Topics for student faculty grants

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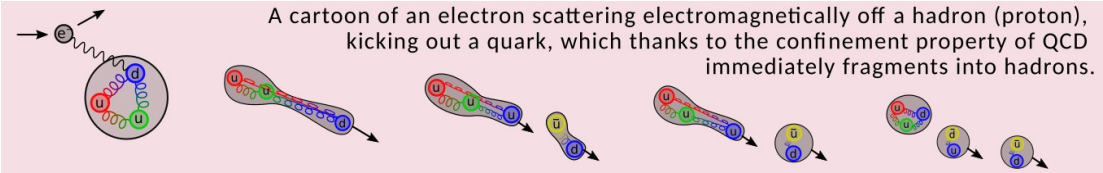
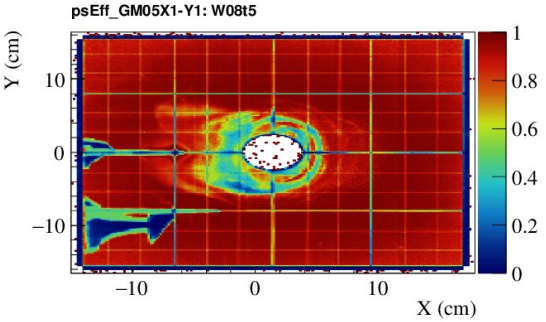
Monte Carlo studies of hadron production in deep inelastic scattering

Our group is studying the distributions of charged hadrons in deep inelastic scattering at COMPASS experiment at CERN to learn about the quarks within the nucleon. However, the distributions of final state hadrons depend not only on the nucleon structure, but also on the fragmentation (hadronisation) process in which the interaction between the struck quark and the spectator quarks give rise to the final state hadrons. In addition, some of the hadrons decay soon after, so part of the hadrons reaching the detectors are secondary. These effects can be studied in Monte Carlo simulations. Recently, a first plugin for fragmentation of polarised quarks has been developed for the Pythia event generator by our Trieste colleague [arXiv:2305.05058]. As we are interested in correlations within the nucleon involving quark spins, we would like to test and start using this model to better understand our experimental observations.



Development of software tools for detector efficiency simulation



Efficiency of a particle detector can vary across the detection plane. There may be broken readout cards serving a group of wires or strips, less efficient photomultipliers of scintillating detectors, effects of space charge or aging in wire chambers... The measurements need to be corrected for these effects. 2D detector efficiency maps were measured and are being used in our simulations. However, unbiased measurement of the efficiency is computationally very intensive. To take into account variation of the efficiency in time, corrections could be determined based on the so-called pseudo-efficiency, which is biased, but much less demanding to obtain. The goal of this project would be to develop a tool for the application of such corrections and in general for easy 2D efficiency comparison and manipulation.

Feasibility studies of hadron channels in deep inelastic scattering

Distributions of hadrons produced in deep inelastic scattering allow us to learn about the quarks within the nucleon. Charged hadrons produced are mostly pions and kaons. Interpretation of the measurements is more accurate if the hadrons are identified, as they are sensitive to different quarks in the nucleon due to their own quark content. The identification is possible using the Cherenkov effect. An alternative is looking at short-lived neutral hadrons like ρ^0, φ, π^0, K^0, Λ or J/ψ via their decay products. It is also desirable to understand to what extent the hadrons from these decays enter the standard charged hadrons sample and how they influence it. The aim of this study is to analyse COMPASS data in a simplified ROOT format checking the yields and simple distributions of the short-lived hadrons to evaluate the feasibility of their further studies.