Workshop summary

Will Brooks, USM Valparaíso

8 March, 2013

Workshop Summary

- Goal: to remind of all the wonderful talks we have heard!
- Method:
  - Humorous interlude - prizes and awards (for POETIC IV)
  - 2 slides per talk for Monday, Tuesday, Wednesday
  - 1 slide per talk from Thursday
  - 0.2 slides per talks from today
  - Poetic interlude
  - Outlook

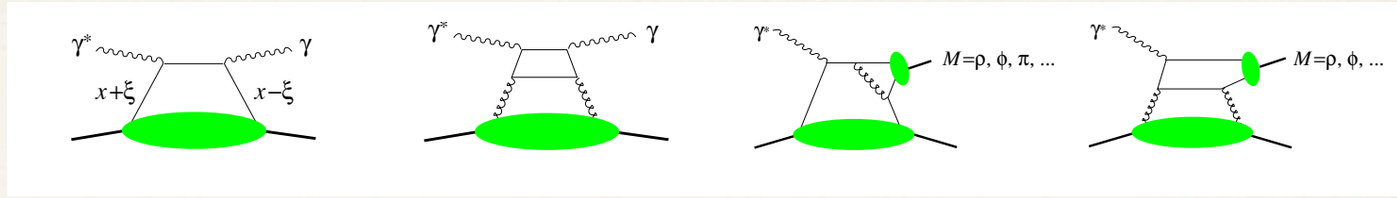
Prizes and Awards for Workshop Talks

.....to be implemented by the POETIC IV local organizers.....

- Top five talks of the workshop
- Jackson Award: largest number of equations per talk
  - Most equations per page
    - Most colorful equations
- Kinetic Learner Prize: most animations per talk
- Simpsons Prize - talk that was most irrelevant to EIC/LHeC
- Ting-Lederman Award: most self-citations per talk
- Sulu Prize: most references that show the Russians did it first
- Brodsky Prize: most slides per talk

Imaging partons at EIC: what, why and how

Markus Diehl

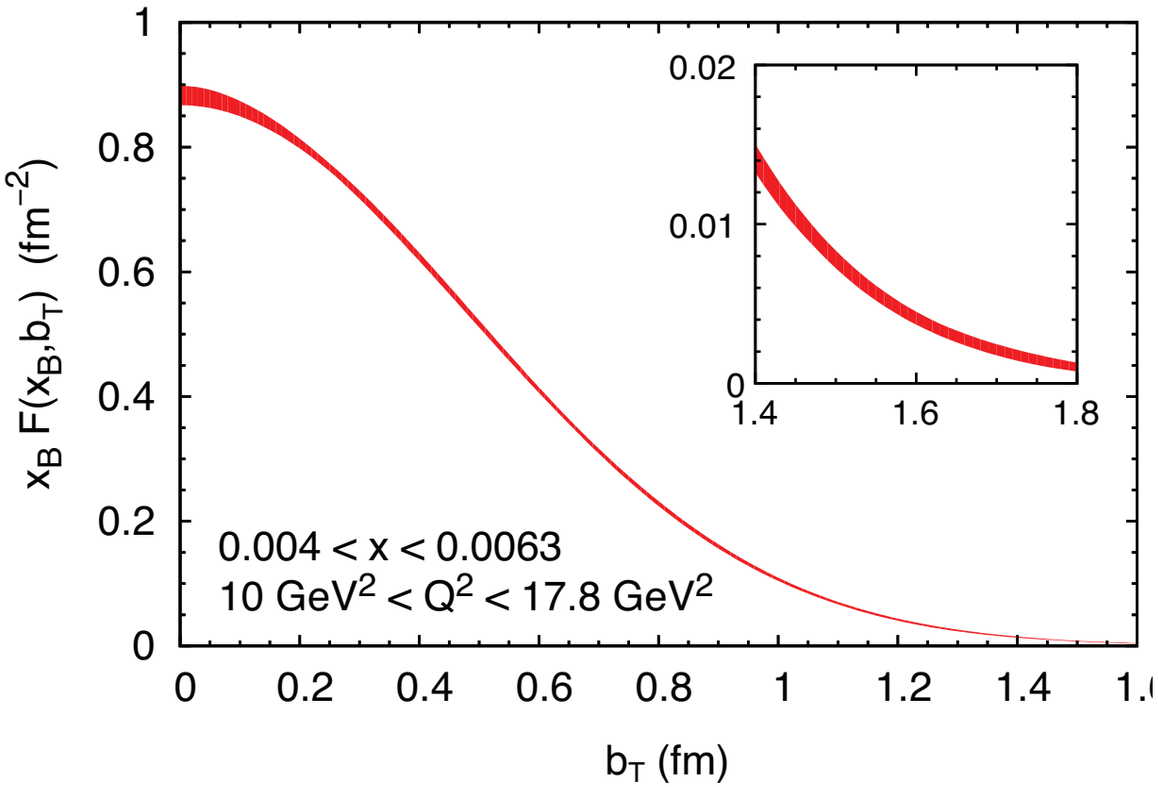


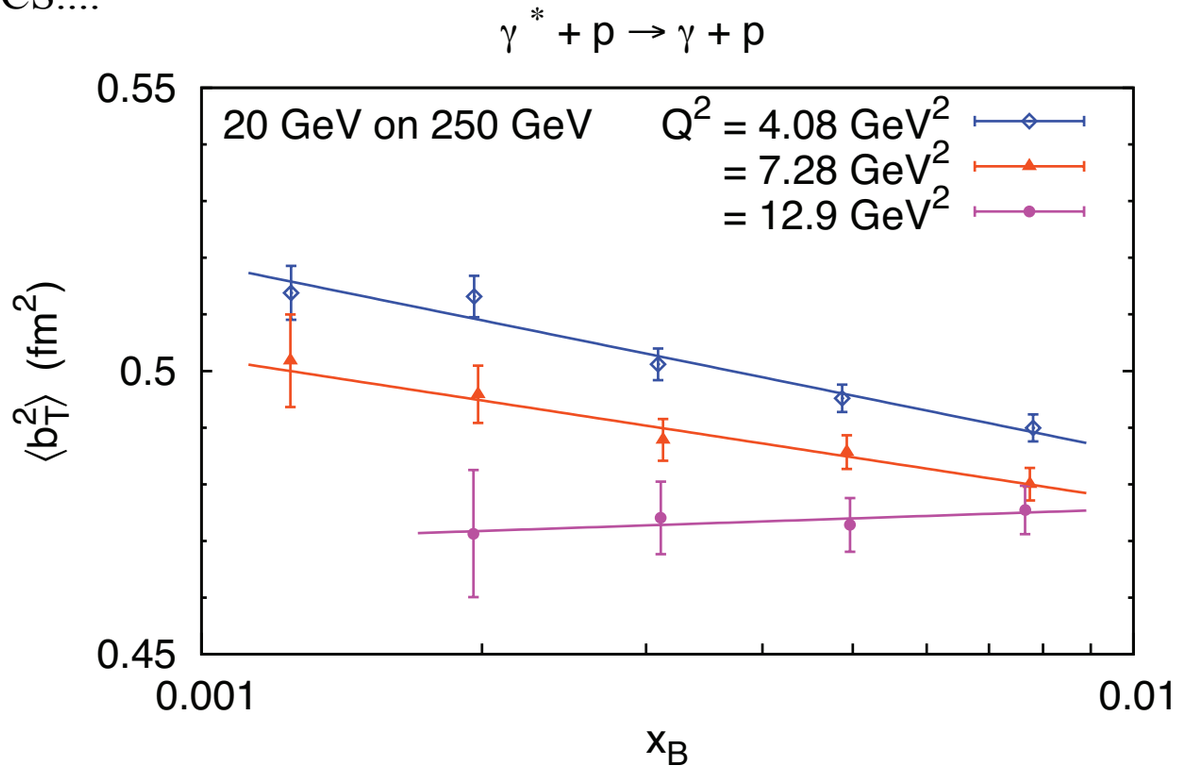
What is the dynamical origin of sea quarks and gluons in QCD?

- Spatial distributions, p_T distributions, x dependence, spin/orbital angular momentum will help to sort this out
- Transverse position distributions for the proton feasible to obtain
- Quantitative $\langle b^2 \rangle$ estimates exist for valence quarks, gluons, and glue +sea, all ~0.6 fm; depends on x at small x, differently for valence/glue
- Spin-orbit correlations - chromodynamic lensing causes shift in **b** (E)
- Experimental access: exclusive processes DVCS, TCS, DVMP: (x_B,Q^2,t)
- EIC dramatically expands kinematic coverage; need high luminosity to exploit it. Wide Q^2 coverage especially important.

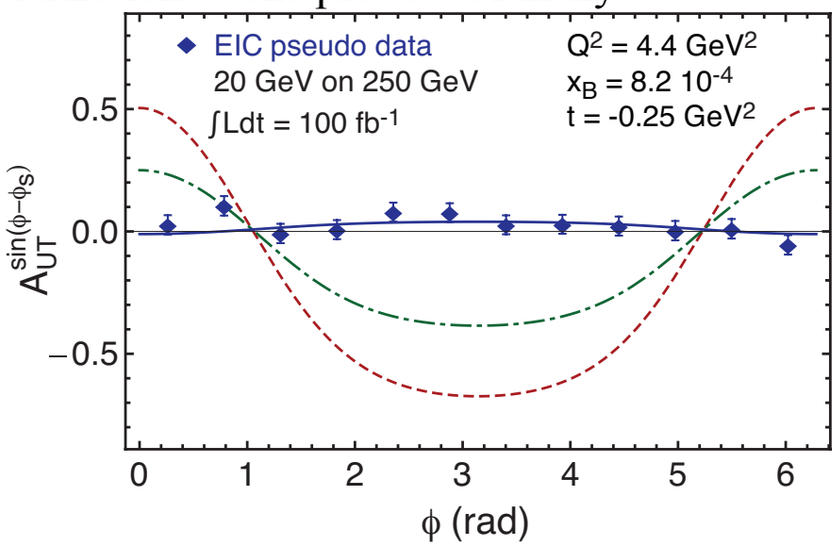
With Stage I EIC:

DVCS....

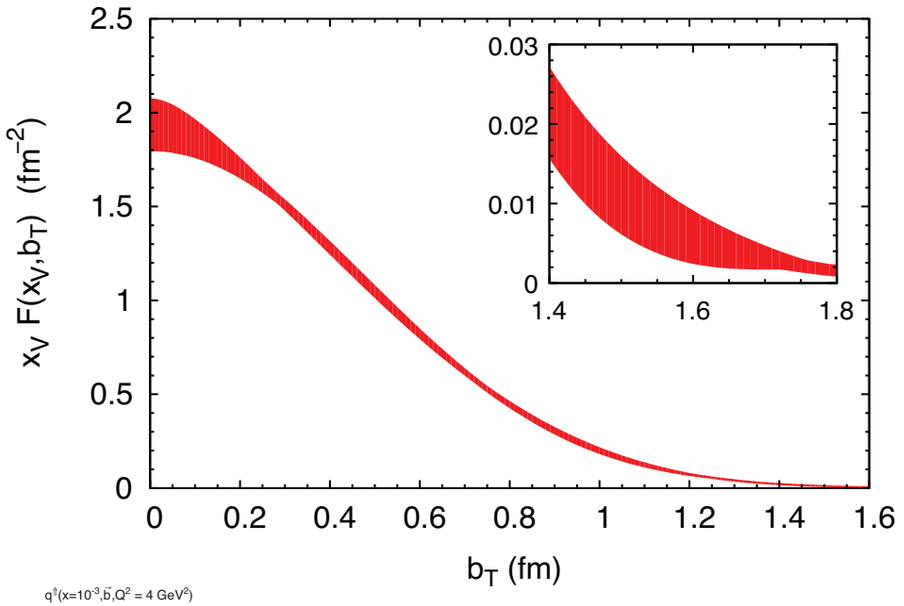




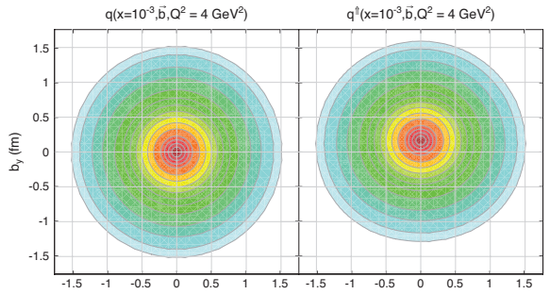
with polarization.... one plot out of many



with J/ψ.....

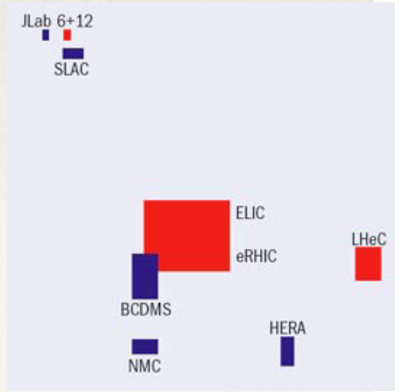


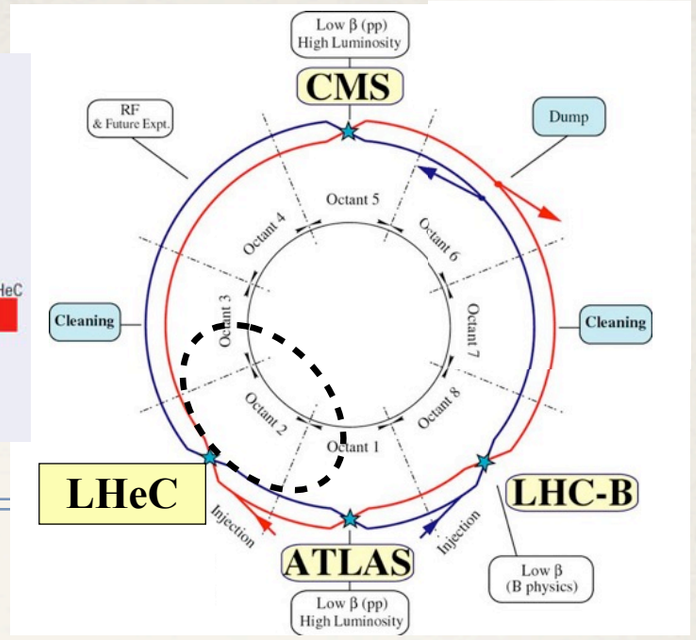
With Stage II EIC:



An Overview of the LHeC

Paul Laycock





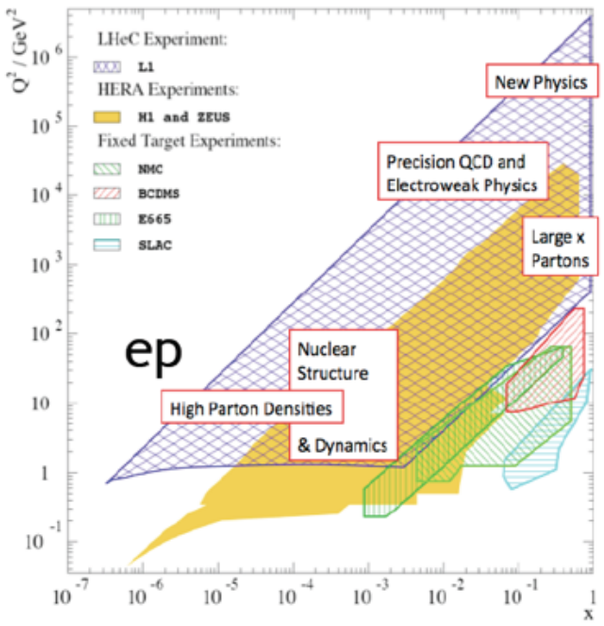
A new collider with unprecedented energy and luminosity

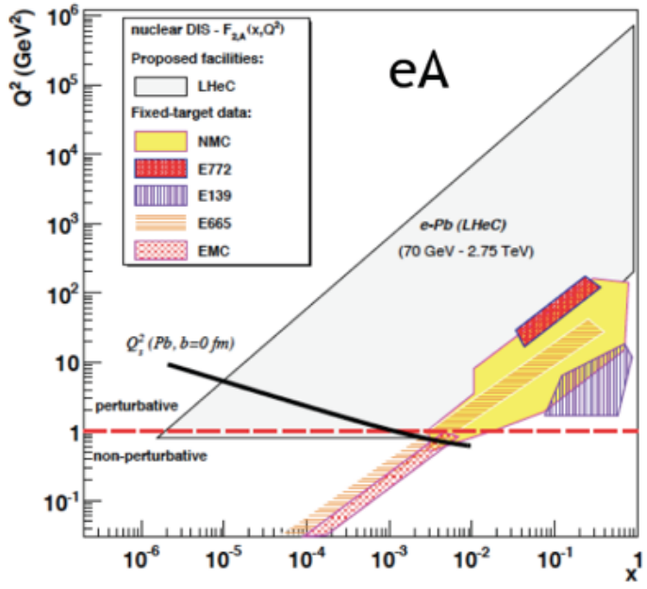
Goes far beyond HERA:

- Nuclear beams: nuclear pdfs, enhanced sensitivity to saturation, availability of deuteron beam for precise tests of isospin symmetry, medium-modified hadronization
- Extended kinematics offer tremendous opportunities for studies of pdfs for gluons and charm, beauty, strange quarks; precision α_s; sensitive Higgs in complementary channel to pp studies; new particle searches;
- Accelerator and detector designs well advanced - 60 GeV e^- ERL
- Conceptual Design Report approved and published

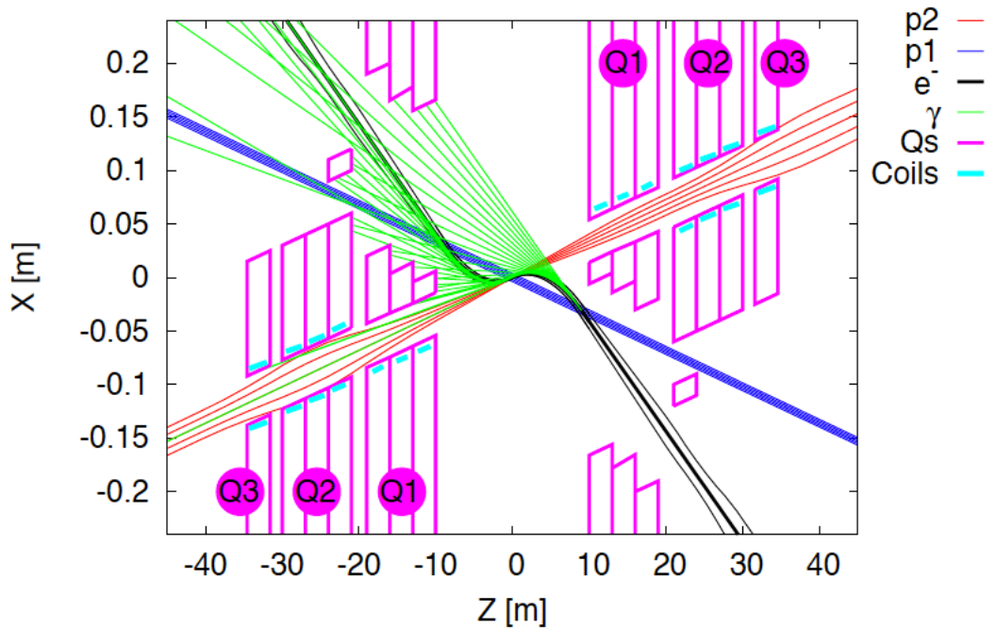
LHeC

Kinematic coverage

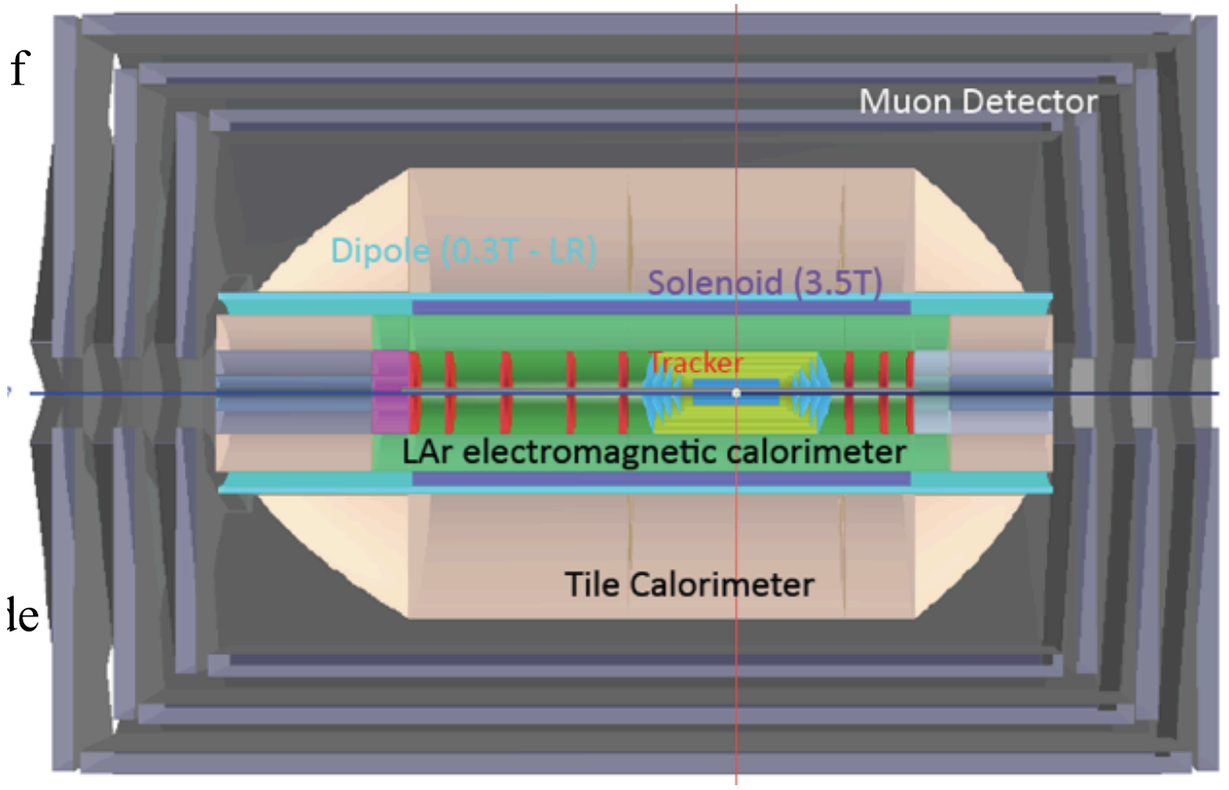




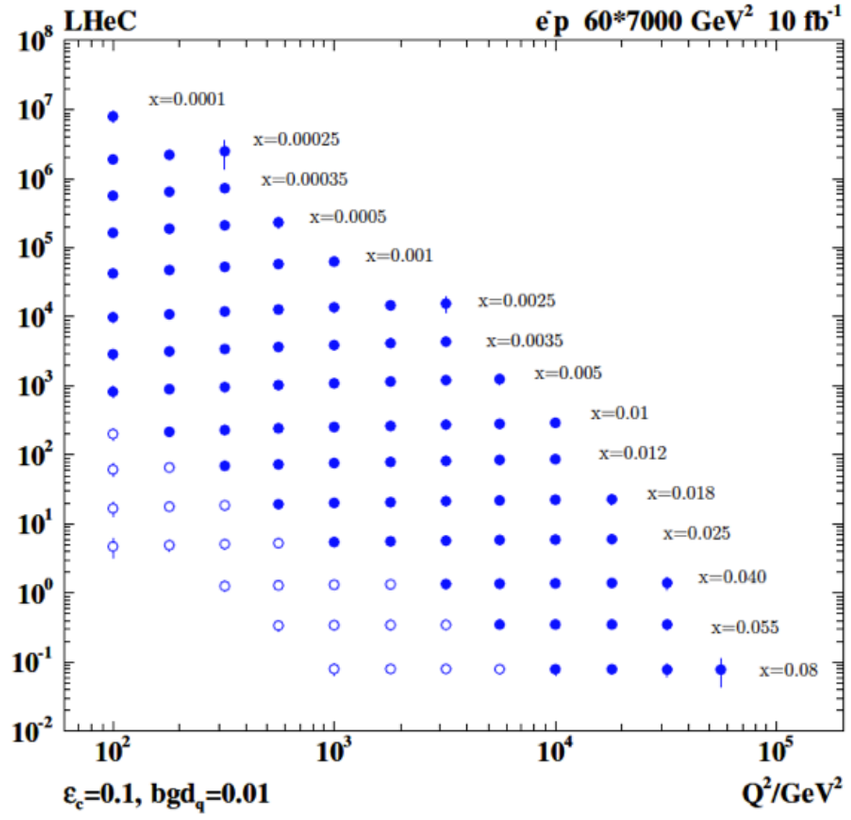
Interaction region



Detector design



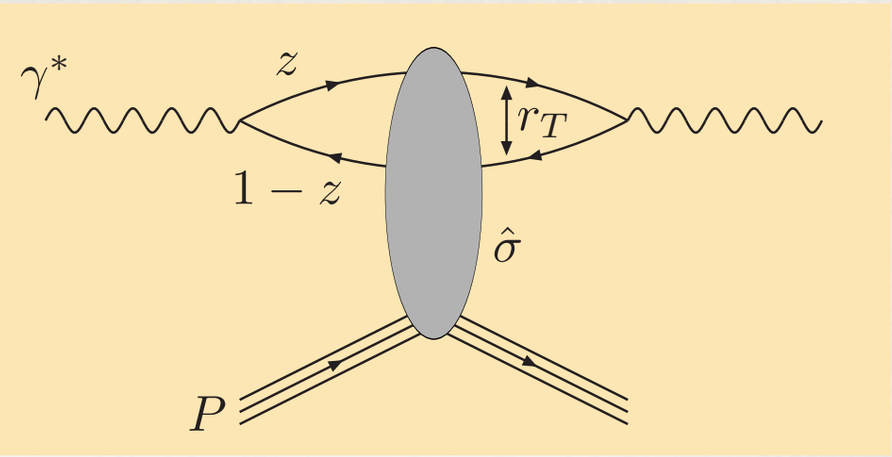
Physics



Diffractive studies with EIC

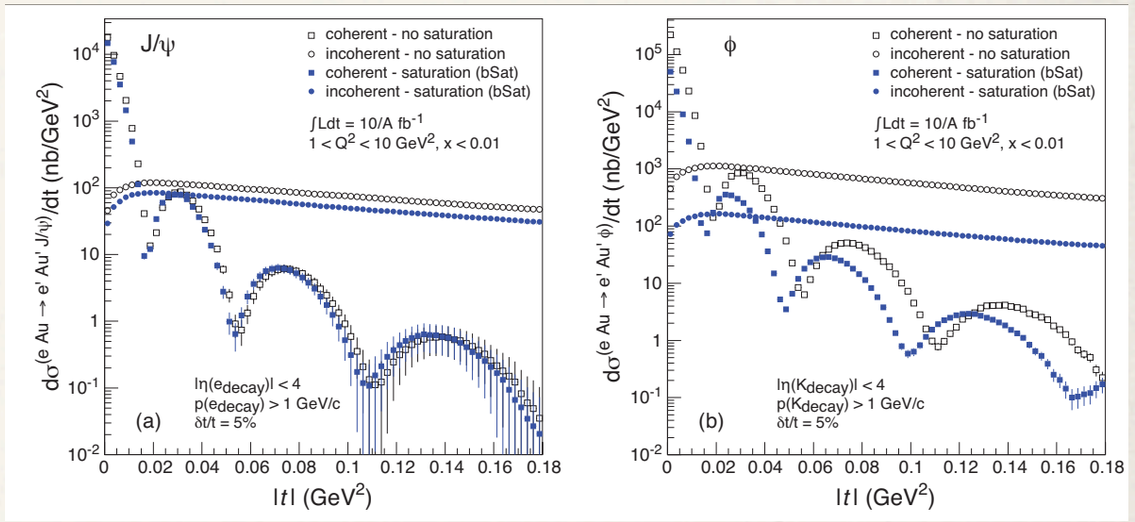
Tuomas Lappi

$$x = x_{\mathbb{P}}\beta \qquad \beta = \frac{Q^2}{Q^2 + M_X^2}$$



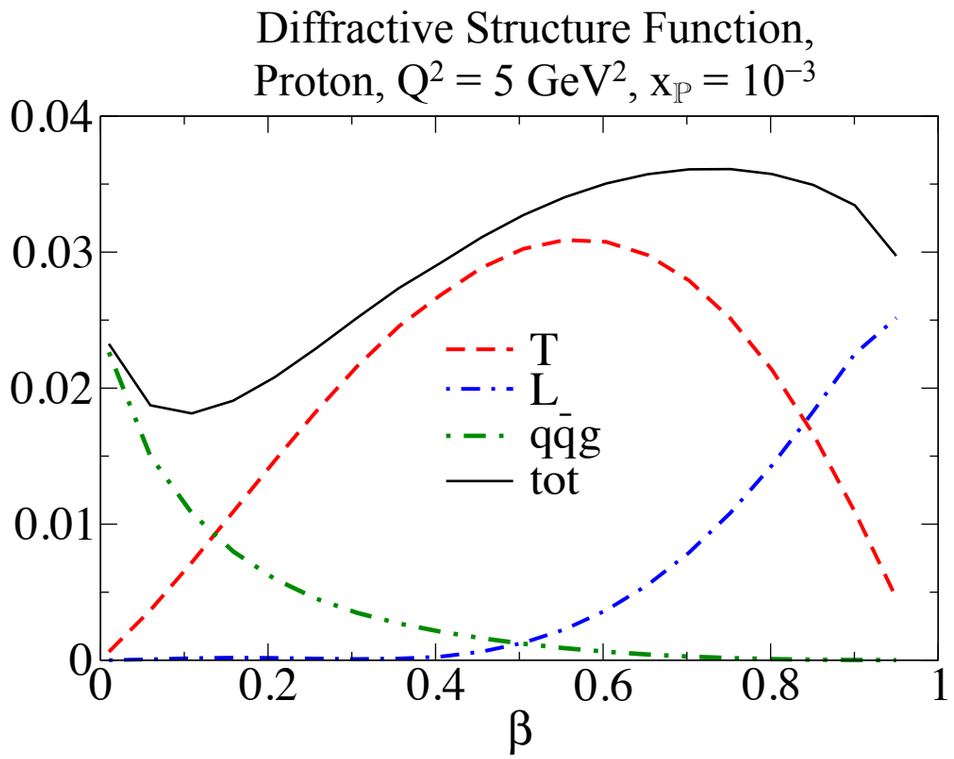
Many interesting diffraction measurements possible with EIC

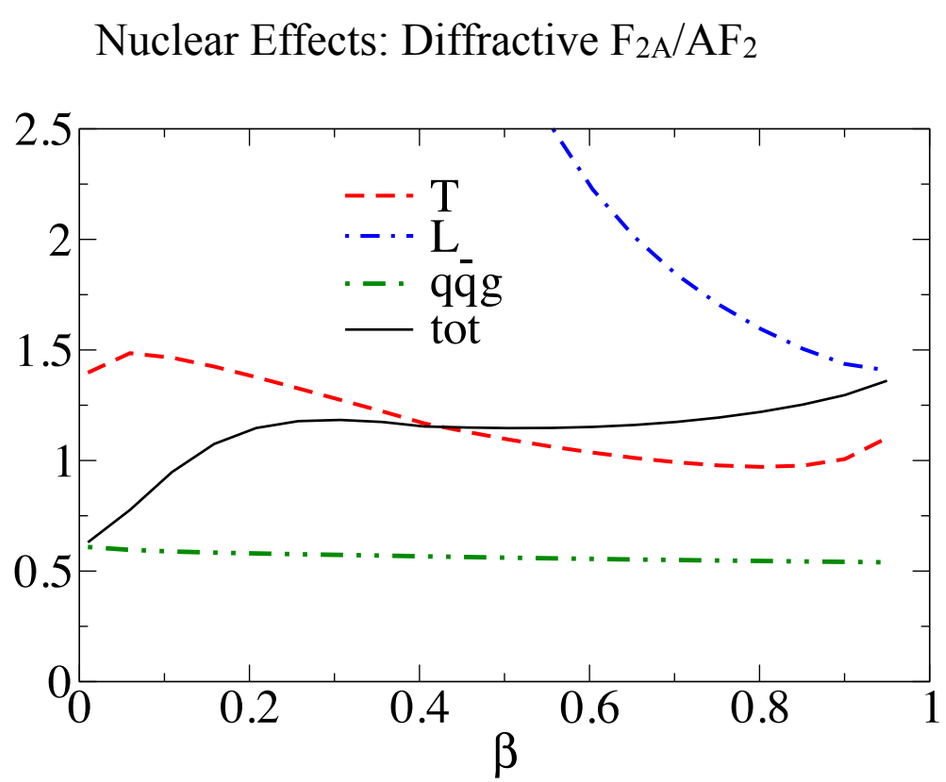
- Universality of the dipole picture - IPsat model for protons, nuclei
  - Diffractive structure function
- Mapping the A, Q^2, $x_{\mathbb{P}}$, β –space
  - Coherent and incoherent diffraction
- t and transverse structure

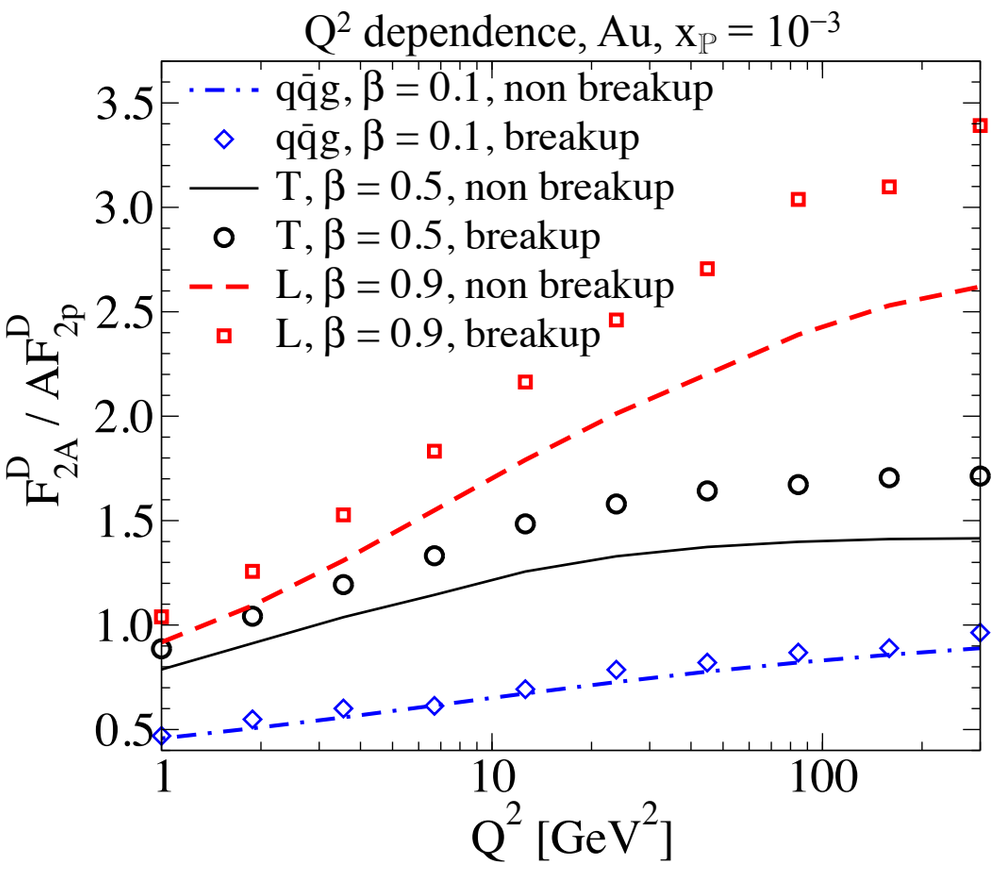


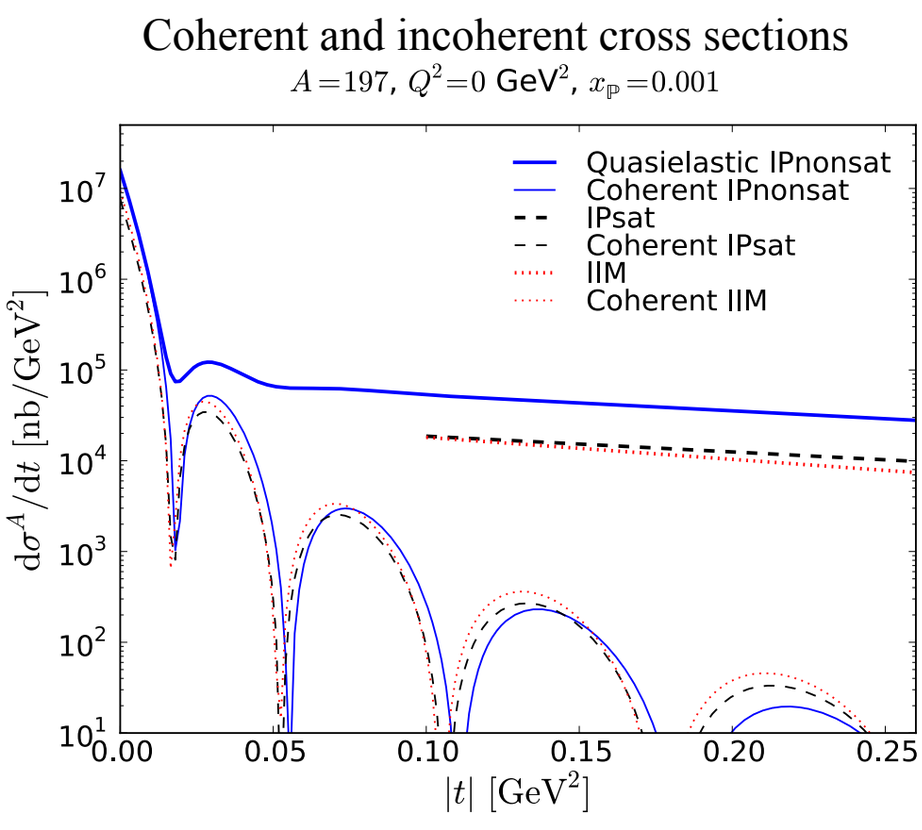
POETIC IV in Jyväskylä!

EIC possibilities:



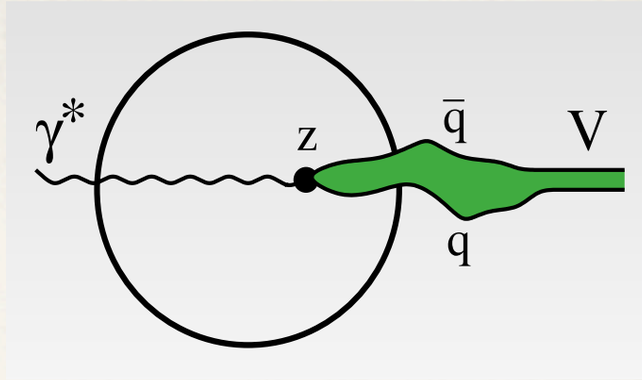






Diffractive electroproduction of vector mesons on nuclei at EIC

Jan Nemchik

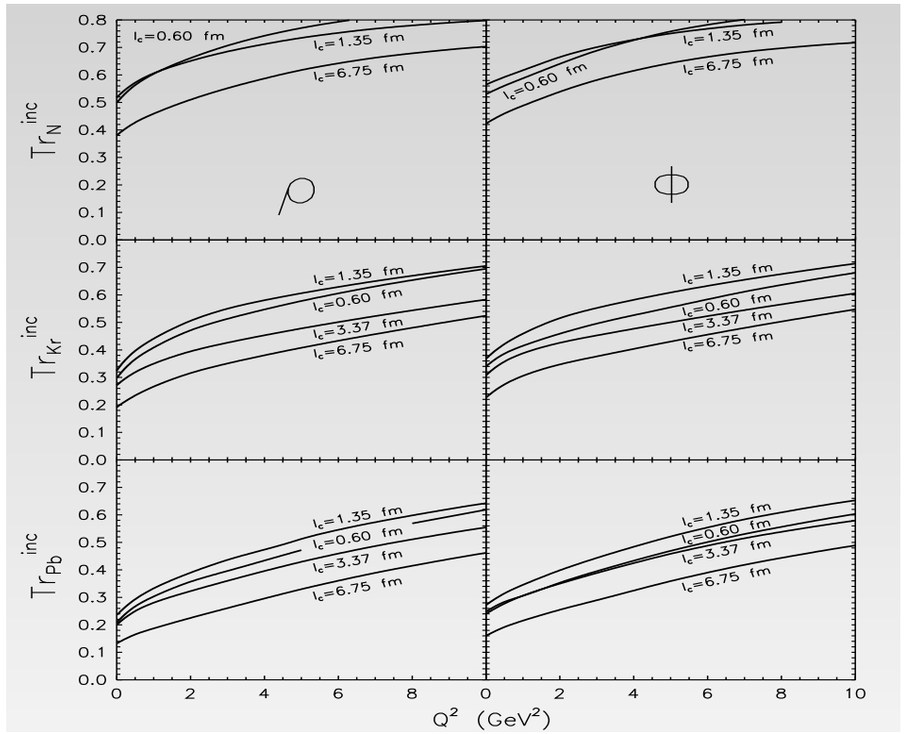


Color transparency, coherence length, vector mesons, gluon shadowing

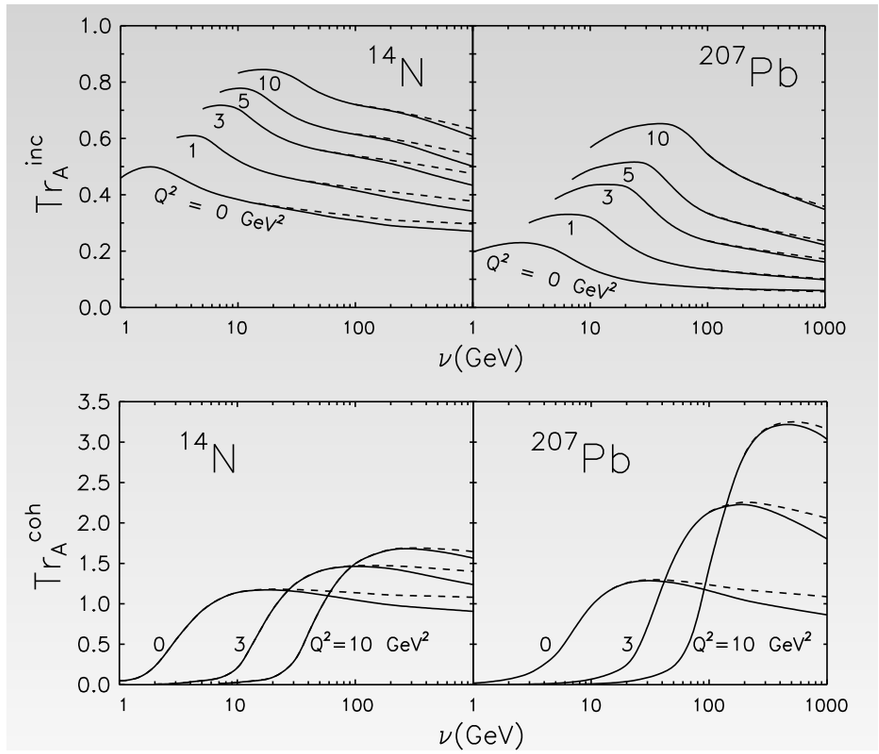
- ⇒ color transparency (CT)
  ⇒ quantum coherence - coherence length (CL)
- ⇒ different regimes of vector meson production
  - ⇒ Color transparency-coherence length ambiguity
- Color dipole phenomenology
  - ⇒ Green function formalism
    - ⇒ comparison with CLAS data at JLab
    - ⇒ comparison with HERMES data
    - ⇒ comparison with E665 data
    - ⇒ perspectives for EIC

EIC predictions

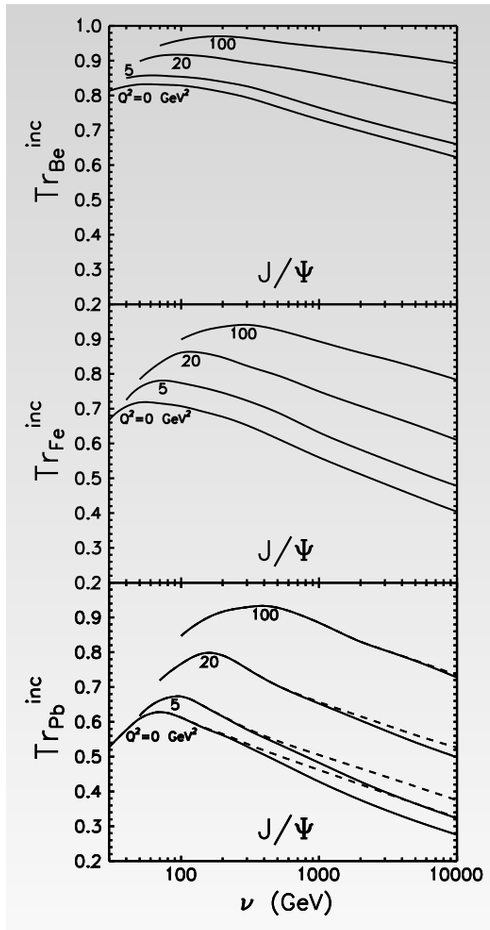
Incoherent vector meson production

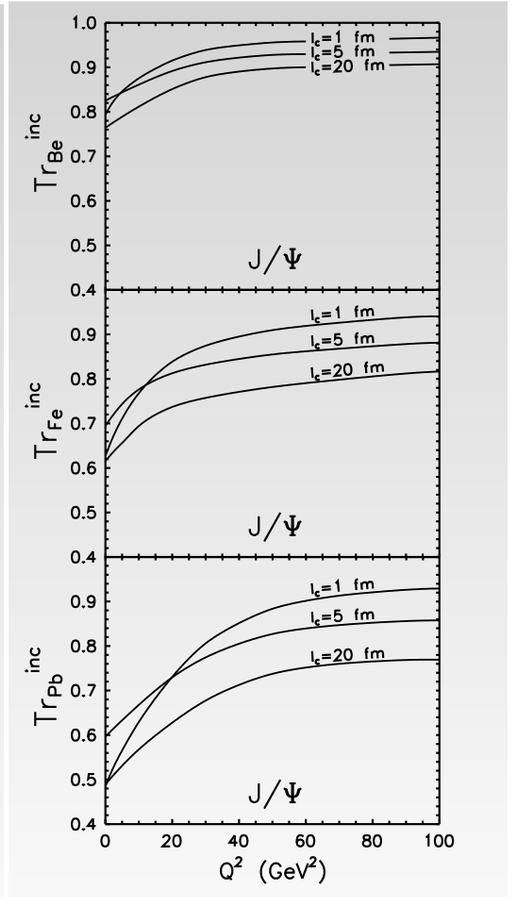


Energy dependence of light vector meson production



Incoherent J/ψ production - energy dependence and Q^2 dependence

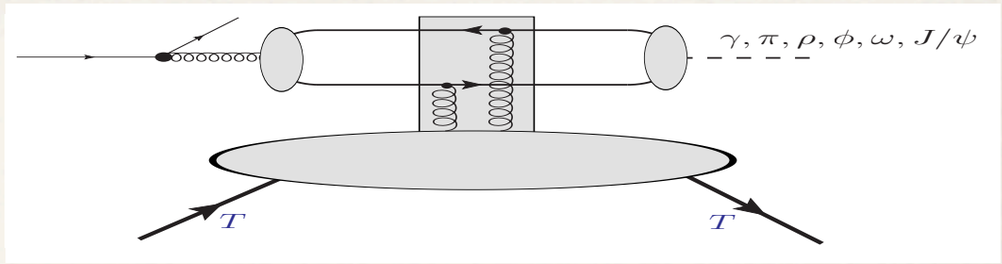




Exclusive processes at HERA and EIC

Predictions of a color dipole model

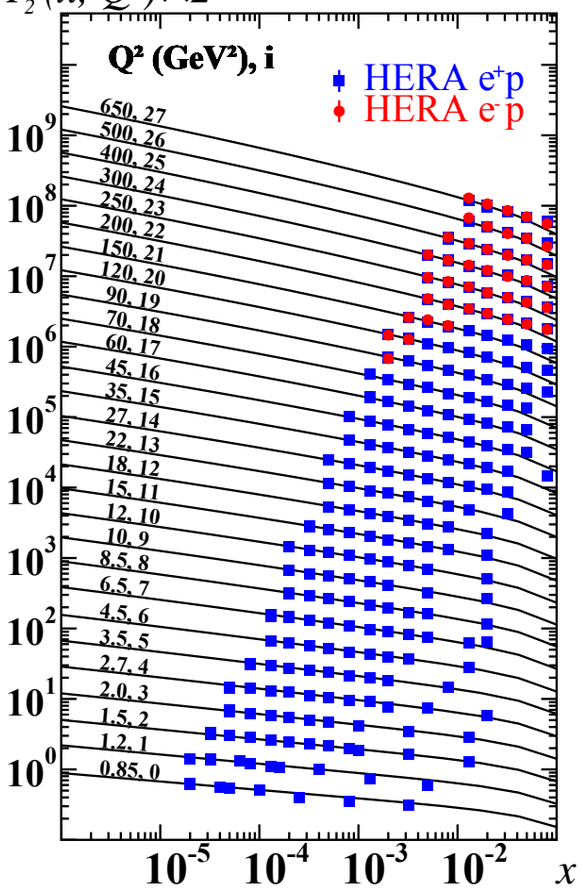
Marat Siddikov

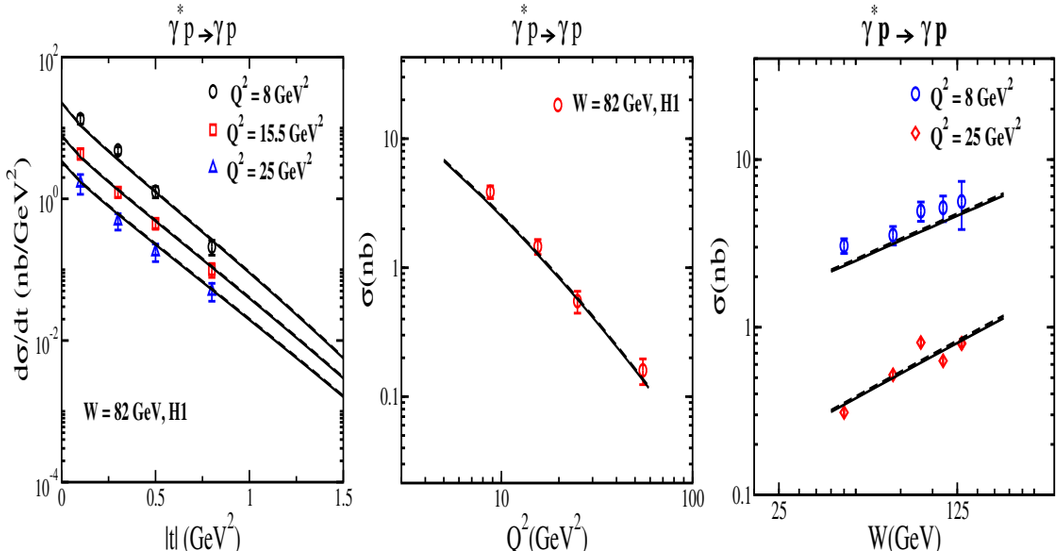


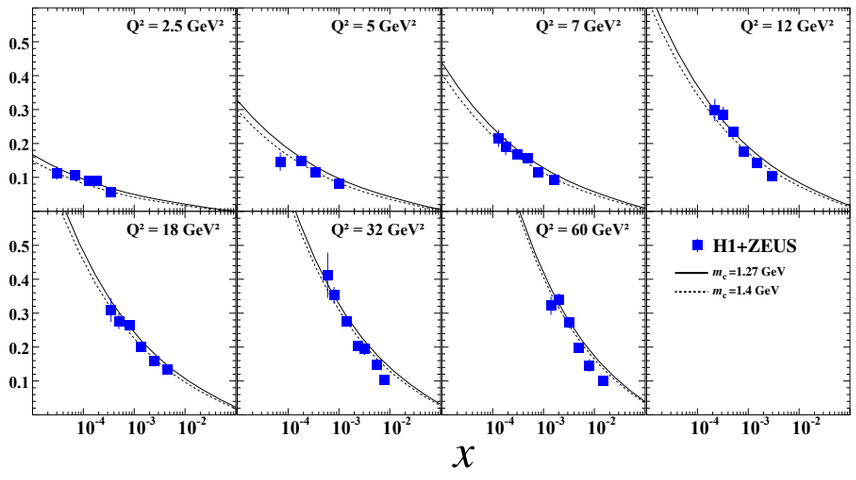
- Comparison of collinear approach and color dipole approach
  - predictions for MINERVA neutrino beam
  - discussion of dipole parameterization types (IPsat used here)
  - result of fitting existing data
    - F_2
    - FL
    - DVCS
    - DVMP
    - t-dependence of vector meson production
    - diffractive slope
- Code is now available for EIC and LHeC studies!

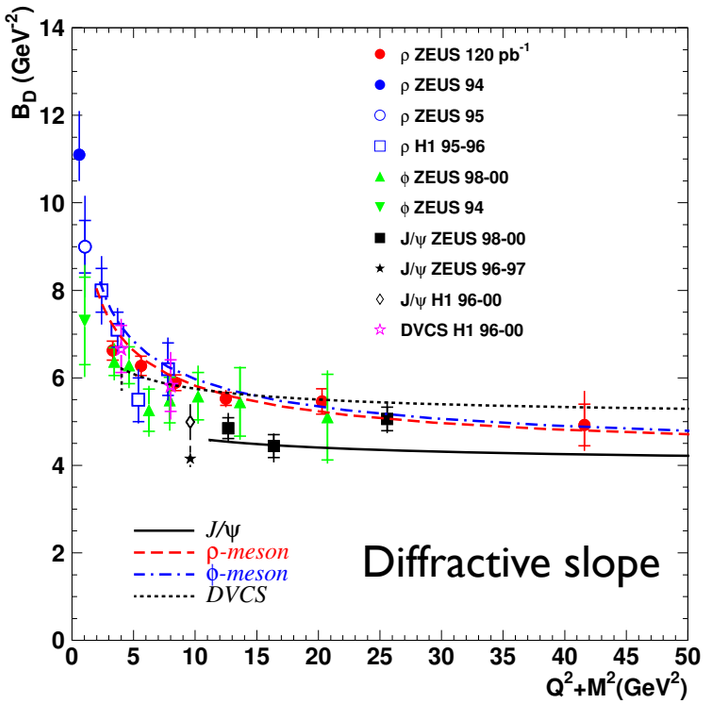
Fits to existing data - dipole model

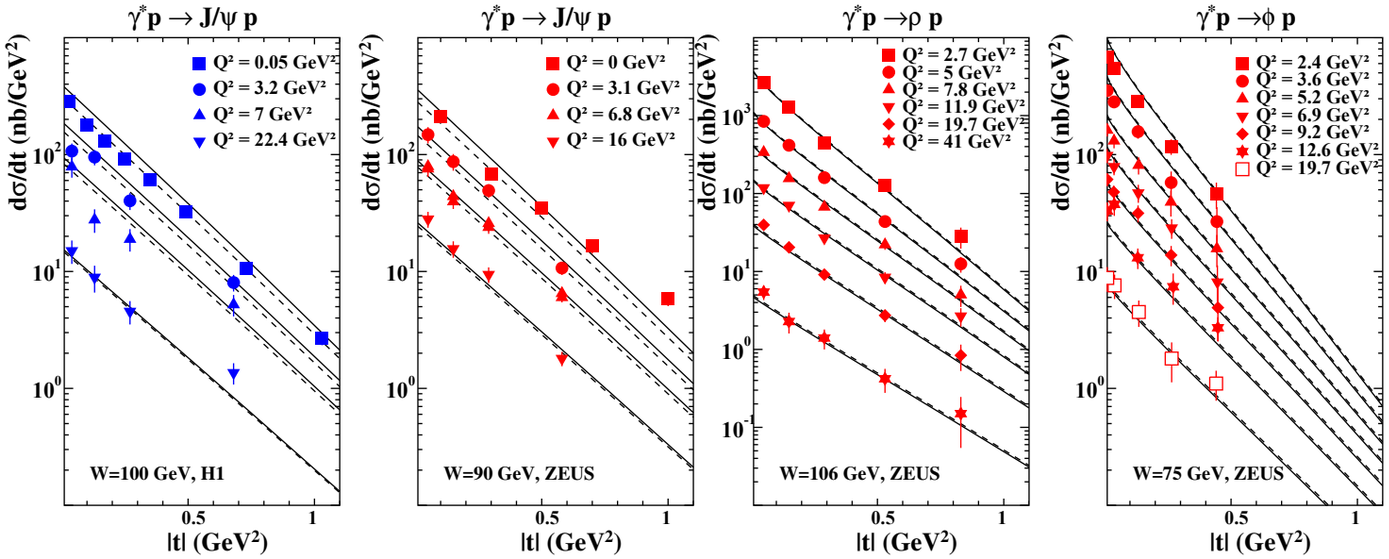
Results for DVCS

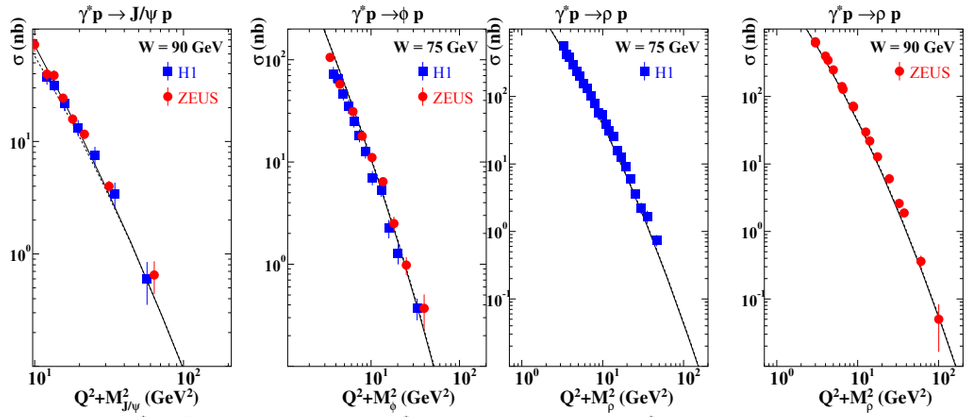


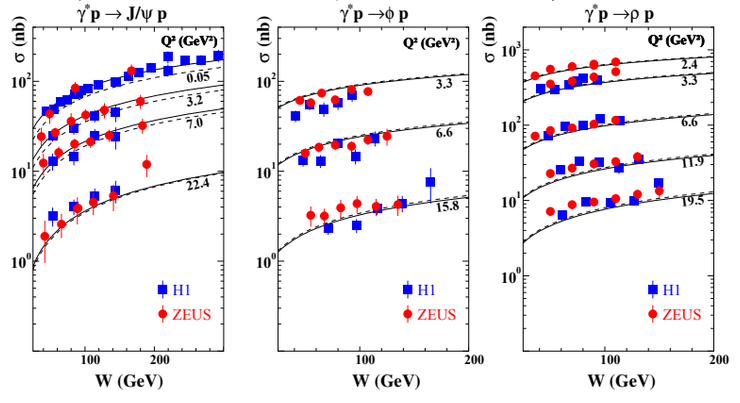






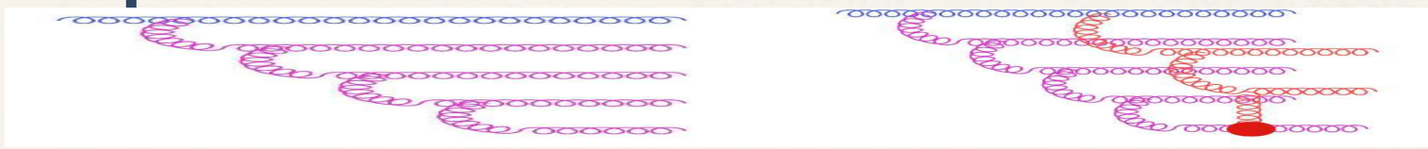






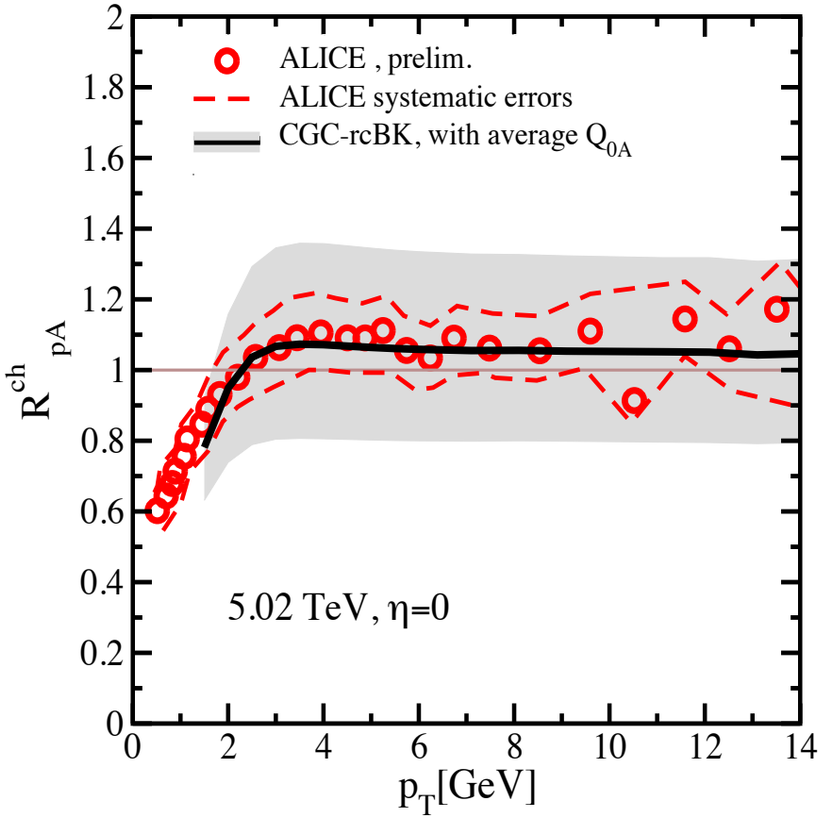
Some CGC predictions for p+A run at the LHC and their implications for EIC

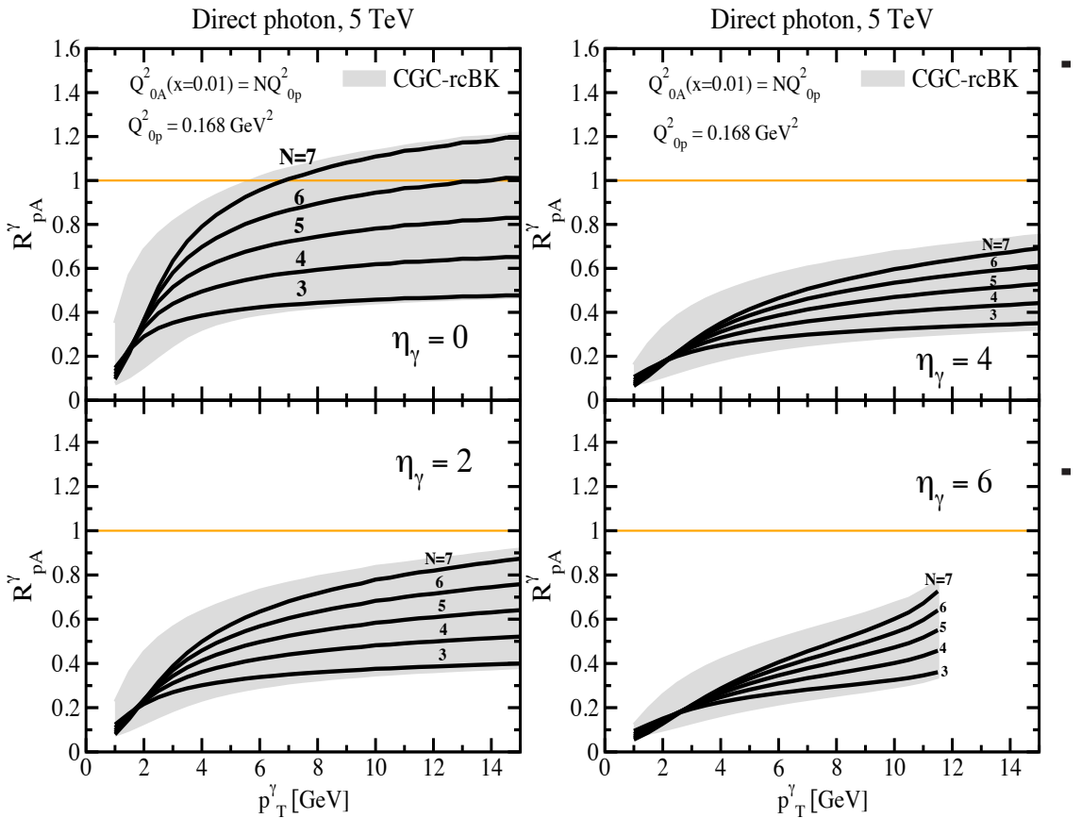
Amir Rezaeian



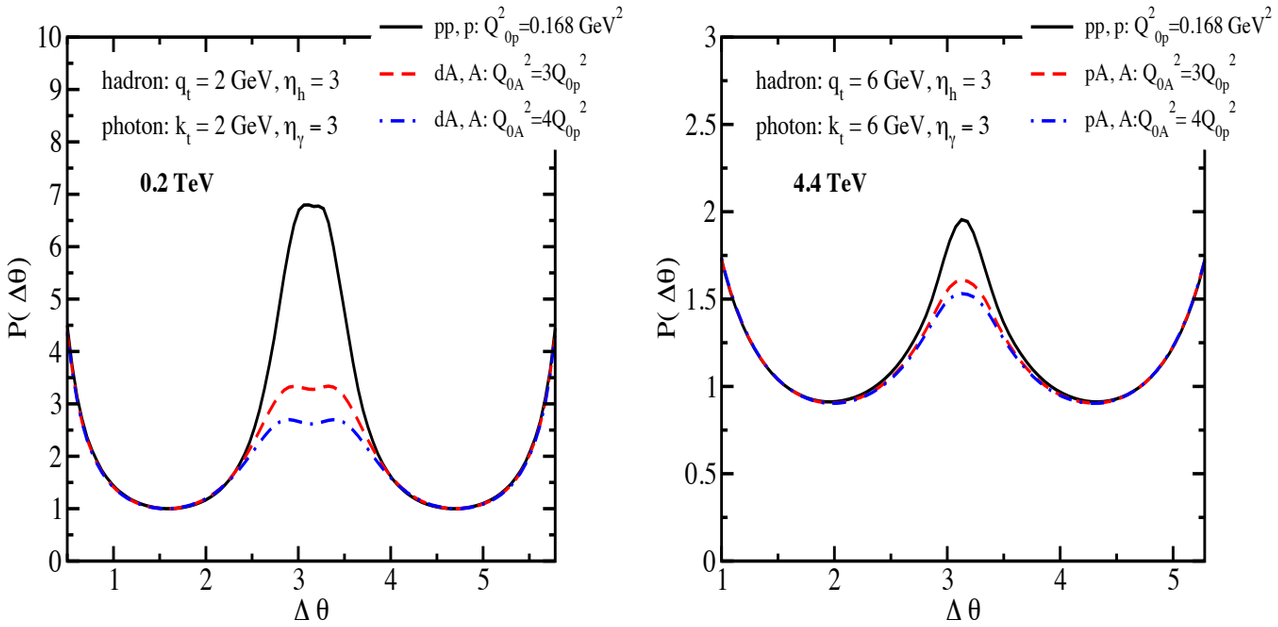
- Motivation for saturation studies; BFKL versus BK-JIMWLK evolution equation
- Saturation (IP-Sat) description of recent combined HERA data
- CGC description of recent combined HERA data: Charm structure function and F_L structure function
- Gluon distribution: collinear factorization v. color dipole approach
- Slope of t-distribution of exclusive processes: a unified picture
- Indications of saturation/CGC at the LHC in pp collisions?
- Predictions for p+Pb at LHC: charged hadrons, direct photons, photon-hadron azimuthal correlations, $\gamma\,\pi^0$ azimuthal correlations

p+Pb @ LHC - predictions within CGC framework

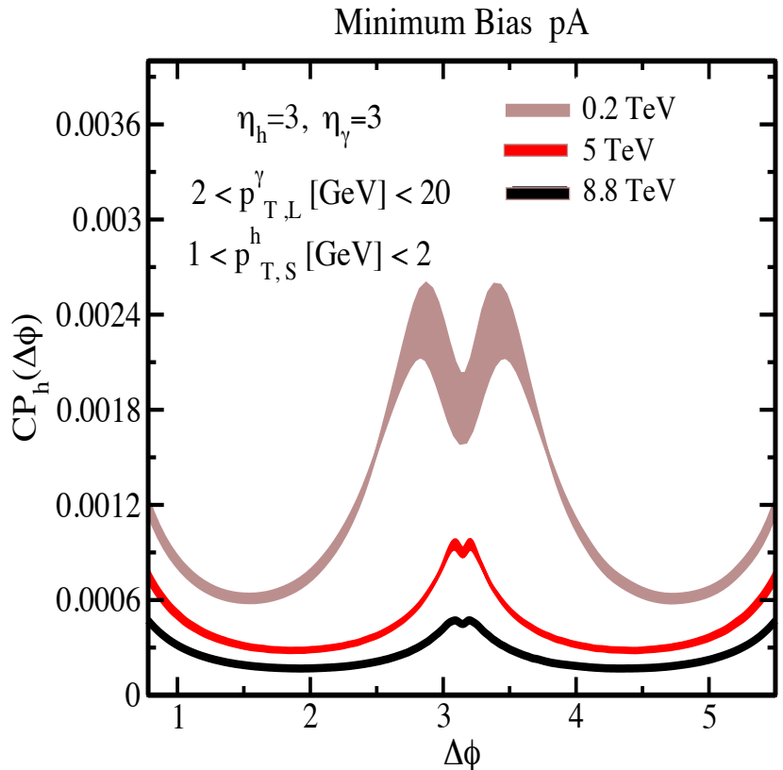




Photon-hadron azimuthal correlations; suppression of away-side correlations

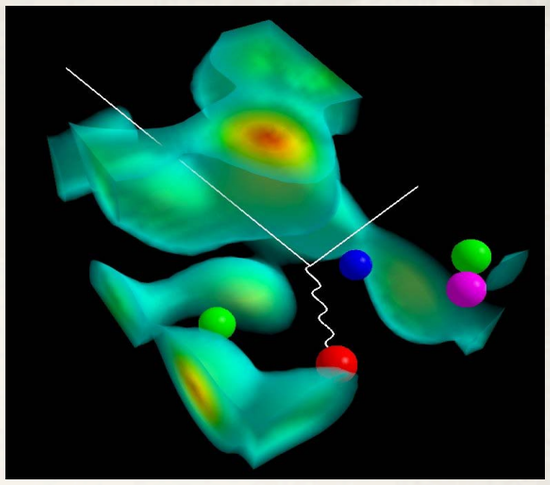


Photon-π° azimuthal correlations, RHIC vs. LHC



Challenges in the Spin and Flavour Structure of PDFs

Tony Thomas



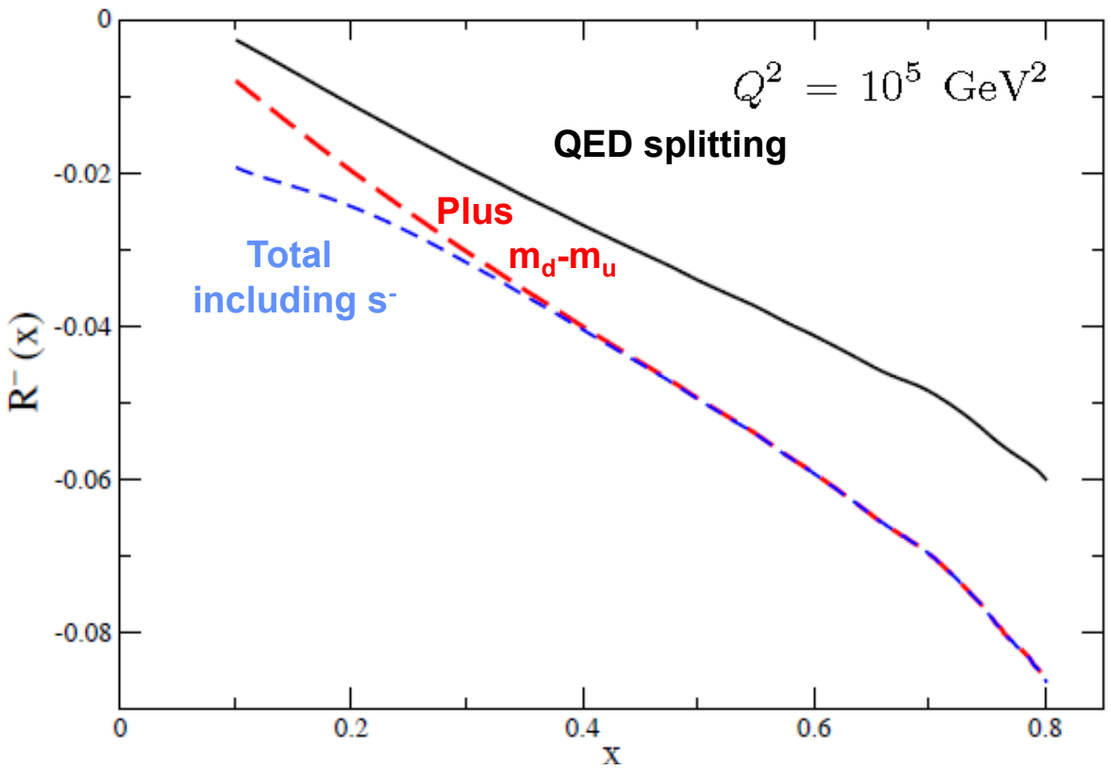
Chiral symmetry of QCD, Charge Symmetry Violation, NuTeV, "isovector EMC effect, octet spin fractions from lattice QCD: proton spin crisis

- Pion cloud and asymmetry of $\bar{u}\bar{d}$ and $s\bar{s}$ in nucleon
- Charge symmetry violation ignored in pdf extractions
  - Diquark effects: charge asymmetry amplified at high x
  - Lattice confirms effect
  - QED splitting creates CSV, increases with Q^2
  - Isovector EMC effect: isovector force in N≠Z nuclei causes shift of momentum from all u to all d quarks, not corrected for by subtraction of weighted structure functions
- NuTeV anomaly disappears after applying corrections for isovector EMC effect, CSV, and strange sea asymmetry

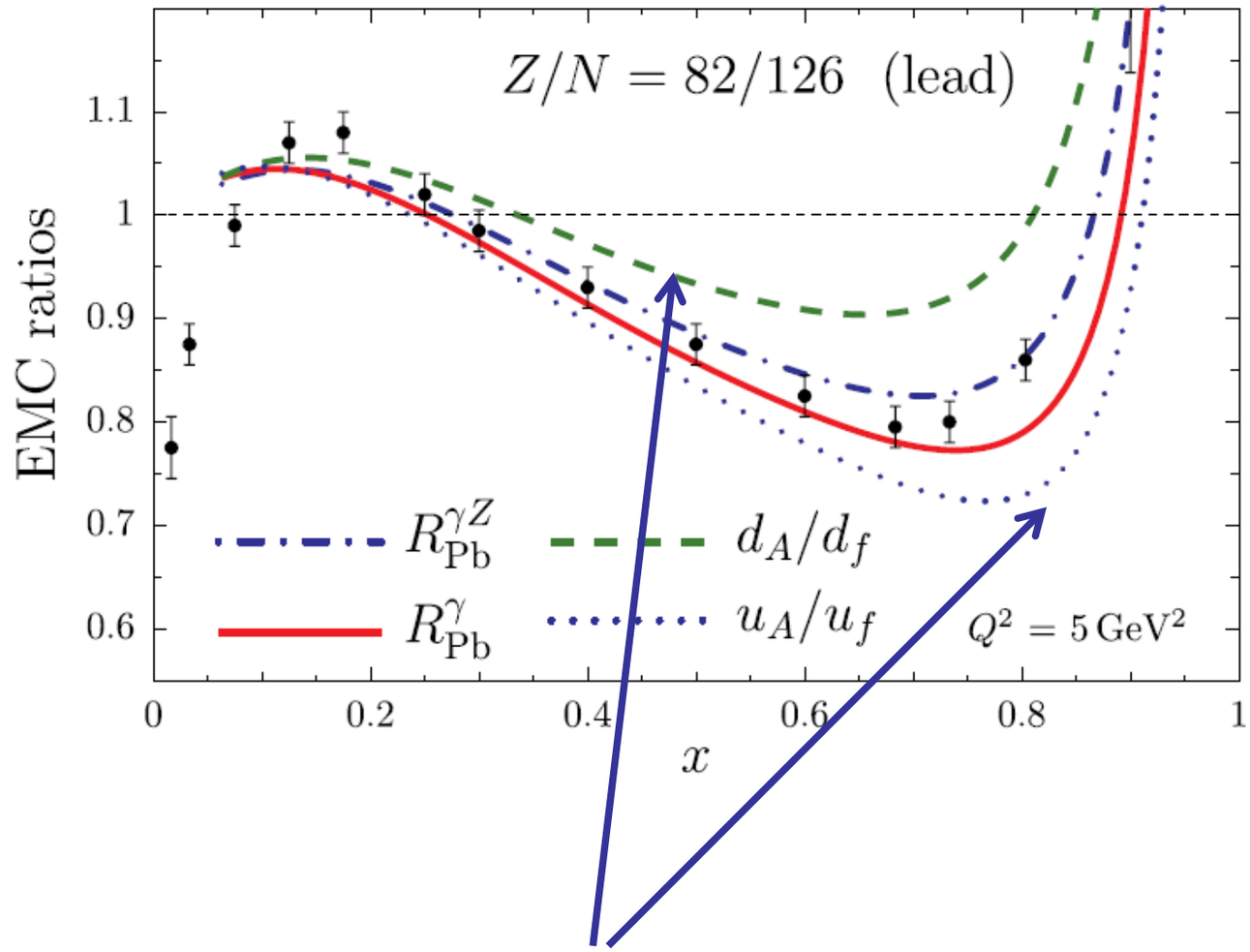
EIC connections

Test of CSV QED splitting
at EIC or LHeC

$$R^-(x) \equiv \frac{2(F_2^{W^-D}(x) - F_2^{W^+D}(x))}{F_2^{W^-p}(x) + F_2^{W^+p}(x)}$$



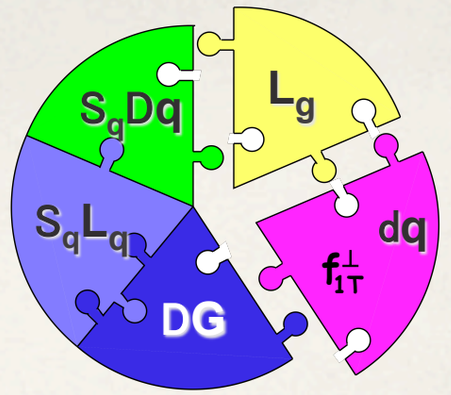
Parity violating DIS and the
EMC flavor dependence



Can also be tested at EIC with reactions

RHIC and EIC: Helicity structure of the nucleon

Elke Aschenauer

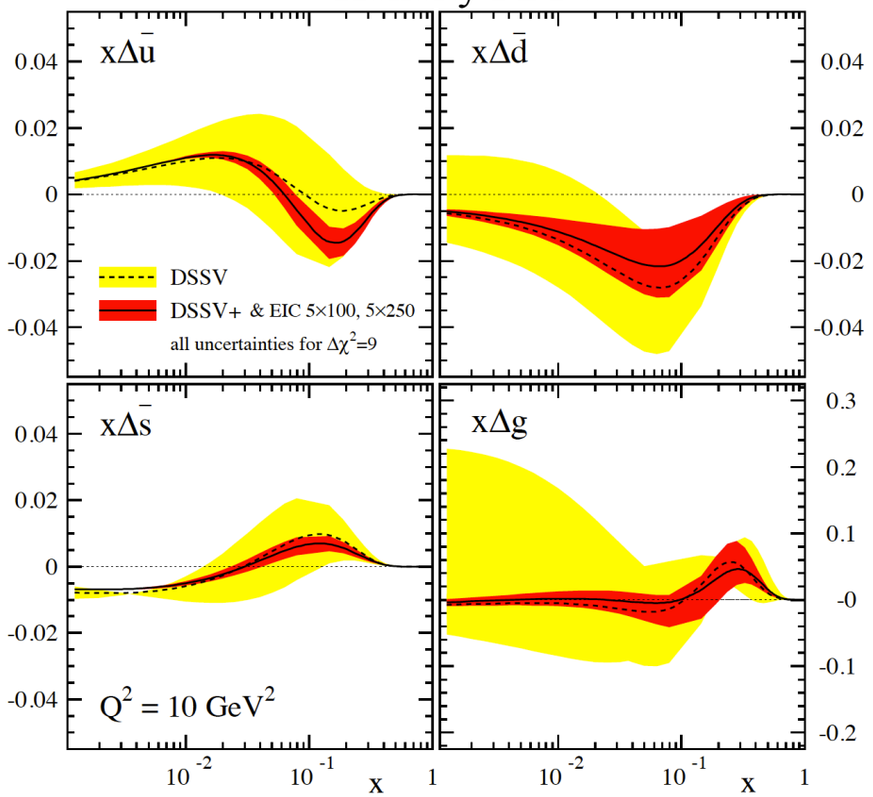


Precision understanding of the components of the nucleon spin

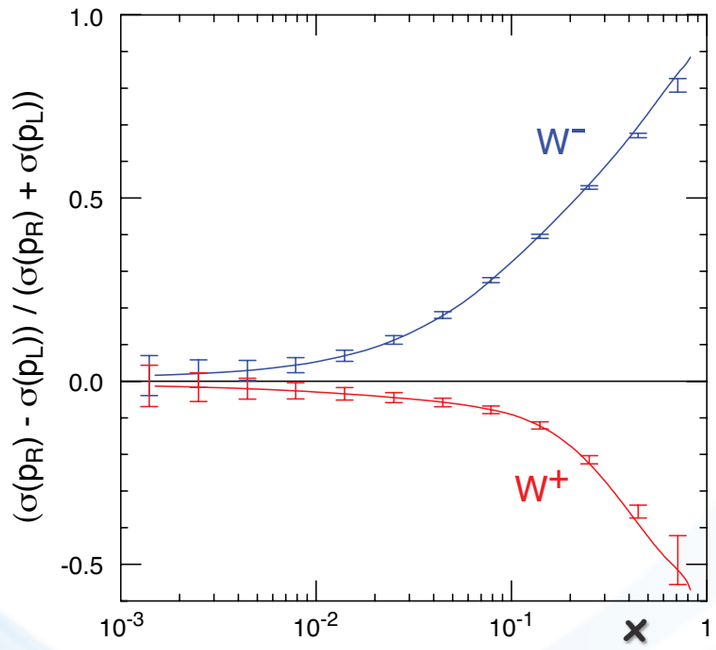
- Summary of open questions and current state of knowledge from various types of polarization measurements - $\Delta g(x,Q^2)$, $\Delta q(x,Q^2)$
- Impact of new data from COMPASS in DIS and SIDIS, especially on $\Delta s(x,Q^2)$
- Impacts of new RHIC data from 2009-2012, especially on $\Delta g(x,Q^2)$
- Aims for the future - reduce uncertainties, go to lower x, take advantage of wide kinematic range of collider
- Superb results using the W boson as a probe - couple to one parton helicity, very high Q^2-scale, extremely clean theoretically, no fragmentation function
- Considerable studies for show that finishing these studies at a high level of quality requires the EIC

EIC impacts

Helicity PDFs



Electroweak asymmetries



EW - ASYMMETRIES

20 × 250 GeV
$Q^2 > 1$ GeV²
$0.1 < y < 0.9$
10 fb⁻¹
DSSV PDFs

very promising!

even doable with 5x250 GeV

BUT:
need to be able to reconstruct x, Q^2 from hadronic final-state
→ limits y-range
→ need polarised MC

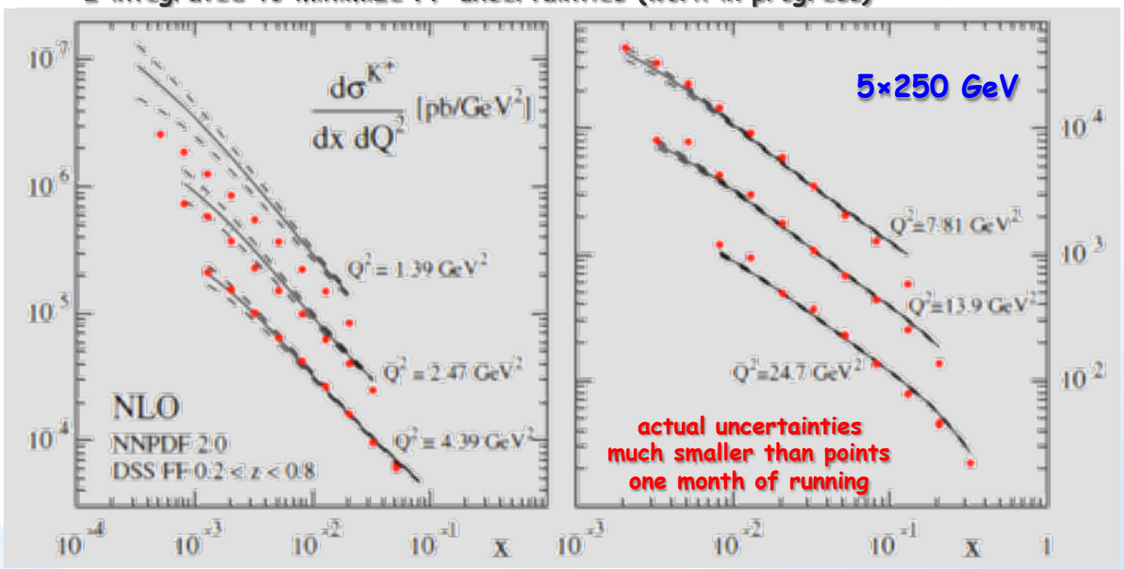
Cabibbo suppressed contributions neglected

$$A^{W^-} = \frac{(\Delta u + \Delta c) - (1-y)^2(\Delta\bar{d} + \Delta\bar{s})}{(u+c) + (1-y)^2(\bar{d}+\bar{s})} \qquad A^{W^+} = \frac{(1-y)^2(\Delta d + \Delta s) - (\Delta\bar{u} + \Delta\bar{c})}{(1-y)^2(d+s) + (\bar{u}+\bar{c})}$$

1ST STUDIES DONE FOR CHARGED KAONS

ECA, M. Stratmann

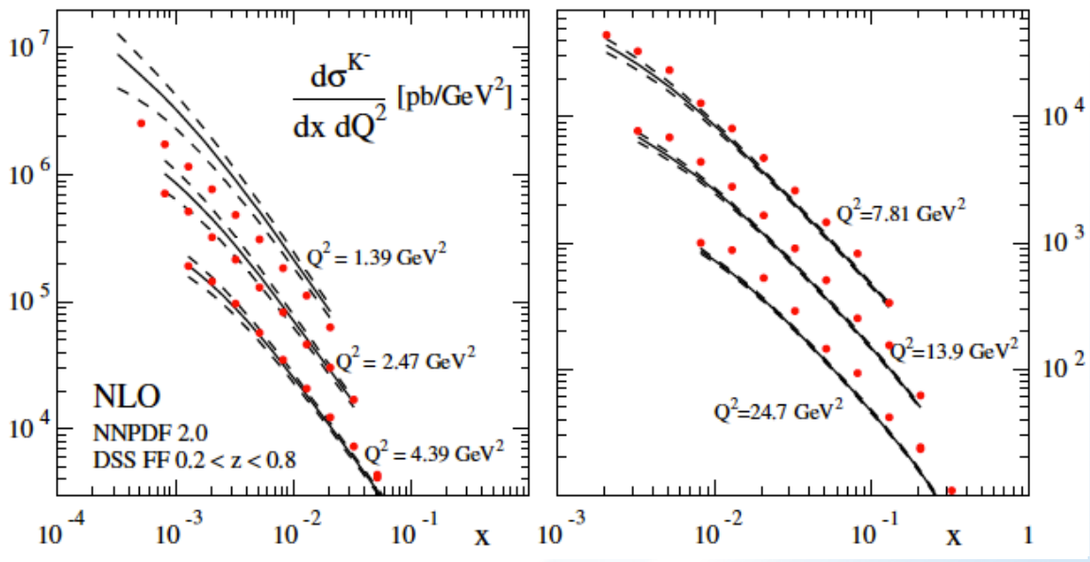
compute K^+ yields at NLO with 100 NNPDF replicas
z integrated to minimize FF uncertainties (work in progress)



PYTHIA agrees very well (despite different hadronization)
--> confidence that we can use MC to estimate yields & generate toy data

KAON STUDIES - CONT'D

how about K^- (relevant for s-sbar separation)

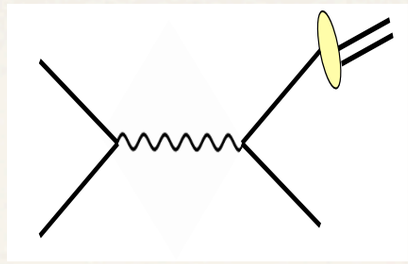


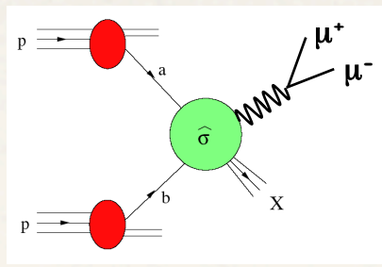
next step: redo study to assess impact with new NNPDF2.3
(using full set of stage-1 energies: 5×100 - 20×250)

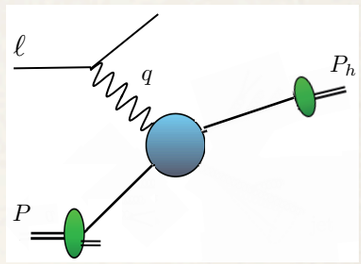
to do: include also $\pi^\pm$; polarized SIDIS and impact on global fit

QCD resummation for semi-inclusive hadron production processes

Werner Vogelsang







- Large log contributions to calculations of cross sections in pQCD: truncation of the perturbative series produces unacceptable inaccuracy. Need to re-sum the logarithmic contributions.
- Techniques have been under development since 1980's
- Drell-Yan process in π-N scattering
- SIDIS
- $e^+e^- \to hX$
- Will be important to take into account at EIC

$\mu p \quad \sqrt{s} = 17.4$ GeV (COMPASS)

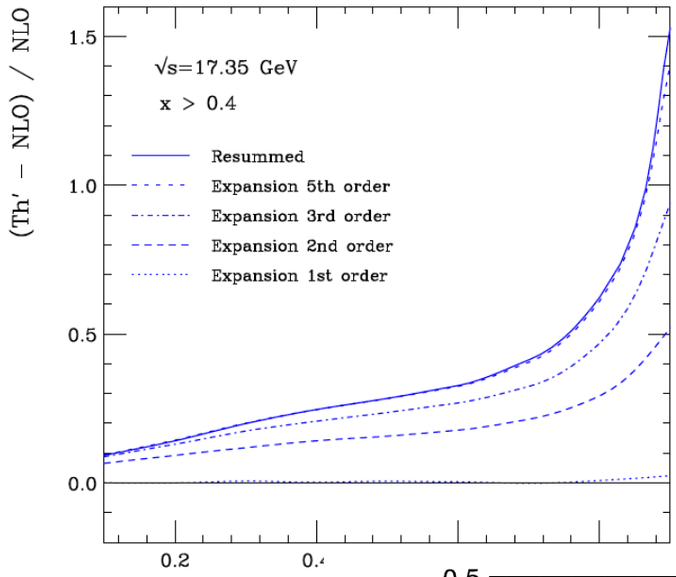
MSTW08 / DSS
(fit to get moments)

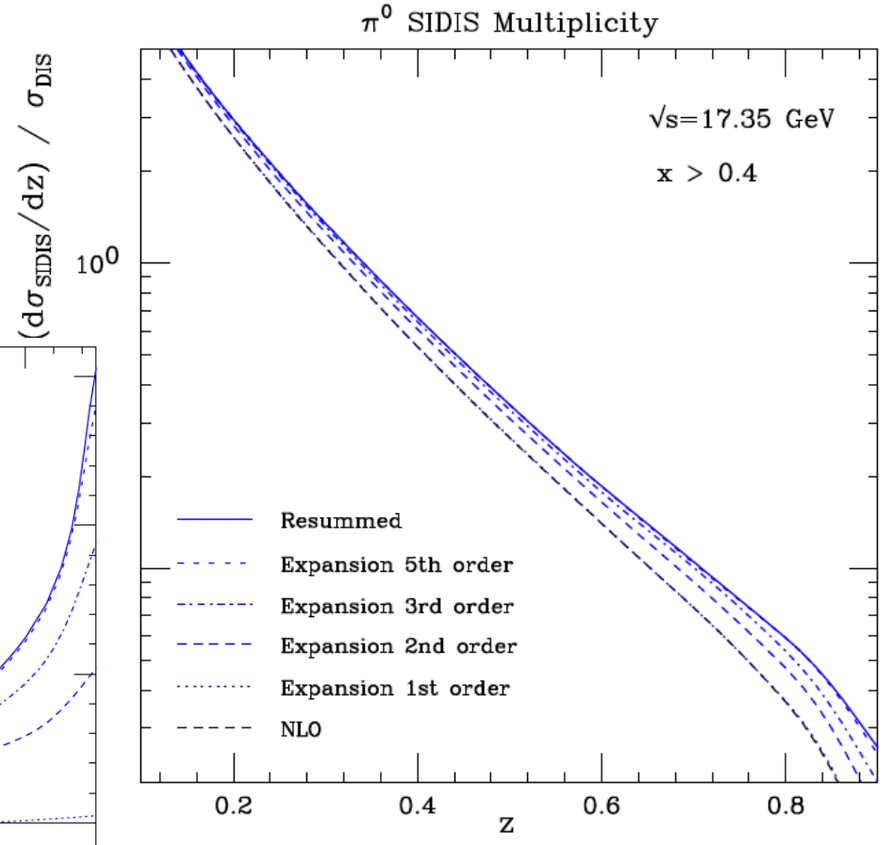
$0.4 < x < 0.7$

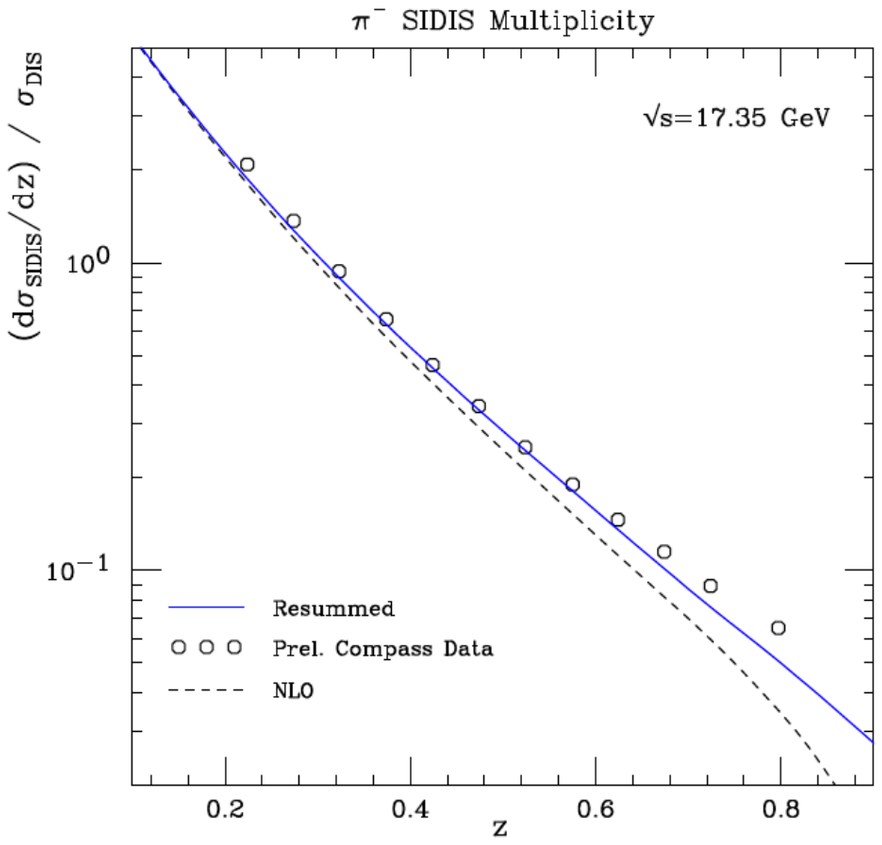
$0.1 < y < 0.9$

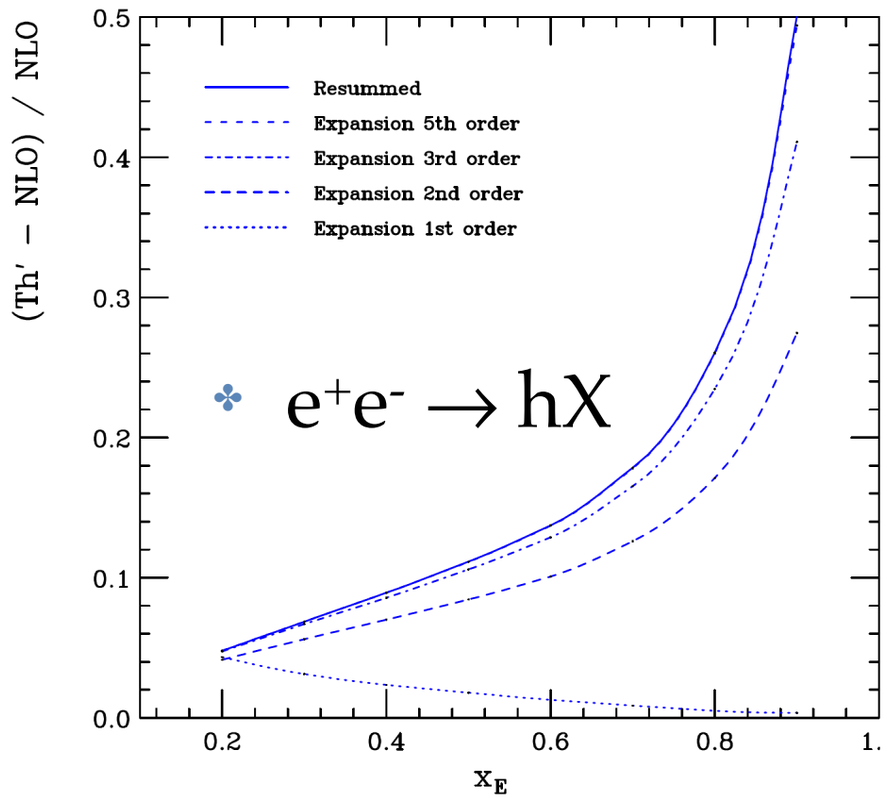
$Q^2 > 1\,\mathrm{GeV}^2$

$W > 7\,\mathrm{GeV}$

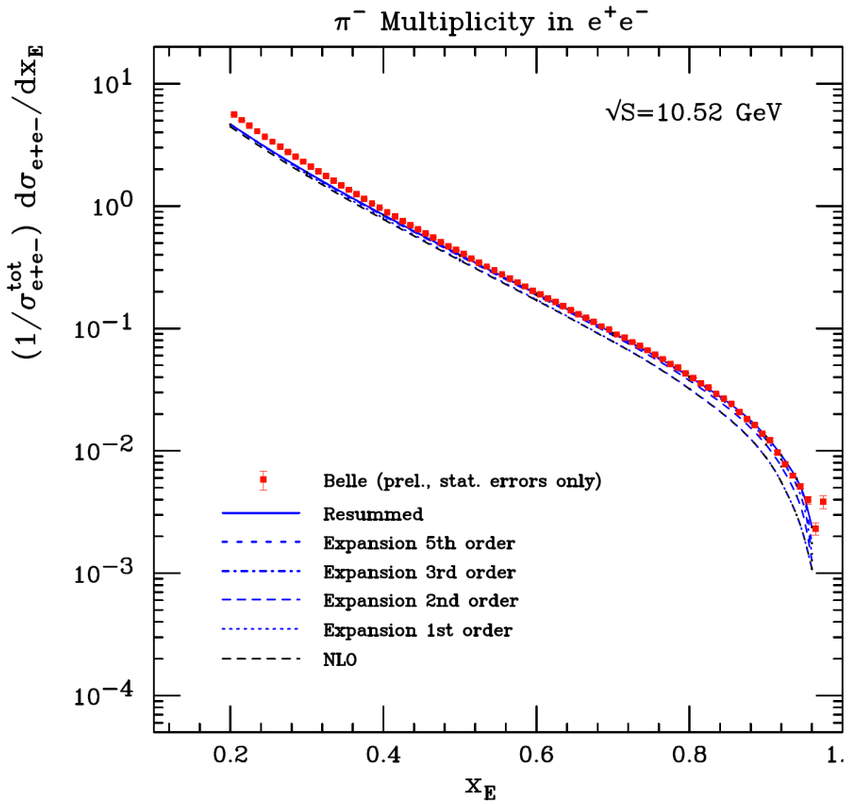






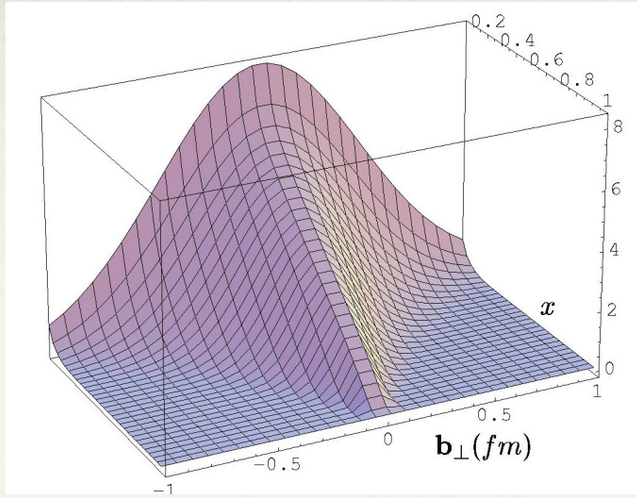


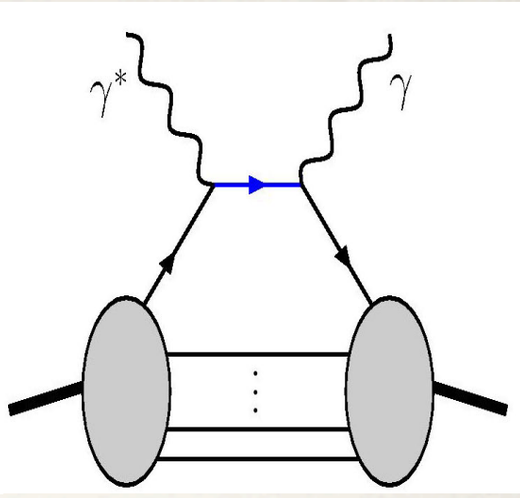
✤ $e^+e^- \to hX$



The Nucleon Spin Sum

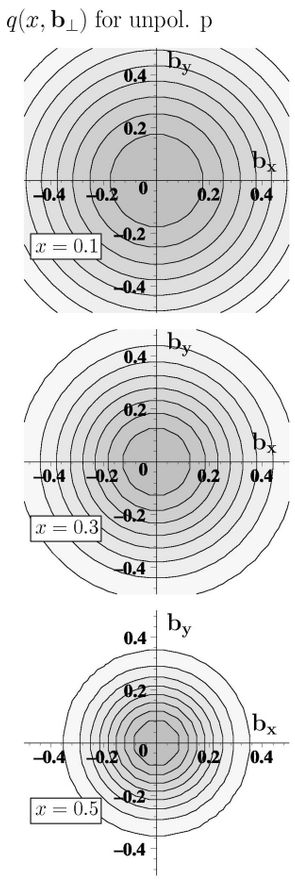
Matthias Burkhardt



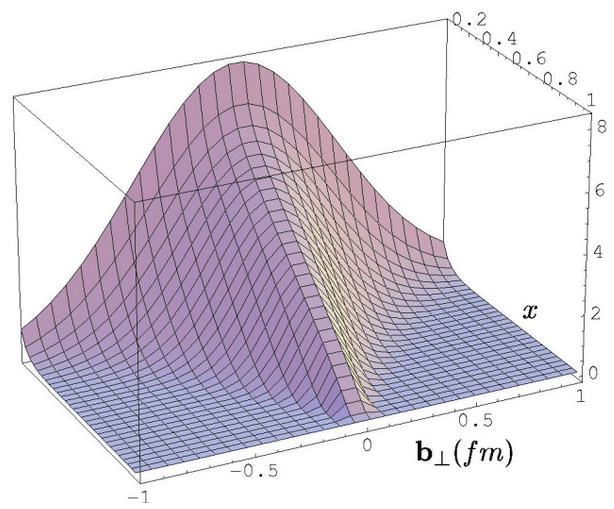


- Review of Generalized Parton Distributions (mainly from DVCS) and their connections to transverse imaging
  - The H GPD gives the b-dependent quark distribution, which demonstrates the 'meson cloud' at small x and 'quark core' at large
    - Polarized protons: *shifted* b distribution; anomalous mag. moment
- Single Spin Asymmetries - Chromodynamic lensing through attractive final state interaction - Sivers distribution, pion production
- Quark-gluon correlations and how they connect to the transverse force on the quark in DIS
  - Obtain g_2 from transversely polarized target measurements, related to the average color Lorentz force
- How final-state interactions can be seen to exert torque on the exiting quark in DIS

Graphical illustrations

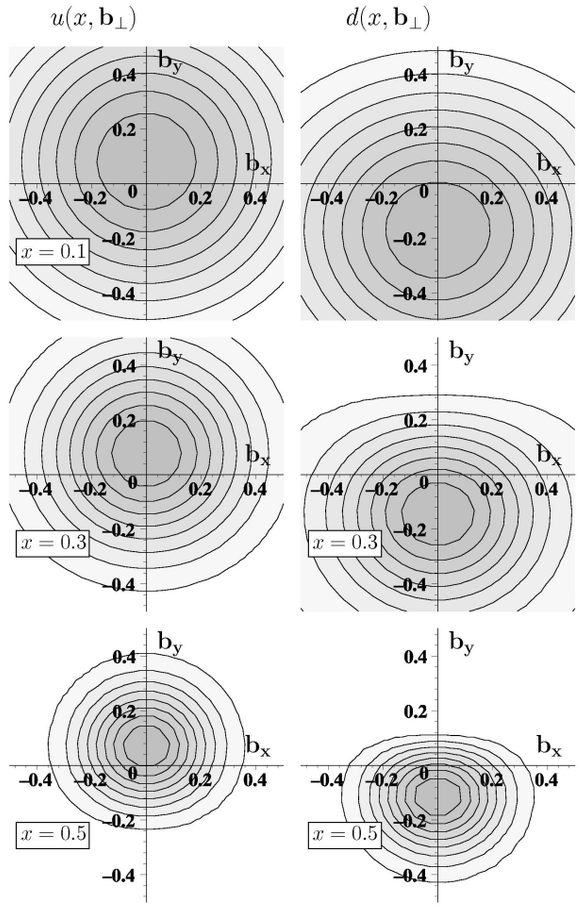


Unpolarized b-dependent quark distributions for three values of x, showing the larger ‘meson cloud’ at smaller x and compact ‘valence core’ at larger x



up quark

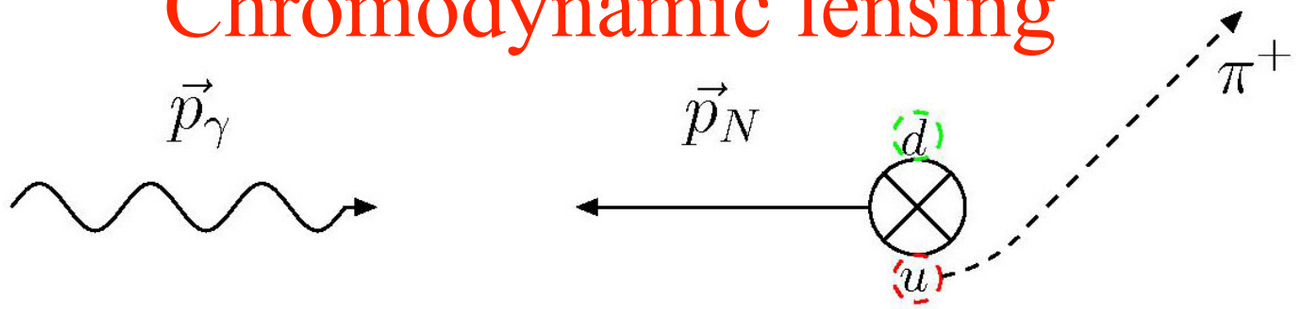
down quark



Polarized b-dependent quark distributions for three values of x, showing the asymmetric distortions and shifts

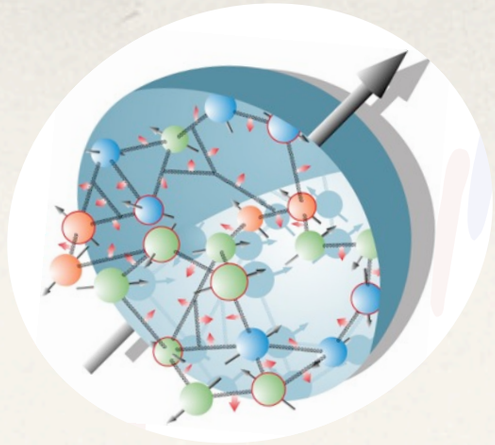
Sivers $f_{1T}^{\perp}$ in semi-inclusive deep-inelastic scattering (SIDIS) $\gamma p \to \pi X$

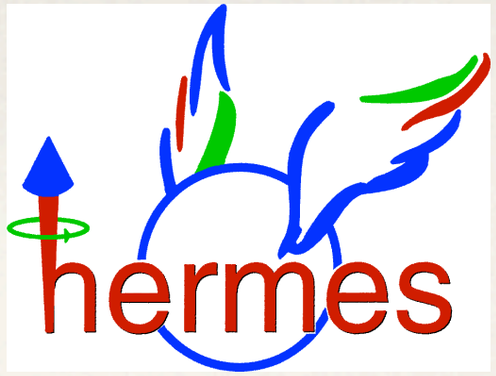
‘Chromodynamic lensing’



HERMES Overview

Gunar Schnell

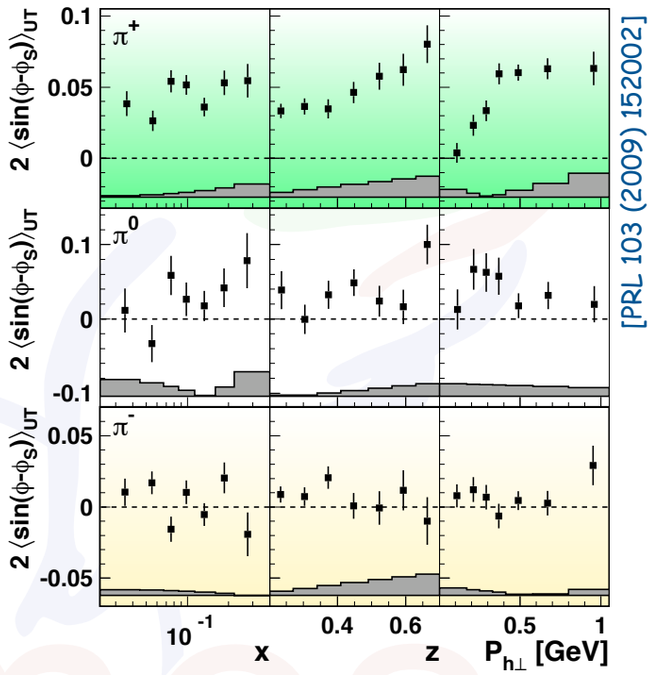




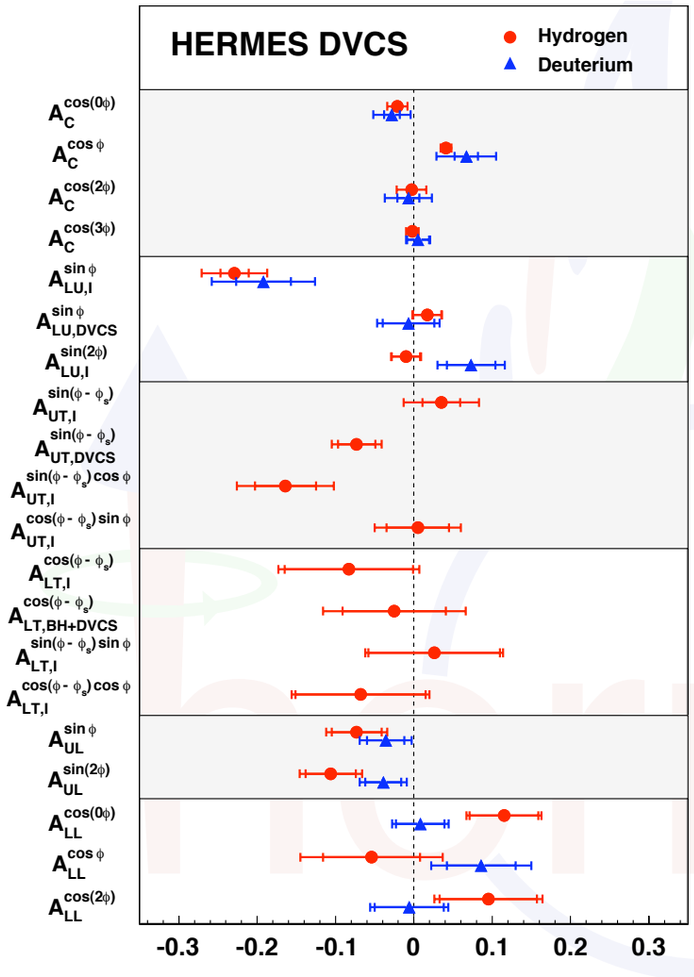
- Description of HERA, HERMES instrumentation, targets, and particle identification capabilities
- HERA-I measurements of quark spin and gluon fractional spin, F_2 for x~0.008-0.7, deuteron-proton cross section ratio, polarized structure function g_1 integral, A_2 and xg_2, helicity density at leading order, identified charged-particle multiplicities, transversity and Collins function, Sivers function, hints of Bohr-Mulders effect, 20 DVCS amplitudes on the proton, 12 on the neutron.
- 23 spin density matrix elements from neutral rho electroproduction, 30 “transverse” spin density matrix elements; phi and omega too...

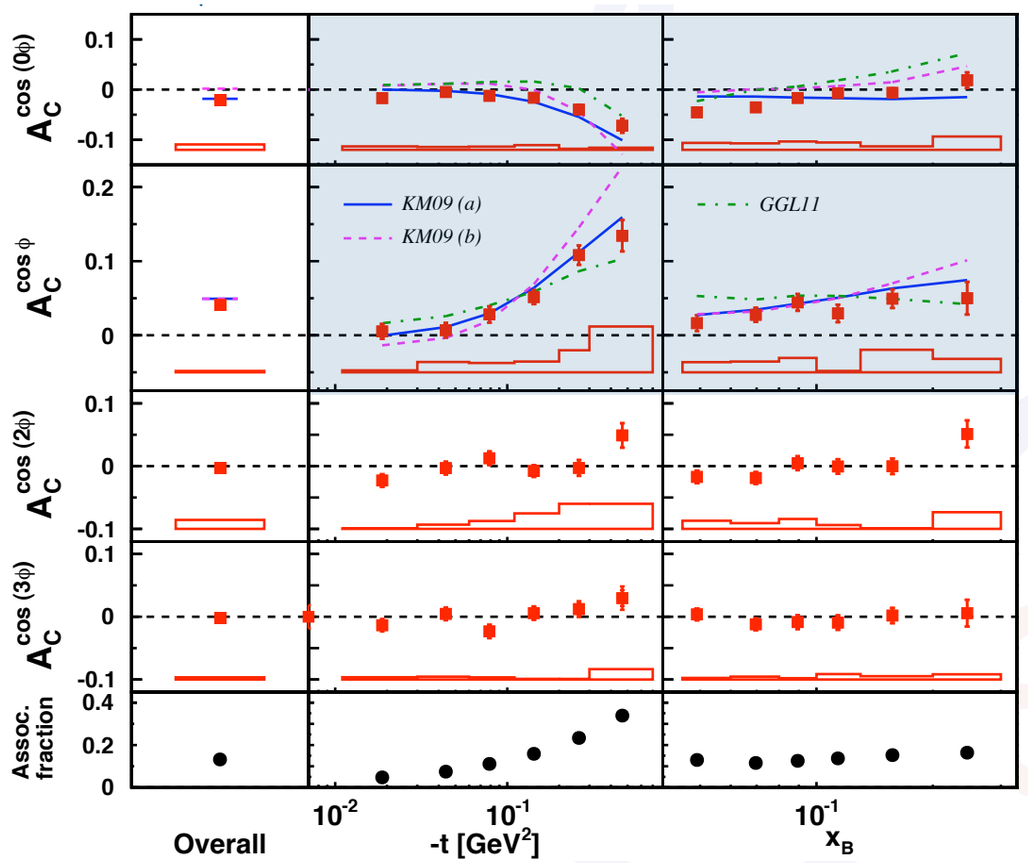
HERMES data

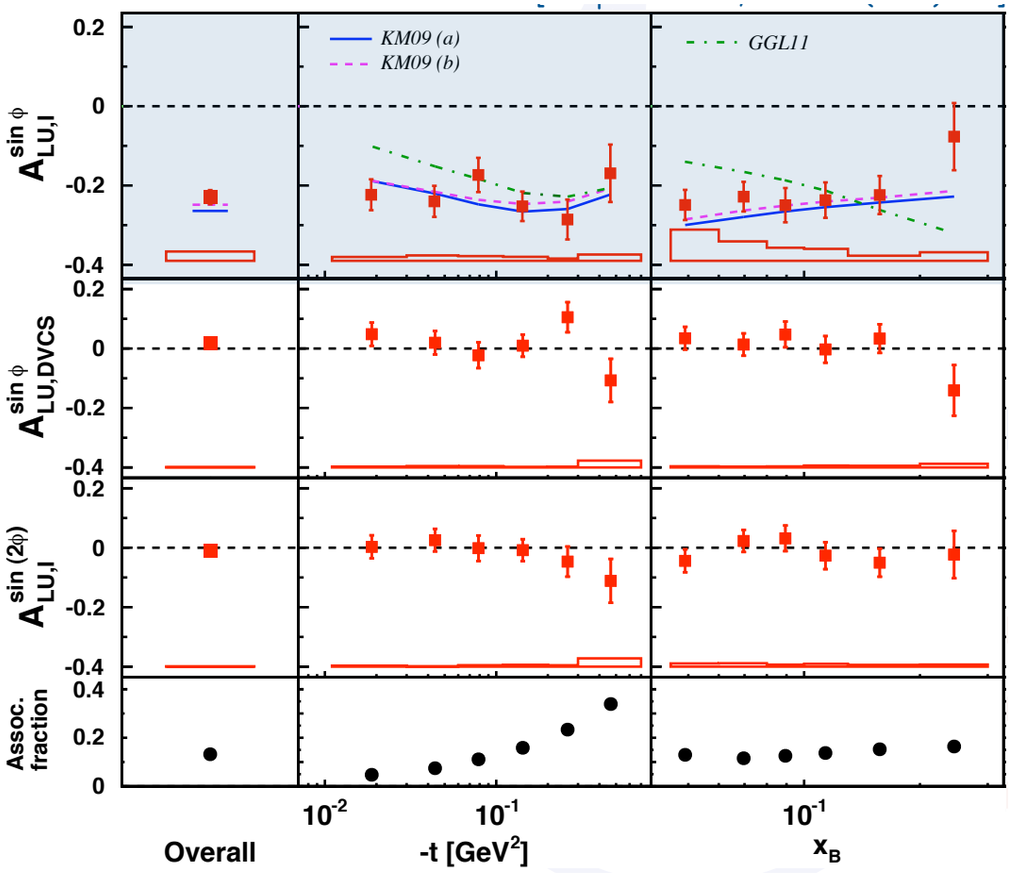
Sivers function



[PRL 103 (2009) 152002]

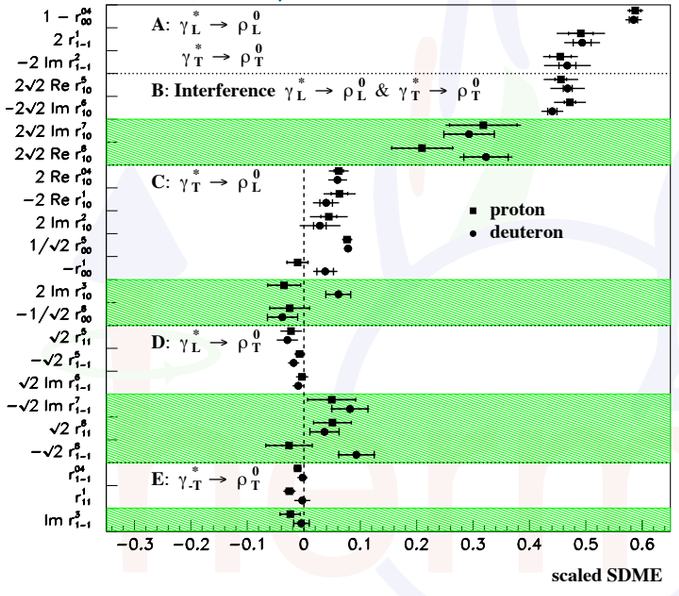






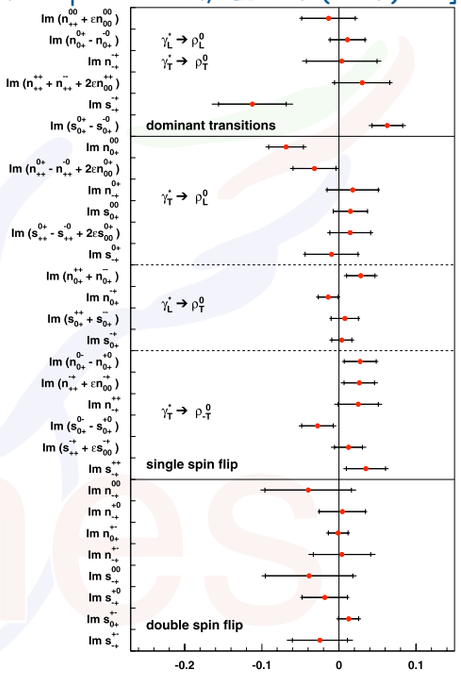
ρ^0 SDMEs from HERMES

[A. Airapetian et al., EPJ C62 (2009) 659]



target-polarization independent SDMEs

[A. Airapetian et al., PLB 679 (2009) 100]



"transverse" SDMEs

DIS With Polarized and Unpolarized Deuterons

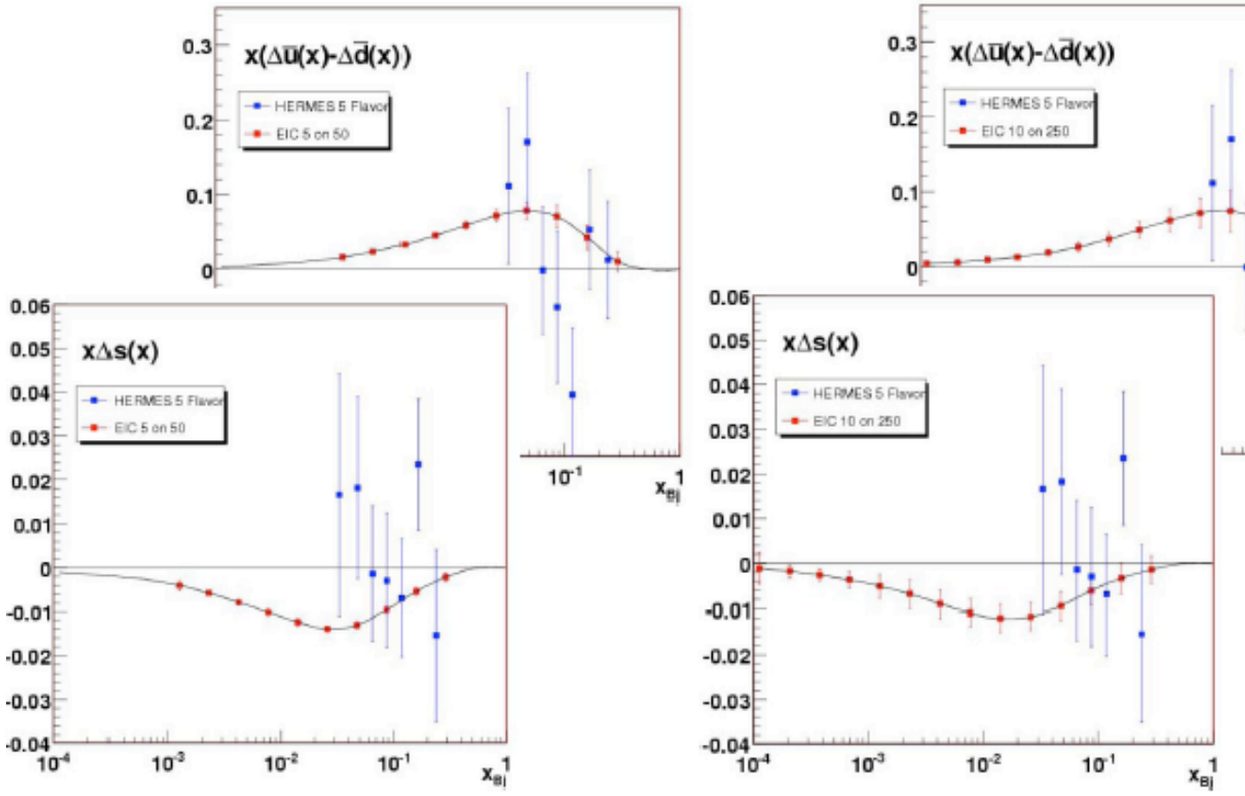
Sebastian Kuhn

PDFs, GPDs, TMDs, SSFs

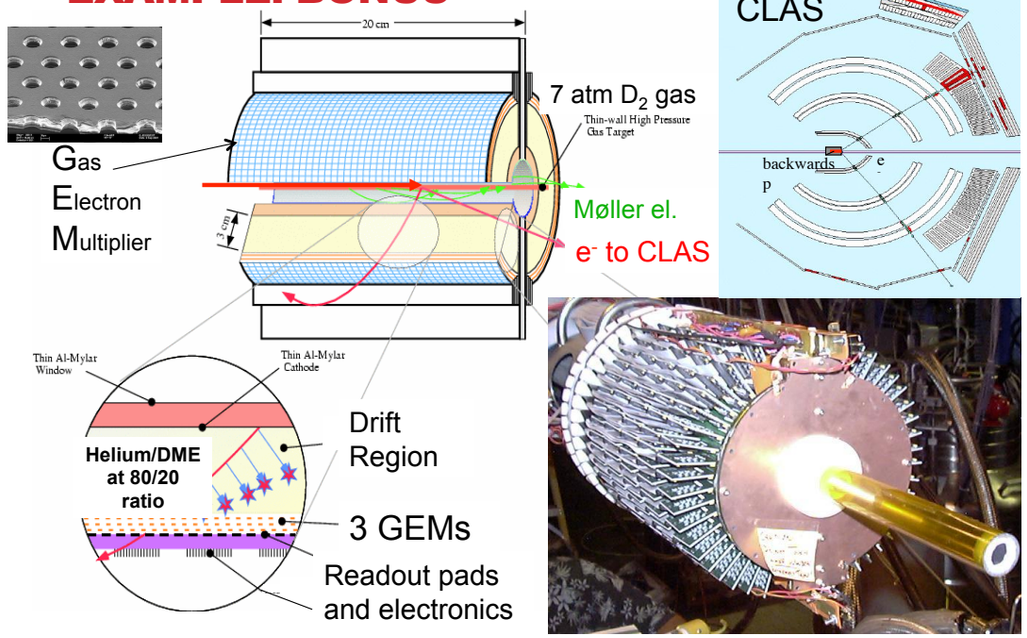
- Longterm goals for the field; what we already know now; what we don't yet know.
- Other experiments: COMPASS, STAR, PHENIX, PANDA/FAIR.
- List of nuclear effects that complicate measurements; and the spectator tagging solution that reduces those effects.
- Plans for JLab 11 GeV spin structure measurements; what that program will include, and what it will not.
- Polarized targets, and prospects for transverse polarization.
- MEIC: layout, spectator tagging, ultra-forward hadron detection
- Exploring nuclear effects with spectator tagging at MEIC

EIC prospects

Longitudinal spin structure

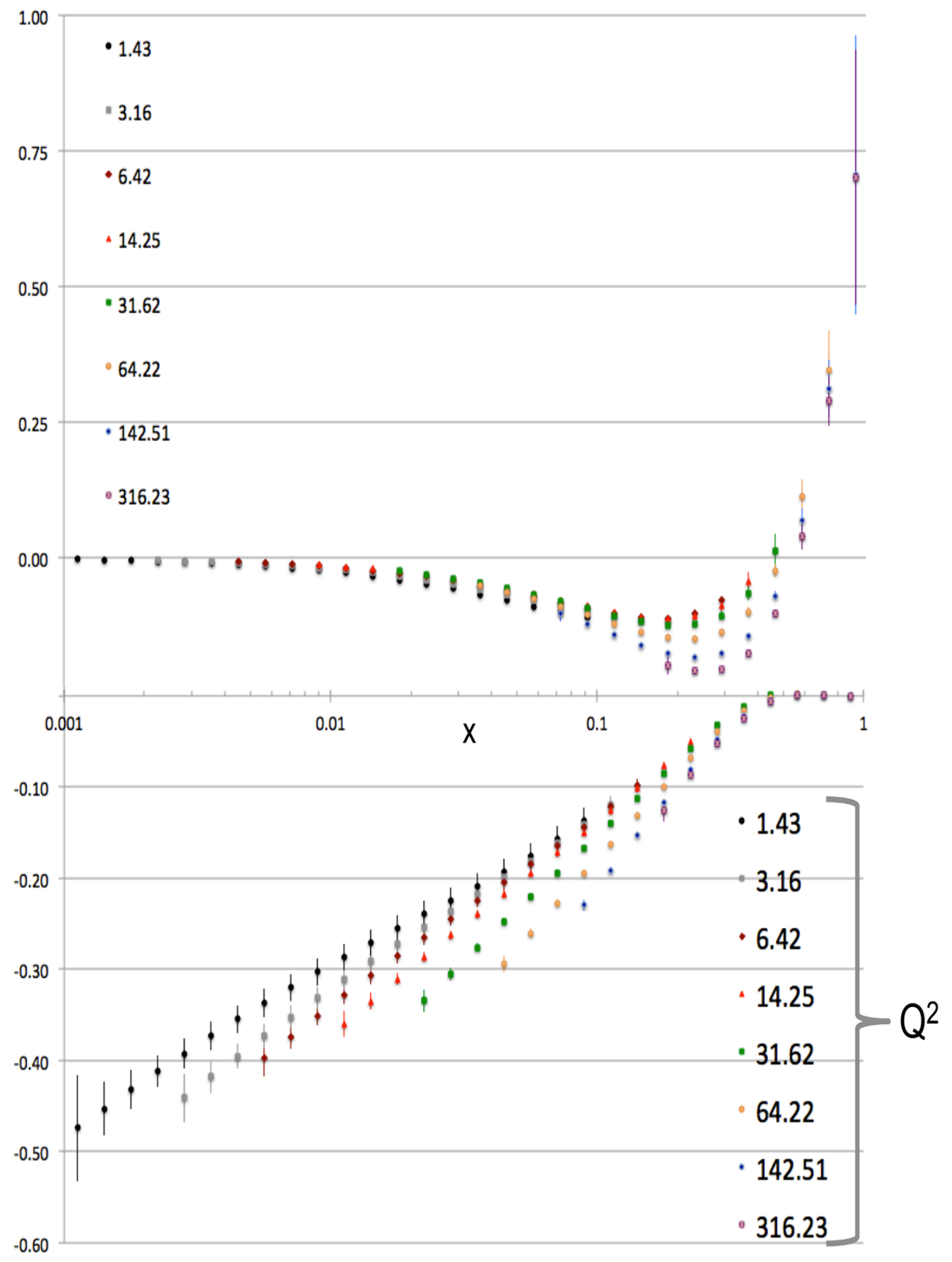


SPECTATOR TAGGING
EXAMPLE: BONUS



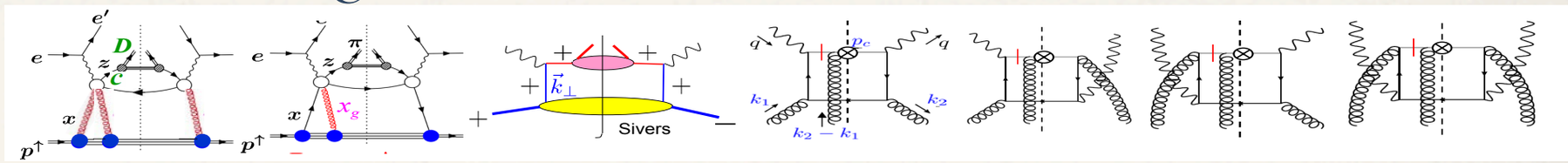
$A_{1n}(x)$ (top) and $g_{1n}(x)$ (bottom) with spectator tagging

$g_{1n}(x)$



Single spin asymmetry in large P_T open charm production at EIC and twist-three multi-gluon correlations in the nucleon

Kazuhiro Tanaka

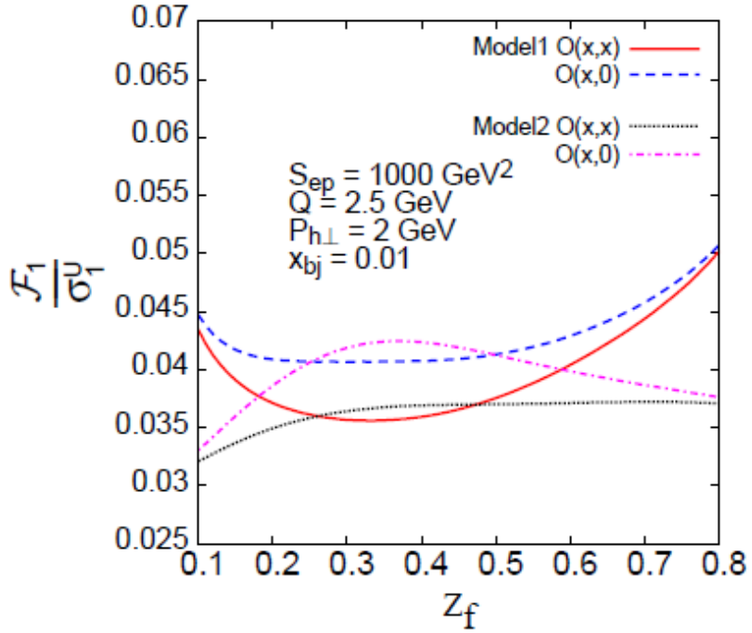


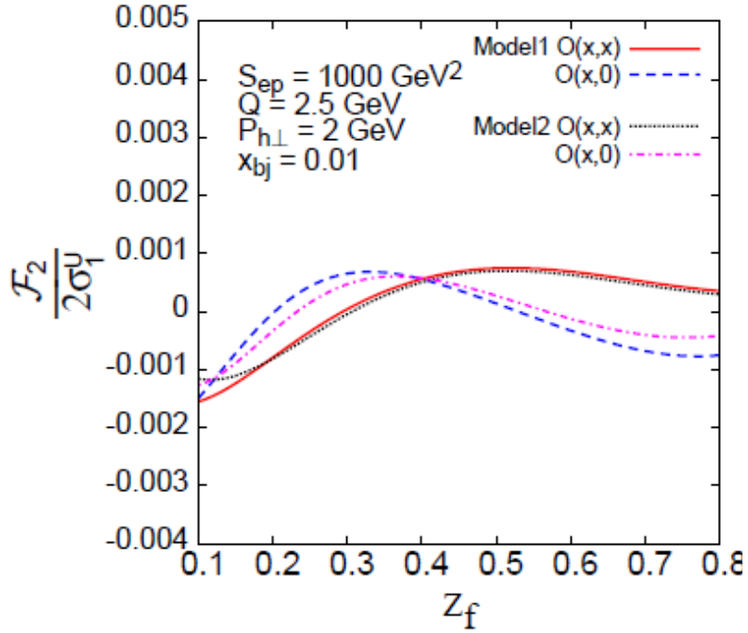
SSA, open charm, multi-gluon correlations

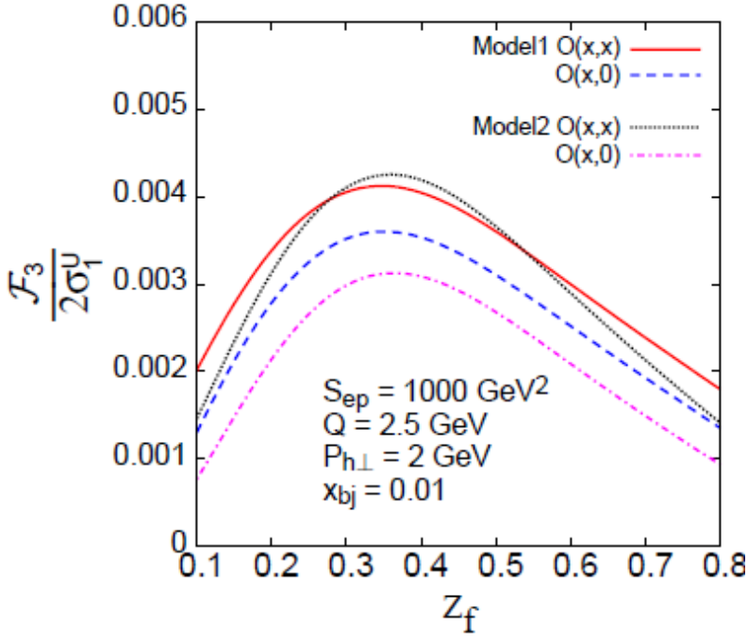
- SIDIS D production: ep→eDX
- Sivers asymmetry as seen at COMPASS and HERMES
- SSA from multi-gluon correlation in SIDIS at $P_{h\perp} >> \Lambda_{QCD}$
- Twist-3 mechanism from three-gluon correlation inside the nucleon - photon-gluon fusion
- EIC should be sensitive to three-gluon correlation through these measurements

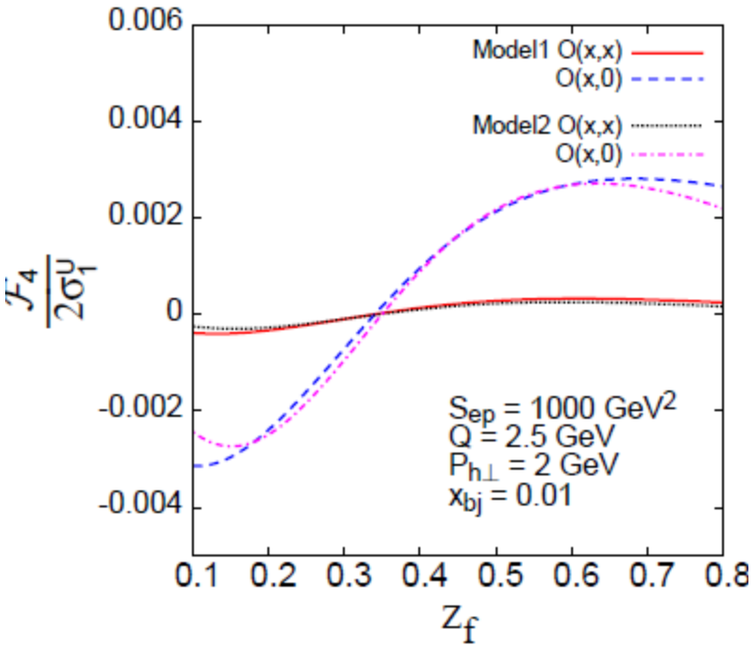
Single Spin Asymmetries at EIC in twist-3 D_0 production with polarized protons - example

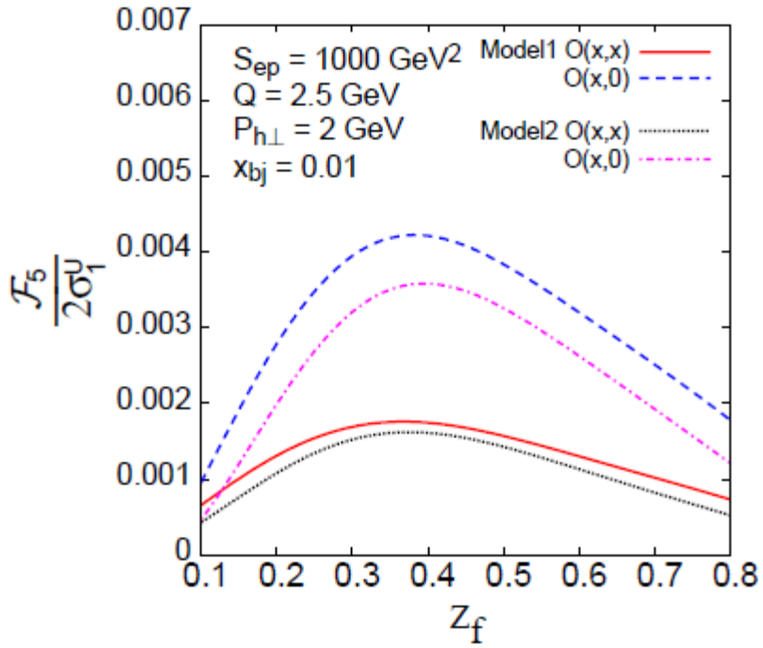
Beppu, Koike, K.T., Yoshida, PRD85 ('12) 114026

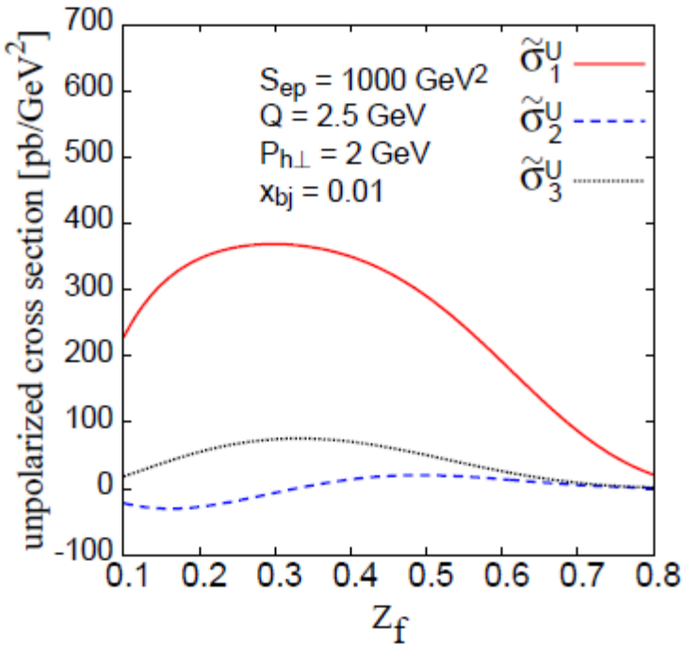








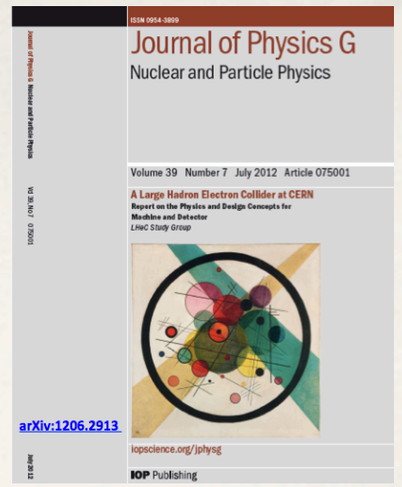




$$\frac{d^5\sigma^{\text{unpol}}_{\text{twist-2}}}{dx_{bj}dydz_f dP_{h\perp}^2 d\phi_h} = \tilde{\sigma}_1^U + \tilde{\sigma}_2^U \cos\phi_h + \tilde{\sigma}_3^U \cos 2\phi_h$$

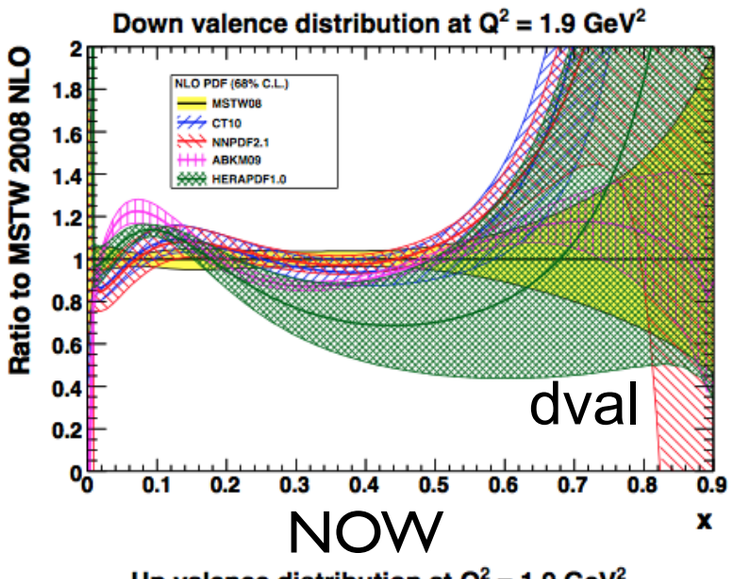
PDFs from LHeC and LHC

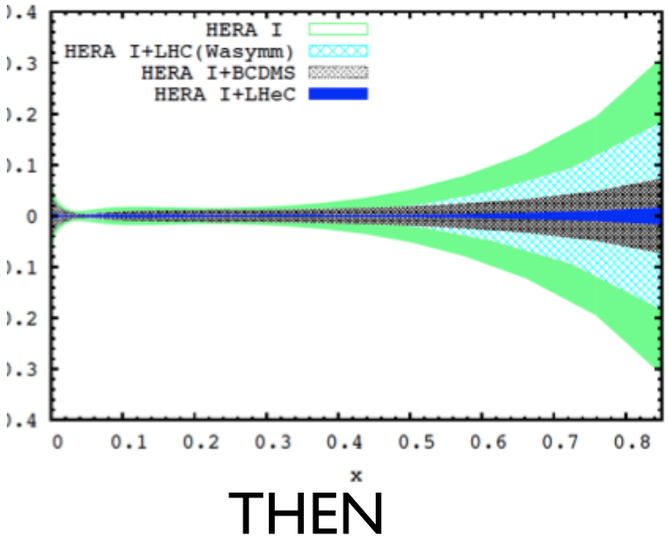
Voica Radescu



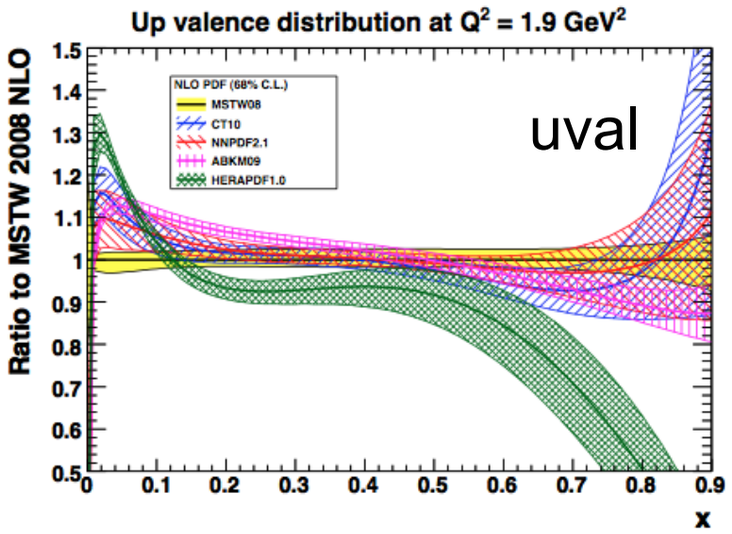
- Review of current status of PDFs and the different assumptions used in extracting them, charged current and neutral current measurements
- Complementarity of DIS, DY, and jets and other probes
- Herafitter (www.herafitter.org) platform available for public use, with many data sets and theoretical tools
- Full LHeC simulation carried out, including statistical and systematic uncertainties
  - Enormous improvement in quark and gluon PDFs with LHeC
- Many improvements/advantages: Gluon-gluon luminosity functions, consistency with HL-LHC higher precision needs, Higgs constraints, reduced analysis assumptions and constraints, heavy quarks, precision α_s, etc.

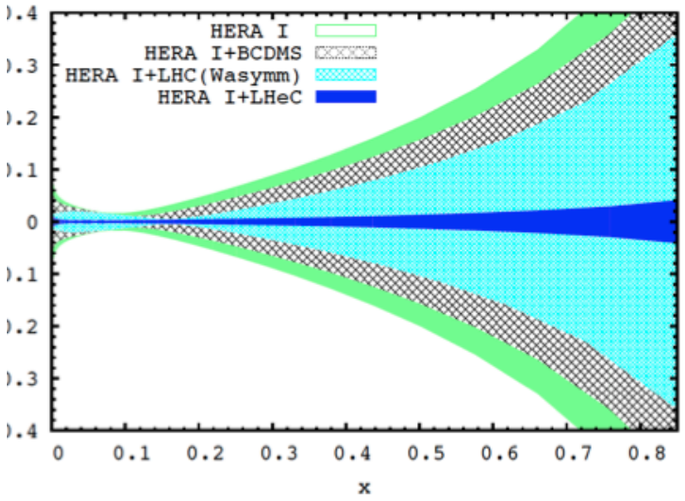
LHeC improvements in PDFs, wide kinematic range



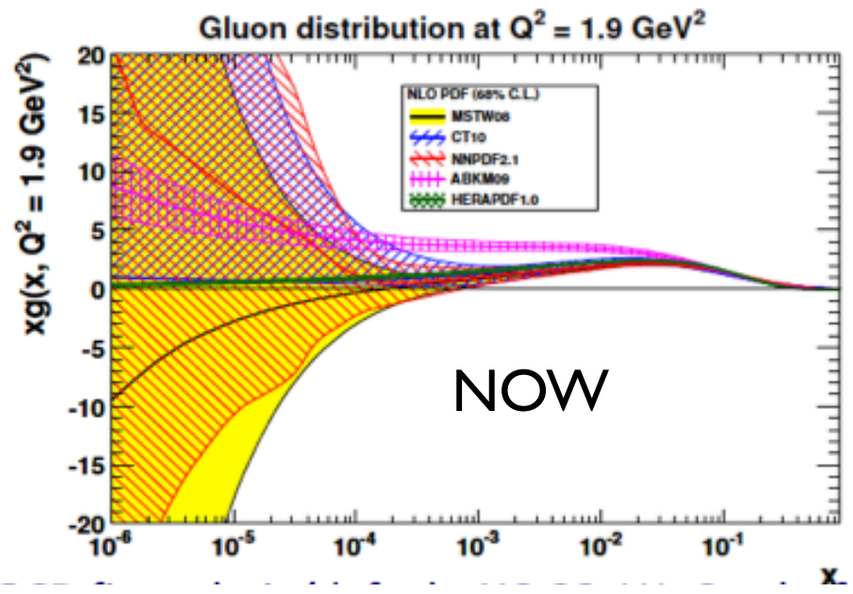


note: 5X smaller vertical scale on "THEN" plots

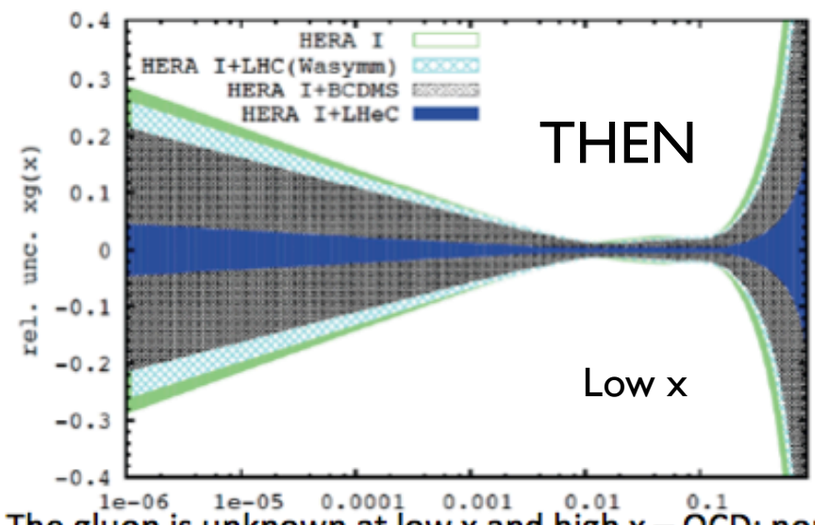


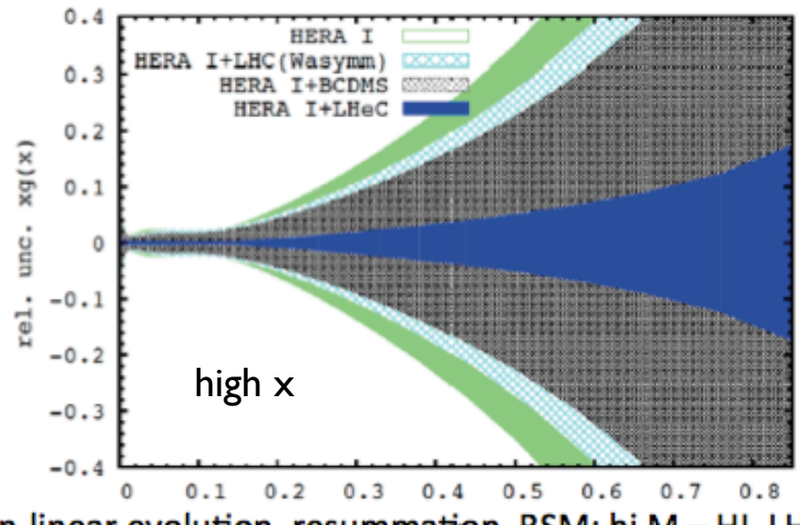


note: 50X smaller vertical scale on "THEN" plots



QCD fit analysis (default: NC,CC, LHeC only, following HERAPDF) with full experimental errors

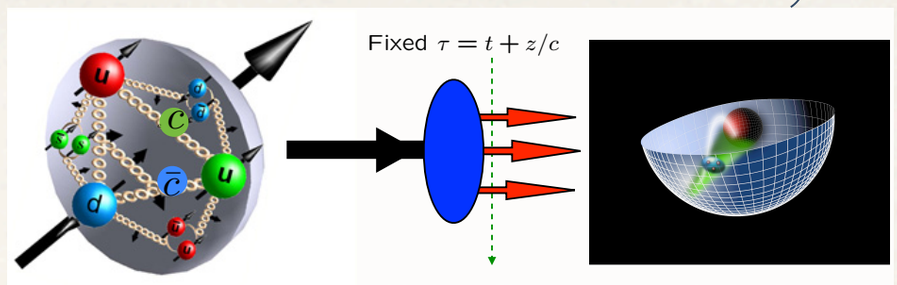




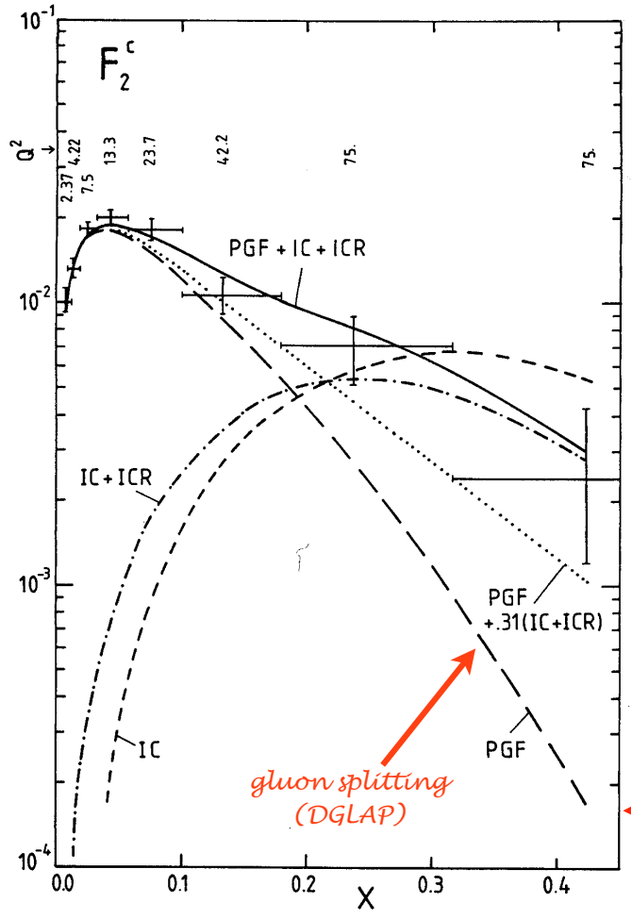
The gluon is unknown at low x and high x – QCD: non-linear evolution, resummation. BSM: hi M – HL-LHC!

Light-Front QCD, Conformal Invariance, and Electron-Ion Collisions

Stan Brodsky



- Goal: an analytic first approximation to QCD
  - As simple as Schrödinger theory in atomic physics; relativistic and frame-independent; naturally includes confinement, chiral symmetry, QCD Coupling at all scales
    - Calculable: light-front wavefunctions, hadron spectroscopy, form factors, hadronic observables, constituent counting rules
    - Light-Front Wavefunctions: rigorous representation of composite systems in quantum field theory
- Leading-Twist Contribution to Real Part of DVCS; intrinsic charm in μ-Fe F_2; final state interactions in semi-inclusive polarized DIS and leading twist Sivers effect; diffractive structure function F_2^D and the QCD Mechanism for rapidity gaps,
- Numerous results in AdS/CFT, and 20 more things....

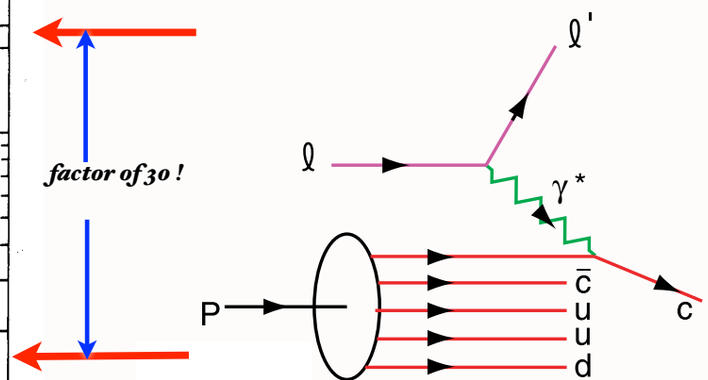


Measurement of Charm Structure Function!

J. J. Aubert et al. [European Muon Collaboration], "Production Of Charmed Particles In 250-Gev Mu+ - Iron Interactions," Nucl. Phys. B 213, 31 (1983).

First Evidence for Intrinsic Charm

Hoyer, Peterson, Sakai, sjb



Can we see intrinsic charm at EIC?

Generalized parton distributions in AdS/QCD

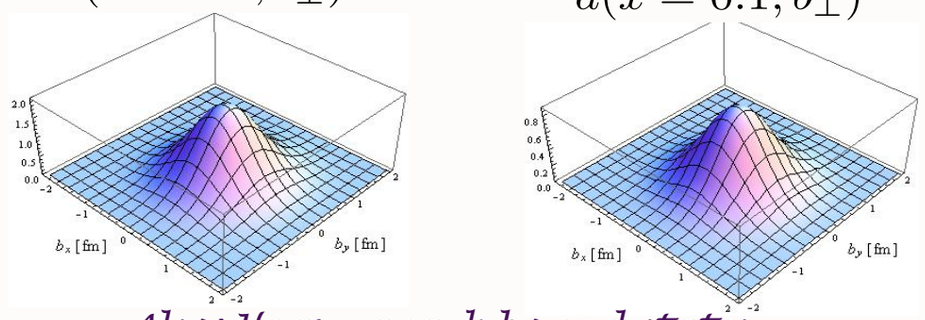
Alfredo Vega[1], Ivan Schmidt[1], Thomas Gutsche[2], Valery E. Lyubovitskij[2*]

[1] *Departamento de Física y Centro Científico y Tecnológico de Valparaíso, Universidad Técnica Federico Santa María, Casilla 110-V, Valparaíso, Chile*

[2] *Institut für Theoretische Physik, Universität Tübingen, Kepler Center for Astro and Particle Physics, Auf der Morgenstelle 14, D–72076 Tübingen, Germany*

(Dated: January 19, 2011)

$u(x = 0.1, \vec{b}_\perp)$ $\qquad$ $d(x = 0.1, \vec{b}_\perp)$



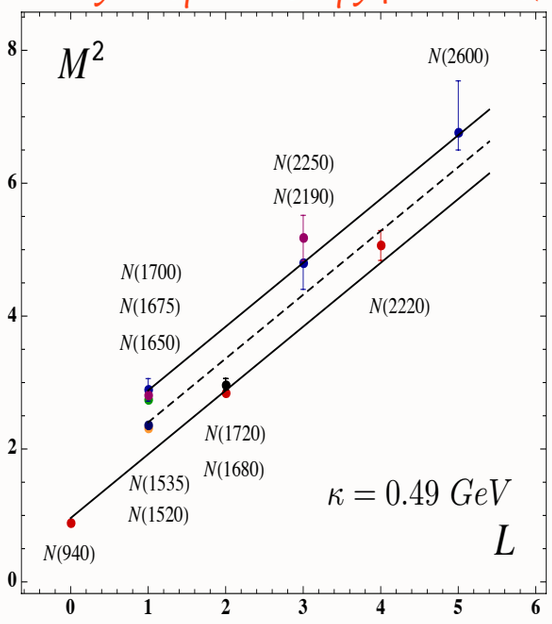
Also: Heavy quark bound states

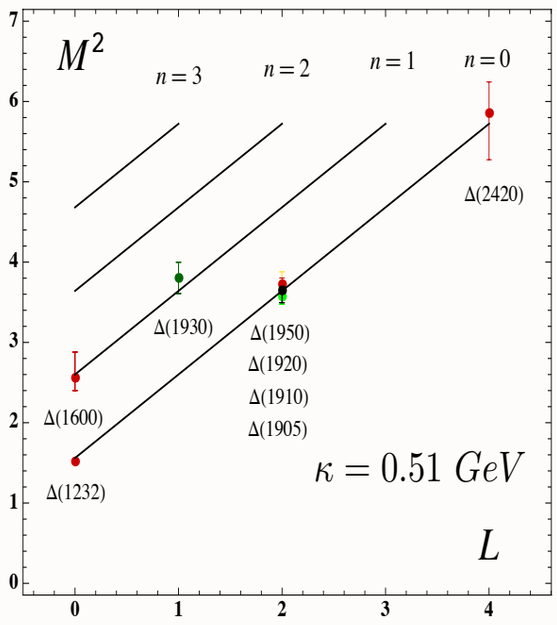
DGLAP / Photon-Gluon Fusion: factor of 30 too small

Two Components (separate evolution):

$$c(x, Q^2) = c(x, Q^2)_{\rm extrinsic} + c(x, Q^2)_{\rm intrinsic}$$

Baryon Spectroscopy from AdS/QCD and Light-Front Holography





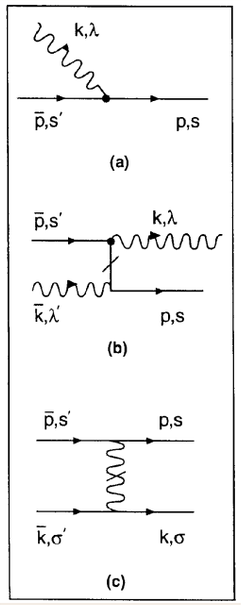
de Teramond, sjb

Light-Front QCD Heisenberg Equation

$$H_{LC}^{QCD}|\Psi_h\rangle = \mathcal{M}_h^2\ |\Psi_h\rangle$$

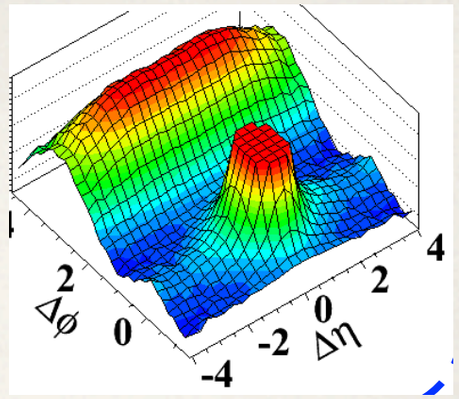
DLCQ: Solve QCD(1+1) for any quark mass and flavors

Hornbostel, Pauli, sjb



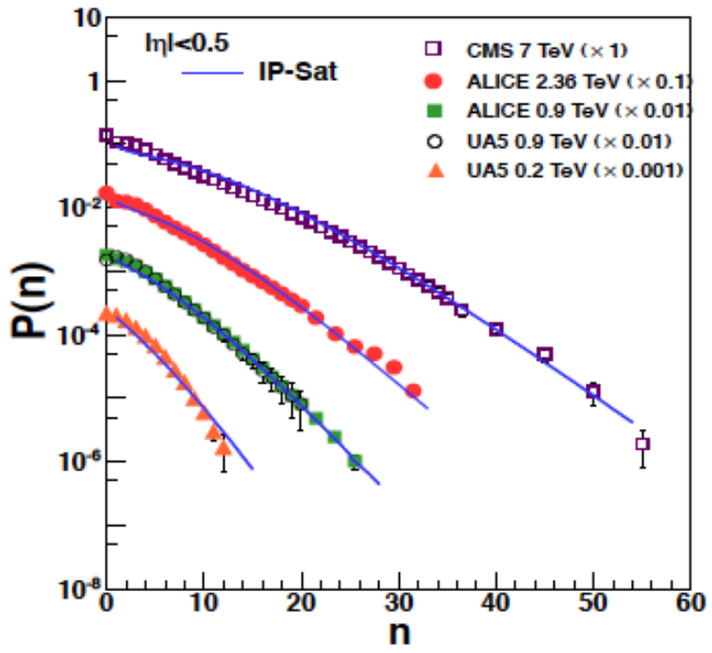
n	Sector	1 qq̄	2 gg	3 qq̄ g	4 qq̄ qq̄	5 gg g	6 qq̄ gg	7 qq̄ qq̄ g	8 qq̄ qq̄ qq̄	9 gg gg	10 qq̄ gg g	11 qq̄ qq̄ gg	12 qq̄ qq̄ qq̄ g	13 qq̄ qq̄ qq̄ qq̄
1	qq̄					·		·	·	·	·	·	·	·
2	gg				·			·	·		·	·	·	·
3	qq̄ g								·	·		·	·	·
4	qq̄ qq̄		·			·				·	·		·	·
5	gg g	·			·			·	·			·	·	·
6	qq̄ gg								·				·	·
7	qq̄ qq̄ g	·	·			·				·				·
8	qq̄ qq̄ qq̄	·	·	·		·	·			·	·			
9	gg gg	·		·	·			·	·			·	·	·
10	qq̄ gg g	·	·		·				·			·	·	·
11	qq̄ qq̄ gg	·	·	·		·			·	·				·
12	qq̄ qq̄ qq̄ g	·	·	·	·	·	·			·	·			·
13	qq̄ qq̄ qq̄ qq̄	·	·	·	·	·	·	·		·	·	·		

Building bridges with ridges: peculiar quantum entanglement at the LHC & structure of matter - *Raju Venugopalan*



- Focus on high multiplicity events: pp, PbPb, pPb
- "Ridge" - rare events with correlation between particles which are well separated in rapidity but totally correlated in azimuthal angle
- Characteristics of events with long range rapidity correlations must arise from dynamics at early time of interaction <1 fm/c
- Color Glass Condensate model is an effective theory which can accommodate pp ridge (saturation) and PbPb ridge (flow)
- N-particle "Glasma" correlations describe LHC multiplicity data
- pPb correlations well-described by this approach: "is a smoking gun for a universal gluon saturation in proton/nuclear wavefunctions"

N-particle Glasma correlations describe LHC multiplicity data



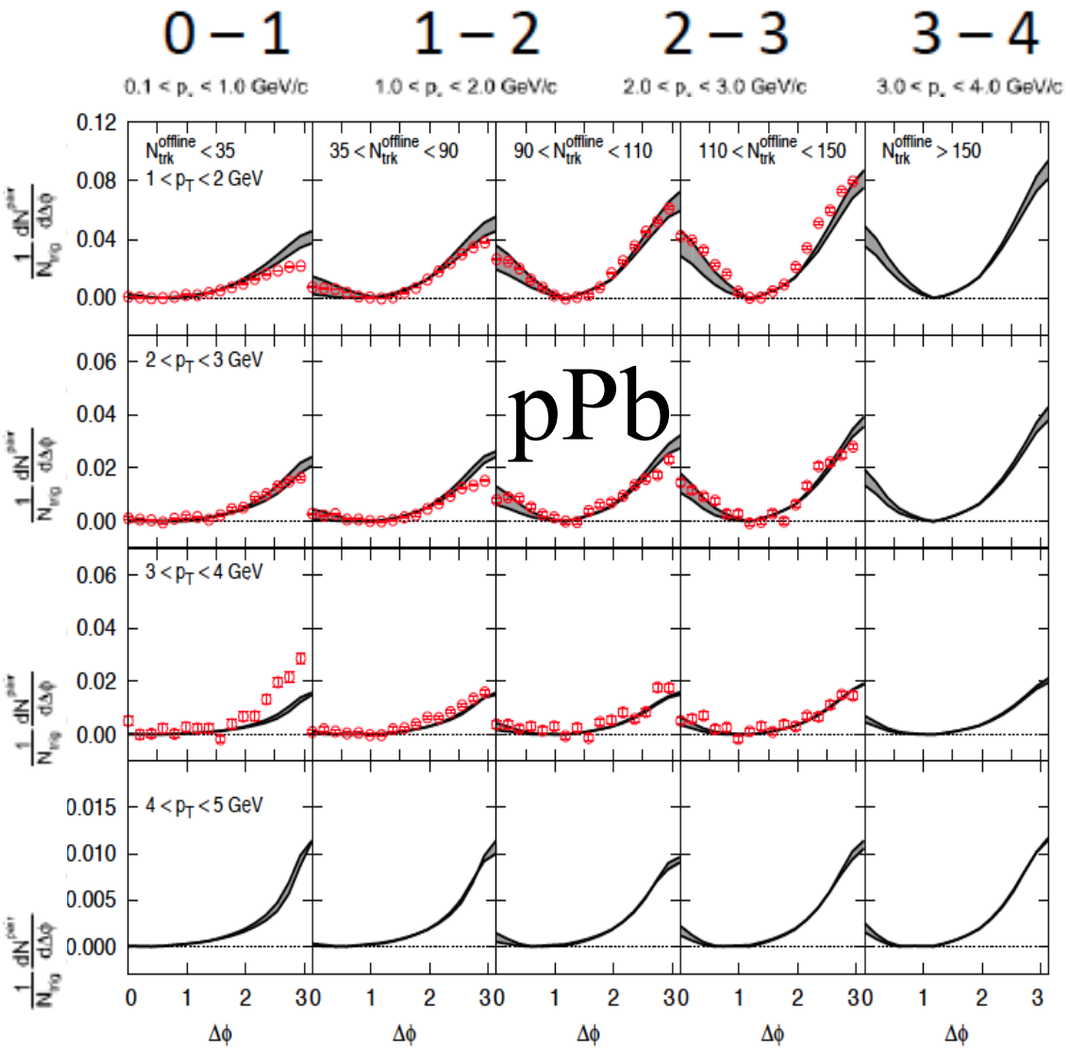
Multiplicity

N<35

35<N<90

90<N<110

N>110



Dusling, RV

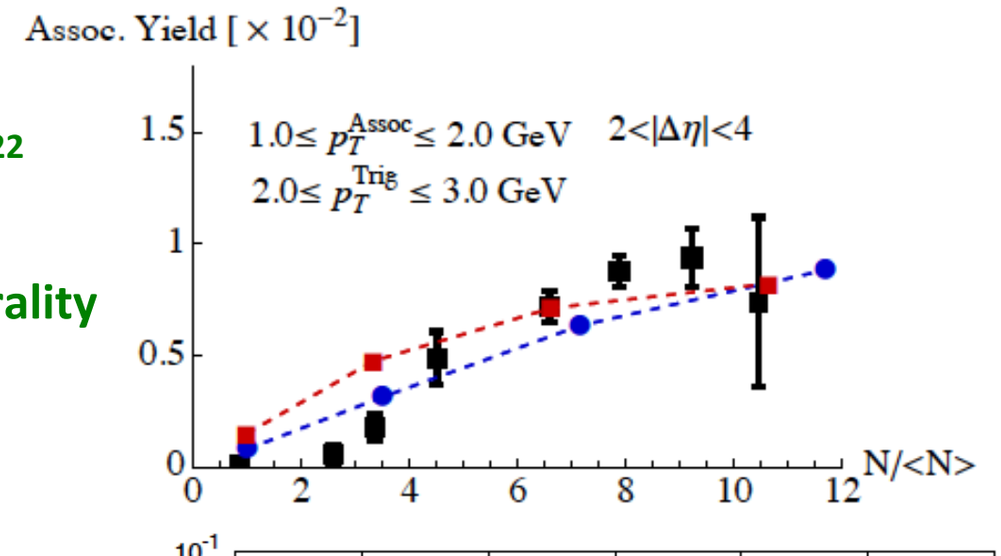
Smoking gun for gluon saturation and BFKL dynamics ?

Quantitative description of pp ridge

Dusling,RV, PRL 1

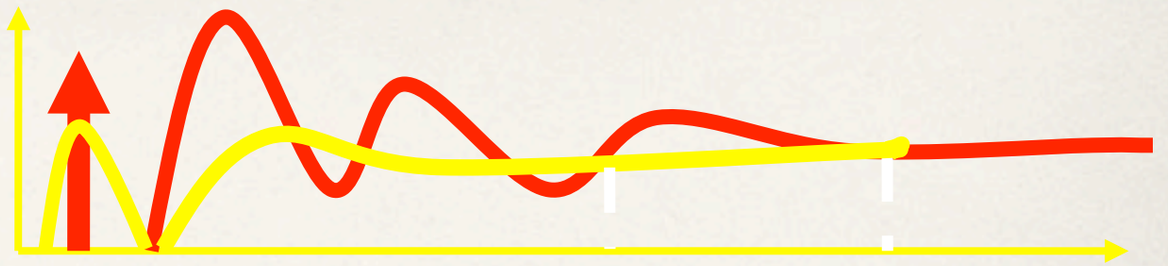
a arXiv:1009.4122

d with centrality

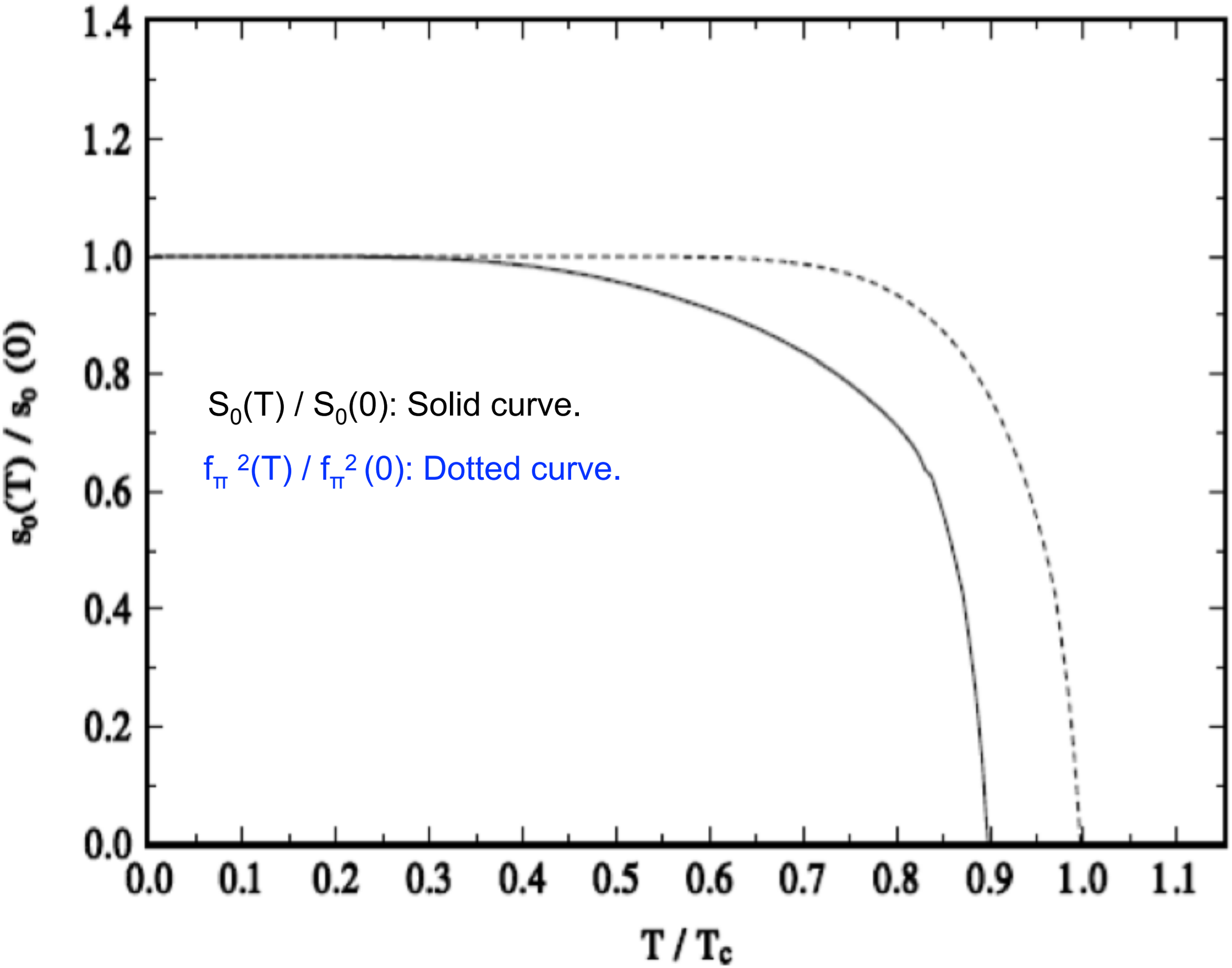


Chiral Symmetry Restoration and Deconfinement in QCD at Finite Temperature

Marcelo Loewe



- Two phase transitions in QCD at finite temperature and/or density:
  - Deconfinement due to color screening
  - Chiral symmetry restoration
- Which are the relevant order parameters in each case?
  - Normally: Polyakov loop (confinement) and the quark condensate (chiral symmetry restoration) are used as order parameters: Propose: the continuum threshold of the hadronic resonance spectral function
- QCD Sum Rules - operator product expansion of current correlators at short distances, and Cauchy's theorem in the complex s-plane.
- Results: continuum threshold $S_0(T)$ is a good phenomenological order parameter; the width of a1 has a divergent behavior as function of T; the coupling $f_{a1}(T)$ vanishes at the critical temperature.

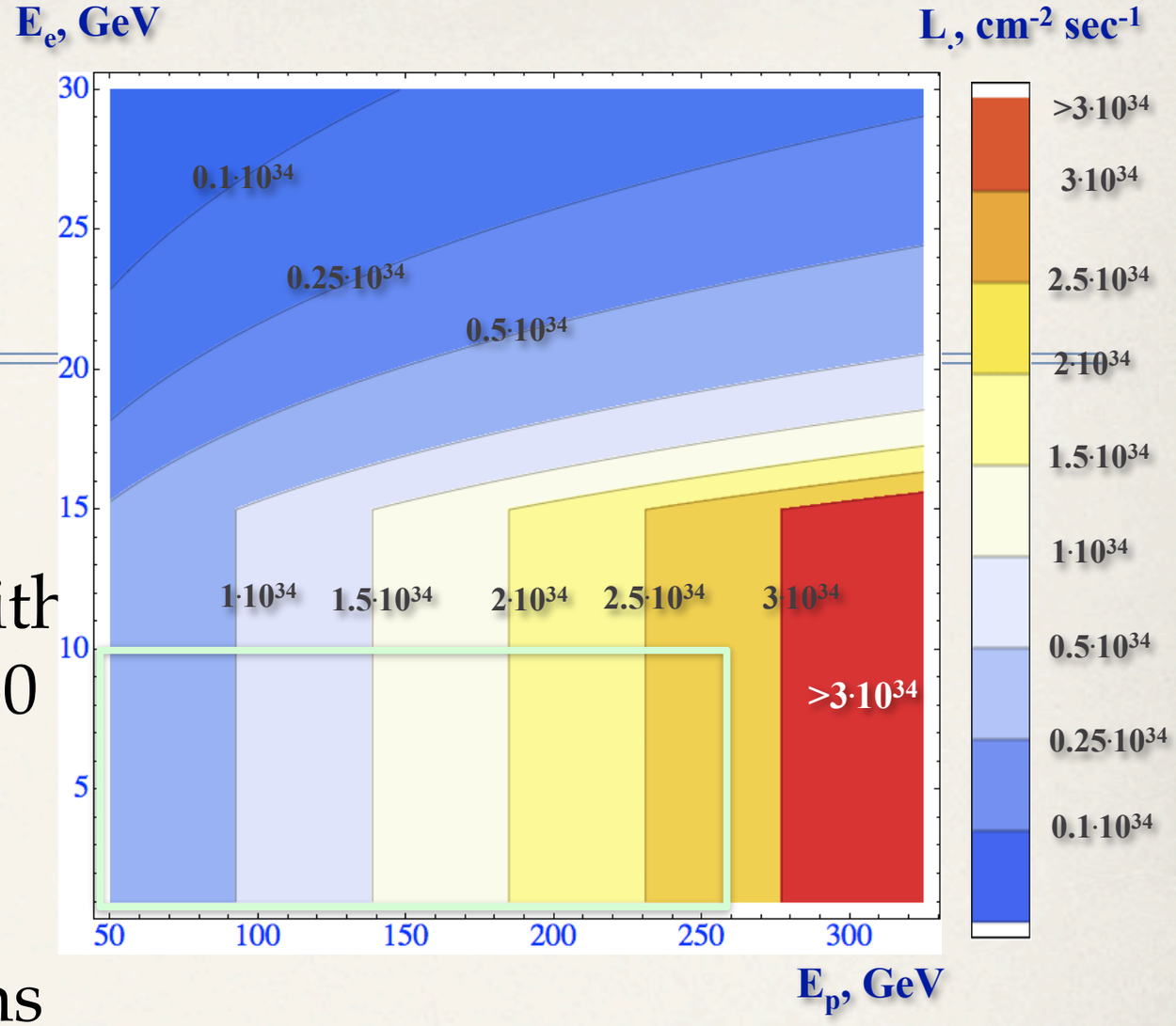

1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
$s_0(T) / s_0(0)$
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
T / T_c
$S_0(T) / S_0(0)$: Solid curve.
$f_\pi{}^2(T) / f_\pi{}^2(0)$: Dotted curve.

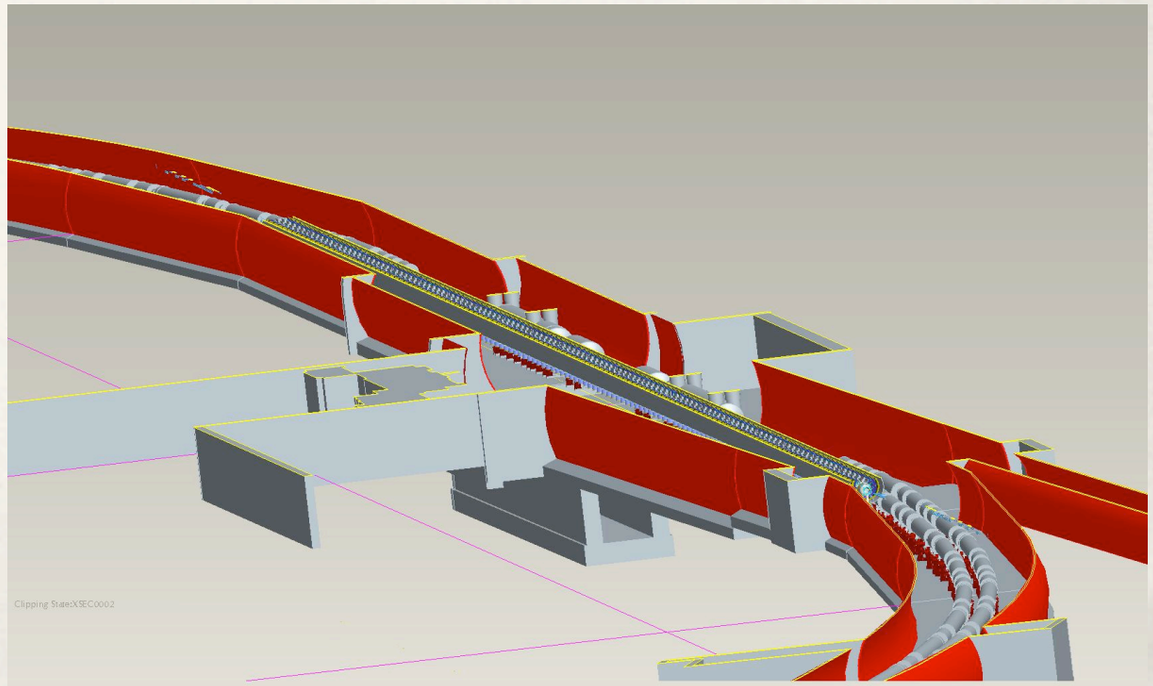
eRHIC and LHeC designs

Vladimir N. Litvinenko

- Description of eRHIC: polarized electrons with $E_e \leq 30$ GeV collide with either polarized protons with $E_e \leq 250$ GeV or heavy ions $E_A \leq 100$ GeV/u
- Energy recovering linac design
- Coherent electron cooling for hadrons
- Small beam size in ERL:small magnets
- Linac-ring colliders: variable hadron energy from 50 GeV to 250 GeV
- Crab crossing
- Assume 50 mA of polarized electrons

eRHIC designed luminosity as function of beam energies

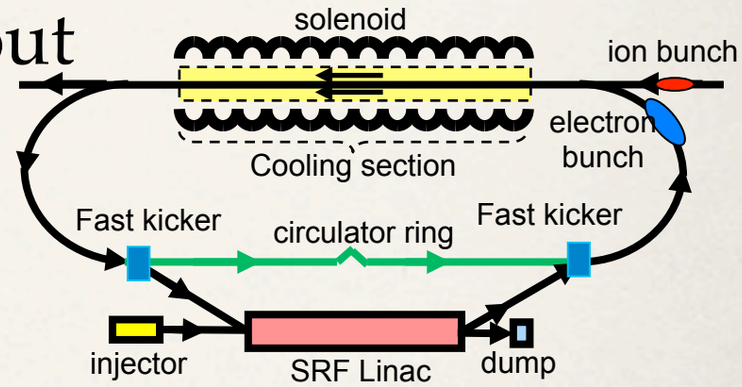




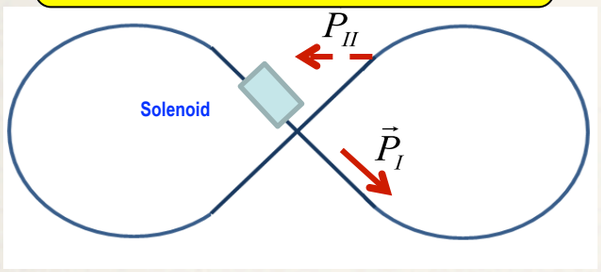
Project of the Electron-Ion Collider at Jefferson Laboratory

Yaroslav Derbenev

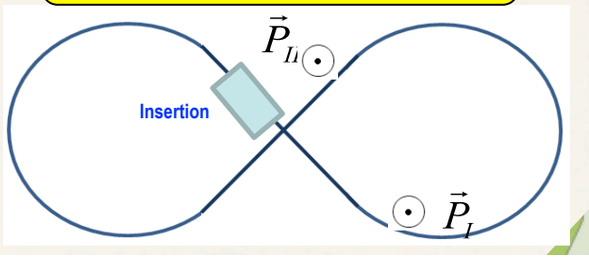
- Medium-Energy Electron Ion Collider (MEIC) layout
- MEIC design choices
- Integrated detector and interaction region
- Polarized beams in MEIC
- Electron cooling

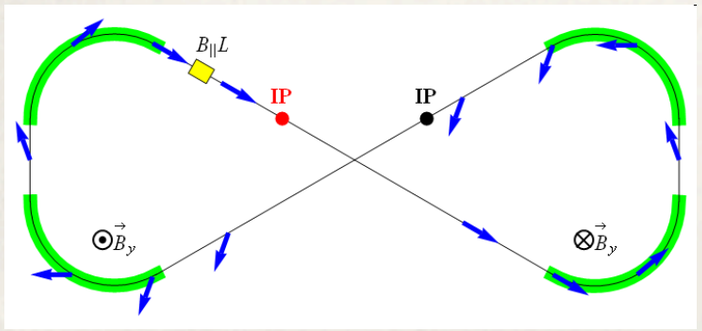


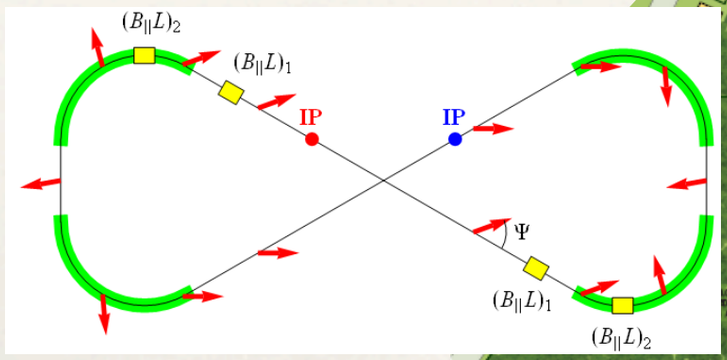
Longitudinal polarization in one straight

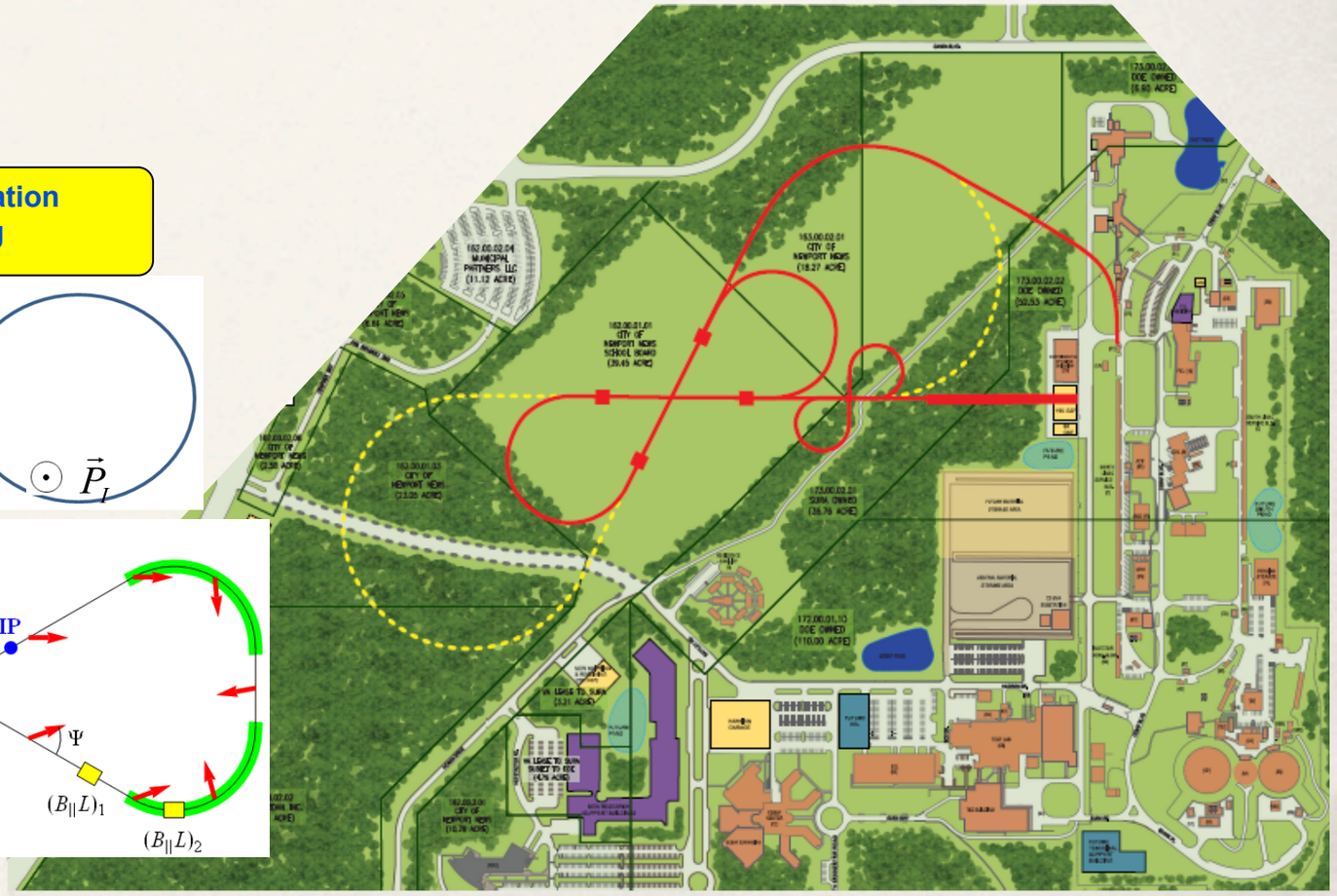


Vertical polarization over all ring





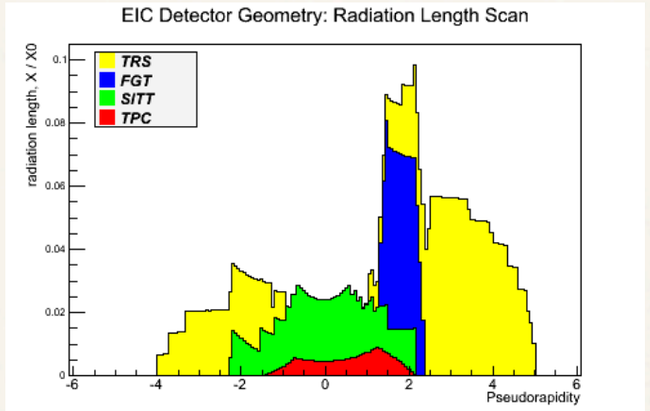


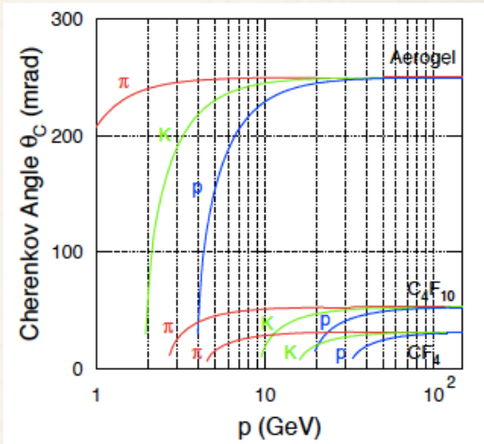


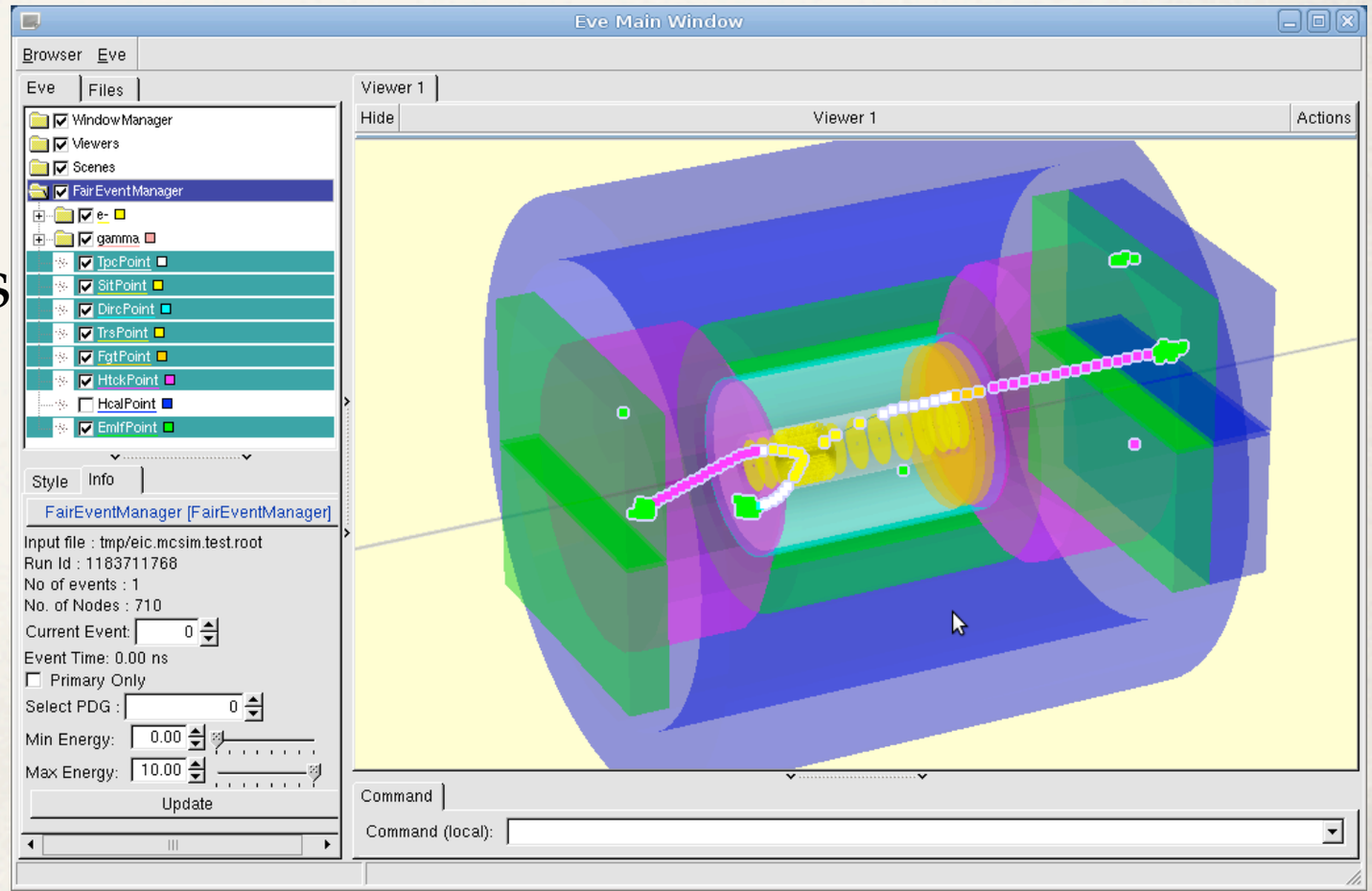
eRHIC Detector R&D and Design

Elke Aschenauer

- Physics requirements
- Kinematics for each particle type, and particle ID needs
- Description of the ongoing site-independent R&D program
- Fast simulation program, and examples of simulation results
- Concepts for the RICH detector systems
- DVCS requirements and constraints
- Luminosity and polarimetry

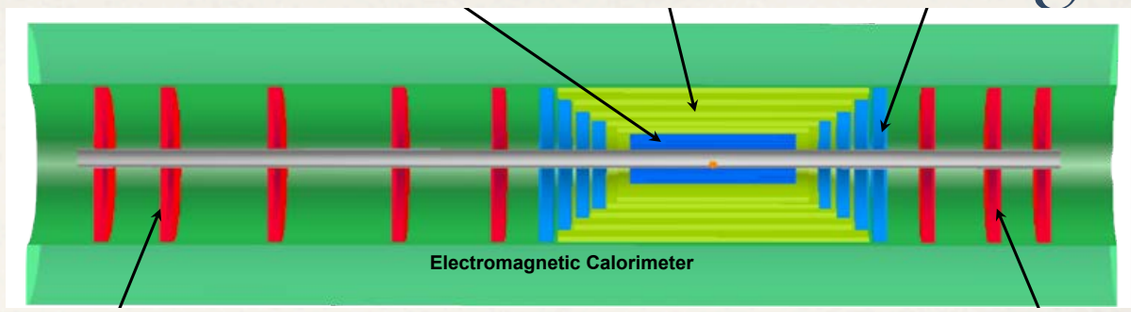




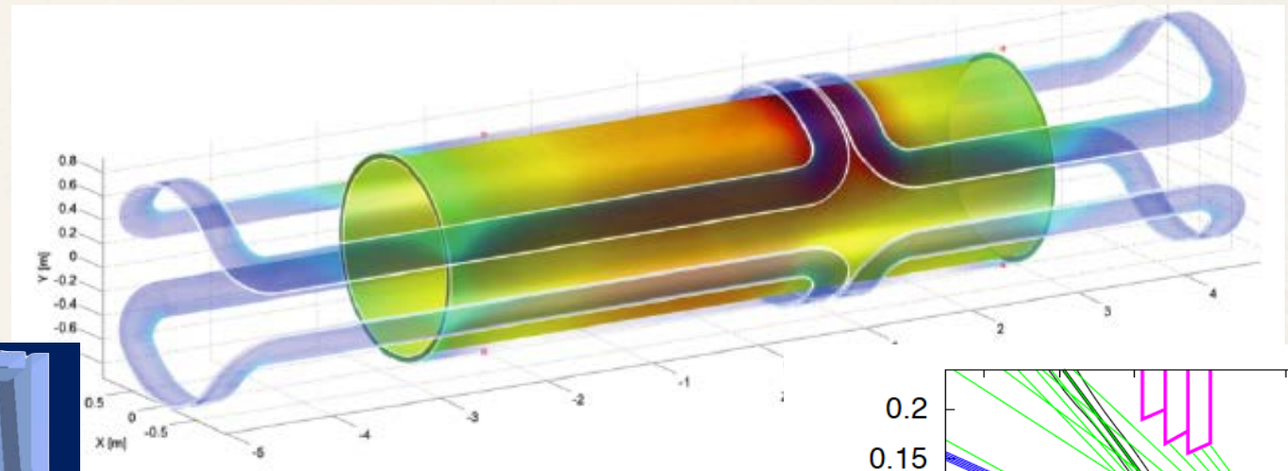


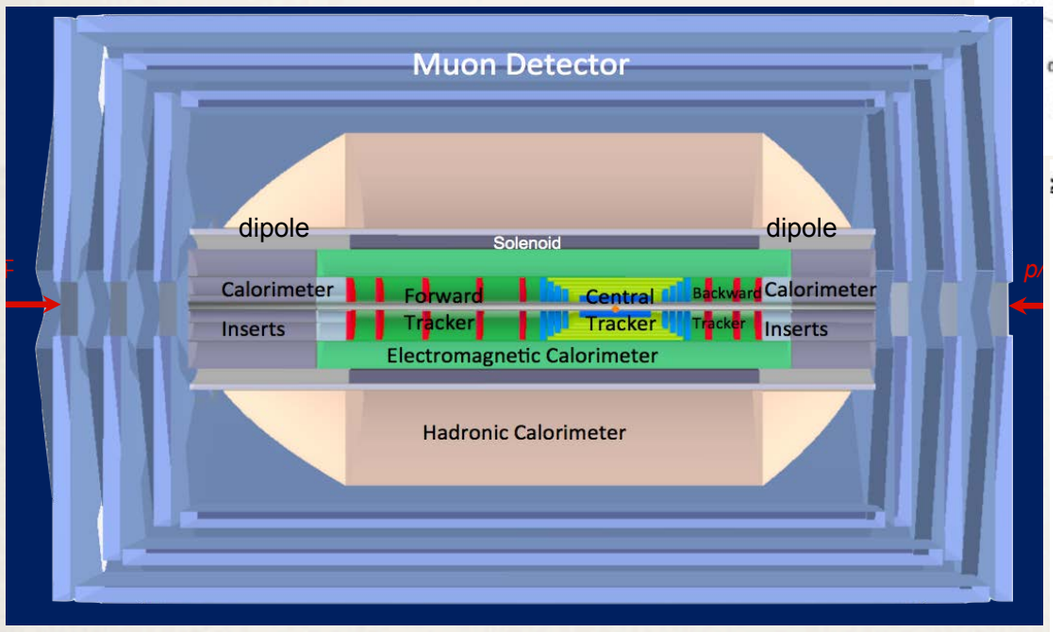
The Large Hadron electron Collider Detector Design Concept

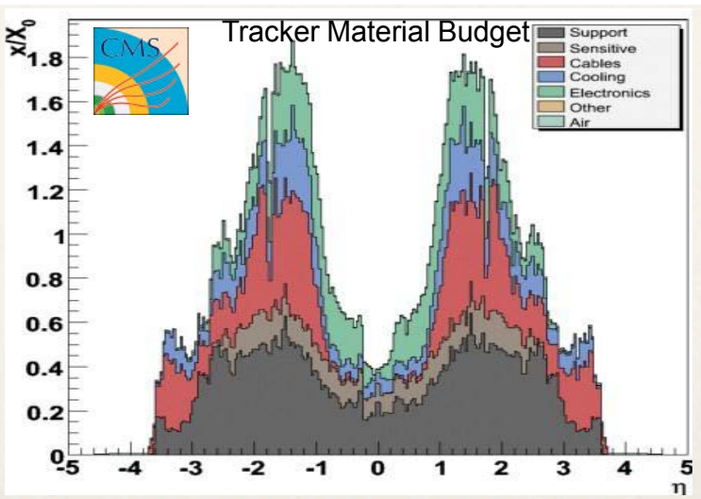
Alessandro Pollini

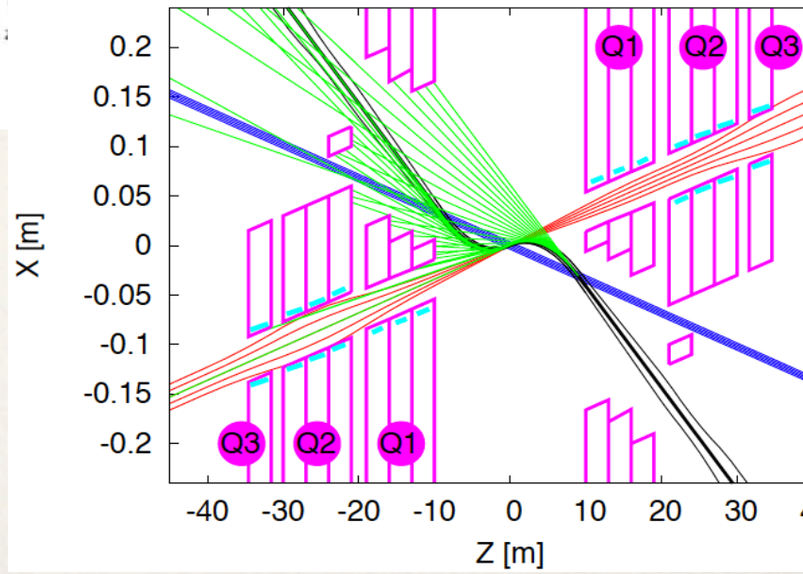


- Experiment requirements and accelerator boundaries: physics, machine, interaction region, detector
- Present Detector Design
- Future and Outlook





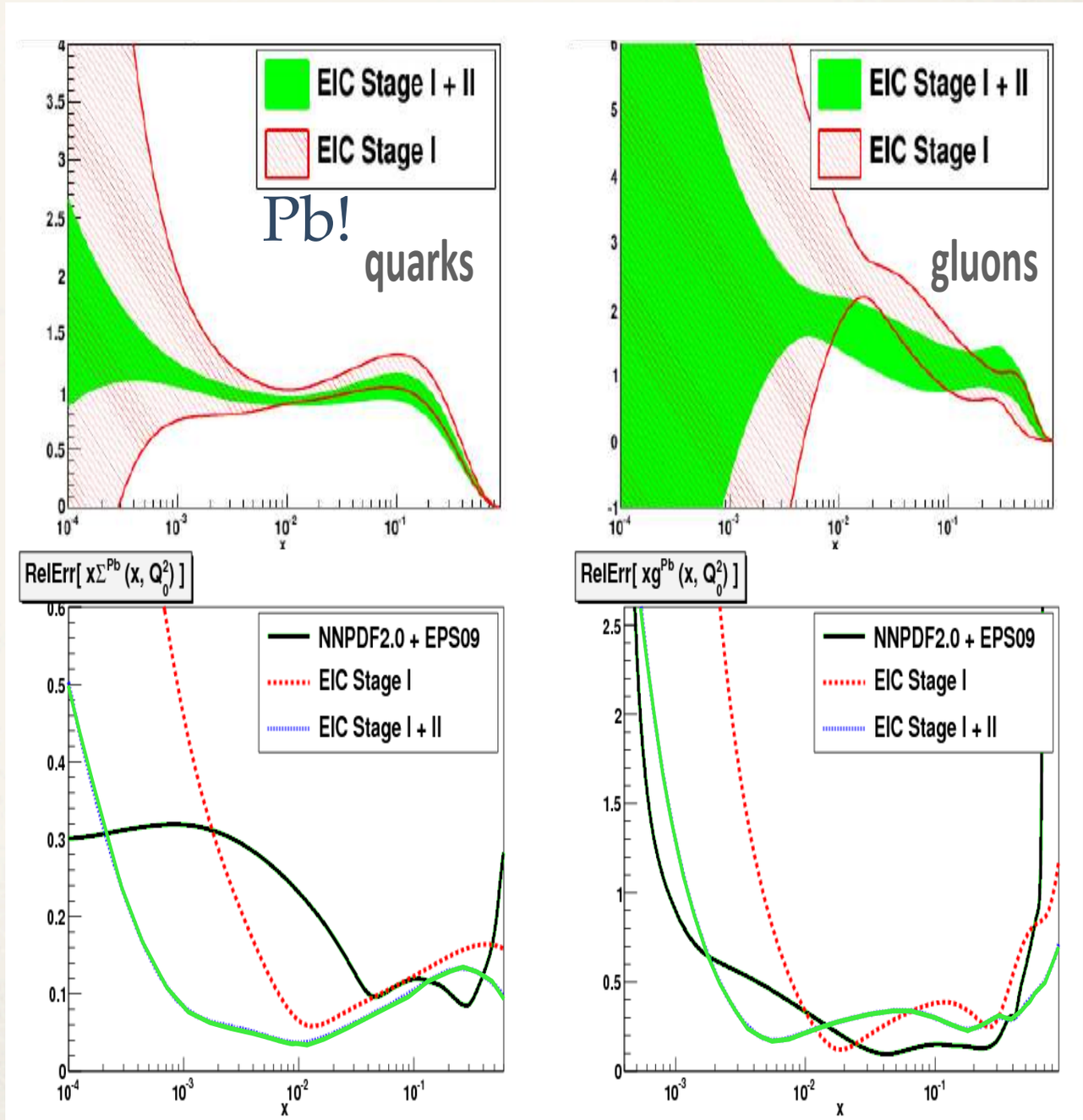




Nucleon and nuclear structure at the EIC

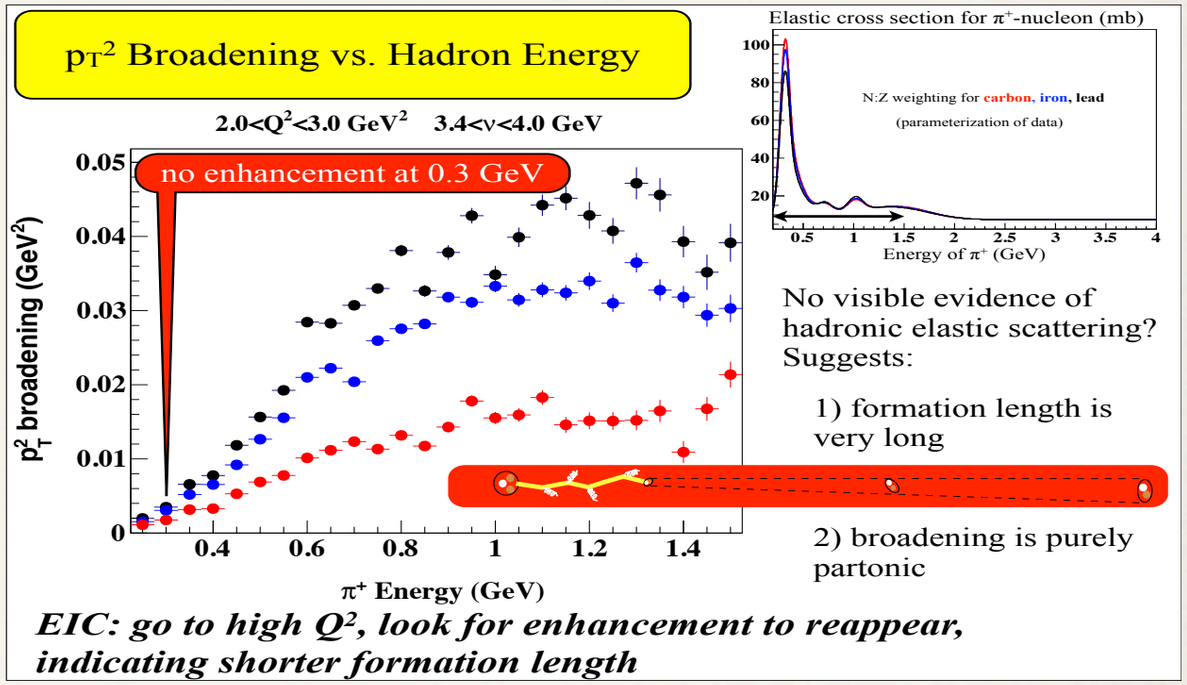
Alberto Accardi

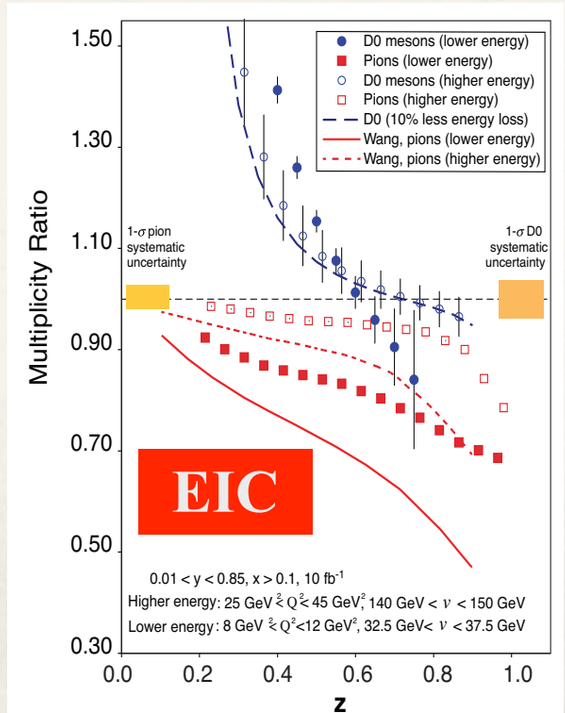
- Protons and Deuterons: partons at large x
  - d/u ratio extrapolated to x=1
  - W' and Z' production @ LHC
- Constraining nuclear uncertainties
  - W,Z in proton collisons
  - JLab, EIC
- From Deuterons to larger nuclei
  - Inclusive DIS from small to large x
  - Jets at the EIC

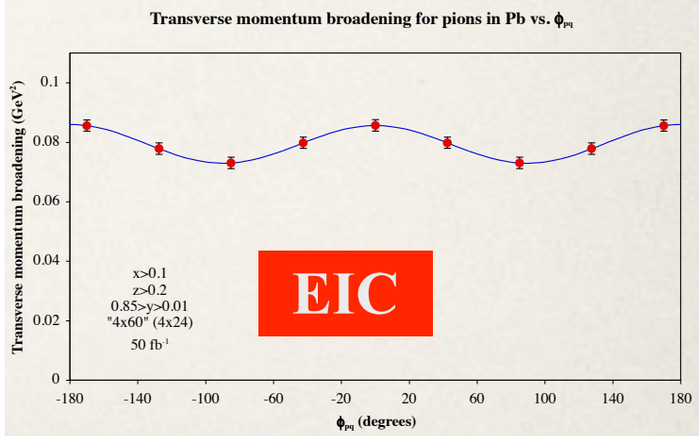


e-A at Large x: Applying Parton Propagation Methods to Investigate QCD Fragmentation, Quantum Fluctuations, and Heavy Quark Energy Loss - *Will Brooks*

- Exploring cold nuclear matter using colored partonic probes
  - Fragmentation properties, quantum fluctuations
- The intensifying puzzle of heavy quark energy loss: EIC role is crucial
- Suppression of fragmentation hadrons in nuclei: elusive mechanism or hidden duality?
  - Wide kinematic extremes of EIC will clarify this



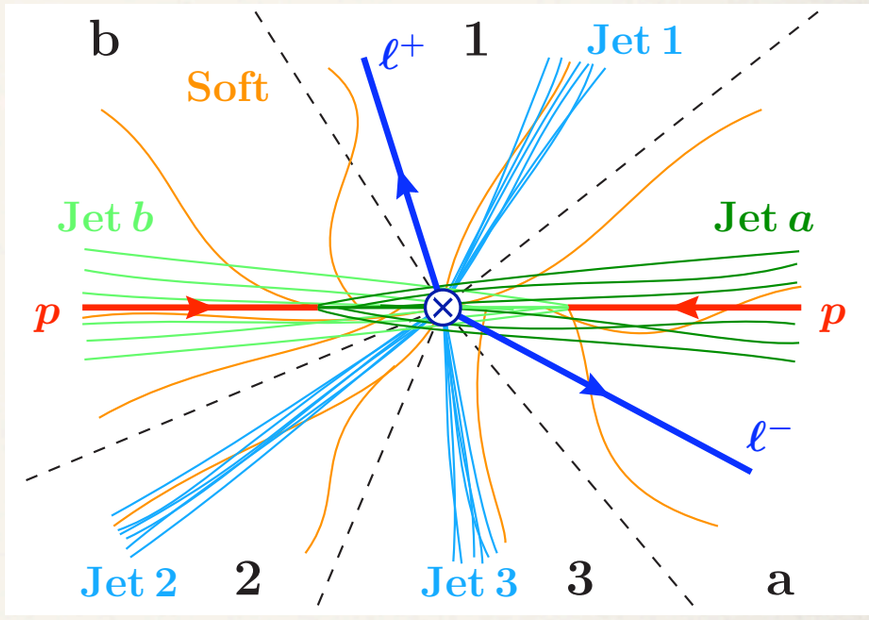




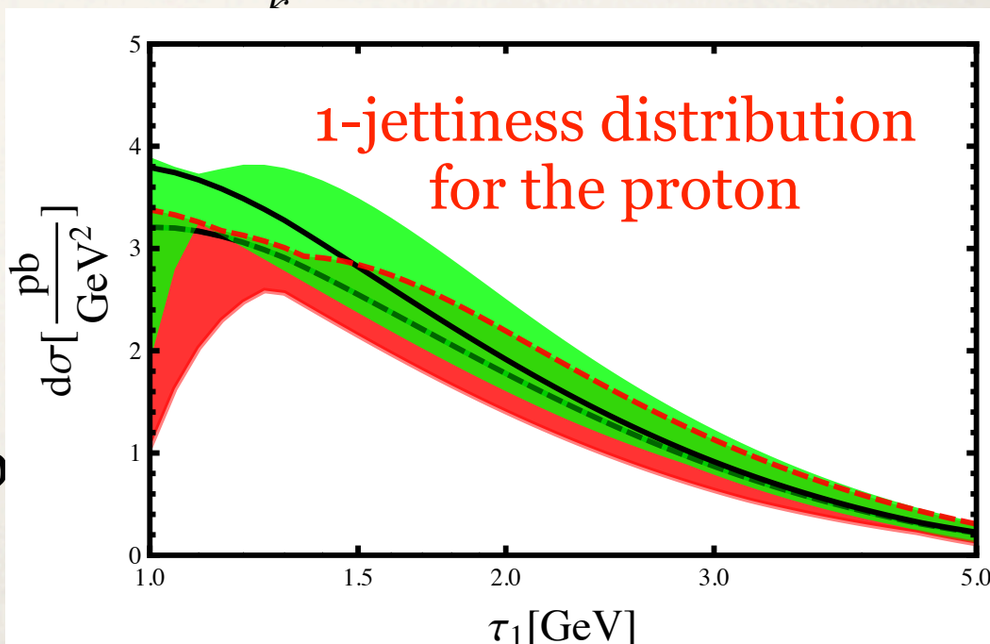
Probing Nuclear Dynamics in Exclusive Jet Production with a Global Event Shape

Sonny Mantry

- Probe e-A nuclear dynamics in exclusive jet production using event shapes, e.g., "1-jettiness"
- Enhanced sensitivity to wide angle soft radiation.
- Factorization properties understood
  - All objects in factorization formula have well defined evolution equations
- Also useful for jet veto studies
- Results given with NNLL resummation.
- Many directions can be pursued with event shape analyses of exclusive jet production to probe nuclear dynamics at the EIC & LHeC

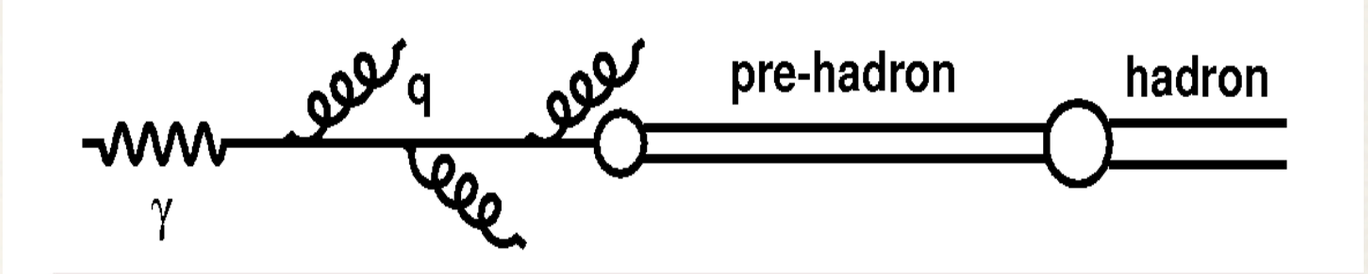


$$\tau_N = \sum_k \min_i \left\{ \frac{2q_i \cdot p_k}{Q_i} \right\}$$

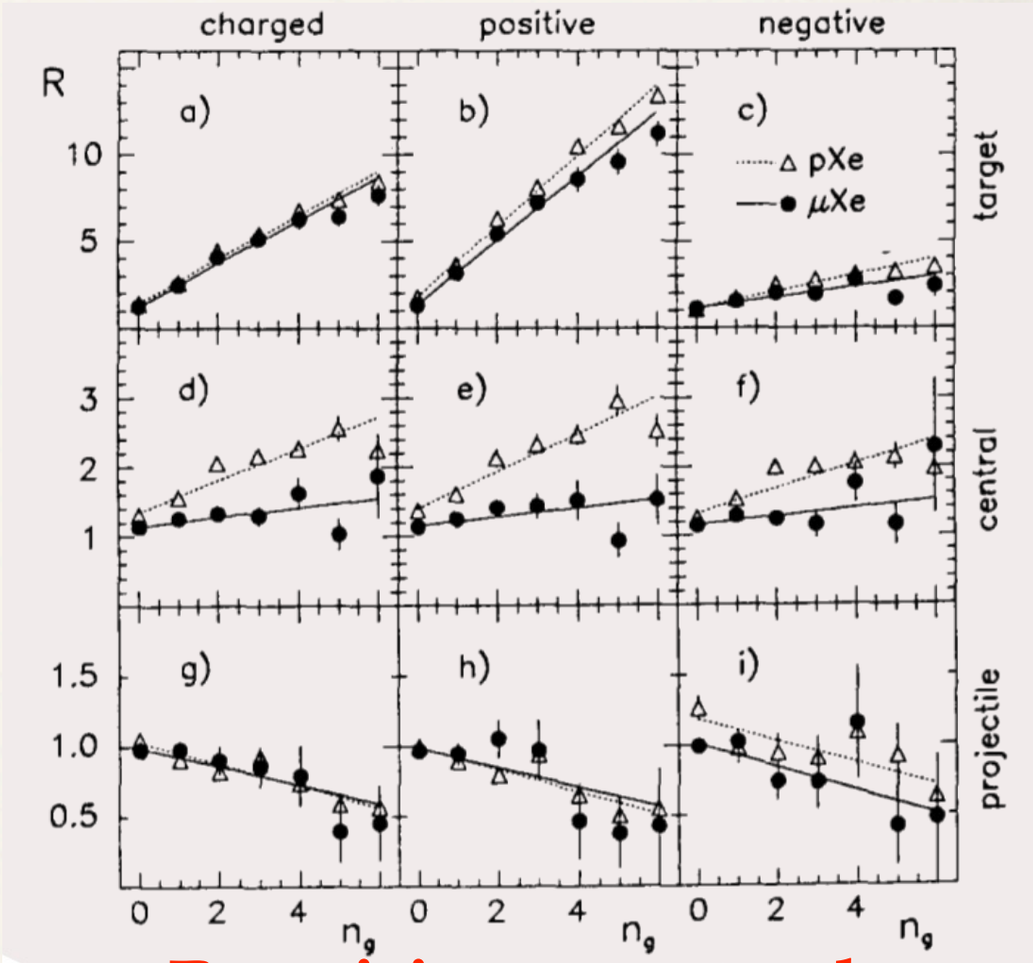


Using Slow Protons in e-A at an EIC

Raphaël Dupré



- How to study hadronization at an EIC ?
- Can we use total charge measured like in RHIC/LHC to determine centrality ?
- Can we find other similar method applicable to lepton scattering ?
- How the nuclei is breaking up?
- Implications for measurement of other nuclear effects
- Review of HERMES nuclear target results
- Statistics and kinematic coverage for EIC multiplicity ratios



Requiring grey tracks enhances nuclear effects by a factor of 2 or more!

Today's talks - a reminder

- Theoretical remarks on Drell-Yan production at small x - *Joachim Bartels*
- eA Physics with the LHeC - *Anna Stasto*
- Diffractive studies with EIC - *Tobias Toll*
- Diffraction and forward physics in ep collisions at the LHeC - *Pierre van Mechelen*
- Proton structure functions at small x: recent results using NLO BFKL and DGLAP evolution - *Martin Hentschinski*
- Gluon shadowing - *Boris Kopeliovich*

‘March days return with their covert light’

Pablo Neruda

March days return with their covert light,
and huge fish swim through the sky,
vague earthly vapours progress in secret,
things slip to silence one by one.
Through fortuity, at this crisis of errant skies,
you reunite the lives of the sea to that of fire,
grey lurchings of the ship of winter
to the form that love carved in the guitar.
O love, O rose soaked by mermaids and spume,
dancing flame that climbs the invisible stairway,
to waken the blood in insomnia’s labyrinth,
so that the waves can complete themselves in the sky,
the sea forget its cargoes and rages,
and the world fall into darkness’s nets.

POETIC IV in Jyväskylä

Stellenbosch — Bloomington — Valparaíso —

University of Jyväskylä Department of Physics

∼ **August 26 – 30, 2013**

Organizing committee:

- T. Lappi
- K. J. Eskola
- T. Renk
- H. Mäntysaari
- …