Search for Instanton Induced Events in Deep-Inelastic Scattering at HERA

H1 Collaboration
DESY, Hamburg, Germany

In QCD, anomalous non-perturbative processes are expected which violate classical laws like the conservation of chirality. Such processes are induced by Instantons. They are non-perturbative fluctuations of the gluon field inducing hard processes and represent tunneling transitions between topologically inequivalent vacua.
In Deep-Inelastic Scattering (DIS) Instanton induced processes are dominantly produced in a quark gluon fusion process. The virtuality of the quark, originating from a photon splitting into a $q\bar{q}$ pair in the instanton background, provides a generic hard scale naturally limiting the instanton size and makes a quantitative prediction of the cross-section possible. The expected cross section for the kinematical region $x_{bj} > 10^{-3}$ and $0.1 < y < 0.9$ is in the order of 100 pb.
The hadronic final state of instanton induced events is simulated by the Monte Carlo program QCDINS. Based on the expected characteristics of the hadronic final state of instanton induced processes (the production of particles with large transverse momenta in a pseudo-rapidity band of 2 units and the isotropic decay of the instanton in its rest system) a search for such processes is performed. The data sample covering $5 < Q^2 < 100$ GeV^2 was taken in the years 1996 – 1997 and corresponds to an integrated luminosity of $\mathcal{L}_{int} \simeq 20$ pb^{-1}. It contains about 1 Million DIS events. Assuming that the hadronic final state looks like simulated by QCDINS, an upper limit on the cross section is set.