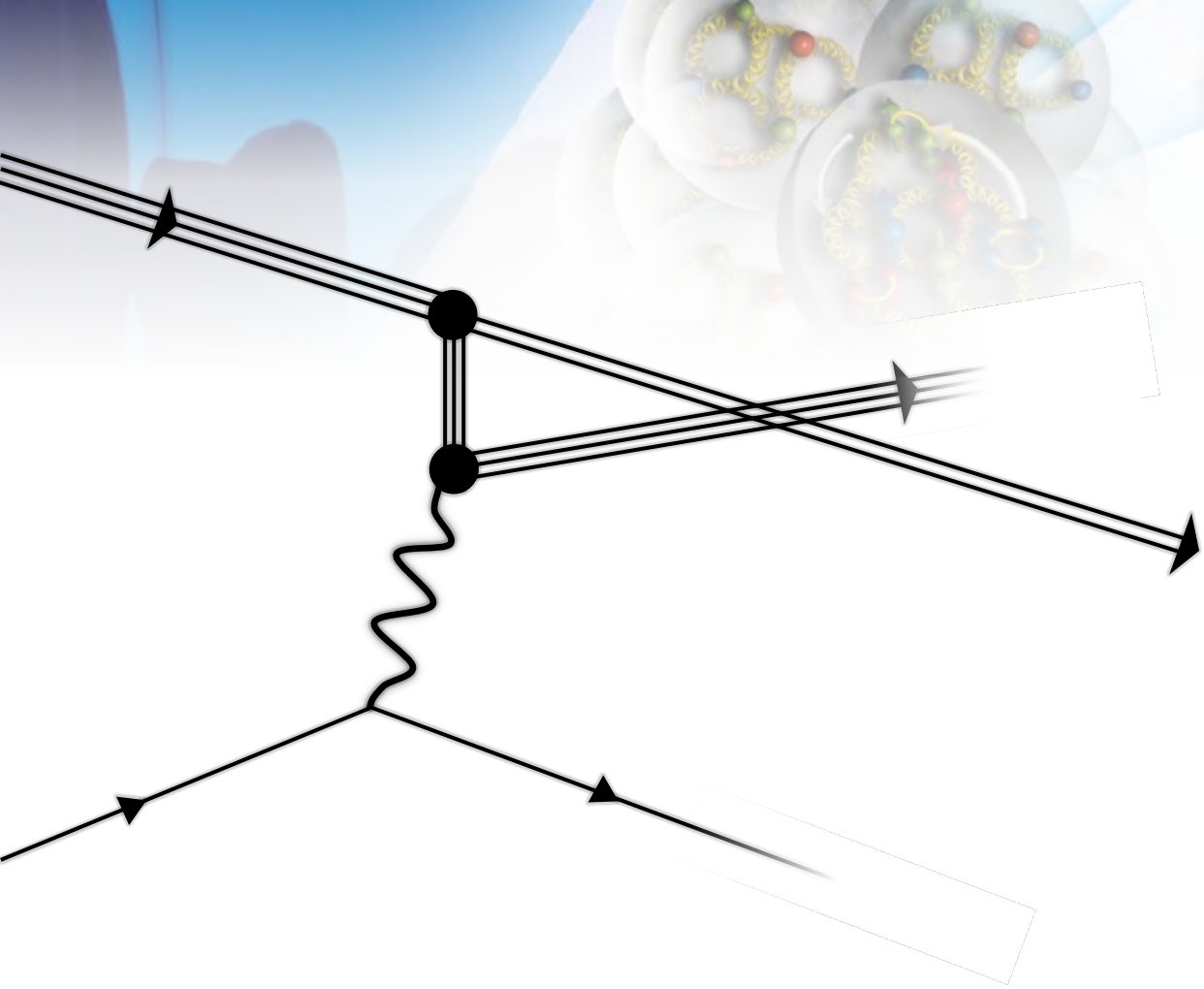
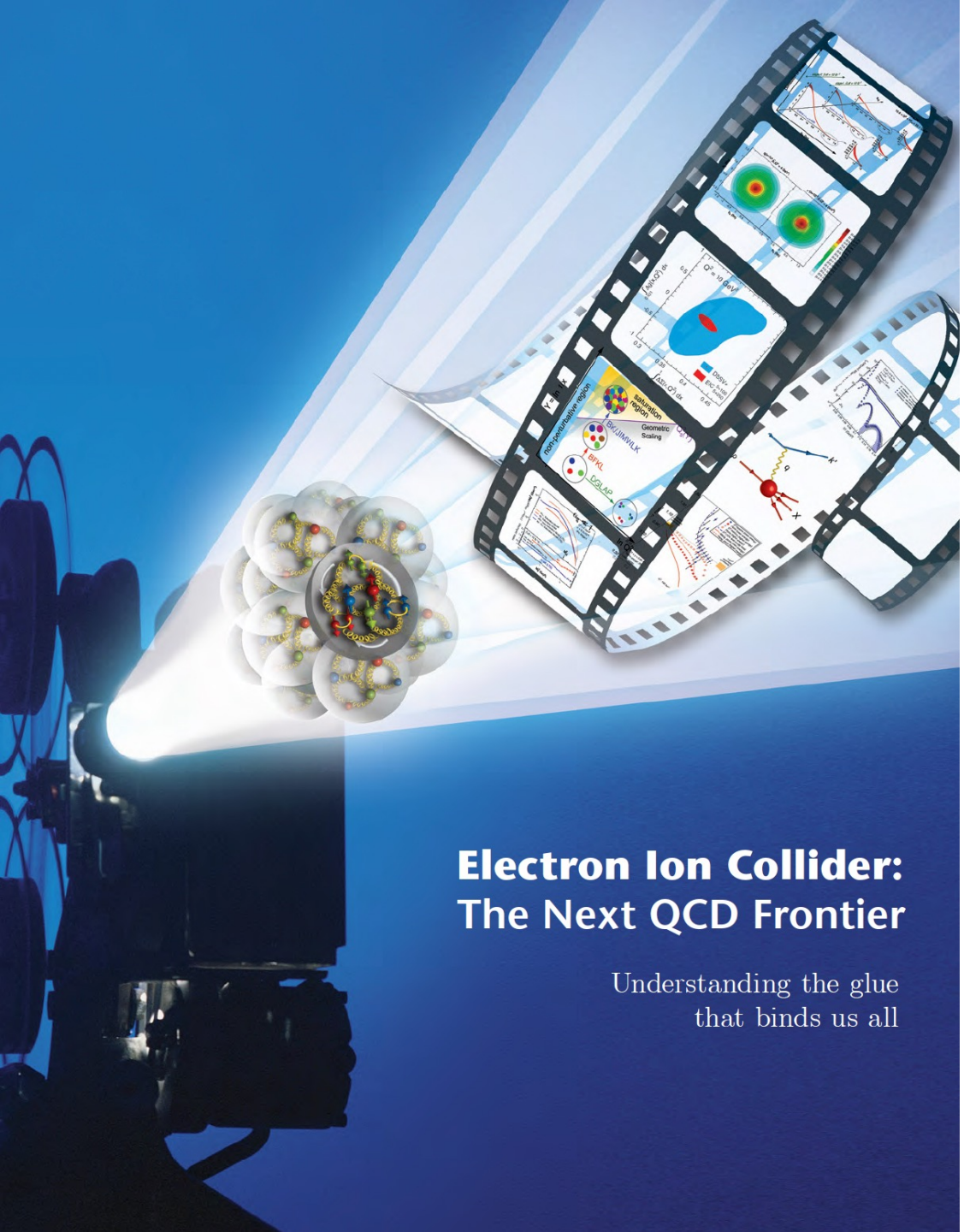


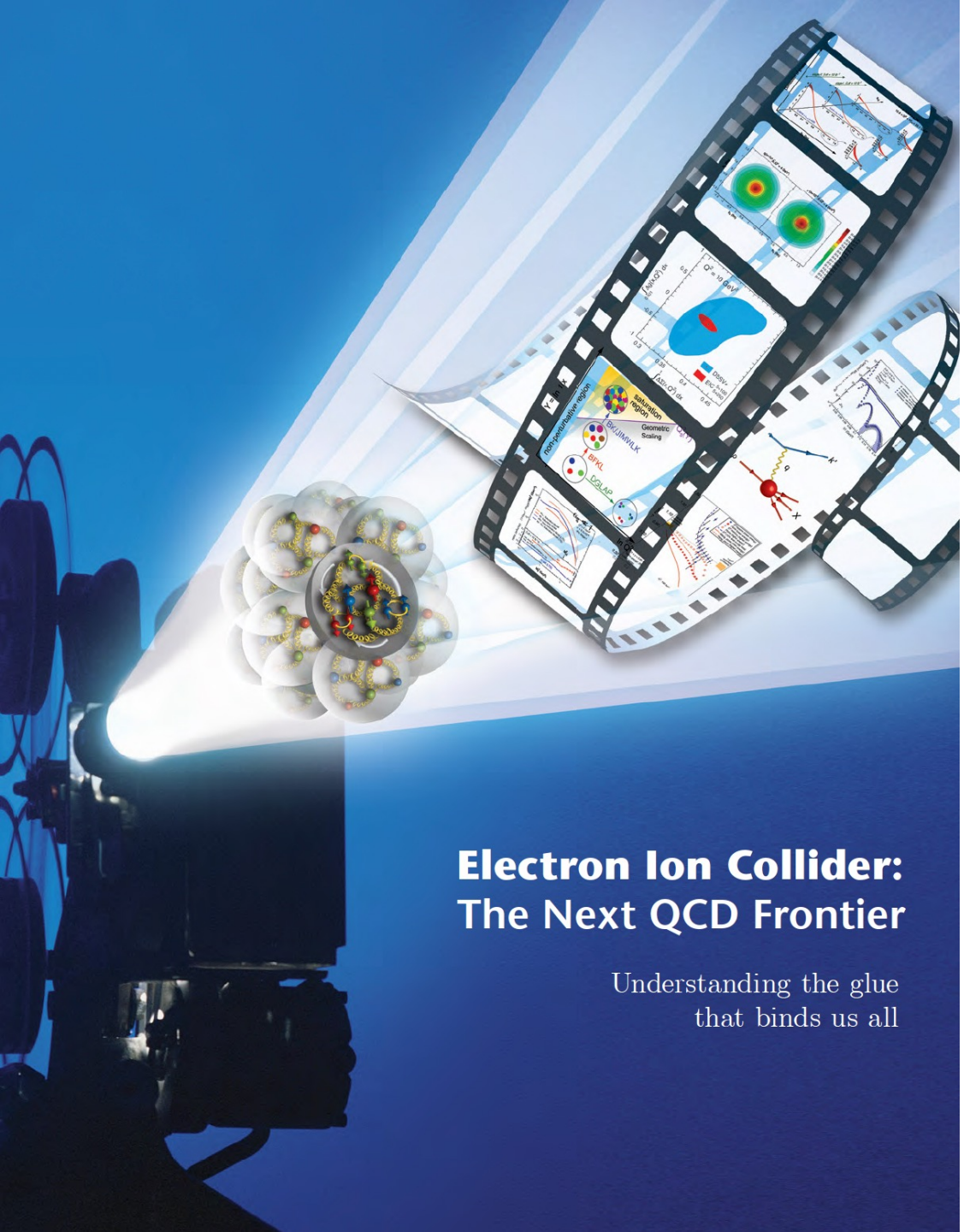
u-channel Physics at the EIC

Zachary Sweger
University of California, Davis

Supported in part by

Nuclear Imaging





Nuclear Imaging

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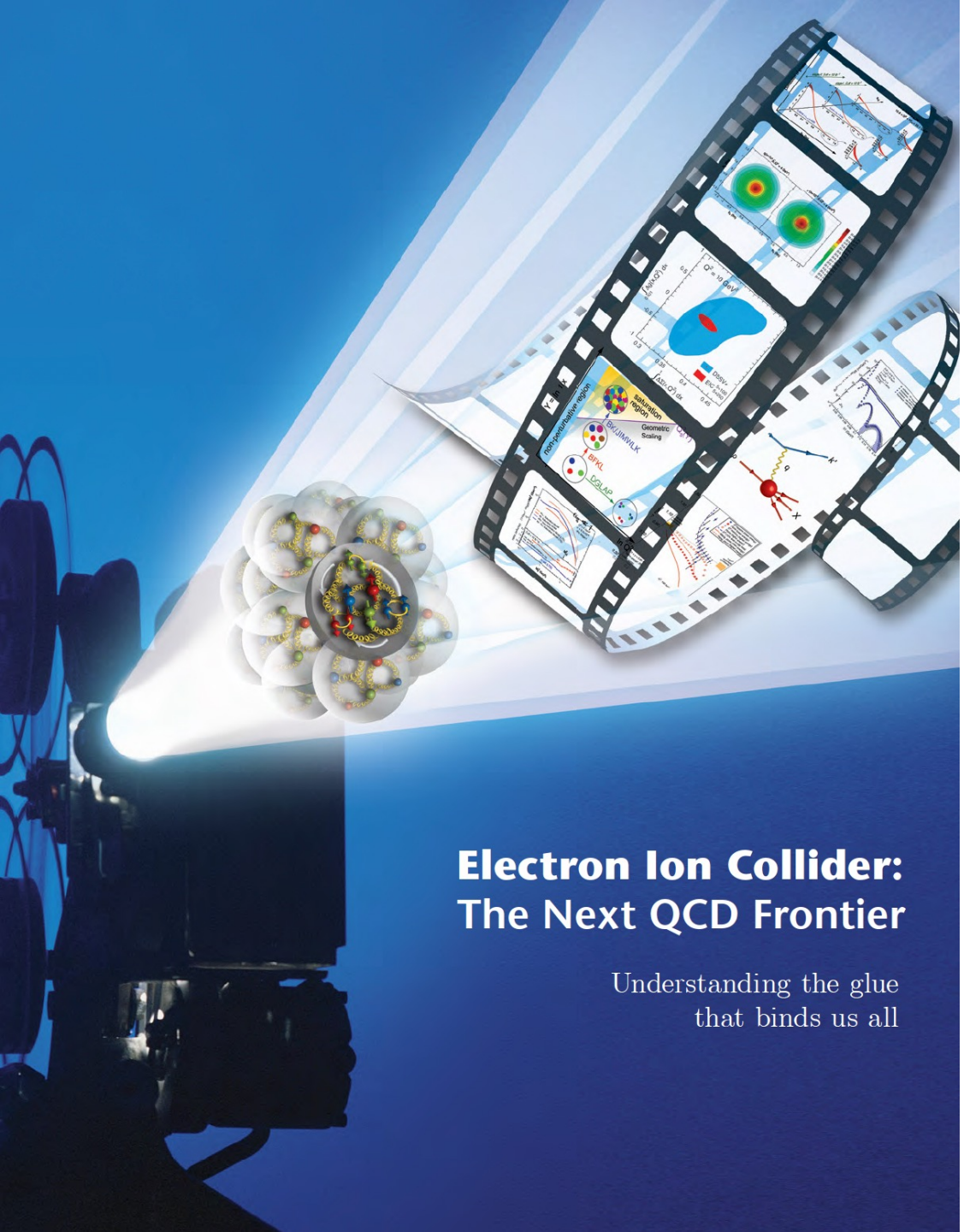
- EIC will be a precision nuclear imaging machine



Nuclear Imaging

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- EIC will be a precision nuclear imaging machine
- Meson production + DVCS golden channels for tomography

Nuclear Imaging

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Tomography at the EIC

Nuclear Imaging

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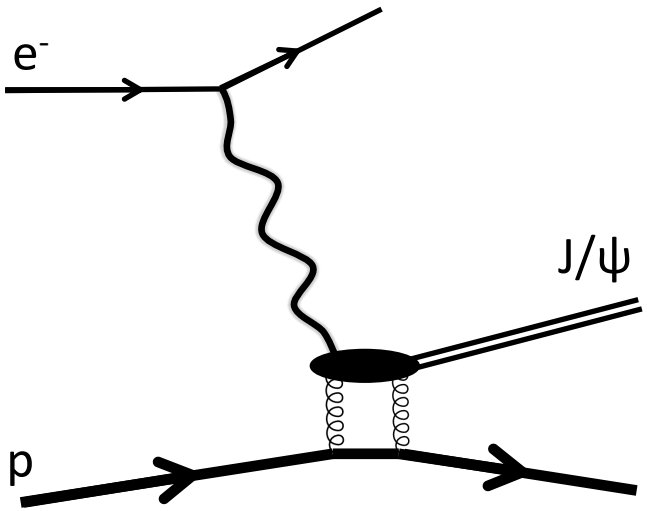
Tomography at the EIC

Scattering/production



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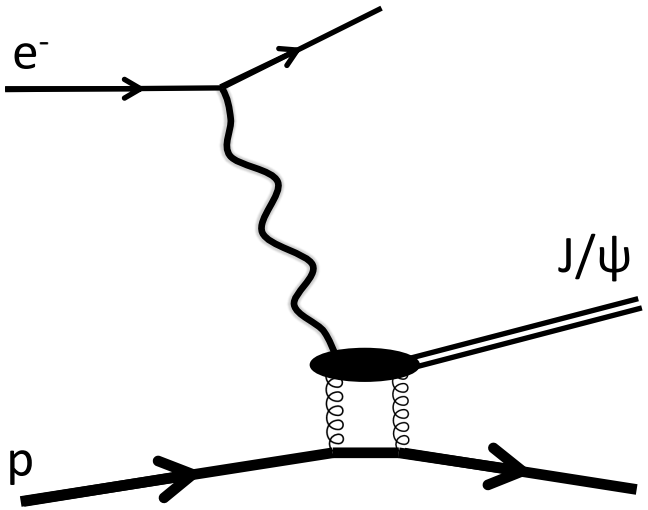
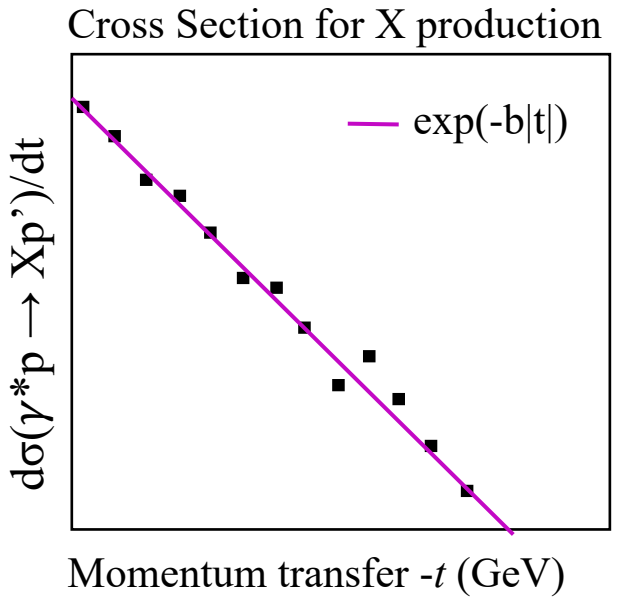


Cross section measurement



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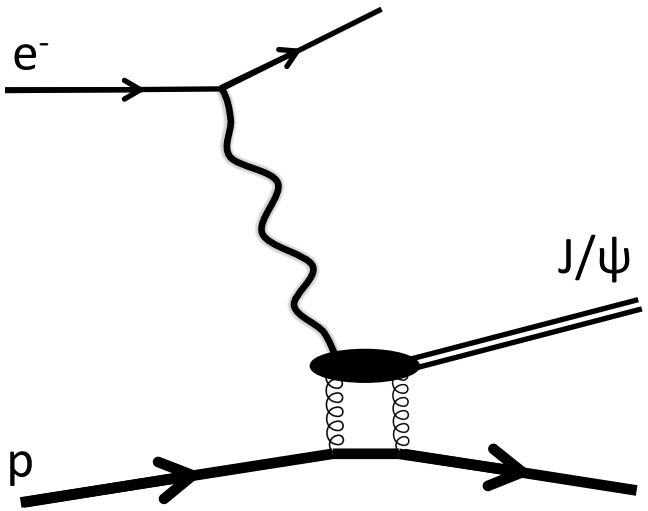

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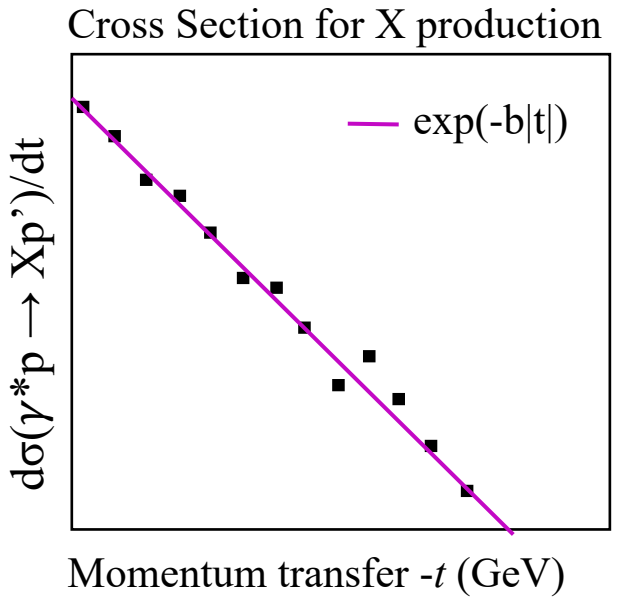
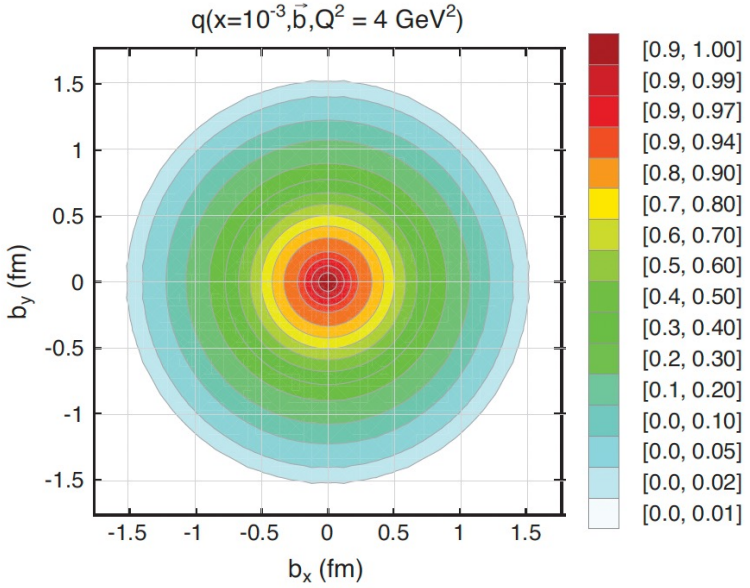
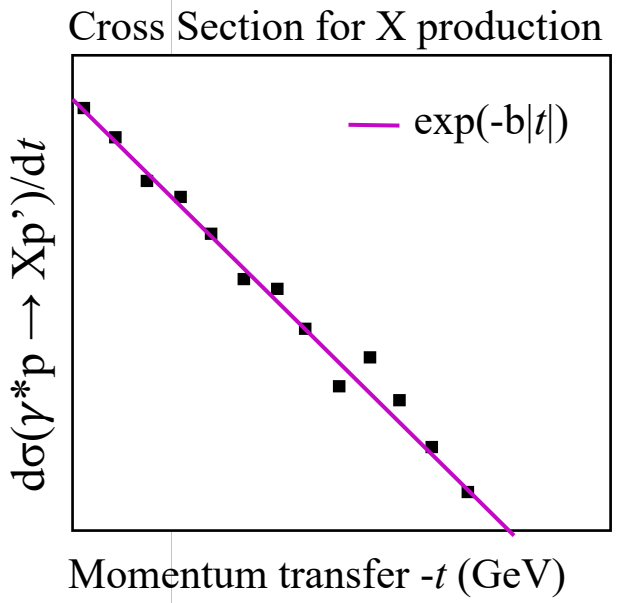


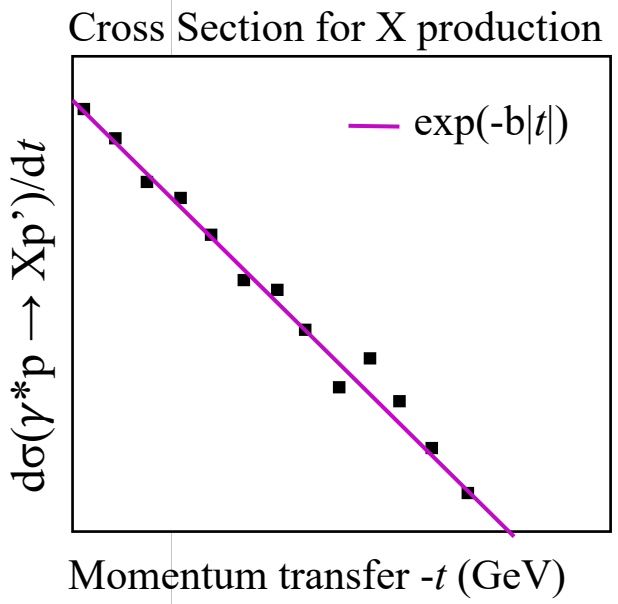
Parton density in transverse plane

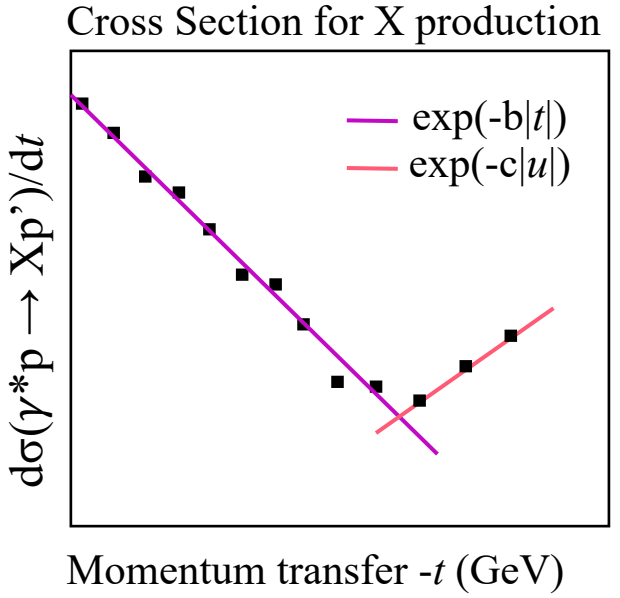


Backward (*u*-channel) Production

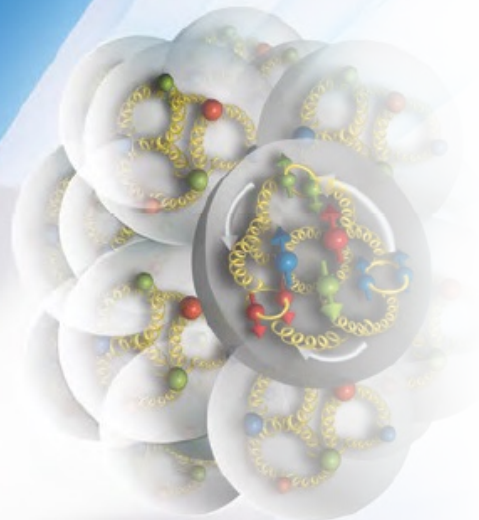


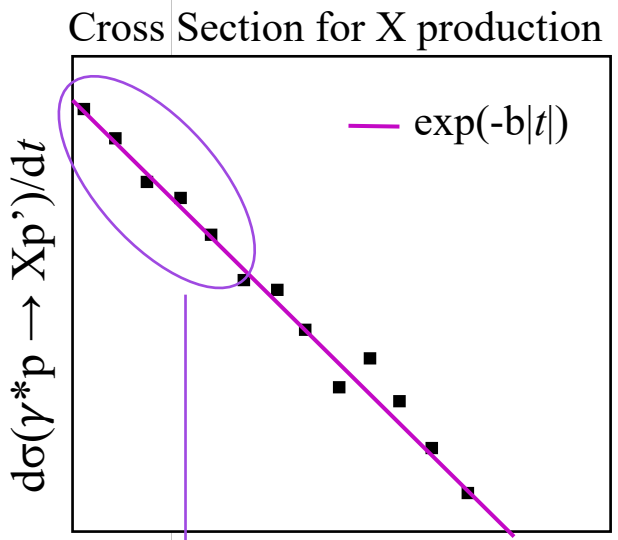
Backward (u-channel) Production

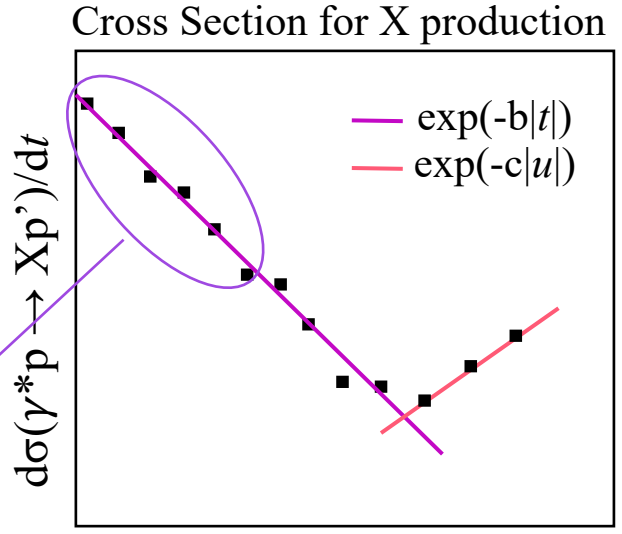


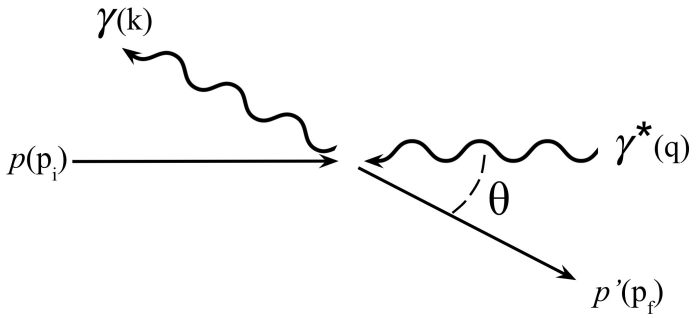


Backward (u-channel) Production



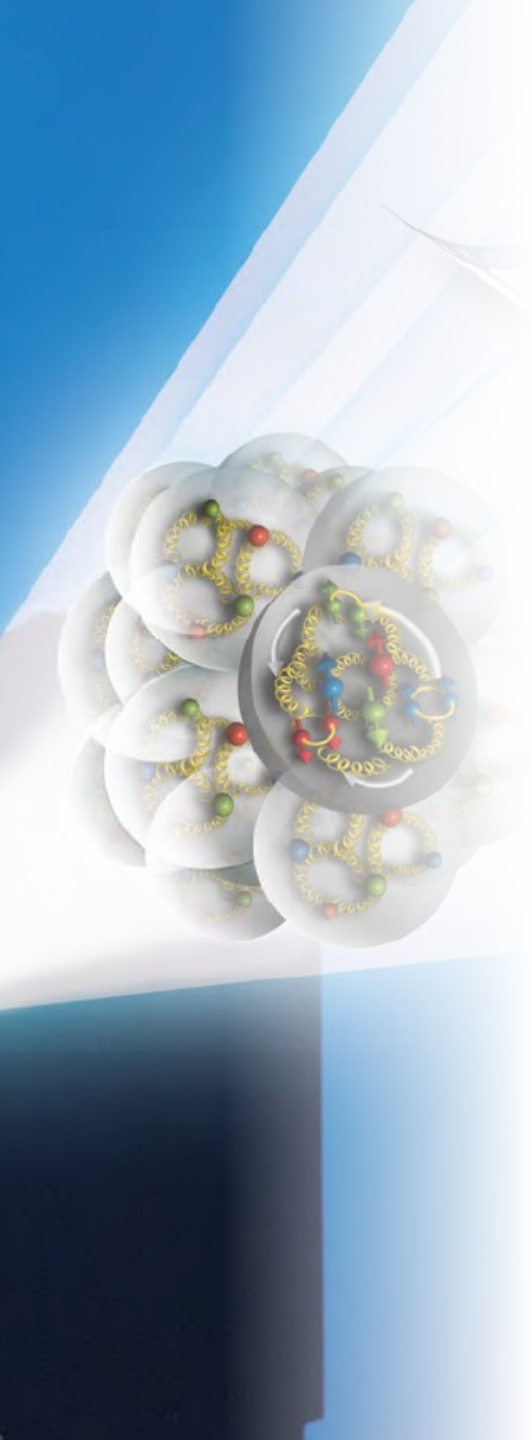


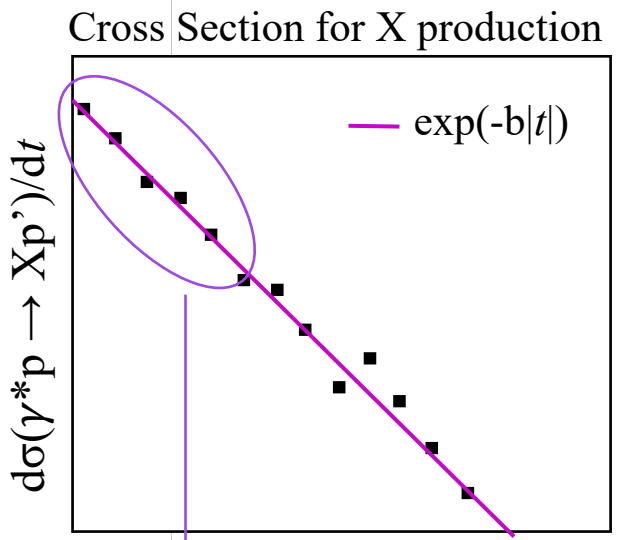


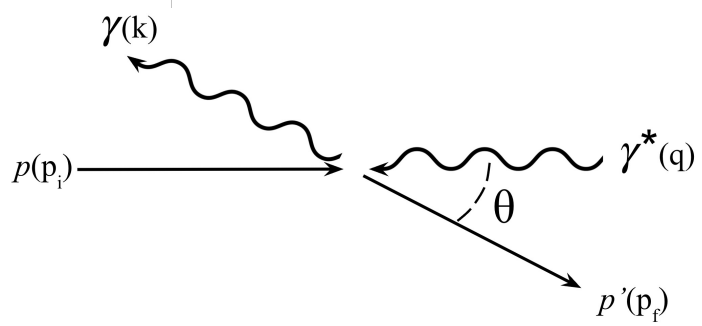


forward scattering/production

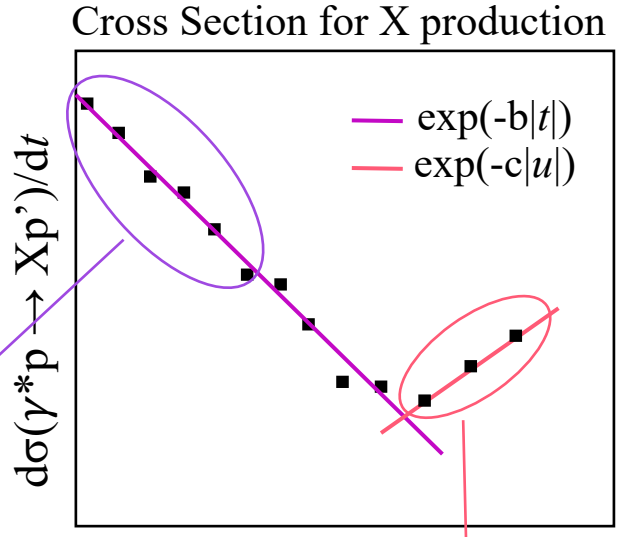
Backward (u-channel) Production

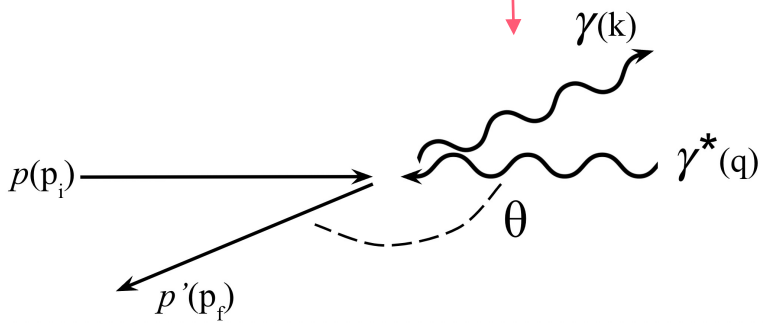






forward scattering/production





backward scattering/production

Backward (u-channel) Theory

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= EIC UG member

Backward DVCS and Proton to Photon Transition Distribution Amplitudes

J.P. Lansberg* [ab], B. Pire[a], and L. Szymanowski [bcd]

Transition distribution amplitudes and hard exclusive reactions with baryon number transfer

B. Pire [a], K. Semenov-Tian-Shansky [b,c,*], L. Szymanowski [d]

PHYSICAL REVIEW D **82,** 094030 (2010)

Spectral representation for baryon to meson transition distribution amplitudes

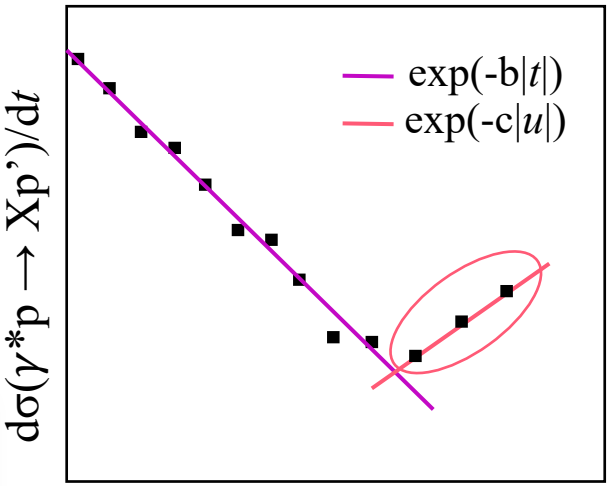
B. Pire,[1] K. Semenov-Tian-Shansky,[1,2] and L. Szymanowski[3]

Progress and Opportunities in Backward angle (u-channel) Physics

C. Ayerbe Gayoso[1], Ł. Bibrzycki[2], S. Diehl[3,4], S. Heppelmann[5], D.W. Higinbotham[6], G.M. Huber[7], S.J.D. Kay[7], S.R. Klein[8], J.M. Laget[6], W.B. Li[a,9,6], V. Mathieu[10,11], K. Park[12], R.J. Perry[13], B. Pire[14], K. Semenov-Tian-Shansky[15,16], A. Stanek[8], J.R. Stevens[9], L. Szymanowski[17], C. Weiss[6], B.-G. Yu[18]

[1]Mississippi State University, Starkville, MS 39762, USA
[2]Institute of Computer Science, Pedagogical University of Krakow, 30-084 Kraków, Poland

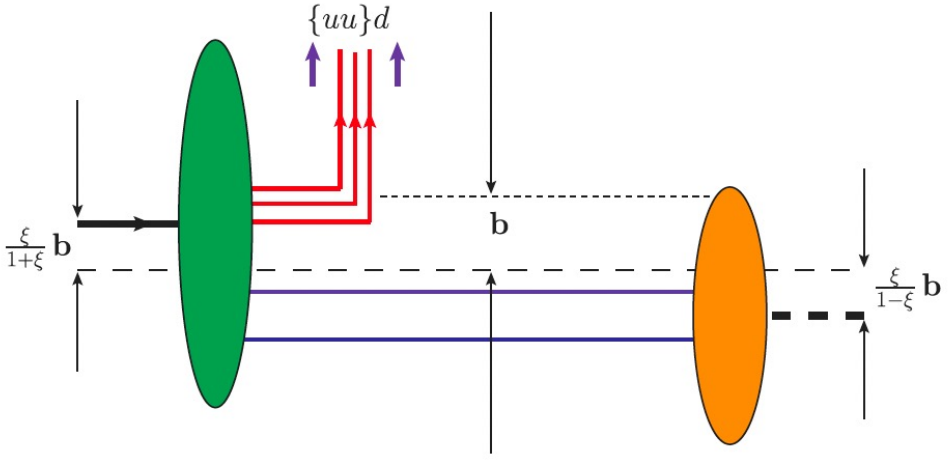
Cross Section for X production



Backward (*u*-channel) Theory

- Forward cross sections (through GPDs) parameterize parton distributions in transverse plane

Backward (u-channel) Theory



B. Pire, K. Semenov-Tian-Shansky, and L. Szymanowski, Phys. Rept. 940, 1 (2021), arXiv:2103.01079 [hep-ph].

- Forward cross sections (through GPDs) parameterize parton distributions in transverse plane
- Backward cross sections (through Transition Distribution Amplitudes – TDAs) parameterize quark clusters and baryon number distributions in the transverse plane

"baryon-to-meson (and baryon-to-photon) TDAs share common features both with baryon DAs and with GPDs and encode a conceptually close physical picture. They characterize partonic correlations inside a baryon and give access to the momentum distribution of the baryonic number inside a baryon. Similarly to GPDs, TDAs – after the Fourier transform in the transverse plane – represent valuable information on the transverse location of hadron constituents."

Backward (*u*-channel) Procedure

Backward Tomography at the EIC

Backward (*u*-channel) Procedure

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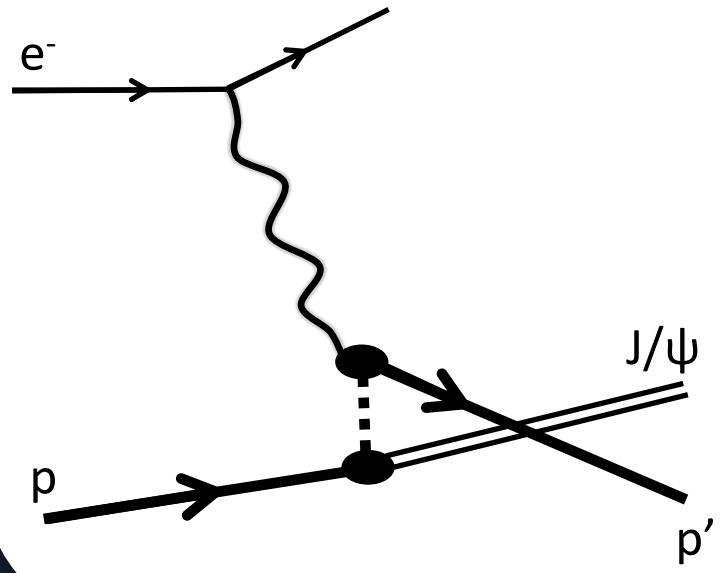
Backward Tomography at the EIC

Backward scattering/production



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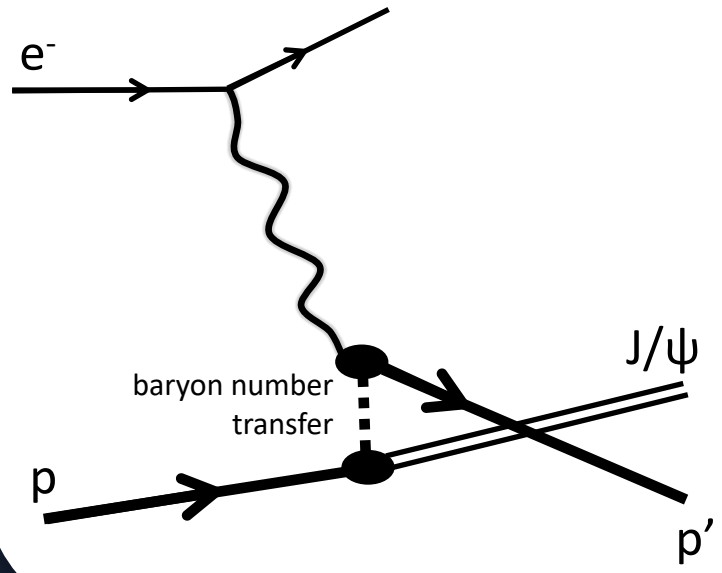

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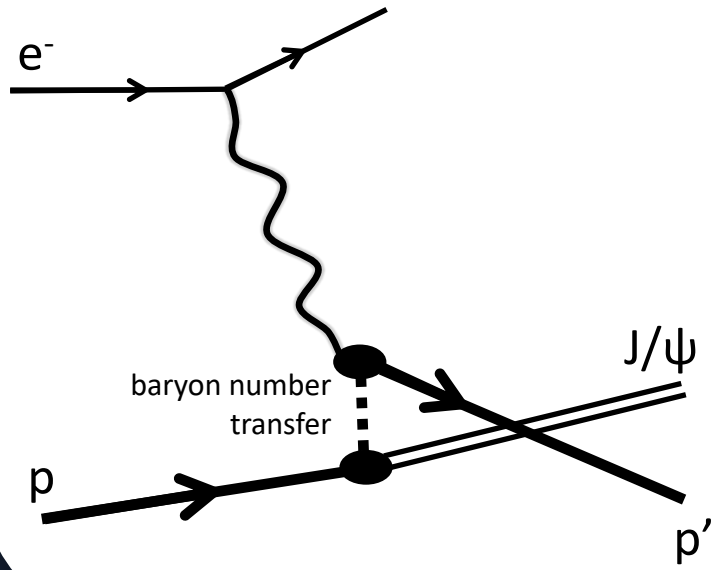
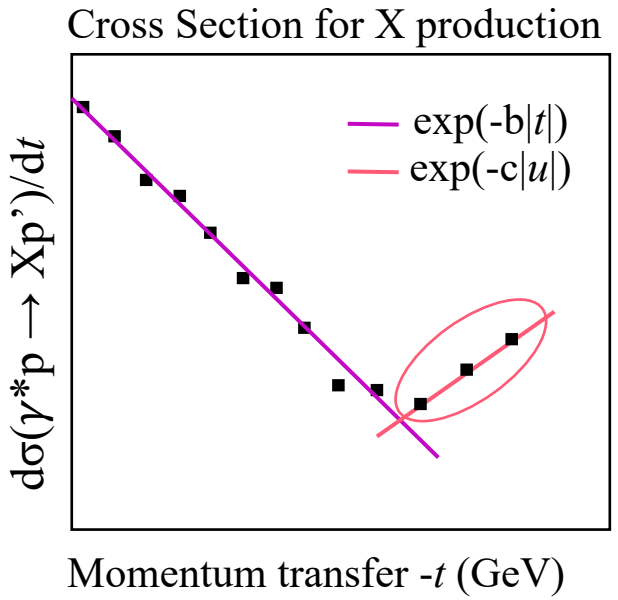


Cross section measurement



Backward (*u*-channel) Procedure

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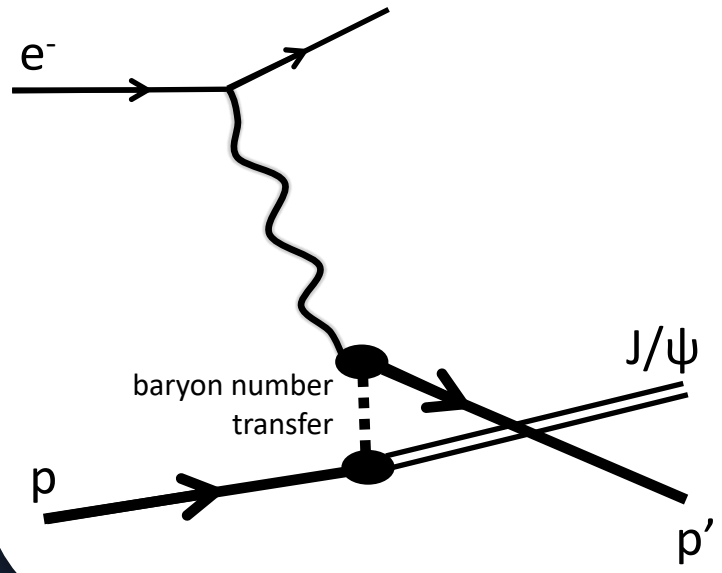
Backward scattering/production



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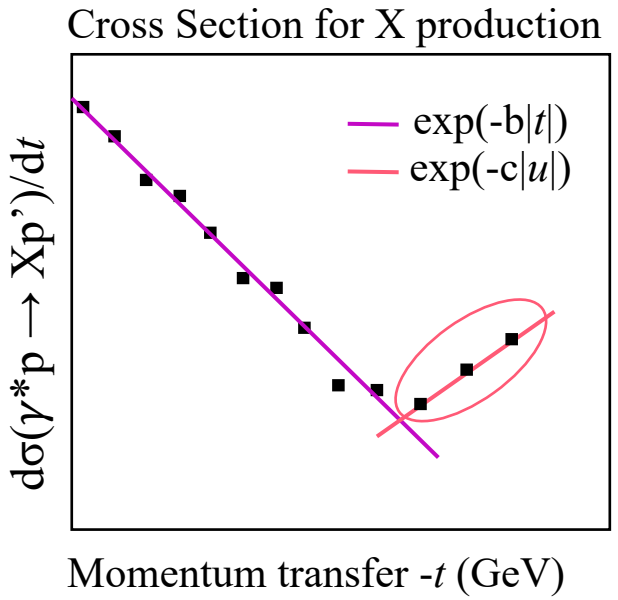
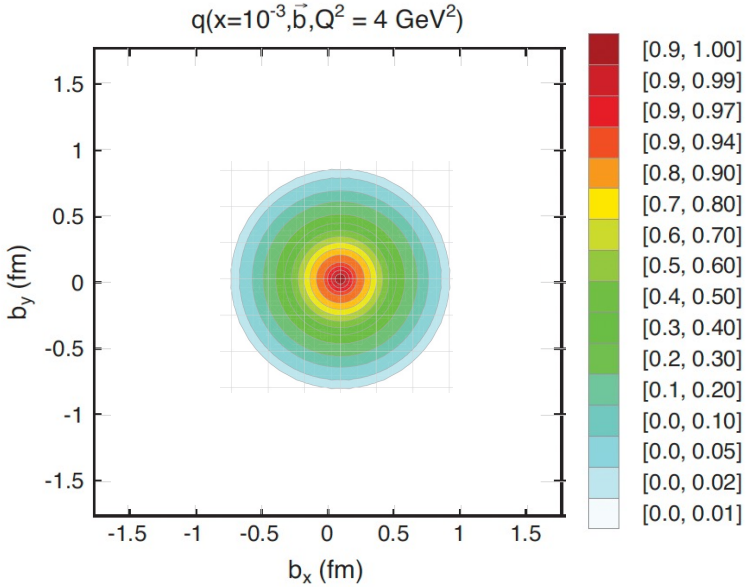
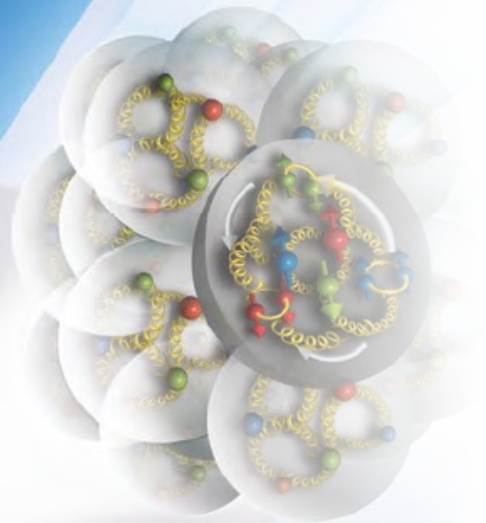


(Partonic correlations)/ (diquark clusters)/(baryon number) in transverse plane



Backward (*u*-channel) Simulations



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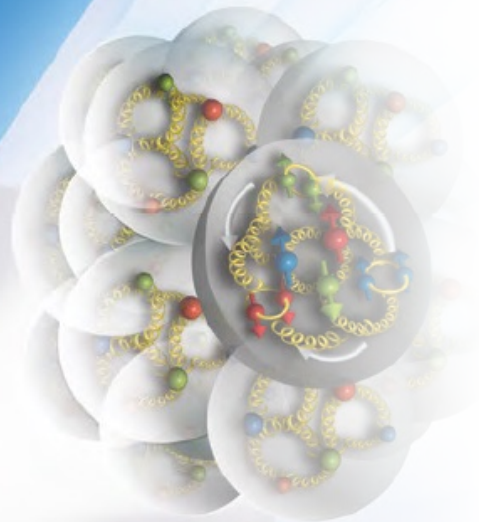
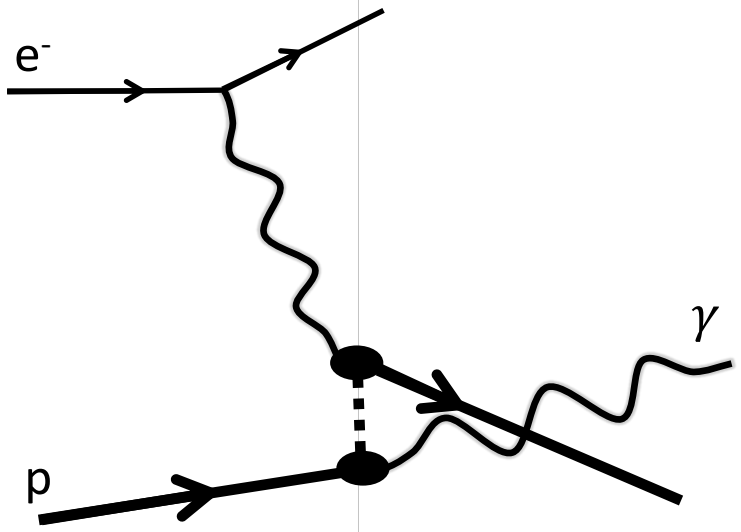
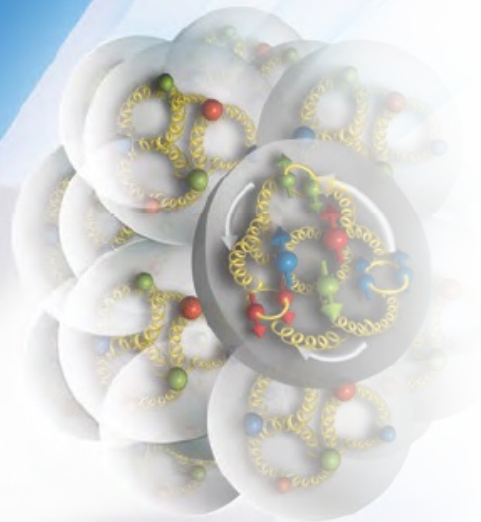


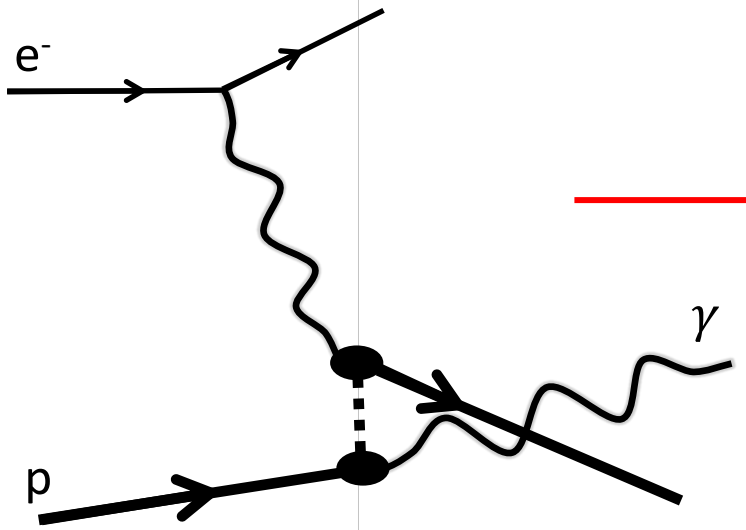
u-channel DVCS



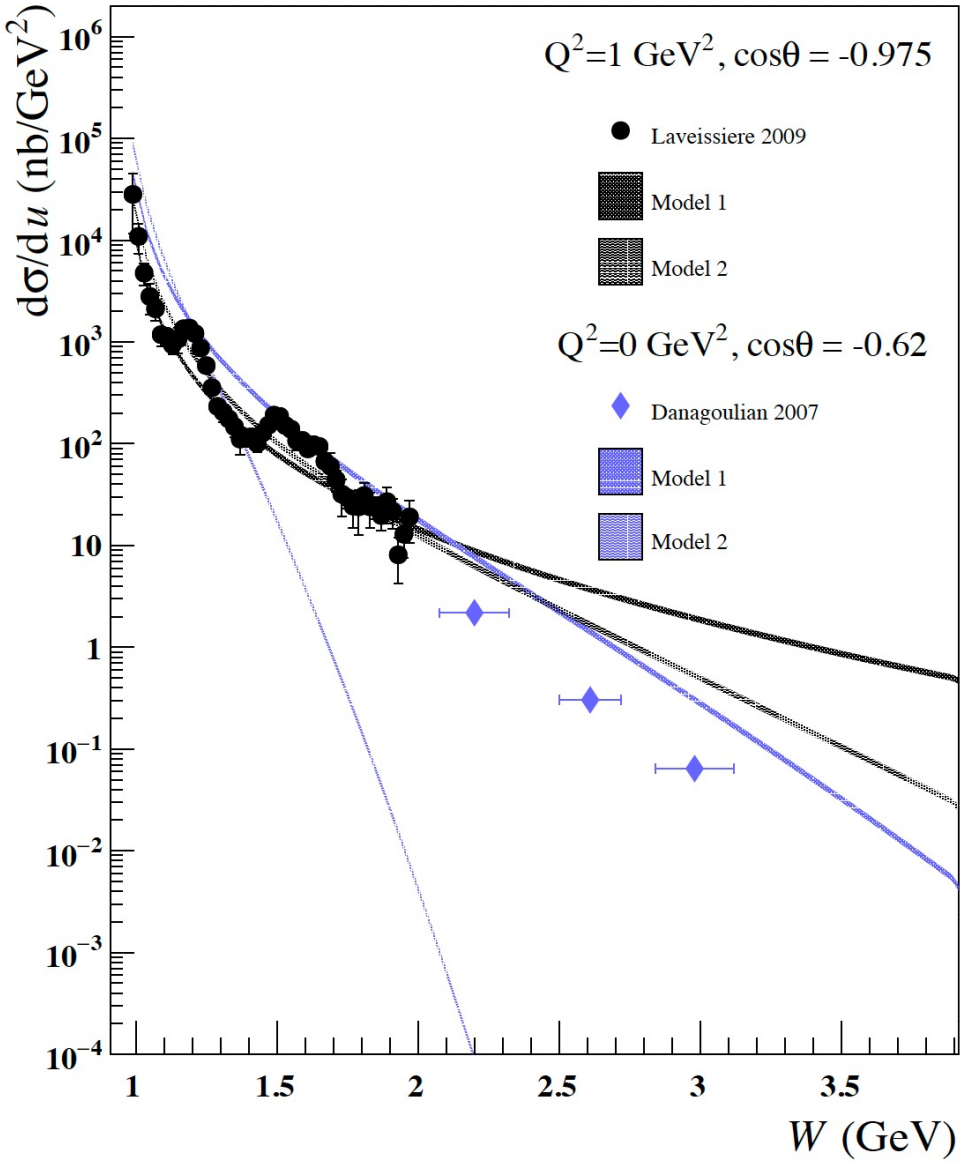
Backward (u-channel) Simulations



u-channel DVCS



u-channel DVCS models



Backward (*u*-channel) Simulations

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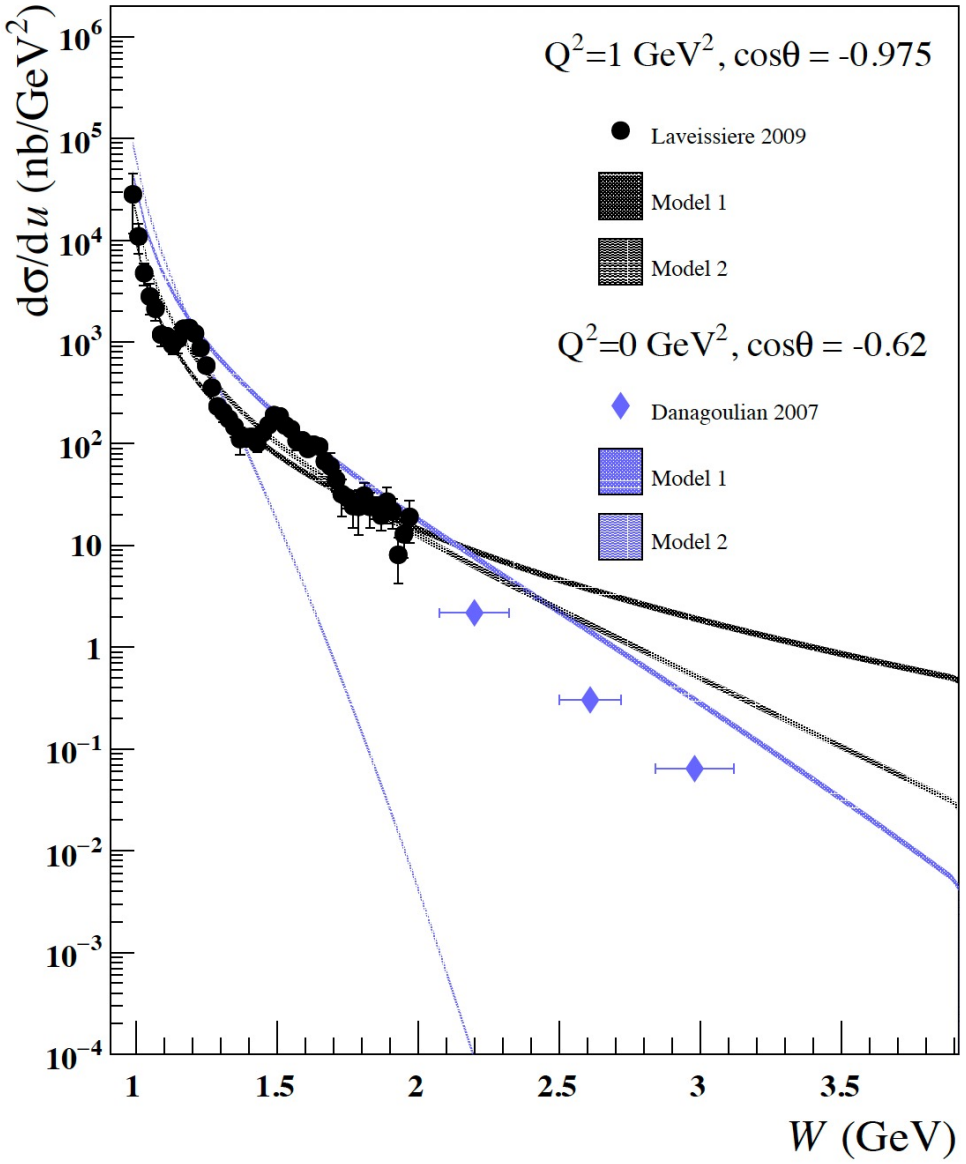

Backward (*u*-channel) Simulations

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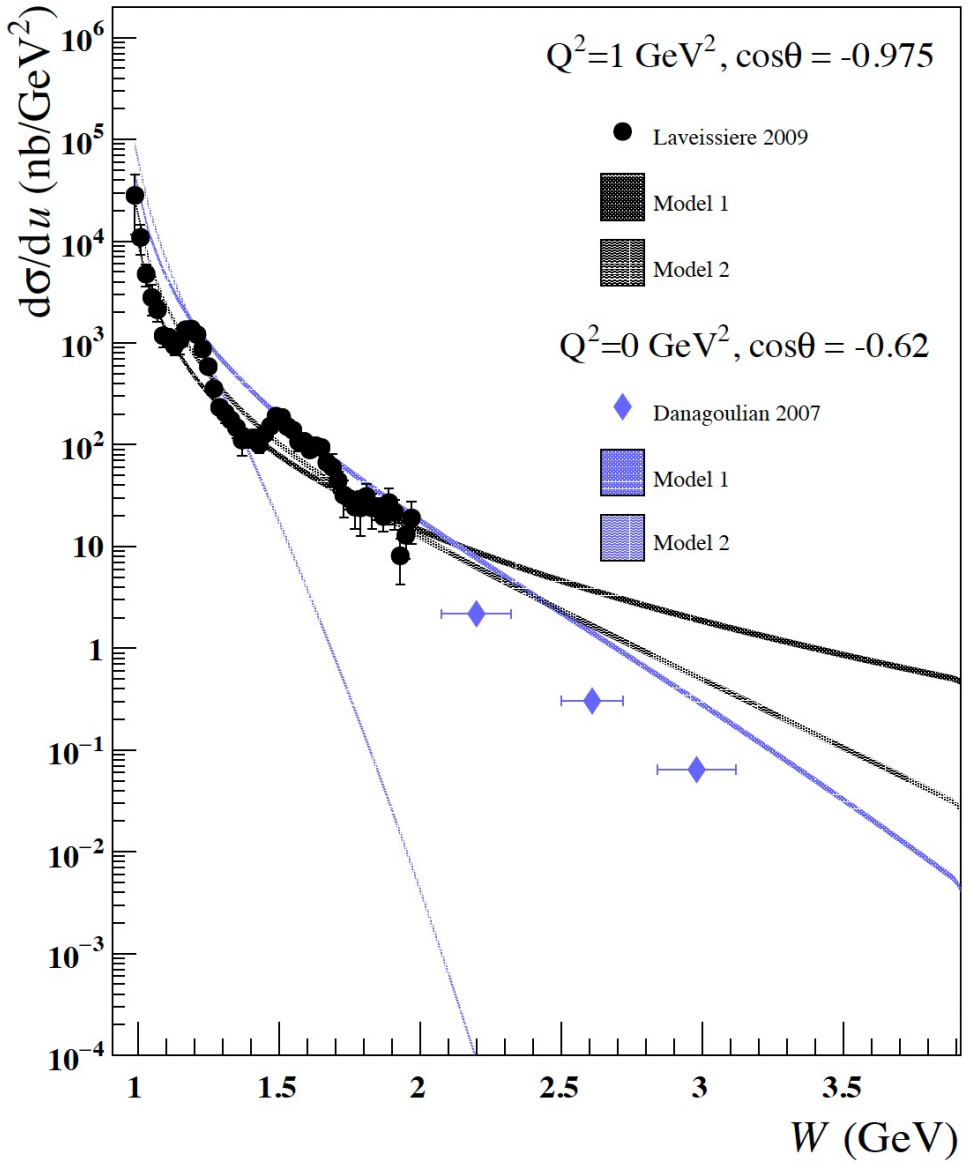
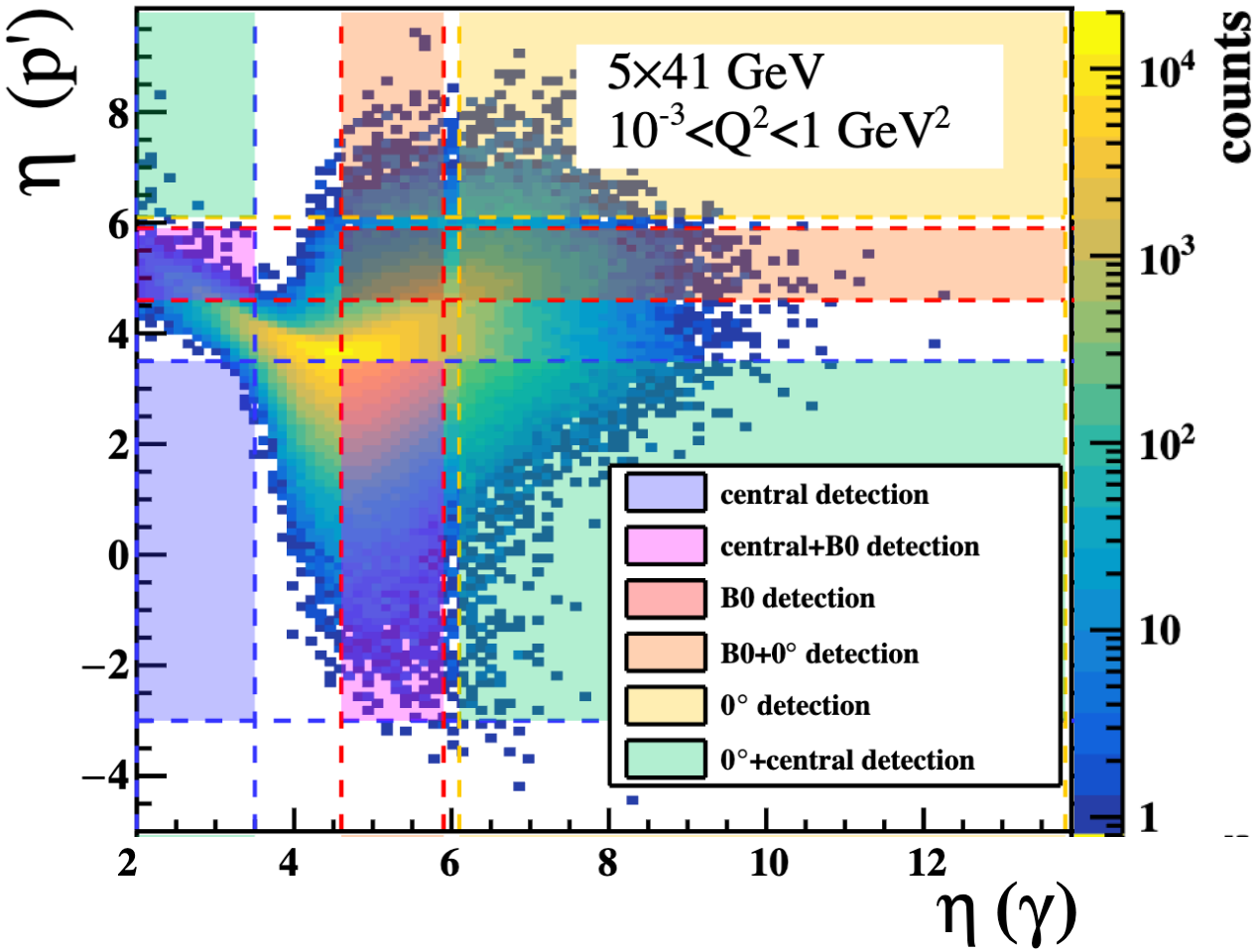


final-state particle kinematics (DVCS)



Backward (*u*-channel) Simulations

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Summary of u-channel studies to-date Phys. Rev. C 106, 015204 (2022)

Process	optimal collision energies	requires	acceptance rate without B0 EMCal	acceptance rate with B0 EMCal
ω	10×100 GeV	ZDC	1.3%	41%
	18×275 GeV	B0 EMCal	6%	63%
ρ	10×100 GeV	B0 tracker	49%	
π^0	18×275 GeV	ZDC	65%	68%
DVCS	18×275 GeV	ZDC B0 EMCal	75%	81%

Backward (u-channel) Simulations

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- **We need electromagnetic calorimetry in the B0**

Backward (*u*-channel) Simulations

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Backward (*u*-channel) Simulations

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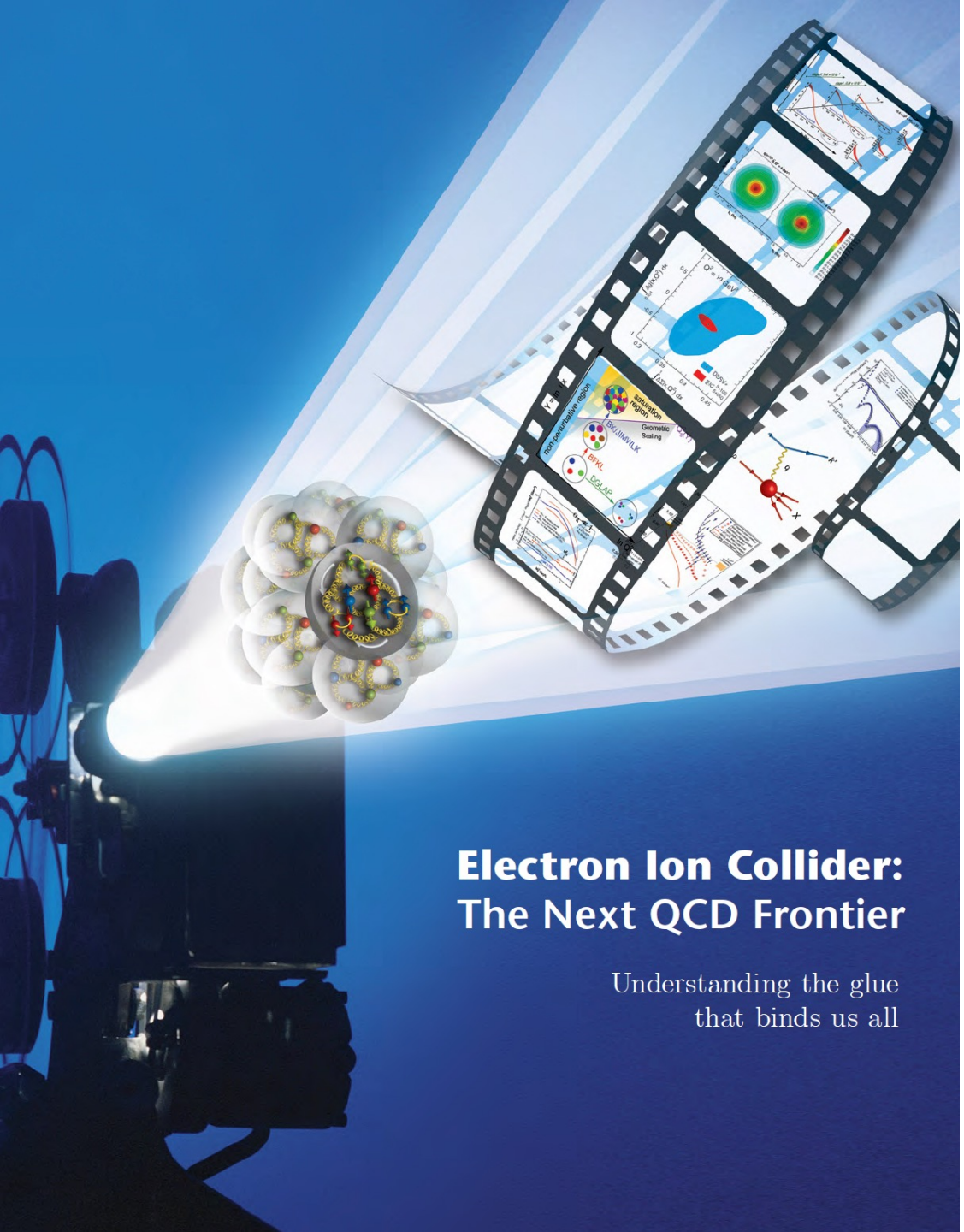
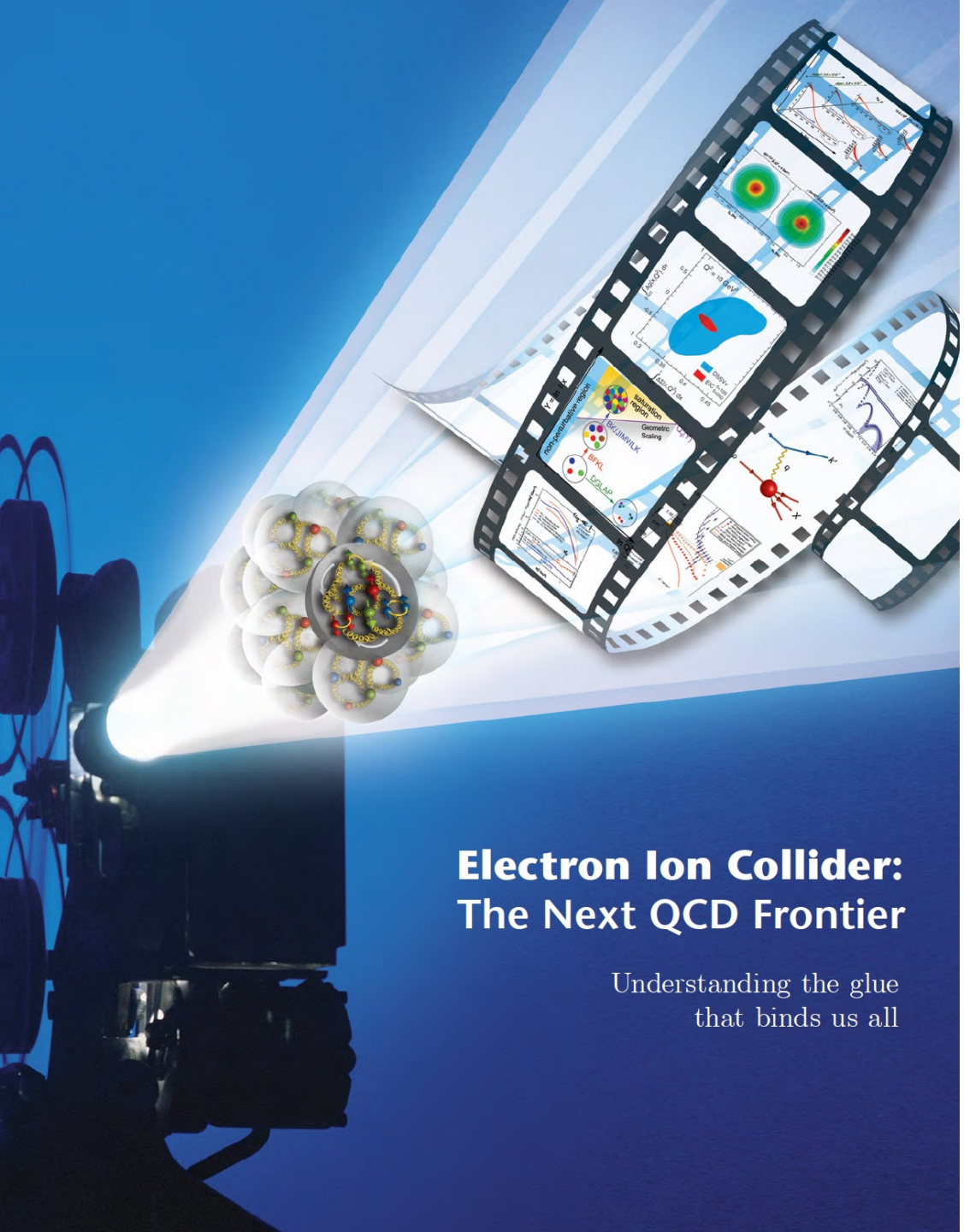
- **We need electromagnetic calorimetry in the B0**
- **We need excellent tracking in the B0**
- **We need excellent ZDC resolution**

Conclusions





Conclusions

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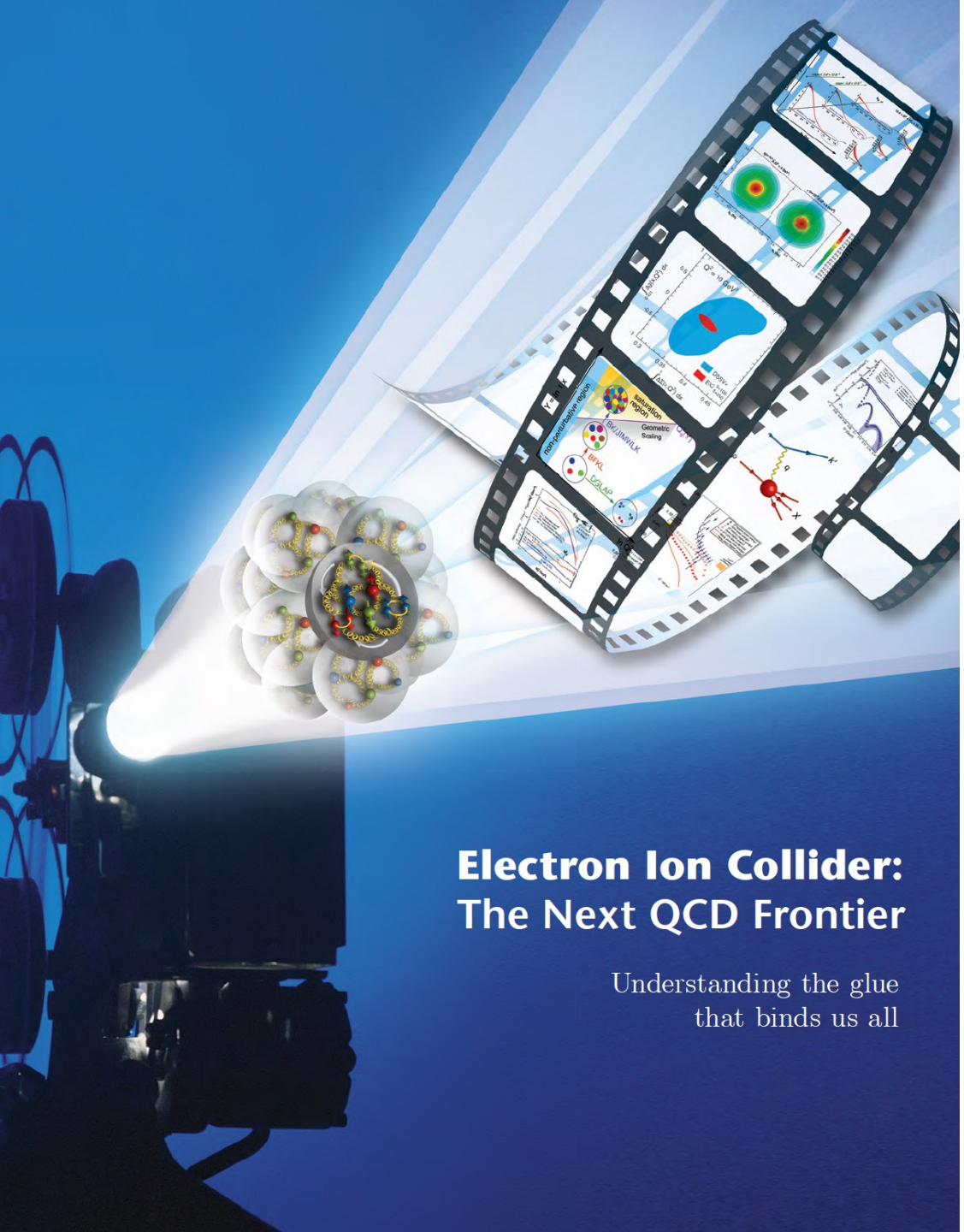
UNIVERSITY OF CALIFORNIA

- *u*-channel is key to achieving the full capabilities of nuclear tomography at the EIC



Conclusions

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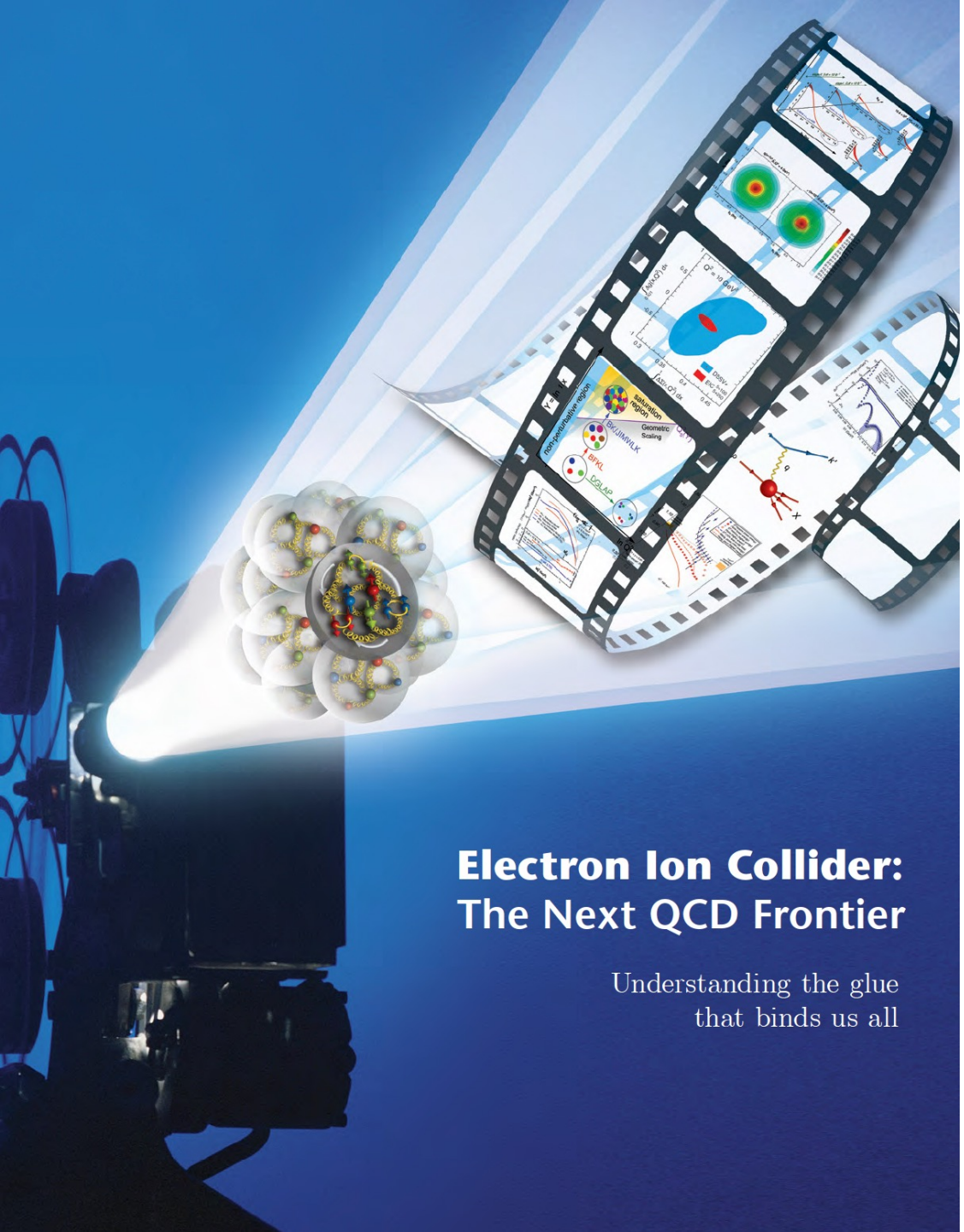
- *u*-channel is key to achieving the full capabilities of nuclear tomography at the EIC
- Impact-parameter-space interpretation of *u*-channel is rich and rapidly developing



Conclusions

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- *u*-channel is key to achieving the full capabilities of nuclear tomography at the EIC
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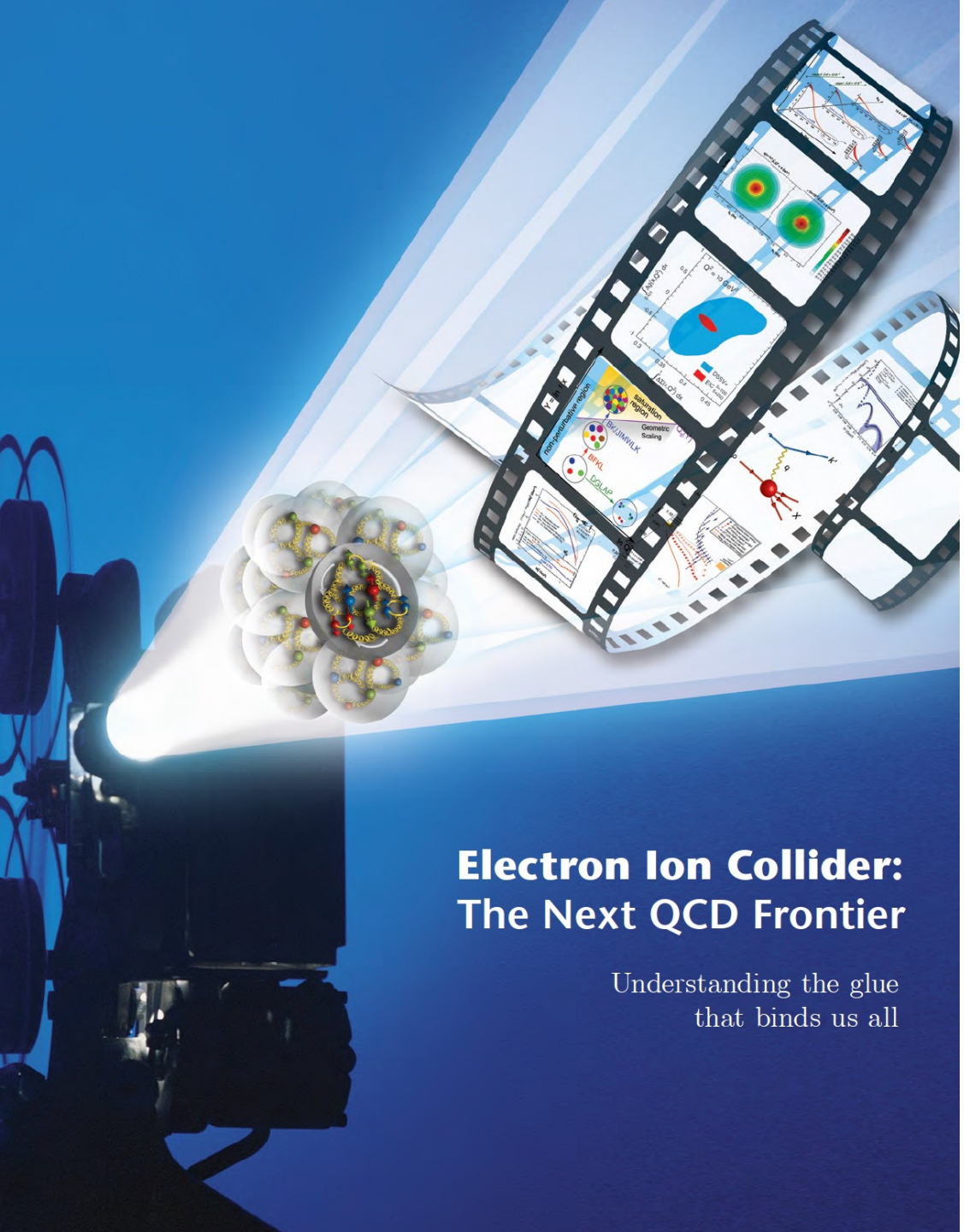
- To do:



Conclusions

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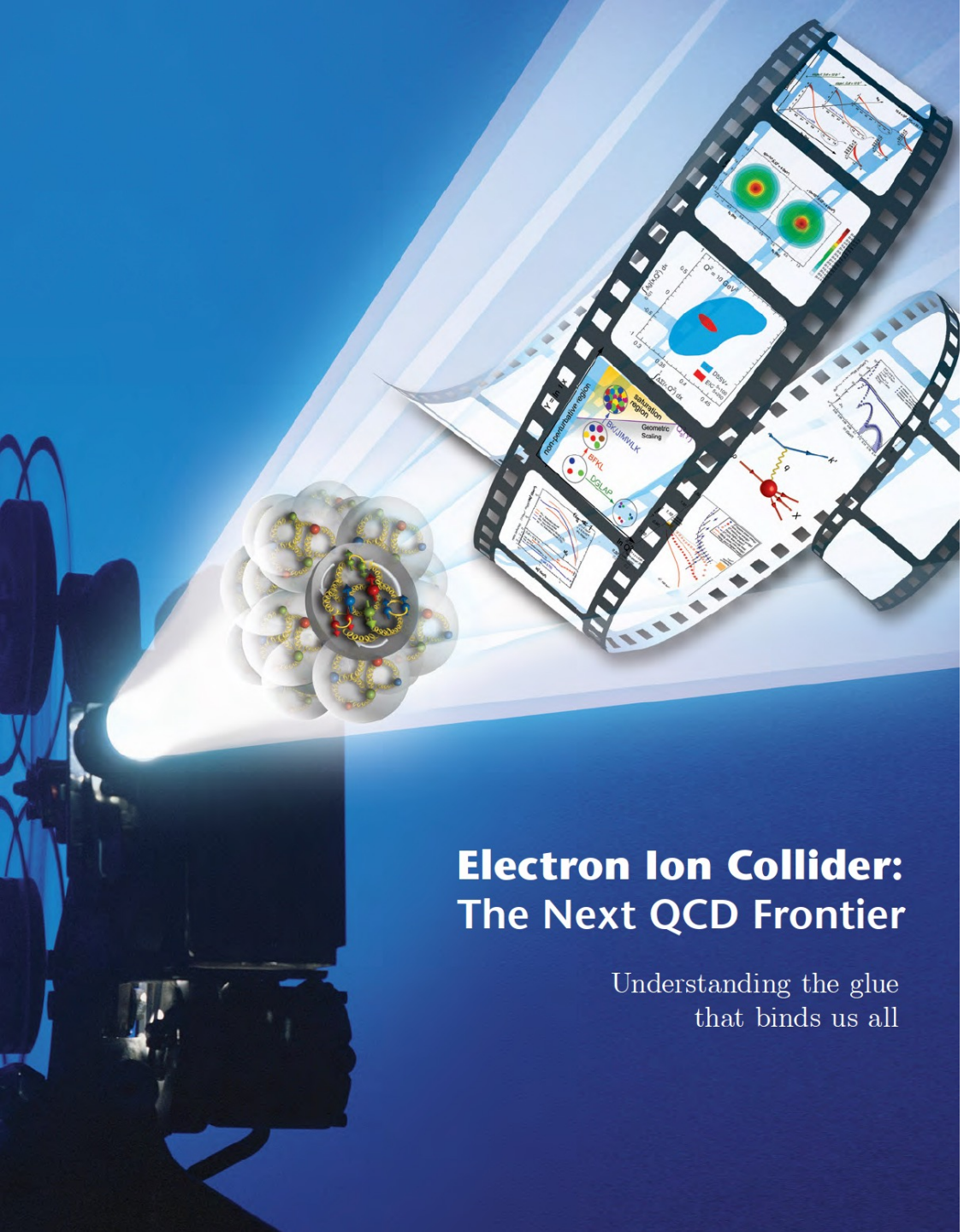
- *u*-channel is key to achieving the full capabilities of nuclear tomography at the EIC
- Impact-parameter-space interpretation of *u*-channel is rich and rapidly developing
- To do:
  - ❑ J/ψ studies



Conclusions

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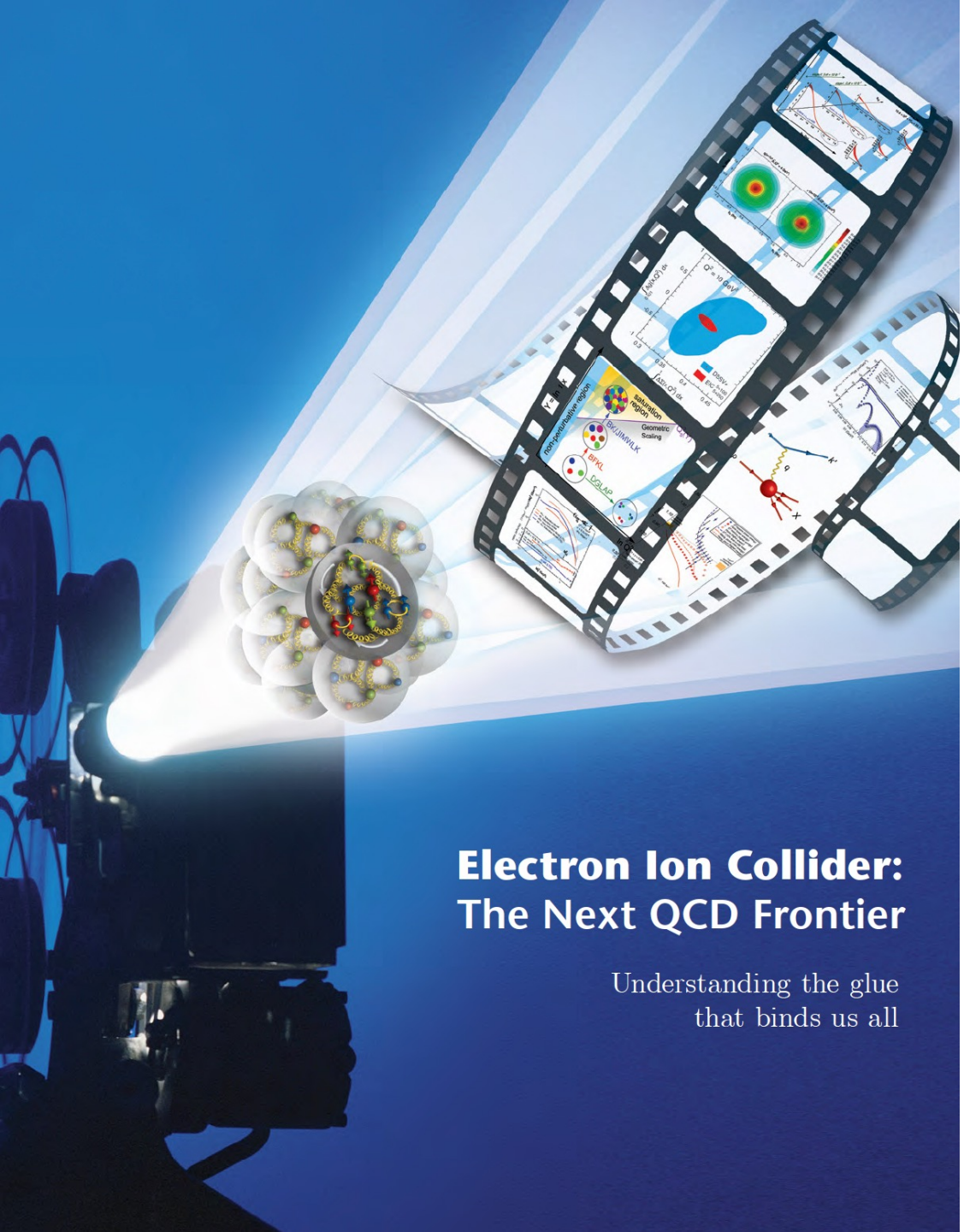

Conclusions

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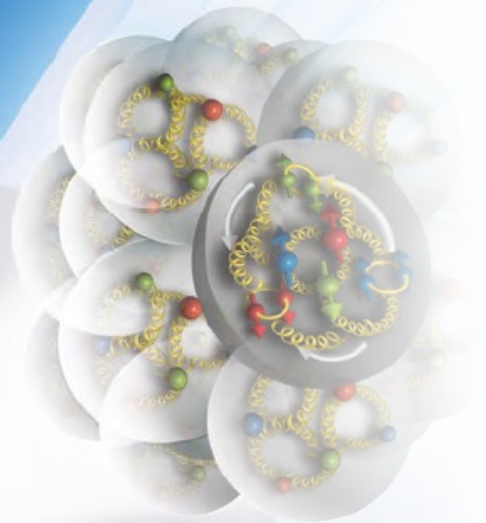
- *u*-channel is key to achieving the full capabilities of nuclear tomography at the EIC
- Impact-parameter-space interpretation of *u*-channel is rich and rapidly developing
- To do:
  - ❑ J/ψ studies
  - ❑ ϕ studies
  - ❑ Full ePIC simulations & reconstruction



Thank you for your attention!

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