Physics & Status Of
The Electron Ion Collider

University of Virginia
April 6, 2010

- Physics motivation: Fundamental open questions in QCD
- Concepts of future collider under consideration in US
- Physics simulations and detector concept/design progress
- Status of EIC project: Progress, activities & prospects of realization

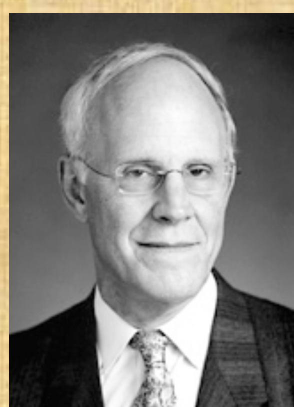
QCD

Folks, we need to stop "testing" QCD and start "understanding" it

Yuri Dokshitzer

1998, ICHEP Vancouver, CA in his Summary Talk

2004 For the discovery of asymptotic freedom in QCD

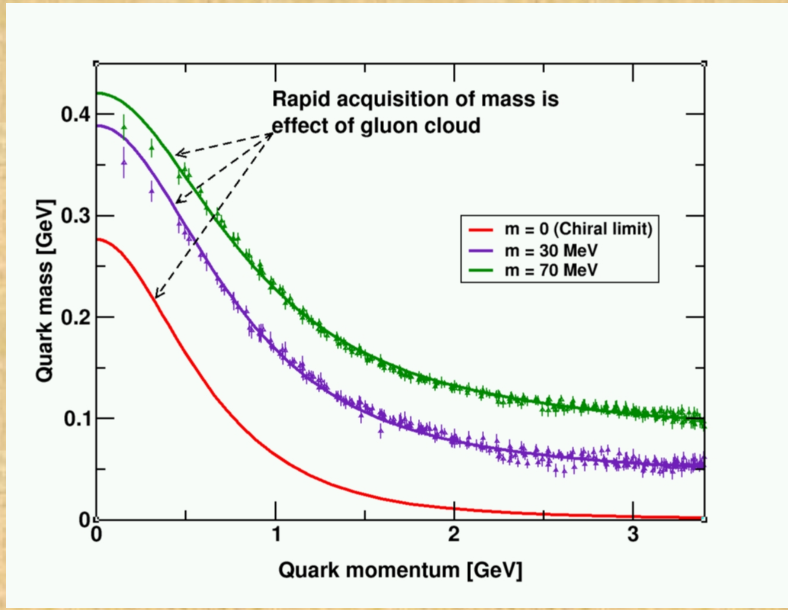


While there is no reason to doubt QCD any more, our level of understanding of QCD remains extremely unsatisfactory

Dissatisfaction: Understanding **Mass** & **Spin** in QCD

We are only beginning to explore high-energy many-body dynamics of QCD

Origin of mass & QCD

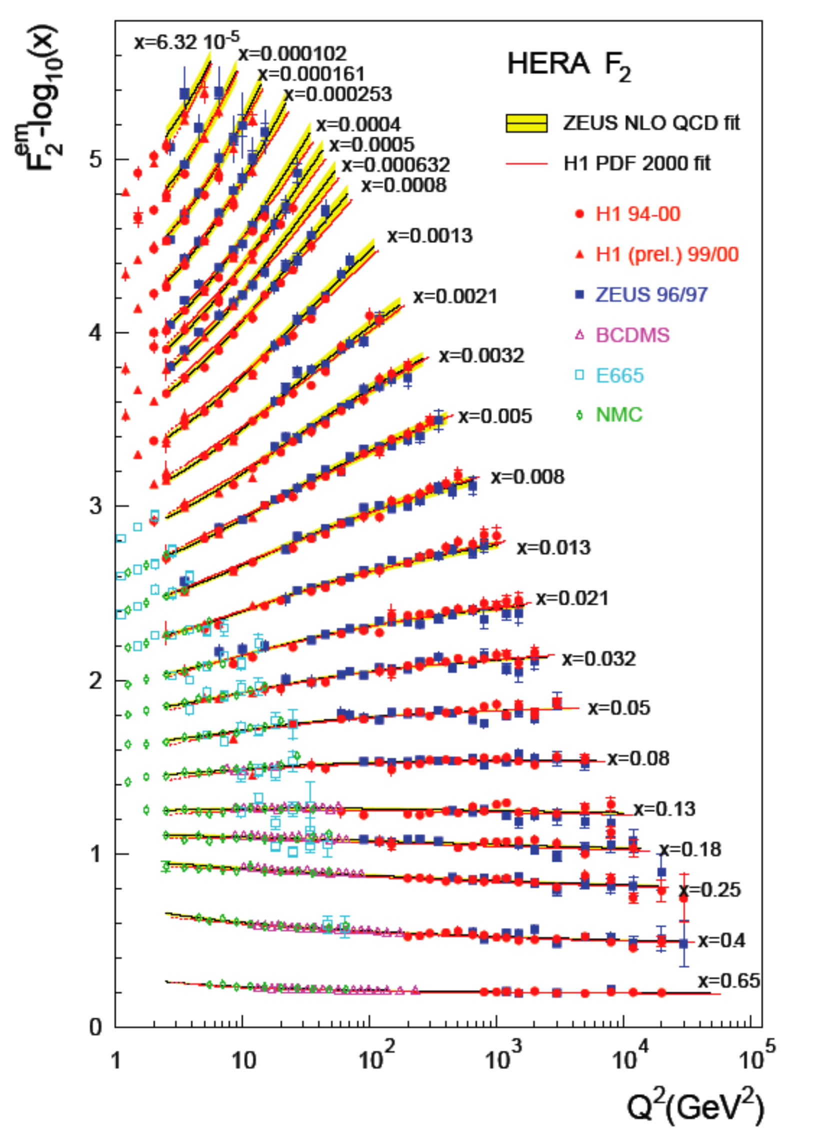


- More than 99% of proton's mass is due to self-generating gluon fields
- Higgs mechanism which is often credited to the mass generation, does not play a role in this case

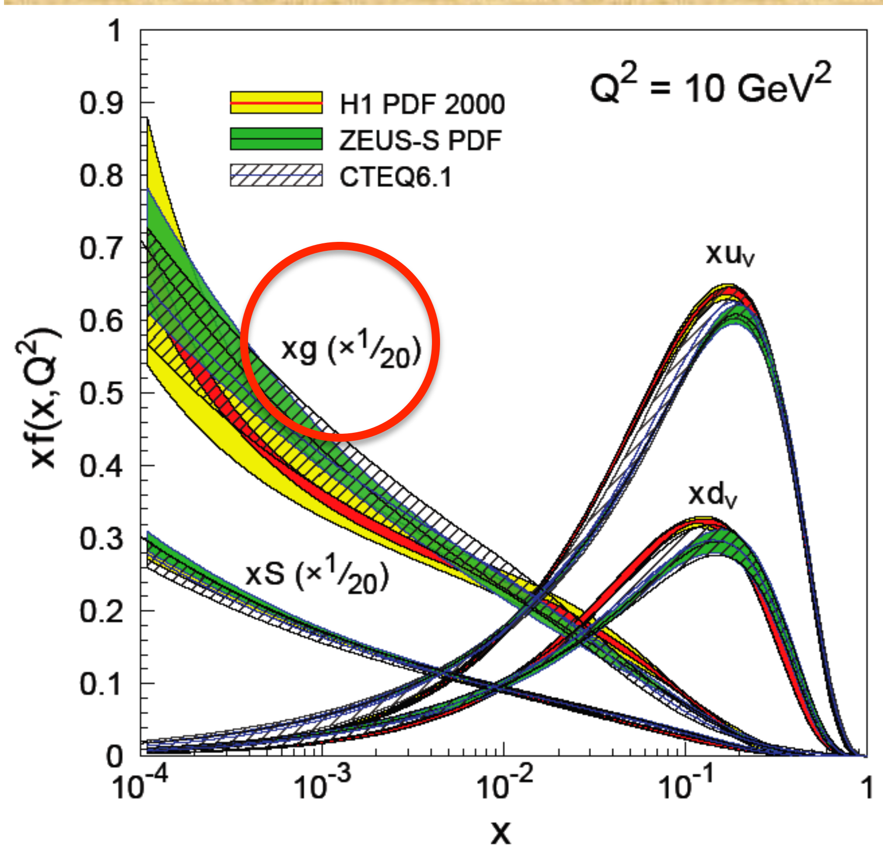
- Similarity between proton and neutron mass indicate that the gluon dynamics is identical in them, and more important than the quarks
- Lattice QCD supports this

How well do we understand the gluons in nucleons and nuclei….?

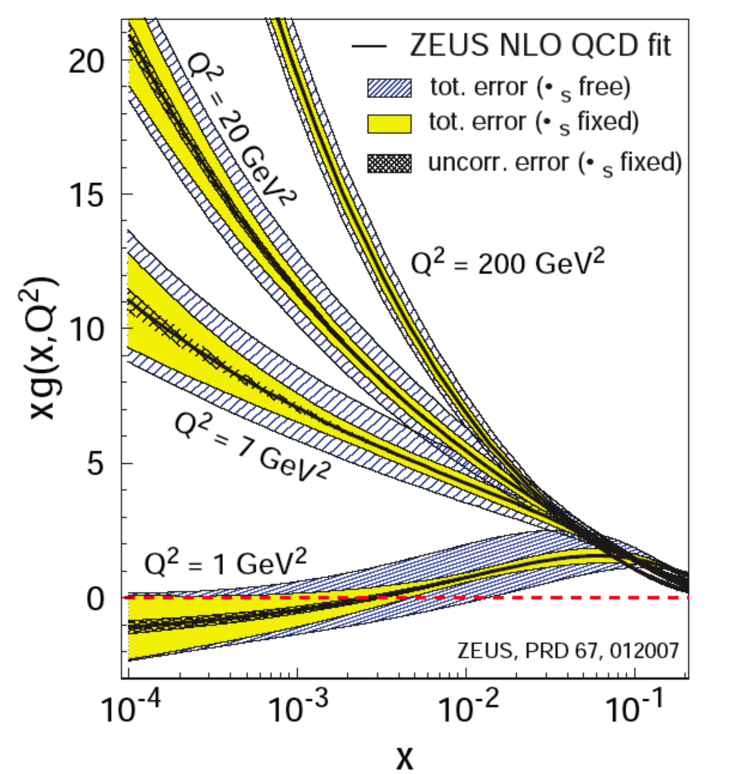
Measurement of Glue at HERA

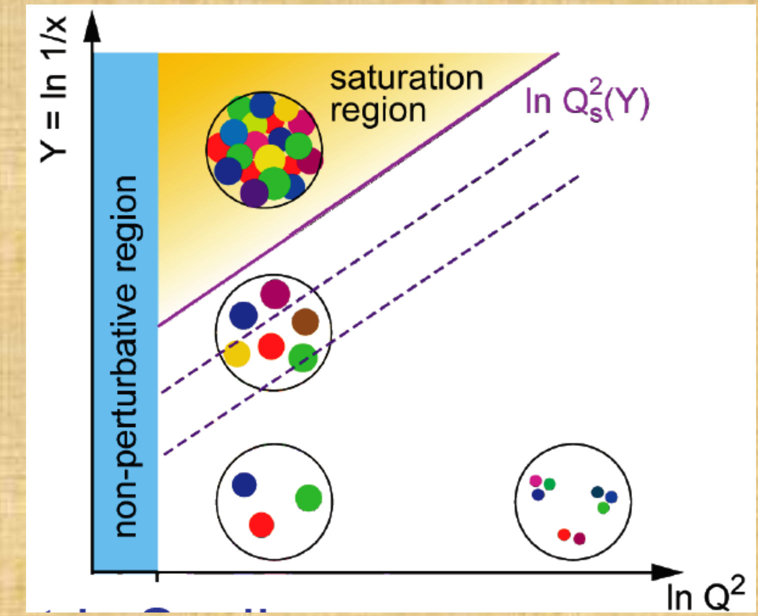


- Scaling violations of $F_2(x,Q^2)$
- NLO pQCD analyses: fits with LINEAR DGLAP equations



Gluons still not well understood!





- Rise at high Q^2, low x
  - Infinite rise, infinite cross section?
  - Is this due to use of linear DGLAP?
  - Direct consequence to high energy hadron cross sections
- Negative g(x) at low Q^2?

- What is the effect of including non-linear effects in DGLAP equation?
  - A possible scenarios: Saturation, Color Glass Condensate

No high enough energy collider

- Experiment with high densities of gluons → Nuclei!

Diffraction: A surprise at HERA

- Diffraction → in the final state, the proton remains intact
- HERA: 820 GeV protons and 27 GeV electrons
  - In proton's rest frame the collisions is equivalent to what you would get when a 50 TeV electron beam hits a stationary proton
- **Surprise: 1/7 of the time, the proton remain intact. Completely unanticipated, astonishing phenomena**
- Presently only explained quantitatively by theoretical ideas based on non-linear gluon dynamics at low x (CGC)
  - Prediction (CGC) predicts that in e-A, the 1/7 → 1/4
  - Needs to be experimentally verified…

How well do we understand the nucleon spin?

If you think you understand hadronic reactions, try to explain them with spin

Experiments with spin have managed to kill more theories and models than any other single variable used in experiments

Nucleon Spin ~~Crisis~~ Puzzle

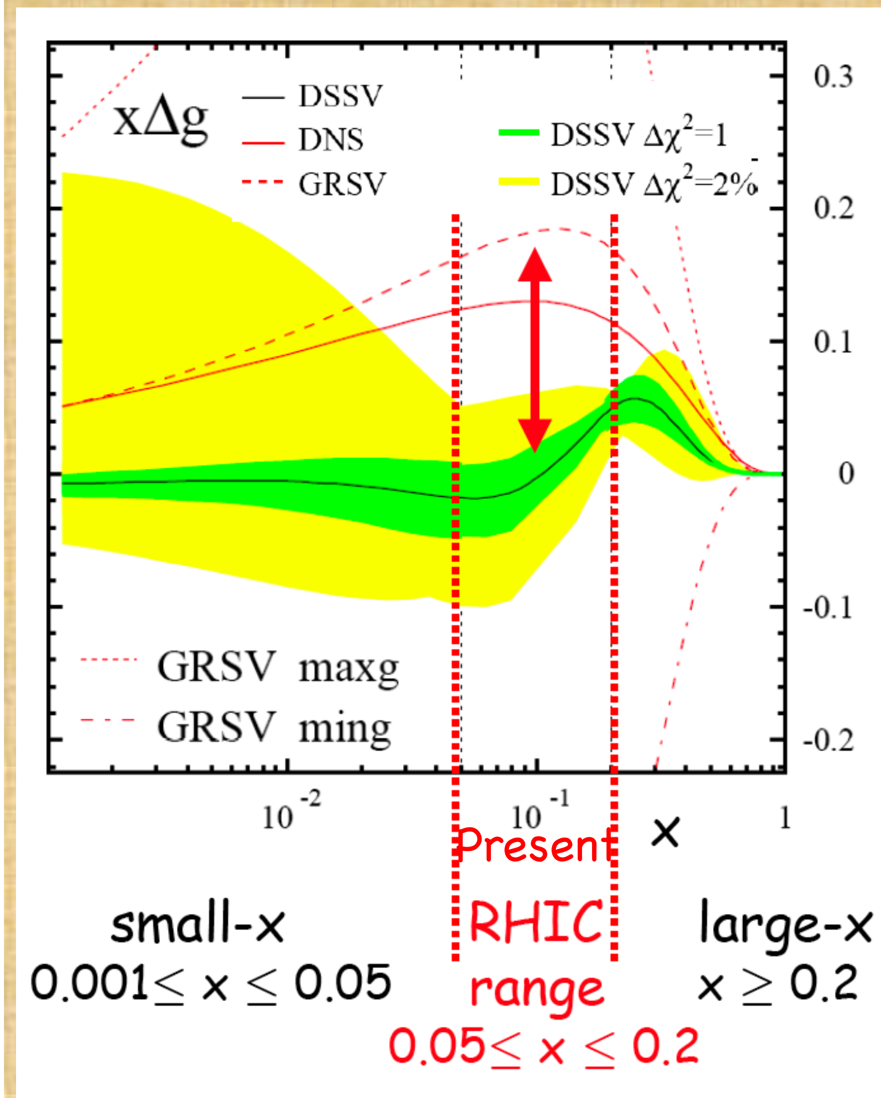
$$\frac{1}{2} = \frac{1}{2}\Delta\Sigma + L_Q + \Delta G + L_G$$

?

$$\frac{1}{2} = J_Q + J_G$$

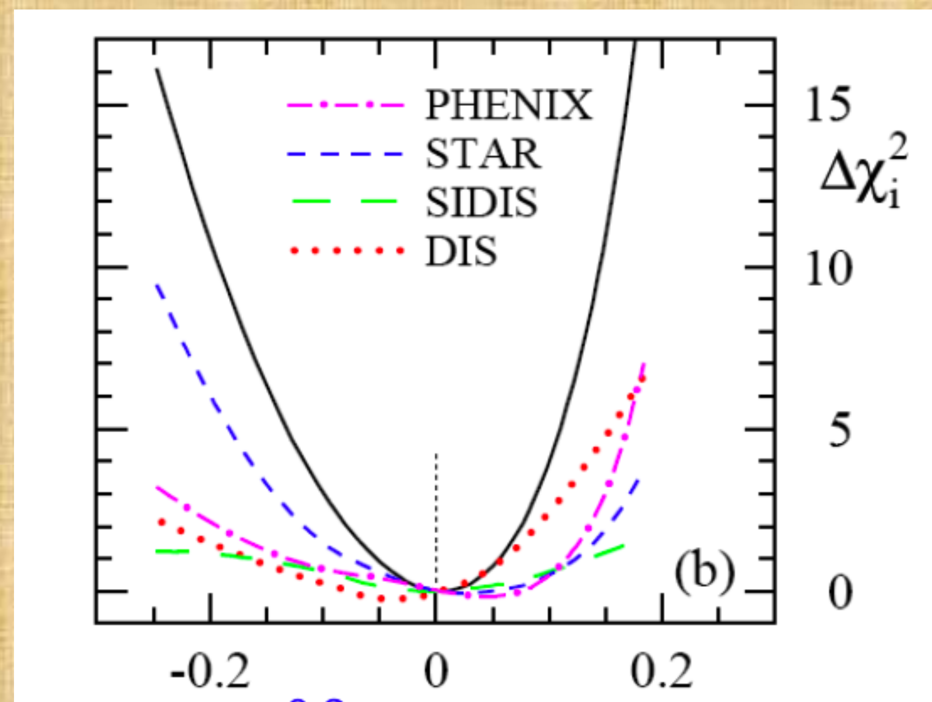
- We know how to measure $\Delta\Sigma$ and ΔG precisely using pQCD in a <u>model independent</u> way
  - ½ ($\Delta\Sigma$) ~ 0.15 : From fixed target pol. DIS experiments
  - RHIC-Spin: ΔG *not large* as anticipated in the 1990s, but *measurements & precision needed at low & high x*
- Orbital angular momenta: L_Q (L_G?)
  - Through GPDs: Model dependences … other theoretical issues..
  - A lot to learn from the12 GeV Jlab & the COMPASS program & ongoing theoretical development
- It would be great to have a 3D tomographic image of a proton…. Transverse spin phenomena (TMDs, GPDs: Q & G)

$\Delta G(x)$ @ $Q^2=10$ GeV^2



de Florian, Sassot, Stratmann & Vogelsang

- Global analysis: DIS, SIDIS, RHIC-Spin
- Uncertainly on ΔG large at low x

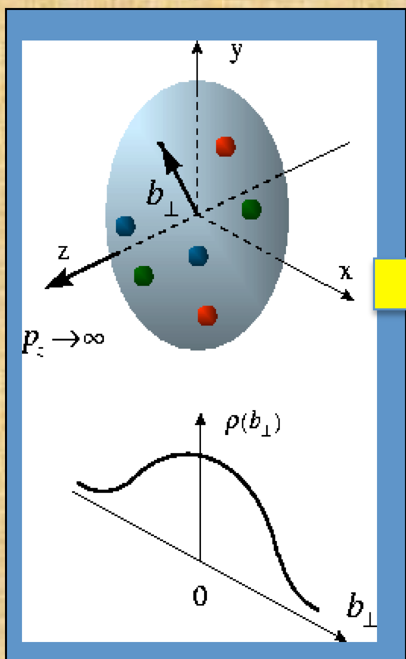


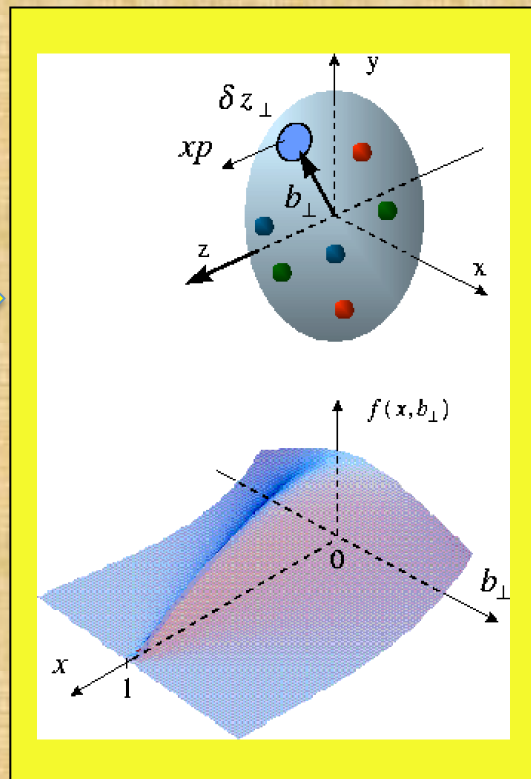
$$\delta g \equiv \int_{0.05}^{0.2} \Delta g(x, 10\ \text{GeV}^2)\,dx$$

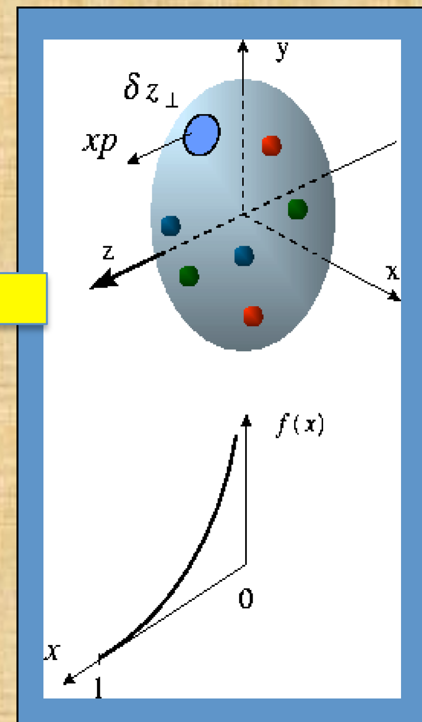
Beyond form factors and quark distributions

Generalized Parton Distributions

X. Ji, D. Mueller, A. Radyushkin (1994-1997)







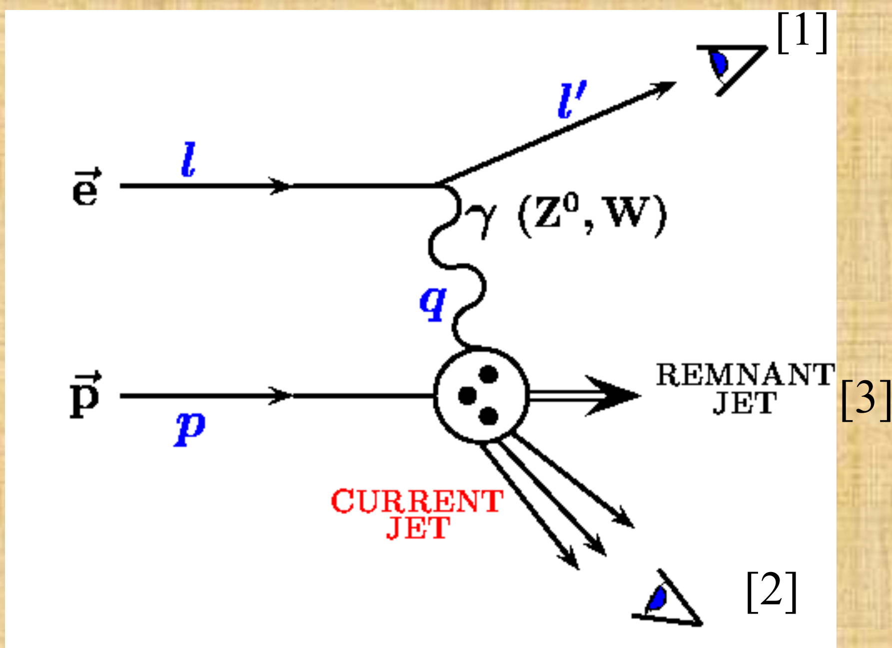
Proton form factors, transverse charge & current densities

Correlated quark momentum and helicity distributions in transverse space - GPDs

Structure functions, quark longitudinal momentum & helicity distributions

The Proposal: Future DIS experiment

A high energy, high luminosity (polarized) ep and eA collider and a suitably designed detector will address these and such fundamental questions in QCD



Measurements:

[1] → Inclusive

[1] and [2] **or** [3] →Semi-Inclusive

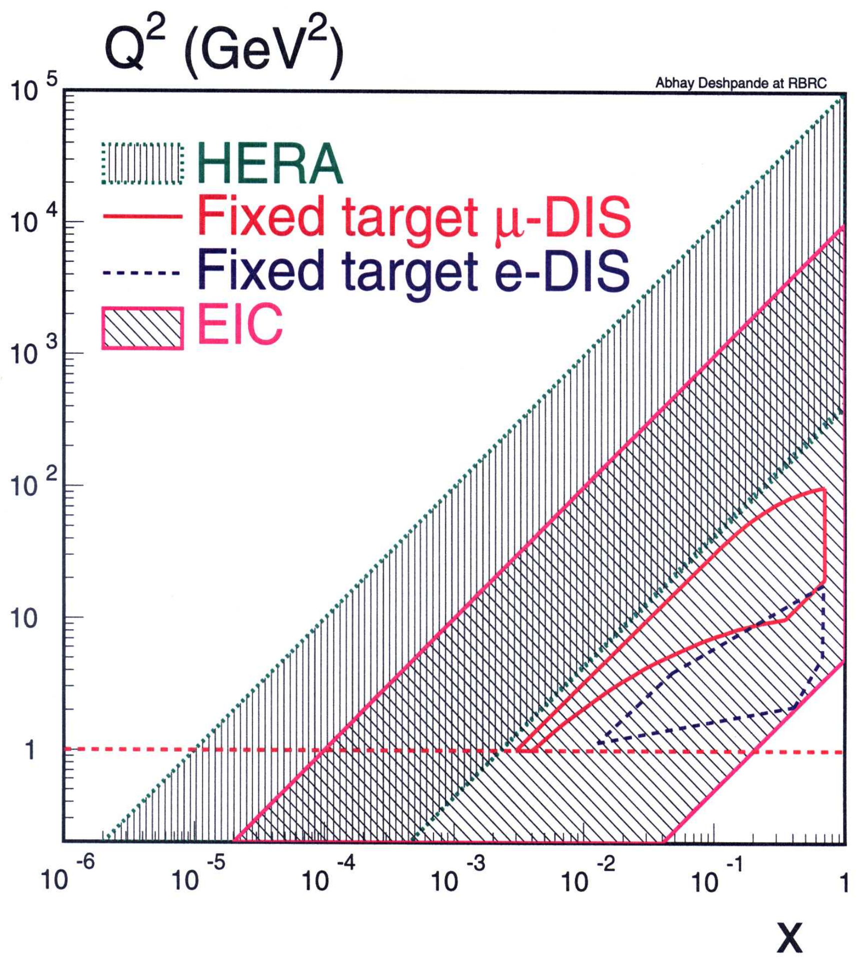
[1] and [2] **and** [3] →Exclusive

Inclusive → Exclusive

Low → High Luminosity

Demanding Detector capabilities

EIC in the US: Basic Parameters



- E_e=10 GeV (5~20 GeV variable)
- E_p=250 GeV (50~250 GeV Variable)
- Sqrt(S_{ep}) = 30~100 GeV
- X_{min} = 10^{-4}; Q^2_{max}= 10^4 GeV
- Beam polarization ~ 70% for e,p
- Luminosity L_{ep} = 10$^{33\text{-}34}$ cm^{-2}s^{-1}
- Aimed Integrated luminosity:
  - 50 fb^{-1} in 10 yrs (100 x HERA)
  - Possible with 10^{33} cm^{-2}s^{-1}

Nuclei:

- p->U; E_A=20~100 GeV
- Sqrt(S_{eA}) = 12~63 GeV
- L_{eA}/N = 10^{33} cm^{-2}s^{-1}

Scientific Frontiers Open to EIC

Polarized Beams

- Nucleon Spin structure
  - Polarized quark and gluon distributions
    - Longitudinal spin structure (Low x critical)
    - Transverse spin structure (wide Q^2 arm critical)
  - Correlations between partons
    - Exclusive processes --> Generalized Parton Distributions
  - Precision measurements of QCD and of EW parameters in SM

Lumi: low → high

- Un-polarized Nucleon Structure
  - Understanding confinement with low x/lowQ^2 measurements
  - Un-polarized quark and gluon distributions
- Nuclear Structure, role of partons in nuclei
  - Confinement in nuclei through comparison e-p/e-A scattering
- Hadronization in nucleons and nuclei & effect of nuclear media
  - How do knocked off partons evolve in to colorless hadrons
- Partonic matter under extreme conditions
  - For various A, compare e-p/e-A

Proton & Nuclear Beams

Machine Designs

eRHIC at Brookhaven National Laboratory using the existing RHIC complex

ELIC at Jefferson Laboratory using the Upgraded 12GeV CEBAF

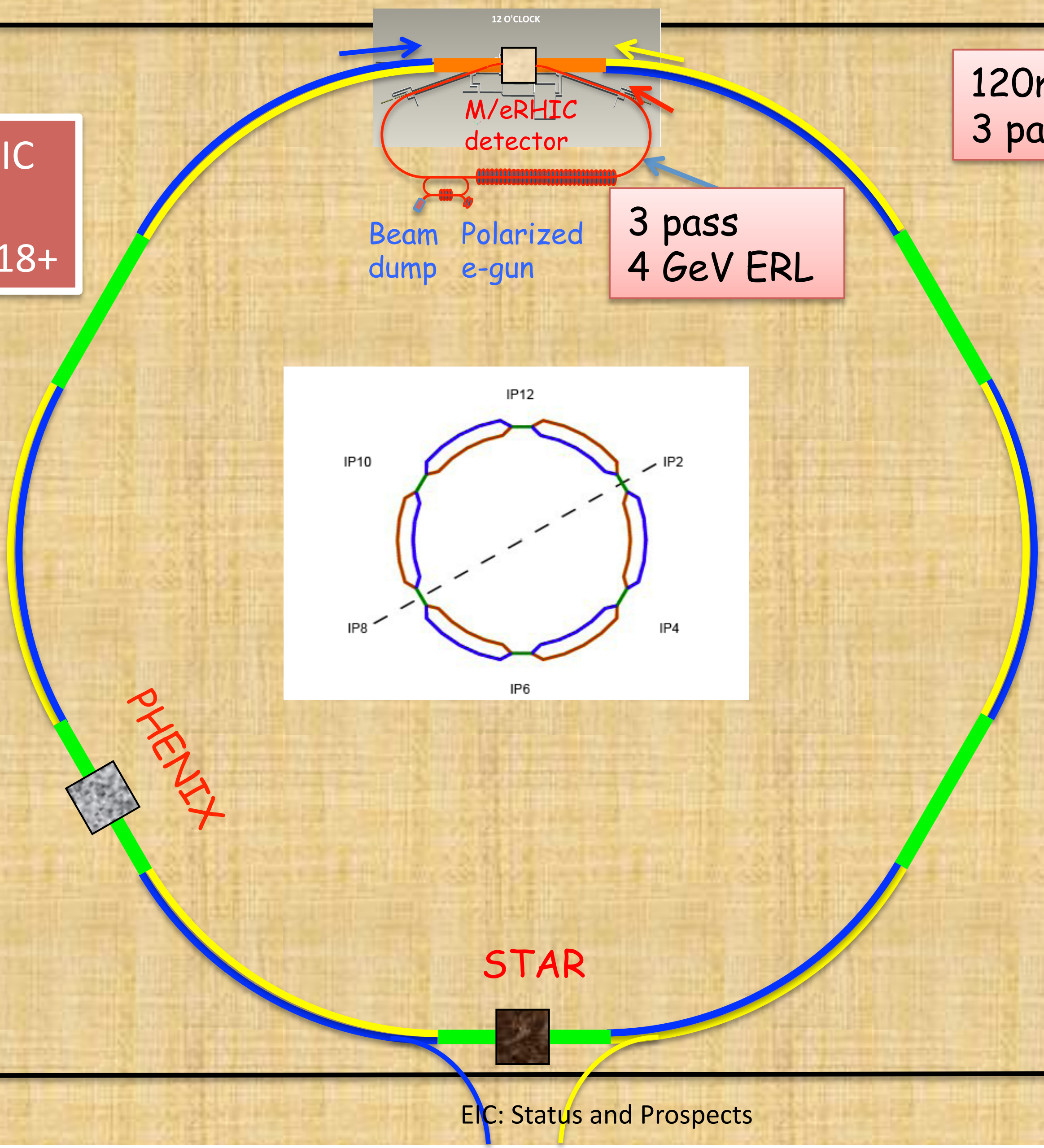
4 GeV e x 250 GeV p – 100 GeV/u Au: ***MeRHIC***

Stage 1 of eRHIC

Possible by 2018+

120m SRF linac
3 passes, 1.3 GeV/pass

3 pass
4 GeV ERL

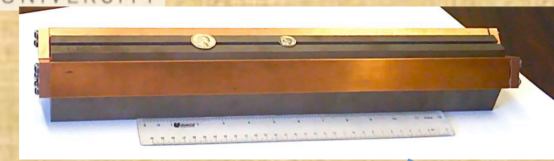


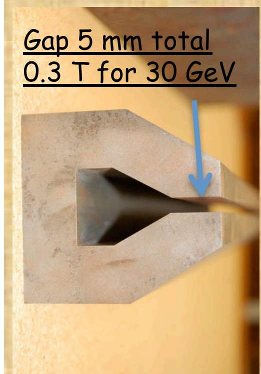
Medium Energy eRHIC

Or

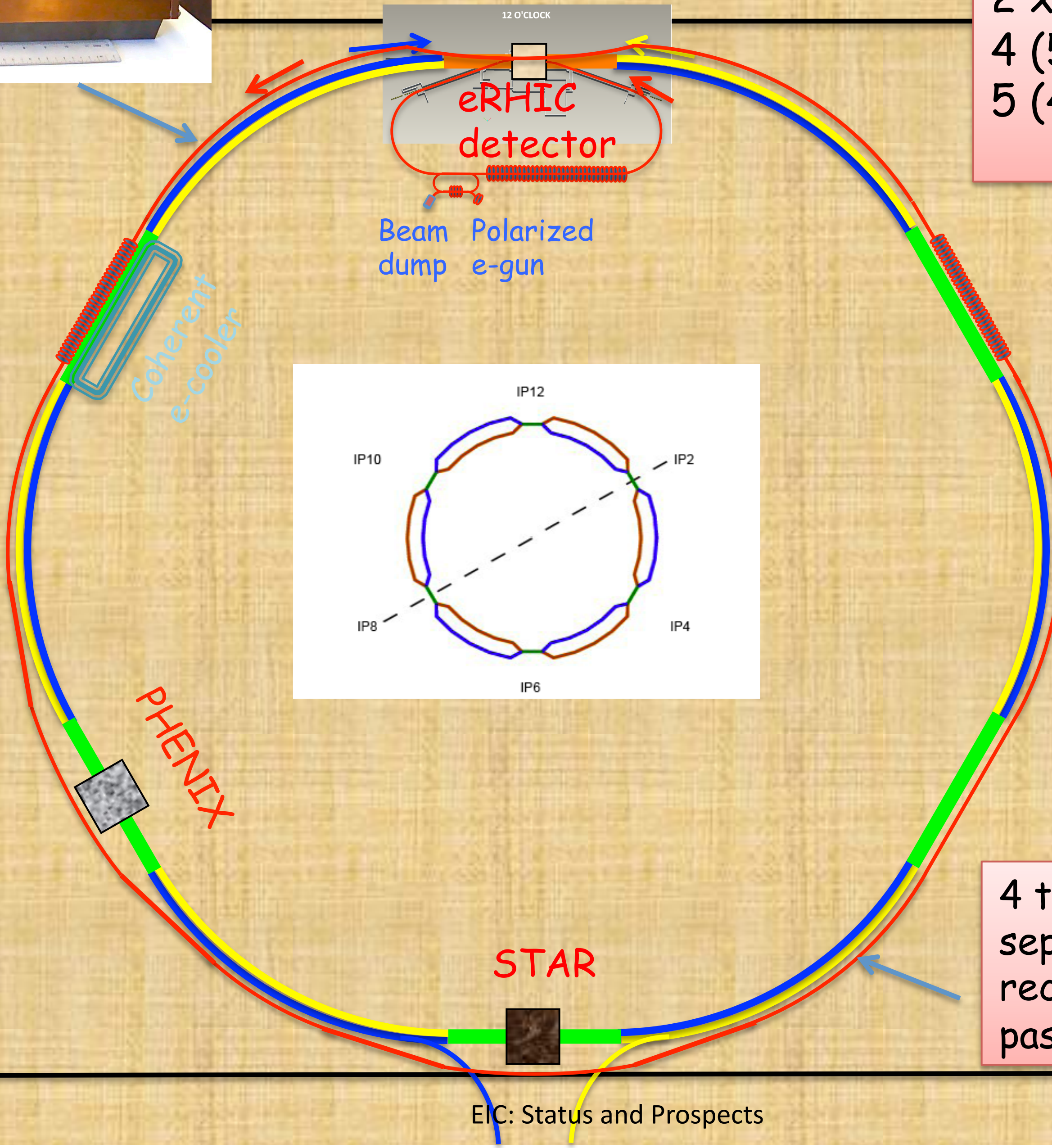
MeRHIC

10 to 20 GeV e x 325 GeV p – 130 GeV/u Au
eRHIC



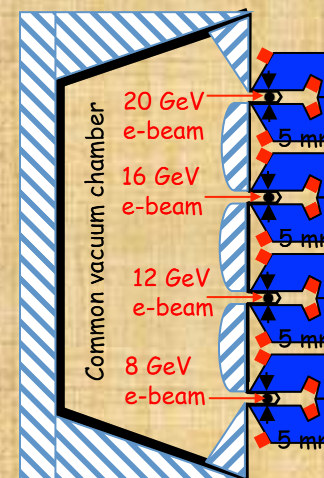


Possibility of 30 GeV low current operation



2 x 200 m SRF linac
4 (5) GeV per pass
5 (4) passes

eRHIC 2020+



4 to 5 vertically separated recirculating passes

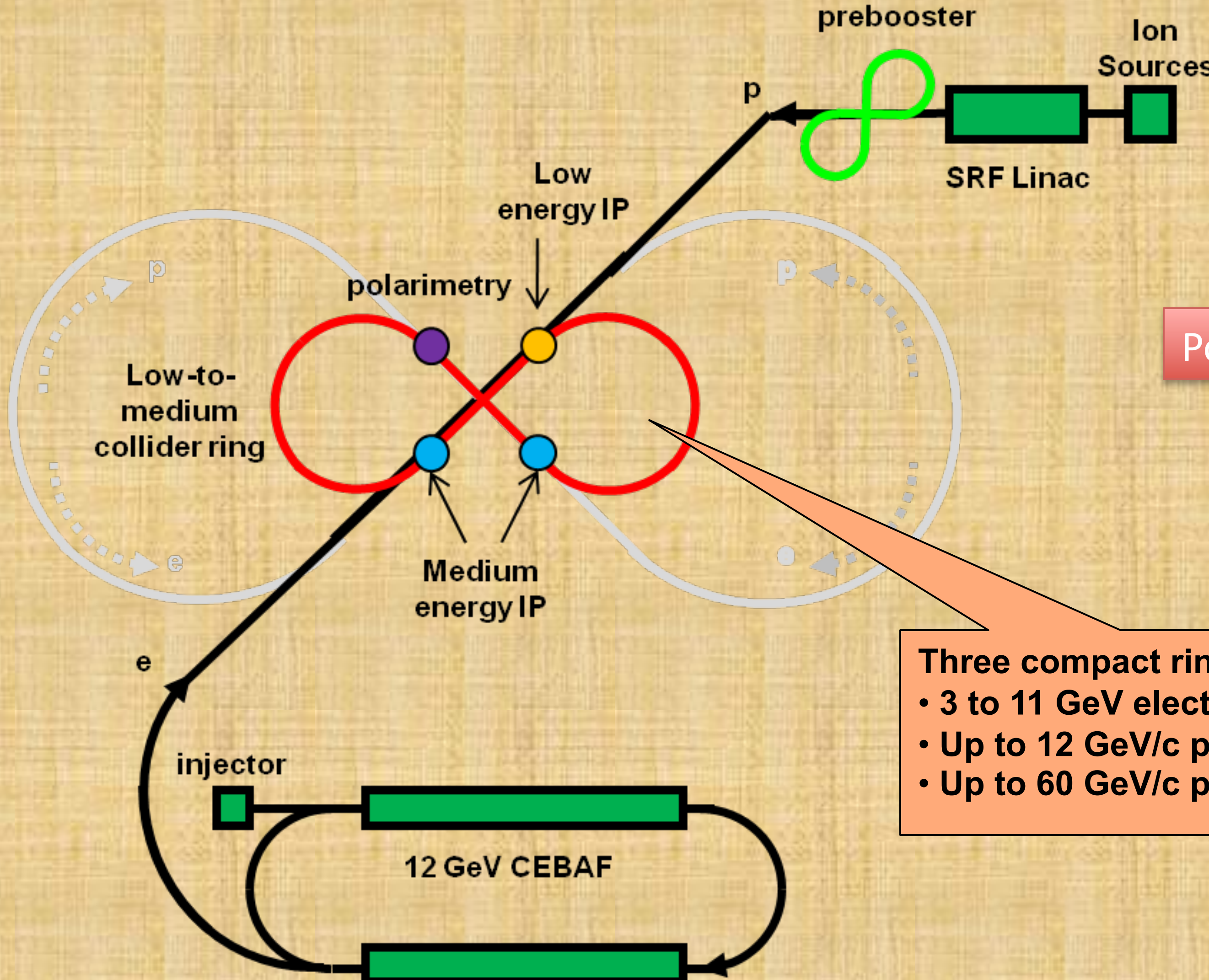
Luminosity in eRHIC

	MeRHIC		eRHIC IR1		eRHIC IR2	
	p /A	e	p /A	e	p /A	e
Energy, GeV	250/100	4	325/130	20	325/130	20
Number of bunches	111	105 nsec	166	74 nsec	166	74 nsec
Bunch intensity (u) , 10^{11}	2.0	0.31	2.0	0.24	2.0	0.24
Bunch charge, nC	32	5	32	4	32	4
Beam current, mA	320	50	420	50	420	50
Normalized emittance, 1e-6 m, 95% for p / rms for e	15	73	1.2	25	1.2	25
Polarization, %	70	80	70	80	70	80
rms bunch length, cm	20	0.2	4.9	0.2	4.9	0.2
β*, cm	50	50	25	25	5	5
Luminosity, $cm^{-2}s^{-1}$	0.1×10^{33} as is 1×10^{33} with CeC		2.8×10^{33}		1.4×10^{34}	

< Luminosity for 30 GeV e-beam operation will be at 20% level>

Office of Nuclear Physics
Exploring Nuclear Matter - Quarks to Stars

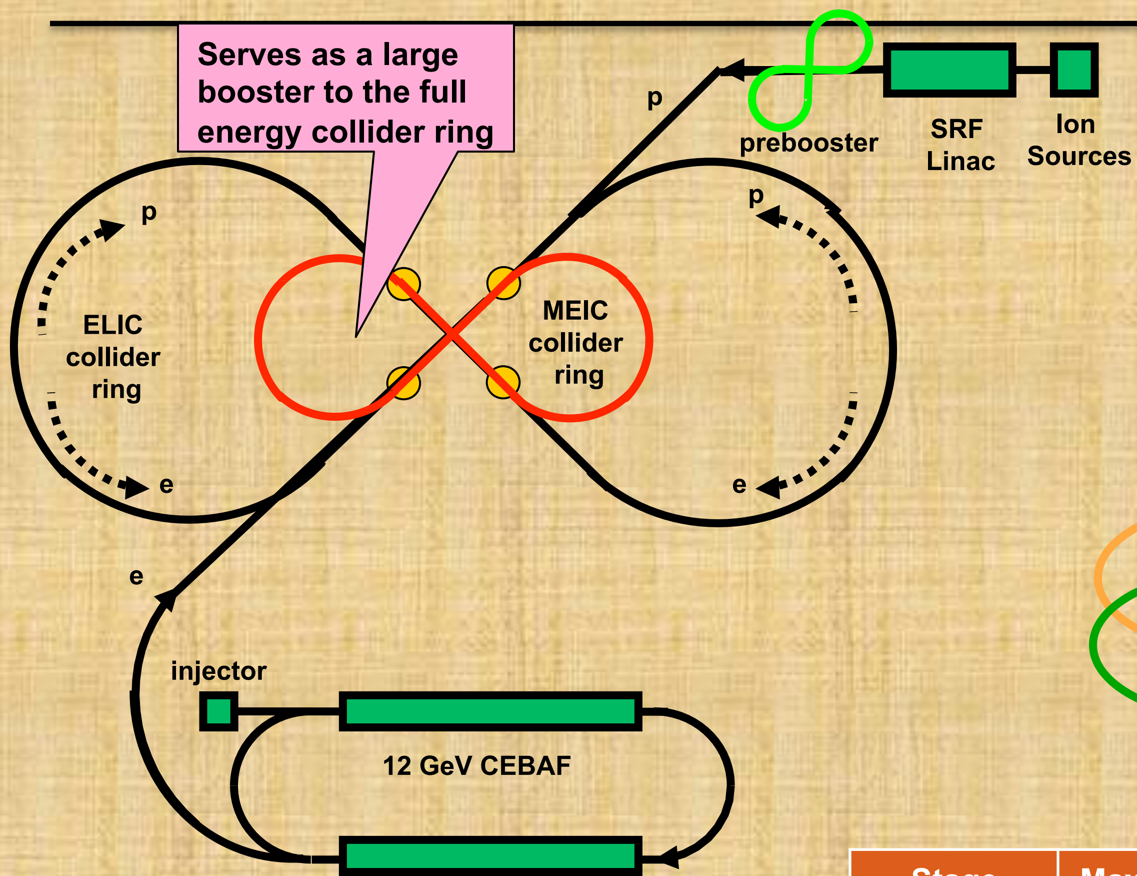
MEIC: A Medium Energy EIC



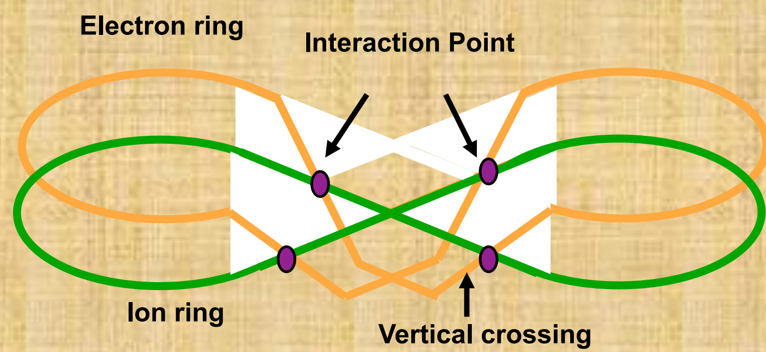
Possible 2020+

Three compact rings:
- **3 to 11 GeV electron**
- **Up to 12 GeV/c proton (warm)**
- **Up to 60 GeV/c proton (cold)**

ELIC: High Energy Upgrade



Circumference	m	1800
Radius	m	140
Width	m	280
Length	m	695
Straight	m	306



Possible 2025+

Stage	Max. Energy (GeV/c)		Ring Size (m)		Ring Type		IP #
	p	e	p	e	p	e	
Low	12	5 (11)	630		Warm	Warm	1
Medium	60	5 (11)	630		Cold	Warm	2
High	250	10	1800		Cold	Warm	4

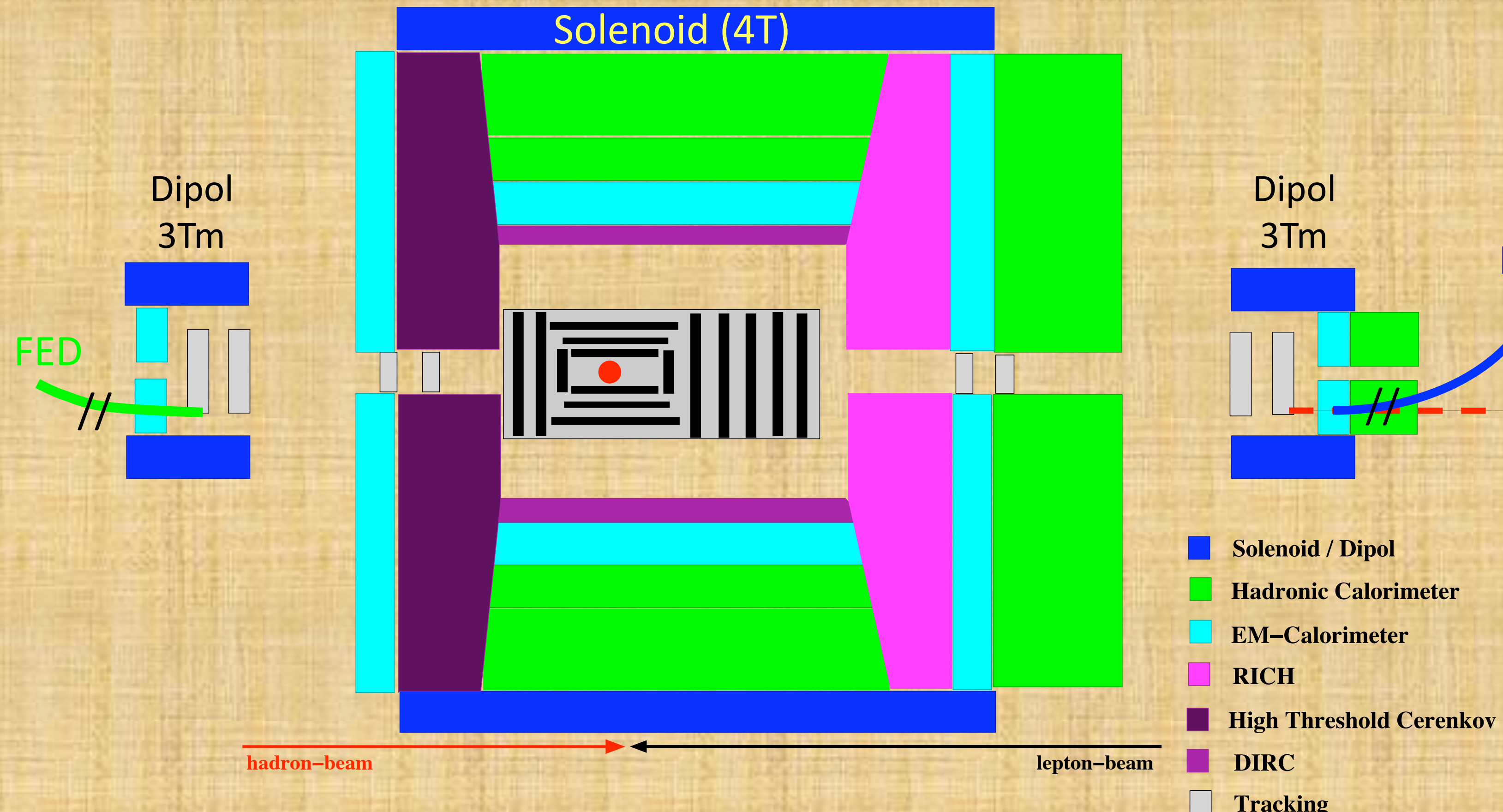
ELIC Main Parameters

Beam Energy	GeV	250/10	150/7	60/5	60/3	12/3
Collision freq.	MHz	499				
Particles/bunch	10^{10}	1.1/3.1	0.5/3.25	0.74/2.9	1.1/6	0.47/2.3
Beam current	A	0.9/2.5	0.4/2.6	0.59/2.3	0.86/4.8	0.37/2.7
Energy spread	10^{-3}	~ 1				
RMS bunch length	mm	5	5	5	5	50
Horiz. emit., norm.	µm	0.7/51	0.5/43	0.56/85	0.8/75	0.18/80
Vert. emit. norm.	µm	0.03/2	0.03/2.87	0.11/17	0.8/75	0.18/80
Horizontal beta-star	mm	125	75	25	25	5
Vertical beta-star	mm	5				
Vert. b-b tune shift/IP		0.01/0.1	0.015/.05	0.01/0.03	.015/.08	.015/.013
Laslett tune shift	p-beam	0.1	0.1	0.1	0.054	0.1
Peak lumi/IP, 10^{34}	$cm^{-2}s^{-1}$	11	4.1	1.9	4.0	0.59

High energy | Medium energy | Low energy

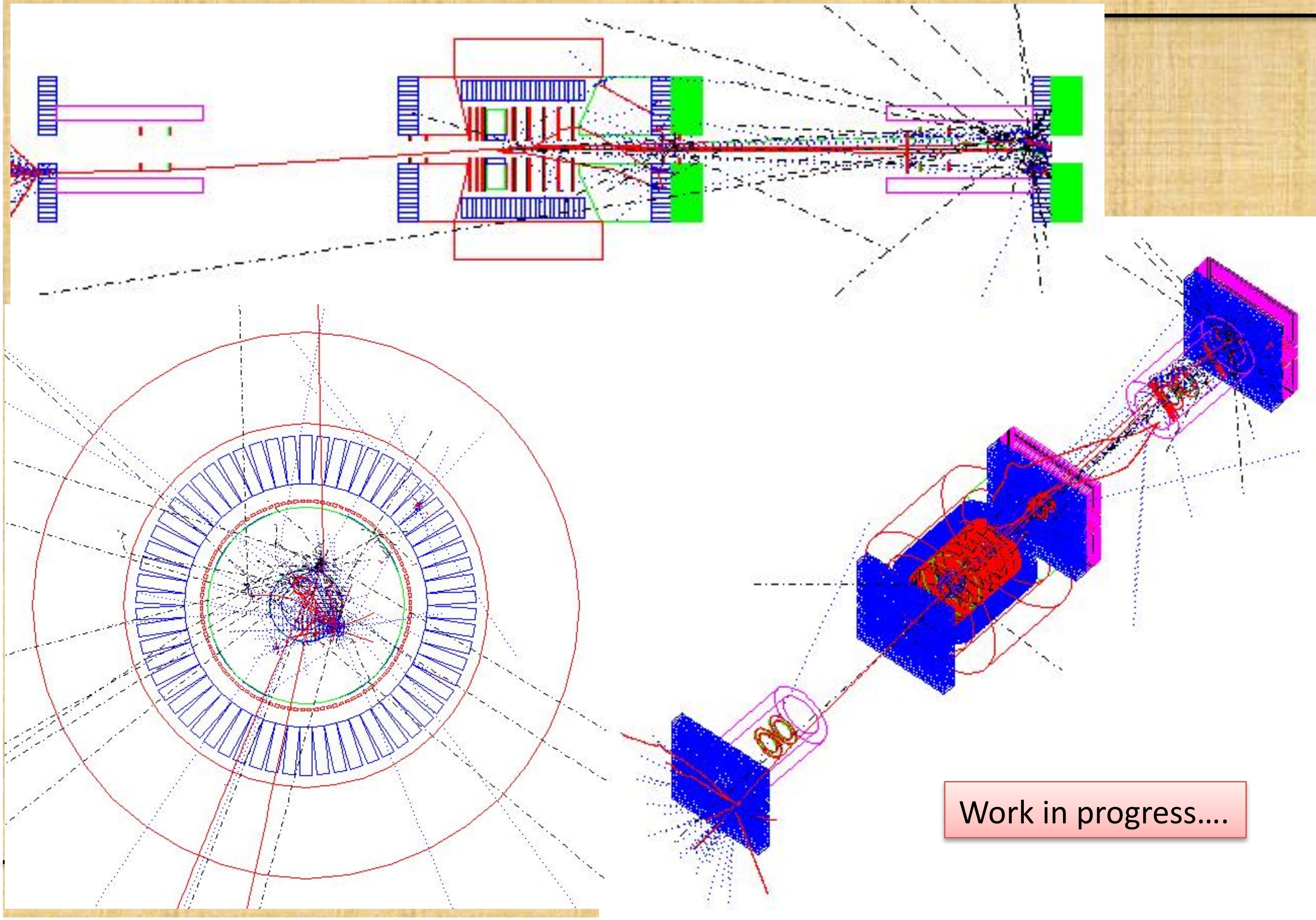
Presented at the last EIC Collaboration Advisory Committee meeting, Nov. 2-3, Jefferson Lab

First ideas for a detector concept



- ❑ Dipoles needed to have good forward momentum resolution
  - ➢ Solenoid no magnetic field @ r ~ 0
- ❑ DIRC, RICH hadron identification → π, K, p
- ❑ high-threshold Cerenkov → fast trigger for scattered lepton
- ❑ radiation length very critical → low lepton energies

MeRHIC Detector in Geant



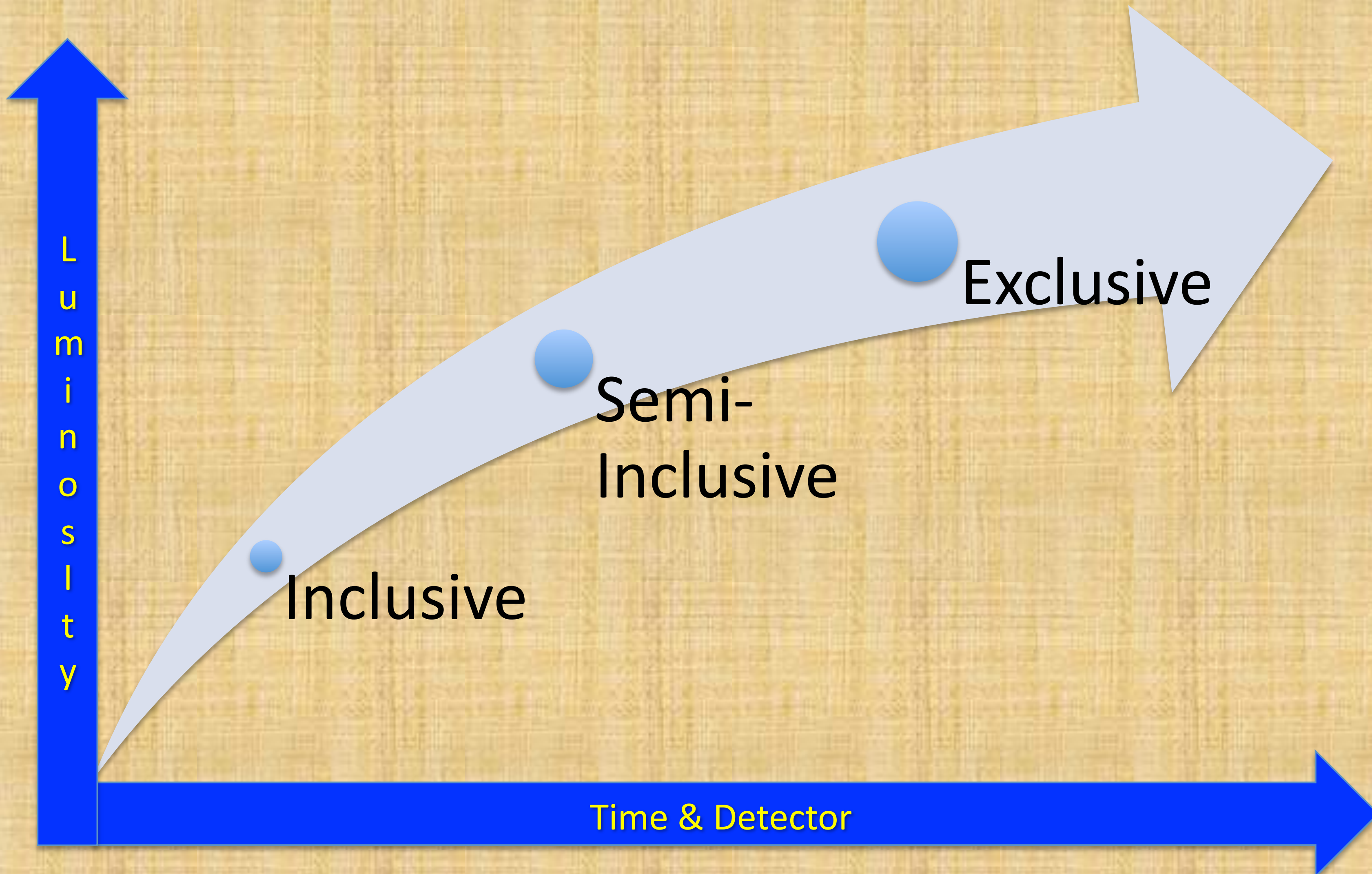
Work in progress….

EIC Data & its impact

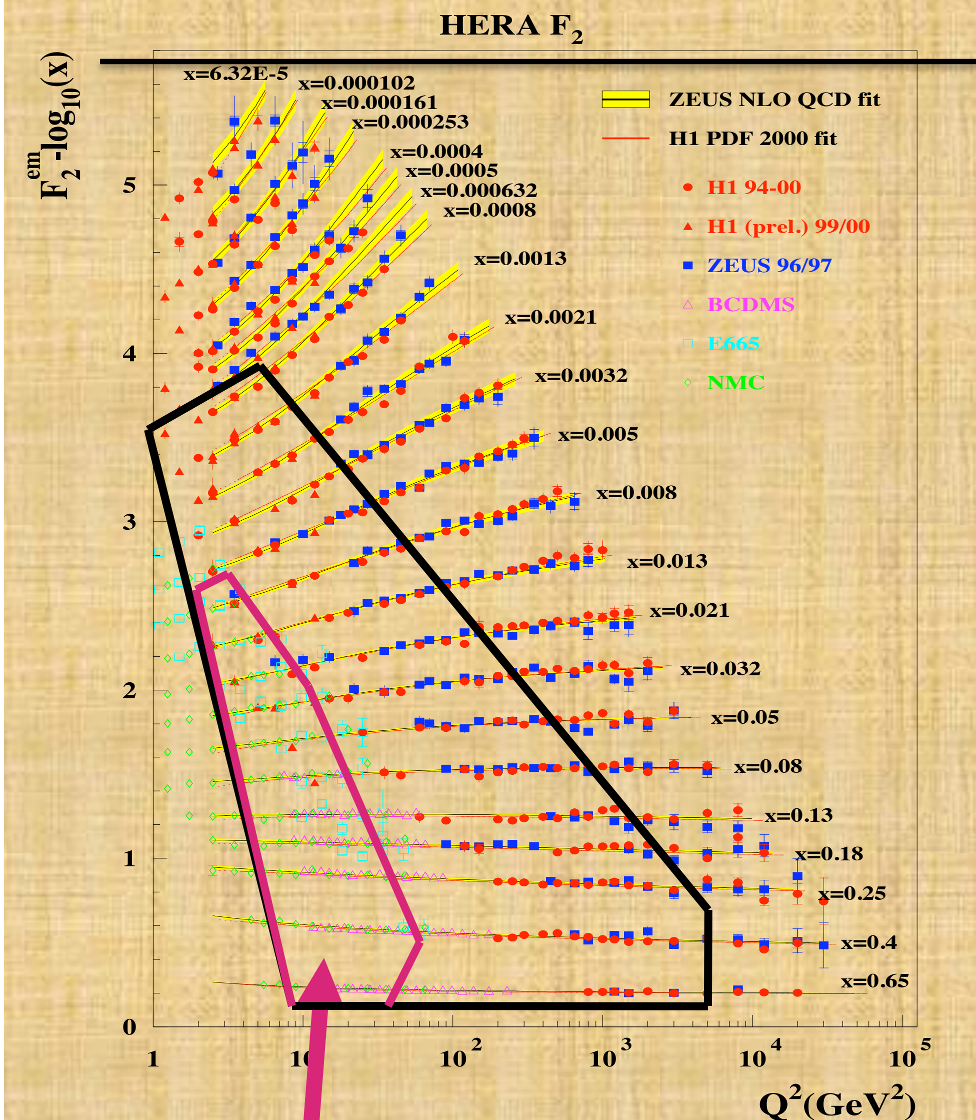
- Type [1]: Inclusive DIS: $L_{ep} \sim 2\ fb^{-1}$
  - Good EM Calorimetry, tracking & good e,p polarimetry
- Type [1,3]: Semi-Inclusive DIS: $L_{ep} \sim 4\text{-}10\ fb^{-1}$
  - Good EM Cal, tracking, good particle ID, good e,p polarimetry
- Type [1,2,3]: Exclusive DIS: $L_{ep} \sim > 10\ fb^{-1}$
  - Excellent EMCal, tracking, particle ID, polarimetry, high rate operations, maximal acceptance
- Precision tests of SM and exploration beyond SM?

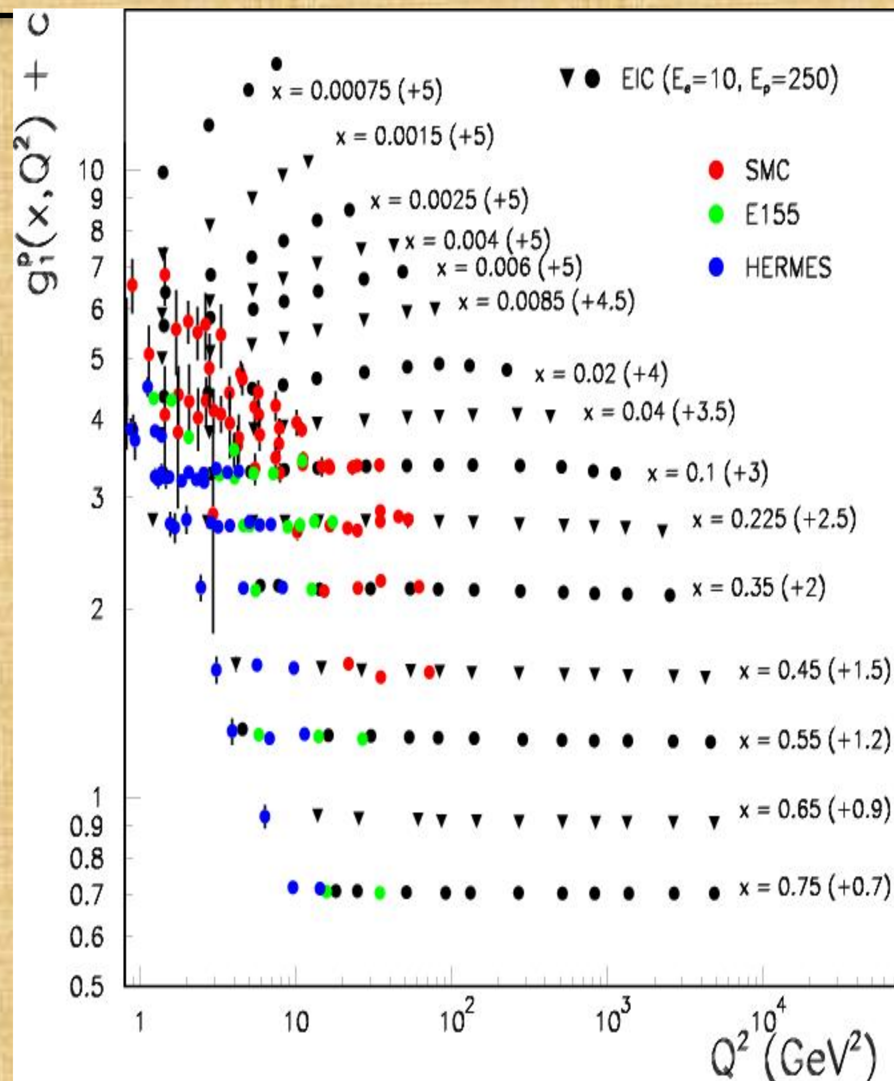
Detector requirements & its integration with machine lattice most demanding for the exclusive measurements

EIC Luminosity vs. Time (Detector)



World Data on F_2^p World Data on g_1^p

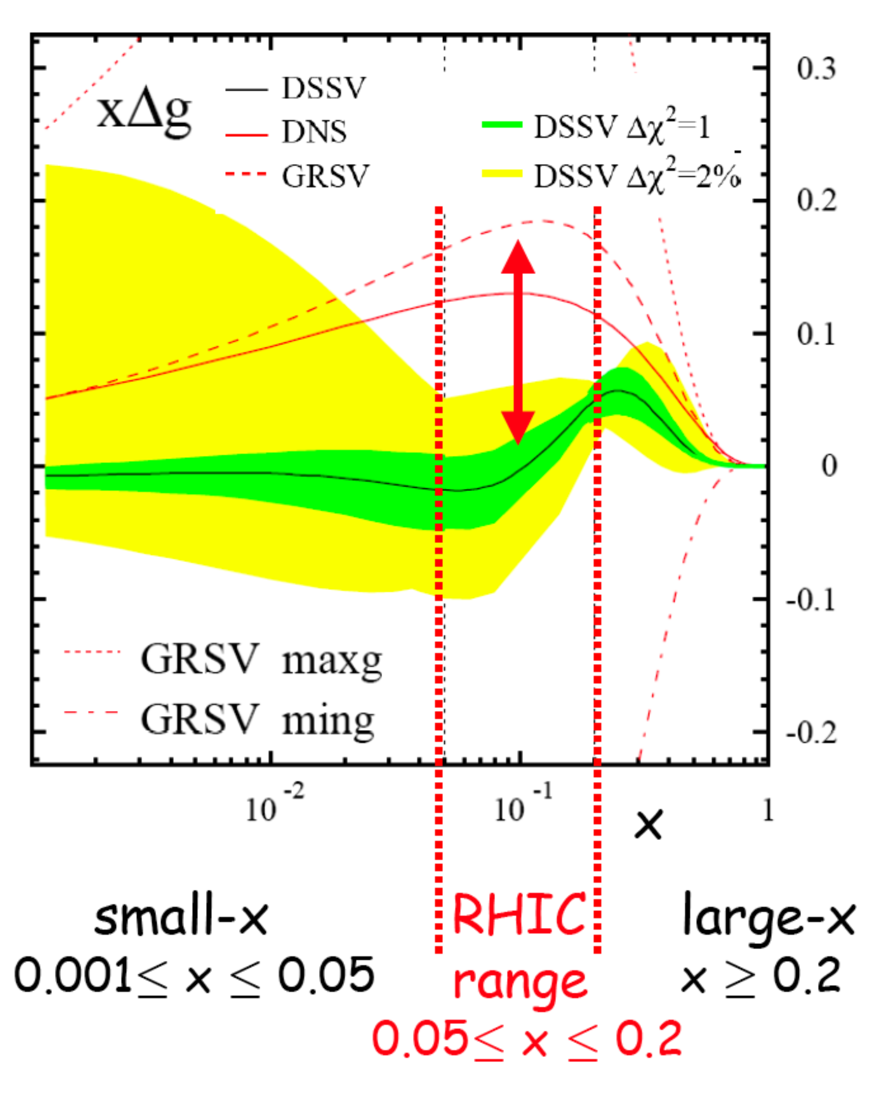




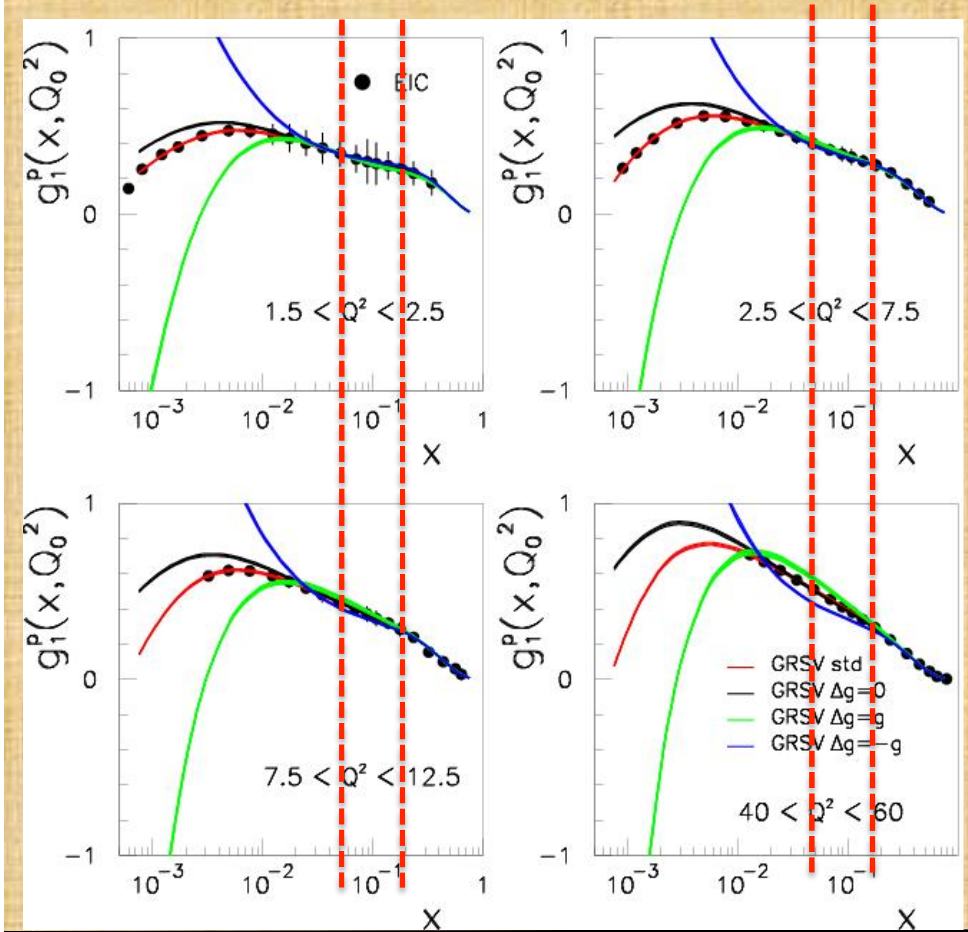
Region of existing g_1^p data

An [EIC] makes it possible!

Precision measurement of ΔG

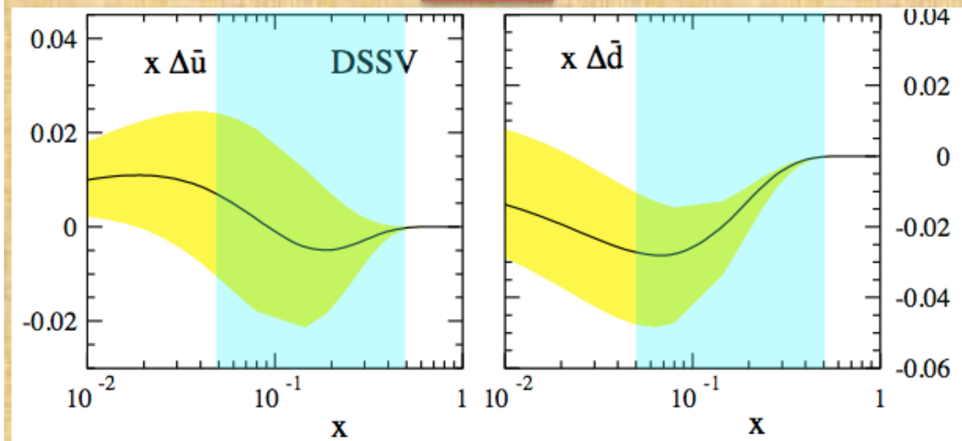


- Different $g_1(x,Q^2)$ curves for different ΔG

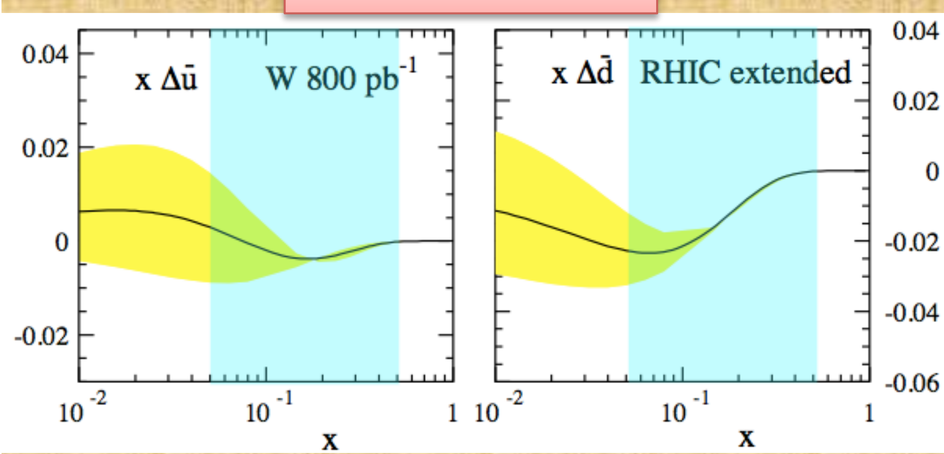


Anti-Quark Distributions

Now



Future with RHIC

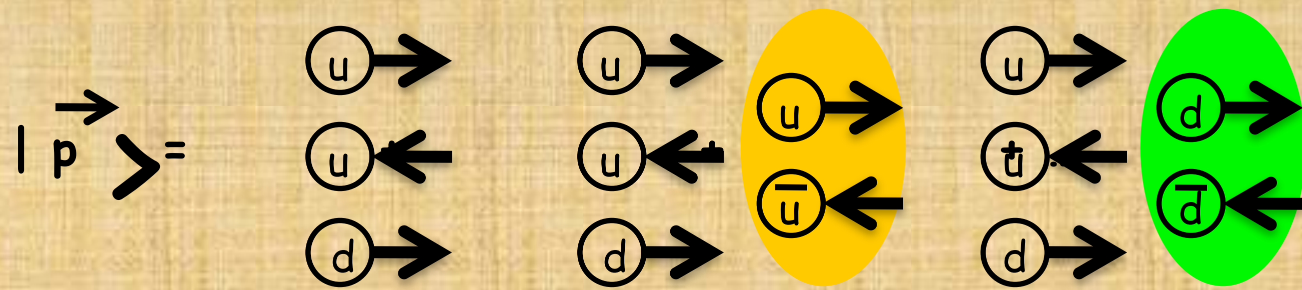


D. DeFlorian, Hi-pT WS at RBRC 3/16/2010

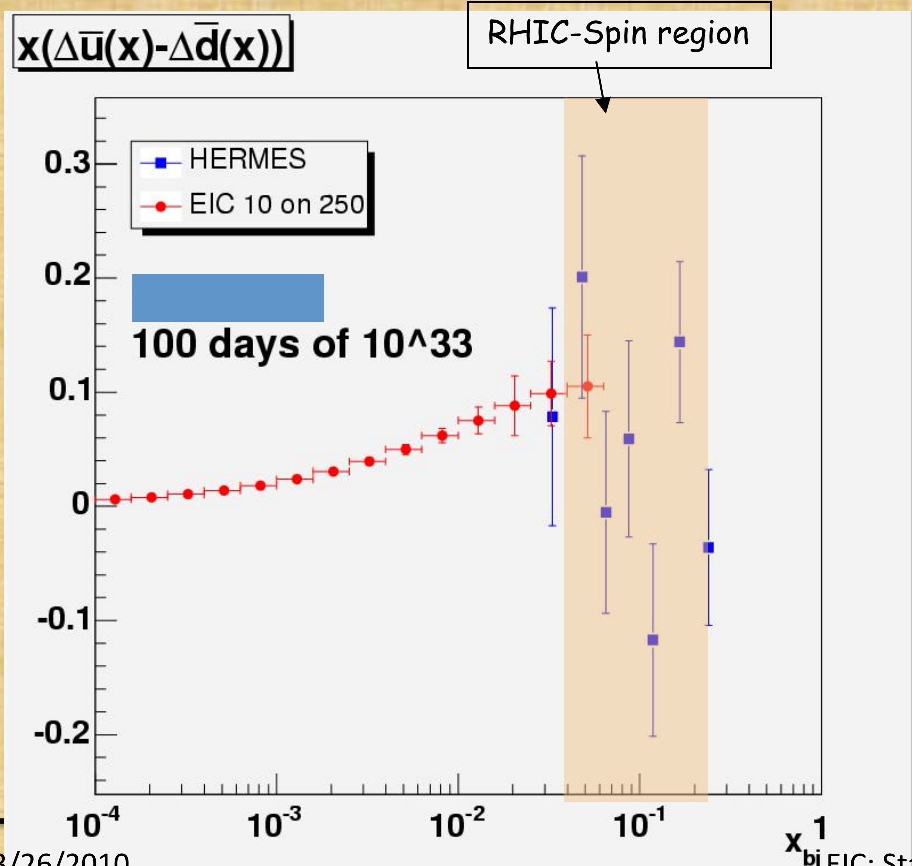
- Although RHIC Data will allow an independent and important avenue to determine anti-quark pdfs, the *low x will remain unexplored.*
- *A future machine needs to be able to access this.*

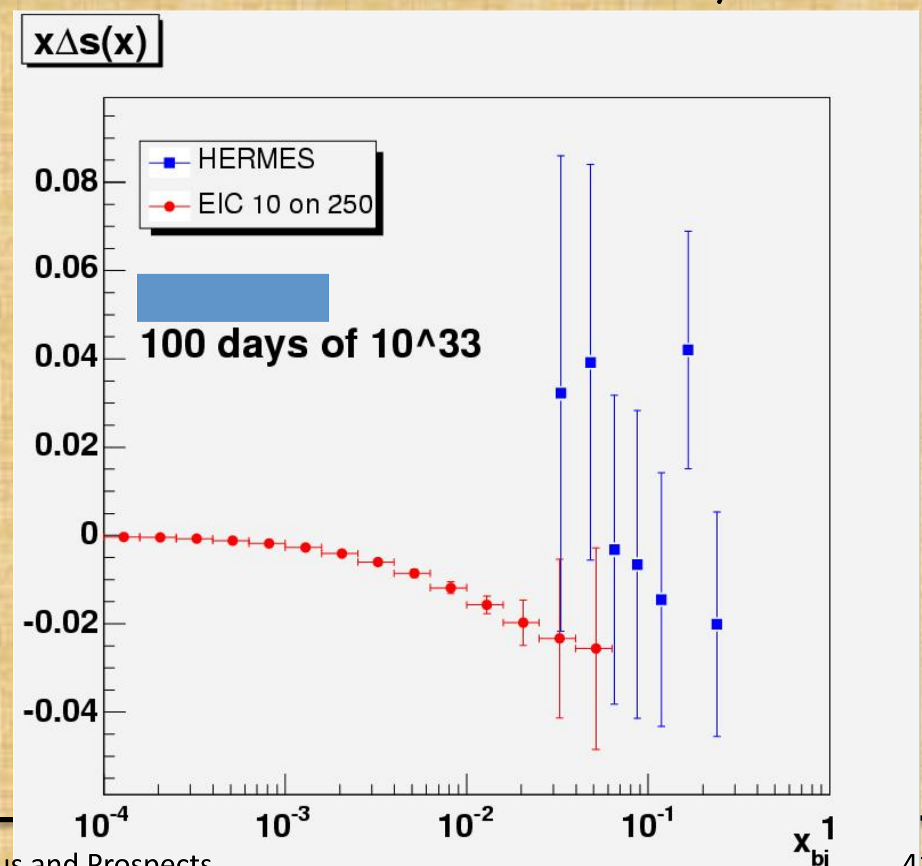
Precisely image the sea quarks

Spin-Flavor Decomposition of the Light Quark Sea

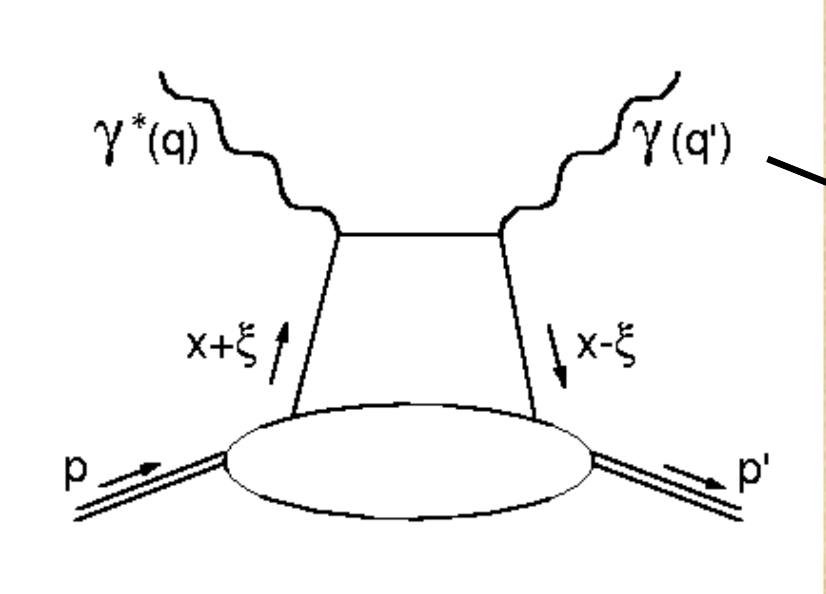


Many models predict
$\Delta\bar{u} > 0, \Delta\bar{d} < 0$





DVCS/Vector Meson Production



- Hard Exclusive DIS process
- γ (default) but also vector mesons possible
- Remove a parton & put another back in!

- Access to Generalized Parton Distributions with theoretically clean connections to partonic orbital angular momentum!

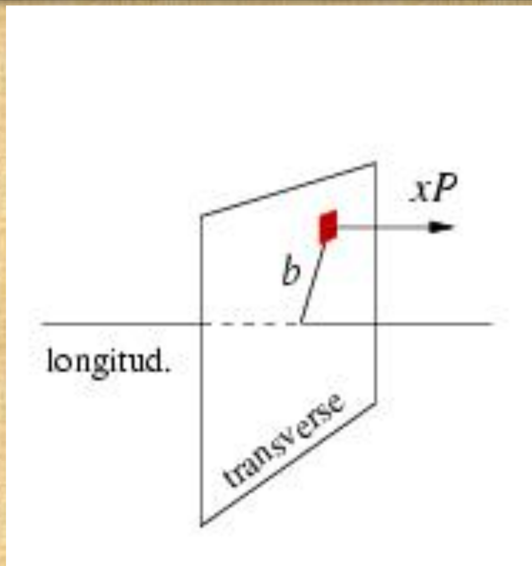
$$\int x dx [H(x,t,\xi) + E(x,t,\xi)] = 2J_{quark} = \Sigma + 2L_q$$

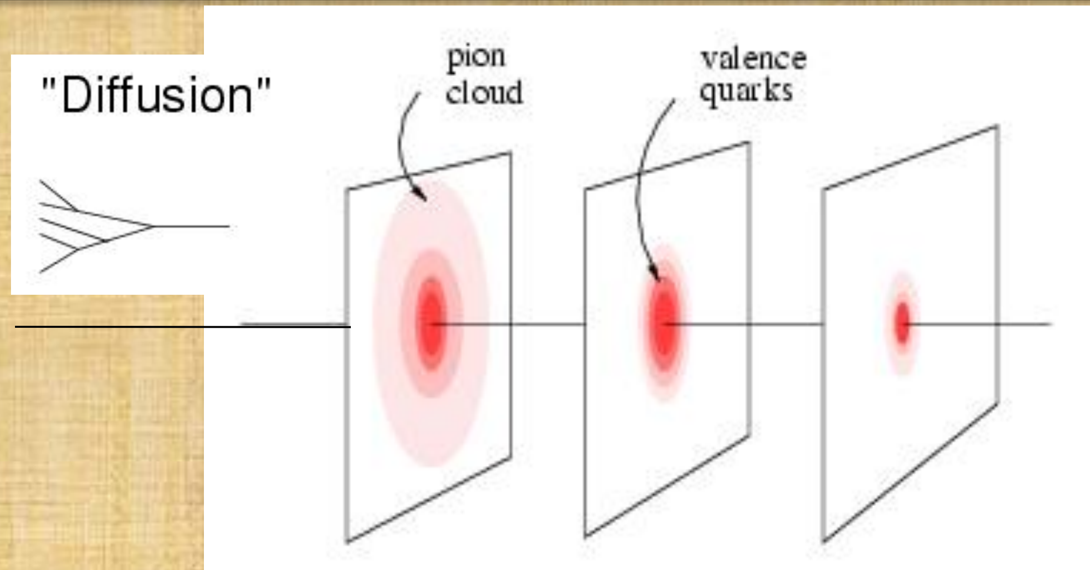
(ξ → 0; t → 0 --> $-Q^2$)

Experimental effort just beginning…To fully explore this physics **beam Charge asymmetries need** to be measured… => Demanding luminosity Requirement

GPDs and transverse parton imaging

Fourier transform in momentum transfer

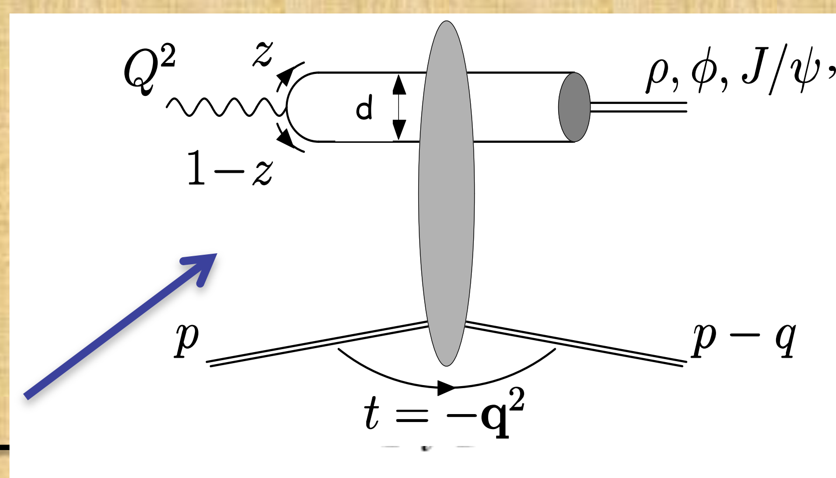


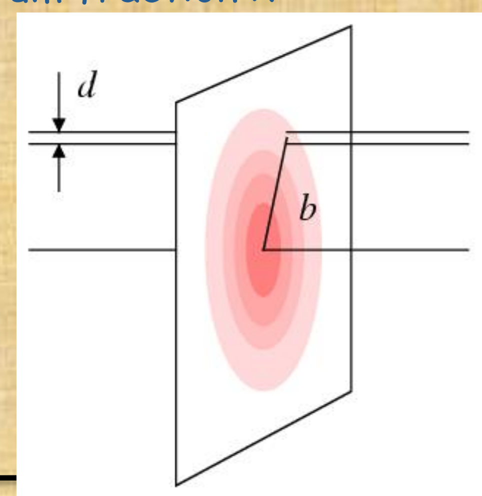


x ~ 0.001 x < 0.1 x ~ 0.3 x ~ 0.8

gives transverse size of quark (parton) with longitud. momentum fraction *x*

EIC:
1) x < 0.1: gluons!
2) ξ ~ 0 → the "take out" and "put back" gluons act coherently.





Fundamental Measurement in QCD:

One example there could be others

Bjorken Spin Sum Rule

(BjSR, 1966)

A paper of historical importance to our field.

Left hand side is purely hadronic, right hand side is a combination of an electro-weak constants and QCD corrections, which are calculable to a higher order than any other QCD quantity!

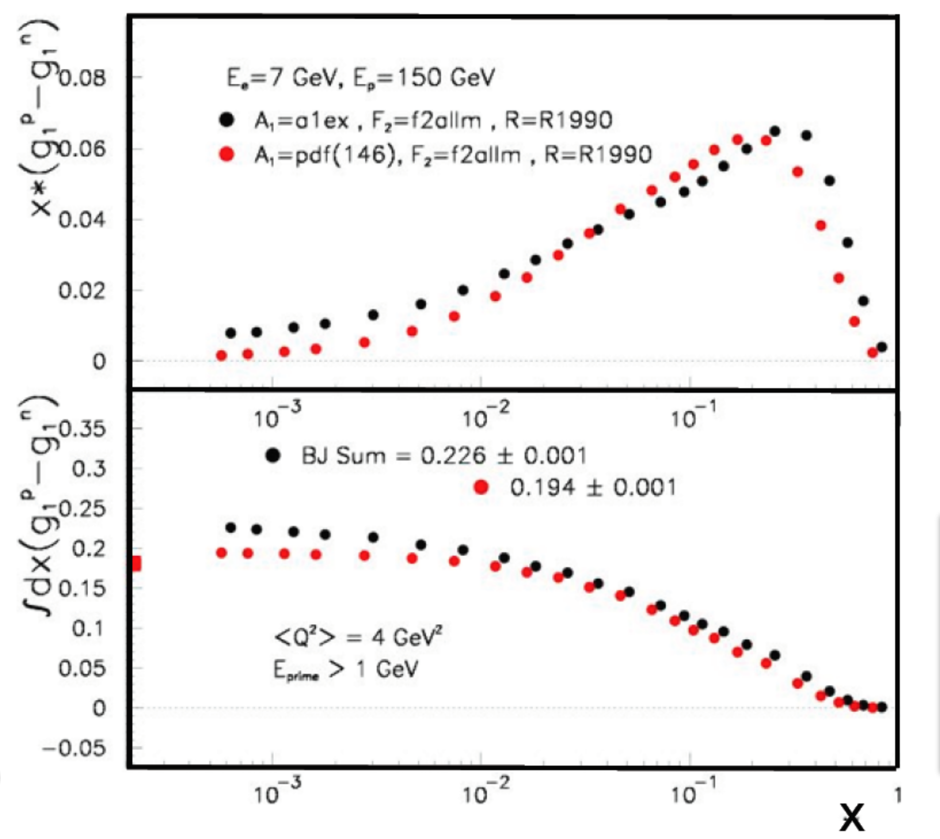
("g-2" of QCD?)

$$\int_0^1 \left[g_1^p(x,Q^2) - g_1^n(x,Q^2)\right] dx = \frac{1}{6}\left[\frac{g_A}{g_V}\right]_{n\to p}\left[1 - \frac{\alpha_s(Q^2)}{\pi} + \mathcal{O}(\alpha_s^2)\right] + \mathcal{O}\left(\frac{1}{Q^2}\right)$$

$$\int_0^1 [g_1^p(x,Q^2) - g_1^n(x,Q^2)]\,dx = \frac{1}{6}\left[\frac{g_A}{g_V}\right]_{n\to p}\left[1 - \frac{\alpha_s(Q^2)}{\pi} + \mathcal{O}(\alpha_s^2)\right] + \mathcal{O}\left(\frac{1}{Q^2}\right)$$

Status Bj sum rule measurement:

- Experimental measurement uncertainty ~8%
- Low x extrapolation uncertainty ~10%
- QCD corrections are known to $\sim[\alpha_S(Q^2)]^4$



Aim to measure with 1-2% absolute accuracy with the EIC

Severe demand on proton and helium or deuteron beam polarimetry

Confirm Bj sum rule: get the best possible value of the strong interaction constant α_S

Some measurements considered so far for the EIC:

- May push the luminosity requirements > 10^{34} $cm^{-2}s^{-1}$
  - Recall that although lower in luminosity than fixed target experiments, the collider is at (high) 100 GeV in CM Energy
- Push the polarimetry and beam quality requirements to the extreme:
  - (dPol/Pol) ~ 1%
  - Ultra low beam divergence for DVCS/Diffraction…

Why not consider using this machine for precision EW-Physics measurements?

Topics under consideration*:

- High energy collisions of polarized electrons and protons and nuclei afford a unique opportunity to study electro-weak deep inelastic scattering
  - Significant contributions from W and Z bosons which have different couplings with quarks and anti-quarks
  - Polarized protons, nuclei (are there nuclear modifications?)
- Parity violating DIS: a probe of beyond TeV scale physics
  - Measurements complimentary (higher Q^2) than the PV DIS 12 GeV at Jlab
- New window for physics beyond SM? $e^- + p \rightarrow \tau^- + X$
  - Lepton flavor violation searches?

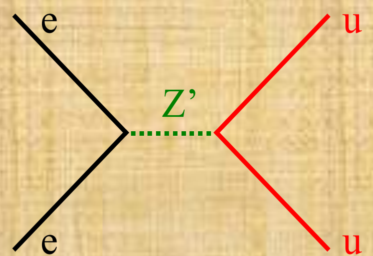
*Initiated through discussions with: M. R. Musolf, K. Kumar
Being pursued by: W. Marciano, K. Kumar, W. Vogelsang, & A. Deshpande (approved BNL-LDRD)

Also Jlab WS: KK & K.Paschke

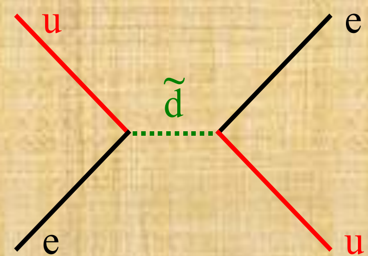
Very Preliminary Parity Violation Study (studied EIC 150 x 10 GeV, e-d scattering)

Measurement of Weinberg angle at a different scale

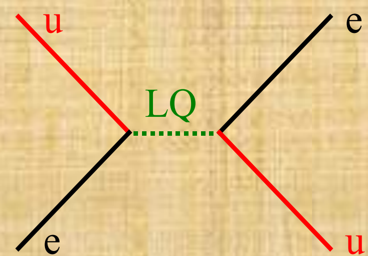
E_6 Z' Based Extensions



RPV SUSY Extensions



Leptoquarks

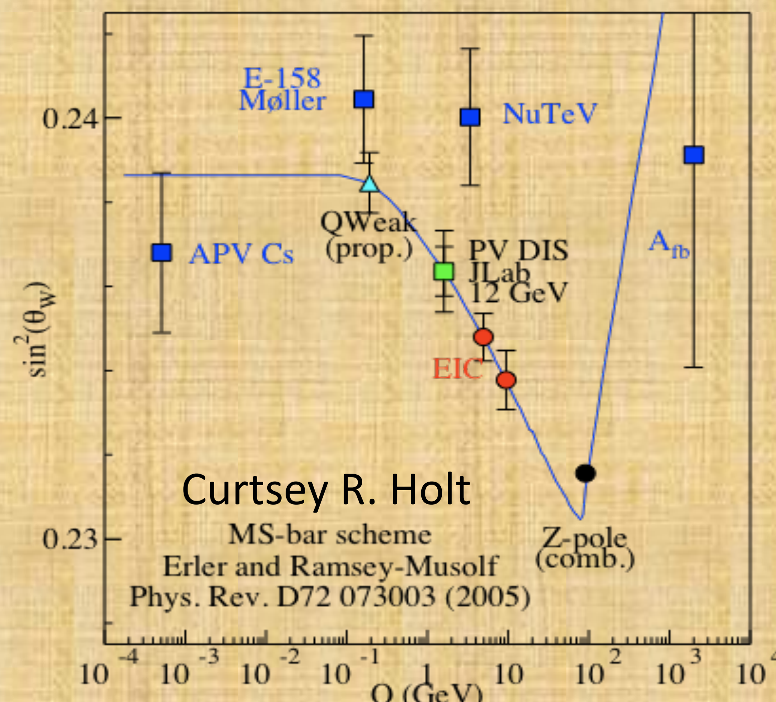


Due to finite Y

$$\left.\frac{\delta \sin^2\theta_W}{\sin^2\theta_W}\right|_{Y=0.46} \approx \frac{1}{2}\left(\frac{\delta A_d}{A_d}\right)$$

$$A_d \approx 2.9 \times 10^{-4}$$

Assumed 10^{35} /cm^2/s, 10 weeks &
100% machine and detector efficiency
Sub 0.5% polarimetry



Study of Glue facilitated by e-A?

- An e-p collider at high energy: HERA (1992-2006)
  - No unambiguous evidence of non-linear QCD effects

- eA at the EIC: will probes interactions over distances L ~1/($2m_N x$)
  - For L > $2R_A \sim A^{(1/3)}$ probe interacts coherently with all nucleons in the nucleus
    - Hence nuclear enhancement

$$(Q_s^A)^2 \approx cQ_0^2 \left[\frac{A}{x}\right]^{1/3}$$

Kowalsky & Teany PRD 68:114005 ==> b & x dependence of Q_s from diffractive and exclusive measurements at HERA

  - Enhancement of Q_s with A ==> non-linear QCD regime at significantly higher x (I.e. lower CM) in A than in a proton!
  - This enhancement is crucial for making the case for i.e. selecting proper values for beam energies and nuclei for eA@RHIC

How does e-A really help?

Nuclear Oomph Factor: $(Q_s^A)^2 \approx c\, Q_0^2 \left(\frac{A}{x}\right)^{1/3}$

Enhancement of Q_S with A

⇒ non-linear QCD regime reached at significantly lower energy in e+*A* than in *e+p*

$$s_{Hera} \approx (330\ \mathrm{GeV})^2$$
$$s_{EIC} \approx (63\ \mathrm{GeV})^2$$
$$\frac{s_{EIC}}{s_{Hera}} \approx \frac{1}{27}$$

Instead of extending *x*, Q reach we increase Q_s

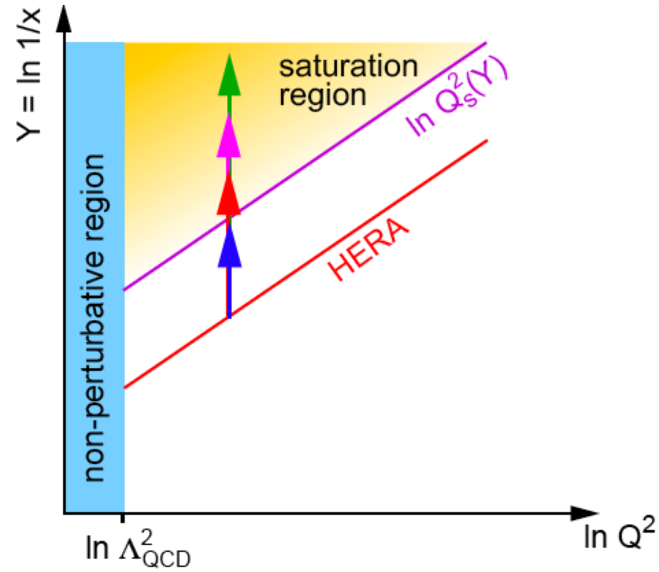
$Q^2 \sim sx$: EIC factor 27 behind (10+100 GeV)

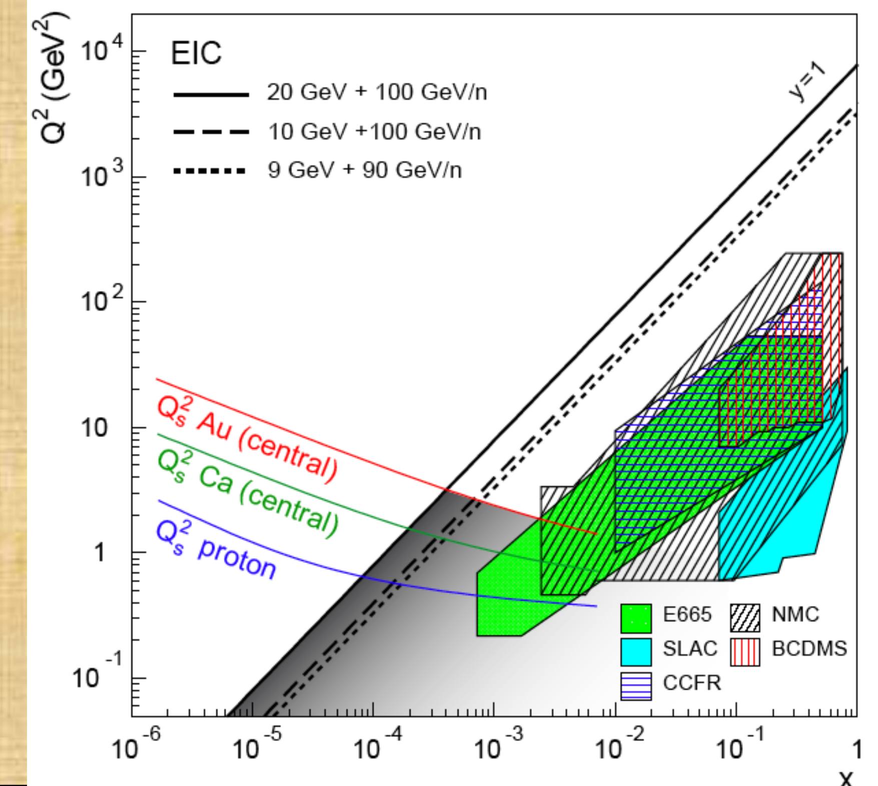
$$Q_s^2(Hera) = Q_s^2(EIC) \rightarrow Q_0^2\ x_{Hera}^{-1/3} = c\ Q_0^2\ A^{1/3}\ x_{EIC}^{-1/3}$$
$$x_{EIC} = x_{Hera} \cdot c^3 A$$
$$c^3 A = 0.5^3 \cdot 197 \approx 25$$

eA physics drives E_e

EIC Beam Energy (GeV)	√s (GeV)	low-x reach compared to HERA (e+p equivalent)
2+100	28	4
10+100	63	18
20+100	89	36
20+130	102	50
30+130	125	71

- We do not know for sure where saturation will be seen
- What is a safe margin over HERA? A 50-100 times improvement may be desired



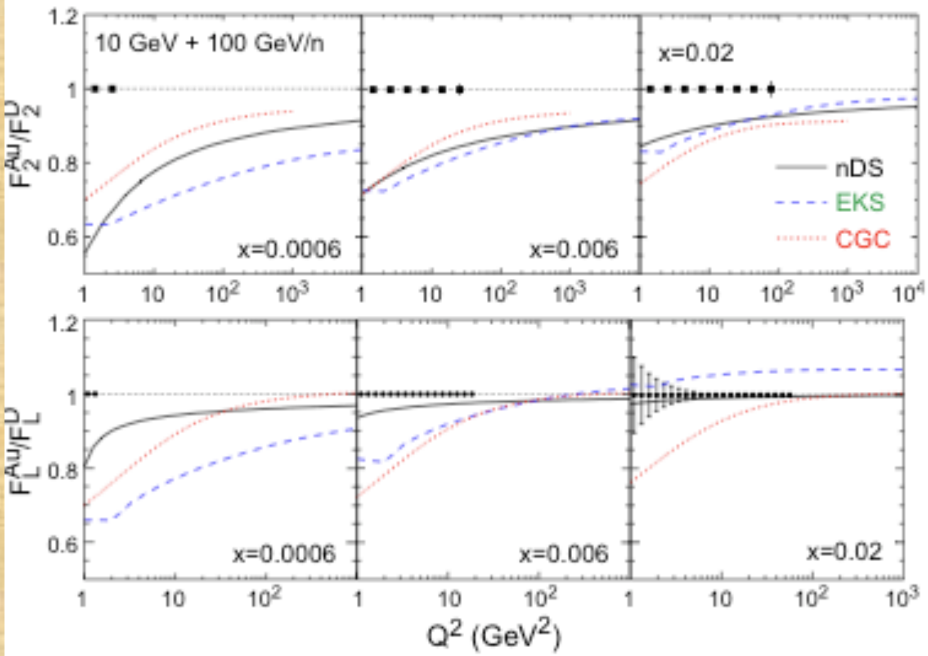


What measurements for e-A physics?

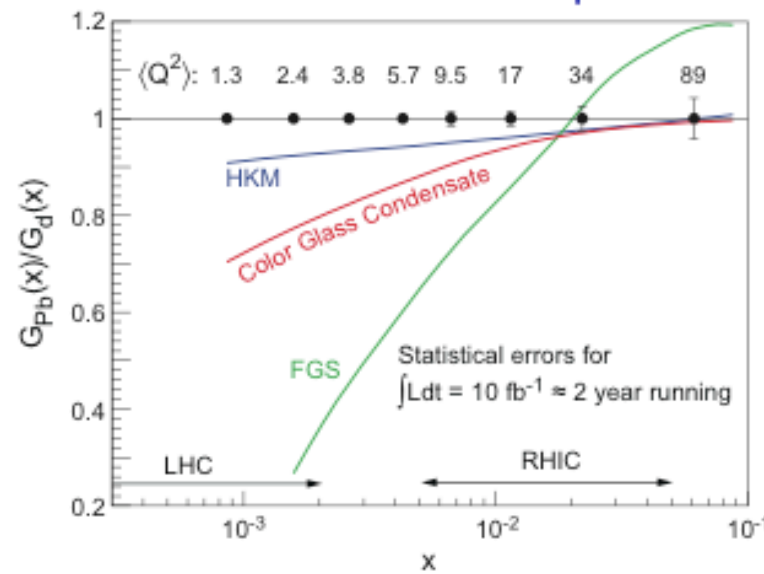
- Precision inclusive measurements of structure functions of nuclei
  - eA → e'X → F_2, F_L
  - eA → e'X+gap → F_2^D, F_L^D **(Inclusive diffraction)**
- Semi-Inclusive measurements
  - eA → e'(π, K,Φ, D, J/Ψ) X
- Exclusive final states
  - eA → e' A' (π, K,Φ, D, J/Ψ)
  - Measurements of x, Q^2, t, M_x^2 for light and heavy nuclei

Preliminary e~A simulations

Simulations to demonstrate the quality of EIC measurements



Folded with EIC acceptance

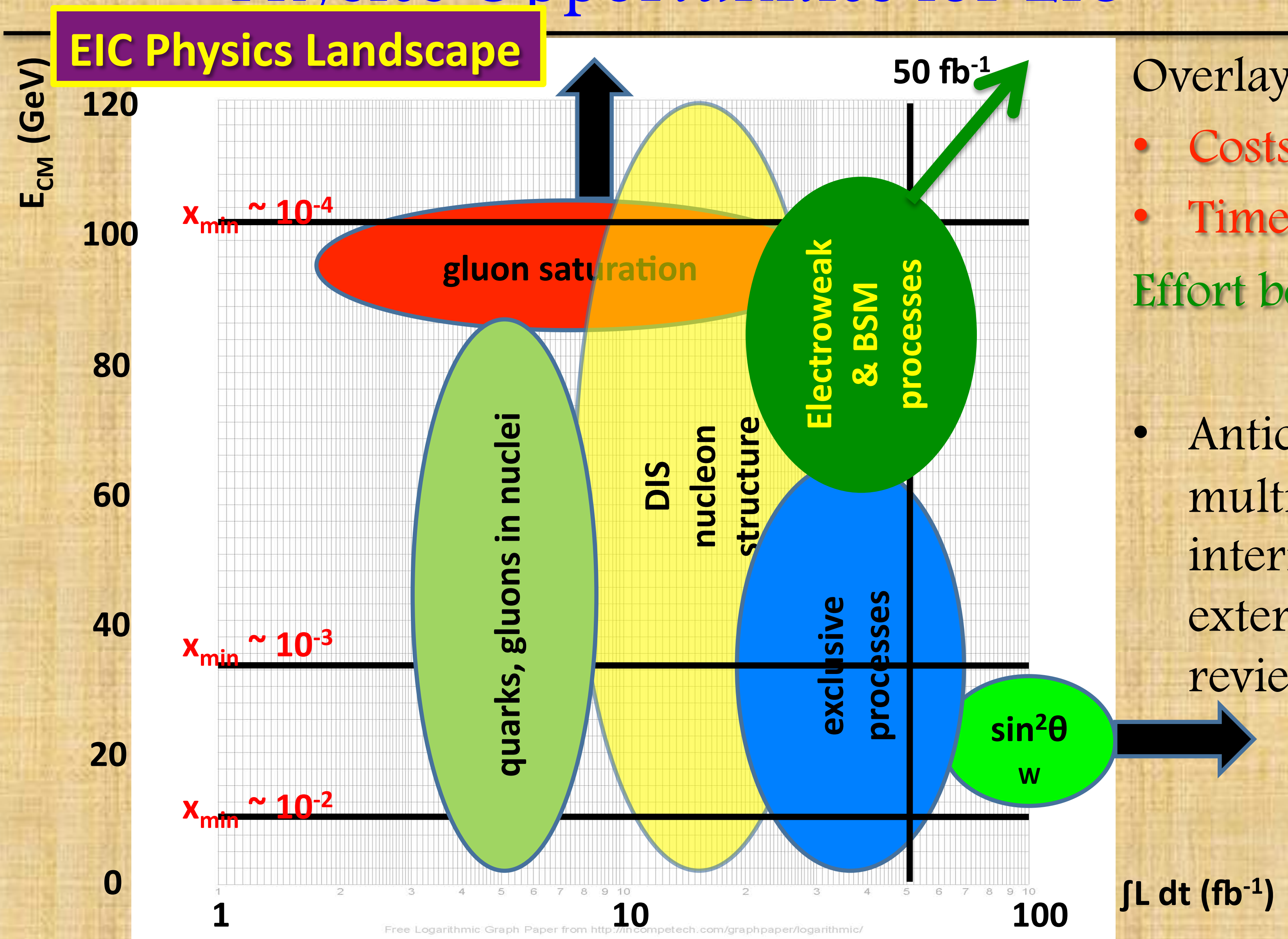


$F_L \sim \alpha_s\, G(x,Q^2)$ requires $\sqrt{s}$ scan, $Q^2/xs = y$

Assume:
L = 3.8 10^{33} cm^{-2} s^{-1} (100x Hera)
T = 10 weeks
duty cycle: 50%
L ~ 1/A (approx)
$\int Ldt$ = 11 fb^{-1}

Plots above:
$\int \mathcal{L}dt$ = 4/A fb^{-1} (10+100) GeV
= 4/A fb^{-1} (10+50) GeV
= 2/A fb^{-1} (5+50) GeV
statistical error only

Physics Opportunities for EIC



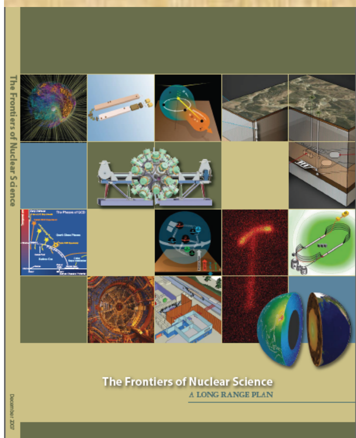
Overlay

- Costs
- Time line

Effort begun

- Anticipate multiple internal & external reviews

EIC in the NSAC 2007 → 2012



“ An electron ion collider (EIC) with polarized beam has been embraced by the US nuclear science community as embodying the vision of reaching the next QCD frontier. The EIC would provide unique capabilities for the study of QCD well beyond those available at existing facilities world wide and complementary to those planned for the next generation of accelerators in Europe and Asia. In support of this new direction: *We recommend the allocation of resources to develop accelerator and detector technology necessary to lay the foundation for a polarized electron ion collider. The EIC would explore new QCD frontier of strong color fields in nuclei and precisely image the gluons in the proton.”*

The Collaboration now preparing for NSAC’s approval for the project For construction in its long range planning meeting anticipated in 2012

The EIC WG/Collaboration
http://web.mit.edu/eicc

[17]C. Aidala, [28]E. Aschenauer, [10]J. Annand, [1]J. Arrington, [26]R. Averbeck, [3]M. Baker, [26]K. Boyle, [28]W. Brooks, [28]A. Bruell, [19]A. Caldwell, [28]J.P. Chen, [2]R. Choudhury, [10]E. Christy, [8]B. Cole, [4]D. De Florian, [3]R. Debbe, [26,24-1]A. Deshpande**, [18]K. Dow, [26]A. Drees, [3]J. Dunlop, [2]D. Dutta, [7]F. Ellinghaus, [28]R. Ent, [18]R. Fatemi, [18]W. Franklin, [28]D. Gaskell, [16]G. Garvey, [12,24-1]M. Grosse-Perdekamp, [1]K. Hafidi, [18]D. Hasell, [26]T. Hemmick, [1]R. Holt, [8]E. Hughes, [22]C. Hyde-Wright, [5]G. Igo, [14]K. Imai, [10]D. Ireland, [26]B. Jacak, [15]P. Jacobs, [28]M. Jones, [10]R. Kaiser, [17]D. Kawall, [11]C. Keppel, [7]E. Kinney, [18]M. Kohl, [9]H. Kowalski, [17]K. Kumar, [2]V. Kumar, [21]G. Kyle, [13]J. Lajoie, [16]M. Leitch, [27]A. Levy, [27]J. Lichtenstadt, [10]K. Livingstone, [20]W. Lorenzon, [14]5. Matis, [12]N. Makins, [6]G. Mallot, [18]M. Miller, [18]R. Milner**, [2]A. Mohanty, [3]D. Morrison, [26]Y. Ning, [15]G. Odyniec, [15]C. Ogilvie, [1]L. Pant, [26]V. Pantuyev, [21]S. Pate, [26]P. Paul, [12]J.-C. Peng, [18]R. Redwine, [1]P. Reimer, [15]H.-G. Ritter, [10]G. Rosner, [25]A. Sandacz, [7]J. Seele, [12]R. Seidl, [10]B. Seitz, [2]P. Shukla, [15]E. Sichtermann, [18]F. Simon, [3]P. Sorensen, [3]P. Steinberg, [24]M. Stratmann, [23]M. Strikman, [18]B. Surrow, [18]E. Tsentalovich, [10]V. Tvaskis, [3]T. Ullrich, [3]R. Venugopalan, [3]W. Vogelsang, [28]C. Weiss, [15]H. Wieman, [15]N. Xu, [3]Z. Xu, [3]W. Zajc.

[1]Argonne National Laboratory, Argonne, IL; [2]Bhabha Atomic Research Centre, Mumbai, India; [3]Brookhaven National Laboratory, Upton, NY; [4]University of Buenos Aires, Argentina; [5]University of California, Los Angeles, CA; [6]CERN, Geneva, Switzerland; [7]University of Colorado, Boulder, CO; [8]Columbia University, New York, NY; [9]DESY, Hamburg, Germany; [10]University of Glasgow, Scotland, United Kingdom; [11]Hampton University, Hampton, VA; [12]University of Illinois, Urbana-Champaign, IL; [13]Iowa State University, Ames, IA; [14]University of Kyoto, Japan; [15]Lawrence Berkeley National Laboratory, Berkeley, CA; [16]Los Alamos National Laboratory, Los Alamos, NM; [17]University of Massachusetts, Amherst, MA; [18]MIT, Cambridge, MA; [19]Max Planck Institut für Physik, Munich, Germany; [20]University of Michigan Ann Arbor, MI; [21]New Mexico State University, Las Cruces, NM; [22]Old Dominion University, Norfolk, VA; [23]Penn State University, PA; [24]RIKEN, Wako, Japan; [24-1]RIKEN-BNL Research Center, BNL, Upton, NY; [25]Soltan Institute for Nuclear Studies, Warsaw, Poland; [26]SUNY, Stony Brook, NY; [27]Tel Aviv University, Israel; [28]Thomas Jefferson National Accelerator Facility, Newport News, VA

** Collaboration Contact/Spokes Persons

- Collaboration Meetings: ~2/year
  - February 2010 at Stony Brook
  - July 2010 at Catholic American U
  - March 2011 at Columbia U.(?)
  - INT Workshop U. Washington September-November 2010
    - Organizers: Boer, Diehl, Venugopalan, Venugopalan, Milner
- EIC Task Forces at Jlab (R. Ent) & BNL (Aschenauer/Ullrich)
- Meetings and workshops with User-Groups ongoing
- International Advisory Committee: (Appointed by BNL & Jlab Managements)
  - J. Bartels (DESY), A. Caldwell (MPI Munich), A. De Roeck (CERN), W. Henning (ANL, Chair), D. Herzog (UIUC), X. Ji (Maryland) , R. Klanner (Hamburg), A. Mueller (Columbia), K. Oide (KEK), N. Saito (JPARC), U. Wienands (SLAC)

EICAC Report : Summary

- Matrix of Science, Design and Cost
  - EIC Stage 1 and the full EIC
- Identify a few most compelling "golden physics" measurements
  - e-p (with polarization) and e-p/e-A physics for the wider physics community
- Dedicated working group activities towards the golden measurements
  - Physics, accelerator, detector studies in detail
- Develop detailed resource loaded schedule
  - Timeline, technical developments and staged realization
- Strive for a timeline with data taking earlier than 2020
- Develop a common accelerator development R&D plan
- Develop and present a common plan for R&D, deliverables, and the resource needs by the next EICAC meeting

Finally….

- Physics of EIC is very compelling to most of us: understanding "what we are made up of (gluons) and how (spin)" is a most fundamental curiosity
- The EIC community is gearing up for the approval of the project in NSAC 2012 Long Range Planning Exercise
  - Realization including cost optimization with science reach
  - EIC Collaboration & JLab Users workshops
    - Simulation studies to finalize the machine and detector design have begun; Detector R&D funding soon
- INT 2010 Workshop in Seattle
- **Join us, contribute to the studies, and play a decisive role in the project. Now is the time to do it….**