The Henryk Niewodniczański
INSTITUTE OF NUCLEAR PHYSICS
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Report on the habilitation thesis

JETS IN PROTON-PROTON AND HEAVY ION COLLISIONS AT THE LHC

written by
Martin Spousta
from the Charles University in Prague

It is a great pleasure to be asked to read the habilitation thesis of dr. Martin Spousta.

Martin Spousta, the Candidate for the associate professorship, presented a habilitation thesis, which comprises of a collection of published papers, authored or co-authored by him. The collection includes eight papers published in scientific journals by the ATLAS Collaboration and two publicly available ATLAS conference notes. The Candidate played a leading role in preparations of these ATLAS publications. The list of presented publications consists also of four conference proceedings written by the Candidate. Four additional papers included in the collection require a special emphasis. Among them is a review article on "JET QUENCHING AT LHC" published by Martin in Mod. Phys. Lett. A and three papers authored either solely by the Candidate or with one or three co-authors, which cover some technical aspects of the jet reconstruction in the presence of huge underlying event background as well as phenomenological studies of the jet quenching phenomenon. All publications comprising the habilitation thesis are grouped into four thematic classes, each of these representing a different area of the Candidate's activity. All of them do justice to the Candidate's role in the advancement of the comprehensive study of jets in high-energy collisions.

The collection of published papers is preceded by an overview, consisting of five chapters and extensive bibliography containing 143 positions. The overview starts with the general introduction to the Standard Model of particle physics, and in particular to its strong interaction sector described by the Quantum Chromodynamics (QCD). It provides a motivation for the study of heavy-ion collisions at the highest energies, and in particular for the jet studies in the presence of the hot and dense matter created in these collisions. This introduction is followed by the discussion of theoretical description of the jet production as provided by the QCD in both perturbative and non-perturbative regimes. Then the jet measurement methods are described, including a critical assessment of advantages and drawbacks of different jet reconstruction algorithms. In chapter 3, the Candidate introduces the phenomenon of jet quenching and presents the experimental evidence for jet quenching from RHIC and LHC experiments, with a detailed discussion of the ATLAS results related to jet quenching. The chapter concludes with a theoretical description of jet quenching. The chapter 4 gives an overall description of the ATLAS heavy ion research program. The presented ATLAS results, obtained for both p+Pb and Pb+Pb collisions, from the study of both soft, low momentum transfer processes and high-transverse momentum objects like electroweak bosons and photons, are discussed in the context of jet measurements. An emphasis is put on the interplay between the soft- and hard-physics phenomena. Chapter 5 gives a short summary and outlines the future perspectives of jet studies.

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The overview can be considered as a guide or elucidation to the collection of published papers. It gives a concise description of the thesis subject, directed to the readers familiar with the topic. It is by no means a criticism from my side, since the physics topic is so broad that a detailed and elementary-level description would take hundreds of pages. Nevertheless, it provides, in my opinion, a satisfactory description of the most important aspects of the study, both theoretical and experimental. It is well written with only few spotted language and editorial errors. Other, although very sparse, shortcomings are:

- On page 1: the statement that the SM does not describe the physics of dark matter and gravity is obviously true, but non-exhaustive as phrasing suggests.
- On page 11, the Candidate is giving values of mean number of participants for LHC, without specifying the collision system (Pb+Pb or p+Pb). In fact the collision system is for the first time mentioned only in chapter 4.
- When discussing the nuclear modification factor, the justification for scaling with the number of binary nucleon-nucleon collisions should be provided.
- On page 89, the 9th reference should be PoS(High-pT physics09)011 to match the attached paper.
- On page 17, the last paragraph should include a reference [65].
- Some awkward phrasings: "longitudinal angle" on page 9; "internal structure observed in heavy ion collisions" on page 23; should be avoided.

However, I strongly emphasize that the above critical remarks do not change my high opinion about the overview and do not affect its excellent *meritum*.

The habilitation thesis presented by Martin Spousta satisfies, in my opinion, the generally accepted standards. It proves Martin's deep knowledge of the thesis subject both at the experimental and phenomenological level as well as his significant contribution to the advancement of our understanding of the jet production in heavy-ion collisions. It has to be noted that the jet study is the foremost and widely disputed topic in the heavy-ion research program.

Overall, in my opinion Martin Spousta has been conducting his research at the exceptionally high level. He has proved himself to be a research physicist with skills spanning the range from experimental, through computational to theoretical and phenomenological physics. It is not surprising for me that he is widely known and respected by the international heavy-ion community. The fact that he gave many talks at international conferences, including invited ones, only proves this recognition. He did an excellent job so far and I am sure that he will continue to make very significant contributions to the field of jet studies. Therefore, I recommend most strongly Martin Spousta for the position of an associate professor and commend his admission to further stages of the habilitation procedure.

Sincerely yours,

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