Short-range correlations and large–x nuclear partons with an Electron-Ion Collider: Summary

C. Weiss (JLab), EMC and SRC Workshop, MIT, 2-5 Nov 2016 Jefferson Lab

- EIC: Energy, luminosity, polarization, detectors
- Tagged DIS on the polarized deuteron — light nuclei
- Gluonic EMC effect and quark flavor separation — mid/heavy nuclei

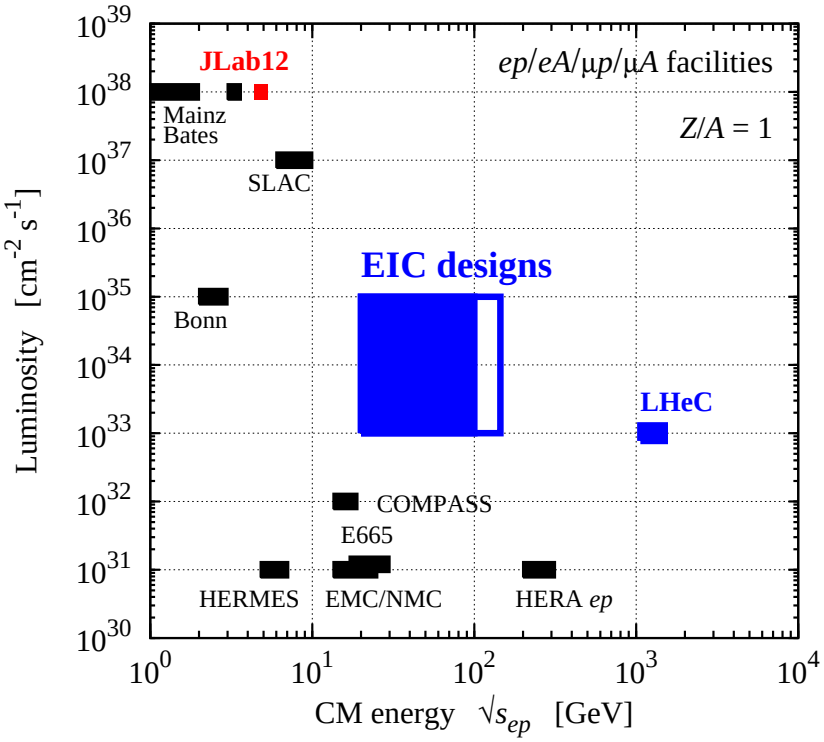
This summary highlights next-generation SRC/EMC measurements enabled by the EIC detection capabilities. Not covered are "traditional" measurements such as inclusive nuclear DIS, transparency etc., with EIC, which also contribute relevant information.

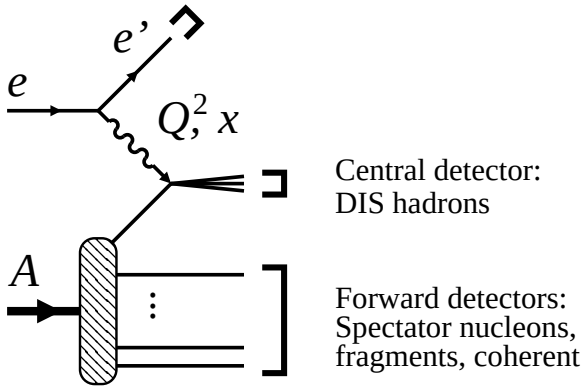
Review: Accardi, Guzey, Prokudin, Weiss, Eur. Phys. J. A **48**, 92 (2012) arXiv:1110.1031

Cosyn, Guzey, Sargsian, Strikman, Weiss, EPJ Web Conf. **112**, 01022 (2016) arXiv:1601.06665;
Cosyn *et al.*, J. Phys. Conf. Ser. **543**, 012007 (2014) arXiv:1409.5768

Chudakov *et al.*, PoS DIS **2016**, 143 (2016) arXiv:1608.08686

EIC: Energy, luminosity, polarization





- CM energy $\sqrt{s_{eN}} \sim$ 20–100 GeV

  Q^2 up to $\sim 10^2$ GeV^2 in DIS

  Coverage from $x \sim 10^{-3}$ to $x > 0.1$

  Large-x measurements possible!

- Luminosity $\sim 10^{34}\,\mathrm{cm}^{-2}\,\mathrm{s}^{-1}$

  Exceptional nuclear configs

  Multi-variable final states

  Polarization observables

- Polarized light ions

  eRHIC: unpol D, pol $^3\mathrm{He}$

  JLEIC: polarized D and $^3\mathrm{He}$ with figure-8

- Next-generation detectors

  Central: PID π/K, vertex detection

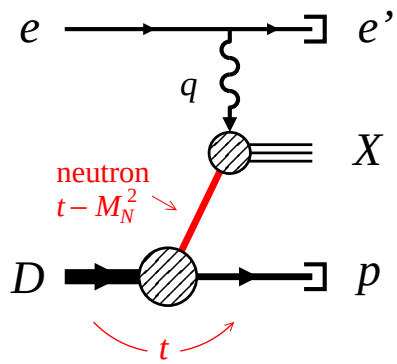
  Forward: Near-full coverage, resolution

EIC: Deuteron DIS with spectator tagging

- Process $e + D(\mathrm{pol}) \to e' + p + X$

  Unique for collider: No target material, forward detection

  Measurement of recoil momentum controls NN config:
  Spatial size, virtuality



- Physics applications

  Free neutron structure functions F_{2n}, g_{1n} etc. from on-shell extrapolation $t \to M_N^2$

  Nuclear modification as function of virtuality/size, "tagged EMC effect"

  FSI studies using azimuthal angle dependence of T-odd structures (IA $= 0$)

  Proton structure with neutron tagging, Δ structure with $\Delta \to \pi N$ tagging

  Extension to $e + {}^3\mathrm{He} \to e' + D + X$, universality

- Forward detection with JLEIC

  Acceptance over wide range of $p_\parallel \approx p_D/2$, transverse $p_T \gtrsim 0$

  Resolution $\delta p_\parallel / p_\parallel < 10^{-3}$, $\delta p_T \lesssim 20$ MeV, limited by beam momentum spread

- R&D project: Physics models, simulation tools, results: https://www.jlab.org/theory/tag/
  Cosyn, Guzey, Higinbotham, Hyde, Nadel-Turonski, Park, Sargsian, Strikman, Weiss$*$, 2014+

EIC: Gluonic EMC effect and flavor separation

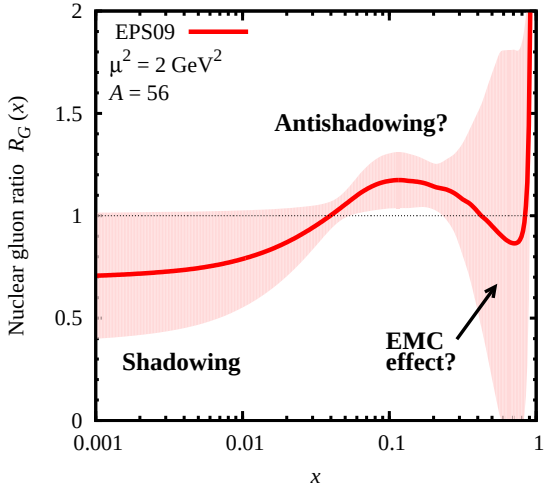
- Gluonic EMC effect with heavy quark probes

  Modification of nucleon's gluonic structure, non-nucleonic components?

  Open charm production as direct probe

  Excellent sensitivity to large–x gluons

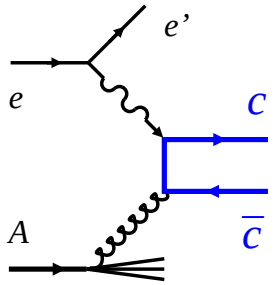
  Charm event identified through D–meson decays: exclusive and/or inclusive modes



- Central detector

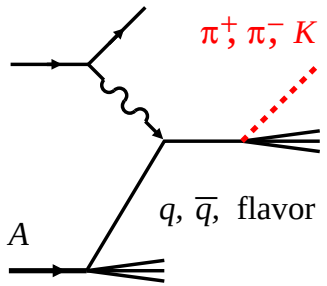
  PID: π, K separation

  Vertex detection for D meson decays



- Flavor separation of nuclear PDFs with π, K

  Quark vs. anqtiquark antishadowing $x \sim 0.1$?



- R&D project: https://wiki.jlab.org/nuclear_gluons/

  Chudakov, Higinbotham, Hyde, Furletov, Furletova, Nguyen, Stratmann, Strikman, Weiss∗, Ye 2016+