Open charm production on nuclei: Sensitivity to nuclear gluon modification
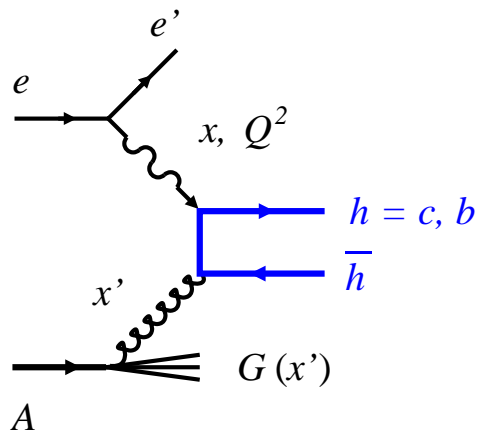
C. Weiss, LDRD Project "Nuclear gluons with charm at EIC," Meeting 02-Mar-16

Corrected version 16-Mar-16

- Study sensitivity of open charm cross section (integrated over x, Q^2 bins) to variation of the nuclear gluon density

- Use LO differential cross section, numerical integration
  Should be confirmed by more detailed studies using HVQDIS

- Use EPS09 PDF parametrization
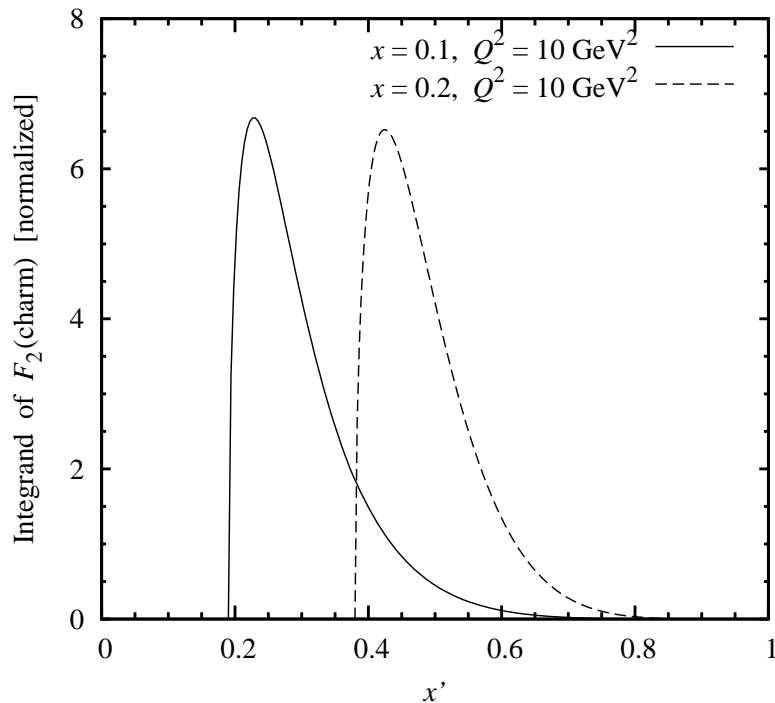
Open charm: LO cross section

$$F_2^h(x, Q^2) = \int_{ax}^{1} \frac{dx'}{x'}\, x'G(x')\, \hat{F}_g^h(x/x',\, Q^2,\, m_h^2,\, \mu^2)$$

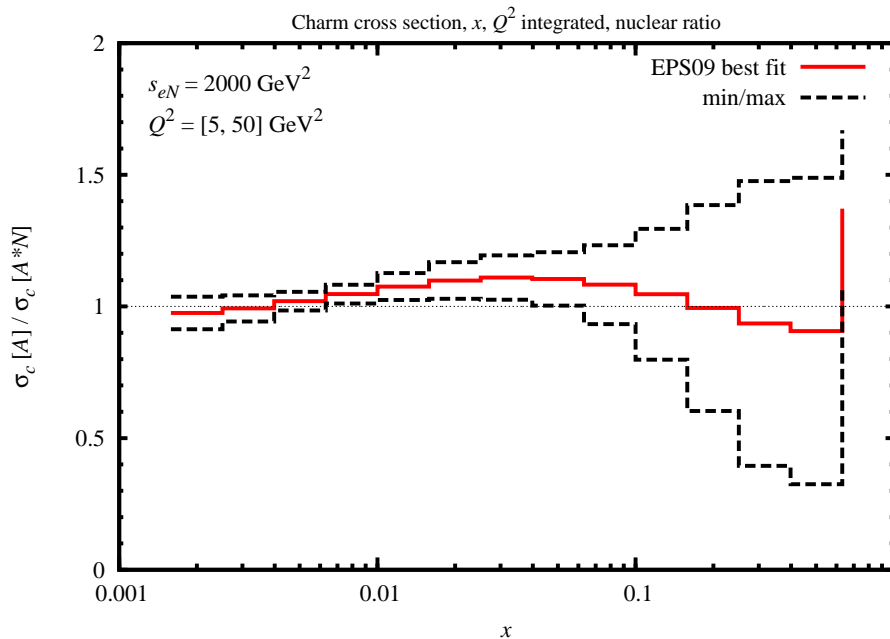coefficient function
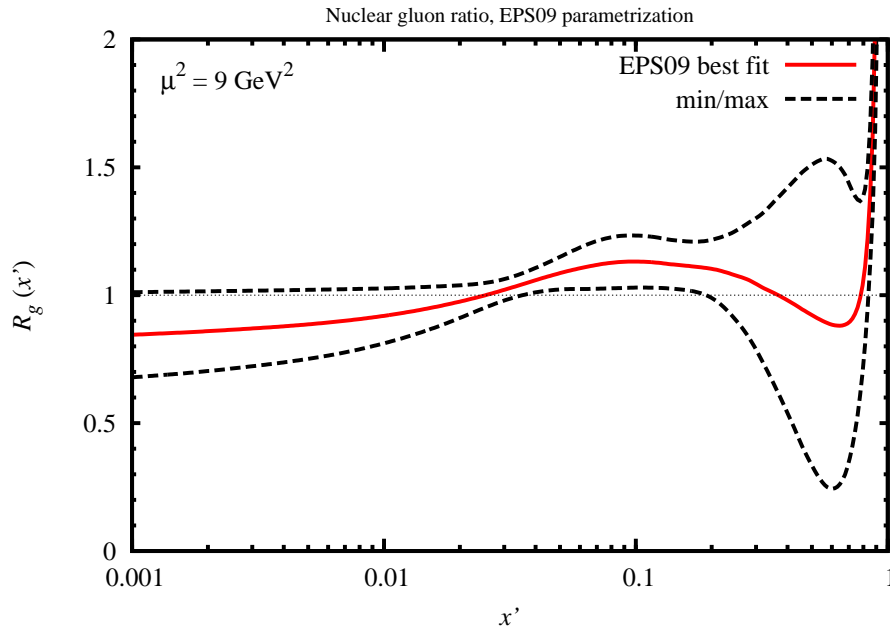
$$a = 1 + \frac{4m_h^2}{Q^2}$$

sets limit of x' integral

- Integrand localized in x' around lower limit ax

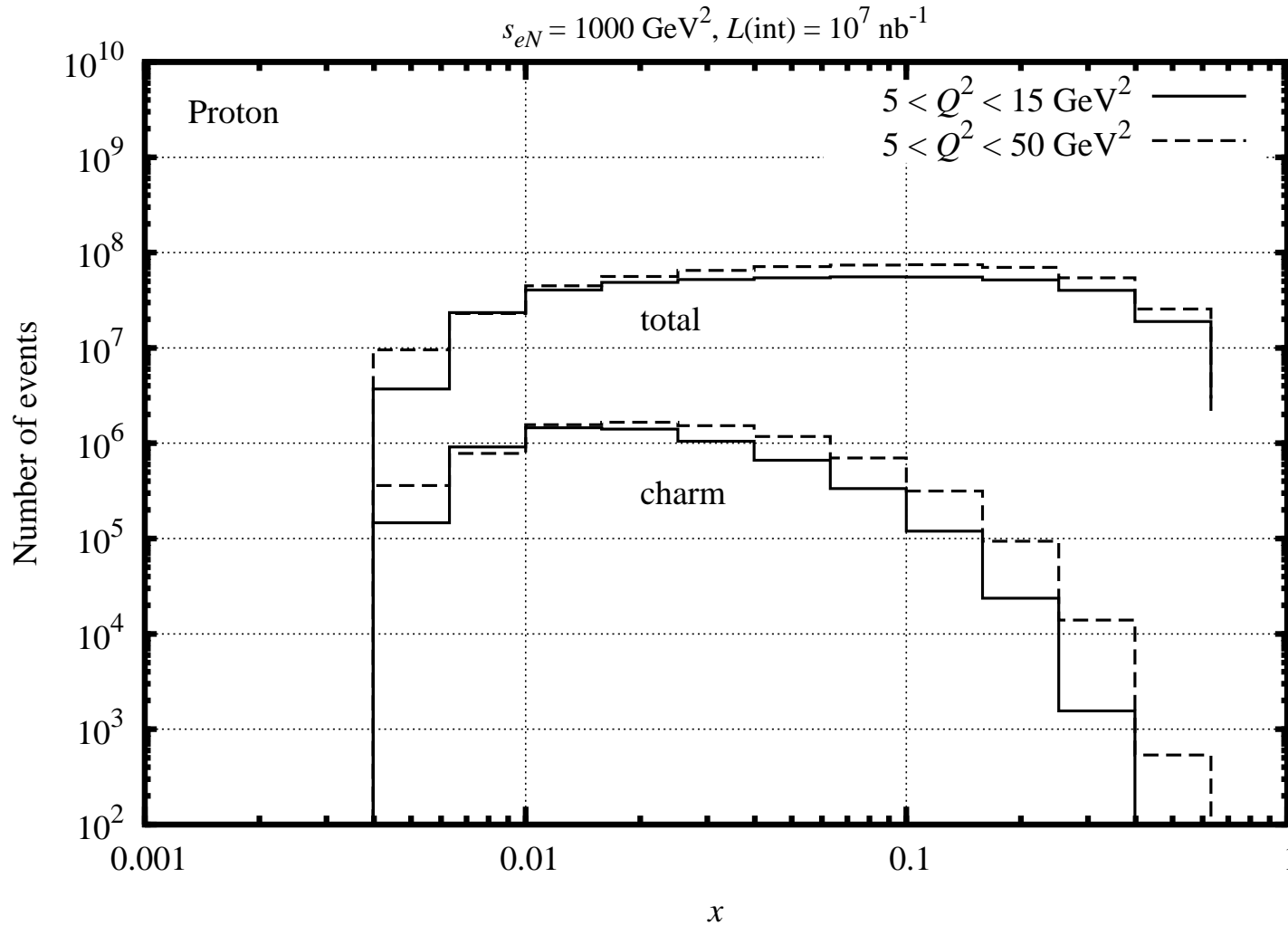- Heavy quark production probes large-x' gluons "almost locally"

Nuclear gluon ratio, EPS09 parametrization

$\mu^2 = 9\ \mathrm{GeV}^2$

EPS09 best fit
min/max

$R_g(x')$

x'

- Large uncertainty in $R_g(x' > 0.2)$

- Variation of cross section

   Variation shifted to $x < x'$

   Large variation at $x > 0.1$

   Very small variation at $x < 0.05$

Charm cross section, x, Q^2 integrated, nuclear ratio

$s_{eN} = 2000\ \mathrm{GeV}^2$
$Q^2 = [5, 50]\ \mathrm{GeV}^2$

EPS09 best fit
min/max

$\sigma_c\,[A] / \sigma_c\,[A{*}N]$

x

- Reasonable chance for experiments

   Impact relative to present error bands

   Probably impossible to detect
   deviation from unity $R_g \neq 1$

- Detailed studies with HVQDIS

$s_{eN} = 1000 \, \text{GeV}^2, \, L(\text{int}) = 10^7 \, \text{nb}^{-1}$

Proton

$5 < Q^2 < 15 \, \text{GeV}^2$ ———
$5 < Q^2 < 50 \, \text{GeV}^2$ – – – –

total

charm

Number of events

x

- Cross sections and rates drop rapidly at large x
- Here proton; nuclear rates comparable $F^c_{2A} \sim A F^c_{2N}$, but luminosity $L_A \approx L_N / A$