Feasibility Search for Processes Induced by Instantons

B.B. Levchenko

Institute of Nuclear Physics, Moscow State University, Russia

Abstract

We propose to study at EIC strong nonperturbative fluctuations of the vacuum gluon fields known as instantons. Instantons are the only truly non-perturbative effects well understood by now and represent fundamental aspects of the QCD dynamics. Despite this fact, the direct experimental verification of instantons is lacking. The ability of EIC to discover the processes induced by QCD-instantons is higher as compared to the HERA collider. Here we list the main results obtained by MC simulations.

At an electron-proton collider with c.m. energy $E = 63$ GeV and in the kinematic domain $Q^2 \geq 100$ GeV^2 the instanton-induced (**I-I**) processes runs with the cross section 0.34 pb, that should be confronted with the value 28.84 pb for the HERA energy 300 GeV. However, the luminosity of HERA is in two order of magnitude lower as will be achieved at EIC and after first two-three years of running we expect few hundred of **I-I** events to be collected in the EIC event sample. At HERA the beam energies (E_e=27.5 GeV, E_p=820/920 GeV) are largely asymmetric and this is a big disadvantage for the **I-I** processes search and reconstruction. A hadronic subsystem emerged from instanton field populates in the laboratory frame the rapidity window [-2,12] and its valuable fraction of 40-50% with $\eta \geq 5$ is allocated in the beam pipe. It is drastically reduce the ability to reconstruct the event kinematics. On the other hand, at EIC the beam energies are less asymmetric and therefore the region $\eta \geq 5$ contains only 10-20% of the hadronic subsystem created by instanton field. This feature significantly increase the EIC discovery reach for **I-I** processes. With nuclear beams, the cross section of **I-I** processes at EIC is the order of 0.34 A pb.

To conclude, the instanton-induced cross section turn out to be in a measurable range at EIC.