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Recent experimental progress in searching for gluon saturation

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Understanding gluon saturation at small x is a central question in high-energy nuclear physics, with deep implications for the non-linear regime of QCD. This talk presents an overview of recent experimental efforts aimed at uncovering signatures of gluon saturation, with a focus on two-particle azimuthal correlations in p+p, p+A, and d+A collisions. Despite theoretical predictions from the CGC framework suggesting broadening and suppression in the away-side peak, no definitive experimental observation of saturation-induced broadening has been confirmed. Multiple confounding effects, such as Sudakov radiation and fragmentation, complicate the interpretation of the correlation widths.

Recent simulation studies incorporating saturation, Sudakov effects, and next-leading-order contributions highlight the subtle interplay between these mechanisms. We also review the role of nuclear PDFs, such as EPPS21 with the extracted gluon densities vanishing at low Q^2.

Looking ahead, the EIC offers unprecedented opportunities to isolate initial-state effects using observables like F_2, F_L, and diffractive processes. We outline prospects for early science measurements at the EIC and the potential for clarifying the non-linear QCD dynamics underlying gluon saturation.

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