News from eRHIC

The glue that binds us all

Are gluons the secret of our existence

$$L_{QCD} = \bar{q}(i\gamma^{\mu}\partial_{\mu} - m)q - g(\bar{q}\gamma^{\mu}T_a q)A_{\mu}^{a} - \frac{1}{4}G_{\mu\nu}^{a}G_{a}^{\mu\nu}$$

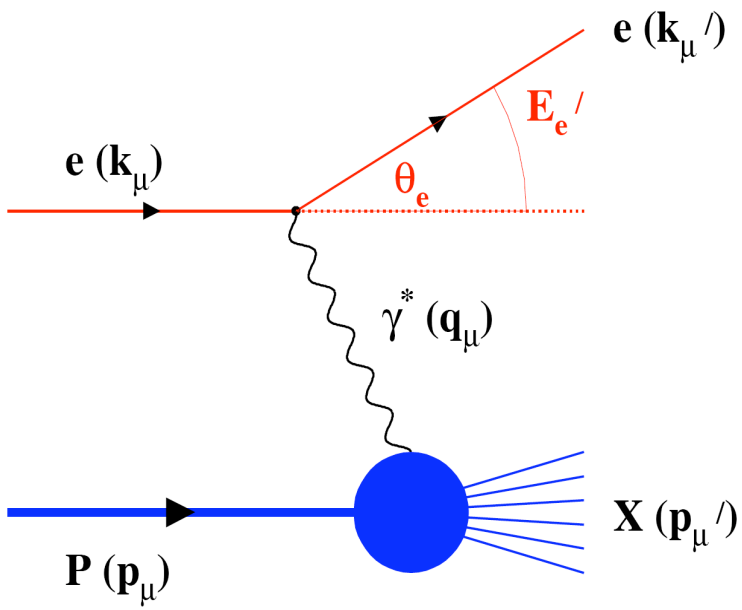
- "Emergent" phenomena not evident from Lagrangian
  - Asymptotic Freedom & Color Confinement
  - Non-perturbative structure of QCD vacuum

- Gluons: mediator of the strong interactions
  - Determine essential features of strong interactions
  - Dominate structure of QCD vacuum (fluctuations in gluon fields)
  - Responsible for > 98% of the visible mass in universe(!)

Questions to Address with the eRHIC

- What is the nature of glue at high density?
  - How do strong fields appear in hadronic or nuclear wave functions at high energies?
- Do gluon densities saturate?
  - What drives saturation, what's the underlying dynamics
  - What are the appropriate degrees of freedom (Pomerons?)
- Does the Color Glass Condensate describe matter at low-x?
- Universality of gluon dynamics & energy dependence
  - Is there a "fixed" point where all hadronic matter have a component of their wave function with the same behavior
- Could a better knowledge of glue help solve the longstanding problem of confinement in QCD?
- What's the role of gluons in the nuclear structure?

DIS Kinematics



$$Q^2 = -q^2 = -(k_\mu - k'_\mu)^2$$

$$Q^2 = 2E_e E'_e (1 - \cos\Theta_{e'})$$

Measure of resolution power

$$y = \frac{pq}{pk} = 1 - \frac{E'_e}{E_e}\cos^2\left(\frac{\theta'_e}{2}\right)$$

Measure of inelasticity

$$x = \frac{Q^2}{2pq} = \frac{Q^2}{sy}$$

Measure of momentum fraction of struck quark

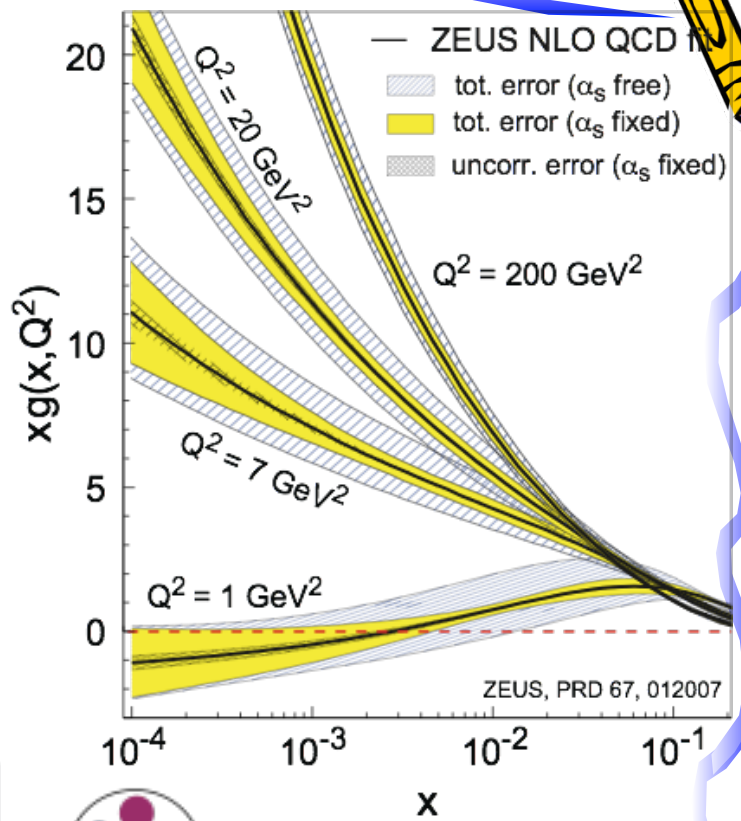
$$\frac{d^2\sigma^{eh\to eX}}{dx dQ^2} = \frac{4\pi\alpha_{em}^2}{xQ^4}\left[\left(1 - y + \frac{y^2}{2}\right)F_2(x,Q^2) - \frac{y^2}{2}F_L(x,Q^2)\right]$$

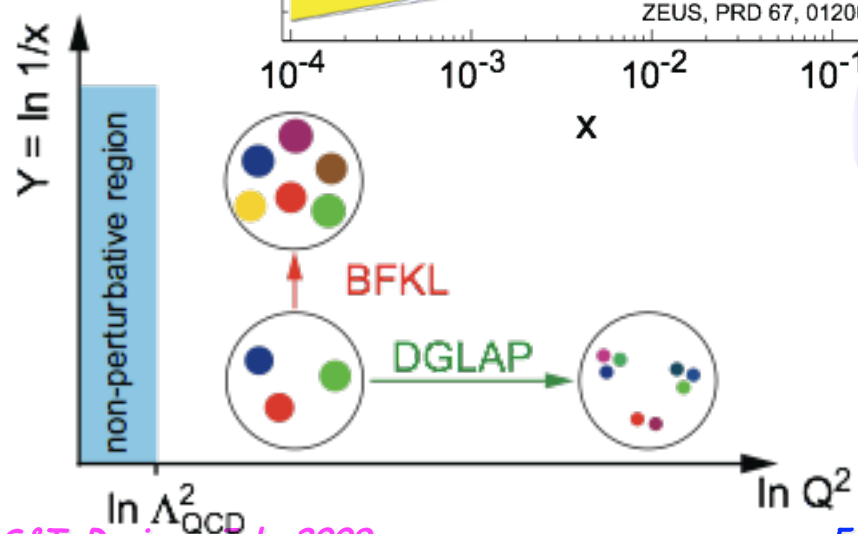
quark+anti-quark mom. dists.

gluon mom. dists

Issues with our Current Understanding

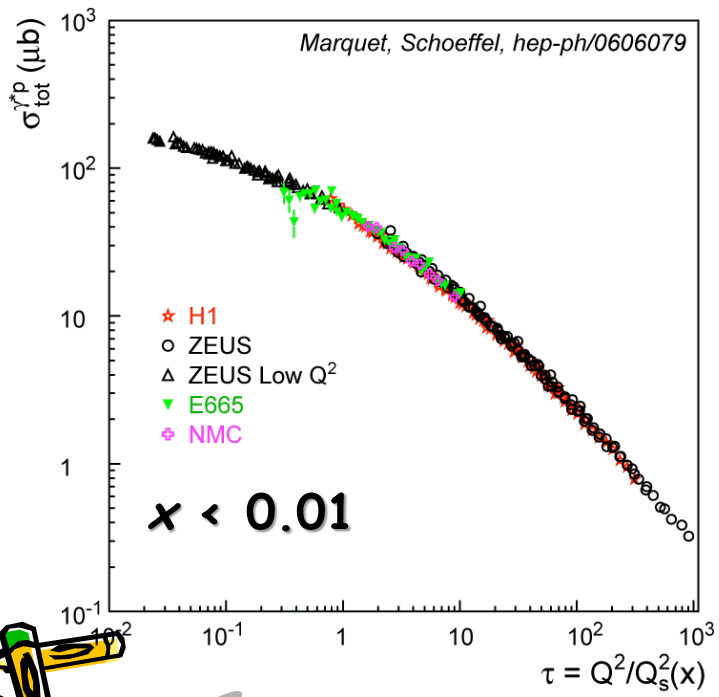
- Linear DGLAP evolution scheme
  - Weird behavior of xG from HERA at small x and Q^2
  - $G(x,Q^2) < Q_{sea}(x,Q^2)$?
  - Unexpectedly large diffractive cross-section
  - built in high energy "catastrophe"
    - xG rapid rise violates unitary bound
- Linear BFKL Evolution
  - Density along with c.s. grows as a power of energy: $N \sim s^{\Delta}$
  - Can densities & cross-section rise forever?
  - Black disk limit: $\sigma_{total} \leq 2\pi R^2$

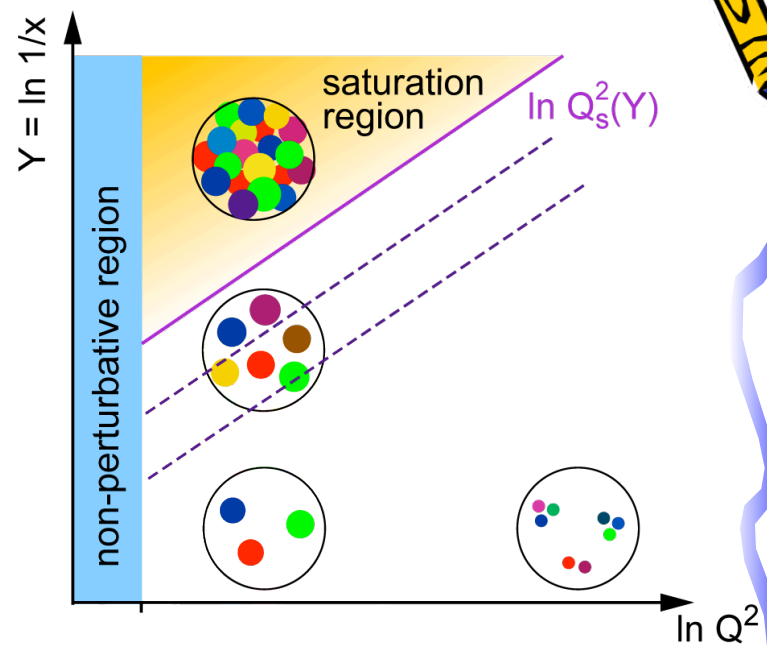




Universality & Geometric Scaling

- Crucial consequence of non-linear evolution towards saturation:
  - Physics *invariant* along trajectories parallel to saturation regime (lines of constant gluon occupancy)
  - Scale with $Q^2/Q^2_s(x)$ instead of x and Q^2 separately





⇐ **Geometric Scaling**

- Consequence of saturation which manifests itself up to $k_T > Q_s$

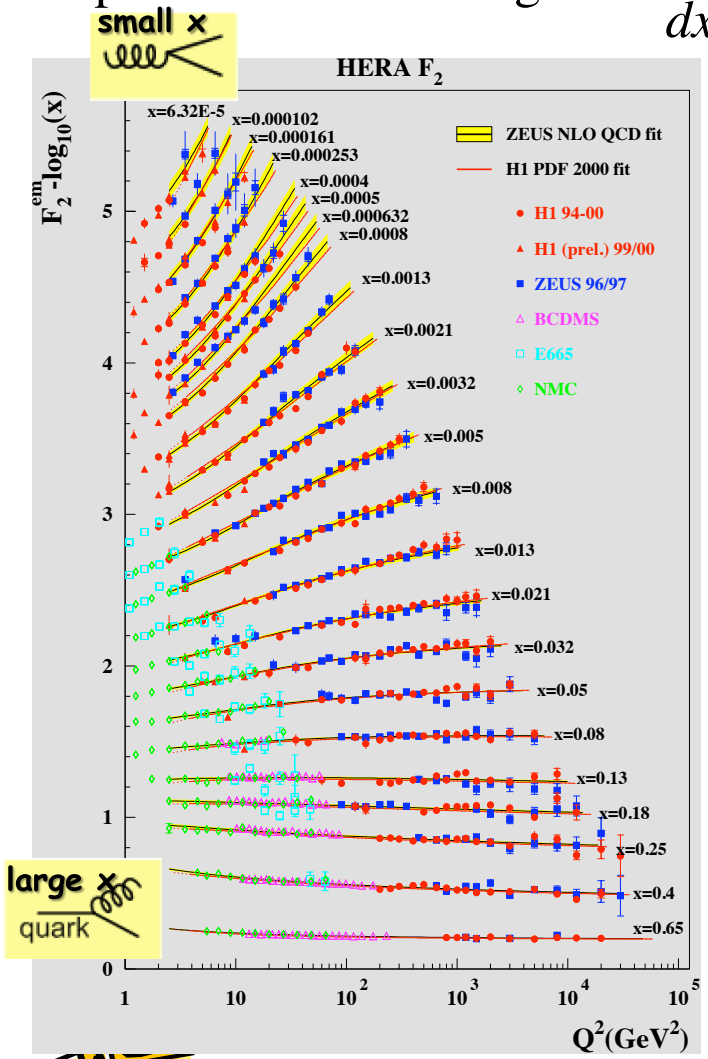
4 Key Measurements in e+A Physics

- Momentum distribution of gluons in nuclei?
  - Extract via scaling violation in F^2: $\partial F^2/\partial \ln Q^2$
  - Direct Measurement: $F_L \sim xG(x,Q^2)$ - requires $\sqrt{s}$ scan
  - Inelastic vector meson production (e.g. J/Ψ, ρ)
  - Diffractive vector meson production ($\sim [xG(x,Q^2)]^2$)
- Space-time distribution of gluons in nuclei?
  - Exclusive final states (e.g. ρ, J,Ψ)
  - Deep Virtual Compton Scattering (DVCS) - $\sigma \sim A^{4/3}$
  - F_2, F_L for various impact parameters
- Role of colour-neutral (Pomeron) excitations?
  - Diffractive cross-section: $\sigma_{diff}/\sigma_{tot}$ (~ 10%: HERA e+p; 30%? eRHIC e+A?)
  - Diffractive structure functions and vector meson productions
  - Abundance and distribution of rapidity gaps
- Interaction of fast probes with gluonic medium?
  - Hadronization, Fragmentation, Energy loss (charm!!)

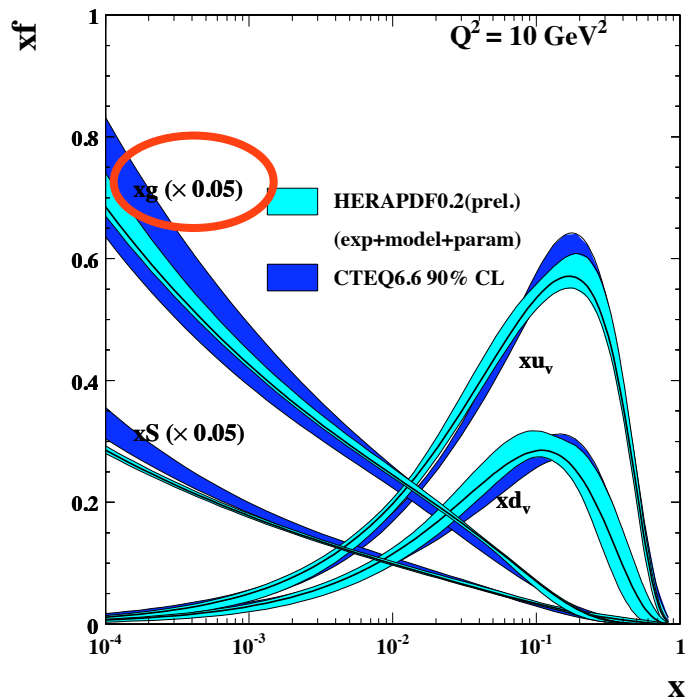
Measure Glue through DIS

Deep Inelastic Scattering:

$$\frac{d^2\sigma^{ep\to eX}}{dxdQ^2} = \frac{4\pi\alpha^2_{e.m.}}{xQ^4}\left[\left(1-y+\frac{y^2}{2}\right)F_2(x,Q^2)-\frac{y^2}{2}F_L(x,Q^2)\right]$$



- Scaling violation: $dF_2/d\ln Q^2$ and linear DGLAP Evolution $\Rightarrow G(x,Q^2)$



F_L: measures glue directly

$$\frac{d^2\sigma^{ep\to eX}}{dxdQ^2} = \frac{4\pi\alpha^2}{xQ^4}\left[\left(1-y+\frac{y^2}{2}\right)F_2(x,Q^2) - \frac{y^2}{2}F_L(x,Q^2)\right]$$

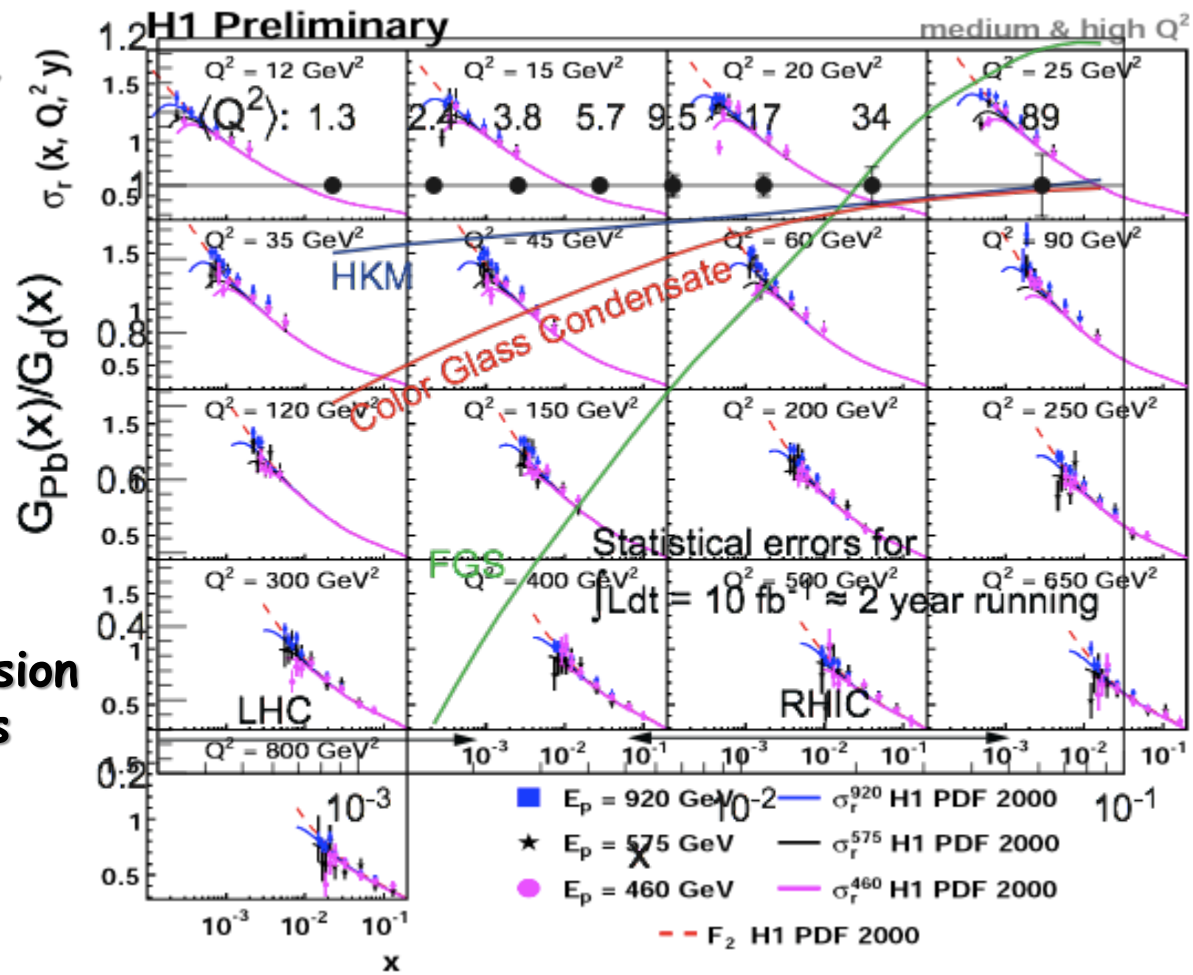
⇒ $G(x,Q^2)$ with great precision

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

Plot contains:

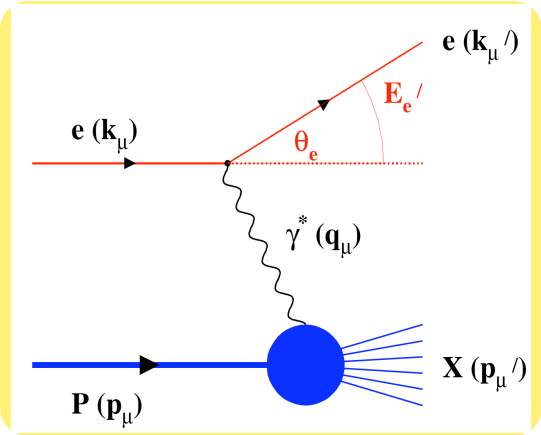
$\int \mathcal{L}dt$ = 4/A fb^{-1} (10+100) GeV
= 4/A fb^{-1} (10+50) GeV
= 2/A fb^{-1} (5+50) GeV
statistical errors only

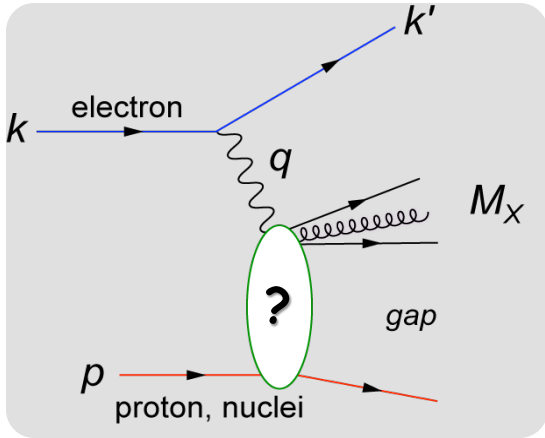
Syst. studies of $F_L(A,x,Q^2)$
- xG(x,Q2) with great precision
- Distinguish between models



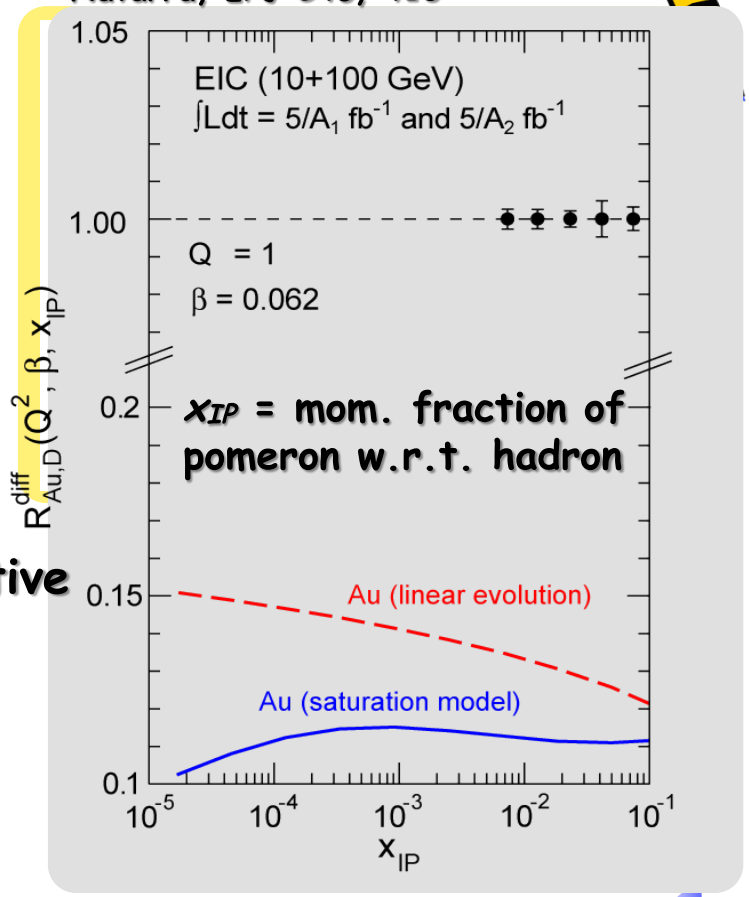
Role of colour-neutral (Pomeron) excitations

Diffractive physics in e+A:





Curves: Kugeratski, Goncalves, Navarra, EPJ C46, 413



- HERA/ep: 15% of all events are hard diffractive
- Diffractive cross-section $\sigma_{diff}/\sigma_{tot}$ in e+A ?
- Predictions: ~25-40%?
- Look inside the "Pomeron"
- Diffractive structure functions
- Exclusive Diffractive vector meson production: $d\sigma/dt \sim [xG(x,Q^2)]^2$!!
- Distinguish between linear evolution and saturation models

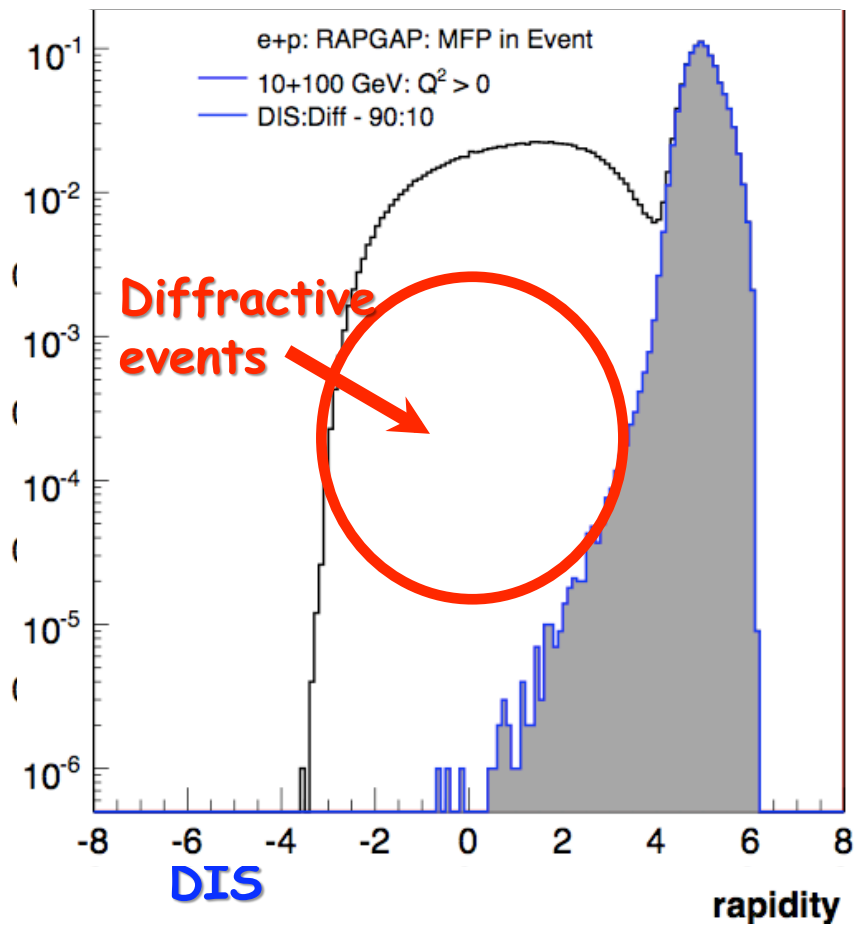
How to measure coherent diffraction in e+A ?

- Can measure the nucleus if it is separated from the beam in Si (Roman Pot) "beamline" detectors
  - pTmin ~ pA θ min
    - For beam energies = 100 GeV/n and θ min = 0.08 mrad:
- These are large momentum kicks, much greater than the binding energy (~ 8 MeV)
  - Therefore, for large A, coherently diffractive nucleus cannot be separated from beamline without breaking up

species (A)	p_T^{min} (GeV/c)
d (2)	0.02
Si (28)	0.22
Cu (64)	0.51
In (115)	0.92
Au (197)	1.58
U (238)	1.90

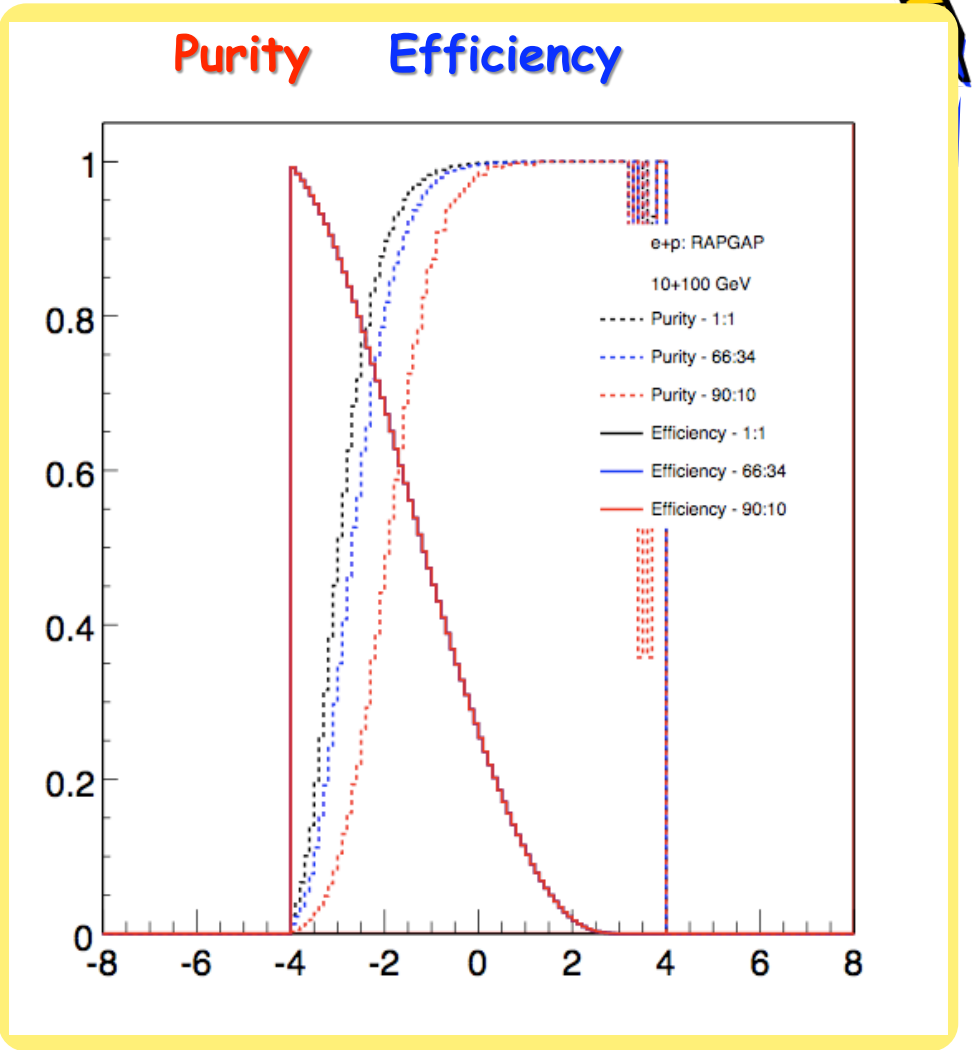
Large rapidity gaps at an eRHIC

- Method:
  - Use RAPGAP in diffractive and DIS modes to simulate e+p collisions at eRHIC energies
  - Clear difference between DIS and Diffractive modes in "most forward particle in event" distributions
    - Little change in distributions with increasing energy



Large rapidity gaps at an eRHIC

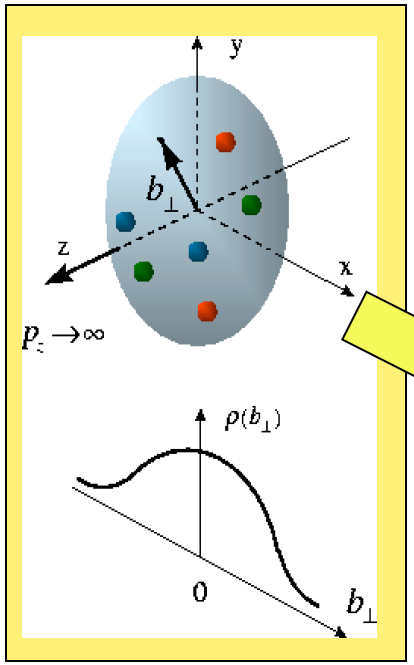
- Efficiency vs Purity:
  - Efficiency = fraction of diffractive events out of all diffractive events in sample
  - Purity = fraction of diffractive events out of all events in sample
  - Possible to place a cut to have both high efficiency and high purity
    - However, reduce the acceptance by 1 or 2 units of rapidity and these values drop significantly
  - Need hermetic detector coverage!!

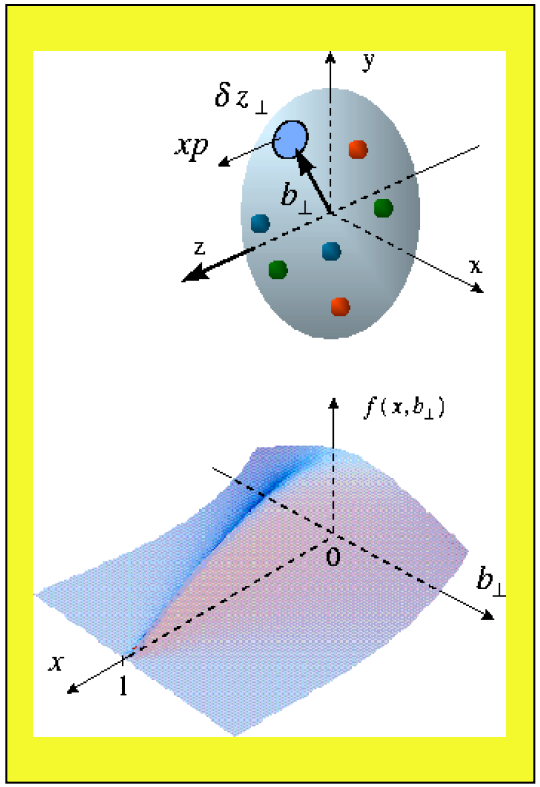


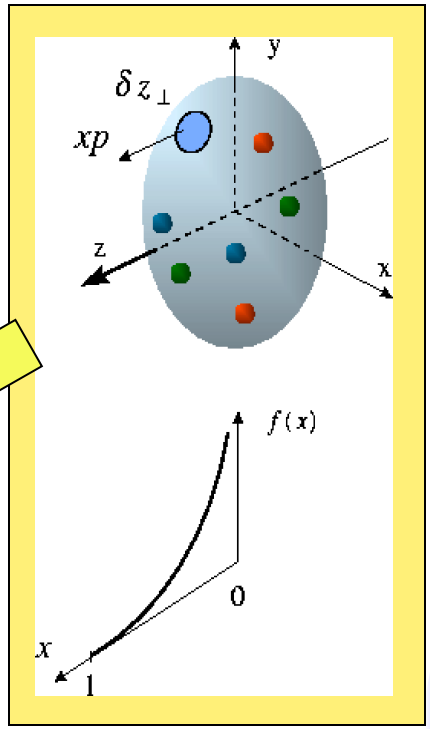
Beyond form factors and quark distributions

Generalized Parton Distributions

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





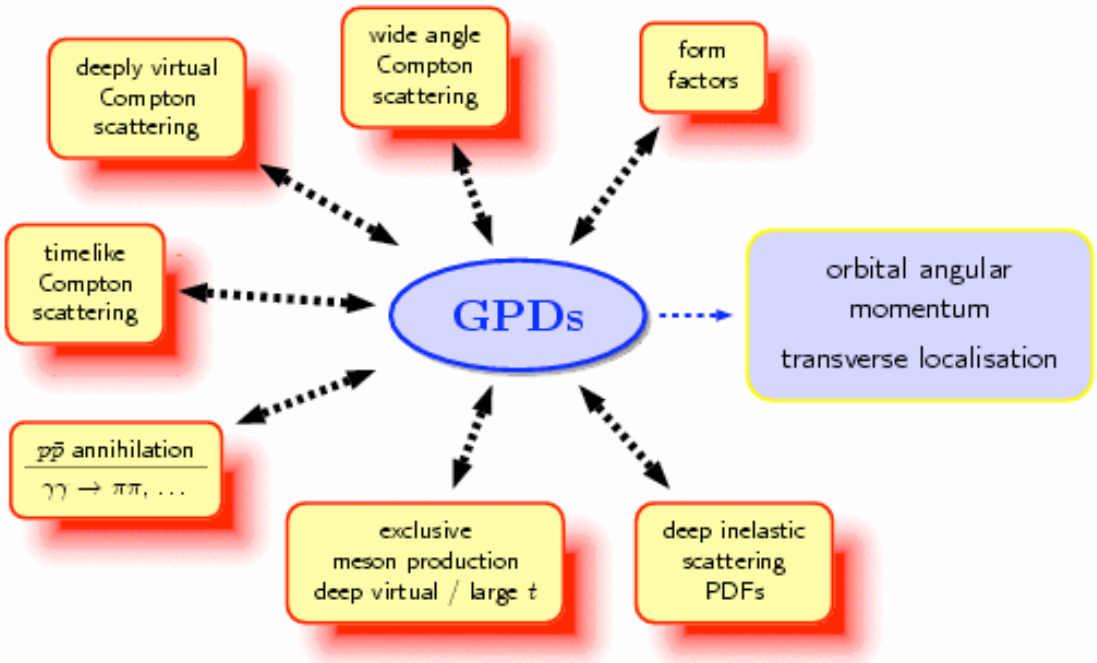


Proton form factors, transverse charge & current densities

Correlated quark momentum and helicity distributions in transverse space - GPDs

Structure functions, quark longitudinal momentum & helicity distributions

How to access GPDs?



$$\frac{1}{2} = J_q^z + J_g^z = \frac{1}{2}\sum_q \Delta q + \sum_q \mathcal{L}_q^z + J_g^z$$

$$J_q^z = \frac{1}{2}\sum_q \Delta q + \sum_q \mathcal{L}_q^z$$

$$J_q^z = \frac{1}{2}\left(\int_{-1}^{1} x\,dx\left(H^q + E^q\right)\right)_{t\to 0}$$

quantum number of final state selects different GPDs:

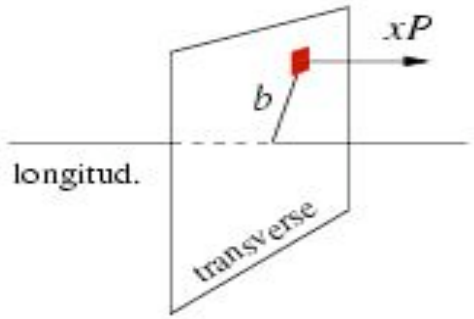
- **theoretically very clean**
  DVCS (γ): H, E, $\tilde{H}$, $\tilde{E}$
- **VM** (ρ, ω, ϕ): H E
- **info on quark flavors**
  PS mesons (π, η): $\tilde{H}$ $\tilde{E}$

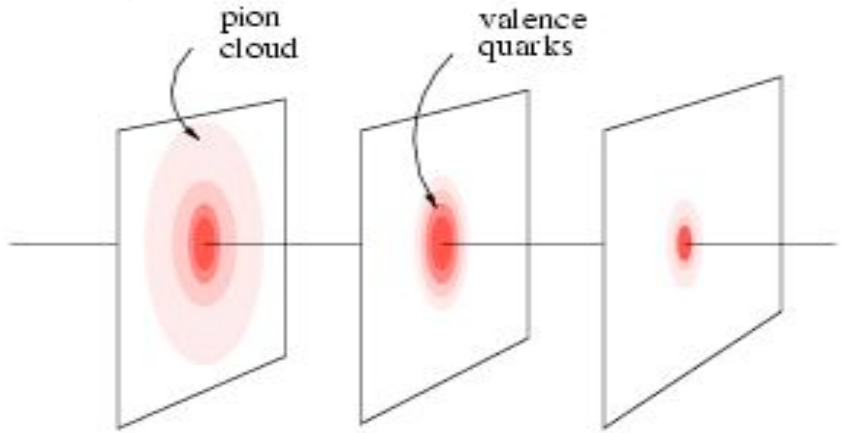
π^0	$2\Delta u+\Delta d$
η	$2\Delta u-\Delta d$
ρ^0	$2u+d$, $9g/4$
ω	$2u-d$, $3g/4$
ϕ	s, g
ρ^+	$u-d$
J/ψ	g

Proton Tomography

Allows for Transverse Imaging

Fourier transform in momentum transfer





x < 0.1 x ~ 0.3 x ~ 0.8

gives transverse spatial distribution of quark (parton) with momentum fraction x

Proton Tomography

[M. Burkardt, M. Diehl 2002]

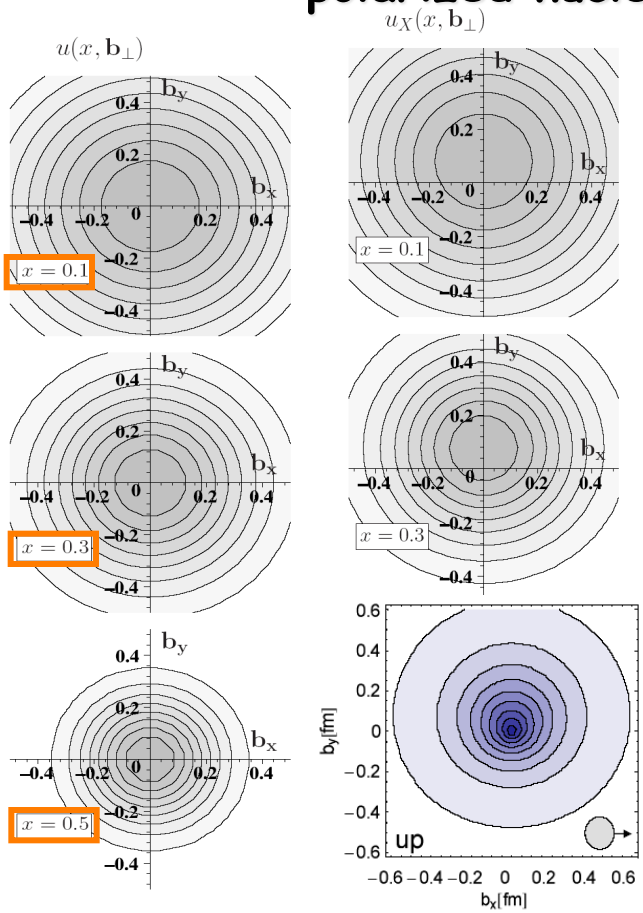
FT (GPD) : momentum space → impact parameter space:

probing partons with specified long. momentum @transverse position $b_\perp$

polarized nucleon:

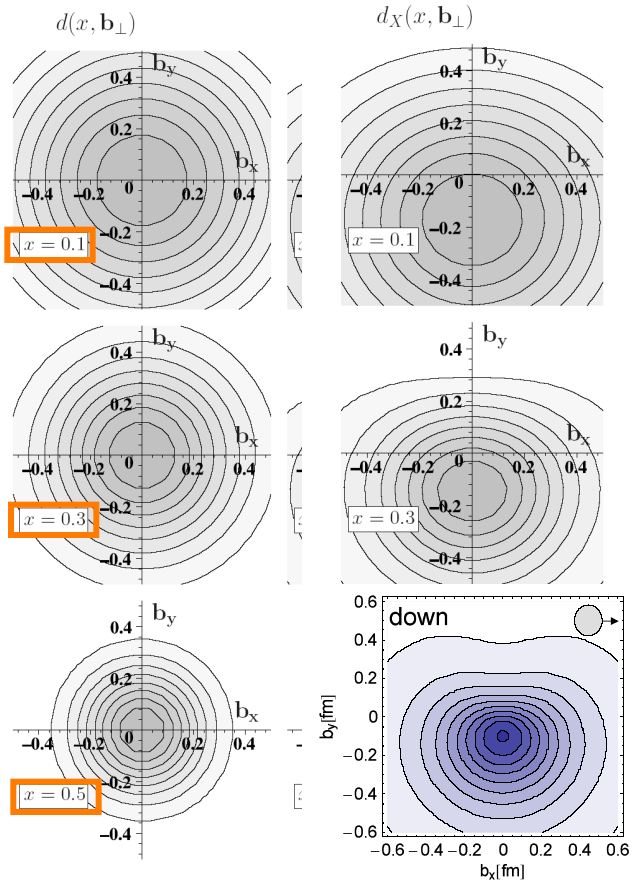
u-quark

[ξ=0]



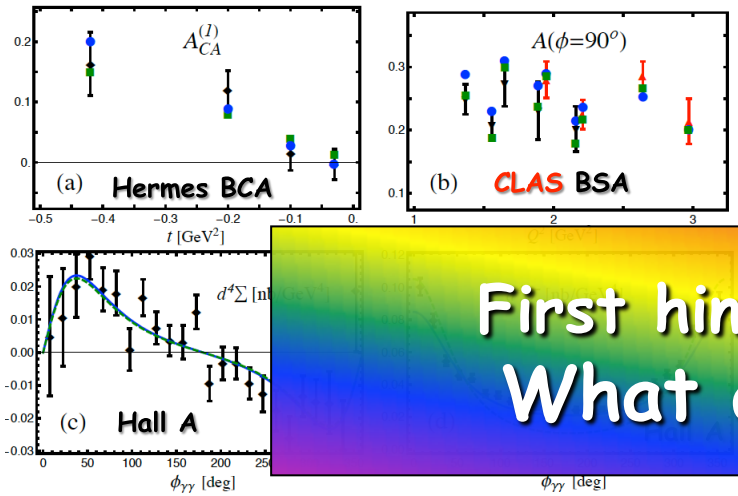
from lattice

d-quark

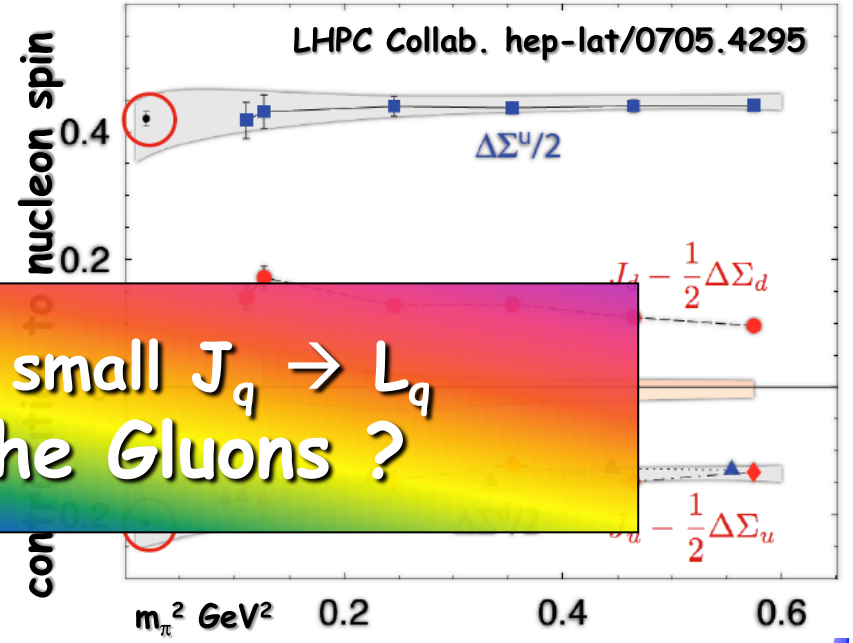


Results from Theory

K. Kumericki & D. Mueller
arXiv: 0904.0458

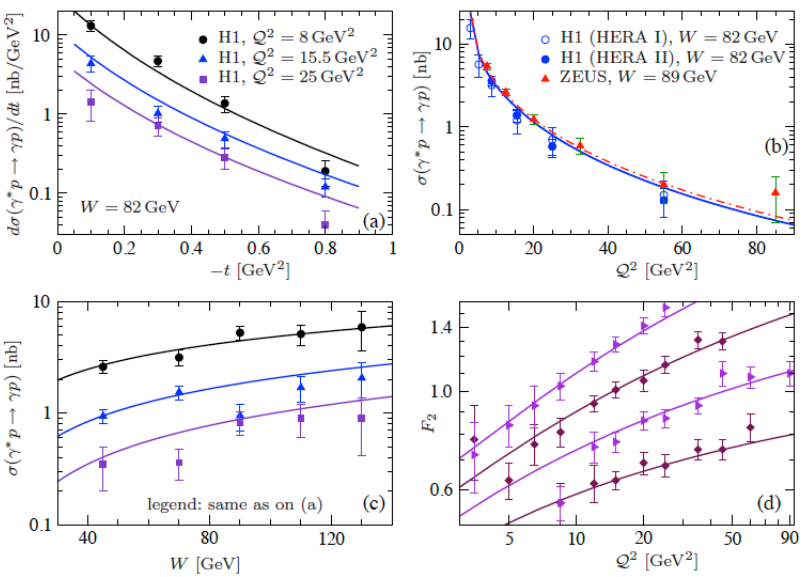


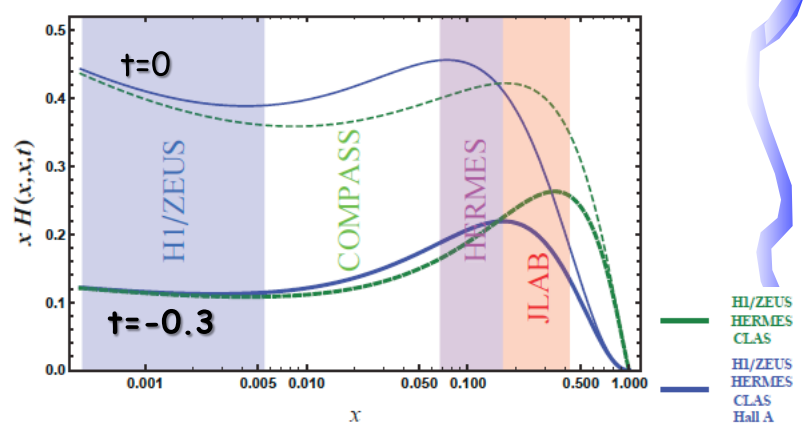
Lattice:



First hints for a small $J_q \rightarrow L_q$
What about the Gluons ?

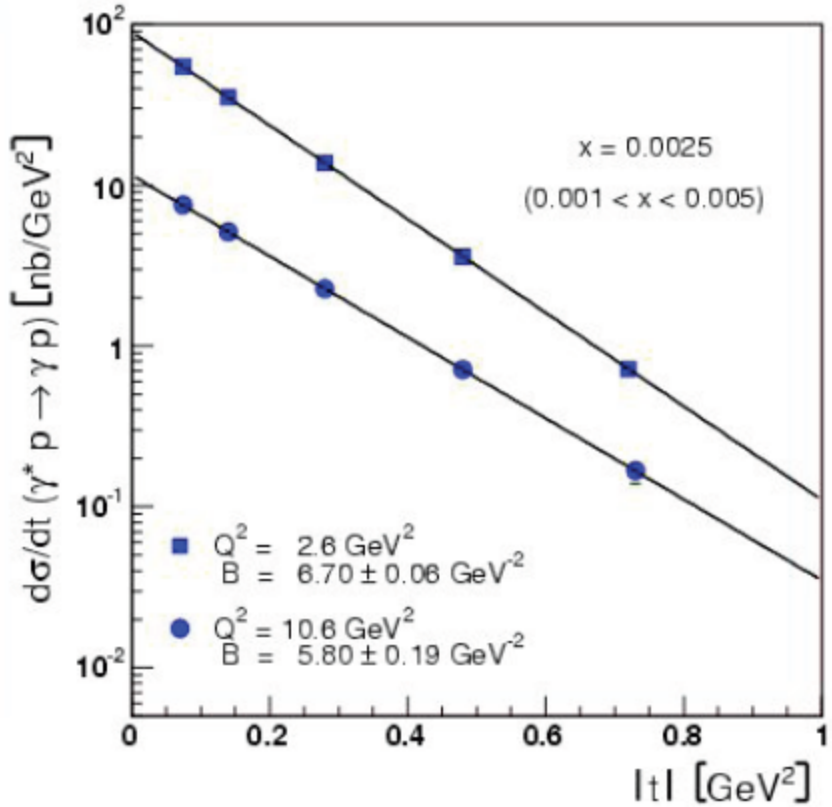
● ■ different GPD parametrisations

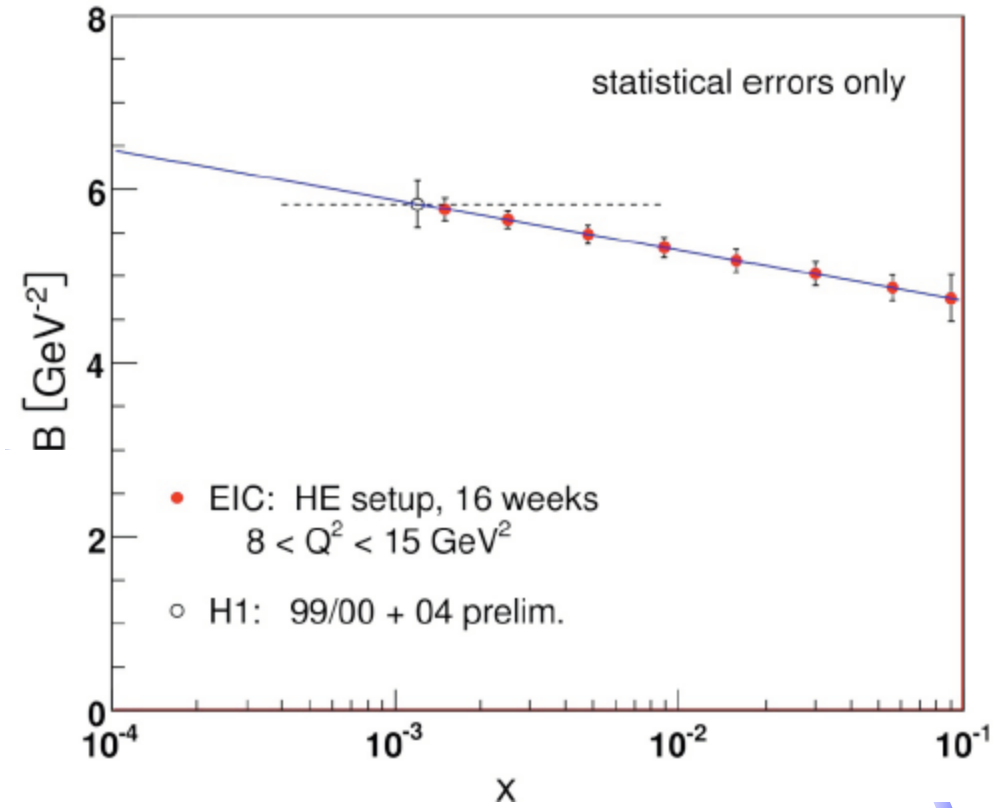




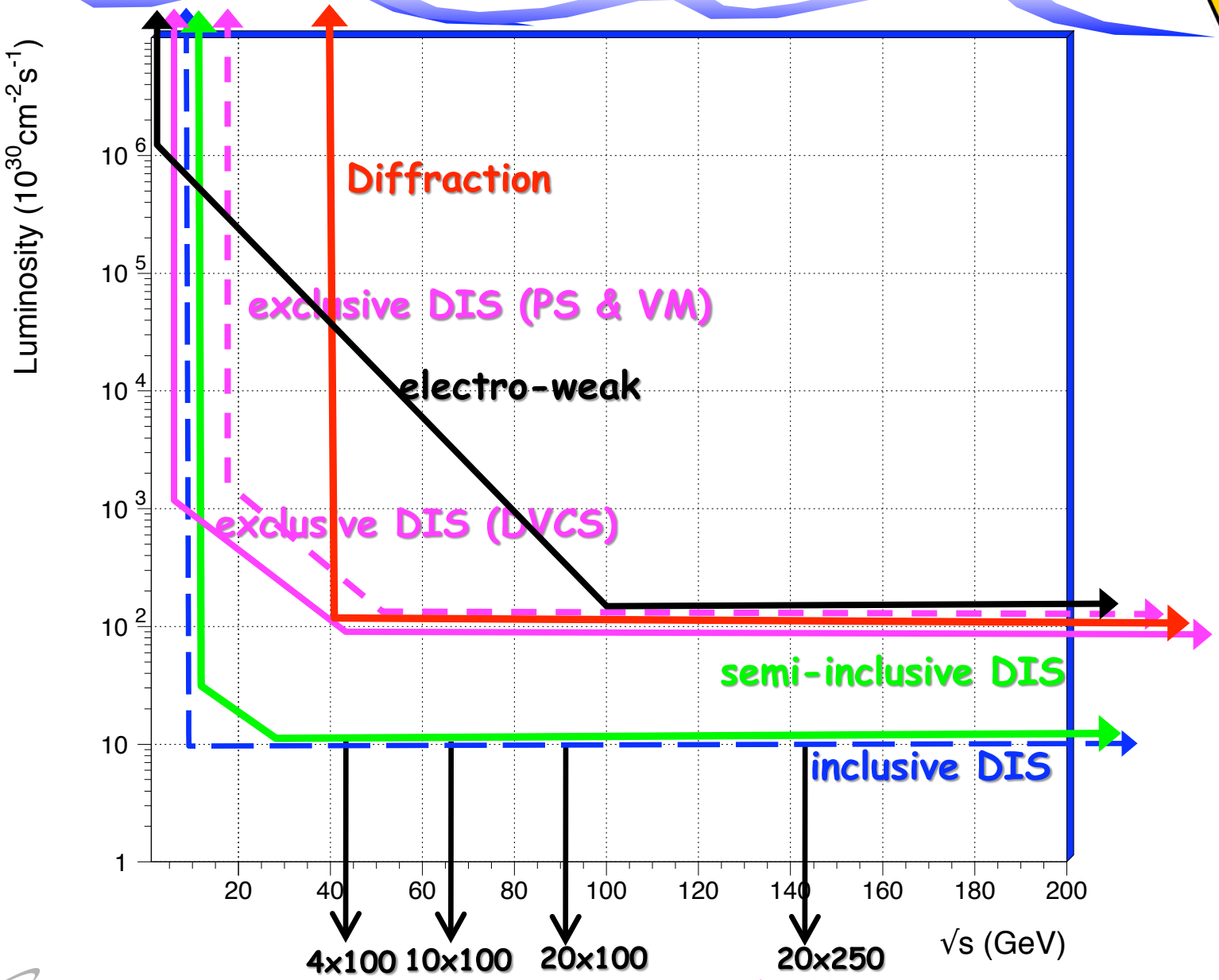
DVCS @ eRHIC

- dominated by gluon contributions
- Need wide x and Q^2 range to extract GPDs
- Need sufficient luminosity to bin in multi-dimensions



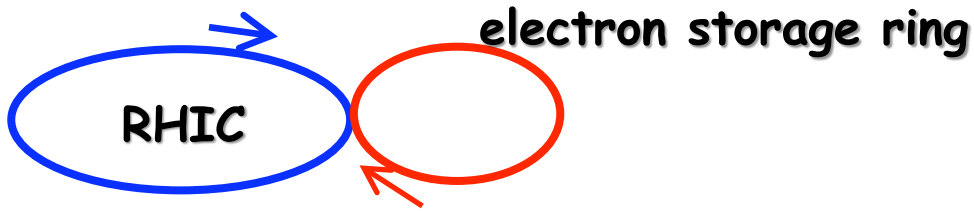


The √s vs. luminosity landscape

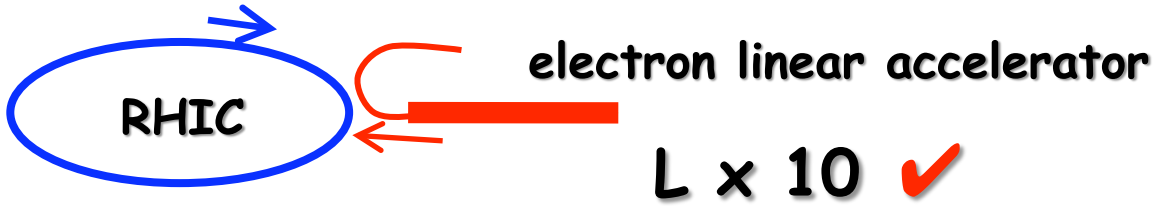


Machine design options

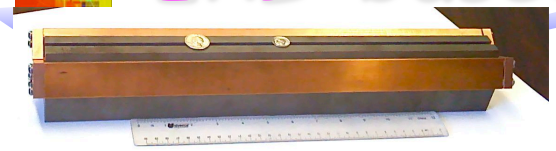
- two main design options for eRHIC
  - Ring-Ring:

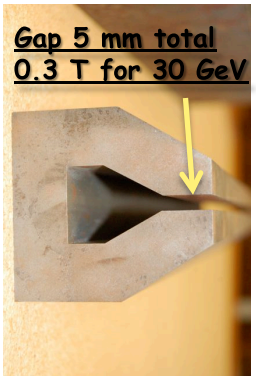


  - Linac-Ring:



ERL-based eRHIC Design





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

eRHIC detector

10-20 GeV e x 325 GeV p
130 GeV/u Au
possibility of 30 GeV @ low current operation

Coherent e-cooler

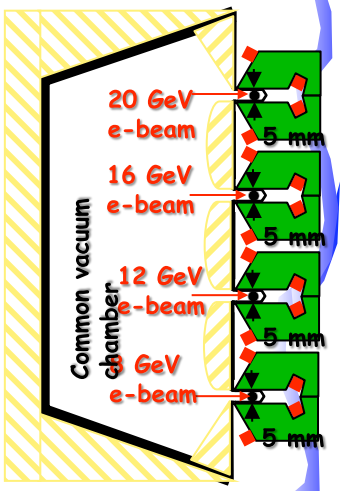
MeRHIC detector

Polarized e-gun

Beam dump

IP12
IP10
IP2
IP4
IP6

STAR



4 to 5 vertically separated recirculating passes

- 10 GeV electron design energy. Possible upgrade to 20 GeV by doubling main linac length.
- 5 recirculation passes (4 of them in the RHIC tunnel)
- Full polarization transparency at all energies for the electron beam;
- Ability to take full advantage of transverse cooling of the hadron beams;

ERL-based eRHIC Parameters: e-p mode

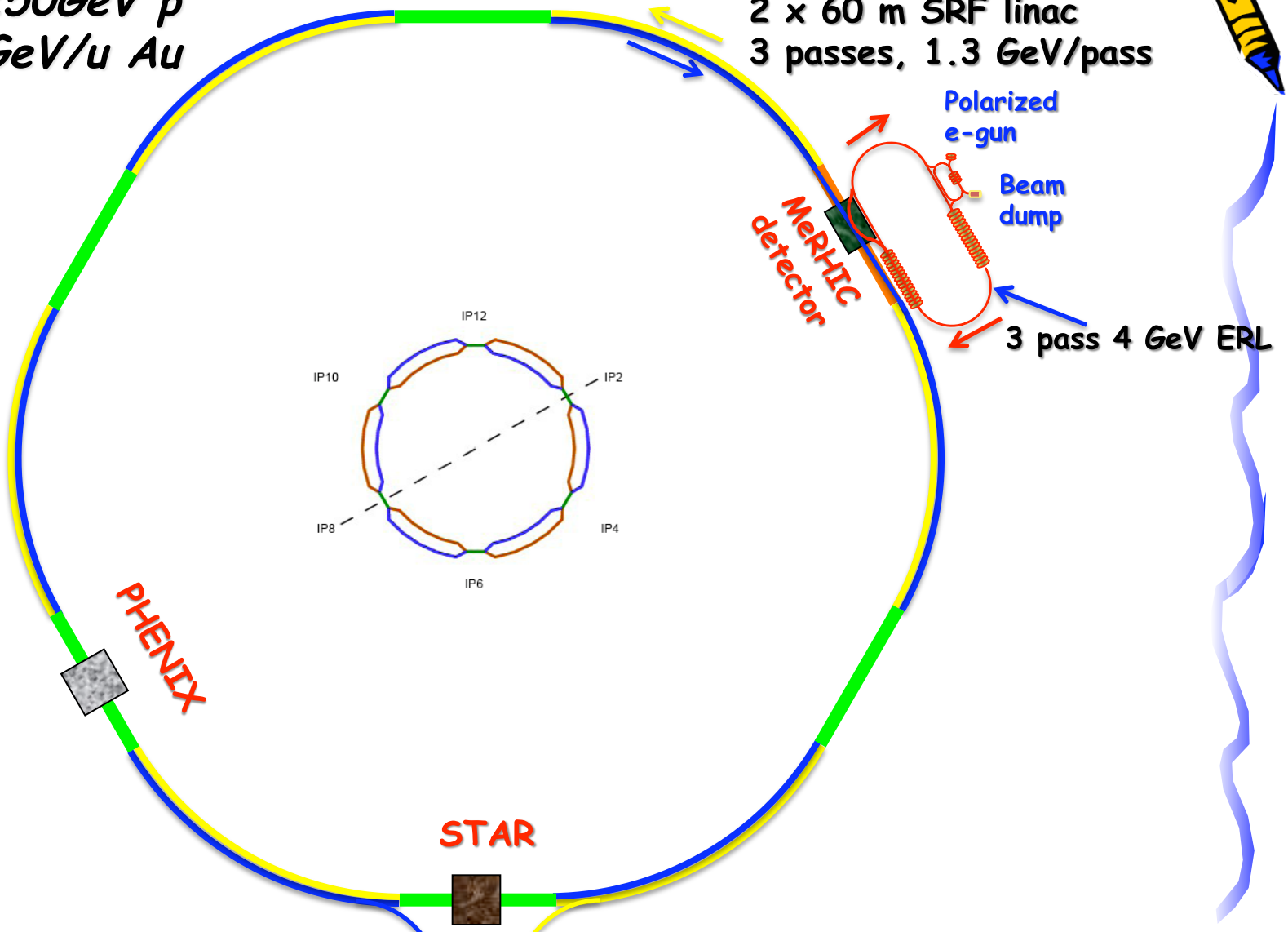
	High energy setup		Low energy setup	
	p	e	p	e
Energy, GeV	250	10	50	3
Number of bunches	166		166	
Bunch spacing, ns	71	71	71	71
Bunch intensity,	$2 \cdot 10^{11}$	$1.2 \cdot 10^{11}$	2	1.2
Beam current (mA)	420	260	420	260
Normalized 95% emittance (π mm mrad)	6	460	6	570
Rms emittance, nm	3.8	4	19	16.5
β^*, x/y, cm	26	25	26	30
Beam-beam parameters, x/y	0.015	0.59	0.015	0.47
Rms bunch length, cm	20	1	20	1
Polarization, %	70	80	70	80
Peak Luminosity,	$2.6 \cdot 10^{33}$ cm^{-2} s^{-1}		$0.53 \cdot 10^{33}$ cm^{-2} s^{-1}	
Aver. Luminosity x1.e33 cm^{-2}s^{-1}	0.87		0.18	
Luminosity integral /week pb^{-1}	530		105	

ERL-based eRHIC Parameters: e-Au mode

	High energy setup		Low energy setup	
	Au	e	Au	e
Energy, GeV	100	10	50	3
Number of bunches	166		166	
Bunch spacing, ns	71	71	71	71
Bunch intensity, 10^{11}	1.1	1.2	1.1	1.2
Beam current, mA	180	260	180	260
Normalized 95% emittance (π mm.mrad)	2.4	460	2.4	270
Rms emittance (nm)	3.7	3.8	7.5	7.8
β^*, x/y (cm)	26	25	26	25
Beam-beam parameters x/y	0.015	0.26	0.015	0.43
Rms bunch length (cm)	20	1	20	1
Polarization (%)	0	0	0	0
Peak e-nucleon luminosity	$2.9 \cdot 10^{33}$ cm^{-2} s^{-1}		$1.5 \cdot 10^{33}$ cm^{-2} s^{-1}	
Average e-nucleon luminosity 1.e33 cm^{-2}s^{-1}	1.0		0.5	
Luminosity integral /week pb^{-1}	580		290	

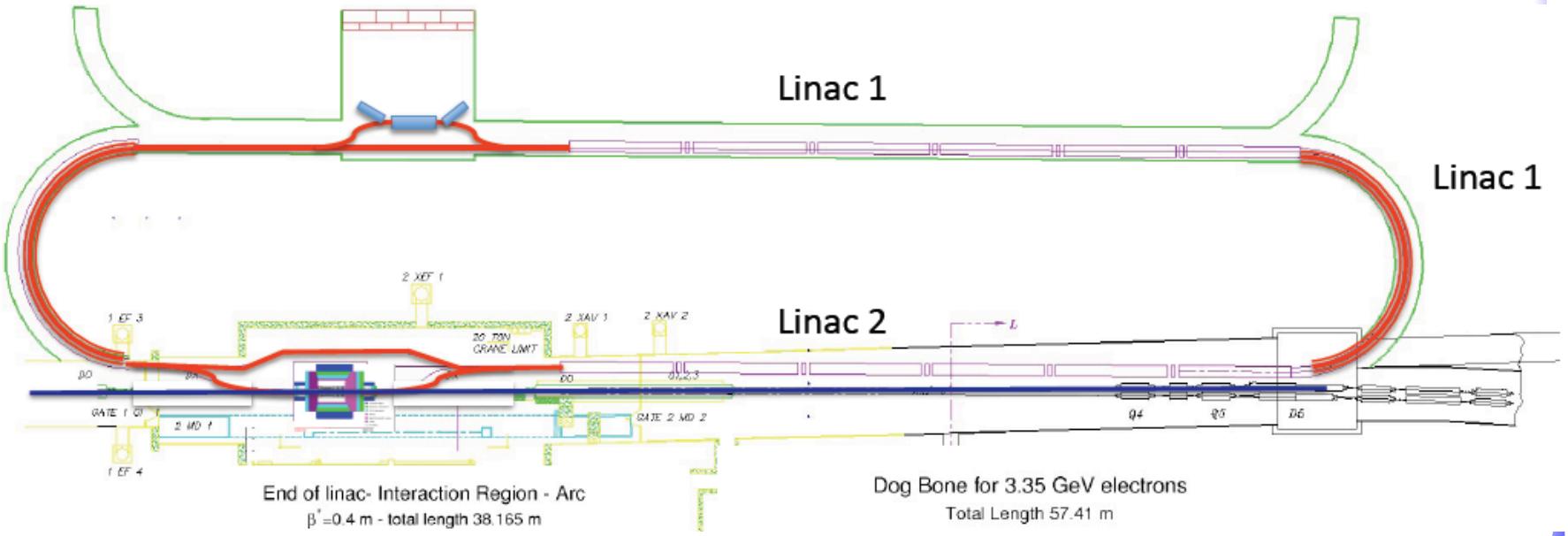
Medium Energy eRHIC Concept - MeRHIC

4GeV e x 250GeV p
100GeV/u Au



Medium Energy eRHIC Concept

- Geometrical constraints: If it is possible use the existing interaction region at RHIC 2 o'clock and wider tunnel to place the superconducting linac inside it. Minimize civil construction cost and re-use for eRHIC already built and installed linac.



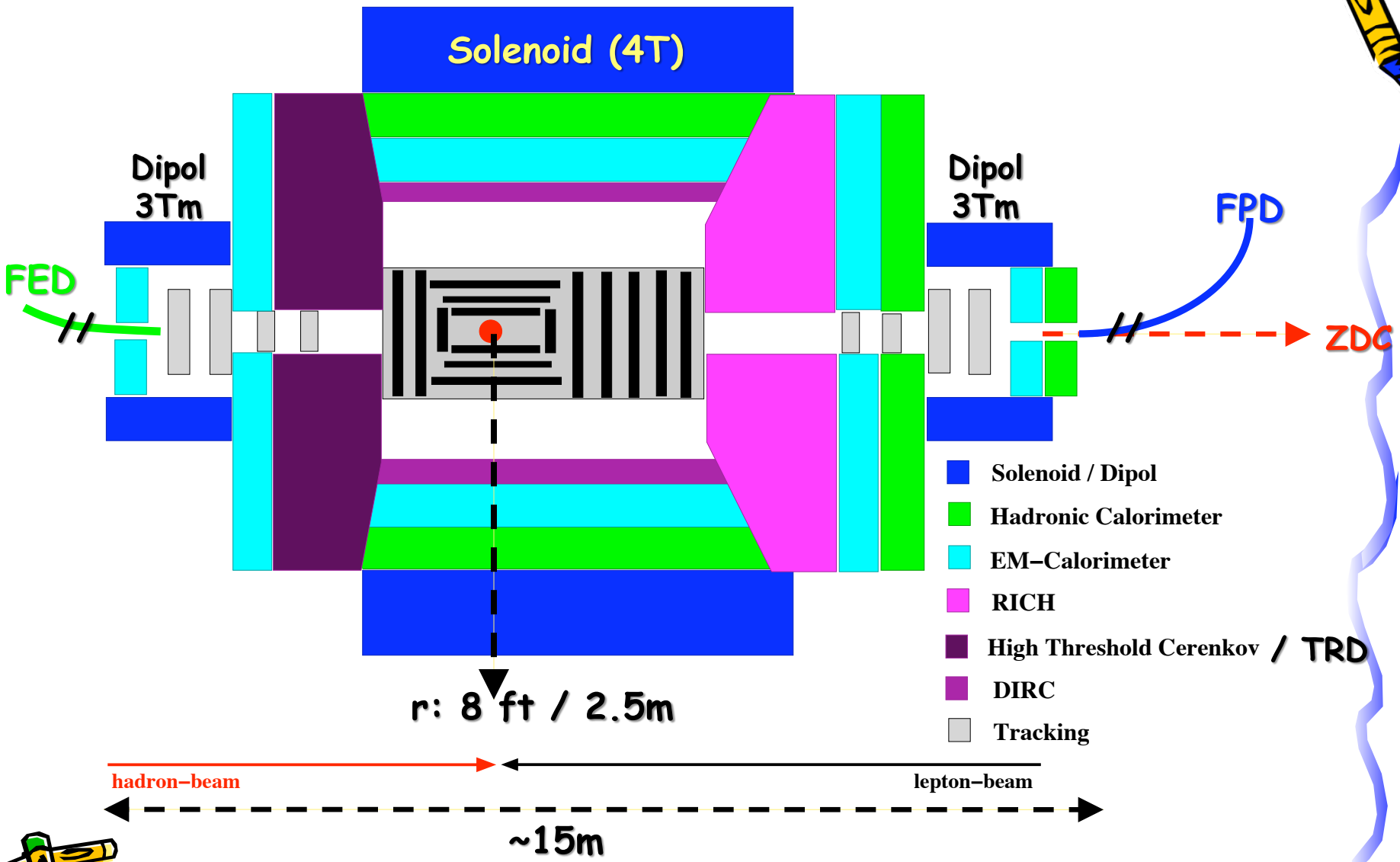
MeRHIC parameters for e-p collisions

	not cooled		pre-cooled	
	p	e	p	e
Energy, GeV	**250**	**4**	**250**	**4**
Number of bunches	**111**		**111**	
Bunch intensity, 10^{11}	**2.0**	**0.31**	**2.0**	**0.31**
Bunch charge, nC	**32**	**5**	**32**	**5**
Normalized emittance, 1e-6 m, 95% for p / rms for e	**15**	**73**	**1.5**	**7.3**
rms emittance, nm	**9.4**	**9.4**	**0.94**	**0.94**
beta*, cm	**50**	**50**	**50**	**50**
rms bunch length, cm	**20**	**0.2**	**5**	**0.2**
beam-beam for p /disruption for e	**1.5e-3**	**3.1**	**0.015**	**7.7**
Peak Luminosity, $1e^{32}cm^{-2}s^{-1}$	**0.93**		**2.3**	

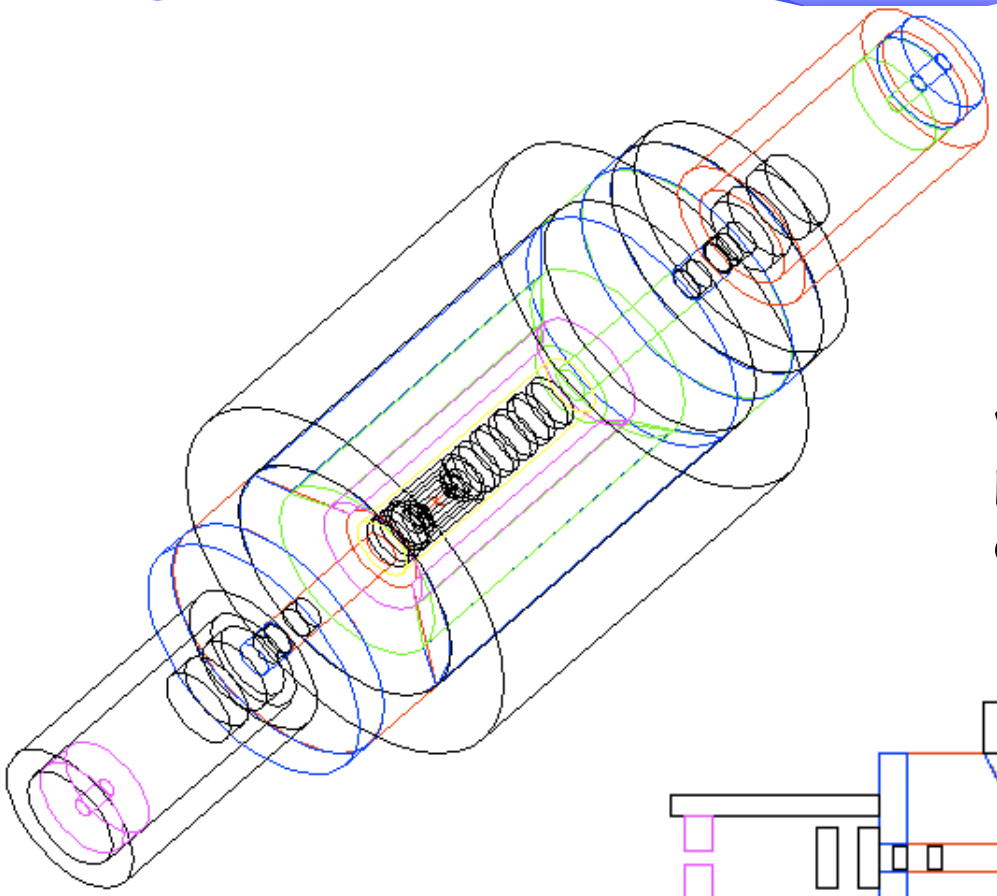
Detector Requirements from Physics

- ep-physics
  - the detector needs to cover inclusive → semi-inclusive → exclusive reactions
    - large acceptance absolutely crucial
    - particle identification (π,K,p,n) over wide momentum range
    - excellent vertex resolution (charm)
    - particle detection for very low scattering angle
  - uncertainty for e/p polarization measurements
  - luminosity measurement uncertainty
- eA-physics
  - requirements very similar to ep
    - most challenging get information on recoiling heavy ion from exclusive and diffractive reactions.

First ideas for a detector concept

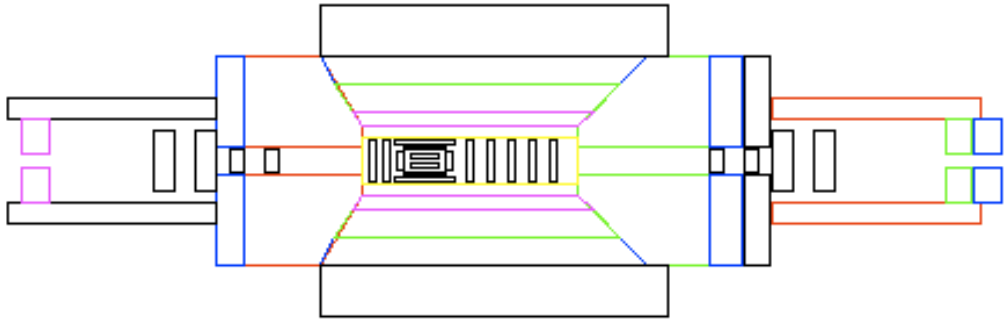


First Geant model of detector



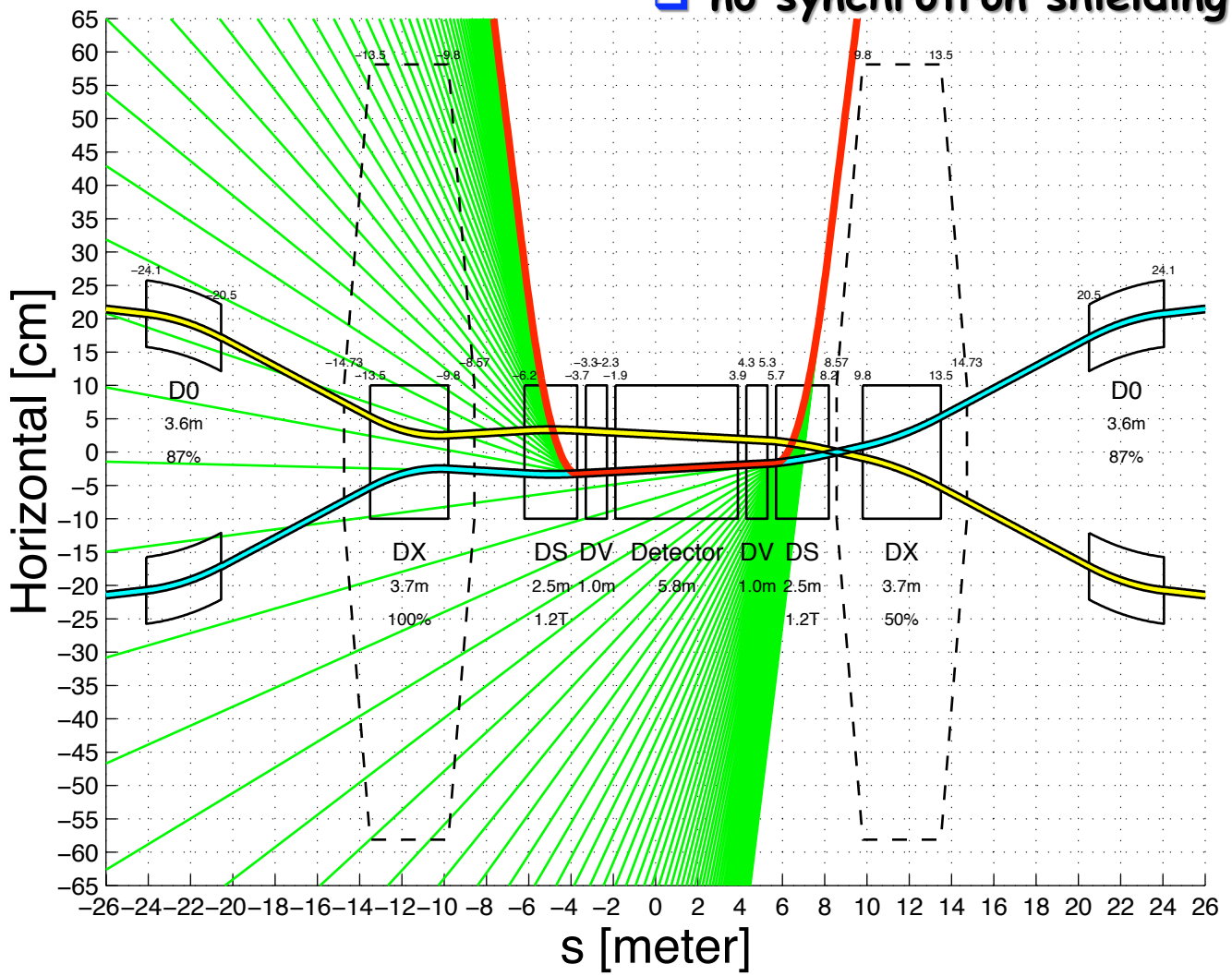
Work done by our three summer students:
William Foreman
Anders Kirleis
Michael Savastio

Will soon be able to simulate key physics channels with realistic detector resolutions



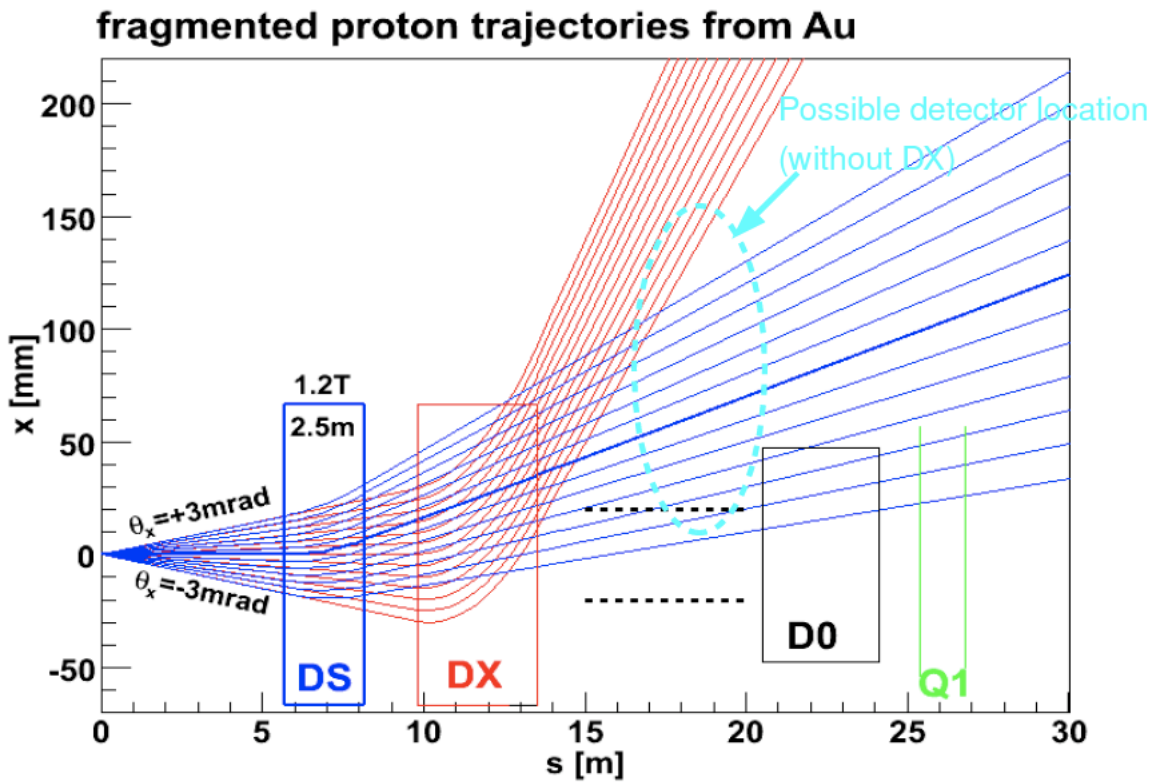
IR-Design for MeRHIC I

- no synchrotron shielding included



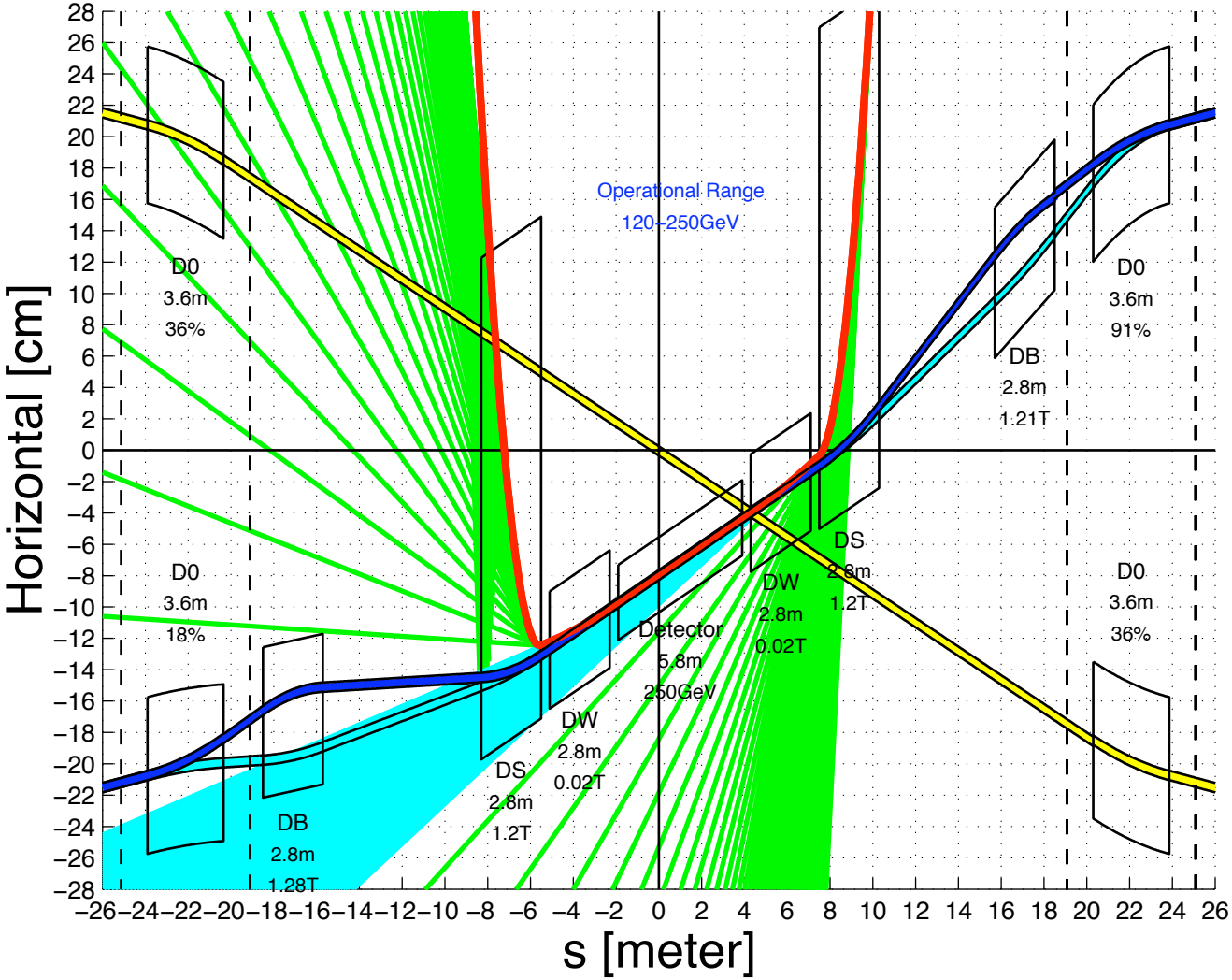
Detection from hadron beam fragments

- Tagging from Au fragments and p in ep
  - suppress incoherent scattering / ensure exclusivity
    - neutrons are detected in ZDC
    - protons use magnetic rigidity Au:p 2.5:1
  - DX magnets disturbs p tagging



IR-Design for MeRHIC II

- no synchrotron shielding included
- allows p and heavy ion decay product tagging



eRHIC group in Physics

- eRHIC taskforce formed
  - weekly meetings
  - concentrate on simulating "golden physics channels" and to develop tools/software to be used by collaboration
  - detector – IR design together with CAD
- In process of hiring 2 PostDocs
- Have 3 students over the summer
- work in close contact with the eRHIC CAD group, BNL theory group and the EIC-collaboration

- Information available at
  - http://www.eic.bnl.gov/
  - https://wiki.bnl.gov/eic/index.php/Main_Page

eRHIC targeted LDRD-proposals

- Accelerator:
  - Proof of principle for a gatling gun polarized electron source
    PI: Ilan Ben-Zvi
  - laser development for polarized electron source
    PI: Treveni Rao
  - undulator development for coherent electron cooling
    PI: Vladimir Litvinenko
  - polarized ^{3}He source development
    PI: Anatoli Zelenski
- Physics / Detector:
  - eA event generator development
    PI: Thomas Ullrich
  - silicon sensor development for compact EM calorimetry
    PI: Eduard Kistenev
  - Roman Pot development for eA/ep diffractive experiments
    PI: Wlodek Guryn

eRHIC targeted LDRD-proposals

- Theory:
  - exploring clear signatures for gluon saturation and universality in eA collisions

    PI: Raju Venugopalan
  - develop electroweak program

    PI: William Marciano

proposals are currently reviewed by outside reviewers

EICIAC's "Comments, Suggestions and Cautious Recommendations"

- Work out a clear and well-defined matrix of science goals vs. accelerator performance parameters (and cost). If possible identify in such a matrix (or perhaps in two separate matrices) the potential approach(es) to realizing key objectives in stages

- Distill and appropriately formulate from the range of research opportunities that the EIC provides a short list of the most compelling science objectives (and possibly "golden experiments") that can convince, and generate support from, the broader science community as represented by NSAC

- As a principal approach to a concise list of science objectives and facility parameters (including detectors), aggressively pursue the planned series of structured workshops

- Further develop the schedule including approximate resource-loading, to provide a timeline for major decisions (including, if at all possible, site decision), technical developments, and (staged) realization

EICIAC's "Comments, Suggestions and Cautious Recommendations" – cont.

- In particular, strive for a timeline (under reasonable assumptions) that provides for data taking before 2020

- An obvious important near-term activity is to work out a detailed and comprehensive R&D plan. The proposed common effort between BNL and JLab should focus, to a substantial extent, on R&D for technologies needed for both facility concepts

- It would be desirable for the EICAC to see a detailed common plan at the next meeting with deliverables & resources needed to reach a buildable design for the LRP. This might also help to reduce the considerable range of possibilities being discussed to a more concrete set of scenarios for the next meeting.

EICAC requested next meeting on ~ Sept. '09 schedule, for 2 days to allow deeper discussion, and with following major deliverables:

- *Coherent R&D plan, timeline, milestones & resource needs*
- *Initial cost-performance-science reach matrix*
- *Short list of "golden measurements" & what will be learned*
- *Implications of golden exp'ts for detector requirements + R&D*

Summary and Outlook

- Still a lot of work ahead of us
  - need to finalize a compelling physics case for medium and high energy eRHIC
  - need to finalize first detector design
    - simulate golden physics channels in this detector frame-work
  - start machine, detector and "physics" R&D

- International Interest in an EIC growing
  - 2 "proposals" in Europe:
    - very low energy: ENC @ FAIR (e: 3.5 GeV, p: 15GeV)
    - very high energy: LHeC @ CERN (e: 70 – 140GeV, p/A:LHC)
- Upcoming events:
  - INT workshop October 19-23 on physics case
  - workshop on EIC @ DNP meeting in Hawai
  - 2nd meeting with EIC-IAC @ JLab 1st & 2nd of Nov.

BACKUP

2008: Staging of eRHIC

- MeRHIC: Medium Energy eRHIC
  - Both Accelerator and Detector are located at IP2 of RHIC
  - 4 GeV e- x 250 GeV p (45 or 63 GeV c.m.), L ~ 1032-1033 cm-2 sec -1
  - 90% of hardware will be used for HE eRHIC
- eRHIC, High energy and luminosity phase, inside RHIC tunnel

  Full energy, nominal luminosity
  - Polarized 20 GeV e- x 325 GeV p (160 GeV c.m), L ~ 1033-1034 cm-2 sec -1
  - 30 GeV e x 120 GeV/n Au (120 GeV c.m.), ~1/5 of full luminosity
  - and 20 GeV e x 120 GeV/n Au (120 GeV c.m.), full liminosity
- eRHIC up-grades – if needed, inside RHIC tunnel

  Higher luminosity at reduced energy
  - Polarized 10 GeV e- x 325 GeV p, L ~ 1035 cm-2 sec -1

  Or Higher energy operation with one new 800 GeV RHIC ring
  - Polarized 20 GeV e- x 800 GeV p (~300 GeV c.m), L ~ 1034 cm-2 sec -1
  - 30 GeV e x 300 GeV/n Au (~200 GeV c.m.), L ~ 1032 cm-2 sec -1

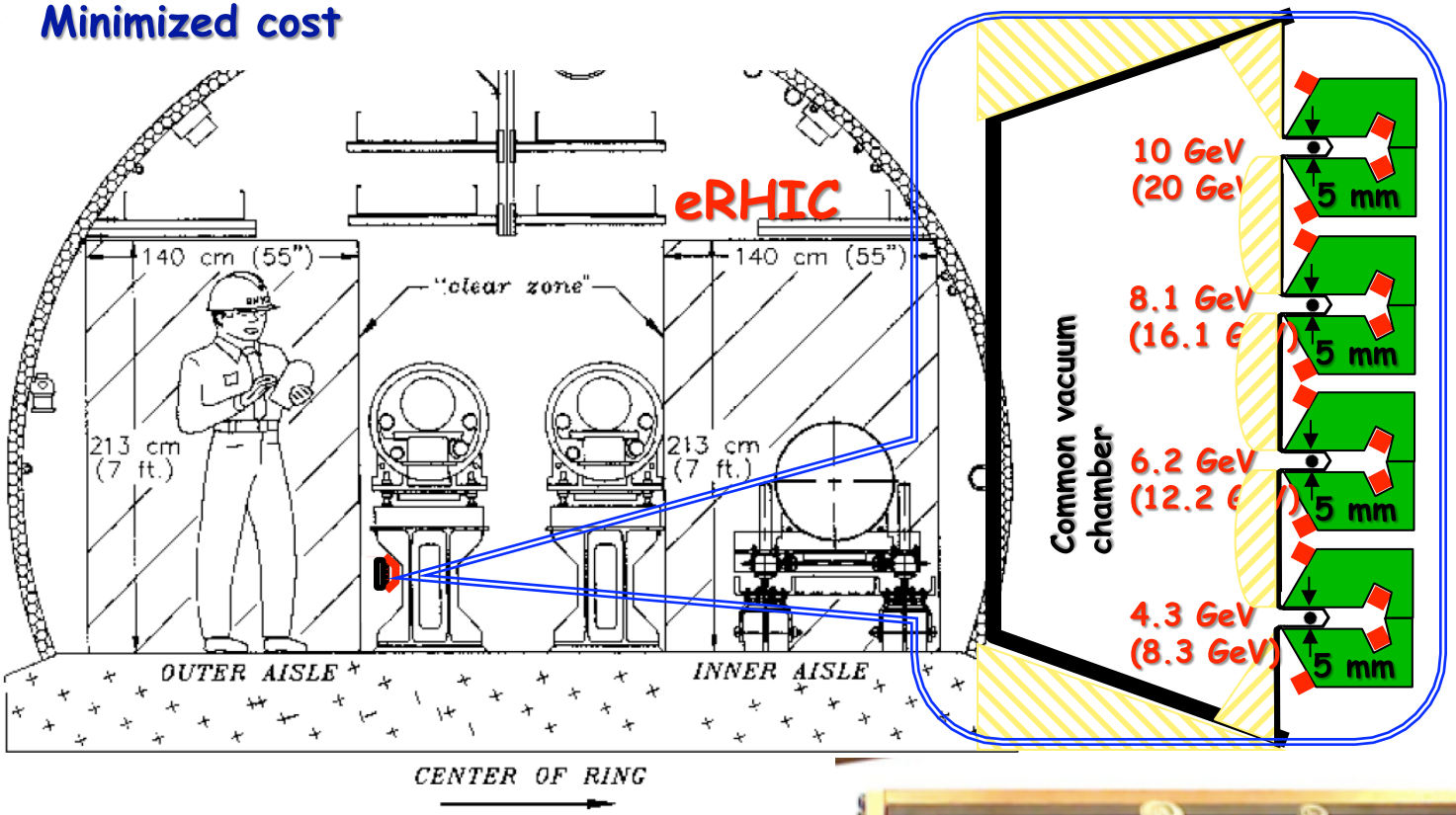
Staging of eRHIC

Re-use, Beams and Energetics

- MeRHIC: Medium Energy electron-Ion Collider
  - 90% of ERL hardware will be use for full energy eRHIC
  - Possible use of the detector in eRHIC operation
- eRHIC – High energy and luminosity phase
  - Based on present RHIC beam intensities
  - With coherent electron cooling requirements on the electron beam current is 50 mA
  - 20 GeV, 50 mA electron beam losses 4 MW total for synchrotron radiation.
  - 30 GeV, 10 mA electron beam loses 4 MW for synchrotron radiation
  - Power density is <2 kW/meter and is well within B-factory limits (8 kW/m)
- eRHIC upgrade(s)
  - High luminosity, low energy requires crab cavities, new injections, Cu-coating of RHIC vacuum chambers, new level of intensities in RHIC
    - Polarized electron source current of 400 mA at10 GeV, losses 2 MW total for synchrotron radiation, power density is 1 kW/meter
  - High energy option requires replacing one of RHIC ring with 8 T magnets

Recirculation Passes

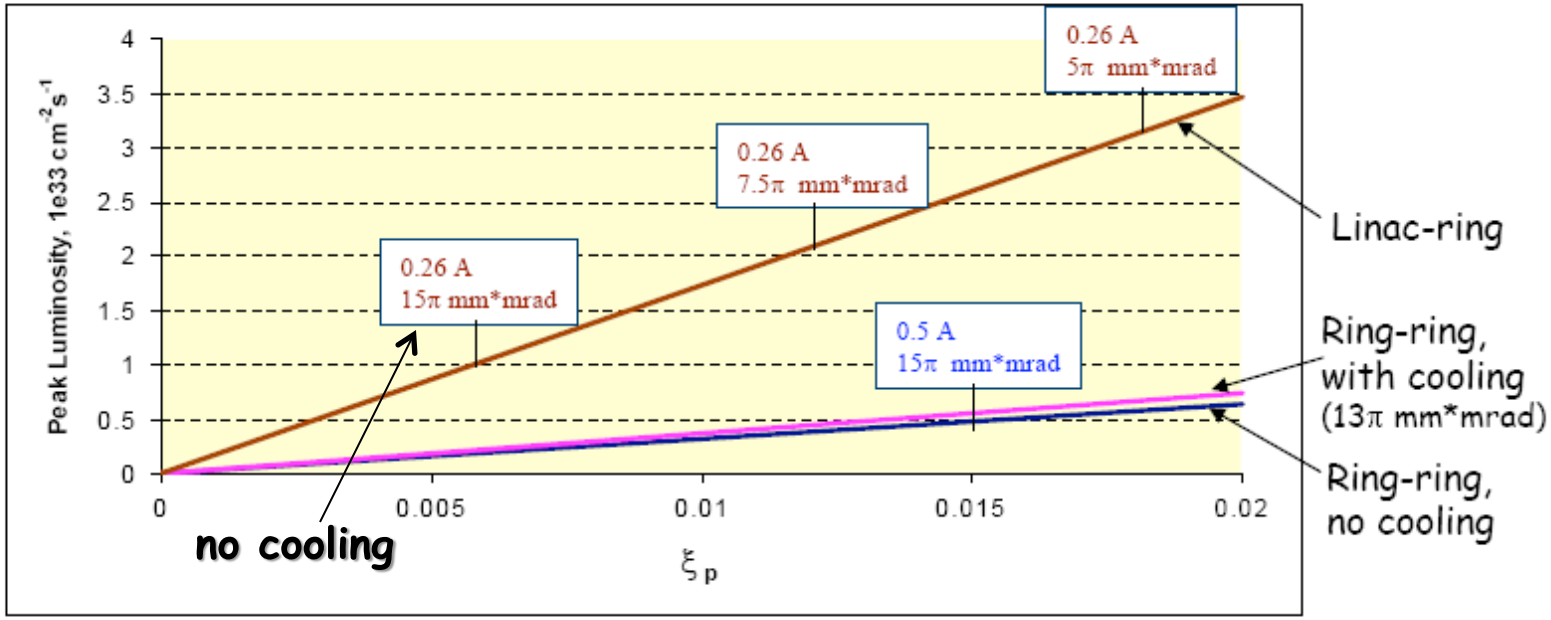
- Separate recirculation loops
- Small aperture magnets
- Low current, low power consumption
- Minimized cost



Prototype magnets are already built
(V. N. Litvinenko)

Luminosity and cooling

Calculations for 166 bunch mode and 250 Gev(p) x 10 Gev(e) setup;

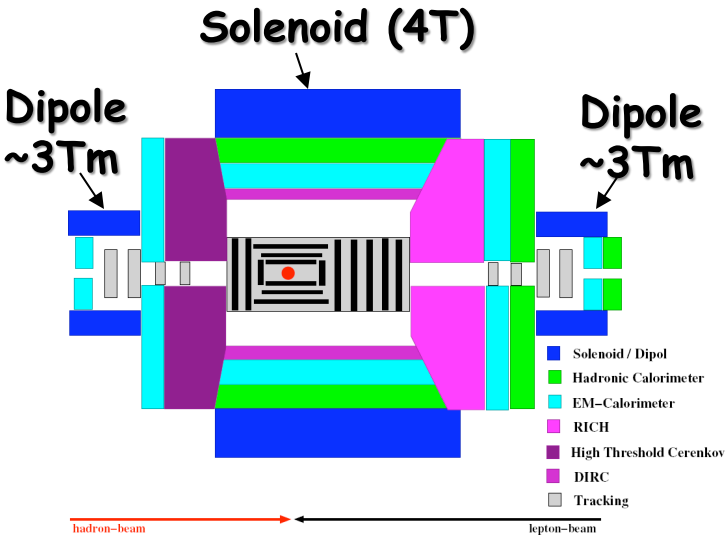


Pre-cooling of the protons at the injection energy (22 GeV) is required to achieve proton beam-beam limit (ξ_p=0.015) and maximize the luminosity. It can be done by electron cooling (in ~1h).

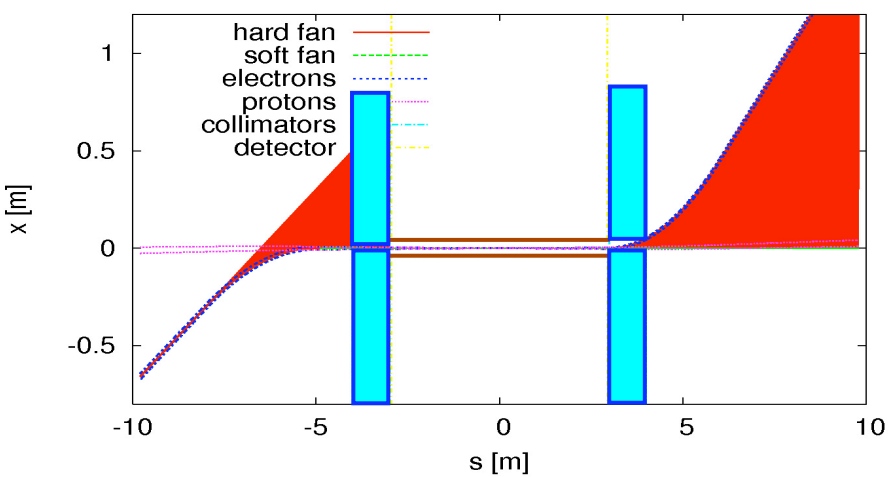
To reduce the electron current requirements it would be great to have the effective transverse cooling at the storage energy (250 GeV) which can effectively counteract IBS and maintain the emittance well below 6π mm*mrad.
Recent revival of the Coherent Electron Cooling idea (V.N.Litvinenko, Ya.S.Derbenev) brings the possibility of the effective longitudinal and transverse cooling for high energy protons. Proof of principle test of CEC has been suggested at RHIC.

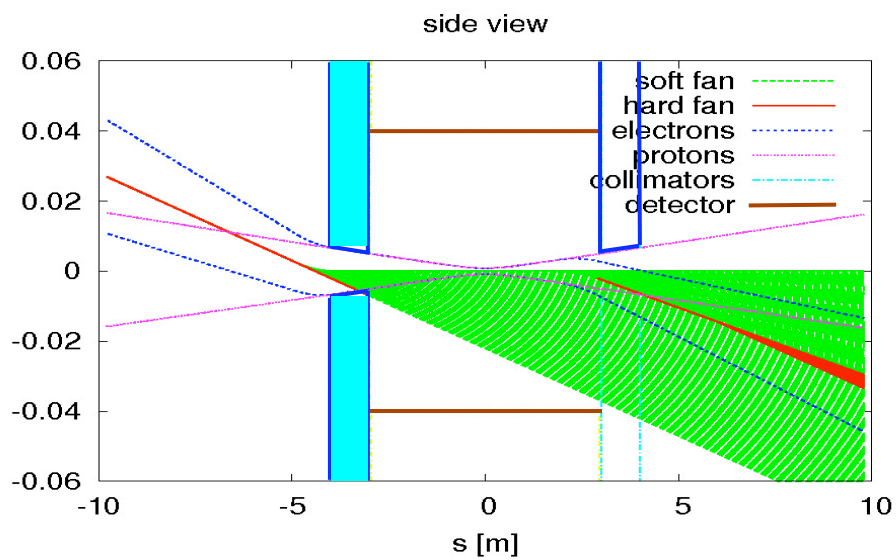
Accelerator and detector integration and SR protection

J.Beebe-Wang, C.Montag, B.Parker, D.Trbojevic



To provide effective SR protection:
-soft bend (~0.05T) is used for final bending of electron beam
-combination of vertical and horizontal bends





Parton Propagation and Fragmentation

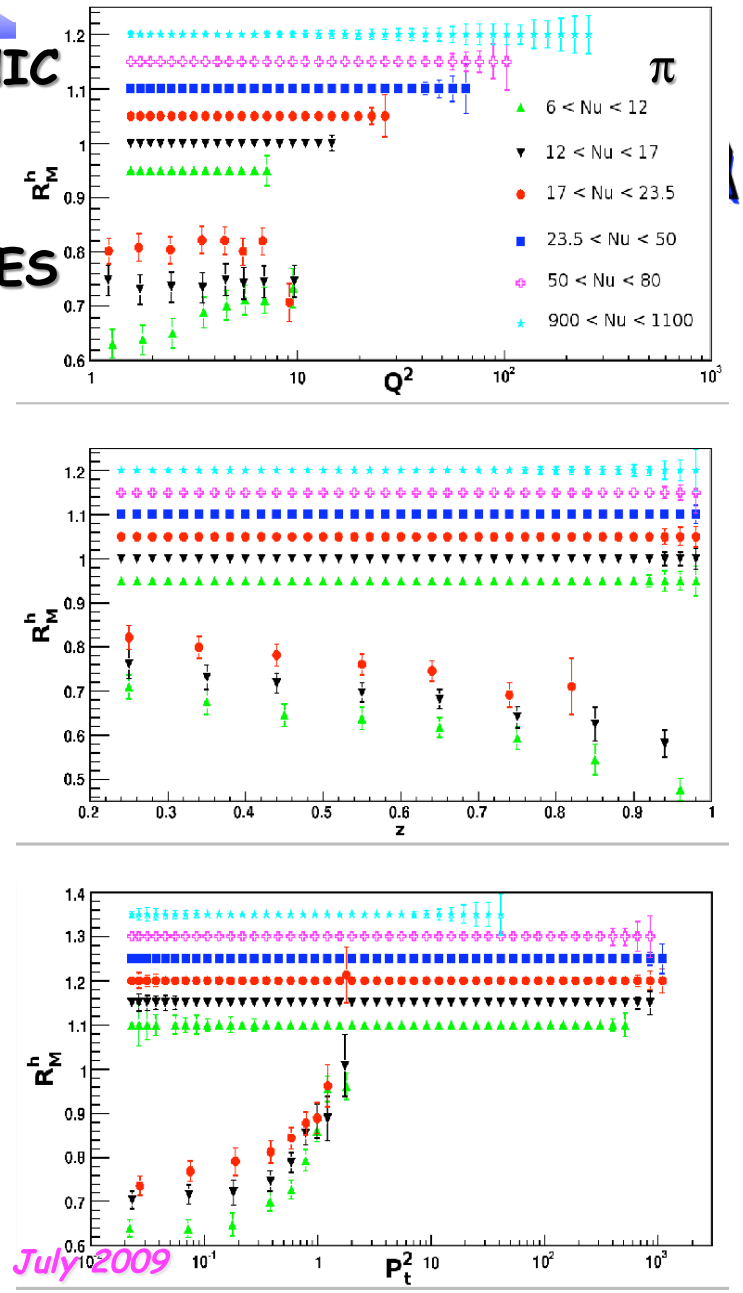
nDIS:

Work in Progress

- Suppression of high-p_T hadrons analogous but weaker than at RHIC
- Simulation with PYTHIA 6.4.19
  - 10 weeks of beam at eRHIC
- eRHIC: Clean measurement in 'cold' nuclear matter
  - 10+100 GeV
  - Large reach in Q^2 and p_T
- Energy transfer in lab rest frame
  - small ν - hadronization inside A
  - large ν - precision tests of QCD
  - eRHIC: $10 < \nu < 1600$ GeV
    HERMES: 2-25 GeV
    - parton energy loss
    - DGLAP evolution and showers
  - eRHIC: can measure heavy flavor energy loss

eRHIC

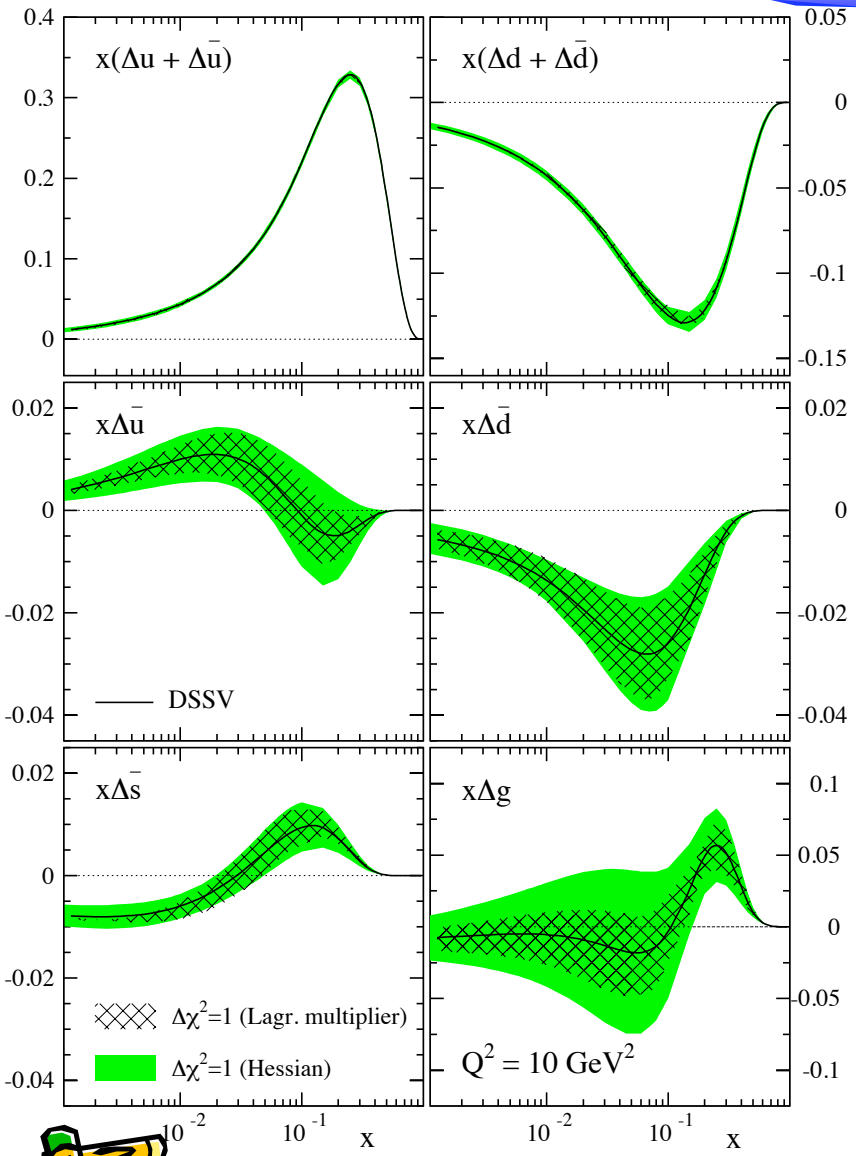
HERMES



Nuclear Modification Measure:

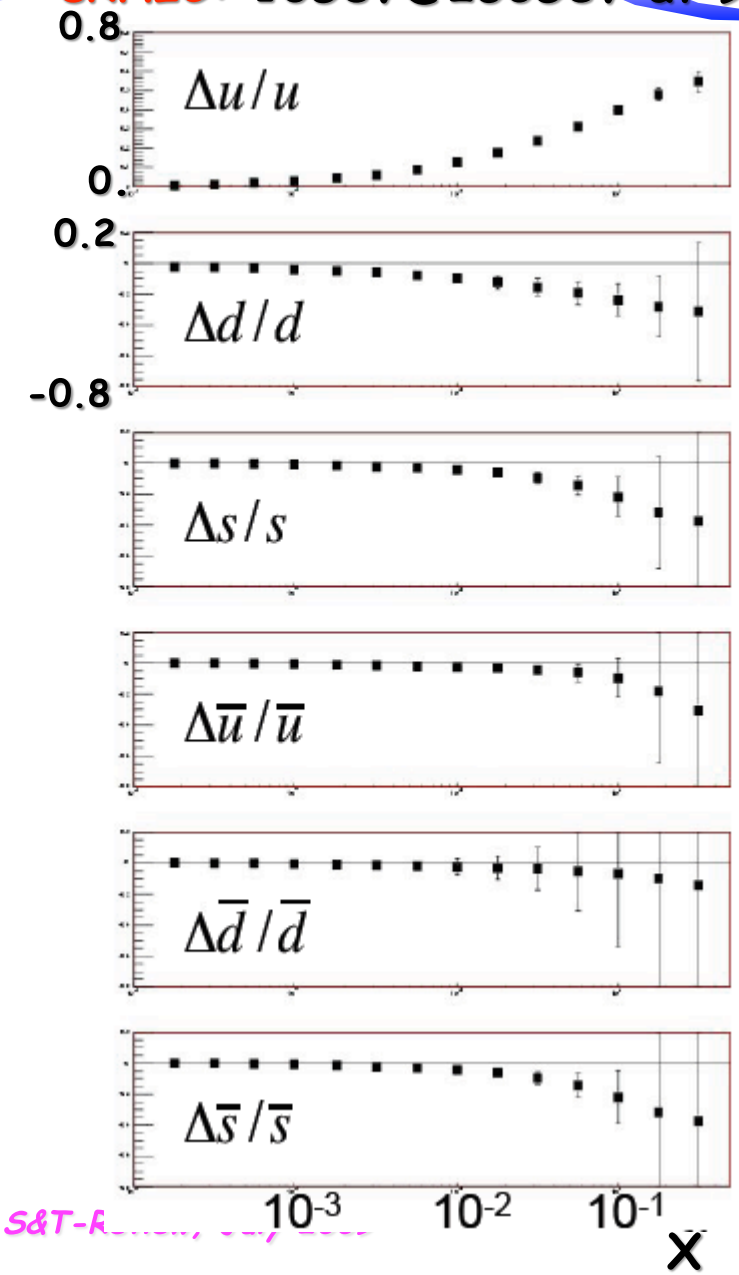
$$R_M^h(z) = \frac{\frac{1}{N_A^{DIS}} \frac{dN_A^h(z)}{dz}}{\frac{1}{N_D^{DIS}} \frac{dN_D^h(z)}{dz}}$$

Polarized Quark Distributions

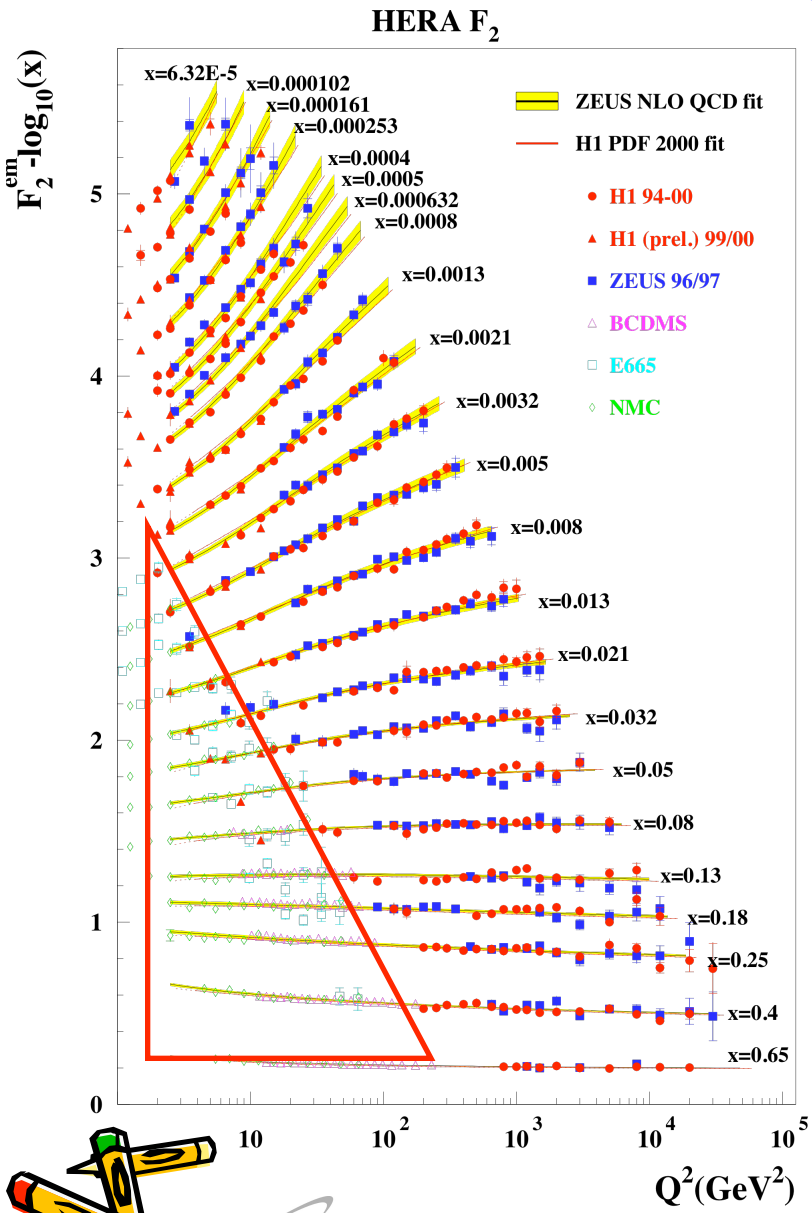


DSSV: arXiv:0904.3821

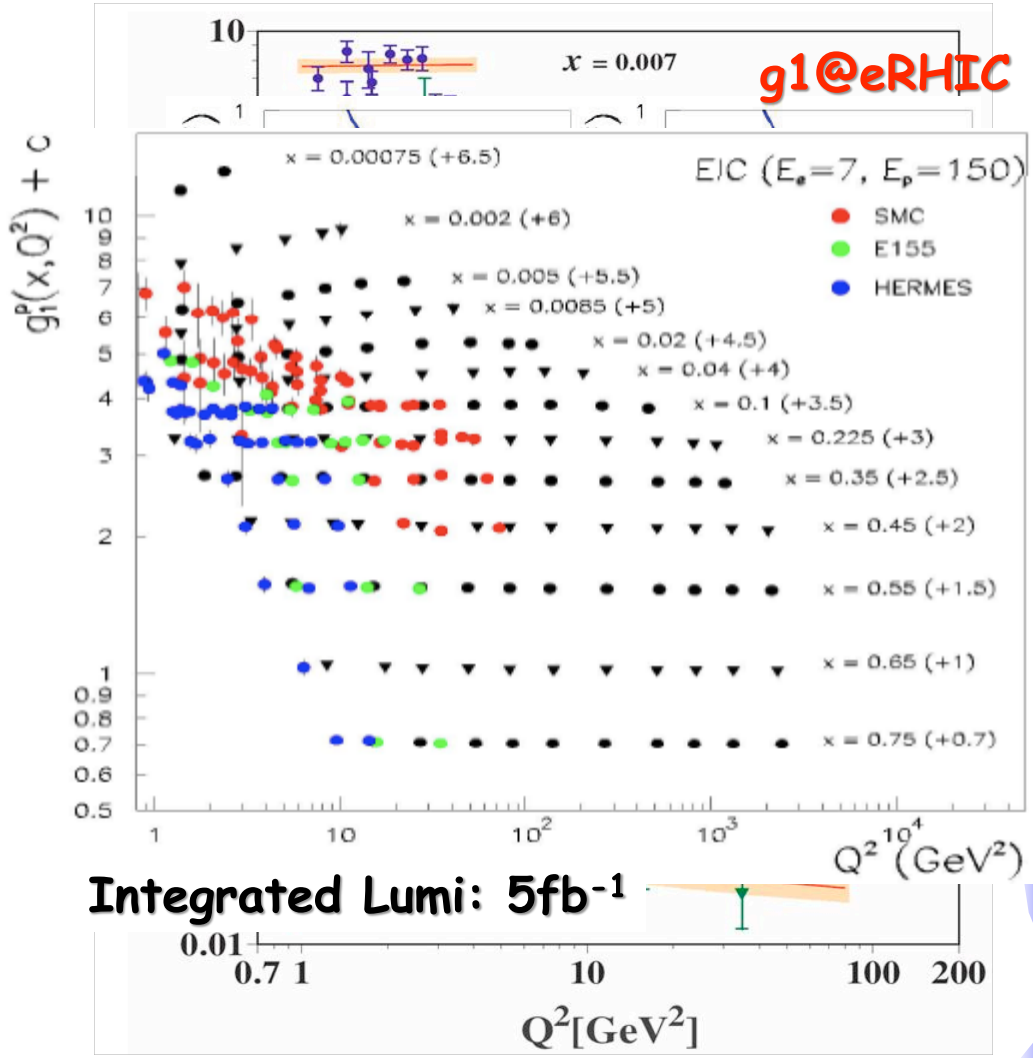
eRHIC: 10GeV@250GeV at 9 fb⁻¹



How to measure ΔΣ and ΔG

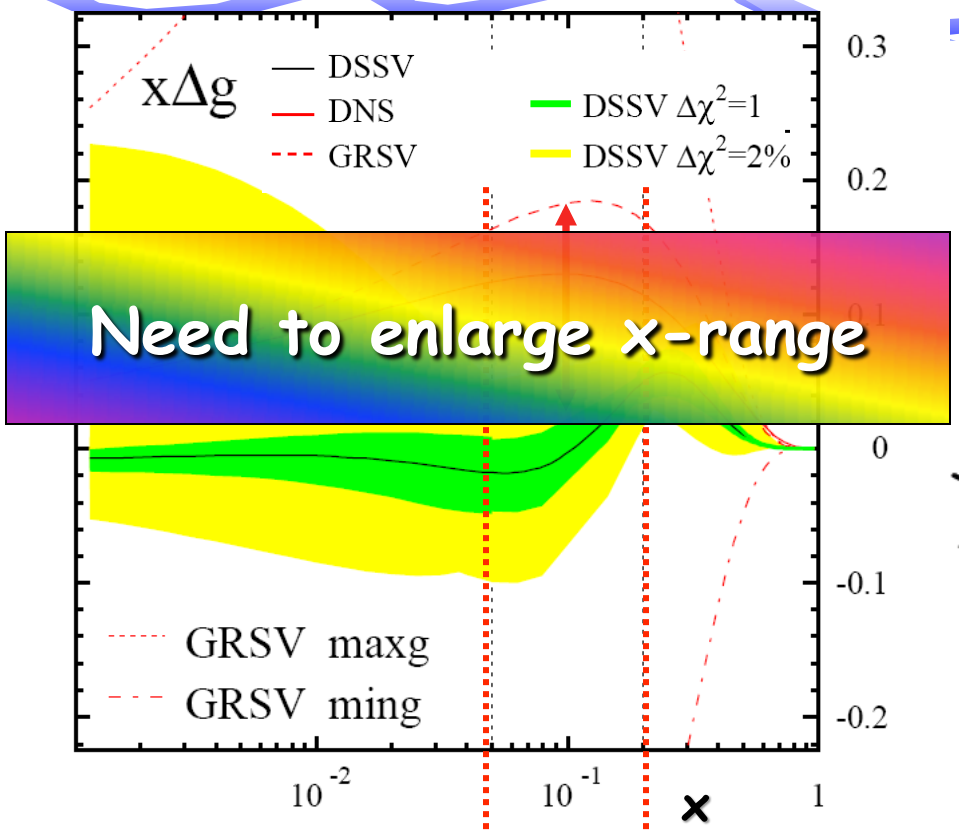


- ΔG: Indirect from scaling violation



Integrated Lumi: 5fb^{-1}

The Gluon Polarization



Need to enlarge x-range

small-x
0.001< x < 0.05

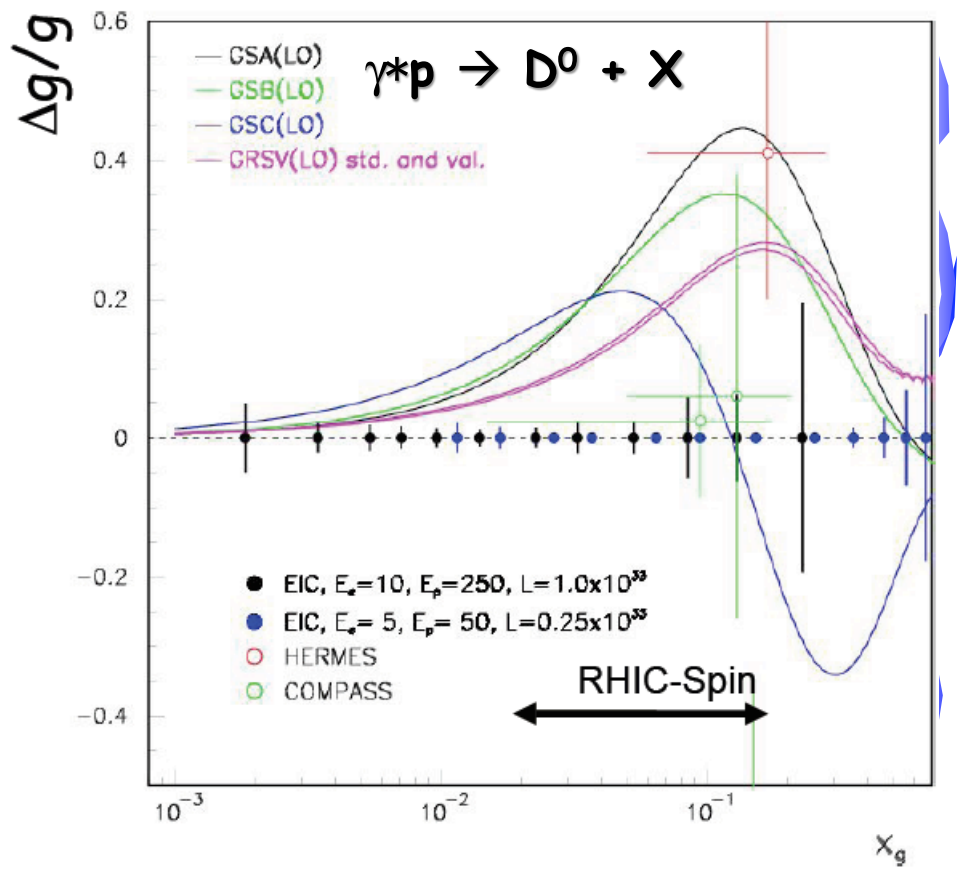
RHIC range
0.05· x · 0.2

large-x
x > 0.2

- Δg(x) very small at medium x
- best fit has a node at x ~ 0.1
- huge uncertainties at small x

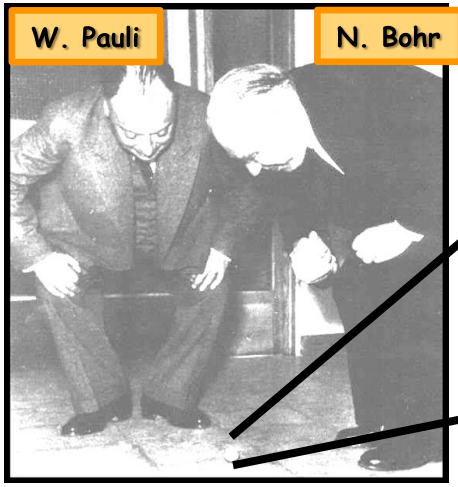
Δg(x) small !?

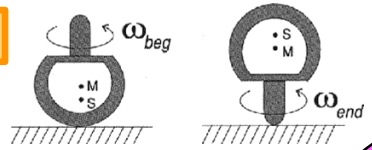
$$\int_0^1 \Delta g(x)\,dx = -0.084 @ 10 GeV^2$$

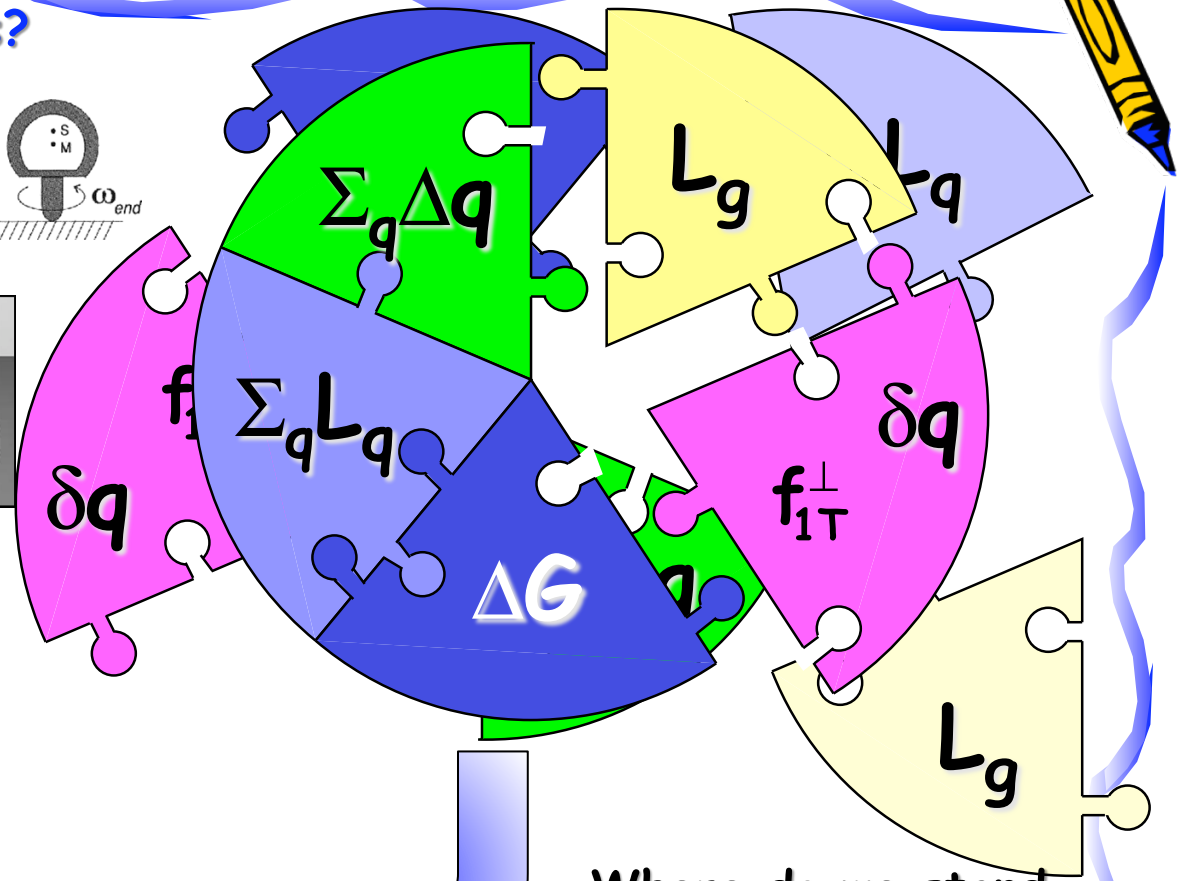


How do the partons contribute

Is the proton spinning like this?







"Helicity sum rule"

$$\frac{1}{2}\hbar = \left\langle P,\frac{1}{2}\middle| J^z_{QCD} \middle| P,\frac{1}{2}\right\rangle = \underbrace{\sum_q \frac{1}{2} S^z_q}_{\text{total u+d+s quark spin}} + \overbrace{S^z_g}^{\text{gluon spin}} + \underbrace{\sum_q L^z_q + L^z_g}_{\text{angular momentum}}$$

Where do we stand solving the "spin puzzle" ?

More Pointed Remarks from Individual EICAC Members

"If the Collaboration is truly interested in expediting the approval process – in time for the Long Range Plan in 2012, and DOE Critical Decisions (CD's) steps afterwards – then it would be prudent to converge on a site decision and machine plan as early as at all possible."

"Time scales beyond 2020 for a start of data taking are de-motivating, and unjustified it seems to me…The cost of the staged project is at the 10% level of what has been invested in RHIC, and comparable to the cost of many single purpose projects planned or envisaged in the nuclear and particle physics communities, so it is not obvious why the lead time should be so long. The laborator(s) (in this example BNL) should investigate possibilities to have a more aggressive time scale, while the EIC collaboration should present a clear and straightforward case for a project of this scope, keeping in mind that the staged project does not already need to reach all the final project goals."

"Of the two alternatives presented, the JLAB concept is in essence a new facility even though built around the existent CEBAF. As such, a lot of (basic) accelerator design work has to be done. The ion ring has a number of challenging beam parameters (e.g. the ultra-short ion bunches, beam lifetimes, figure-8 rings etc.). This is not to ignore the challenges for eRHIC."

EIC Organisation

EICC Steering Committee
- Abhay Deshpande*, Stony Brook, RBRC
- Rolf Ent, Jlab
- Charles Hyde, ODU/UBP, France
- Peter Jacobs, LBL
- Richard Milner*, MIT
- Thomas Ulrich, BNL
- Raju Venugopalan, BNL
- Werner Vogelsang, BNL

** contact persons*

International Advisory Committee
- Jochen Bartels (DESY)
- Allen Caldwell (MPI, Munich)
- Albert De Roeck (CERN)
- Walter Henning (ANL) chair
- Dave Hertzog (UIUC)
- Xiangdong Ji (U. Maryland)
- Robert Klanner (U. Hamburg)
- Katsunobu Oide (KEK)
- Naohito Saito (KEK)
- Uli Wienands (SLAC)

Working Groups:

ep Physics
- Ernst Sichterman, LBL
- Werner Vogelsang, BNL
- Christian Weiss, JLAB

eA Physics
- Vadim Guzey, JLAB
- Dave Morrison, BNL
- Thomas Ullrich, BNL
- Raju Venugopalan, BNL

Detector
- Elke Aschenauer, BNL
- Edward Kinney, Colorado
- Bernd Surrow, MIT

Electron Beam Polarimetry
- Wolfgang Lorenzon, Michigan

2 collaboration meetings/year

First meeting with IAC 16th of February @ SURA Headquarters in Washington

BNL eRHIC Taskforce

- The BNL Task Force for the EIC is led by:
  - Elke Aschenauer
  - Thomas Ullrich
- Other members of the task force are:
  - Ramiro Debbe
  - Jamie Dunlop
  - Wlodek Gury
  - Ed Kistenev
  - Matt Lamont
  - J. H. Lee
  - Pavel Nevski
  - Peter Steinberg
- Theory support
  - Raju Venugopalan
  - Werner Vogelsang

With support from CAD and other members from the physics depart.

Existing Experiment Luminosities

- Hera :
  - H1 and Zeus:
    - $10^{31} cm^{-2} s^{-1}$
    - 27GeV e+/e- 920GeV p $\sqrt{s}$ = 320GeV
    - did measure:
      - inclusive & semi-inclusive DIS
      - exclusive reactions (DVCS)
      - diffractive physics
      - electro-weak
  - Hermes:
    - fixed target 27GeV e+/e- $\sqrt{s}$=7.2GeV
    - polarised: $5 \times 10^{31} cm^{-2} s^{-1}$; unpol: $10^{32-33} cm^{-2} s^{-1}$;
    - did measure:
      - inclusive & semi-inclusive DIS
      - exclusive reactions (DVCS, pS, VM)
      - spin physics

Existing Experiment Luminosities

- CERN
  - Compass
    - fixed target 160GeV $\mu+/\mu-$ $\sqrt{s}=17$GeV
    - polarised: ~10^{31}cm^{-2}s^{-1}; unpol: 10^{32-33}cm^{-2}s^{-1};
    - did measure:
      - inclusive & semi-inclusive DIS
      - exclusive reactions (VM)
      - spin physics
    - plan to measure:
      - exclusive reactions (DVCS, PS)
      - Drell Yan
  - SMC, NMC and EMC very similar, with different beam energies