Internship report: stability test of 2008 COMPASS data

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Abstract

The main goal of this project is to look for the abnormal runs from COMPASS experiment (2008). The COMPASS data being analyzed for each run were already preselected before the stability test. For seeking the abnormal runs, different parameters in each event are extracted and investigated, such as the position of primary vertices, angular distribution of recoiled protons, invariant mass of three pions, etc. By plotting values of the parameters from each different run, run number 70195, 69612, 70223, etc can be directly selected out because of disparities to the normal runs. The most significant abnormalities result from the inconsistency of half width value from pions and photons' invariant mass. The explanation of these disparities are made by further inspecting the corresponding photon number from ECAL2 and recoiled proton angular distribution.

1 Introduction

The COMPASS stands for "Common Muon and Proton Apparatus for Structure and Spectroscopy", a fixed target experiment for investigation of nucleon spin structure and hadron spectroscopy. The final experimental results are concluded by analyzing the data recorded by multiple kinds of detectors during process of scattering. Due to the complexity and sensitivity of COMPASS detectors, recorded data can be easily sabotaged by unexpected external conditions, such as electronic malfunction or unusual shutdown of components. The data with those unwanted effects should be selected out for improving the quality of data analysis in the final step. In this project, the abnormality resulting from these effects are only investigated for the data with different run numbers. By calculating and comparing values of multiple characteristic parameters of each run, the abnormal runs can be identified and further examined to postulate their probable causes. In the end, by checking the already existed information in log book, it then can be determined the data of which runs should be discarded.

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2 Target and Detectors

COMPASS experiment comprises large number of detectors, for identifying and measuring the particles coming out of interaction vertices. There are also detectors which monitor the particle beams and trigger other components to decide when the signals should be read out or not. In this section, the basic functionalities of different kinds of detectors are introduced in a simple manner.

2.1 Particle beam and target

To create the projectile particle beam, the proton beam, which is accelerated by the Super Proton Synchrotron (SPS), is firstly directed into Beryllium. From the nuclear reaction between proton and Beryllium nucleus, a secondary hadron particle beam is created, which is the incoming particle beam for the scattering experiment. In this project, the hadron beam is selected to be negative charged pion beam. But a small fraction

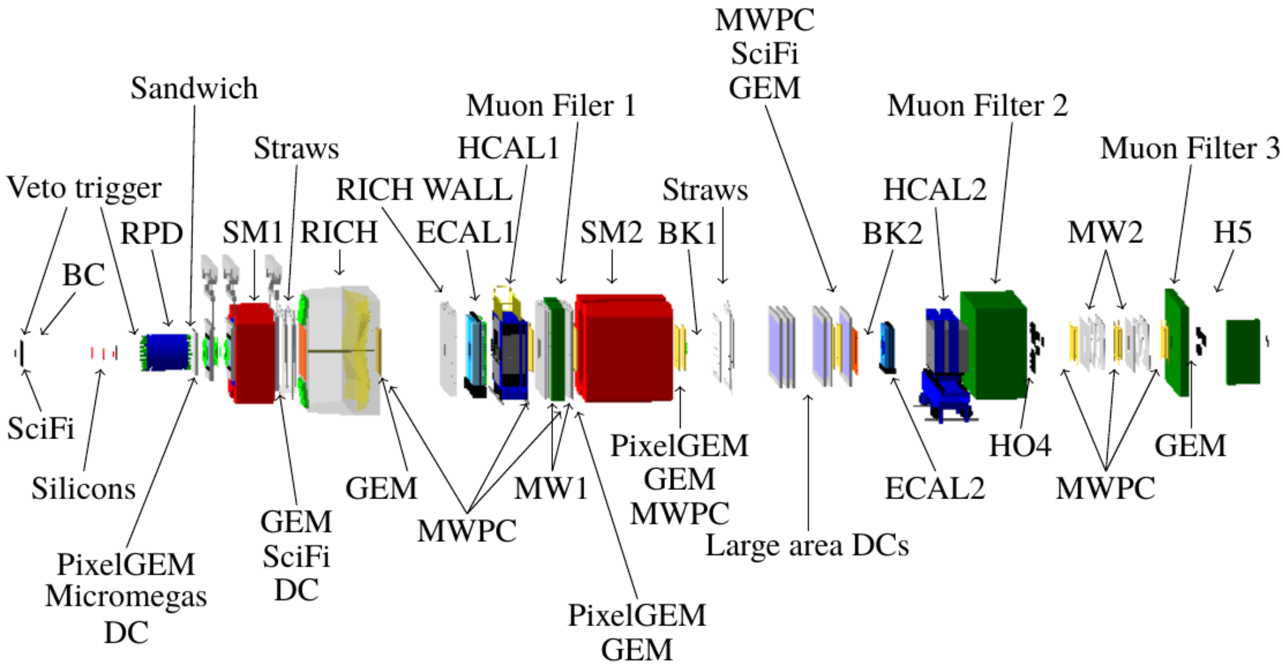

Figure 1: The layout of COMPASS detectors. The length of whole setup is around 50 meters. Pion beam comes from the left side of detectors and hits the target, which is surrounded by recoil-proton detector (RPD). On the right side of target, two different sets of detectors are used to measure out-going particles with small and large scattering angles.

of Kaon (2.4 %) can also exist in the incoming particle beam [ref]. The proton target, onto which pion beam is diverted, is in form of liquid hydrogen stored in a 40 cm height cylindrical container (see section).

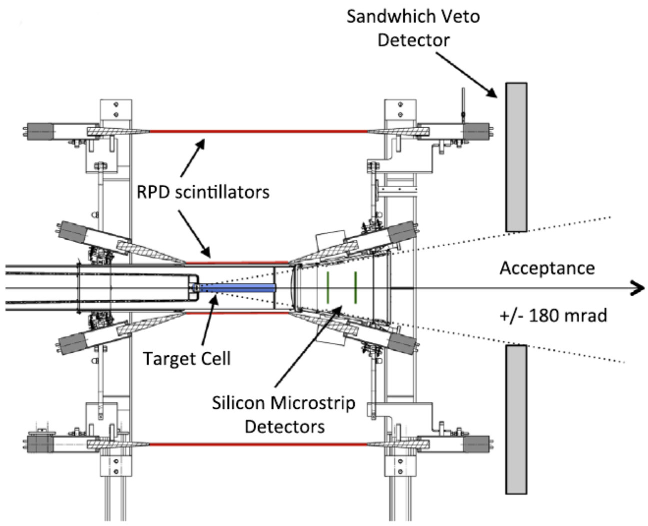

Figure 2: Scheme of detectors around the target region. The sandwich veto on the right prevent unmeasurable events with large scattering angles. Source: [ref]

2.2 Detector layout

The layout of COMPASS detectors is shown in figure 1. Proton target is located inside the RPD (recoil-proton detector). On the left of target locate SciFi (scintillating fiber), BC (Beam counter) and silicon detectors. The coincidence of signals from SciFi and BC is used for the beam trigger, setting the time reference of whole system. The silicon detectors are applied for determining the location of projectile beam, which is further used to calculate the position of primary vertex. On the downstream very close to the target, there are sandwich veto and PixelGEM/Micromegas/DC (Pixel GEM detector, micromegas detectors and drift chamber). The function of sandwich veto is to reject the signal readout when the scattering angle of out-going particle is too large to measure. The structure of sandwich veto can be seen in figure 2, where the veto is triggered if scattering angle is out of acceptance.

3 Process and data preselection

3.1 Scattering process

3.2 Data acquisition

3.3 Data preselection

4 Analysis and results

5 Conclusion

References