



2021 EIC UG Meeting Early Career Workshop

July 29-30, 2021

We are pleased to announce the 2021 EIC UG Meeting Early Career workshop. This event, dedicated to students and postdocs but open to everyone, will be held on July 29-30, 2021, the Thursday and Friday before the annual EIC User Group meeting.

Aims of the workshop:

- Increase the visibility of EIC-related contributions from students and postdocs.
- Offer a platform to students and postdocs to connect and exchange knowledge.
- Provide a venue to present and discuss EIC physics, detector, and accelerator science ahead of the User group meeting.

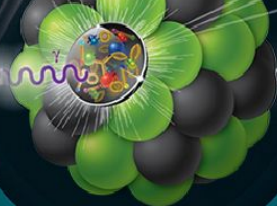
<https://indico.jlab.org/event/438>

2021 EIC UG Meeting: Early Career Workshop Summary

Jennifer Rittenhouse West
&
Wenliang (Bill) Li

on behalf of the 6 workshop organization
committee members

Poster by: Joanna
Griffin, Graphic
Designer at JLab



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<https://indico.jlab.org/event/438>

Event Organizing committee:

EIC²
EIC Center at Jefferson Lab

2020 Research Fellows

Postdoctoral research fellows



Charlotte Van Hulse
Orsay, France



Wenliang (Bill) Li
William & Mary, Virginia



Jennifer Rittenhouse West
LBNL, California

Graduate student fellows



Chiara Bissolotti
Pavia, Italy



Bhawin Dhital
Old Dominion University, Virginia



Jackson Pybus
MIT, Massachusetts

Senior scientist resources for us:



Douglas Higinbotham
Jefferson Lab



Miguel Arratia
UCR, California



Narbe Kalantarians
VUU, Virginia



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General Info:

- 27 submitted abstracts
- 3 invited speakers for special sessions
- 120 registered participants
- Average per session attendance: ~ 30

Workshop Code of Conduct:

- Adopted from:
<https://www.cosmologyfromhome.com/code-of-conduct/>

Our twitter feed:

- https://twitter.com/ion_early
- After workshop survey through Twitter



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<https://indico.jlab.org/event/438>



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Electron-Ion Collider Early Career Workshop

30 Tweets



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Electron-Ion Collider Early Career Workshop

@ion_early

First Annual EIC Early Career Workshop, 29-30 July 2021
EIC physics prior to the EIC User Group Meeting, August 2021
indico.jlab.org/event/438/

Joined May 2021

41 Following 33 Followers

Tweets

Tweets & replies

Media

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Pinned Tweet



Electron-Ion Collider Early Career Workshop @ion_early · Jul 24 ...

The Electron-Ion Collider Early Career Workshop right around the corner!! Check out our fantastic lineup of speakers - this is going to be 2 days of excellence:

indico.jlab.org/event/438/

You can still register, up until the last moment - the more the merrier 🌟🌟🌟🌟



Electron-Ion Collide ...
@ion_early



2021 EIC UG Meeting Early Career Workshop
Welcome to the EIC Early Career Workshop 2021!
Check us out on the ...
indico.jlab.org



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<https://indico.jlab.org/event/438>

- Idea by Wenliang Li last September!

Initiating a postdocs/students only EIC workshop/conference next year? [Inbox x](#)



Wenliang Li <wenliang.billlee@googlemail.com>

Fri, Sep 18, 2020, 2:01 PM

to jrwest@slac.stanford.edu, cvanhuls@mail.cern.ch, Bhawin, jrpybus@mit.edu, chiara.bissolotti01@ateneopv.it, Douglas ▾

Dear EIC fellows:

This is Bill, a postdoc at College of William and Mary. Just like you, I am also one of the EIC fellowship recipients. First of all, I would like to congratulate all of us for this wonderful opportunity to further our individual research.

After going to many of the recent EIC related workshops, I noticed one thing: there are very few talks given by the main work forces, namely the graduate students and postdocs. Most of the presentations given are mainly within their sub working group. This is not an ideal scenario when one wants to publicize his/her work and exchange knowledge with others.

How do you like the idea that we initiate a workshop that only involves the postdocs and students on the EIC related research topics? Lets say next July or August?

As the initiator of this proposal, I will look into the funding opportunities to host the workshop, such as JLab initiative fund, etc. Of course, I will draft the funding plan on behalf of all of us.

Many thanks and please let me know your thoughts. Even you think I am crazy, :)

Best wishes and have a great weekend,

Bill

Day 1

Start @
10am EDT

10:00	Welcome - Wenliang Li (College of William and Mary) ()		
10:05	Special session - Wenliang Li (College of William and Mary) (until 10:50) ()		
10:05	Invited talk on Accelerator Physics - Andrei Seryi (JLAB) ()		
10:50	--- Break ---		
11:00	Presentation Session - Bhawin Dhitai (Old Dominion University/Jefferson Lab) (until 12:15) ()		
11:00	An ultrafast harmonic kicker for the RCS injection of the EIC - Gunn Tae Park (Jefferson Lab) ()		
11:15	The Scintillating Fiber Tracking Detector, a qualitative approach - Carlos Ayerbe Gayoso (Mississippi State University) ()		
11:30	Time measurements using ultra fast silicon detectors with a 120 GeV Proton Beam for the TOPSIDE Detector Concept at the Electron-Ion Collider - Manoj Jadhav (Argonne National Laboratory) ()		
11:45	High-performance DIRC detector for the future Electron-Ion Collider - Dr Nilanga Wickramaarachchi (The Catholic University of America) ()		
12:00	Tagged measurements of Short-Range Correlation at the EIC - Florian Hauenstein (Old Dominion University) ()		
12:15	--- Lunch ---		
12:35	Presentation Session - Jackson Pybus (MIT) (until 13:35) ()		
12:35	Diffraction dissociation in electron-nucleus collisions: theory and phenomenology - Anh Dung Le (CPHT, CNRS Ecole Polytechnique, IP Paris) ()		
12:50	Neutron Spin structure from e-3He scattering with double spectator Tagging at EIC - Dien Nguyen (MIT) ()		
13:05	QCD dynamics in nuclei: Diquarks and the Novel Color Singlet Hexadiquark - Dr Jennifer Rittenhouse West (Berkeley Lab and the EIC Center at Jefferson Lab) ()		
13:20	Design of a Stripline Injection Kicker for the Hadron Storage Ring of Electron-Ion collider - Medani Sangroula (Brookhaven National Laboratory) ()		
13:35	--- Break ---		
13:45	Presentation Session - Jennifer Rittenhouse West (Berkeley Lab and the EIC Center at Jefferson Lab) (until 15:00) ()		
13:45	Meson Structure Studies at EIC - Richard Trotta (The Catholic University of America) ()	 	
14:00	Accessing pion GPDs through the Sullivan process at the future EIC - Jose Manuel Morgado Chávez (Universidad de Huelva) ()		
14:15	Gluon spatial distributions in the nucleon - Brandon Kriesten (University of Virginia) ()		
14:30	u-Channel P10 Production at EIC - Wenliang Li (William & Mary) ()		
14:45	Investigation of Vector Meson Backward-Production Capabilities at the EIC - Zachary Sweger (UC Davis) ()		

Invited session on
accelerator physics

Accelerator & Hardware

Diffraction Studies + N,
N-N Internal structure

Probing Hadron Structure

End @
3pm EDT

Day 2

Start @
10am EDT

10:00	Special session - Chiara Bissolotti (University of Pavia and INFN) (until 10:35) ()	🔗
10:00	Invited talk: Opportunities for hadron structure studies at the EIC - Andrea Signori (University of Pavia and Jefferson Lab) ()	🔗
10:35	--- Break ---	
10:40	Presentation Session - Chiara Bissolotti (University of Pavia and INFN) (until 11:40) ()	🔗
10:40	Nuclear TMDs and 3D imaging in nuclei - John Terry (UCLA) ()	🔗
10:55	Towards twist-2 T-odd TMD gluon distributions - Francesco Giovanni Celiberto (ECT*/FBK Trento & INFN-TIFPA) ()	🔗
11:10	Probing gluon TMDs with tagged and reconstructed heavy flavor hadron pairs at the EIC - Sooraj Radhakrishnan ()	🔗
11:25	Constraints on Gluon Distribution Functions in the Nucleon and Nucleus from Open Charm Hadron Production - Matthew Kelsey (Wayne State University) ()	🔗
11:40	Group Photo on Zoom I - Wenliang Li (William & Mary) (until 11:45) ()	🔗
11:45	--- Break ---	
12:10	Presentation Session - Charlotte Van Hulse (JCLab) (until 13:25) ()	🔗
12:10	Entanglement, partial set of measurements, and diagonality of the density matrix in the parton model - Haowu Duan (North Carolina State University) ()	🔗
12:25	Forward dijets in proton-nucleus collisions at next-to-leading order: the real corrections - Yair Mulian (Jyväskylä University) ()	🔗
12:40	Jet fragmentation functions at the EIC - Fanyi Zhao (UCLA) ()	🔗
12:55	Multiple parton scattering and gluon saturation in dijet production at EIC - Yuan-Yuan Zhang (CCNU) ()	🔗
13:10	Λ_c^+ baryon production at future EIC - Yuanjing Ji ()	🔗
13:25	--- Break ---	
13:30	Presentation Session - Wenliang Li (College of William and Mary) (until 14:35) ()	🔗
13:30	VR Event and Detector Display for ATHENA - Sean Preins (University of California Riverside) ()	🔗
13:45	Deeply learning deep inelastic scattering kinematics - Abdullah Farhat (Old Dominion University) ()	🔗
14:00	Simultaneous Monte Carlo analysis of parton densities and fragmentation functions - Eric Moffat (Old Dominion University) ()	🔗
14:15	eHIJING: an EIC event generator for jet tomography - Welyao Ke (University of California, Berkeley; Lawrence-Berkeley National Lab) ()	🔗
14:35	--- Break ---	
14:45	Special session - Jennifer Rittenhouse West (Berkeley Lab and the EIC Center at Jefferson Lab) (until 15:20) ()	🔗
14:45	Data Visualization - Lawrence Weinstein (Old Dominion University) ()	🔗

Invited session on Theory

GPDs and TMDs

← Zoom Photo @ 11:40 am EDT

Jets and Baryon Production

Innovative utility/tools

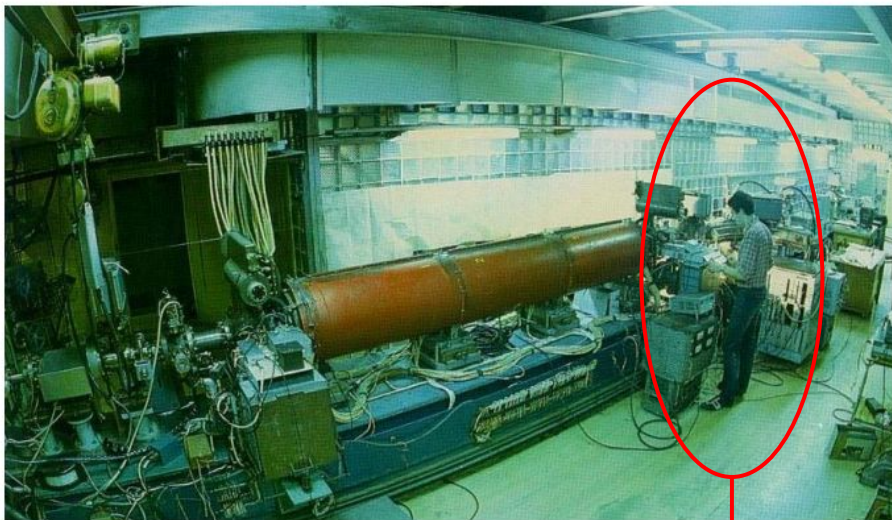
Invited session on Data Visualization

End @
3:20pm EDT

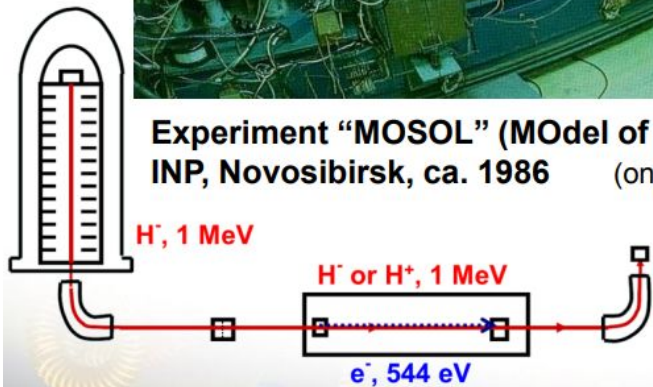
Group Photo!



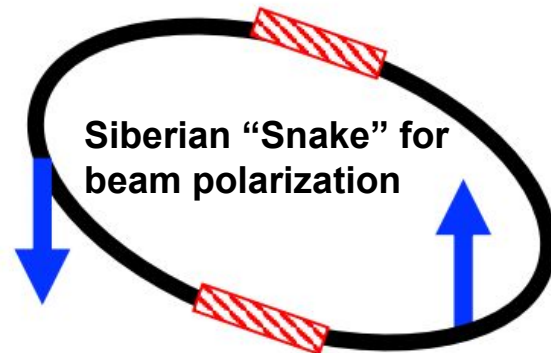
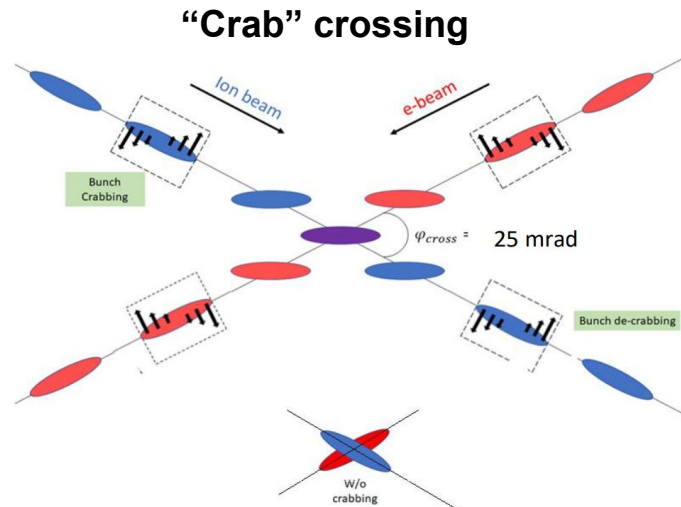
Invited presentation #1: Accelerators, Andrei Seyri



Experiment "MOSOL" (MOdel of SOLenoid) – Budker INP, Novosibirsk, ca. 1986 (on the photo – today's speaker)



Young Andrei in 86



Invited presentation #2: Opportunities for hadron structure studies at the EIC

By Andrea Signori

- 00 home
- 01 about
- 02 goals
- 03 design
- 04 benefits
- 05 status
- 06 views

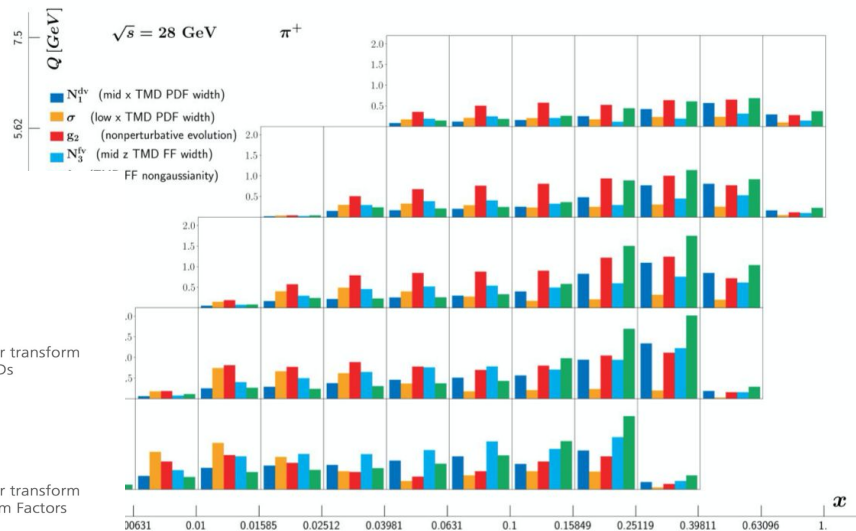
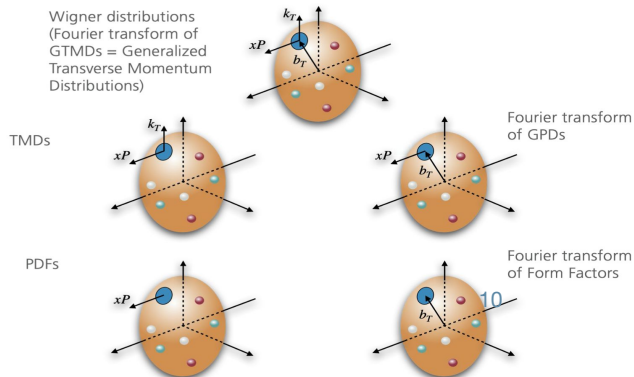
Precision 3D imaging of protons and nuclei
An Electron-Ion Collider will take three-dimensional precision snapshots of the internal structure of protons and atomic nuclei.

Solving the Mystery of Proton Spin
An EIC would reveal how the teeming quarks and gluons inside the proton combine their spins to generate the proton's overall spin.

Search for Saturation
A unique form of matter, the color glass condensate, may be produced for study for the first time by an EIC, providing deeper insights into the nature of the strong force.

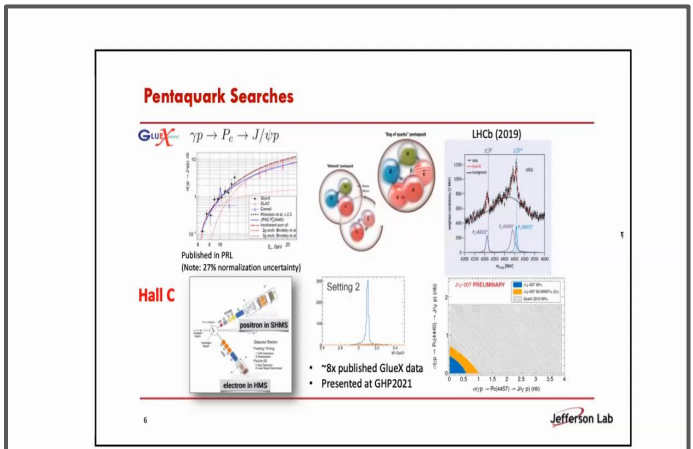
Quark and Gluon
Experiments at an EIC would observe in isolation but

The hadron structure landscape



TMD impact studies

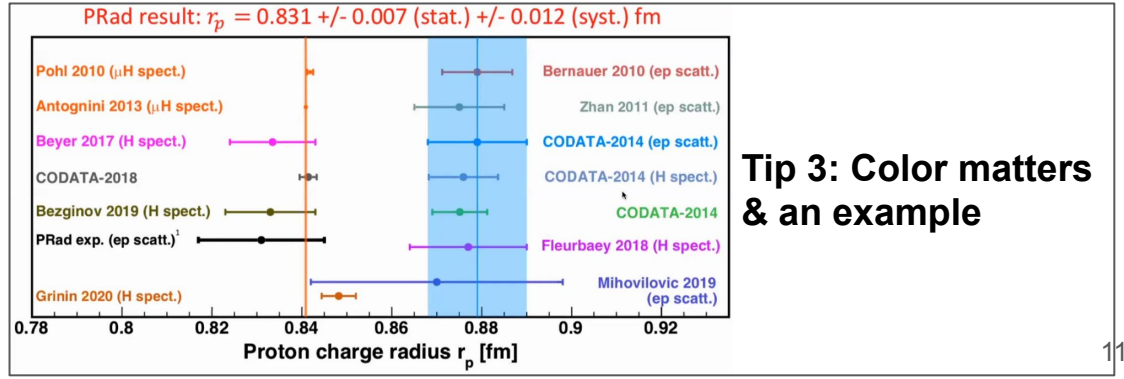
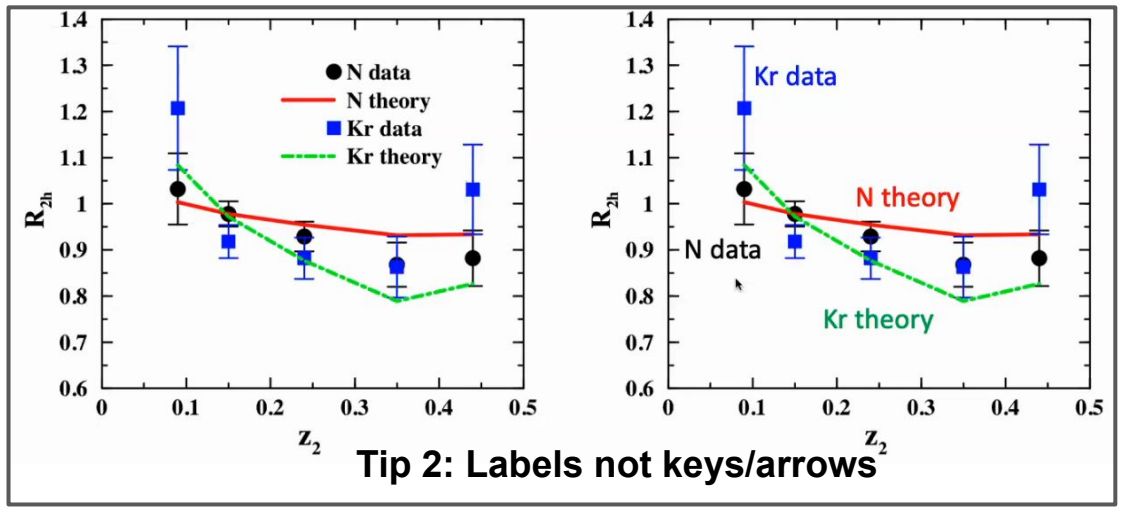
Invited presentation #3: Data visualization by Larry Weinstein



Headers and footers convey little information

Tip 1: Don't waste space & an example

21



Session Summaries

Thursday Sessions

- **Accelerator & Hardware**
 - **Session Convenor/Chair: B. Dhital**
 - **5 talks**
- **Diffraction Studies + N, N-N Internal structure**
 - **Session Convenor/Chair: J. Pybus**
 - **4 talks**
- **Probing Hadron Structure**
 - **Session Convenor/Chair: J. Rittenhouse West**
 - **5 talks**

Friday Sessions

- **GPDs and TMDs**
 - **Session Convenor/Chair: C. Bissolotti**
 - **4 talks**
- **Jets and Baryon Production**
 - **Session Convenor/Chair: C. Van Hulse**
 - **5 talks**
- **Innovative utility/tools**
 - **Session Convenor/Chair: W. (Bill) Li**
 - **4 talks**

Student Fellows: first time chair a session, did a fantastic job.

EIC UG Early Career Workshop, July 29 – 30 (B. Dhital)

✚ **Presentation session : Accelerator and Hardware at EIC, July 29 (11:00 am – 12:15 pm)**

✚ 5 presentations :

- **Gunn Tae Park, Jefferson Lab** - *An Ultrafast Harmonic Kicker: deflecting device that can deliver a sharp kick on the selected bunches.*
- **Carlos A. Gayoso, Mississippi State University** - *The Scintillating Fiber Tracking Detector : fast detector useful for trigger process.*
- **Manoj Jadhav, Argonne National Lab** - *Time Measurements using Ultra-Fast Silicon Detectors : for particle identification.*
- **Nilanga Wickramaarachchi, The Catholic University of America** - *High Performance DIRC Detector : for precise measurement and identification of particles.*
- **Florian Hauenstein, Old Dominion University** - *Tagged Measurements of Short-Range Correlations (SRC) : interesting SRC physics and simulated quasi-elastic SRC experiments at EIC.*

Diffractive Processes & Internal Structure of Nuclei Session (J. Pybus)

- **Anh Dung Le (CPHT, CNRS Ecole Polytechnique, IP Paris)** — Diffractive dissociation in electron-nucleus collisions: theory and phenomenology
- **Dien Nguyen (MIT, Jefferson Lab)** — Neutron Spin structure from e-3He scattering with double spectator Tagging at EIC
- **Jennifer Rittenhouse West (Berkeley Lab, EIC Center at Jefferson Lab)** — QCD dynamics in nuclei: Diquarks and the Novel Color Singlet Hexadiquark
- **Medani Sangroula (Brookhaven National Lab)** — Design of a Stripline Injection Kicker for the Hadron Storage Ring of Electron-Ion collider

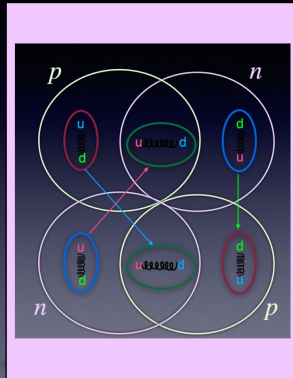
Diffractive Processes & Internal Structure of Nuclei Session: All great! A sample...

Convener: J. Pybus

“Diquarks & the Hexadiquark Structure in Nuclei,”
Jennifer Rittenhouse West

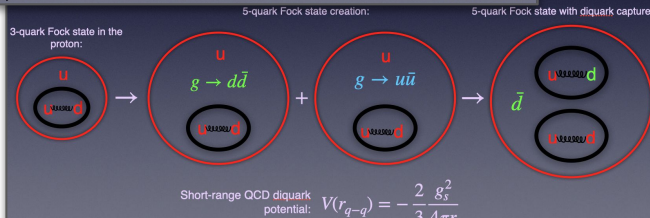
Fundamental QCD effects in nuclei

- Fundamental QCD degrees of freedom: color charged quarks and gluons
- fQCD underlies all of nuclear physics but often unnecessary to descend to that level - Effective field theory sufficient!
- Experimental puzzle: 1983 EMC effect, mysterious quark behavior in nuclei
- Diquark & Hexadiquark solution proposed
- *Diquark implications* → Experiment: SeaQuest/NuSea/NA51/NMC, excess of \bar{d} quarks in the proton sea
- *Diquark implications* → Future experiments: EIC, SpinQuest, measurements of quark and sea quark contributions to nucleon spin



EXCESS

the d quark

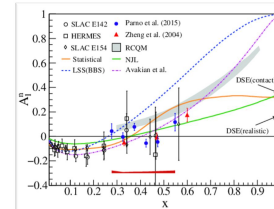


“Neutron spin structure from e-3He with Double spectator tagging at EIC,” Dien Nguyen

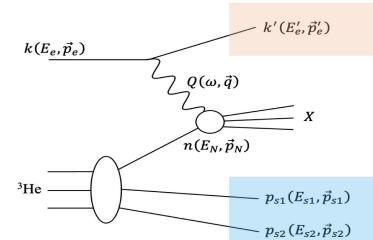
Spin structure function obtained from asymmetry measurement

$$A_1(x, Q^2) = \frac{\sigma^{\uparrow\downarrow} - \sigma^{\uparrow\uparrow}}{\sigma^{\uparrow\downarrow} + \sigma^{\uparrow\uparrow}} \approx \frac{g_1(x, Q^2)}{F_1(x, Q^2)}$$

- Neutron asymmetry necessary for the flavor study
- No free neutron target



Double spectator tagging suppress model dependence



- Select the active nucleon in the reaction and break up channel
- Suppress the contribution of non-nucleonic degree of freedom
- “Effective” free neutron target

Thursday afternoon session: Hadron Structure

- Convener: Jennifer Rittenhouse West, LBNL
- Talk 1: “**Meson Structure Studies at EIC**,” *Richard Trotta*, The Catholic University of America
- Talk 2: “**Accessing pion GPDs through the Sullivan process at the future EIC**,” *Jose Manuel Morgado Chávez*, Universidad de Huelva Spain
- Talk 3: “**Gluon Spatial Distributions in the Nucleon**,” *Brandon Kriesten*, University of Virginia
- Talk 4: “**u-channel π^0 production at the EIC**,” *Wenliang Li*, William and Mary
- Talk 5: “**Investigation of Vector Meson Backward-Production Capabilities at the EIC**,” *Zachary Sweger*, University of California Davis

Hadron structure session: Highlights

Convener: J. Rittenhouse West

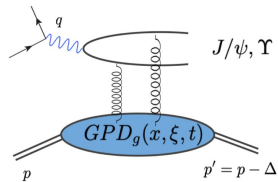
“Gluon spatial distributions in the nucleon,” B. Kriesten

Pion GPDs through the Sullivan process at EIC was presented in two separate presentations Richard Trotta and Jose Manuel Morgado Chávez!

Exclusive Measurements of Gluon Distributions

Exclusive electroproduction of vector mesons (such as the J/ψ) probe the gluon content of nuclei.

Gluon GPDs enter the vector meson production cross section.
Y. Guo, X. Ji, Y. Liu [arXiv:2103.11506](#)

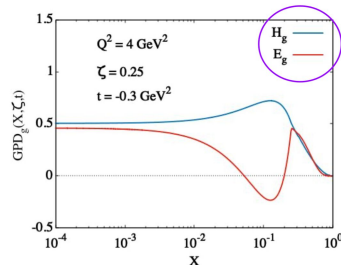


$$\frac{d\sigma}{dt} \propto \left(1 - \frac{t}{4M^2}\right) E_2^2 - 2E_2(H_2 + E_2) + (1 - \xi^2)(H_2 + E_2)^2$$

$$E_2 = \int_0^1 dx E_g(x, \xi, t) \quad H_2 = \int_0^1 dx H_g(x, \xi, t)$$

EIC White Paper [arXiv: 1212.1701](#)

Flexible Gluon GPD Model



Allows us to calculate gluon angular momentum observables as they appear in experiment.

B. Kriesten, P. Velie, E. Yeats, F.Y. Lopez, S. Liuti [arXiv:2101.01826](#)

Phenomenology of pion GPDs: Sullivan process

We have established a way of building pion GPD models fulfilling all of the QCD theoretical constraints, so...

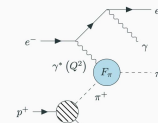
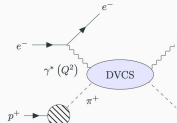
Question: Can we probe those pion GPDs through experiment?

DVCS amplitudes are parametrized by hadron GPDs.
[X.-J.-PRD:7114(55)1997]

Sullivan process [J.D.Sullivan-PRD:1732(5)1972]

One pion exchange approximation: [D.Amrath et al.-EPJC:179(58)2008]

- $-t < 0, 6 \text{ GeV}^2$
 - $\sigma_L \gg \sigma_\perp$
- } Met at EIC [EICYR:phys.ins-det/2103.05419]



Employed for EFFs.
[G.M.Huber et al.-PRC:045203(78)2008]

Can we probe pion GPDs?

[D.Amrath et al.-EPJC:179(58)2008]

Pion GPDs: Asymmetry (EIC)

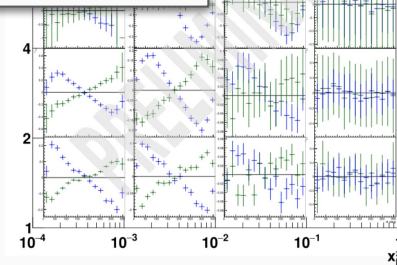
“The Sullivan process is expected to provide access to pion GPD models at the future EIC.

The reason for that being that a non-zero asymmetry means that we can “isolate” the interference term. And this is what we need.” - JMMC

Legend:

L-beam: 18 GeV
H-beam: 275 GeV

Blue: LO
Green: NLO



Non-zero asymmetry: optimism about measuring DVCS on pions at future EIC.

“Our model is an attempt to study what size we would expect the gluon GPDs to be given the current data available from lattice calculations.” - BK

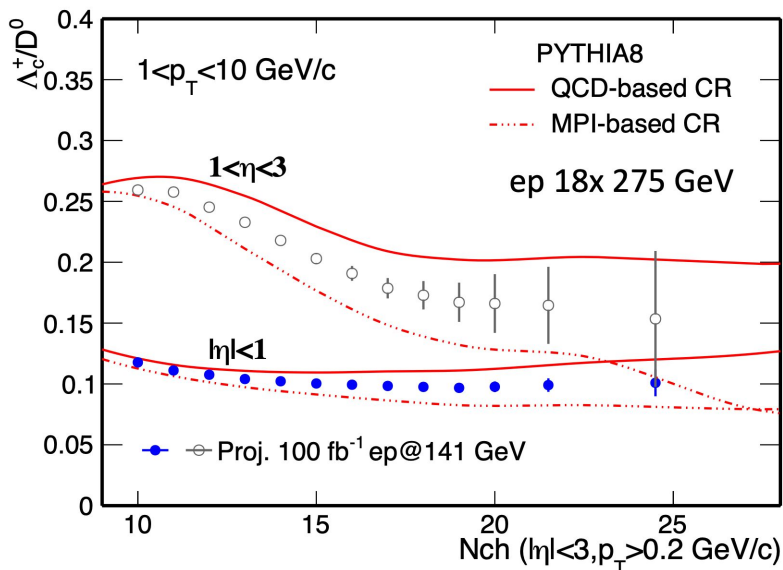
Jets and hadron formation (Charlotte Van Hulse)

- Entanglement, partial set of measurements, and diagonality of the density matrix in the parton model, Haowu Duan
- Toward full result for NLO dijet production in proton-nucleus collisions, Yair Mulian
- Jet fragmentation functions at the EIC, Fanyi Zhao
- Multiple Parton Scattering and Gluon Saturation in Dijet Production at EIC, Yuan-Yuan Zhang
- Charm baryon production in the future EIC, Yuanjing Ji

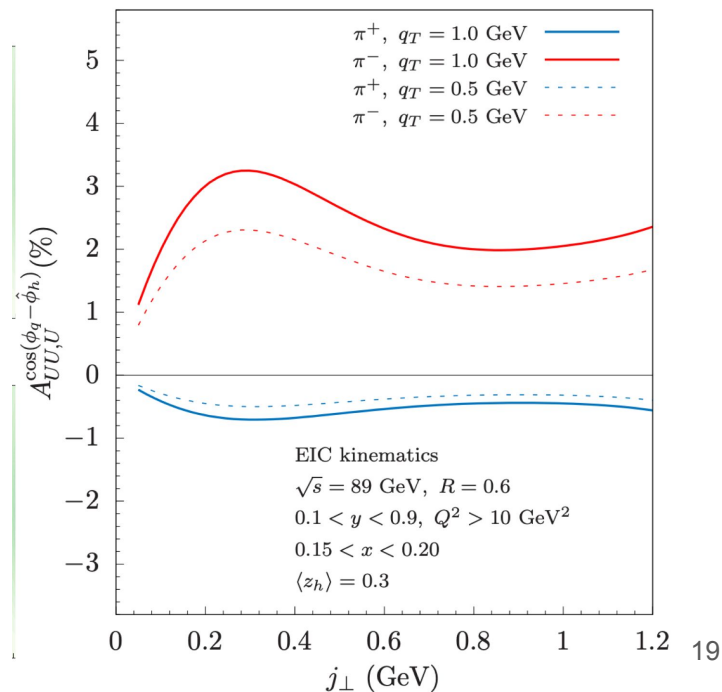
Jets and hadron formation session: A few of the results

Study non-universality of charmed baryon production, through the inclusion of color reconnection (Yuanjing Ji).

Projected uncertainties at an EIC



Hadrons in jets (described by TMDJFFs) provides complementary access to TMD PDFs. Sizeable asymmetries in the spin-dependent $ep \rightarrow e + \text{jet}(h) + X$ process can be measured at an EIC. (Fanyi Zhao)



GPDs and TMDs session (Chiara Bissolotti)



UCLA Mani L. Bhaumik Institute
for Theoretical Physics

Nuclear TMDs and 3D imaging in nuclei (arXiv:2107.12401)

John Terry

In collaboration with Mishary Alrashed, Daniele Paolo Anderle,
Zhong-bo Kang, and Hongxi Xing

**the first extractions of the nuclear modified
TMDPDF and TMDFFs**

**gluon TMDs in a
spectator model**

**Toward twist-2 T -odd
TMD gluon distributions**

Francesco Giovanni Celiberto

ECT*/FBK Trento & INFN-TIFPA

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Trento Institute for
Fundamental Physics
and Applications



HAS QCD
HADRONIC STRUCTURE AND
QUANTUM CHROMODYNAMICS

Toward twist-2 T -odd TMD gluon distributions

Francesco Giovanni Celiberto

ECT*/FBK Trento & INFN-TIFPA

ECT*

EUROPEAN CENTRE FOR THEORETICAL STUDIES
IN NUCLEAR PHYSICS AND RELATED AREAS



TIFPA
Trento Institute for
Fundamental Physics
and Applications



HAS QCD

HADRONIC STRUCTURE AND
QUANTUM CHROMODYNAMICS

gluon TMDs in a spectator model

Probing gluon TMDs with reconstructed and tagged heavy flavor hadron pairs at the EIC

Sooraj Radhakrishnan

*Kent State University/ Lawrence Berkeley National Laboratory
(In collaboration with Xin Dong, Yuanjing Ji, Matthew Kelsey, Nu Xu)*

pair tagging with good purity will benefit
gluon transverse momentum dependent
measurements

Constraints on Gluon Distribution
Functions in the Nucleon and Nucleus
from Open Charm Hadron Production

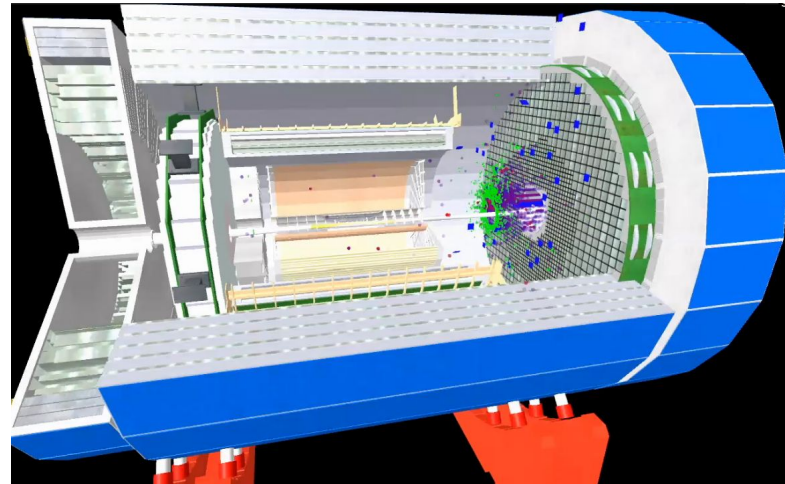
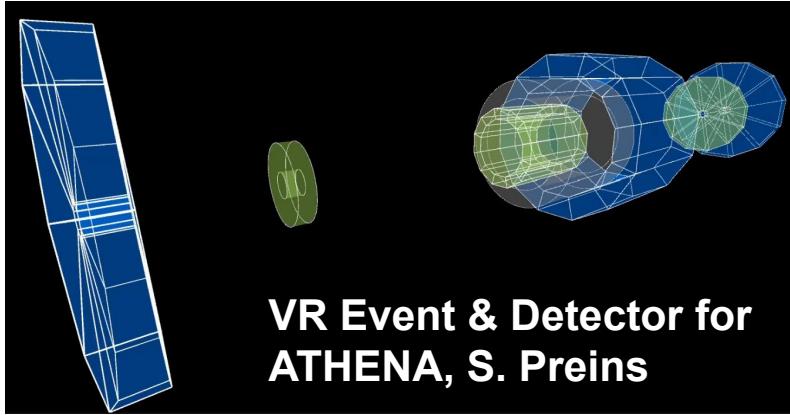


Matthew Kelsey*
Wayne State University

*EIC UG Meeting Early Career
Workshop July 29-30, 2021*

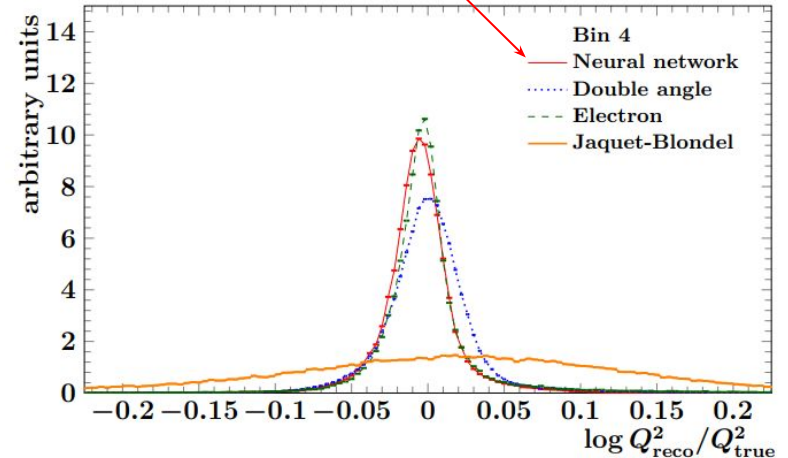
Effects of intrinsic charm on
projected data

Session Summary: Interesting EIC Utility/Tools (Wenliang Li)



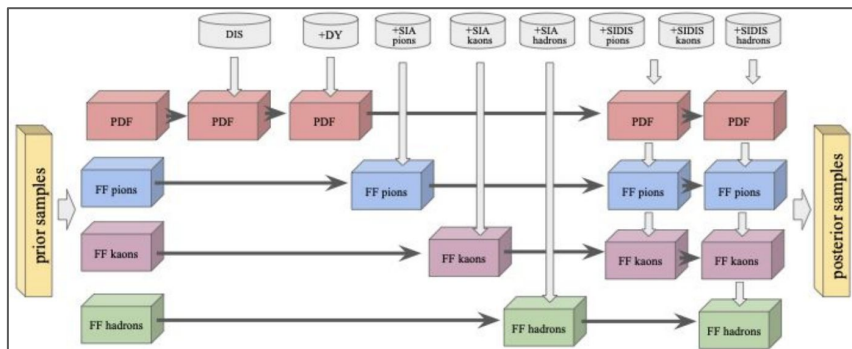
Deeply Learning DIS Kinematics,
A. Farhat

Reconstructed Q^2 with Zeus data
machine learning (red) vs other method

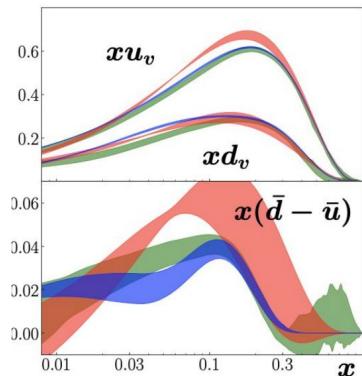


Session Summary: Interesting EIC Utility/Tools (Wenliang Li)

Simultaneous MC analysis of parton densities and fragmentation functions, E. Moffat

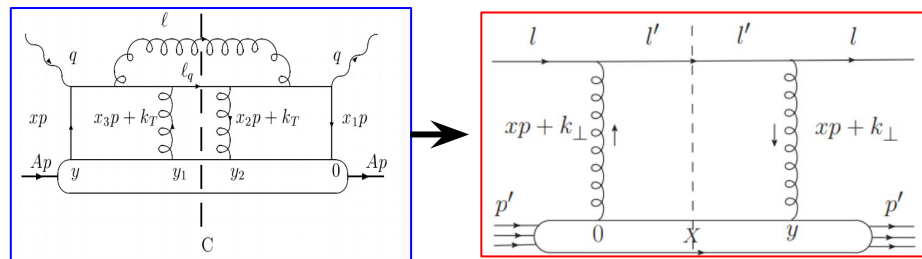


PDFs



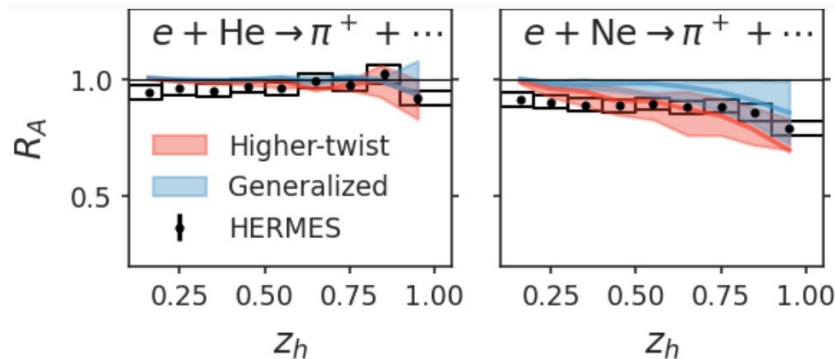
Example results:
extracted PDFs from
the simultaneous fit

eHIJING: an event generator for jet tomography at the EIC, Weiyao Ke



P+P collision tool turning to e+P collision
to study TMDs, EIC predictions coming in 3-4 month

Preliminary results compared to data



Survey Results

Issues:

- Time unfavorable for Asian participants
- Talks are too short
- Schedule is crammed
- Not in person



Electron-Ion Collider Early Career Workshop @ion_early · Jul 30

...

How did we do with the first annual EIC Early Career Workshop?

More invited speakers ✓

28.6%

More talks/longer talks

14.3%

Great & will attend 2022!

57.1%

Not great, won't return!

0%

Our hope/plan: Annual EIC Early Career Workshop, a new tradition! 20 years from now we can look back to our origin story, starting from that one Bill Li emailed in 2020...