1.0 Phenomenological Study of Hadronization in Nuclear and High-Energy Physics Experiments

Principal Investigator: Markus Diefenthaler

Project Status

In addition to weekly remote meetings, we held two in-person workshops at Jefferson Lab (December 1-2 2016 and February 20-22 2017). In our workshops, we reached out to the Jefferson Lab community via a Pythia8 tutorial by Stefan Prestel (Fermilab) and a theory seminar by Leif Lönnblad (LUND). In the first months of our project, we have focused on three milestones of our project:

Milestone 1 In a comparison to HERA data at both high (H1, ZEUS) and low energies (HERMES), we have started to verify Pythia8 as a Monte Carlo Event Generator (MCEG) for deep-inelastic scattering (DIS). As part of our December 2016, we held a first tutorial session for simulating DIS data with Pythia8 that was well received (40 participants). We are in process of writing up our publication on "Describing Deep-Inelastic Scatting in Pythia8".

Milestone 2 A key difference between the nuclear physics (NP) and high-energy physics (HEP) approaches is the treatment of hadronization. We are studying these differences and have designed an analysis where simulated events of electron-positron annihilation using MCEG are used to construct semi-inclusive observables to be described within the QCD factorization theorem. We have found a good agreement between NP and HEP approaches in the energy ranges from 30 GeV to 1TeV. We are currently analyzing the region below 10 GeV.

Milestone 3 We have started the work on a publication to compile a list of instances where traditional NP and HEP efforts have worked toward solutions to similar, though superficially different, physics problems.

Project Plan

Milestone 1 We aim to publish our manuscript on "Describing Deep-Inelastic Scatting in Pythia8" in European Physical Journal C in FY17.

Milestone 2 We will analyze the region below 10 GeV in detail and are planning to submit our publication in FY17.

Milestone 3 We will provide translations between the terminology, notation and conceptual viewpoints of NP and HEP methods, so that researchers in each subfield may better communicate. We aim to provide a rigorous mapping between concepts formulated in TMD factorization theorems and those used in non-perturbative hadronization theory.

Milestone 4 The work on a hadronization plugin for Pythia8 will start in the second half of FY17.

Budget (until March)

Labor $14,926
Purchase Labor/Consultant $2158
Staff Travel $2,952
Other Travel $10,317
Conference Fees $100
G&A $13,420
Total $43,873

Budget: The LDRD staff will provide a graph of budget progress after you submit your report. It will become an appendix to your report, and be on a separate page.

Publications

Workshops/Conferences

M. Diefenthaler, *Mapping the hadronization description in Pythia to the correlation functions of TMD factorization*, invited talk at the "7th Workshop of the APS Topical Group on Hadronic Physics" (GHP17), Washington, DC, USA, February 1-4, 2017.

M. Diefenthaler, *Mapping the hadronization description in Pythia to the correlation functions of TMD factorization*, invited talk at the " 3D Nucleon Tomography Workshop", Jefferson Lab, Newport News, VA, USA, March 15-17, 2017.