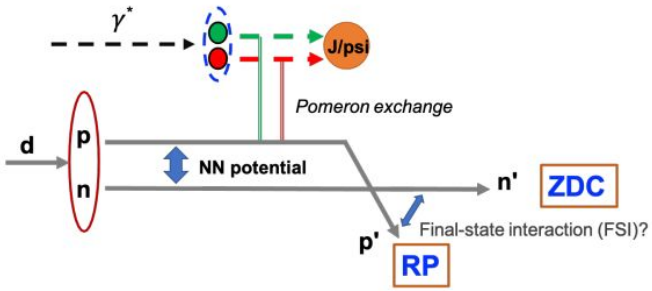
Diffraction & Tagging WG Summary

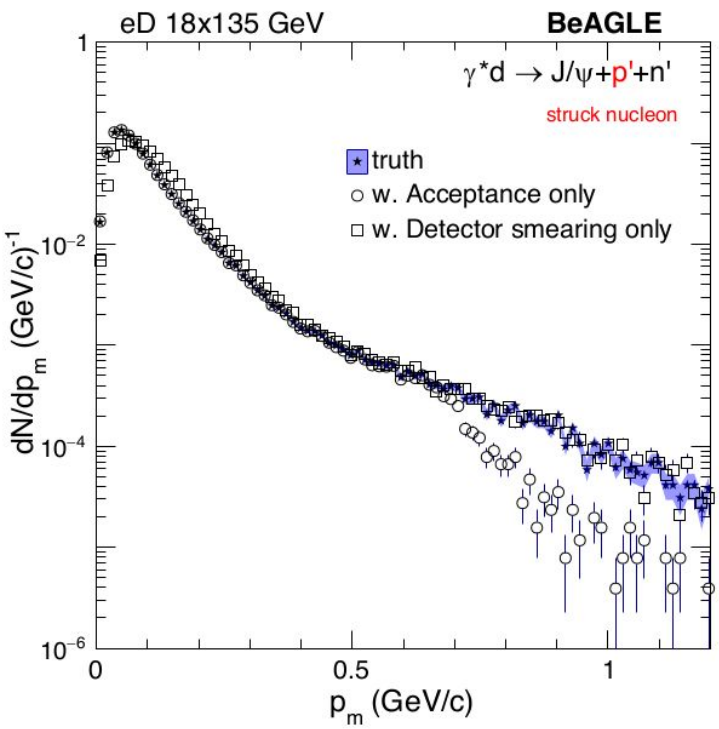
Wim Cosyn, Doug Higinbotham, Or Hen, Spencer Klein, Anna Staśto

Deuteron breakup kinematics in BeAGLE event generator

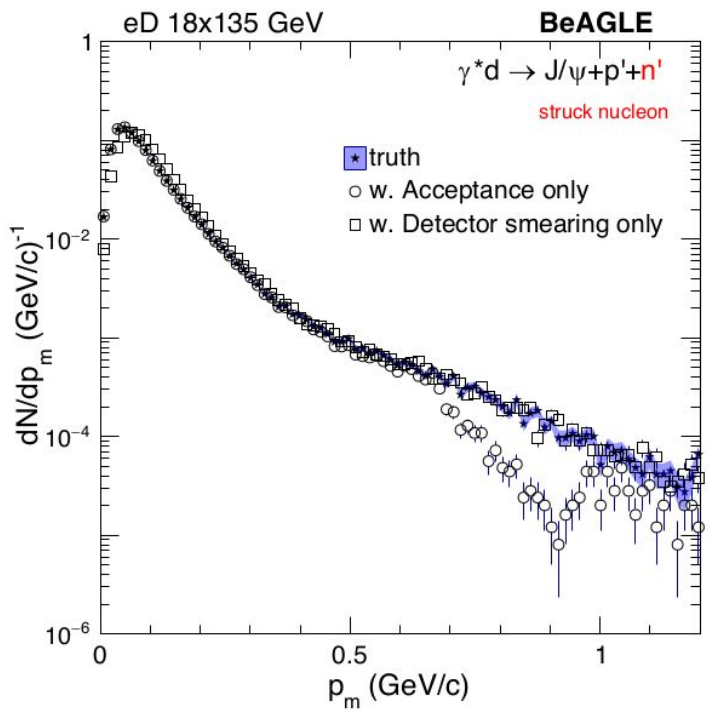
Kong Tu [BNL]



- Single and double tagging
- Toy forward detectors
- Study of detector smearing & acceptance
- Different kinematic variables for spectator
- Follow-up: realistic simulations by A. Jentsch



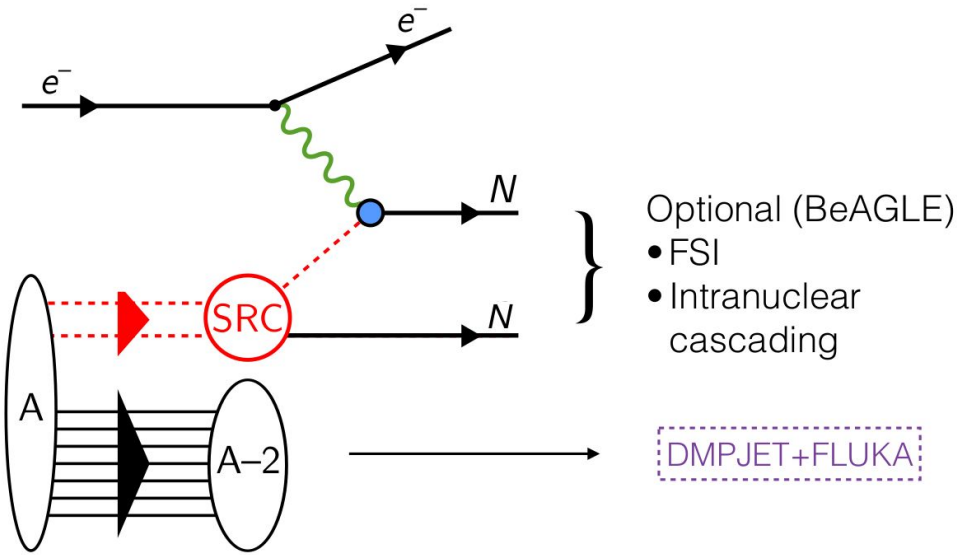
Neutron spectator tagging



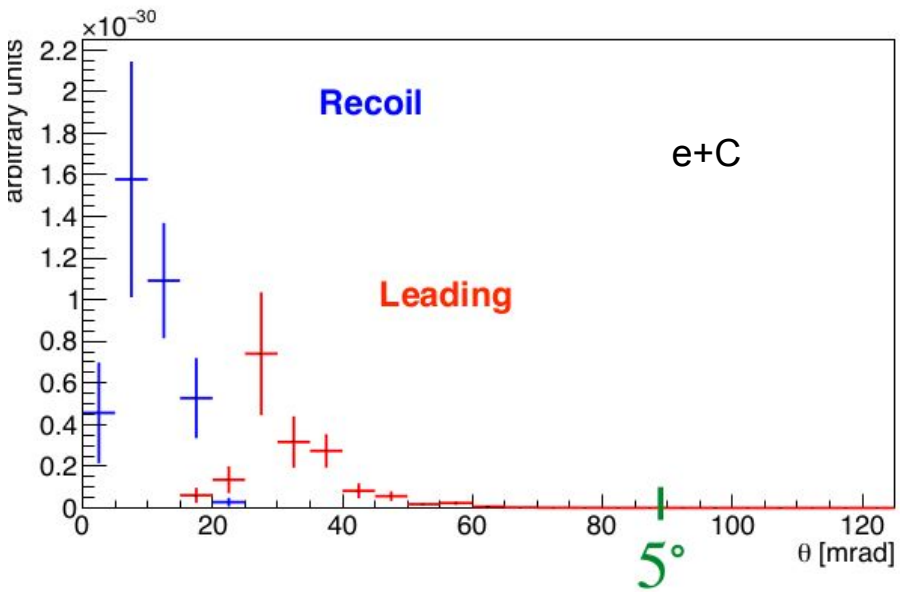
Proton spectator tagging

Detection of SRC nucleons
F. Hauenstein [ODU/MIT]

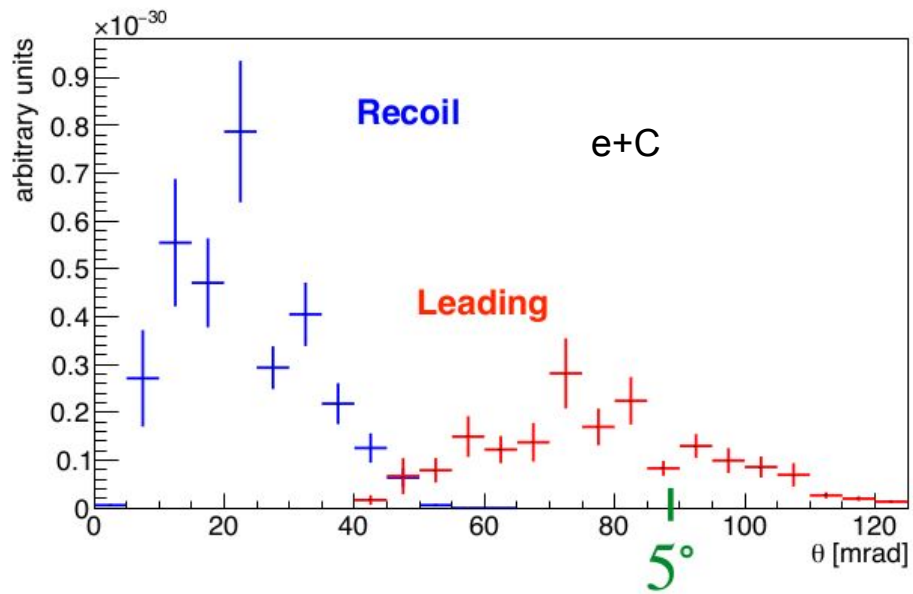
- QE e+A -> e'+N+N'+(A-2)
- GCF+BeAGLE
- Near future: FSI study; g4e/EICROOT
- Longer term: tagged DIS at high p_miss



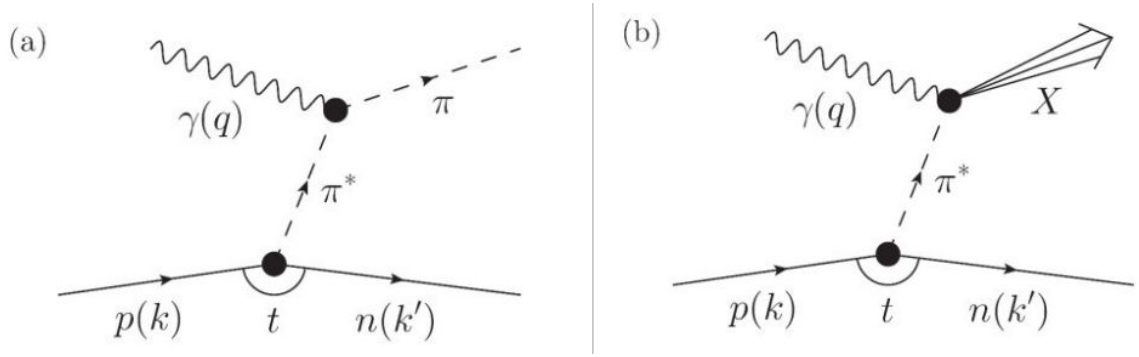
10 GeV x 50GeV/nucleon



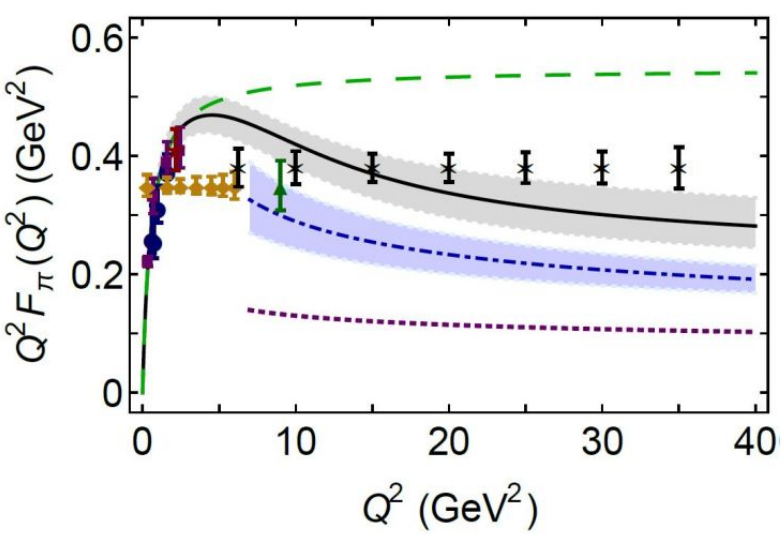
10 GeV x 20.5GeV/nucleon

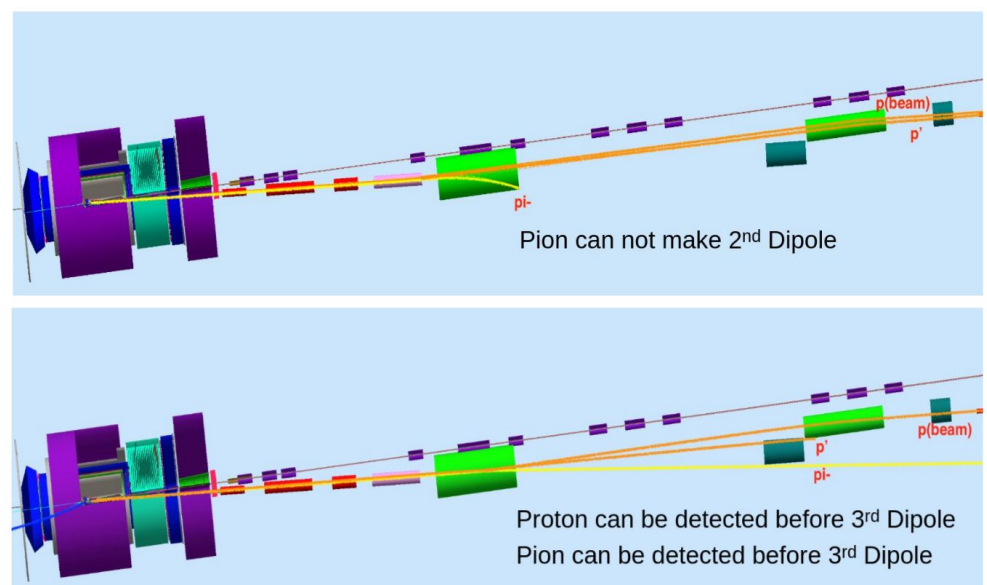


Meson structure
R.Trotta; T. Horn[CUA]

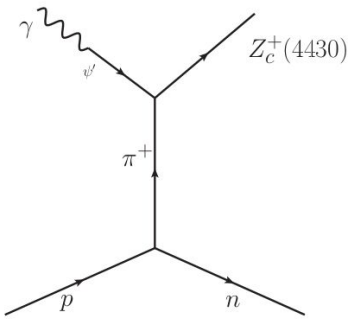


- Sullivan process
- pion/kaon FF/SF
- FFQ and ZDC: $dp_L / p_L \sim 10^{-4}$, $dp_T \sim 20$ MeV, complete coverage to $p_T = 0$
- Good hadronic calorimetry to for large-x resolution
- g4e: put virtual detectors at different z-locations in between the magnets
- For $p(e,e'K^+\Lambda^0)X$, the decay products of the Λ^0 must be tracked through the very forward spectrometer

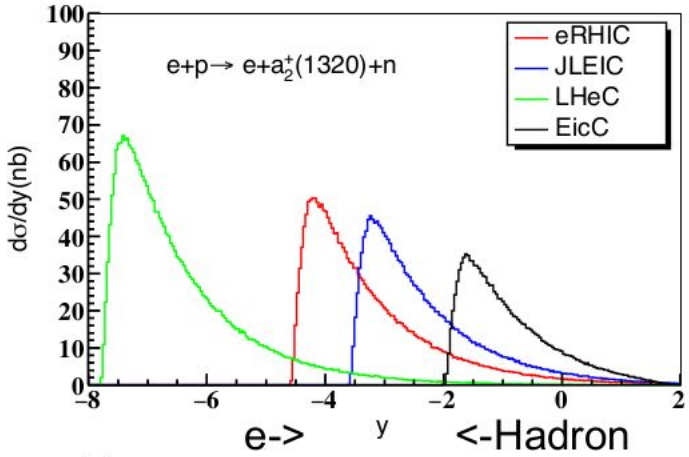


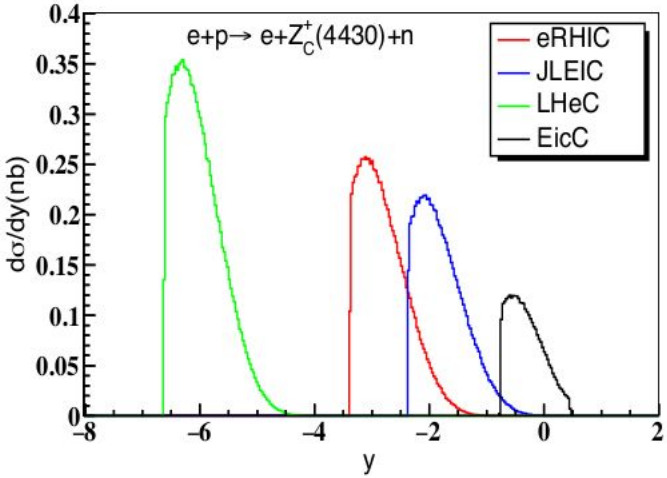


Near threshold photoproduction
Spencer Klein [LBNL]



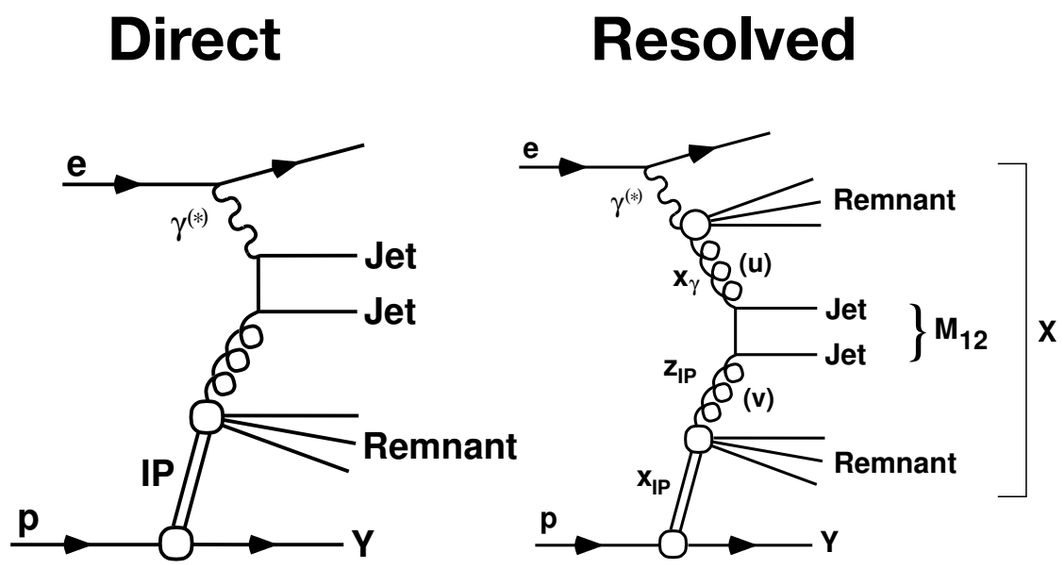
- Photo- and electroprod. Model in eStarlight
- Meson trajectories: $a_2^+(1320)$ & $Z_c^+(4430)$
  - Requires good instrumentation in the hadron-going direction
- Baryon trajectories
  - Need to detect vector mesons with rapidity <~ beam rapidity
  - Implications for baryon stopping





- The $a_2^+(1320)$ is mainly at negative rapidity
  - σ is large
    - ~80 nb at eRHIC
- The $Z_c^+(4430)$ is also at negative rapidity, but, because of its mass, is somewhat more centrally produced.
  - σ is moderate
    - 0.26 nb at eRHIC

Diffractive dijets



M. Klasen

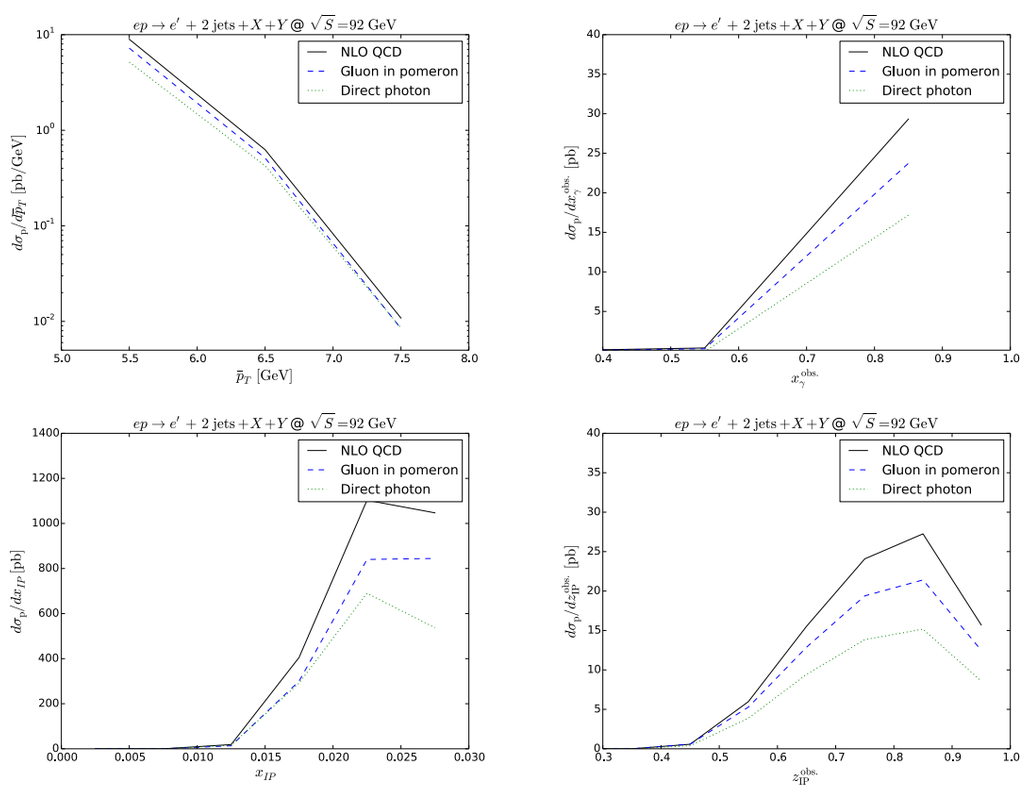
Diffractive dijets can provide vital information:

Test of factorization in diffractive DIS

Additional constraint on the diffractive gluon PDF both in proton and nuclei

Diffractive photoproduction of dijets at the EIC

V. Guzey, M. Klasen, in preparation



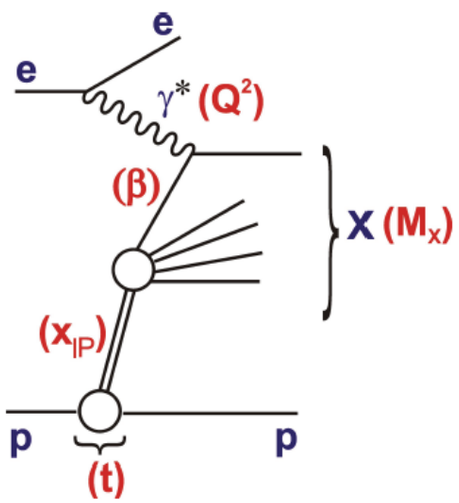
Simulations of diffractive dijets for the EIC

Experimental conditions:

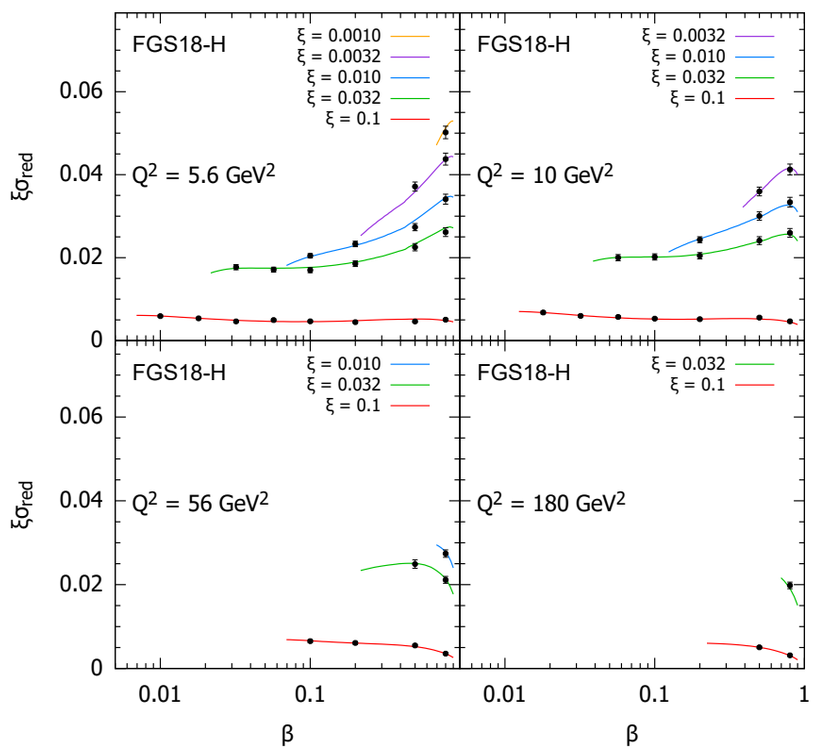
- Electron-proton collisions with 21 GeV $\times$ 100 GeV
- Diffraction: $M_Y < 1.6$ GeV, $|t| < 1$ GeV^2, $x_{IP} < 0.03$
- Photoproduction: $Q^2 < 0.1$ GeV^2, $0 < y < 1$
- Jet definition ($\sim$ H1): Anti-k_T ($R = 1$), $p_{T1,2} > 5$ (4.5) GeV

Inclusive diffraction

A.Stasto



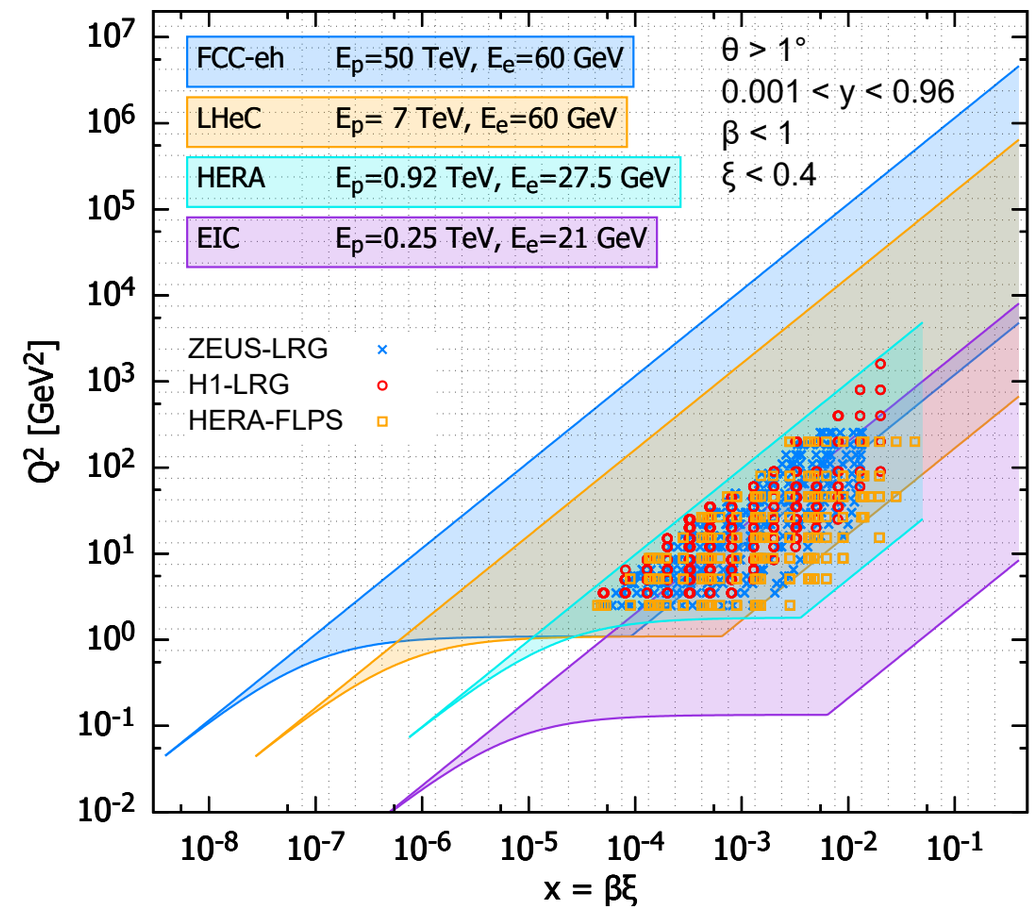
e-Au E_{Au}/A = 100 GeV, E_e = 21 GeV, L = 2 fb^{-1}



Pseudodata for the reduced diffractive cross section at EIC.

Possibility of high quality data within first few days of running of EIC!

Kinematics for diffraction:



EIC possibilities :

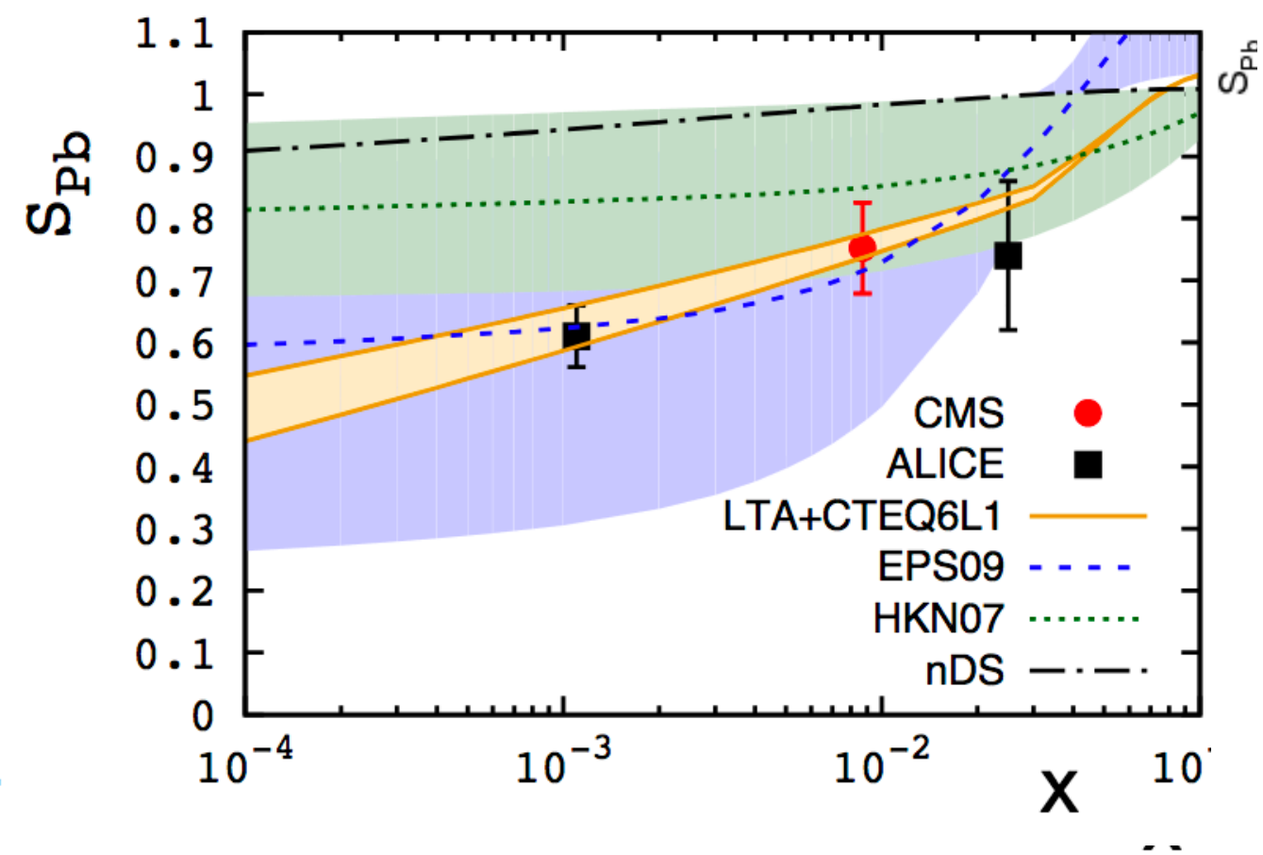
- Extend the HERA range towards large x
- Disentangle Pomeron/Reggeon contributions
- Pinning down the diffractive PDFs at large β
- First extraction of nuclear PDFs

Coherent/incoherent vector meson production off nuclei

M.Strikman

Elastic production of J/ψ
Comparison of Leading Twist shadowing model with the UPC data from LHC

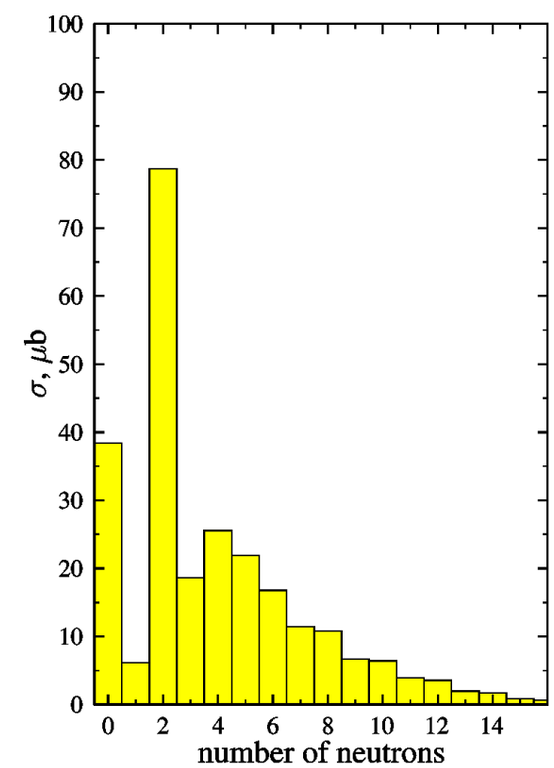
$$S_{Pb} = \left[\frac{\sigma(\gamma A \to J/\psi + A)}{\sigma_{imp.approx.}(\gamma A \to J/\psi + A)}\right]^{1/2} = \frac{g_A(x,Q^2)}{g_N(x,Q^2)}$$



Large gluon shadowing consistent with the leading twist theory prediction of FGS2012.

Challenges in VM production off nuclei:

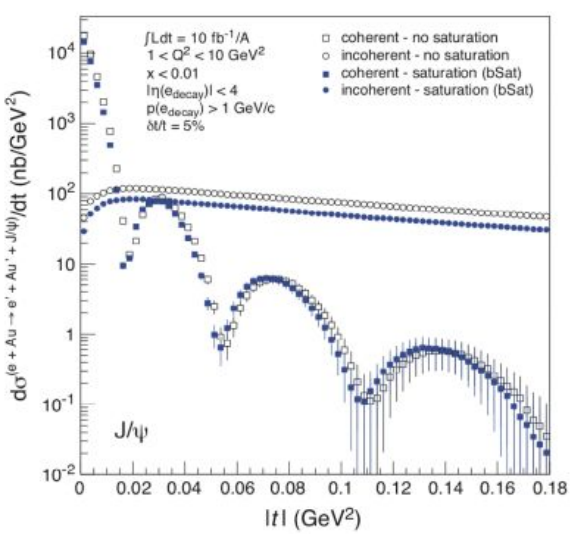
Inclusive diffraction - impossible to measure t; more difficult to separate coherent and incoherent diffraction, and to measure diffractive mass (since typical masses at EIC are rather small)

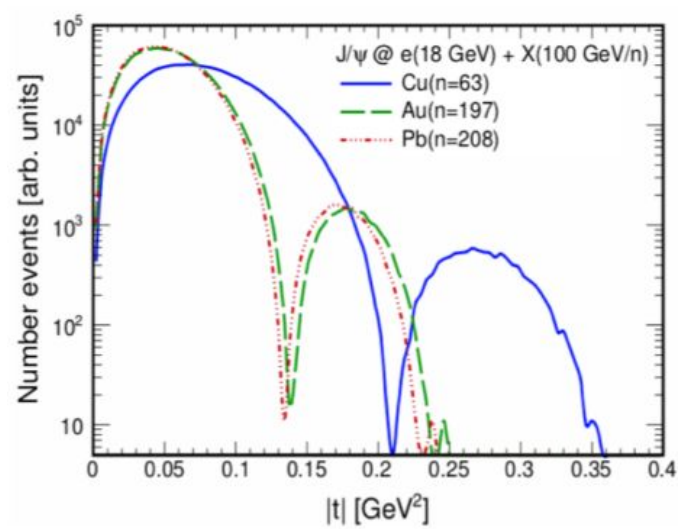


Number of neutrons produced in quasielastic VM production off nuclei

Coherent and incoherent vector meson production
S. Klein [LBNL]

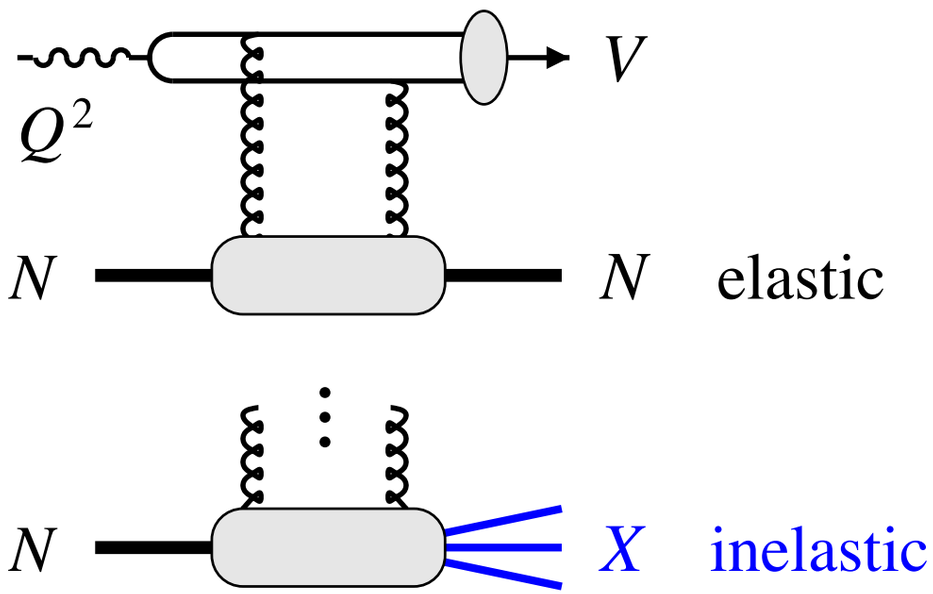
- White paper: J/ψ ; ϕ
  - ϕ -> K^+K^- not easy
  - ϕ->l^+l^- 70k (80k) per 10fb^{-1}/A for ep(eA); Requires good PID
- Lighter mesons correspond to larger dipoles which display more shadowing
  - Systematic study to fully map out saturation as a function of x,Q^2
  - Separate Y(1S),Y(2S),Y(3S)
  - Reconstruct low p_T kaons from ϕ
- Coh/incoh: how well can we use nuclear breakup to classify events?
- Some incoherent photoproduction does not lead to neutron emission.
- Pileup events can make coherent photoproduction look incoherent.



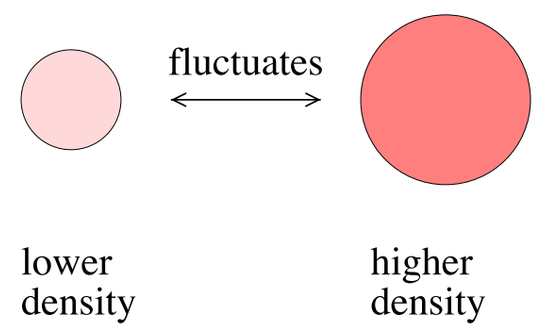


Inelastic and elastic vector meson production and gluon fluctuations

C.Weiss



Measurement of elastic and inelastic vector meson production provides unique window into the gluon density fluctuations



Setup for the EIC:

Diffractive vector meson production $e + p \to e' + V + p/X$

$V = J/\psi, \rho^0, \phi$, $x = (10^{-3}, 10^{-1})$, $Q^2 = (0$, few 10 GeV$^2)$, $|t| = (0, \sim 1$ GeV$^2)$

Need good t-coverage at low $|t| \sim 0.1$ GeV^2 for extrapolation to $t = 0$

Forward-going system

Elastic: proton, $x_L \approx 1 - x$, $p_T \lesssim 1$ GeV $\to$ far-forward

Dissociative: X(mass $\lesssim 5$ GeV), contains $p, n, \pi; \Lambda, K$ $\to$ forward and far-forward

Measurements of the fluctuations of the gluon density will challenge understanding of the nucleon structure (potentially connected with the mechanism of chiral symmetry breaking in QCD.

Important for the understanding of other processes: gap survival probability in proton - proton scattering.

Outlook for Pavia

- Several topics are being run through simulations
  - See which ones drive detector requirements most
  - Meson structure looks “golden” in that regard

- Other topics need to start running simulations
  - Additional workforce always welcome!