Early inclusive physics at the EIC

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ePIC/EIC Early Science Workshop
CFNS, Stony Brook University
April 24-25, 2025

Starting point: early science matrix

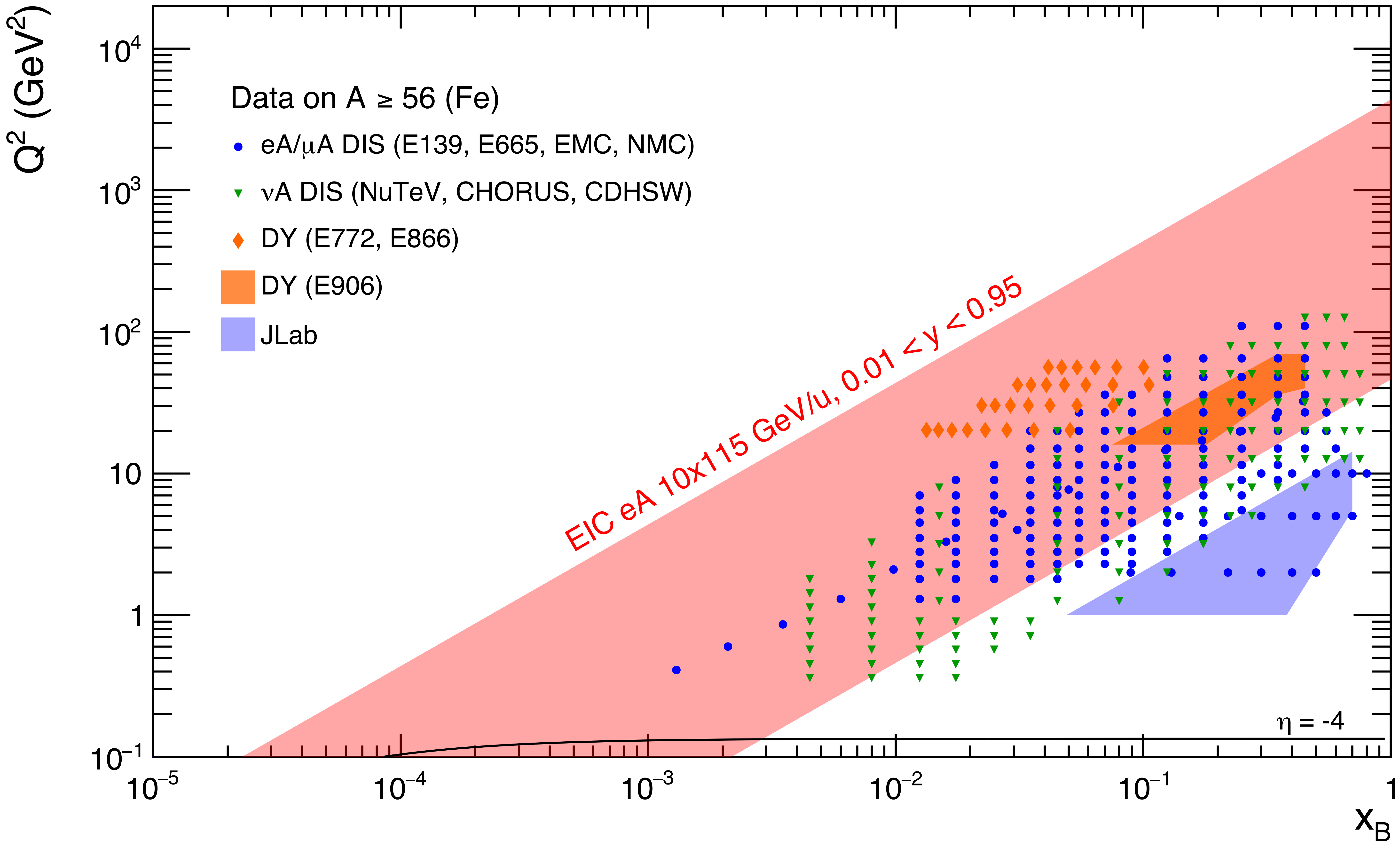
	Species	Energy (GeV)	Luminosity/year (fb-1)	Electron polarization	p/A polarization
YEAR 1	e+Ru or e+Cu	10 x 115	0.9	NO (Commissioning)	N/A
YEAR 2	e+D e+p	10 x 130	11.4 4.95 - 5.33	LONG	NO TRANS
YEAR 3	e+p	10 x 130	4.95 - 5.33	LONG	TRANS and/or LONG
YEAR 4	e+Au e+p	10 x 100 10 x 250	0.84 6.19 - 9.18	LONG	N/A TRANS and/or LONG
YEAR 5	e+Au e+3He	10 x 100 10 x 166	0.84 8.65	LONG	N/A TRANS and/or LONG

Note: the eA luminosity is per nucleon

Inclusive physics priorities and highlights in first 5 years

	Data	Observables	Physics highlights
Year 1			
Year 2			
Year 3			
Year 4			
Year 5			

Year 1: unpolarized eA scattering (10x115 GeV)



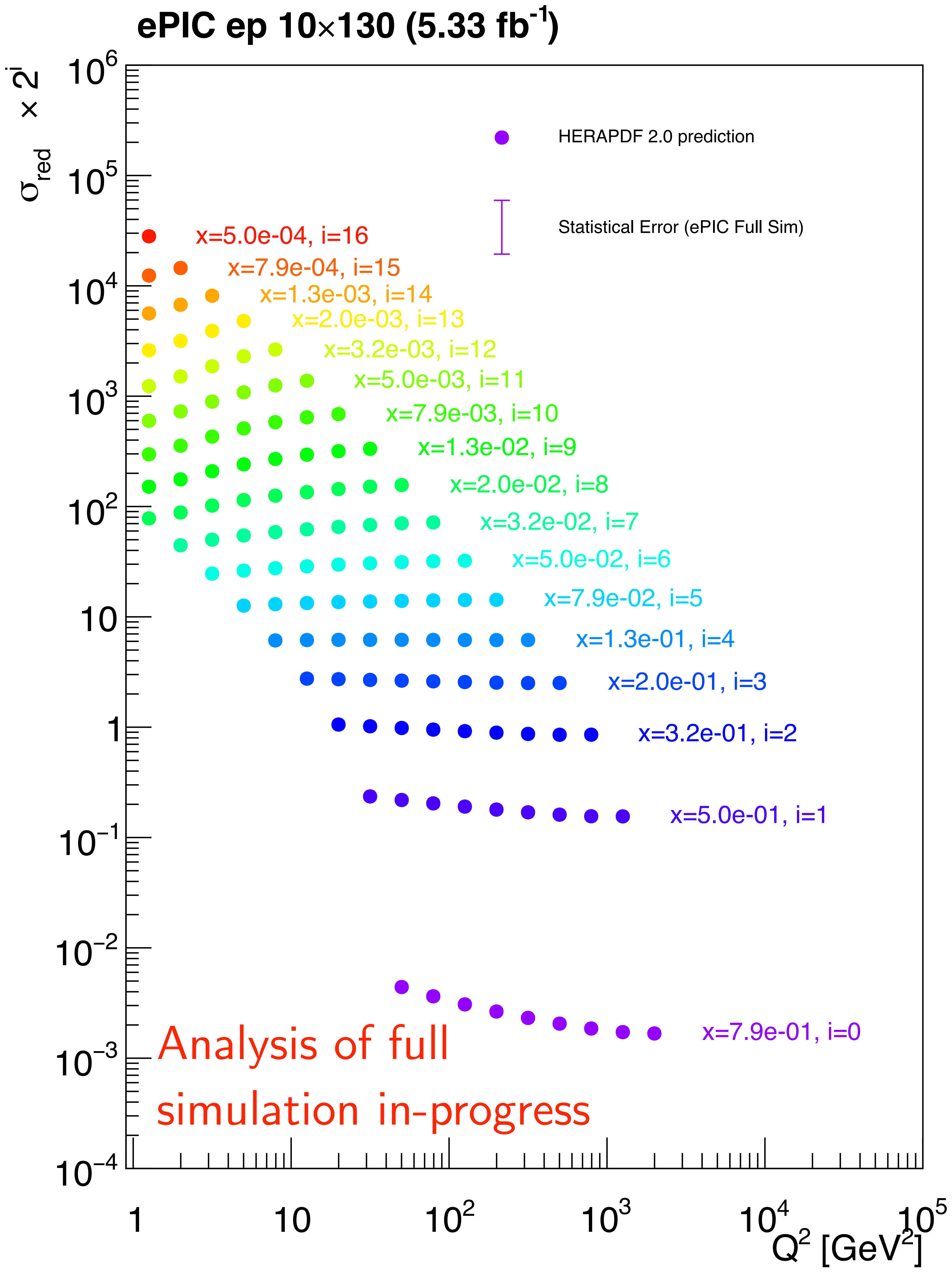
- Nuclear PDFs:
  - Total/differential cross sections
  - Order of magnitude extension to low-x/shadowing region

Inclusive physics priorities and highlights in first 5 years

	Data	Observables	Physics highlights
Year 1	Unpolarized *eA*, 10x115 GeV	Total/differential *eA* cross sections	Nuclear PDFs in low-x/shadowing region
Year 2			
Year 3			
Year 4			
Year 5			

Year 2: unpolarized eD and (transversely) polarized ep (10x130 GeV)

- Proton PDFs:
  - Total/differential ep cross sections
  - Surpass HERA integrated luminosity in <1 year
  - Bridge gap between HERA, JLab
- Neutron structure:
  - F_2^D/F_2^p (historical "neutron proxy")
  - Spectator-tagged F_2^n
- Nuclear PDFs/medium modification:
  - F_2^A/F_2^D
- Proton spin:
  - Transverse double spin asymmetry $A_\perp^p$ (small contribution to A_1^p)



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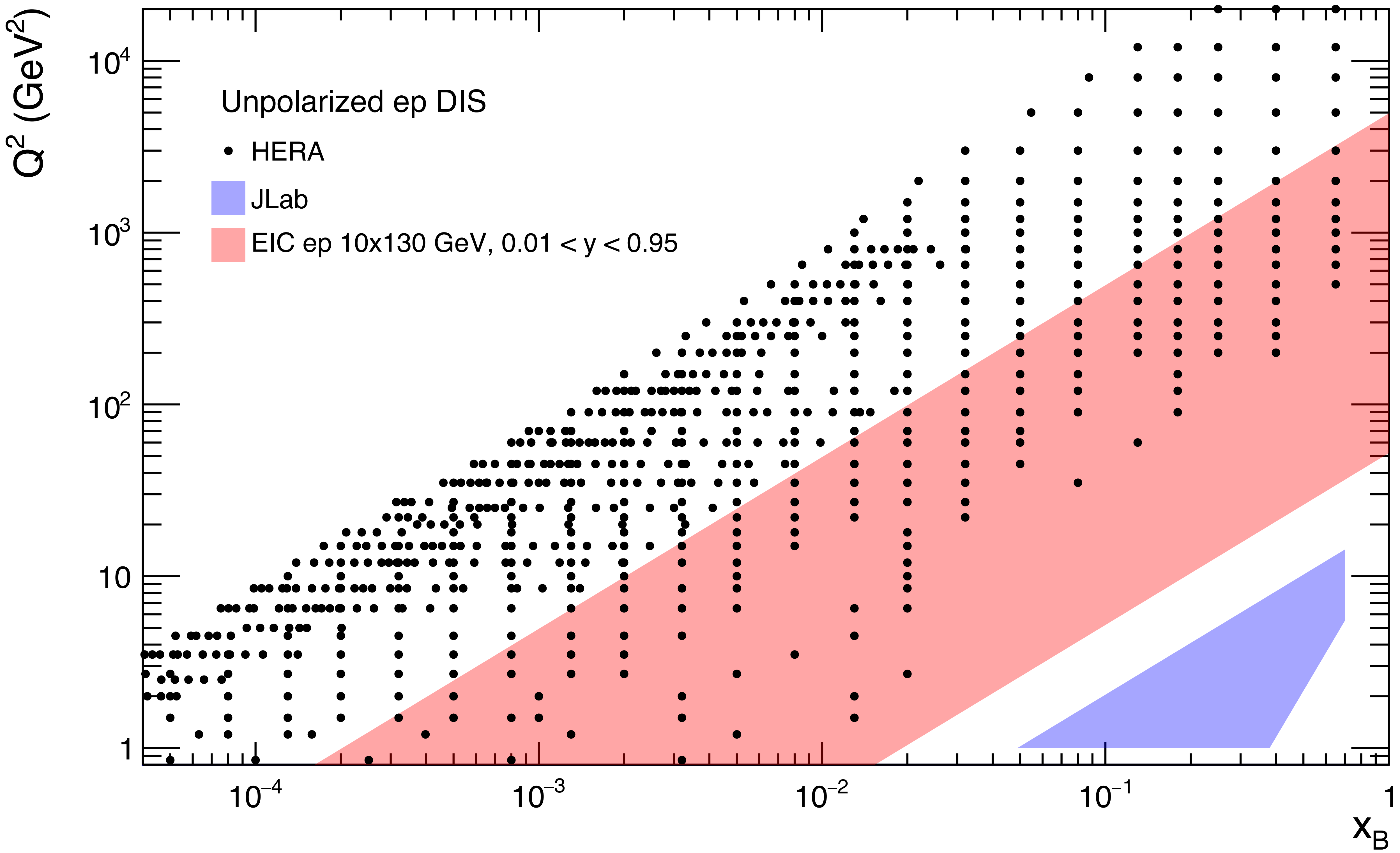
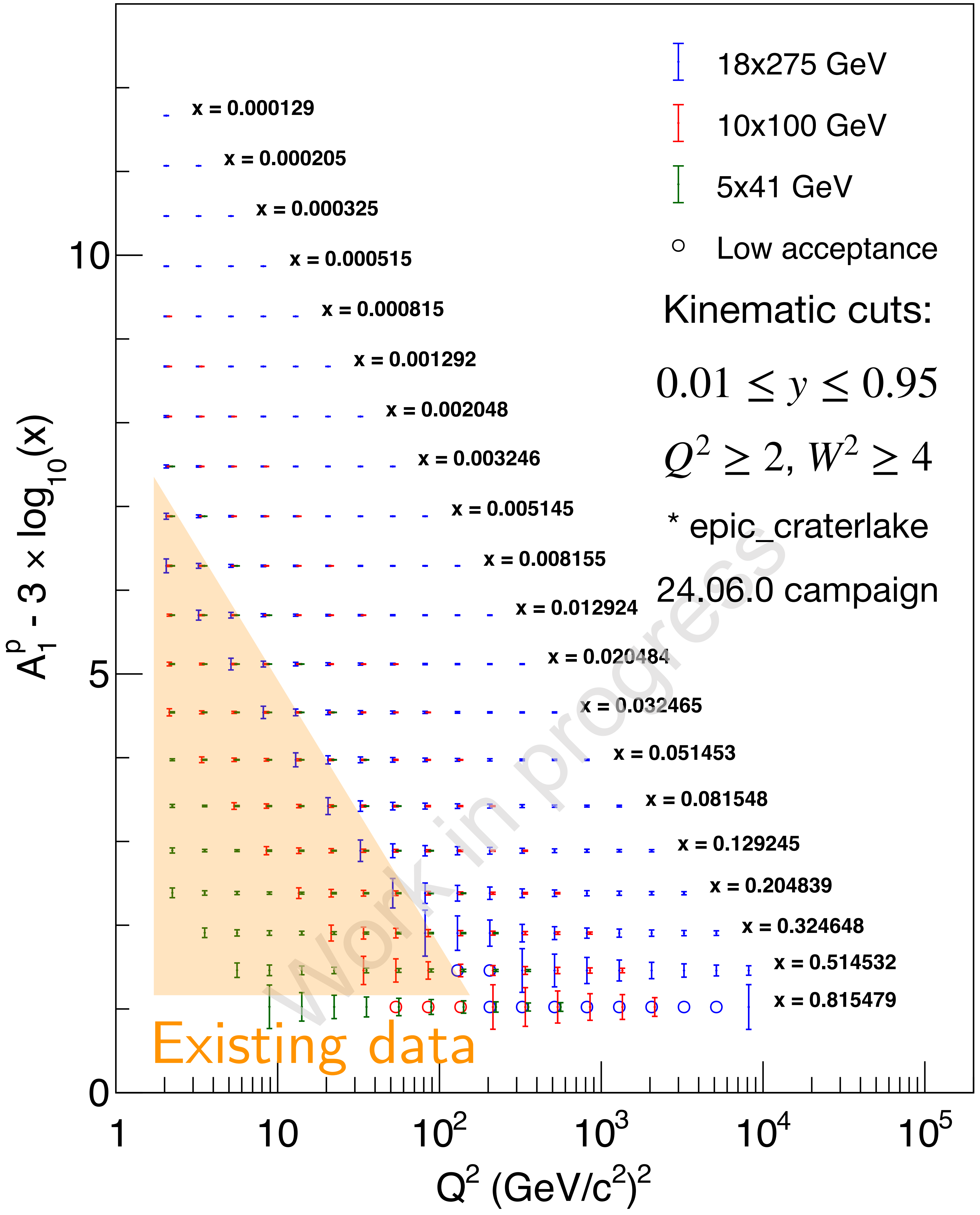


Inclusive physics priorities and highlights in first 5 years

	Data	Observables	Physics highlights
Year 1	Unpolarized *eA*, 10x115 GeV	Total/differential *eA* cross sections	Nuclear PDFs in low-x/shadowing region
Year 2	Unpolarized *eD*, 10x130 GeV Polarized *ep* (transverse), 10x130 GeV	Total/differential *ep* cross sections, transverse spin asymmetry, cross section ratio	Proton PDFs at large-x/Q^2, F_2^D/F_2^p
Year 3			
Year 4			
Year 5			

Year 3-4: fully polarized *ep* (10x130 and 10x250 GeV)

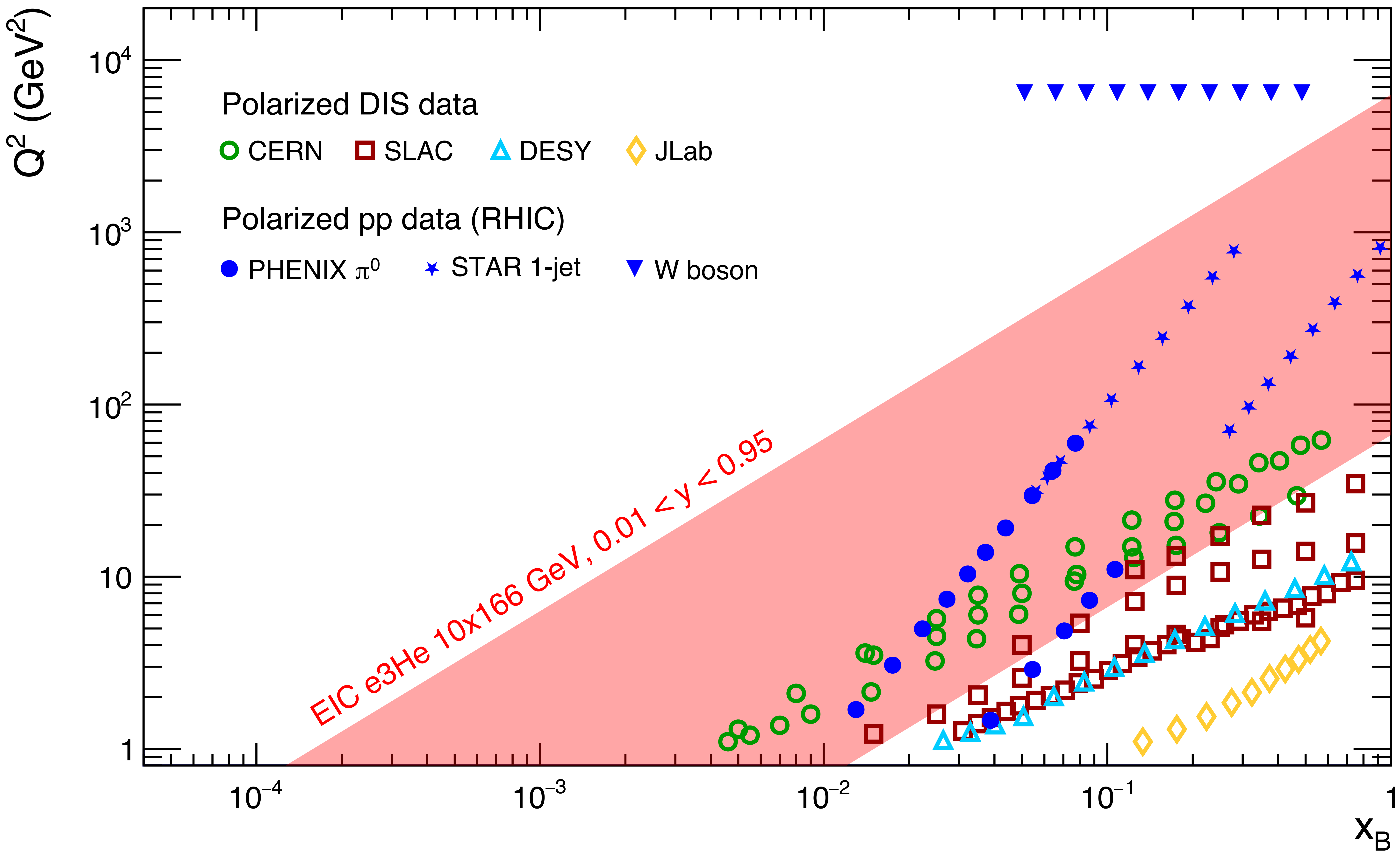
- Proton spin:
  - Longitudinal double spin asymmetry $A_{\parallel}^{p}$
  - Combine with $A_{\perp}^{p}$ to get $A_{1}^{p} \approx g_{1}^{p}/F_{1}^{p}$
  - At 10x130 GeV, partial overlap with existing data



Inclusive physics priorities and highlights in first 5 years

	Data	Observables	Physics highlights
Year 1	Unpolarized *eA*, 10x115 GeV	Total/differential *eA* cross sections	Nuclear PDFs in low-x/shadowing region
Year 2	Unpolarized *eD*, 10x130 GeV Polarized *ep* (transverse), 10x130 GeV	Total/differential *ep* cross sections, transverse spin asymmetry, cross section ratio	Proton PDFs at large-x/Q^2, F_2^D/F_2^p
Year 3	Polarized *ep* (longitudinal)	Longitudinal spin asymmetry	A_1^p
Year 4	Polarized *ep*, 10x250 GeV	Double spin asymmetries	A_1^p at low(er)-x
Year 5			

Year 5: unpolarized eAu (10x100 GeV), fully polarized e^3He (10x166 GeV)



- Neutron spin:
  - A_1^n from $A_1^{^3He}/A_1^p$
  - Double spectator-tagged A_1^n
- Light nuclear structure:
  - $F_2^{^3He}/F_2^D$
- More heavy nuclear PDFs (maybe saturation?):
  - Total/differential eAu cross sections

Inclusive physics priorities and highlights in first 5 years

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Year 1	Unpolarized *eA*, 10x115 GeV	Total/differential *eA* cross sections	Nuclear PDFs in low-x/shadowing region
Year 2	Unpolarized *eD*, 10x130 GeV Polarized *ep* (transverse), 10x130 GeV	Total/differential *ep* cross sections, transverse spin asymmetry, cross section ratio	Proton PDFs at large-x/Q^2, F_2^D/F_2^p
Year 3	Polarized *ep* (longitudinal)	Longitudinal spin asymmetry	A_1^p
Year 4	Unpolarized *eAu*, 10x100 GeV Polarized *ep*, 10x250 GeV	Total/differential *eAu* and *ep* cross sections, spin asymmetry	A_1^p at low(er)-x, *eA* PDFs in low-x, saturation?
Year 5	Unpolarized *eAu* 10x100 GeV, Polarized e^3He, 10x166 GeV	Total/differential *eA* cross sections, spin asymmetry, cross section ratio	A_1^n, F_2^{He3}/F_2^D

Next steps for early science studies

- ep events at early-science energy in simulation campaigns
  - Replace 10x100 GeV with 10x130 GeV?
- eA events in simulation campaigns
  - eD (needed), e^3He (done?), eAu (needed)
- QED radiative effects
- Photoproduction background
- More detailed assessment of systematics
  - Further development of electron ID
  - Realistic study of ECAL calibration with simulation

Points of discussion

- What about F_L and CC?
  - Limited by beam energies available in first 5 years
  - Important goals, but not early-science
- Where does calibration fit into this?
- How to divide luminosity between species?
- How should publications be staged (e.g., cross sections vs. impact papers)?