

Report on habilitation thesis

The structure of hadrons at high energy in QCD

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The habilitation thesis is devoted to the structure of proton. The quest started with the first Rutherford's experiments. Still, hundred years later, we do not understand fully how the proton is made out of its constituents, quarks and gluons, despite the fact that the theory of strong interactions, Quantum Chromodynamics (QCD), has been known for more than 40 years.

The thesis summarizes the major author's contributions to this long quest of understanding proton structure. In the first chapters, the author provides the reader with the necessary theoretical and experimental background. He also sets in his contributions to the picture of the overall effort on understanding the hadronic matter. Selection of the author's papers is then given in the three appendices. The author nicely and in detail documents his personal contributions to them.

The seven papers in Appendix A are selected articles published as a member of H1 Collaboration at HERA collider at DESY. They represent both, the early work from 1992 when Dr. Contreras started his work in the H1 Collaboration as a doctoral student in the group from Dortmund University, and the later work when he led several H1 analysis as a professor in Mexico, either of his own or of his Ph.D. students. For the technical work, he contributed to the improvements of the energy calibration of scattered electrons and to the solving several hardware issues with the Central Silicon Tracker detector. His scientific research focused on the analysis of the forward jet production. A subject which is closely related to his phenomenological work, presented in Appendix B.

The author selects four papers on phenomenology of proton structure at small values of fractional momenta x published by himself and a few colleagues. The first two papers are dedicated to the extraction of intercept of BFKL pomeron from the measured forward jet cross sections. The third article proposes an extension of the geometric scaling of parton distributions functions to larger values of x . The last article, submitted to the journal at the time of writing, represents author's recent work. It is related to the saturation phenomenon and the interpretation of the $F_2(x, Q^2)$ structure function data measured by the HERA experiments.

The third group of five papers represents selected articles published as a member of ALICE Collaboration, an experiment at CERN dedicated to the study of heavy ion collisions delivered by LHC. Dr. Contreras joined the collaboration in 2000. He contributed to the construction of VZERO detector. This device consists of two disks of plastic-scintillators. It provides trigger for hadronic activity. It is used as well to veto background interactions, to

measure luminosity, and to measure the multiplicity of the events. In addition, it is very good to tag rapidity gap events and to select ultra-peripheral collisions. Again, there is a very nice connection between the hardware activities and the author's scientific interest. He led several analysis of photon-production processes in the ultra-peripheral collisions. This work was well recognized by the collaboration and he became later on a convener of the corresponding physics group in the ALICE collaboration.

Dr. Contreras mature scientific personality emerges strongly from the work presented in this habilitation thesis. His work covers many aspects of experimental particle physics, both technical and analysis oriented. The responsibilities given to him in H1 and ALICE experiments show how valuable his work is for the two collaborations and it shows him as a well-respected member of the experimental particle physics community. The author's keen scientific interest in the understanding of the structure of hadronic matter is demonstrated by the series of phenomenological papers, dedicated to certain aspects of proton structure, related to the gluon content at small values of fractional momenta x . The successful leadership of Ph.D. students, documented in the habilitation thesis by several selected papers from this cooperation, then speaks about excellent abilities to motivate students and to steer them through the beginnings of their carrier.

Therefore, I have no doubt that Dr. Jesús Guillermo Contreras work satisfies all the requirements for his habilitation and I recommend a title *docent* to be granted to him.

In Prague, 13. 11. 2015

doc. Mgr. Alexander Kupčo, Ph.D.

