Workshop on Forward Physics and QCD at the LHC, the future Electron Ion Collider and Cosmic Ray Physics

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Hotel Guanajuato, Ciudad de Guanajuato, Mexico

Book of Abstracts

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Vector meson photoproduction in ultra-peripheral p-Pb and Pb-Pb collisions at the LHC with ALICE

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Vector mesons are copiously produced in ultra-peripheral collisions where the impact parameter is larger than the sum of the radii of the two projectiles, implying that electromagnetic induced processes become dominant.

Light vector meson photoproduction cross sections can be used to study Glauber-Gribov shadowing effects at the hadronic level while the photoproduction of heavy vector mesons is expected to be sensitive to the poorly known gluon structure function and gluon shadowing effects at low Bjorken x.

The ALICE Collaboration has published the first measurements of the $\rho 0$, J/ψ and $\psi(2S)$ photoproduction cross section in ultra-peripheral Pb-Pb collisions and that for exclusive J/ψ photoproduction off protons in ultra-peripheral proton-lead collisions at the LHC and has obtained a substantially larger data set in 2015-2018 from LHC Run 2, allowing much more detailed studies of the production mechanism to be performed. In particular, the increased energy and more detailed measurements in the forward region in Run 2 give access to lower values of Bjorken-x than in previous studies. In this talk, an overview of the past results from Run 1 and the latest available results from Run 2 will be given. The results are compared to theoretical models.

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A generator of forward neutrons for ultra-peripheral collisions: nOOn

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The study of photon-induced reactions in collisions of heavy nuclei at RHIC and the LHC has become an important direction of the research program of these facilities in recent years. In particular, the production of vector mesons in ultra-peripheral collisions (UPC) has been intensively studied. Owing to the intense photon fluxes, the two nuclei participating in such processes undergo electromagnetic dissociation producing neutrons at beam rapidities. Here, we introduce the nOOn (pronounced noon) Monte Carlo program, which generates events containing such neutrons. nOOn is a ROOT based program that can be interfaced with existing generators of vector meson production in UPC or with theoretical calculations of such photonuclear processes. nOOn can also be easily integrated with the simulation programs of the experiments at RHIC and the LHC. In this talk, an overview of the theoretical formalist together with short tutorial and few results will be given.

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Impact parameter dependence of collinearly improved Balitsky-Kovchegov evolution

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The Balistky-Kovchegov equation has been solved including the impact-parameter dependence. Previous attempts to include this dependence have been spoiled by the presence of the so-called Coulomb tails produced by the evolution. We show, that using the collinearly-improved kernel to the BK equation, the Coulomb tails are heavily suppressed which allows for a correct description of existing data –both of the structure function and exclusive vector meson production–, as well as for the prediction of processes that are feasible for measurement at future facilities such as EICs.

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Multi-TeV flaring from high energy blazars: An evidence of the photohadronic process

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The high energy peaked blazars are known to undergo episodes of flaring in GeV-TeV gamma-rays involving different time scales and the flaring mechanism is not yet well understood despite long term simultaneous multiwavelength observations. These gamma-rays en route to Earth undergo attenuation by the extra galactic background light.
Using the photohadronic model, where the seed photons of the jet follow a power-law spectrum and considering a template extragalactic background light model, we derive a simple relation between the observed multi-TeV gamma-ray flux and the intrinsic flux which depends on a single parameter. We study 42 flaring epochs of 23 blazars and found an excellent fit to most of the observed spectra, further supporting the photohadronic origin of multi-TeV gamma-rays.
We note that we can also constrain the power spectrum of the seed photons during the flaring period. Moreover, for blazars of unknown redshifts whose multi-TeV flaring spectra are known, stringent bounds on the former can be placed using the photohadronic model.

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Super quasars

Author: Владимир Пастушенко[None]

Here, in the axioms of dynamic space-matter, a unified theory of all mathematical and physical theories is presented, with the possibility of studying the energy levels of the singularity of the set of Rji (n) objects of singularity in the quantum system of OLji (m) coordinates, the dynamic space-matter of the whole Universe.

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Super quasars

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Here, in the axioms of dynamic space-matter, a unified theory of all mathematical and physical theories is presented, with the possibility of studying the energy levels of the singularity of the set of Rji (n) objects of singularity in the quantum system of OLji (m) coordinates, the dynamic space-matter of the whole Universe.
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Spin and Forward Physics with the STAR detector: Measurements and Future Plans

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The spin program at the STAR experiment at the Relativistic Heavy Ion Collider (RHIC) has explored many interesting topics and has helped our understanding of nuclear physics. In particular, non-vanishing transverse single-spin asymmetry measurements at RHIC and other experiments have shown that there is a rich substructure of the nucleon that needs further exploration in both theory and experiment. The STAR forward upgrade will utilize RHIC's unique capability of colliding polarized proton and heavy ion beams to make much more accurate measurements of Drell-Yan as well as jets, hadrons in jets, and dijets, among others. The new forward system will be in operation for the pp, pA and AA runs starting in Fall 2021 and utilize the latest developments in detector technologies so that they are ready for an electron ion collider (EIC). The forward upgrade will cover $2.5 < \eta < 4.0$, by installing two new forward tracking systems and a new calorimeter system. The tracking systems will consist of silicon disks and small thin gap chambers. The calorimeter system will consist of a preshower hodoscope, an electromagnetic calorimeter and a hadronic calorimeter. This talk will show some of the recent results from STAR's spin program as well as the design and capabilities of the forward upgrade and how it will complement measurements from a future EIC.

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New transverse single spin asymmetry measurement of pi0 production at zero degree using RHICf detector

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It has been under debate for more than three decades for the origin of transverse single spin asymmetry of forward meson production in the polarized proton+proton collision at high energy. Despite of intensive theoretical developments in pQCD framework, it is still an open question whether it is initial or final state effects. On the contrary, the latest experimental results raised possible contribution from none pQCD degree of freedom to the observed asymmetry. Thus the new experiment RHICf is executed at the STAR interaction point in order to examine possible finite asymmetry in the kinematics range where non-pQCD is expected to dominate. In this talk, new preliminary results of pi0 asymmetry at almost zero degree measured in transversely polarized proton+proton

collision at sqrt(s)=510GeV are presented. A global interpretation in conjunction with existing data is discussed.

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The ATLAS Forward Detector System - an Status Report

Author: James Pinfold[1]

[1] *University of Alberta (CA)*

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An overview of the status of the ATLAS Forward Detector system consisting on the detectors: LUCIC, ZDC, AFP and AlFA, will be given. I will also report on planned upgrades to each detector for LHC RUN-3 and HL-LHC.

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The Status and Future Plans of the MoEDAL Experiment and its MAPP- Detector Upgrade

Author: James Pinfold[1]

[1] *University of Alberta (CA)*

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AN overview of the MoEDAl experiment will be given, including latest results. In addition MoEDAL's plans for LHC Run-3 and Run-4 data taking will be presented, emphasizing the MAPP (MoEDAL Apparatus for Penetrating Particles) upgrade and its physics program.

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Desing and simulation of a cryostat and a field cage for a LArTPC for test in DUNE Collaboration

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Currently, the DUNE Collaboration is making several tests in small detectors with the components that will be used in the DUNE detectors to avoid and detect future problems in the massive detectors. In this talk, I show the design and simulation of the cryostat and HV system for a LArTPC to make tests of relevance in cool electronics and photodetection for the DUNE Collaboration.

The design of the cryostat is based in the ASME Code and the simulation of the heat transfer is made in COMSOL Multiphysics. The design of the field cage was made based on the results of the simulation for the shape and the uniformity of the electric field in the active Drift volume. I present the simulated physical results and an estimated quote to construct this cryostat and HV system.

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Cosmic-ray physics in ALICE at CERN

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ALICE is one of the four main experiments at the CERN Large Hadron Collider. The location of the ALICE detector allows us to study the muonic component of cosmic rays, since it is located 52 meters underground with 28 meters of rock above it. The ALICE detector is able to detect atmospheric muons from extensive air showers, making possible the study of topics related to cosmic-ray physics. At this depth, only atmospheric muons with energies greater than 15 GeV can reach the detection zone. The analysis of the multiplicity distribution of atmospheric muons reconstructed by the Time Projection Chamber (TPC) of ALICE is presented. The comparison with modern Monte Carlo simulations solves the long standing issue of rate of events with an extremely large multiplicity of muons. An overview of analyses of recent data collected by ALICE is also discussed.

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The use of QCD evolution to detect gluon saturation in exclusive photo-production of vector mesons

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We investigate photo-production of vector mesons J/Psi and Upsilon measured both at HERA and LHC, using 2 particular fits of inclusive unintegrated gluon distributions. The fits are based on non-linear Balitsky-Kovchegov evolution (Kutak-Sapeta gluon; KS) and next-to-leading order Balitsky-Fadin-Kuraev-Lipatov evolution (Hentschinski-Sabio Vera-Salas gluon; HSS). We find that linear next-to-leading order evolution can only describe production at highest energies, if perturbative corrections are increased to unnaturally large values; rendering this corrections to a perturbative size, the growth with energy is too strong and the description fails. At the same time, the KS gluon, which we explore both with and without non-linear corrections, requires the latter to achieve an accurate description of the energy dependence of data. We interpret this observation as a clear signal for the presence of high gluon densities in the proton, characteristic for the onset of gluon saturation.

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Review of results using heavy-ion collisions at CMS

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Probing QCD: from heavy ion collisions to the EIC

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Study of initial conditions in small collision systems at LHC energies with String Percolation Model

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Recent results of heavy ion collisions and future opportunities with fast timing upgrades at CMS

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A generator of forward neutrons for ultra-peripheral collisions: nOOn

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The use of QCD evolution to detect gluon saturation in exclusive photo-production of vector mesons

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We investigate photo-production of vector mesons J/Psi and Upsilon measured both at HERA and LHC, using 2 particular fits of inclusive unintegrated gluon distributions. The fits are based on non-linear Balitsky-Kovchegov evolution (Kutak-Sapeta gluon; KS) and next-to-leading order Balitsky-

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Conclusion and farewell

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