Center for Particle Physics and Phenomenology

UCL Université catholique de Louvain

10 September 2010

To Doktorské Studium

Univerzita Karlova v Praze

Evaluation of the doctoral dissertation by David Šálek titled "Measurement of the Longitudinal Proton Structure Function in Diffraction at H1 Experiment and Prospects for Diffraction at LHC"

Subject of the thesis concerns the proton structure – one of the fundamental issues in particle physics since 1960s and discovery of quarks, and later gluons. These discoveries led in 1970s into establishing Quantum Chromo Dynamics (QCD) as the theory of strong interactions, and eventually to the Standard Model of particle physics. Thesis of Mr Salek discusses measurements performed at HERA – a unique electron-proton collider built in beginning of1990s to provide improvement in resolving power of the proton structure by at least one order of magnitude. This allowed on one hand for stringent verifications of fundamental assumptions in QCD like the pointlike (structure-less) nature of quarks, and on the other hand for novel, deep tests of dynamical aspects of QCD.

Experimentally, the major tool for studying the proton structure, also at HERA, has been the Deep Inelastic Scattering (DIS), and one of the most important results from HERA was observation of a large fraction of diffractive events (where the incoming proton remains intact after interaction) in DIS. Studies of the diffractive scattering became afterward a major research activity not only at HERA, but also at Tevatron, the proton-antiproton collider at Fermilab in the United States. Finally, the diffractive studies at HERA provide valuable insights into QCD, which are relevant for proper understanding of first measurements of the proton-proton interactions at the CERN Large Hadron Collider (LHC), and also for further investigations at a new high energy frontier which just begun in 2010.

The thesis contains the obtained, original results in two major parts: regarding the phenomenological studies of DIS in Chapter 3, and the measurements of diffraction in Chapters 6, 7 and 8. The interesting phenomenological studies were done in collaboration with theorists and were published. The major reported contribution and original result is the first measurement of F_L in diffraction in the H1 experiment. This is not only a novel, but also an important result of fundamental interest. The experimental task leading to it was difficult and complex – it required making very careful measurements of two types at different beam energies, and very deep understanding of the experimental aspects and possible systematic effects. In addition, Mr Salek has made a crucial technical contribution to this and other measurements in H1, by developing a sophisticated calibration technique of the hadronic final states.

Chemin du Cyclotron, 2 B-1348 Louvain-la-Neuve
Téléphone (32 10) 47 32 44 – Télécopie (32 10) 45 21 83
Krzysztof.Piotrzkowski@uclouvain.be

The measurement of F_L provides a coherency test of QCD description of the proton structure as well as of the diffractive phenomena in particle physics.

Finally, although mentioned in the (English) title, the dissertation does not contain original results regarding the diffractive studies at the LHC but only a short introduction to this subject.

The dissertation is well structured and contains the relevant and detailed information. It discusses the subject correctly and thoroughly. One may note however that its editing could be improved, especially given the relevance and complex nature of the studied subject -- in particular, many figure captions require improvements and the thesis reading and understanding would profit from omissions of the jargon expressions. Finally, the discussion of the thesis major results would profit from restricting the description of the already developed measurements (of the inclusive F_L), and by expanding more some relevant aspects of the presented discussions, like the proton dissociative backgrounds, for example.

In summary, the dissertation by David Salek represents a very solid and important experimental work which should be fully sufficient for obtaining the doctoral degree. Mr Salek has shown that he mastered a wide variety of the vital research skills and techniques and is very well prepared to continue deep and meaningful research in particle physics.

Prof. Krzysztof Piotrzkowski

Center for Particle Physics and Phenomenology

UCLouvain

Chemin du Cyclotron, 2 B-1348 Louvain-la-Neuve
Téléphone (32 10) 47 32 44 -- Télécopie (32 10) 45 21 83
Krzysztof.Piotrzkowski@uclouvain.be