About me:

I am Tetiana Yushkevych, a postgraduate student of the Department of Theoretical and Experimental Nuclear Physics at Odessa State Polytechnic University. In the last four years, the topic of my research has been “Applying of the Laplace method for elastic and inelastic hadron scattering”.

In addition to that, I took part in a project on “Development of a method of multiparticle fields for elastic and inelastic hadrons scattering” on a government grant (national registration number: 0119U103982).

I have written software in FORTRAN and C and I would like to learn more about modern scientific software as an IRIS-HEP Fellow. I believe that I can apply my knowledge in practice in Fellowship program, which will allow me to develop as a specialist in my chosen field.

Understanding Semi-Inclusive Measurements

Measurements of semi-inclusive deep-inelastic scattering (SIDIS) offer a tremendous opportunity to learn about the partonic structure of nucleons. For a correct phenomenological interpretation of the information they encode, it is vital to develop tools that allow experimental data to be connected to the corresponding theoretical framework. Factorization theorems only apply under specific kinematic conditions, essentially dictated by power counting. It is therefore very important to be able to identify as precisely as possible the sensitivity of each data subset to those kinematic requirements.

Region indicators, R_i, first introduced in Refs. [1, 2],have been implemented to quantify our confidence in the proximity of SIDIS observables to a particular physical mechanism. For this purpose a new tool, “affinity” has been derived to facilitate the separation of phase space regions where different factorization formalisms apply [3]. The main idea is to quantify affinity by combining information from the Monte Carlo generation of partonic configurations and the resulting ratios R_i into a single estimate of proximity to a particular hadron production region, which ranges from 0% to 100%. The affinity to the TMD current fragmentation region has been estimated for HERMES and COMPASS datasets for unpolarized multiplicities, and for Jefferson Lab and EIC kinematics. The proximity of the current fragmentation region for large transverse momenta described by a collinear QCD treatment, and the transition region from the TMD to collinear factorization descriptions has been quantified as well [4].

Further phenomenological research and special theoretical studies are required to for the target and central region. This will include the extension of software tools and will be the focus of my project.

Project Plan:

Week 1

Study the paper "New tool for kinematic regime estimation in semi-inclusive deep-inelastic scattering" [3] and the nuclear theory provided in it.

Week 2

Familiarize myself with the Jupyter Notebook provided by Jefferson Lab. By the end of the week, I will be able to understand its functions and parameters.

Weeks 3-4

Modify the Notebook e.g., for another experiment and kinematic region.

Weeks 5-6

Modify the theory, i.e. changing the parameters that go into the affinity calculations, and studying the effects.

Weeks 7-8

Writing new software, also using Jupyter Notebooks, for studies of the parameter space. The main questions will be:

- How does the affinity results for a given experiment, obtained in the Jupyter Notebook, depend on the theoretical parameters?
- Which one are the most dominant ones?

Week 9

Wrap up the project. Prepare a report on the results of research. Create and present a final presentation of the project.

References:

1. M. Boglione, J. Collins, L. Gamberg, J.O. Gonzalez-Hernandez, T.C. Rogers and N. Sato, *Kinematics of current region fragmentation in semi-inclusive deeply inelastic scattering*, Phys. Lett. B766 (2017) 245 [1611.10329].
2. M. Boglione, A. Dotson, L. Gamberg, S. Gordon, J.O. Gonzalez-Hernandez, A. Prokudin et al., *Mapping the kinematical regimes of semi-inclusive deep inelastic scattering*, JHEP 10 (2019) 122 [1904.12882].
3. M. Boglione, M. Diefenthaler, S. Dolan, L. Gamberg, W. Melnitchouk, D. Pitonyak, A. Prokudin, N. Sato, Z. Scalyer, *New tool for kinematic regime estimation in semi-inclusive deep-inelastic scattering*, JHEP 04 (2022) 084 [2201.12197]
4. J. Collins, L. Gamberg, A. Prokudin, T.C. Rogers, N. Sato and B. Wang, *Relating transverse momentum dependent and collinear factorization theorems in a generalized formalism*, Phys. Rev. D94 (2016) 034014 [1605.00671].