

Theoretical and Computational Physics highlights in April 2024

Dr. J. Dudek attended a special workshop on “Hadron Spectroscopy with Strangeness”, organized as part of the JSA postdoctoral prize of Peter Hurck, and presented an invited talk concerning new lattice QCD results on the spectrum of excited meson resonances with 1^{--} , 2^{--} and 3^{--} JPC quantum numbers, soon to appear in a publication. Experimentally these resonances are poorly understood, and new data in photoproduction from GlueX are expected to help resolve long-standing mysteries about their nature.

JET ANGULARITIES IN DIJET PRODUCTION

A new paper [arXiv:2404.04168] by Dr. Yang-Ting Chien and collaborators provides precise predictions for a broad class of generalized jet angularities for upcoming new measurements at the Relativistic Heavy Ion Collider (RHIC). At this energy regime and because of the RHIC jet kinematics, significant hadronization effects are at play while underlying event contributions are small, and they are studied using parton-to-hadron transfer matrices. The paper discusses the importance of understanding jet substructure in proton-proton collisions as a solid baseline for meaningful studies of medium effects in heavy-ion collisions.

XYZ SPECTROSCOPY AT ELECTRON-HADRON FACILITIES

Inclusive production processes will be important for the first observations of XYZ states at new-generation electron-hadron colliders, as they generally benefit from larger cross sections than their exclusive counterparts. New theoretical work [arXiv:2404.05326] by Drs. Gloria Montagna, Arkaitz Rodas, Adam Szczepaniak, and colleagues from the Joint Physics Analysis Center (JPAC) makes predictions for semi-inclusive photoproduction of the $\chi_{c1}(1P)$ and $X(3872)$, whose peripheral production is assumed to be dominated by vector exchanges. The applicability of vector-meson dominance is validated in the axial-vector charmonium sector, and production rates are calculated at center-of-mass energies relevant for future experimental facilities. The semi-inclusive cross sections near threshold are found to be enhanced by a factor of 2 ? 3 compared to the exclusive reaction and well-suited for a first observation in photoproduction.

POWER CORRECTIONS TO TMD FACTORIZATION

Particle production in hadron-hadron scattering with transverse momentum of produced particles much smaller than the invariant mass is described in a new paper [arXiv:2404.15116] by Dr. Ian Balitsky in the framework of transverse-momentum-dependent (TMD) factorization. Typically, the leading contribution is given by quark-antiquark TMDs. However, some angular distributions of produced particles are defined by quark-quark-gluon TMDs forming power corrections proportional to q_T^2/Q^2 . The paper contains the full list of such power corrections for the Drell-Yan hadronic tensor at large N_c . Analysis of the Drell-Yan power corrections is necessary groundwork for the calculation of power corrections to the TMD description of semi-inclusive deep-inelastic scattering processes at Jefferson Lab and the Electron-Ion Collider.