Update on Gluon Saturation in EIC Yellow Report

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EIC opportunities for Snowmass

EIC Yellow report exercise

- Started in January 2020
- Working group structure:
  - Detector WG + subgroups
  - Physics WG + 5 subgroups
- Currently with reviewers
- Publication Feb 2021

Purpose of YR exercise

Document status of
physics studies and detector concepts
$\Longrightarrow$ physics-driven detector requirements!

(YR focus not newest theory, but key processes that have well developed MC tools)

Report structure:

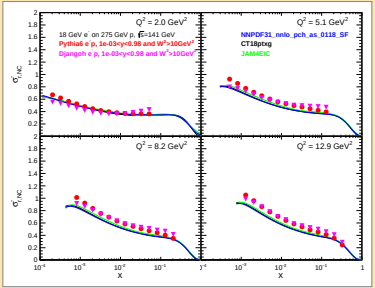
- Summary (29 pages)
- Physics: EIC measurements & studies (200 p)
  1. Global properties & parton structure of hadrons
  2. Multi-dimensional Imaging of Nucleons, Nuclei, and Mesons
  3. The Nucleus: A Laboratory for QCD
  4. Understanding Hadronization
  5. Connections with Other Fields
- Physics: **Detector requirements** (130 p)
  1. Inclusive measurements
  2. Semi-Inclusive Measurements
  3. Jets and Heavy Quarks
  4. Exclusive Measurements
  5. Diffractive Measurements and Tagging
- Detectors ($\sim$ 300 pages)

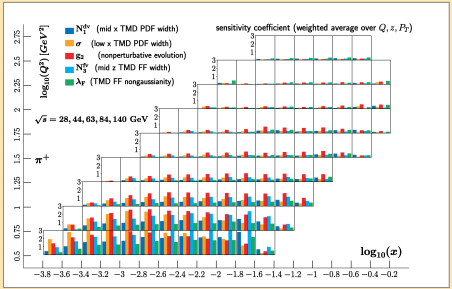
Purpose of YR exercise

No specific "saturation" section.
In the following: a few key processes with detector requirement studies

Inclusive and SIDIS

- Total ep & eA cross sections
  - Baseline for small-x,
    (Not discussed in a saturation specific manner in YR)
    Note typically $Q^2 > 1\text{GeV}^2$ cut.
  - Errors systematics-dominated (at least for σ_r)
- SIDIS & dihadrons
  - Also access to TMD $\Longrightarrow$ intrinsic k_T $\Longrightarrow$ Q_s
  - Dihadrons: "smoking gun" for CGC?
- Inclusive heavy quarks
  - Important for saturation, together with $F_{2,L}$
  - Nontrivial detector requirements:
    - Vertex resolution
    - tracking down to low p_T ($\gtrsim$100MeV)
- Jets: high p_T not really small-x @ EIC

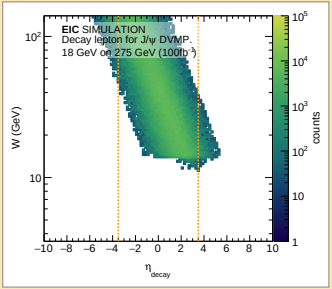


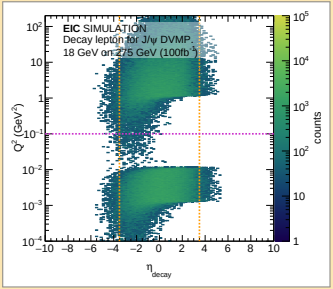


Exclusive measurements

Overall design challenge:
minimize dead zone at fwd η

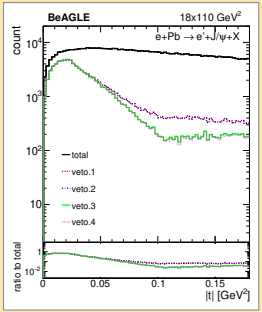
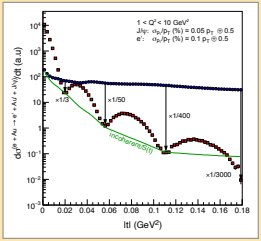
- Exclusive vector mesons:
  - Particular focus on J/Ψ, but of course measure ρ, ϕ, Υ
  - Down to lowish x: $\sim 10^{-3}$ for light, $< 10^{-2}$ for J/Ψ
  - Major improvement w.r.t HERA in
    - statistics
    - t-resolution
    - nuclear target
  - DVCS, TCS in similar kinematics
- Inclusive diffraction
- Diffractive dijets: Wigner distribution!
- Light ions
- Neutron structure:
  deuteron+ spectator p tagging
- Meson structure (Sullivan process $e + p \to e + \pi + n \to e' + X + n$)





Target breakup

Coherent vs incoherent diffraction (target breakup vs non-breakup)

In Good-Walker paradigm physics of average vs fluctuations of gluon density

- Proton: detect in RP $\Longrightarrow$ kinematics + coherence
- Nucleus: kinematics in central detector, vetoing incoherent challenge!
- Light ions: (relatively) unexplored at small-x