

Referee Report on the Doctoral Dissertation

PhD Student: Markéta Pešková

Thesis: Proton structure studies using hard exclusive processes at COMPASS experiment

The PhD thesis of Markéta presents the GPD study with the data collected by the COMPASS experiment. Extending beyond the one-dimensional description of a parton, GPDs correlates its transverse spacial degrees of freedom together with its longitudinal momentum and can render rich information of the hadron of which the parton consists. Markéta's work focuses on the analysis of exclusive π^0 production, which is expected to give access to the chiral-odd GPDs. These GPDs can lead to important insights into proton properties, such as the asymmetry in distribution of polarized quarks inside a unpolarized proton.

In this thesis, the introduction and Chapter 1 give rather detailed descriptions of the basics and theoretical background of GPD study, which I find enjoyable to read. The COMPASS experimental setup dedicated for GPD program is introduced in Chapter 2. The ECALs are essential for detecting the photons from pion decay, and the calibration of them are shown in Chapter 3. Different challenges in the calibration are discussed in this chapter and I think they are reasonably treated. Chapter 4 describes the data processing and event selection, together with the Monte Carlo simulation and background treatment. Ensuring the exclusivity of events and the proper removal of backgrounds are crucial and are addressed in this chapter. The extraction of exclusive π^0 production cross section, together with the study of systematic uncertainties, are presented in Chapter 5. It's nice to see the detailed and thorough examination on various systematic effects. The conclusion is then given in the end.

Overall, the thesis is appropriately structured and drafted with fluent English. One small issue that I noticed is that there are figures placed few pages away from the text where they are first mentioned (for example, figure 1.3). While the wording can be improved sometimes and there are some typos, the thesis in general is easy to understand. Regarding the content of the thesis, there are a few comments and questions I have, which are listed below:

1. In page 11, it is interesting to see the spin decomposition of Jaffe-Manohar , not the one from Ji, is mentioned. Since it is Ji's definition that has the direct link to obtaining the orbital angular momentum by GPDs. Please comment on the difference between these two decompositions and the reason why the one from Jaffe-Manohar is discussed in the text.
2. The latest exclusive π^0 measurement at JLab Hall A using 12 GeV electron beam was published in 2021. Please include their result in Chapter 1 as well.
3. Can the exclusivity of events be identified by the missing-mass technique in COMPASS, just like JLab Hall A?
4. What is the uncertainty of the π^0 distribution amplitude available at this point? Please comment on the impact of it in the extraction of GPDs.

The results acquired by Markéta using new 2016 dataset is consistent with the previous COMPASS publication. With better uncertainty, the results can serve as stronger constraint to GPD parameterization. Moreover, the possibility of studying cross section evolutions in ν and in Q^2 is demonstrated in this study. With the dedicated studies and robust analysis presented in the thesis, the work and ability expected for obtaining a PhD degree is justified without doubt. Markéta Pešková, in my opinion, is well qualified for defending this thesis work.

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Taoyuan City (Taiwan), August 26 2024