

1.0 Geometry Tagging for Heavy Ions at JLEIC

Principal Investigator: Vasilii Morozov

Project Status

We achieved all of the milestones for the first half of the 2017 fiscal year as stated in the original proposal:

- Implementation of the BeAGLE and Sartre codes at JLab, and interfacing them to JLEIC Large-Acceptance Detector simulations (GEMC).

The BeAGLE and Sartre codes have been successfully implemented at JLAB and interfaced to GEMC. A new input format called “beagle” has been added to GEMC that allows one to directly read BeAGLE and Sartre output files in GEMC. We used the JLEIC full-acceptance detector implemented in GEMC to start quantifying the detector’s performance with events generated in BeAGLE and Sartre. Due to improvements in the model code BeAGLE (external to the project), we were able to extend our results to the very lowest values of x accessible. Our results so far clearly indicate that geometry tagging using the large acceptance forward detector capabilities will have an essential impact on JLEIC physics. In particular, we have already achieved an effective energy-enhancement factor for saturation of more than 3, and an effective A -enhancement factor for propagation length studies of more than 4.

- Confirmation that the BeAGLE code is tuned to describe key existing data, as well as possible for the non-shadowing region, fine-tuning it if needed.

The BeAGLE code has been tuned as well as possible to E665 e+Pb forward neutron data as well as the ZEUS ep forward proton and neutron data. Going beyond the requirements of the bullet, we have confirmed that the tune also works with shadowing turned on in BeAGLE as well as with shadowing turned off. The BeAGLE program includes Pythia 6.4, which must also be tuned to describe forward ep data. A collection of fits to forward protons from ZEUS ep data were used by the BeAGLE authors to tune the Pythia part of BeAGLE. Forward neutrons were also used as part of the Pythia tune.

- Investigating the interpolation properties of existing Sartre cross-section tables for Au, Pb and Ca. If needed for accurate interpolation at JLEIC energies, we will improve the interpolation mechanism and/or add finer grid tables in certain kinematic regions for Au.

We investigated Sartre interpolation. It will work at JLEIC energies for Ca and Au. In order to use Pb, we will need to make a copy of the Au tables, perhaps with small modifications for the difference between Pb and Au. The authors have said that the uncertainties in Sartre are larger than that difference in any case. As planned, this work will occur as part of the relevant October 2017 bullet. As part of our investigation, we suggested some improvements in the interpolation which have been implemented by the authors.

Project Plan

We are on track to achieve the following milestones by the end of the 2017 fiscal year as stated in the original proposal.

- A detailed study of the resolution of the nuclear geometry parameters d (distance traveled in the nucleus after first collision) and b (impact parameter), for SIDIS eAu collisions using the JLEIC Large Acceptance Detector, using BeAGLE.

Studying SIDIS resolution for d and b is underway. We now expect to be able to extend this study to cover the full range of accessible x down to $x \sim 0.0008$.

- Using the geometry tagging, a detailed study of the ability to constrain key physics model parameters: τ_0 , the average formation time of the produced particles in their own rest frame before they are allowed to participate in intranuclear cascades and q -hat, the parameter controlling the strength of particle absorption in nuclear matter.

This milestone should be able to proceed as planned.

- Using the geometry tagging, a detailed study of light and heavy flavor propagation in the target nucleus to better confront and constrain theoretical models of in-medium parton propagation and hadronization.

This milestone should be able to proceed as planned.

- A first look, using Sartre, at our ability to tag coherent diffraction events by rejecting incoherent diffraction based on nuclear evaporation.

We have found indications that precision measurement of gluon saturation using coherent diffraction is faced with challenging backgrounds. This suggests that the JLEIC strategy of near-complete forward detection may well be invaluable for this essential physics.

- If needed for accurate interpolation at JLEIC energies, we will add finer grid tables (for Sartre) in certain kinematic regions for Pb and Ca.

We investigated Sartre interpolation. It will work at JLEIC energies for Ca and Au. In order to use Pb, we will need to make a copy of the Au tables, perhaps with small modifications for the difference between Pb and Au. This work is straightforward and will occur as planned.

- Tuning BeAGLE to JLab12 energies.

Tuning BeAGLE to JLAB12 energies is not expected to be difficult and we should emphasize that JLEIC is the main focus of our LDRD effort.

Budget

We are on schedule and on budget. We do not request any changes in the milestones or budget to complete the project. See Appendix for an up-to-date budget report.

Publications

N/A, work is still at a too early stage for a publication

Workshops/Conferences

N/A, work is still at a too early stage for presenting at a conference