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Exploring High-Energy QCD Through Diffractive Vector Meson Production in Ion Collisions

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Exclusive diffractive processes offer a unique window into Quantum Chromodynamics (QCD) in the high-energy regime. The foundation for these studies, established by Lipatov and collaborators, introduced the QCD Pomeron and the Balitsky-Fadin-Kuraev-Lipatov (BFKL) equation, which governs gluon ladder exchanges. Recent investigations have highlighted the impact of BFKL evolution on observables in photon-induced interactions at the LHC.

This work focuses on applying the BFKL formalism to study diffractive vector meson production at large momentum transfer (t) in pp,Pbp and $PbPb$ collisions. The rapidity distributions of vector meson cross-sections are evaluated within the forward rapidity range, $3.2 < y < 5.8$, which will be probed by the FoCal detector at the ALICE experiment during its operation in 2027-2029.

By bridging theoretical predictions with experimental measurements, this study aims to deepen our understanding of QCD in the high-energy limit, elucidating the role of diffractive processes and rapidity gaps in hadronic and nuclear collisions.

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