STUDY OF THE PROTON STRUCTURE VIA DEEPLY VIRTUAL COMPTON SCATTERING AT COMPASS AT CERN

Overview The generalized parton distributions GPD provide the most complete description of the partonic structure of the nucleon including form factors and parton distributions. They give a 3-dimension picture of the nucleon by determining the correlations between position and momentum of partons inside the nucleon. These functions can be accessed by deeply virtual Compton scattering which is studied for the first time at COMPASS at CERN. The proposed work is the participation to all the different steps of an experiment: detector technique, data taking, analysis of the data and interpretation of the results.

DESCRIPTION OF THE RESEARCH TOPIC

Proton keeps still several secrets: it is made of quarks and gluons but the total mass of its constituents is really smaller than the proton mass, the nucleon spin is ½ but the sum of the intrinsic spin contributions of quarks and gluons does not give ½. A detailed 3 dimensional picture providing the correlations between position and momentum of partons inside the proton can be made using deeply virtual Compton scattering (DVCS). Two complementary programs have been initiated by physicists from the Irfu/SPhN at Saclay, using 12 GeV electron beam at JLab in USA and 160 GeV muon beam at COMPASS at CERN exploring the quark valence domain and the sea quark and gluon domain respectively.
The proposed work concerns the DVCS experiment at COMPASS at CERN. First tests have been performed in 2012 (see fig. 1) and the data taking will be done during 2 times 6 months in 2016 and 2017. In the DVCS reaction the high energy 160 GeV polarized muon beam scattering on a hydrogen target provides a virtual photon which interacts with the constituents of the proton to give a unique real photon emitted at high energy in the forward direction and a proton recoiling with a small energy at large angle. To select at best this exclusive channel among all numerous competing reactions, a recoil proton detector, CAMERA, has been designed and built by the Saclay team.

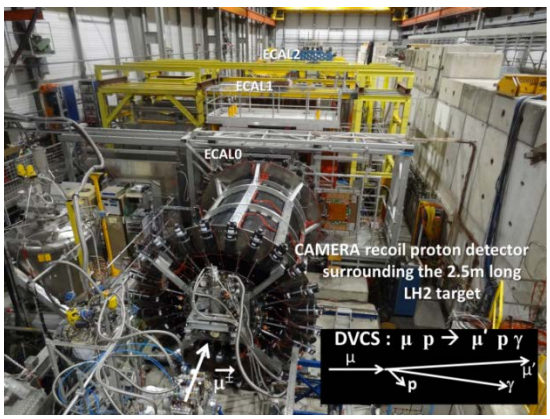

Figure 1 : The COMPASS experiment at CERN with the recoil proton detector CAMERA installed around the target or all the other detectors along 60m downstream.

DESCRIPTION OF THE TEAM

The PhD student will work in the laboratory of Nucleon Structure (LSN) at the Irfu/SPhN at the CEA-Saclay and in the site of the COMPASS experiment at CERN close to Geneva. The COMPASS collaboration comprises 220 physicists from 13 countries. The SPhN team plays important roles in the COMPASS Collaboration (from management of the Collaboration to realization of several key detectors and development of scientific programs). The SPhN team has initiated and is leading the new DVCS experimental program and the data analysis.

PROPOSED WORK

The student will participate to all the different steps of an experiment: preparation of the detectors, learning of detection techniques and detector calibration, data taking during 2 times 6 months in 2016 and 17 and data analysis as well as interpretation and comparison to simulations based on MC method using different GPD models.
The data analysis will also be done in parallel by another student from another institute. Regular meetings with the collaboration will be organized to give the opportunity to the students to present and discuss their results.
Preliminary internships can be done on related topics.

DEVELOPED SKILLS

Programming and performing data analysis.
Statistical methods, C++, ROOT.
Detection technics for nuclear physics.
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