Kinematics studies for DVCS and deep exclusive π^0

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April 24^{th} 2020

Introduction

The golden channel to access GPDs is DVCS because fatorization has been proven at all orders and there is no meson structure involved in the process unlike DVMP.

To put the most stringent constrains on a GPD, the dream would be to have:

- Many observables: cross sections, beam/target asymmetries,
- Differential in Q^2, t, ϕ, x_B if allowed by statistics,
- with the fewest holes as possible in the acceptance => Focus of the beginning of this study.

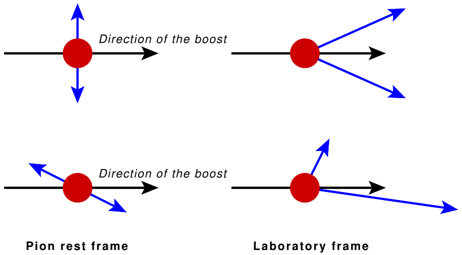
These holes can be caused by:

- gaps between detectors,
- unsubtractable contamination.

π^0 contamination

The main background is the deep exclusive π^0's.

The π^0 energy is shared between the two photons depending on the symmetry of the decay.



In other words, it is a fraction of the decays which are responsible of the DVCS contamination. By Monte-Carlo simulation, you can estimate this fraction as long as you have a sample of cleanly identified π^0s in data for normaliization.

Getting a clean π^0 sample

We need to detect the two gammas of the π^0-decay. But there might be two limitations preventing us from getting the 2 gammas:

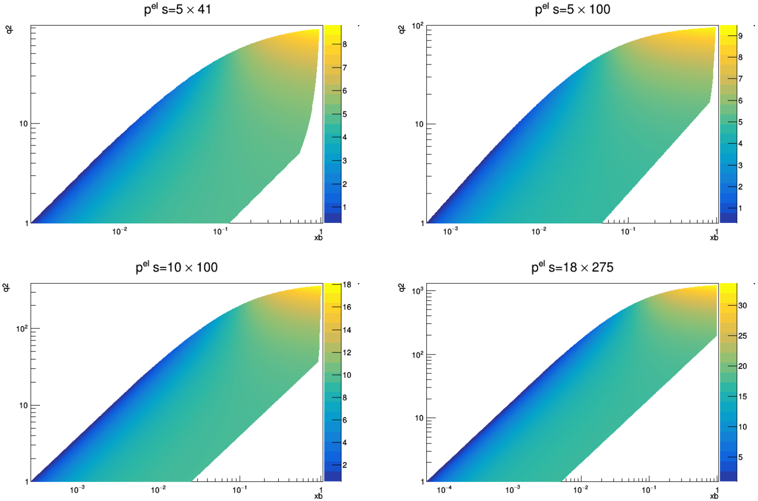
minimum for the energy deposit in the EM calorimeter to be detected => photons are above the threshold in the calorimeter.finite angular resolution => Single cluster for two photons in EM calorimeter.

In the following, we are going to look at π^0 for three t-values:

- $t=t_{min}$ for which the π^0 has the maximum energy for a given Q^2, x_B => Angular resolution
- t=-0.5 GeV^2 and t=-1 GeV^2 => π^0 energy decreases but must be detectable.

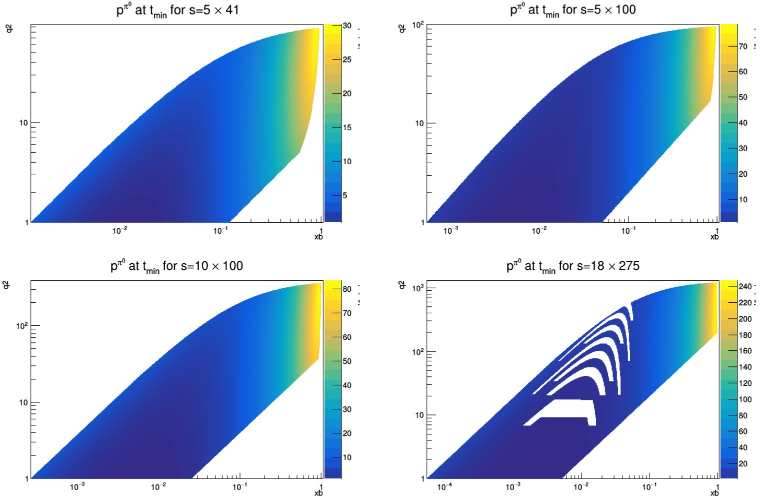
Although we focus on π^0, all the plots are extremely similar to DVCS.

Main cuts: $0.01<y<0.95$ and $W>2$ GeV



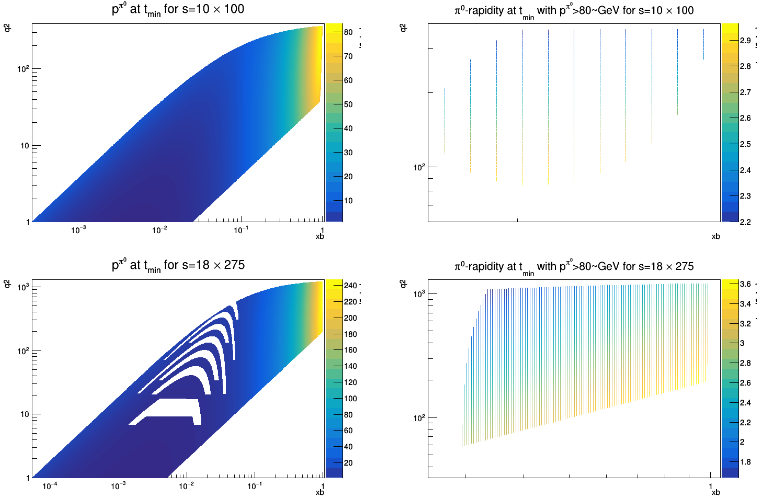
π^0-momentum at t_{min}

For π^0 momentum higher than 80 GeV, two clusters start to merge: Need to look at clustering algorithms and calorimeter granulometry to define high Q^2/x_B boundary.



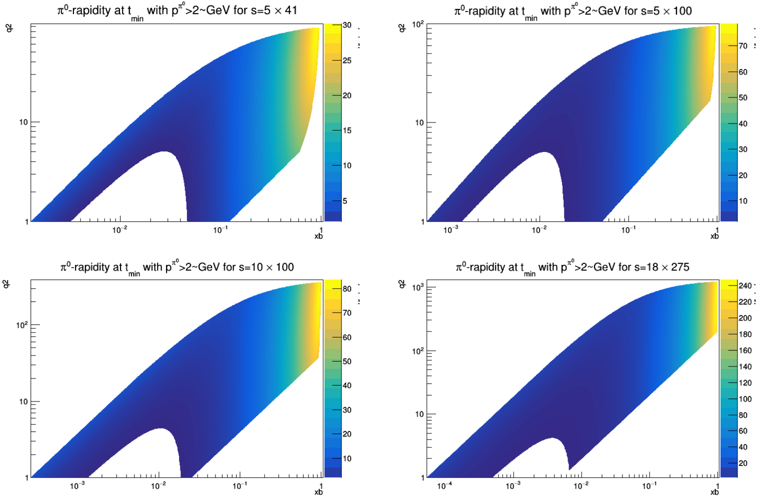
π^0-rapidity at t_{min} for π^0>80 GeV

These π^0's go in the hadron endcap. But the angular resolution doesn't seem to be a pressing matter.



π^0-momentum above 2 GeV for t_{min}

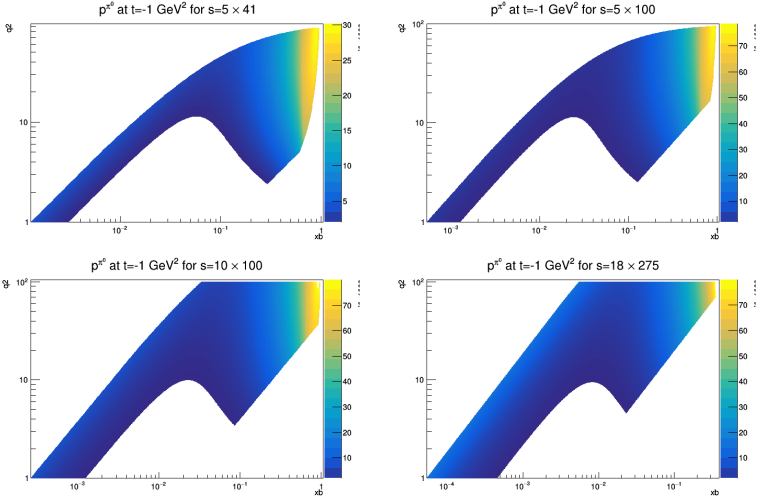
A significant Q^2/x_B phase space has a π^0-momentum below 2-GeV.



So the detection threshold in the EM calorimeter is an important parameter.

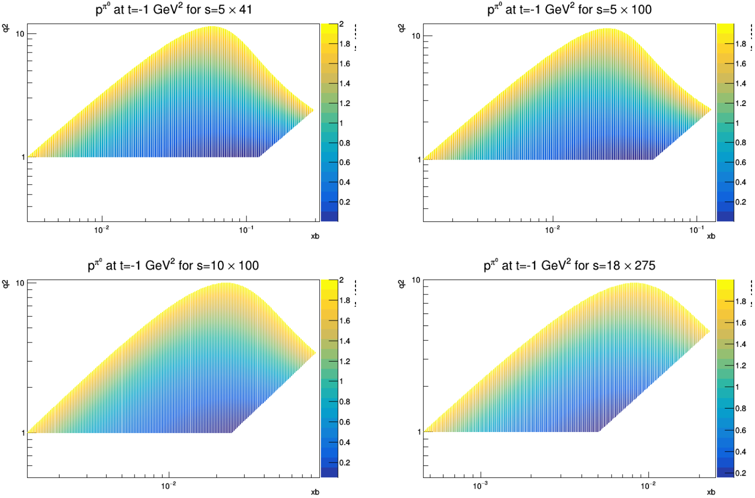
π^0-momentum above 2 GeV for t=-1 GeV^2

It is even worse when considering t=-1 GeV^2.



Zoom on low momentum π^0

Need to evaluate the consequences on the t-truncation depending on the detection threshold in calorimeter.



Partial conclusion

- the angular resolution of EM calorimeter in hadron endcap will definitely limit the reach to high-high Q^2 for high x_B for high s. But how much statistics to we expect after a decade running?
- Probably most annoying, the π^0-momentum can be very low for xB between 10^{-1} and 10^{-2} for Q^2<10 GeV^2. Therefore the thresold for detection may truncate the t-range.

Perspective

- Need to look at the acceptance: proton acceptance and 3-particle acceptance in four dimensions.
- Once all key parameters has been identified, then proceed with pseudo-data with “realistic” acceptance and test full chain in collaboration with PARTONS team.

I try to avoid as much as I can for the moment to play with model:

- The photon electroproduction cross section is driven by Bethe-Heitler.
- Quid about the reliability of models for π^0. Safe assumtpions: The lower the $Q^2 andthehigherx_B, thiehigherthe \pi^0$ cross section will be. Fair estimate: compare both cross sections at phi=180 degrees.