms	`\mus`	µs
`\ns`	ns	`\ps`	ps	`\fs`	fs
`\mhz`	MHz	`\khz`	kHz	`\hz`	Hz
`\invps`	ps^{-1}	`\invns`	ns^{-1}	`\yr`	yr
`\hr`	hr				

C.4.4 Temperature

`\degc`	°C	`\degk`	K

C.4.5 Material lengths, radiation

`\Xrad`	X_0	`\NIL`	λ_{int}	`\mip`	MIP
`\neutroneq`	n$_{\text{eq}}$	`\neqcmcm`	n$_{\text{eq}}$/cm^2	`\kRad`	kRad
`\MRad`	MRad	`\ci`	Ci	`\mci`	mCi

C.4.6 Uncertainties

`\sx`	σ_x	`\sy`	σ_y	`\sz`	σ_z
`\stat`	(stat)	`\syst`	(syst)		

C.4.7 Maths

`\order`	$\mathcal{O}$	`\chisq`	χ^2	`\chisqndf`	χ^2/ndf
`\chisqip`	χ^2_{IP}	`\chisqvs`	χ^2_{VS}	`\chisqvtx`	χ^2_{vtx}
`\chisqvtxndf`	$\chi^2_{\mathrm{vtx}}/\mathrm{ndf}$	`\deriv`	d	`\gsim`	$\gtrsim$
`\lsim`	$\lesssim$	`\mean[1] \mean{x}`	$\langle x \rangle$	`\abs[1] \abs{x}`	$\|x\|$
`\Real`	$\mathcal{R}e$	`\Imag`	$\mathcal{I}m$	`\PDF`	PDF
`\sPlot`	*sPlot*				

C.5 Kinematics

C.5.1 Energy, Momenta

`\Ebeam`	E_{BEAM}	`\sqs`	$\sqrt{s}$	`\ptot`	p
`\pt`	p_{T}	`\et`	E_{T}	`\mt`	M_{T}
`\dpp`	$\Delta p/p$	`\msq`	m^2	`\dedx`	$\mathrm{d}E/\mathrm{d}x$

C.5.2 PID

`\dllkpi`	$\mathrm{DLL}_{K\pi}$	`\dllppi`	$\mathrm{DLL}_{p\pi}$	`\dllepi`	$\mathrm{DLL}_{e\pi}$
`\dllmupi`	$\mathrm{DLL}_{\mu\pi}$				

C.5.3 Geometry

`\degrees`	$^\circ$	`\krad`	krad	`\mrad`	mrad
`\rad`	rad				

C.5.4 Accelerator

`\betastar`	β^*	`\lum`	$\mathcal{L}$	`\intlum[1] \intlum{2 fb`$^{-1}$`}`	$\int\mathcal{L} = 2\ \mathrm{fb}^{-1}$

550 ## C.6 Software

551 ### C.6.1 Programs

	\bcvegpy	Bcvegpy	\boole	Boole	\brunel	Brunel
	\davinci	DaVinci	\dirac	Dirac	\evtgen	EvtGen
	\fewz	Fewz	\fluka	Fluka	\ganga	Ganga
	\gaudi	Gaudi	\gauss	Gauss	\geant	Geant4
	\hepmc	HepMC	\herwig	Herwig	\moore	Moore
	\neurobayes	NeuroBayes	\photos	Photos	\powheg	Powheg
	\pythia	Pythia	\resbos	ResBos	\roofit	RooFit
552	\root	Root	\spice	Spice	\urania	Urania

553 ### C.6.2 Languages

	\cpp	C++	\ruby	Ruby	\fortran	Fortran
554	\svn	SVN				

555 ### C.6.3 Data processing

	\kbytes	kbytes	\kbsps	kbits/s	\kbits	kbits
	\kbsps	kbits/s	\mbsps	Mbytes/s	\mbytes	Mbytes
	\mbps	Mbyte/s	\mbsps	Mbytes/s	\gbsps	Gbytes/s
	\gbytes	Gbytes	\gbsps	Gbytes/s	\tbytes	Tbytes
556	\tbpy	Tbytes/yr	\dst	DST		

557 ## C.7 Detector related

558 ### C.7.1 Detector technologies

	\nonn	n^+-on-n	\ponn	p^+-on-n	\nonp	n^+-on-p
559	\cvd	CVD	\mwpc	MWPC	\gem	GEM

560 ### C.7.2 Detector components, electronics

	\tell1	TELL1	\ukl1	UKL1	\beetle	Beetle
	\otis	OTIS	\croc	CROC	\carioca	CARIOCA
	\dialog	DIALOG	\sync	SYNC	\cardiac	CARDIAC
	\gol	GOL	\vcsel	VCSEL	\ttc	TTC
	\ttcrx	TTCrx	\hpd	HPD	\pmt	PMT
	\specs	SPECS	\elmb	ELMB	\fpga	FPGA
	\plc	PLC	\rasnik	RASNIK	\elmb	ELMB
	\can	CAN	\lvds	LVDS	\ntc	NTC
	\adc	ADC	\led	LED	\ccd	CCD
	\hv	HV	\lv	LV	\pvss	PVSS
561	\cmos	CMOS	\fifo	FIFO	\ccpc	CCPC

C.7.3 Chemical symbols

`\cfourften`	C_4F_{10}	`\cffour`	CF_4	`\cotwo`	CO_2
`\csixffouteen`	C_6F_{14}	`\mgftwo`	MgF_2	`\siotwo`	SiO_2

C.8 Special Text

`\eg`	*e.g.*	`\ie`	*i.e.*	`\etal`	*et al.*
`\etc`	*etc.*	`\cf`	*cf.*	`\ffp`	*ff.*
`\vs`	*vs.*				

D Supplementary material for LHCb-PAPER-20XX-YYY

This appendix contains supplementary material that will posted on the public cds record but will not appear in the paper.

Please leave the above sentence in your draft for first and second circulation and replace what follows by your actual supplementary material. For more information about other types of supplementary material, see Section 8. Plots and tables that follow should be well described, either with captions or with additional explanatory text.

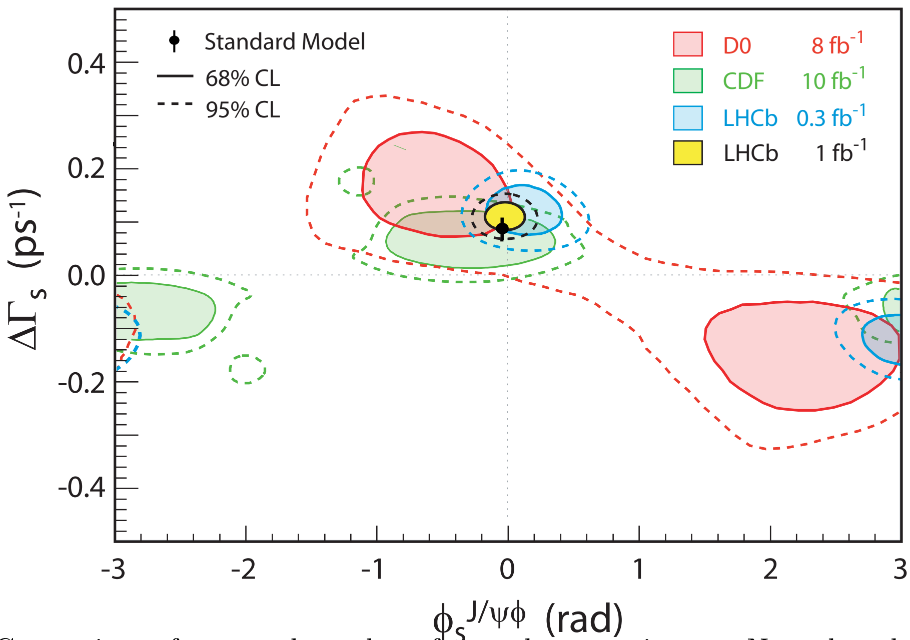

Figure 2: Comparison of our result to those from other experiments. Note that the style of this figure differs slightly from that of Figure 1

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