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Dear Colleagues

It is with a great interest that I read a doctoral thesis of Radek Žlebčík.

The subject of the thesis is hard diffraction at HERA, more specifically in the H1 experiment. Diffraction was in a focus of interest of high energy physics since nineteen sixties. There are several reasons for that. First, it was shown that the Pomeron - a central object in diffractive scattering - asymptotically dominates total hadron-hadron cross sections, and hence is the essence of strong interactions at high energy limit. It was also realised that it is deeply related to the properties of QCD vacuum. With advent of HERA ep collider it became possible for the first time to study partonic content of diffractive exchange. This gave a new boost to diffractive physics. However in spite of wealth of experimental data and a great variety of measurements of different diffractive processes a 'mystery' of the Pomeron is still not fully revealed from first principles. It represents a complicated interplay of soft and hard phenomena, and theoretical uncertainties of the soft part are still large. Hence understanding of colour singlet exchange remains a major challenge in QCD.

One of the important and hot topics in the area of diffraction at HERA is the question of universality of diffractive parton density functions (DPDFs), as determined in deep-inelastic ep scattering, and factorisation properties of diffraction. The answer to this question should clarify to which extent these DPDFs can be used to predict cross sections in other diffractive process at HERA and also on hadron-hadron colliders. Therefore the topic of this thesis is definitely of current interest.

For a long time the experimental situation in this field was rather controversial, as the H1 and ZEUS analyses came to different conclusions about factorisation breaking in hard diffractive photoproduction. In spite of several attempts to clarify the issue it remained unresolved, due to some unavoidable differences in data samples and analyses techniques between the two experiments.

The presented thesis summarises a new decisive approach to resolve this ambiguity. In the scope of current analysis a new measurement has been proposed and performed, based on the tagged proton diffractive dijet data samples both in photoproduction and DIS regimes. This

for the first time allowed to provide clean measurement of elastic diffraction, free of proton dissociation admixture, which contaminated previous published data by $\sim 20\%$. In addition, a simultaneous analysis of photoproduction and deep-inelastic data samples in otherwise identical experimental conditions and phase space led to a significant improvement in the precision of the final result.

Presented work made new contribution in two distinct areas:

- understanding of extremely complex Very Forward Proton Spectrometer (VFPS) and its implementation in the H1 analysis framework, thus simplifying all future analyses using this device;
- measurement of diffractive dijet cross sections in photoproduction and DIS regimes and their ratio to corresponding QCD expectations at the NLO. The double ratio Data/NLO for γp and DIS cases allowed to determine suppression factor $\langle S^2 \rangle$ with high precision and hence unambiguously establish QCD factorisation breaking in photoproduction at HERA.

The result presented in the thesis is of great scientific importance, in particular because theoretical estimates of *survival probability* $\langle S^2 \rangle$, being a consequence of soft non-perturbative effects, is strongly model dependent. Therefore this measurements can be used to discriminate between different models and to tune them for more precise prediction of corresponding suppression at the LHC.

In the course of the analysis the author demonstrated both high experimental skills and good understanding of sophisticated theoretical calculations as implemented in several NLO QCD programs. Last but not least, it is nice to see that the complicated, but scientifically more solid unfolding technique is used to correct data for detector effects, rather than simplified bin-by-bin correction method which could introduce significant bias to the final result.

It is also worth to mention, that the thesis is well written, contains comprehensive introduction and uses most recent data and results from all HEP colliders. I could figure out only very few caveats and typos (e.g. the phase space in terms of pseudorapidity η is defined slightly differently in tables 5.4 and 6.1) which do not spoil overall good impression of this work. One remark is that sometimes the explanations seem to me too 'shorthand' assuming, that the reader is able to 'reconstruct' by himself some intermediate lines of arguments, which are obvious to the author.

In conclusion, I believe that in spite of few minor remarks of cosmetic nature the presented thesis "Diffractive Dijet Production with Leading Proton in ep Collisions at HERA" by Radek Žlebčík meets high standards and requirements for the Doctoral work.

Yours sincerely

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