Opponent report of dissertation thesis

Student: Ing. Lukáš Kramárik
Name of the thesis: Open charm production at STAR

This thesis reports about first measurements of D^0 meson production in d+Au collisions with STAR experiment, measured with improved precision thanks to the added HFT detector. The topic is very relevant and of large interest in the community. Student managed to finalise full data analysis on new dataset, made significant advancements in the state-of-the-art methods to reconstruct charm mesons, and performed pioneering work in this direction, as can be seen from his publication. The presented methods bring important insights into the reconstruction of heavy flavor hadrons, which will be hopefully exploited by not only other members of the STAR collaboration, but also elsewhere. The work was presented at well-known international conferences which added to student's visibility in the field. The presented results are important, although new data with higher statistics would be beneficial to allow for conclusions with higher significance. Nevertheless, this work represents an important first step, which is usually the most difficult one, and it will help in future studies, which can build on the knowledge gained from this work.

While the value of presented results is obvious, and the student clearly gained expertise in this topic, I think that the text of the thesis and clarity of the description of technical analysis steps would benefit from more editing and couple more rounds of proof reading. Many terms such as „collective behavior", „transport coefficients", „FONLL calculations", „Pythia tune", „coalescence vs. fragmentation hadronisation mechanism", etc. were not introduced properly, or were described only later in heavy-flavor-specific section, while it would be more appropriate to describe it sooner. The first chapter was written in a form of a list of current measurements, instead of an overall picture based on all these available measurements. The same applies to the Summary, where I would expect to see how the results, including those obtained by the student, contribute to the overall knowledge about mechanisms that affect charm quark propagation through the medium (hot or cold) and its hadronisation, or how does it constrain properties of the QGP and other stages of a heavy-ion collision: did the measurements provide any constraints on transport coefficients? Can we provide estimates of the diffusion coefficient, as was done recently by ALICE collaboration? Can we at least attempt to quantify the potential fraction of CNM effects that contribute to the (un)suppression of Raa in heavy-ion collisions? If the student could try to make this kind of summary in his presentation, it would be an added value to the defense.
In addition, I would like to ask few questions for clarification:

- Fig. 4.4: It is not very intuitive for me to understand why the peak of significance is at such high BDT response values. For example, in the lowest pT bin the peak of significance is at BDT response value = 0.7, but I would say that the highest significance can be around BDT values of 0.4 or 0.5, where background is still close to 0, but signal is higher compared to BDT response = 0.7. Could the student elaborate a bit more about this?
- I would like to ask the student to elaborate more about primary vertex reconstruction efficiency because it was not clear to me from the text. Wouldn't it be useful to do primary vertex re-fit after excluding the D^0 decay products? In that way it is ensured that the vertex position is not biased.
- Fig. 4.38: normally the yield values are not plotted in the center of the pT bin, but are shifted to the left, because the yield is usually falling exponentially. Perhaps, if this would be taken into account, the black fit would be more compatible with the overall trend from 2003 results. Was this tried?
- Fig. 4.38: it would be good to comment on why the older results from 2003 are obtained down to lower pT, while I understood that the HFT detector, added only in 2016, would have a significant added value to the results, especially at lower pT region.
- Based on the comparison of presented results with those from Au+Au collisions, it was concluded that the suppression at pT<2 GeV/c in Au+Au can be explained by CNM effects. However, isn't the supression at low pT believed to be a scaling effect, because the particle production at low pT scales with N_{part} rather than N_{coll} ? Or maybe this doesn't apply to production of heavy flavor particles ?

The results presented in this work are of high quality and represent a complex and new analysis performed individually by the student, which proved his ability to conduct a scientific research on a good level. Therefore, I recommend this work for defense.

In Prague, 23. 1. 2024

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