EIC Detector R&D Progress Report
Reporting Period: From October 26, 2012 To May 17 2013

Project Name: 2012-5 Physics Simulations

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Past

What was planned for this reporting period?

1. We planned to publish two papers related to the newly developed program Sartre, an event generator for exclusive vector meson production in diffractive ep and eA collision based on the dipole model. The first paper was intended to focus on the methods and underlying theory of Sartre as well as predictions for diffractive processes in eA collisions at an EIC. Intended target journal was PRC. The second paper was intended to be more an in-depth technical description of the code to be submitted to the Computer Physics Community. We also planned to construct an on-line user's manual where the program will also be available for downloading.

2. We intended to continue the work with Marco Stratmann (BNL) on developing a new technique to calculate the running of the structure functions F_2 and F_L in e*p* and eA without going down to parton level. This was planned to be conducted in collaboration with Martin Hentschinski (BNL). This novel technique would allow to make direct and precise predictions for the EIC in the linear QCD picture to be compared with predictions of higher-twist (saturation) scenarios.

3. We planned to start studies of fits to unintegrated gluon densities within the CASCADE framework. CASCADE is an event generator for ep collisions developed by Hannes Jung from DESY. The fit will be made within the dipole model to HERA data. The resulting unintegrated gluon density can then be extended to *e*A using techniques we invented during the development on Sartre. This should ultimately lead to the extension of CASCADE to generate eA collision with saturation in the initial state. That is a tool urgently needed to study eA collisions at an EIC.

What was achieved?

We published the physics paper (Phys.Rev. C87 (2013) 024913), and are on the verge of submitting the mentioned paper to CPC. We have constructed an extensive on-line user's manual available in html and a public web site and repository on google-code, where the program is also available for downloading (http://code.google.com/p/sartre-mc/).

For the publication (PRC) we showed for the first time with Sartre that the spatial gluon distribution of a nuclei can indeed be experimentally extracted from exclusive vector meson production at an EIC. This is one of the key measurements at an EIC. We showed that the accessible t-range and statistics are sufficient to conduct this study.

Marco Stratmann and Martin Hentschinski have worked out the technical aspects of using physical anomalous dimensions, and we are now in a position where the method can be used for comparative studies of structure

functions between DGLAP and rcBK. These studies are complex but good progress has been made.

We have begun to perform fits of the unintegrated gluon densities with CASCADE using the new version of HERA-fitter.

What was not achieved, why not, and what will be done to correct?

All projects related to this R&D are underway. The work on the extension of the CASCADE generator to eA was slightly delayed due to the work load of the prime author (Hannes Jung). The new technique of evolving the structure function F_L and F_2 was delayed due to unexpected numerical issues that are solved now.

Future

What is planned for the coming months and beyond? How, if at all, is this planning different from the original plan?

We plan to finish the unintegrated gluon fit with CASCADE in the next weeks and use it to extend CASCADE to *e*A-collisions. We plan to implement CASCADE into the framework of the existing *e*A-hybrid, using our nuclear uPDFs in CASCADE for matrix-elements and parton evolution, Pythia for hadronization (standard in CASCADE), and FLUKA (in DPMJetIII) as an afterburner for hadronic energy-loss in a cold medium and nuclear breakup and evaporation.

With our dipole model, saturation is inherent for small x in the nuclear initial state. We also have plans to include perturbative saturation in the CCFM-evolution in CASCADE.

We will continue to not only maintain but improve the Sartre event generator and keep the documentation up to date.

What are critical issues?

Maintain man power past the current R&D effort to maintain and possibly extend the developed event generators for the EIC community.

Additional information:
None.