REVIEW OF THE PHD THESIS

Study of Heavy Flavor at the STAR Experiment

by Ing. Miroslav Šimko

Reviewer: Ing. Miroslav Krůs, Ph.D.

The dissertation reports on the study of charmed baryon in heavy ion (Au+Au) collisions at RHIC within the experiment STAR. The charmed baryons due to their early formation are promissing probes of the created nuclear matter possibly even QGP which still represents a hot topic in high energy physics.

The dissertation is divided into 5 chapters. First there chapters represent a general introduction to the quark-gluon plasma and heavy ion collisions. Other two chapters represent author's contribution. The first chapter introduces the Standard model of particle physics, asymtotic freedom of quarks in QCD and quark-gluon plasma including its expected experimental signatures. Furthermore, the heavy ion collision physics is also presented and its connection to strongly-coupled QGP. The second chapter is focused on the physics of heavy flavor particles; observation of the enhancement of baryons over mesons at RHIC and LHC being the general assumption of QGP signatures. This also can be a consequence of quark coalescence during hadronization process. The history of Λ_c measurements is given within this chapter including the measurements of Λ_c/D^0 for various collisions including Pb+Pb at LHC. The third chapter introduces the RHIC collider including overview of runs during 2013-2020. Furthermore the STAR experiment is described in detail together with its main components: TPC, TOF, HFT, ZDC, and VPD. Within this chapter author also included his contribution to callibration of ZDC towers. The fourth chapter is dedicated to reconstruction of Λc baryon during Au+Au collisions during runs 2014 and 2016. The individual steps of the analysis are described in detail – various cuts use and their optimization, centrality and primary vertex determination, daughter particle track reconstruction including the secondary vertex determination, background subtraction procedure (HFT importance is stressed), detector efficiency correction and systematic error determination. Chapter 5 summarizes the analysis results. The concluding chapter gives the thesis overview, obtained results and also gives an outlook and perspective for further research.

I have a few questions for the author:

1) In chapter 4.1, in the text you state that p_T cut for protons and pions are < 3 GeV/c and < 2 GeV/c, respectively but in corresponding table, you require > 3 GeV/c and > 2 GeV/c. Could you explain that?
2) In Figure 4.36 left panels, what is the difference between top and bottom, do you have the similar figures for run-2016 data? You present here gaussian fit for 3 points, whereas Figure 5.1 (data from combination of both runs) showing the fit over 6 point. Are the data from 2016 of better quality than those from run 2014?
3) As author stated at the beginning of his thesis, that Λ_c can indicate whether hadronization occurs via coalescence, did the analysis revealed that? If the data are

compared to the model of Catania group, it is shown that hadronization occurs via coalescence and fragmentation as in Figure 5.3. Are also avaiable models for fragmentation only, why did you choose to compare your data just with Catania model?

4) Is there any difference or similarity between data from ALICE Pb+Pb @ 5 TeV and you STAR data Au+Au @ 0.2 TeV? Do they suggest coalescence hadronization?

The author performed significant amount of important research and achieved original results on the reconstruction of Λ_c which is not easy task due to its short lifetime and available detector resolution. The author actively presented his work, in behalf of STAR Collaboration, on several international conferences; his analysis results in the paper in PRL being a journal with high impact factor. The author also contributed to the STAR experiment operation and maintanence including the callibration of several detectors.

The submitted work fulfills the requirements for the final work of doctoral studies. Consequently, I recommend, after successful defense, to award Ing. Miroslav Šimko the Ph.D. degree.

Prague 3/3/2021

Ing. Miroslav Krus, Ph.D.

Ústav fyziky plazmatu AV ČR, v. v. i.