Summary of Pre-town Meeting on SPIN Physics at future Electron Ion Collider

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September 13, 2014

Jefferson Lab
Thomas Jefferson National Accelerator Facility

Pre-town meeting at Jefferson Lab

- **Meeting**

  August 13 - 15, 2014
  Thomas Jefferson National Accelerator Facility

- **Goals**

  The goal of this meeting was to have a critical number of scientists from the Spin physics community gathered with the purpose to update and sharpen our message as it relates to the case for the Electron Ion Collider in the USA

- **Participants**

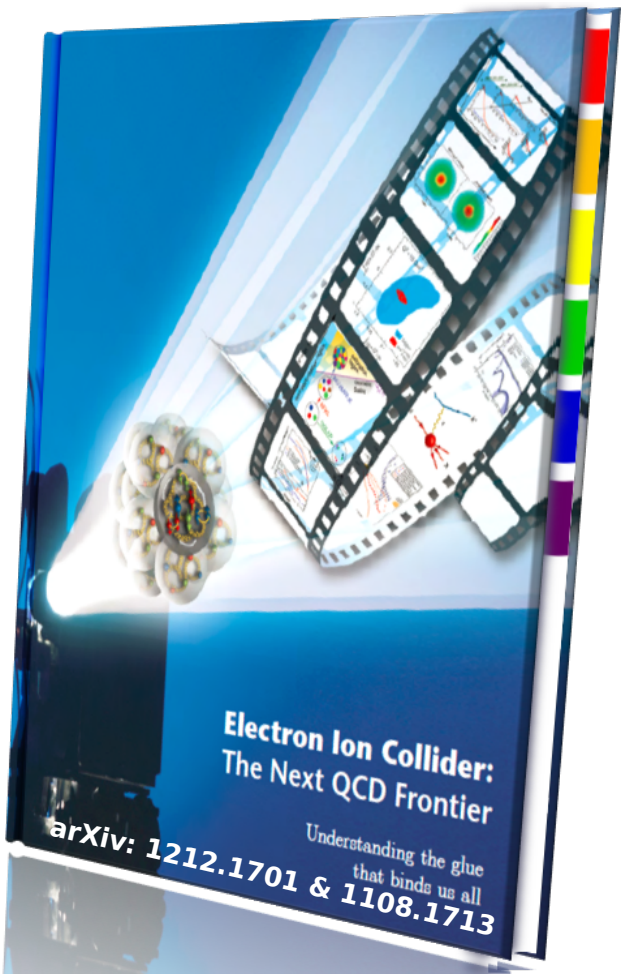
  44 scientists from JLab, BNL, LBNL, LANL, SLAC and other labs and universities including 6 remote participants from Europe

- **Results**

  http://www.jlab.org/conferences/pretownjlab2014/

Electron Ion Collider in the USA

Broad agreement of the Spin physics community that the next facility should be Electron Ion Collider



Explore “sea” quark and gluon dominated region.

From the White Paper:

– High luminosity up to

$$L \sim 10^{34}\ (\mathrm{cm}^{-2}\mathrm{s}^{-1})$$

– Variable energy range

$$\sqrt{s} = \sim 20 \text{ to } \sim 100\ (\mathrm{GeV})$$

– Polarized, longitudinally and transversely, for the proton and light-ions

– Unpolarized heavy-ion beams

– wide acceptance detector and good PID

EIC White Paper (2012) is an excellent summary of EIC physics

The goal of the meeting was to review progress in the last 2 years in SPIN physics and “3-D” structure of the nucleon

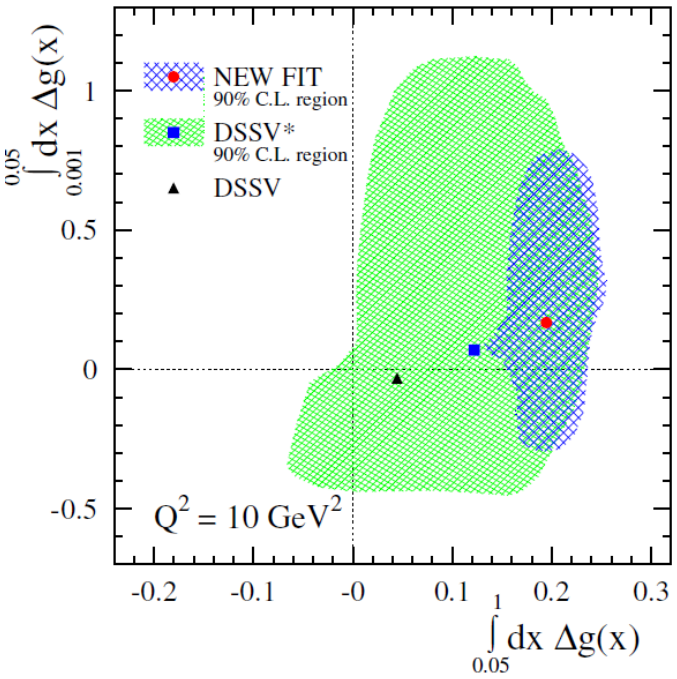
Helicity structure at EIC

W. Vogelsang
E. Aschenauer
W. Melnitchouk
E. Sichtermann
J. Qiu
Many others

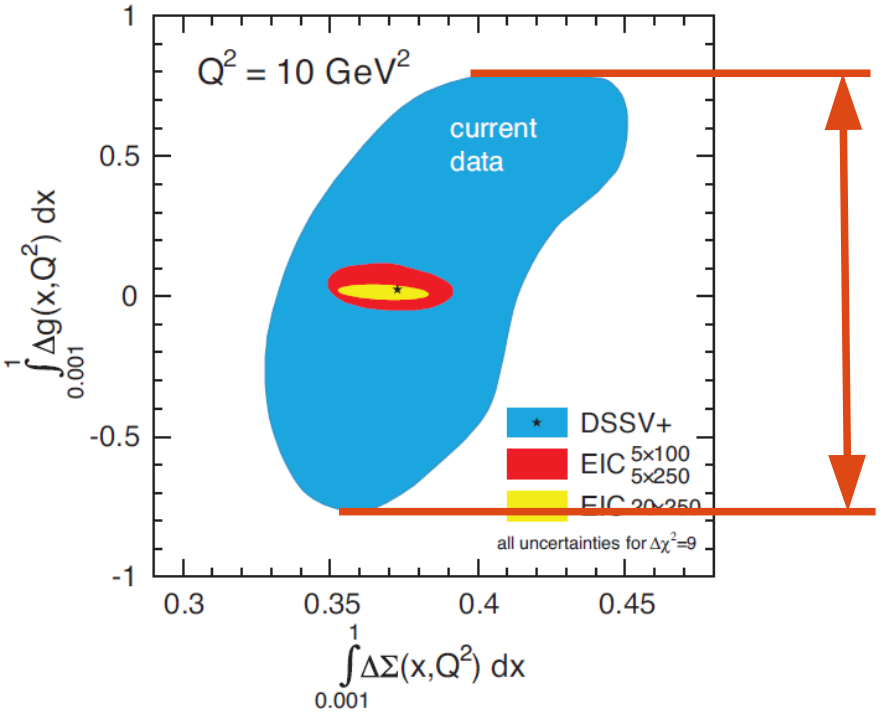
Without EIC we will never have a good quantitative knowledge of Spin decomposition of the nucleon

$$\frac{1}{2} = \frac{1}{2}\Delta\Sigma + L_q + \Delta G + L_g$$

Current knowledge



PRL 113, 012001 (2014)



EIC White Paper

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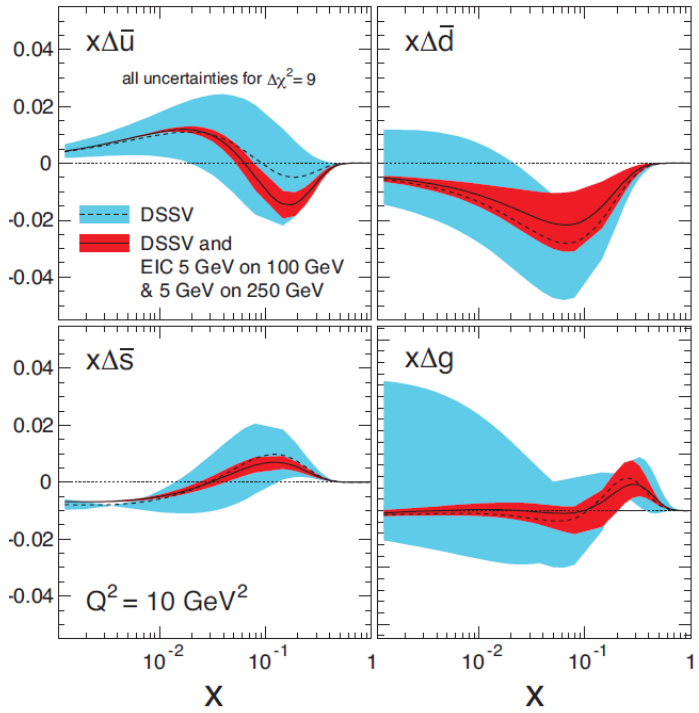
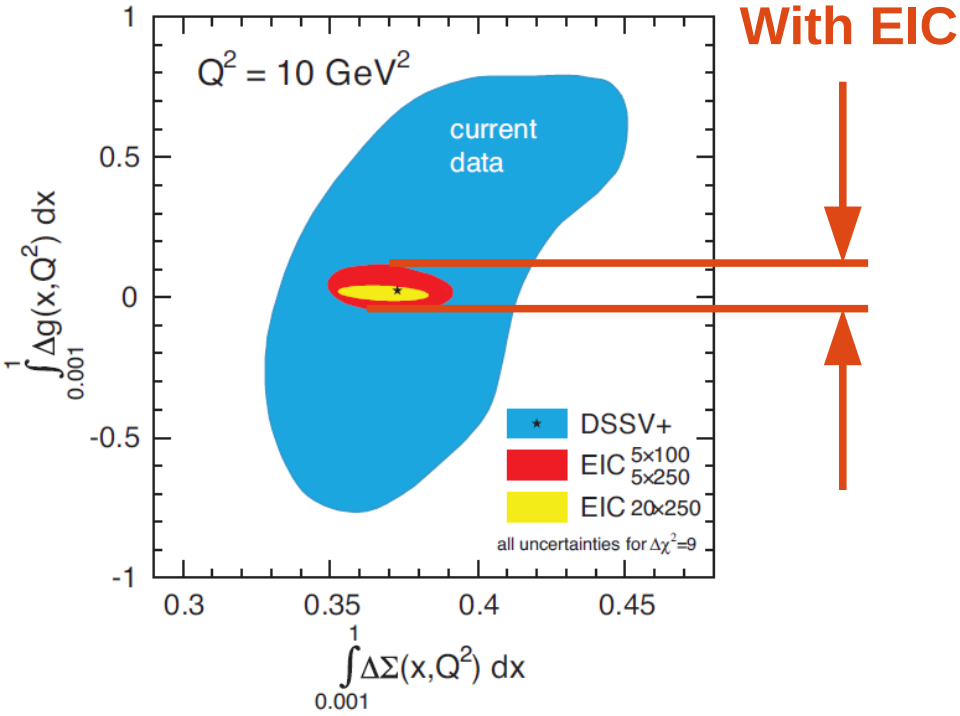




Also functions, not only integrated quantities
No other facility in the World can do it!

3D structure of the nucleon

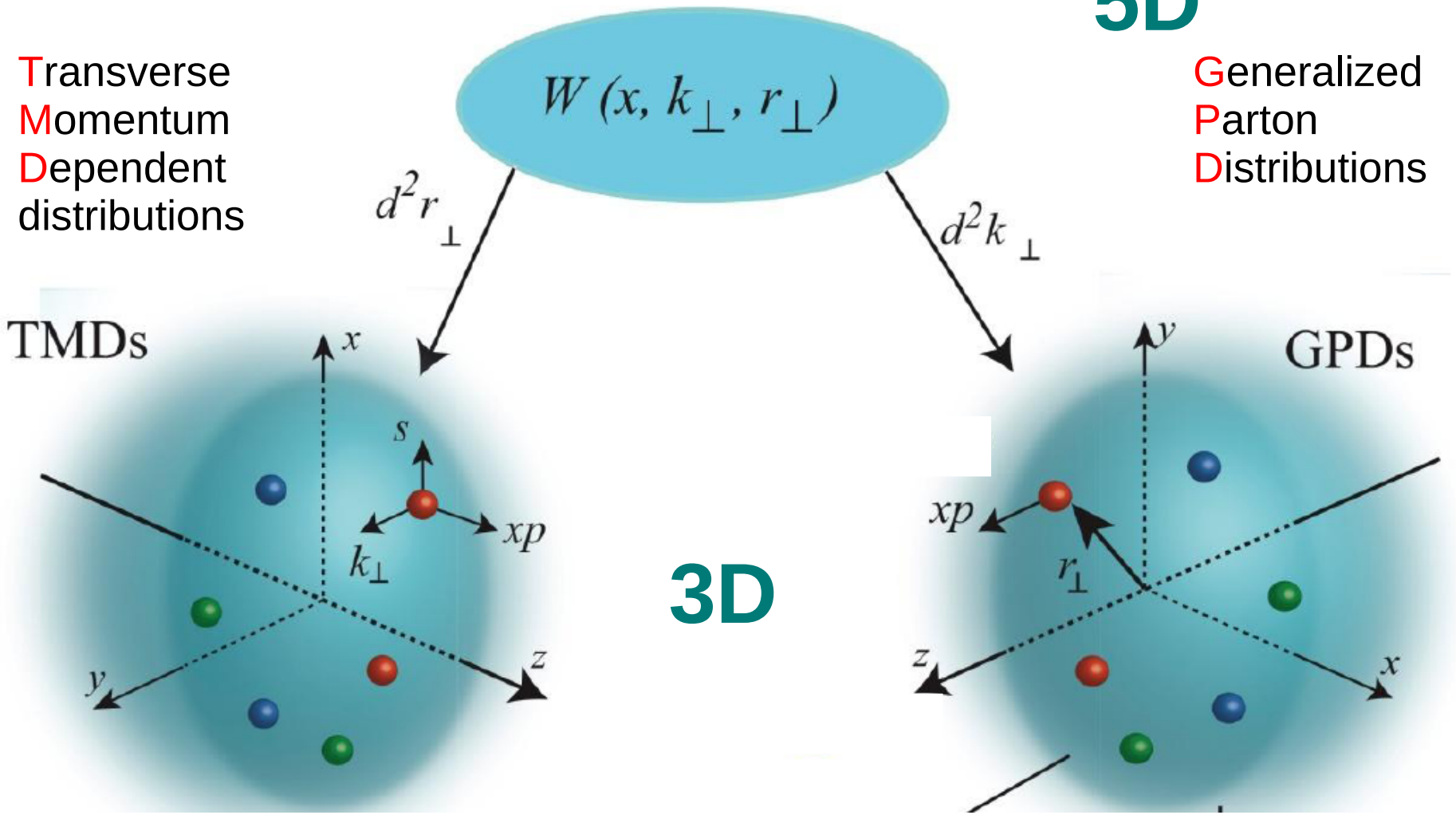
F. Yuan
C. Weiss
M. Burkardt
X. Ji
A. Radyushkin
Many others

Wigner function

5D

Transverse
Momentum
Dependent
distributions

Generalized
Parton
Distributions



3D

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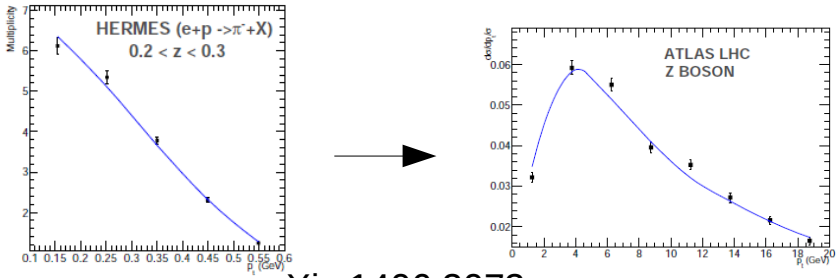
TMDs

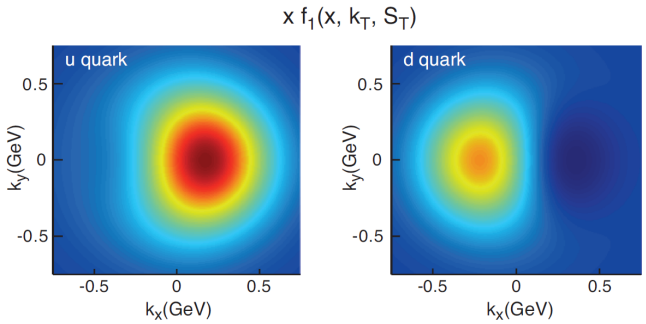
Enormous progress of understanding of evolution. We are able to span energies of JLab 6 GeV up to LHC

$\sqrt{s} \sim 7$ GeV $\qquad$ $\sqrt{s} \sim 7$ TeV



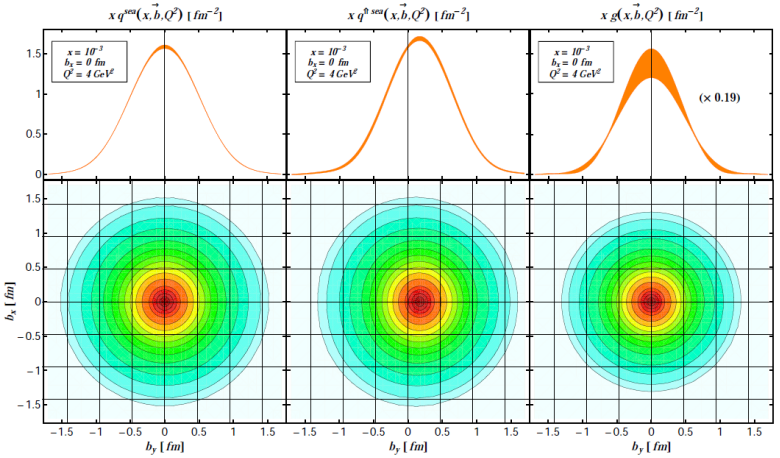
arXiv:1406.3073

Publication by JLab, HERMES, COMPASS data on multiplicities is an essential step forward towards better understanding of TMDs



GPDs

Important progress of analysis of EIC impact



JHEP 1309 (2013) 093

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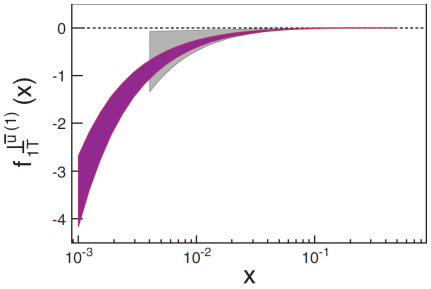
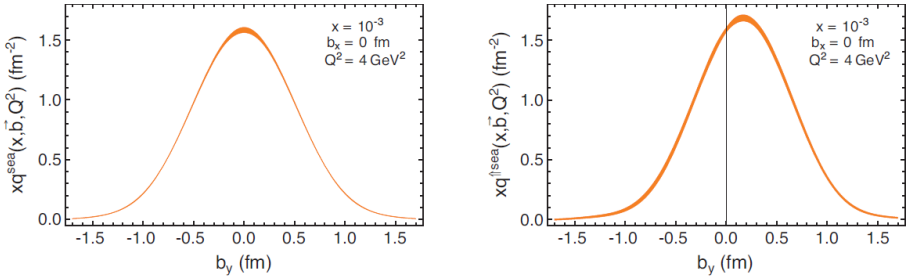
Data of EIC is essential for our understanding of hadron structure in the regime dominated by “sea” quarks and gluons

$\bar{u}$ TMD Sivers function at EIC



Sea quark GPD functions at EIC



Progress of lattice QCD and other non-perturbative methods is very encouraging and is complementary to our experimental goals of EIC

We are going to discover new phenomena and new structures associated with hadron dynamics

Spin physics community is thrilled about the prospect of building an Electron Ion Collider in the USA

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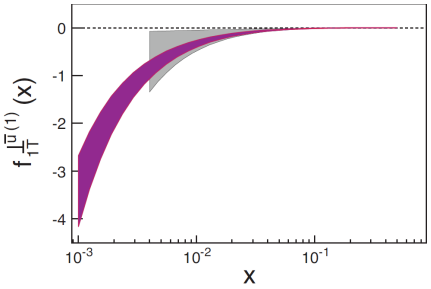

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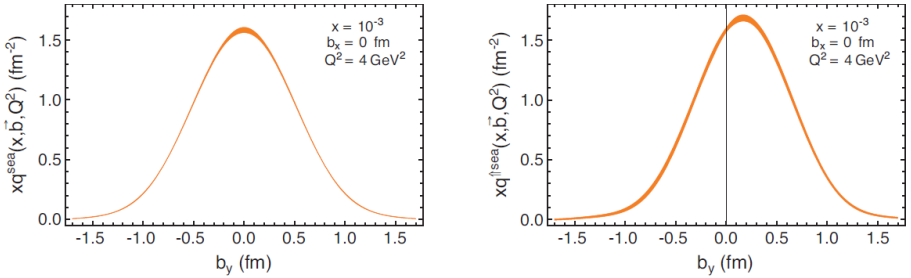

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THANK YOU!