

## « EXPERIMENTAL STUDY OF THE NUCLEON 3D-IMAGING AT JEFFERSON LAB »

### OVERVIEW

The experimental study of the nucleon structure in terms of its elementary constituents, quarks and gluons, is one of the main research programs followed at Jefferson Lab (JLab) in the USA. More specifically, the study of the Generalized Parton Distributions (GPD) offers new insights on the nucleon, giving access for the first time to a 3-dimensionnal information about its structure. Recent theoretical progress is associated to an active experimental program in this field of hadronic physics. Indeed, the energy of the electron beam delivered by the JLab accelerator has been increased from 6 to 11 GeV, opening a new kinematical domain with an unprecedented statistical accuracy.

Generalized Parton Distributions are accessible through exclusive processes, *i.e.* all particles of the final state are detected. The simplest process to access GPDs is Deeply Virtual Compton scattering (DVCS)  $ep \rightarrow e\gamma$ . A dedicated experiment, lead by the CEA in the Hall B of JLab, will run in 2016, once the accelerator and experimental halls have been upgraded. The CEA is not only leader in this field, but actively participates to the upgrade of the detectors in Hall B. Indeed, a new generation cylindrical tracker is currently under construction at the institute and will be placed around the target, as seen on Figure 1. This very high-tech detector – the first of its kind – will allow to separate the DVCS events from the background.

### DESCRIPTION

#### GROUP/LAB/SUPERVISION

The student will join the “Laboratoire Structure du Nucleon” (LSN, Hadronic Physics Lab) in SPnN. LSN is composed of two experimental teams respectively based at JLab and CERN, and of a theory/phenomenology team. The student will have the possibility to contribute to all aspects of her/his group. This mixed experiment-theory laboratory is *de facto* the ideal place for the experimental studies previously introduced.



**Figure 1 :** Cylindrical Micromegas tracker for CLAS12 under construction at IRFU.

### MISSION

The PhD student will participate to the end of the installation, the integration and the first tests in beam operation of the cylindrical tracker. Therefore he will actively participate to the crucial phase which is the start of CLAS12, the brand new spectrometer currently being installed in the Hall B, in the end of 2016.

Then, the student will participate to data taking in 2017. Then will follow the calibration and analysis of the corresponding data. Finally, in collaboration with the phenomenology team of LSN, he will work at the interpretation and publication of the first DVCS data at 11 GeV.

This thesis is particularly complete: It will allow participating to all the phases of an experiment, from the integration of the detectors to the publication of the results.

The student should expect frequent trips to the USA for the installation and data taking, as well as to the rest of world for presenting his results.

### REQUIRED SKILLS AND FORMATION

The PhD student should have a basic knowledge in instrumentation and computer science in order to efficiently participate to the first part of the thesis. An experience of oriented-object programming, ideally in C++, would be an asset for



the data analysis, without being mandatory. The data interpretation and the phenomenology will be based on a basic knowledge in Quantum Chromodynamics (QCD).

In order to apply, the students need to have or prepare an M2-level or equivalent (as provided by an engineering school for instance).

Summary of required skills: Electronics, signal processing, mechanics, instrumentation, numerical analysis, simulation, object oriented programming, synthetic thinking, oral presentation, teamwork.

## COLLABORATIONS

The student will interact with several local actors: experimentalists of IPN/Orsay, theorists of CPhT in Ecole Polytechnique and of LPT in Orsay. He will be a member of the CLAS collaboration. He will present his results to the represented experimental collaborations in the laboratory and also in international congresses.

## CONTACTS

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