Dear Jesse, Tom, all,

I am commenting on version “2019-07-22-lamkpublication_v4" of your paper. This paper describes nicely the motivation (first time that this is measured), the used method and analysis, and the results together with a discussion on its implications. Especially the analysis and method part is discussed in quite some technical detail, which might be needed for this analysis (sometimes I was wondering if all details are needed, but that is of course up to you and the IRC). In addition, I had the impression that the very last paragraph (emission asymmetry) seems to be added later during the writing process. It is not (or at least not very clear) in the initial motivation and in my opinion also missing in the abstract and summary. I think one could work a bit to better integrate it in the whole text (especially since most of the appendix adds even more details to that specific part).

I have a few general questions and comments here and more minor ones in the attached pdf (also there you might find some non-editorial ones, I hope that is OK with you):

- In the introduction there is twice an outlook to the results that are presented later on (if I am not wrong). I would not do it at this stage and focus on existing measurements (none?) and theoretical expectations.
- Very often I had the impression that colloquial terms are used. Not being a native speaker I might be wrong, so please feel free to ignore my comment if you think that it is not applicable.
- When introducing the used nomenclature (L71-73) I think it would be good to be more explicit: "LambdaK for all LambdaK combinations", "ΛK+ for ΛK+ ⊕ ΛbarK-", "ΛK- for ΛK- ⊕ ΛbarK+", "ΛK0S for ...". I was a bit confused at this stage.
- "Daughter/mother": these terms are used very often and while we do not have a strict guidelines in ALICE on that I personally would like to suggest to use a gender neutral form, e.g. "decay products" and "decaying particle" or something similar.
- Figures: I had the impression that many different styles are used. Additionally, there are more detailed comments to the figures below. But this could be worked on during the collaboration round or after in my opinion.

As usual, please feel free to contact me, if something is not clear.

Best regards,
Michael

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Non-editorial (so you don’t need to address them if you feel this is beyond my task here ;)):
- Averaging/central value: in the systematic uncertainty section you write that you average the data points over all systematic variations. I am wondering, how do you average the stat.

uncertainty? Since this is non-trivial, I guess this was discussed with the IRC.
- Systematic uncertainties, selection criteria: do you vary all parameters (table 5) at the same time and build one uncertainty from it? Or do you vary line by line and do a quadratic sum? The latter would be probably an overestimation in my opinion, since correlations would not be taken into account.
- Systematic uncertainties, other contributions: perhaps I missed it, but how do you treat uncertainties in two-track cuts (~L160), the normalization range (~L180), the BG normalization (L324) and other sources of uncertainties to the lambda_ij (or do you assume there are none except the tau? I would assume that there should be uncertainties on the values in Table 4)?

General:
- I used the guidelines (https://twiki.cern.ch/twiki/bin/view/ALICE/GuidelineEditing) for my review. I am listing here things that I found in this draft, but better to check again.
- Avoid using physics slang such as "cuts", "cut tuning", etc. Use precise terms; "obtain" instead of "get", "require" instead of "cut on", "selection criteria" instead of "cuts", etc.
- Avoid footnotes; they tend to drift onto wrong page. If the information is needed, why not having it in the text?
- "Pb-Pb" --> "Pb--Pb"
- In the guidelines we suggest "space--time" (evolution) instead of "space-time", but I am not sure, which one is correct.
- Assuming that you use American spelling: In American English, the rule is to use a comma before and after "i.e." and "e.g.".
- Only capitalize the first word and proper nouns of section and subsection headings unless the publisher requires otherwise
- Avoid ":" before the equation (in particular when it interrupts the flow of the sentences)
- I think "bin" is a rather technical term, which I woudl substitute: "centrality bins" --> "centrality percentile ranges" for example.
- I didn’t really check on the tenses, but you might want to check again the guidelines on the tense: https://twiki.cern.ch/twiki/bin/viewauth/ALICE/GuidelineEditing#Tense

Title:
- Usually we try sentences not to start with a symbol. Not sure if this applies to titles as well.

Abstract:
- L6/7: Repeating "measurements": perhaps one can be replaced
- L8: the "from" in "from ALICE at the LHC" sounds a bit strange to me. Does it refer to "measurements from"?

Text:
- L24: "two (or many)-particle" --> "two- (or many-) particle"
- L27-29: "Current femtoscopic studies are able to extract the size, shape, and orientation of the pair emission regions, as well as offering estimations of the total time to reach kinetic decoupling and the suddenness of particle emission." --> Would be good to add a (or several) reference(s) to that statement (perhaps a recent femto summary paper?)
- L29-31: "Non-identical particle analyses additionally allow for the measurement of the space-time separation of the single particle source emitting regions." --> Reference
- L31-32: "The momentum and species dependence of femtoscopic measurements affirm the collective nature of the hot and dense matter created in heavy-ion collisions." --> Reference
- L37-38: "The femtoscopic signal demonstrates that the strong interaction acts..." --> Is this a result of this paper? Or of another work? If the latter, then reference is missing. If the first, then it would probably good to point that out.
- L43: "(anti)" --> "(anti-)"? If yes, then twice
- L45: "select regimes" --> "selected regimes"?
- L46/47: repeated "measurements"
- L51: as above, "as observed in the ΛK+ system" refers to this measurement?
- L56: the "from" in "from ALICE at the LHC" --> see above
- L62: "two particle" --> "two-particle"
- L72: Assuming that you use American spelling: In American English, the rule is to use a comma before and after "i.e." and "e.g.". --> in this case only one after is needed (since you write it in brackets). The later occurrences should be treated accordingly.
- L73: "ΛK0S , ΛK+ ⊕ ΛK- is simply ΛK+" --> I do not quite understand, for "ΛK+ ⊕ ΛK-" you write "ΛK+", but what about "ΛK0S"?
- L75: "dataset" --> "data set"?
- L75: "The dataset analyzed is from" --> sounds strange to me, perhaps reformulate?
- L77: "The events were classified according to their centrality" --> I think one should mention the word "percentiles" somewhere.
- L78: "z-position" --> "z position"?
- L86: "pT" --> "transverse momentum pT" (or was it introduced before?)
- L88/89: "Time-of-Flight (TOF)" --> "Time-Of-Flight (TOF)"
- L92: "time-of-flight" --> "time of flight"? Not sure?
- L93: "Nσ" --> "nσ"? To be checke din other ALICE papers. If you change it, make sure it is done in the full text.
- L99: Don't start a sentence with a symbol.
- L99: What do you mean with "track detection"? Tracking is done with TPC only I thought. Or you mean that tracks were also matched to the TOF?
- L100: "secondaries" --> "secondary particles" (not sure if "secondaries" is slang)
- Table 1: Caption has to be put above, perhaps there could be put a few more words to it, e.g. "Charged kaon (K+-) selection criteria"
- L113: Don't start a sentence with a symbol.

- L117: Why "point of closest approach", but "distance-of-closest-approach"? Is there a reason to have "-" in one and none in the other case?
- L127: Avoid footnotes; they tend to drift onto wrong page. If the information is needed, why not having it in the text?
- L130-137: Fix enumerations according to guidelines: "Lists: Capitalize and punctuate lists if the items are sentences. If the items are one or a couple of words, one uses commas after the item and a full stop after the last one - if it ends the sentence started before the list itself. If the items are longer than that, use sentences."
- L144: "Figure" --> "Fig.~" ("Figure" only at the beginning of a sentence)
- Table 2/3: see comment table 1
- Table 2/3: Daughter Cuts --> not capitalized, in general: why some words are written capital in the table and others not? I would have them all non-capitalized...
- Equation 1: the ingredients to that formula are not defined.
- L174: "term is contained the particle interaction information" --> "term the particle interaction information is contained"
- L178, 180: Don't start a sentence with a symbol.
- L186: "binned both in primary vertex location (2 cm bin width) and in centrality (5% bin width), and only events within a given bin are mixed; i.e. only events of like centrality and of like primary vertex location are mixed." --> Instead of using rather technical terms such as binning etc. it would probably enough to say that "only events of like centrality (within 5%) and of like primary vertex location (within 2 cm) are mixed." or similar.
- L191: "statistics" --> see guidelines: "Statistics" refers to a field of mathematics. Avoid the jargon use of "statistics" as a substitute for "data": "With more data (not "higher statistics") we could measure the Higgs boson mass." Use "improve the statistical precision" rather than "improve the statistics".
- L191: "kT-dependences" --> "kT dependences"?
- L191-192: "are comparable, so an integrated analysis is acceptable." --> where do you show this? If later, then why not bringing the statement only later?
- Eq. 4: comma missing after equation
- Eq. 5: I think this equation needs to be split into two lines
- Eq. 5: comma missing after equation
- L218: is "fake" colloquial?
- L219-220: Commas needed around "whose members originate as daughters from resonances "
- Eq. 6: I would have a "with" before the lambda_ij (perhaps start a new equation)
- Eq. 6: comma missing after equation
- Eq. 7: comma missing after equation
- L252-261: I think it would help to write out somewhere the reaction between lambda_ij and N_ij. I was confused when reading this paragraph (probably reflected in the following comments, some of them might be rather naive for that reason).
- L254: "in the experimental sample" --> I am not sure I understand correctly, is this taken from experiment or from real data?
- L256: "MC HIJING data" --> sound strange to me. Perhaps simply

"HIJING simulations"?
- L257: "which have been run through GEANT to simulate the detector response" --> sounds colloquial to me, please reformulate.
- L261: What is the number of LambdaK pairs? N_ij? I thought this would be the number of ij pairs?
- L263: sound very colloquial to me: "in the eyes of...", "particle born from..."
- L277: "hodgepodge" --> colloquial?
- L278: Use passive instead of "we''/"our". That is not a strict rule though...
- Table 4: caption above table
- Table 4: don't start with a symbol
- L294: "generated with MC HIJING data" --> see earlier comment
- L302: "which" --> ", which"
- L305: "is due primarily to" --> "is primarily due to"?
- L305: what about other sources? Not necessarily to be added to the text but for my own information...
- L306: "event-plane angles" --> this term is not defined before, also I would write "event plane"
- L306: avoid footnotes, see earlier comment (also in the footnote there is the symbol for the event plane that is not introduced)
- L307/308: "intermediate-k_*" and "low-k_*" without "-" in my opinion.
- L308: "but a clean view of it " --> colloquial?
- L314: remove "(open triangles)", "(closed circles)", "(dashed curves)", and "(solid curves)": I am not sure if this detail is needed in the text itself, it is enough to have it in the caption and/or legend in my opinion.
- Equation 9,10: comma missing after equation
- L321-322: "before use with the experimental data" --> is this correct english?
- L331: "This rotation rids the pairs of any femtoscopic correlation" --> I was not aware of the term "to rid sth", but I trust you here as native speakers.
- L339: "between all analyses" --> A relationship can only be "between" two things. For three or more things, use "among". Check also other occasions of "between"...
- L341: Why not adding the "N" once more after "normalization parameter", just to be clear.
- L335-341: I am wondering, why alpha and beta from the background are not mentioned here? They are extracted for each pair and centrality seperately, I guess?
- Equation 11: comma missing after equation
- L361 and following: "errors" --> "uncertainties"
- L361-362: "To quantify the systematic errors on the data, all correlation functions built using all varied cut values were bin-by-bin averaged, and the resulting variance of each bin was taken as the systematic error" --> I do not understand what was done here, probably needs reformulation. I think it would help to start with the fact that selection criteria were varied to estimate the systematic uncertainties and then you can explain the detail of which value was taken as central and which as uncertainty...
- Table 5: caption above table, don't start with a symbol.
- Table 5: See comment in guidelines on "systematics":

"Systematics" is not an English word. Use "systematic uncertainty" or "systematic bias" instead.
- L380: "between the different ΛK charge" --> see comment above for "between"
- L385: "represent statistical errors, while boxes represent systematic errors" --> I would move this information to the caption.
- L385-388: also the details on the style of lines could be moved to the caption, in the text I woudl just mention what is shown (but w/ o its representation on the figure).
- L390: "30-50%" --> "30--50%"
- Caption Fig.3: I would at least add a short description of what the lines are. And also mention systematic uncertainties.
- L410: reformulate "vs."
- L412: "Figure" -> "Fig.~" (see comment above)
- L412: reformulate "vs."
- L413: "centralities" --> "centrality ranges"
- L414: avoid footnotes, see earlier comment
- L429 and 432/433: "out","side","long" not introduced, or do you consider it clear from mentioning "LCMS"?
- L438: "to the second moments " --> probably it is just me that doesn't understand the connection, but how do we measure the second moments?
- L444 and later: Also "C00", "C11" etc. are not introduced
- L444: "1D" --> "one-dimensional"
- L437-452: this paragraph seems somehow "added on top". Since it contains a lot of extra information, I think it should be extended a bit with a short intro and definitions (see above). Also the results of this section are not mentioned in the summary or the abstract, aren't they?
- Caption Fig. 6: Don't start with symbol
- Caption Fig. 6: "1D" --> "one-dimensional"
- Caption Fig. 6: "a non-zero value reveals the asymmetry" -> "." missing?
- Table 6: caption above table
- Table 6: "(sys.)" --> "(syst.)"
- Table 6: somehow the style of table 6 looks different than the other tables in the paper, but perhaps I am wrong.

Appendix:
- L555-556: "rid the correlation functions of the non-femtoscopic background" --> see comment above
- L563: "Figure" --> "Fig.~"
- L564: "does a very good job" --> colloquial? I would rather write that the CF is 1 in regions, where no femto signal is expected?
- L566: I am wondering, where this appendix B is referenced in the text (except in the introductory summary)? If it is not referenced, then I would remove the appendix.
- Eq. B1: comma after equation
- Eq. B1 (and later in the text): should the "C" not be roman (it stands for Coulomb and is therefore not a variable)?
- L572: Don't start a sentence with a symbol
- L574: Don't start a sentence with a symbol

- Eq. B2: comma after equation
- L575: "where, the" --> "where the"
- Eq. B3: "." after equation
- Eq. B4: "." after equation
- Caption Fig. A1: Don't start a sentence with a symbol
- Caption Fig. A1: "centralities" --> "centrality intervals"
- L582: "Fig." --> "Figure " (in the beginning of sentences, elsewhere "Fig. ")
- L588: "one-dimension" --> "one-dimensional"
- L588/589: as commented in the main text the "spherical harmonic decomposition" is not introduced anywhere.
- L605: Remove ")" after Figure number.
- Caption Fig. C3: Don't start a sentence with a symbol
- Caption Fig. C3: "centrality bin" --> "centrality interval"

References
- "et al." not in italics
- [8]: "The alice experiment at the cern lhc" --> Why everything non-capital?
- [8]: Why there is this extra link here? This is not there for other references.
- [15]: journal etc. missing
- [17]: why not citing the latest version? https://journals.aps.org/prd/abstract/10.1103/PhysRevD.98.030001
- [30]: missing information (links etc.)

Figures (could also be done during or after Collaboration review):

- check again the guidelines on figures (https://twiki.cern.ch/twiki/bin/viewauth/ALICE/GuidelineEditing#Figures_and_Tables)

- "Clearly indicate the subfigures with (a) (b), (left) (right) etc. in the caption." (from guidelines): While this is done in the current draft, I was wondering if it would help to actually add (a), (b),.. in some of the figures (especially if they have 6 panels) to make the description simpler. But of course, i leave it up to you.
- Be sure to label both axes of a plot and include the units. Give the binning of one-dimensional histograms in the y axis label, e.g."Events/ 50 MeV"
- Try to make the figures with a uniform style and size throughout the paper (they seem all to have a different style, especially 5,6,C2,C3)
- Avoid use of triangles in figures
- XX--YY% instead of XX-YY% (en-dash instead of dash as in the text)

- Fig 2:
-- remove "preliminary"

-- systematic uncertainties not in the legend
-- fit not in legend

- Fig 3:
-- remove "preliminary"
-- data points not in the legend
-- systematic uncertainties not in the legend
-- fit not in legend

- Fig 4:
-- remove "preliminary"
-- systematic uncertainties not in the legend
-- I am wondering, if one should write the reference directly into the legend (as this is usually done in other ALICE papers), this would make also the additional substitution obsolete ([A] = [2] etc.)
-- Suppress the horizontal lines at the end of the error bars

- Fig 5:
-- systematic uncertainties not in the legend

- Fig 6:
-- add "ALICE" and collision system
-- add legend with data and systematic uncertainties

- Fig C1:
-- systematic uncertainties not in the legend
-- the large brackets in the fit formula look very strange
-- "N" in "dN" italic, "t" in "Delta t*" italic
-- are these observables (r* and t*) explained actually in the text?

- Fig C2:
-- legend missing: what are the symbols, what is the line? Somewhere should be written Terminator on the text

- Fig C3:
-- systematic uncertainties not in the legend
-- light green and magenta shouldn't be used (invisible in projections)