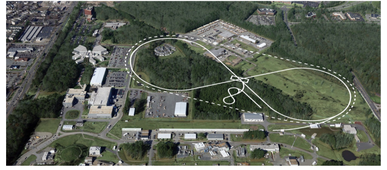

# Nuclear Gluons with Charm at a future EIC


## Dien Nguyen for LDRD project LD1601

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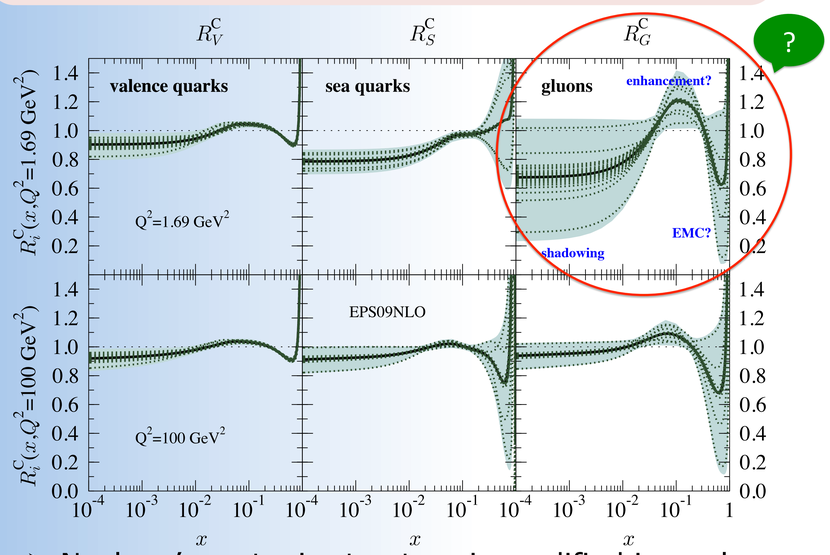
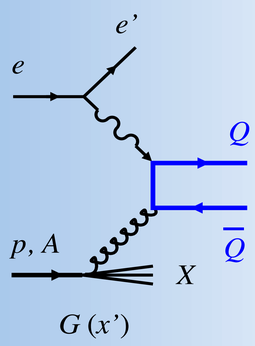
## Nuclear Gluons




- Nucleon's partonic structure is modified in nucleus
- Is nuclear gluon density suppressed at x>0.3 ?
- Are gluons enhanced at x~0.1 (antishadowing) ?

## Charm production




- Clean probes of Gluons because of coupling to Charm, Beauty quarks
- Heavy-Quark production have been used in eP (HERA), PP (LHC)
- Can be adapted to nuclei

## Why collider

Fixed Target:


Squared Center-of-mass Energy

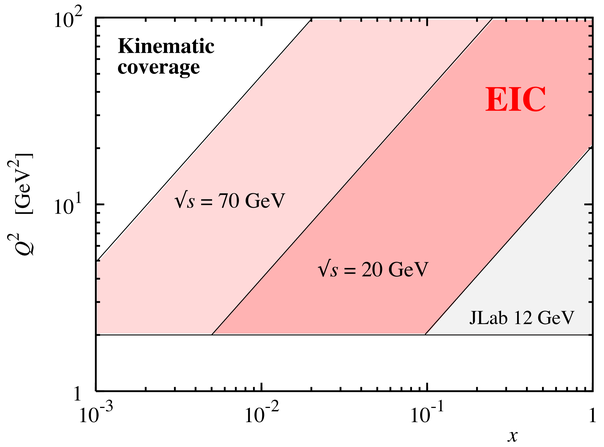
$$S = 2 * M_p * P_{lab}$$

Collider:

$$S = 4 * E_e * E_P$$

Collider can go to much higher S to get to high Q2 and Heavy-Quark final states

## Electron-Ion-Collider




- Electron-ion luminosity of ~$10^{34}$ cm$^{-2}$ s$^{-1}$
- Center-of-mass energy 20-70 GeV (eP)
- Next-generation detector, Particle ID, resolution make excellent combination for clean probes using heavy quarks

## Simulation tools

**HVQDIS:**

- Uses QCD, heavy quark fragmentation function and nucleon PDFs (CTEQ5, GRV98)
- Permits MC integration over phase space
- Calculates the differential cross section for Charm production.

**$F_2^{CC}$ Code:**

- QCD based parameterization of Charm structure function
- Calculates absolute cross section for C production in fixed bin of x and $Q^2$

**EPS09:**

- Modification factor for PDFs in nuclei

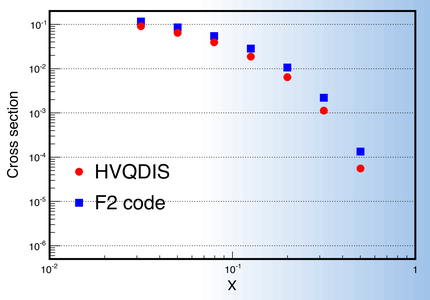
$$F_i^A(x,Q^2) = R_i^A(x,Q^2) * F_i^P(x,Q^2)$$

Nuclear 's PDFs | EPS09 | Nucleon's PDFs

## Results

**First result:**

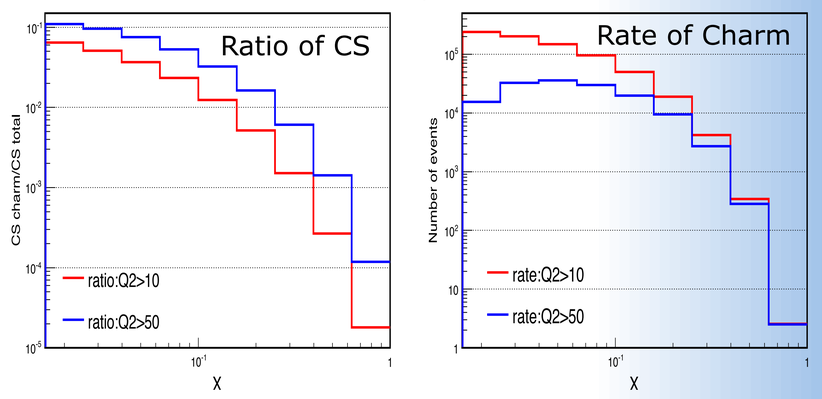
- Compared C CS from HVQDIS and $F_2^{cc}$ code
- Good agreement (30%) sufficient for simulation




**Second result:**

- Added EPS09 and CTEQ6 in HVQDIS for nuclear PDFs
- Estimate the rate of Charm production and total

S=4000, L=$10^6$ nb$^{-1}$




- Rate of Charm production drops rapidly at x> 0.1
- Ratio of Charm to total cross section higher with higher $Q^2$, but rate of Charm is lower with higher $Q^2$
- Optimize where ratio is high and rate is reasonable

## Summary

- Prospect of direct probe of nuclear gluon at x>0.1
- Reasonable C production rate with JLEIC luminosity
- Next steps for C reconstruction and physics in progress

## References


1. https://wiki.jlab.org/nuclear_gluons/
2. Nuclear PDF parameterization EPS09 Eskola et al. 2009
3. B. W. Harris and J. Smith Phys. Rev. D57 (1998) 2806