Landmarks of GPDPortal/Small-x/TMDPortal/SIDIS-3D-EXP joint project

The purpose of this document is the definition of the main landmarks resulting from the fusion of **four projects**: GPDPortal, Small-*x* gluons in colliders, TMDPortal, SIDIS-3D-EXP. Despite all of these projects are concerned with the study of hadronic structure, they encompass a broad range of topics. In order to better justify the allocation of the requested resources, we categorise the project into two main macro-areas:

1. exclusive and diffractive processes,
2. inclusive and semi-inclusive processes.

For each macro-area, we list a number of tasks requesting and justifying the workforce necessary to carry them out. It is important to stress that the accomplishment of each task will result in a contribution to a common virtual infrastructure, a web portal, which will collect the outcomes of this project making them available to the community.

1.1 Exclusive and diffractive processes

This part of the project is concerned with the study of processes characterised by exclusive or diffractive events. These two processes encode different, and yet related, information on hadron structure. On the one hand, exclusive processes give access to generalised parton distributions (GPDs) which, broadly speaking, provide **a spatial picture** of the distributions of partons inside hadrons. Diffractive processes, on the other hand, probe the so-called **saturation regime** in which hadrons are predominantly populated by gluons, that give rise to non-linear effects in their evolution caused by recombination.

The proposed tasks are:

- The implementation of **next-to-leading order (NLO) corrections** to hard exclusive processes, impact factors, and evolution equations. The purpose is to allow for the extraction of hadron-structure properties from data for exclusive and diffractive processes to NLO accuracy. Given the typical energies of exclusive and diffractive processes, NLO corrections are known to be large and thus necessary for and accurate description of data. For this task, we request one postdoc year.
- The implementation of **higher-twist** (HQ) effects in exclusive processes aimed at extracting GPDs from data. Since exclusive processes are characterised that low energy scales, HQ are expected to be sizeable in this kinematic regime. Therefore, their implementation is fundamental towards an accurate extraction of GPDs. Also for this task we request one postdoc year.
- The implementation and the deployment of **mechanical constraints** on GPD parametrisations. The purpose is to study of the mechanical properties of hadrons through the energy-momentum tensor (EMT), which encodes fundamental information on the structure of hadrons. Again, we request one postdoc year to devote to this task.

1.2 Inclusive and semi-inclusive processes

Inclusive and semi-inclusive processes give direct access to **momentum distribution** of partons within hadrons, thus providing complementary information with respect to exclusive processes. However, contrary to the exclusive and diffractive cases, inclusive and semi-inclusive processes are intrinsically characterised by larger energies. For this reason, thanks to past, current, and future high-energy facilities such as HERA, Tevatron, the LHC, and the EIC, a large amount of precise data is already present and

more will soon become available. For the point of view of hadronic structure, this puts us in a unique position in that this experimental information needs appropriate tools to be analysed. This is the purpose of this part of the project: providing the community with numerical tools aimed at the extraction of information on the hadron structure from inclusive and semi-inclusive processes to high accuracy.

We propose the following tasks:

- The construction and the deployment through a **public platform** of a framework devoted to the extraction of **transverse-momentum distributions** (TMDs) from experimental data. We will make publicly available the most accurate theoretical calculations currently available within different formalisms, as well as cutting-edge methodologies exploiting **machine-learning** techniques for the extraction of TMDs. We plan to devote 1.5 postdoc years to this task.
- We also plan to host on the same platform deployed for TMDs, a numerical framework devoted to the extraction of **collinear fragmentation functions** (FFs) from data. FFs are fundamental quantities that encode information on the non-perturbative processes that lead to the formation of hadrons from partons. Moreover, they are also fundamental to constrain TMDs in **semi-inclusive processes** characterised by identified hadrons in the final state, such has semi-inclusive deep-inelastic scattering (SIDIS). We request 0.5 postdoc years to carry out this task.
- We aim at developping GPU-based algorithms for a **joint analysis of COMPASS and CLAS12** data for **SIDIS observables**. More spefically, we propose to develop and make public through the PYTHIA Monte-Carlo event generator a parton shower able to include TMD and spin effects in the hadronisation. Using this tool, we will also perform impact studies via full simulations and reconstructions using the software stack that is presently developed by the **ePIC Collaboration** at the EIC. One postdoc year is requested for this task.

In conclusion, considering both parts of the project, we request resources to cover a total of **six postdoc years**. Estimating an average cost of 65k euros per postdoc-year and including 25% of overhead costs, the budget requested amounts to **520k euros**.