NC Cross Section Comparison with Theory

Matt Posik
Temple University

2nd EIC Yellow Report Workshop
Pavia, Italy
May 20-23, 2020

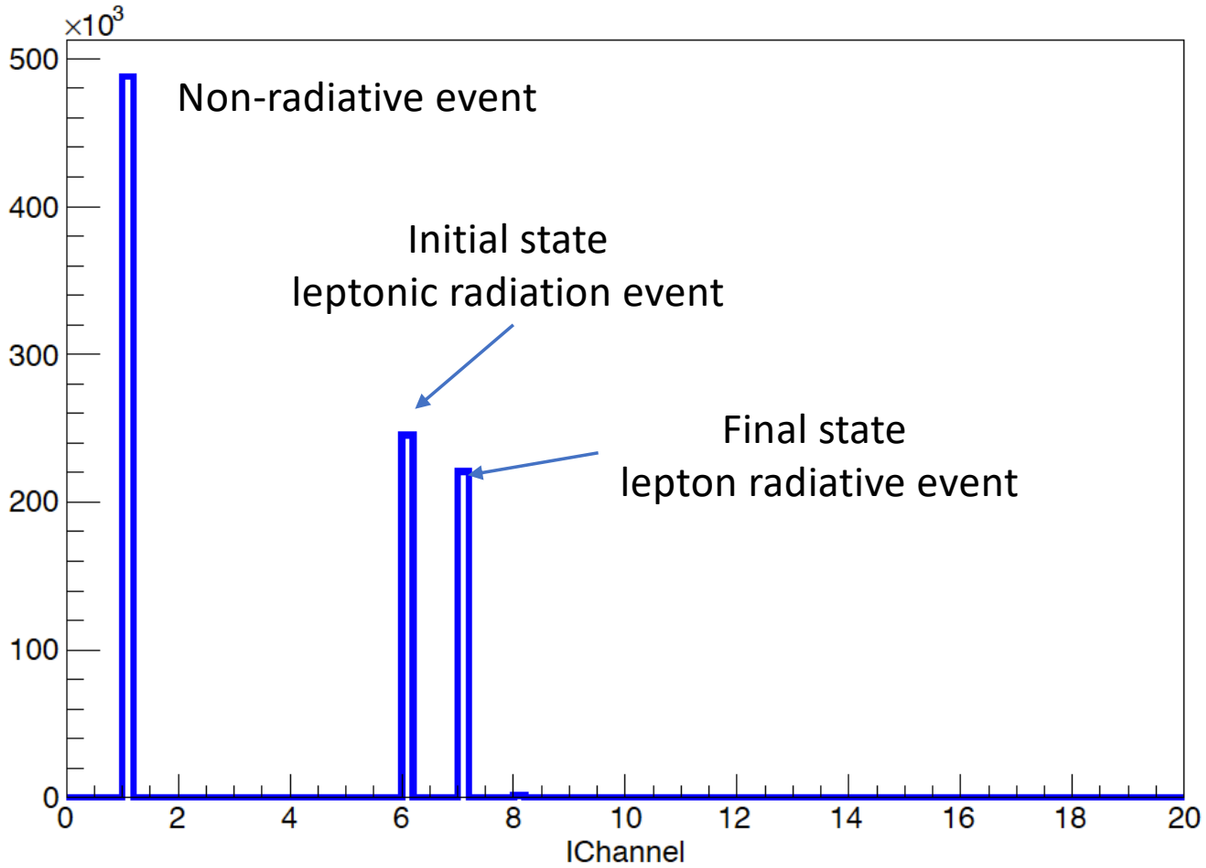
College of
Science and Technology
TEMPLE UNIVERSITY®

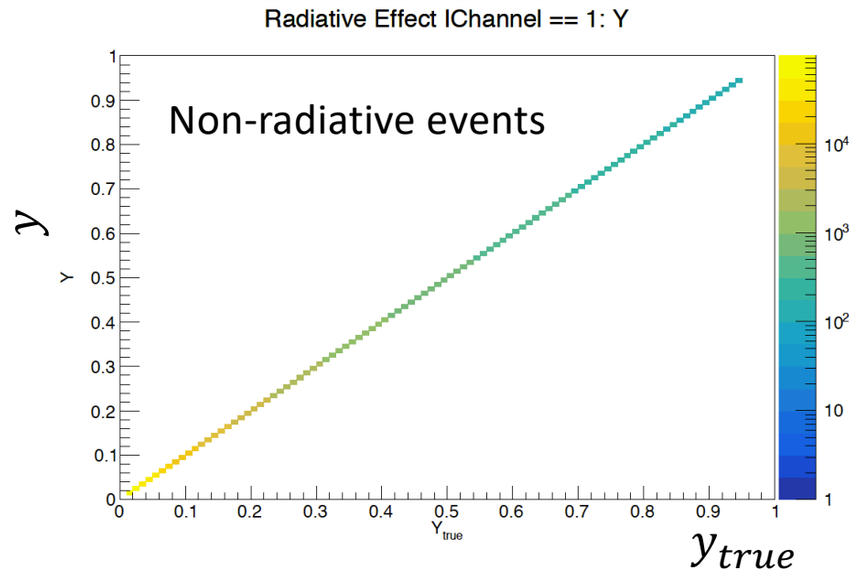
Goal

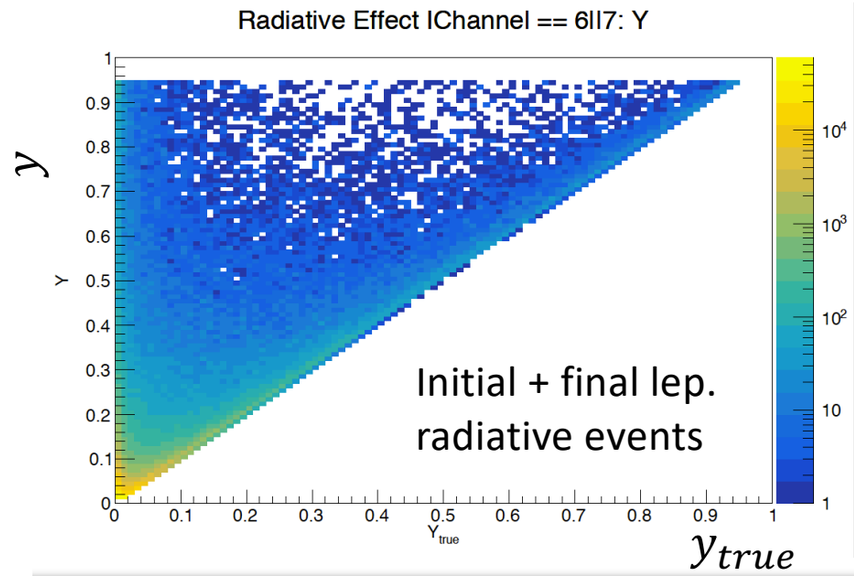
1. Use MC generator to simulate collisions
   - DJANGHO located on BNL EIC machine
   - /afs/rhic.bnl.gov/eic/restructured/env/dev/bin/djangoh
2. Generate theory curves from PDFs
   - Use PDFs to generate unpolarized cross sections
   - Code : https://github.com/JeffersonLab/txgrids
3. Reweight MC simulated event distributions with theory values
   - Under analysis now

MC Generation and Radiative Events

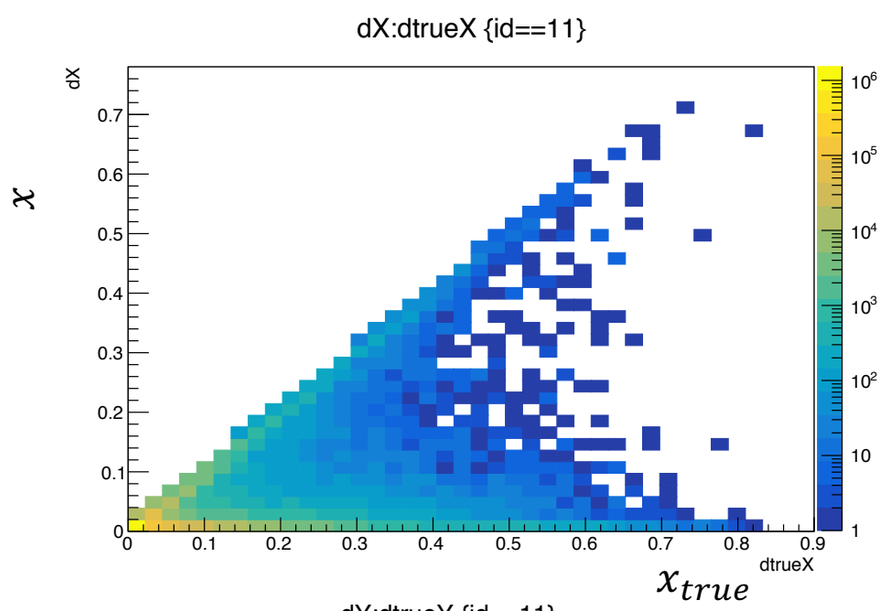
- DJANGHO Radiative Effects
  - Neutral current (no rad and rad)
  - 18x275 ep ($\sqrt{s} = 140.7\ GeV$)
  - 1 Million events

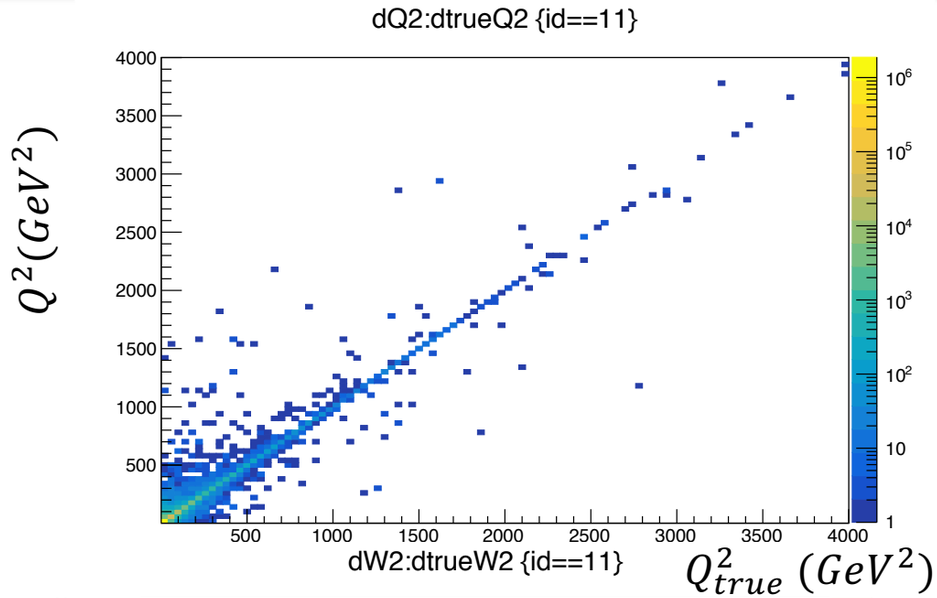


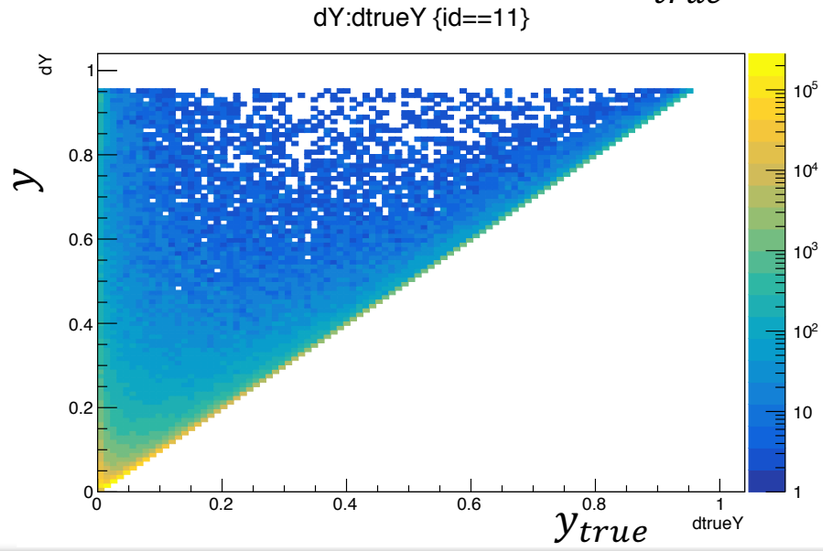


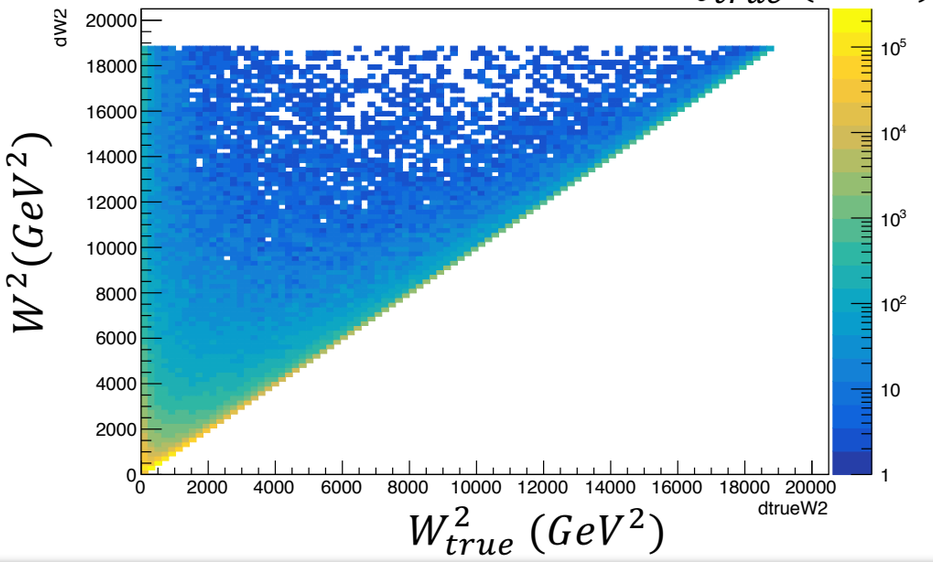


Radiative Effects on DIS Electron Kinematics



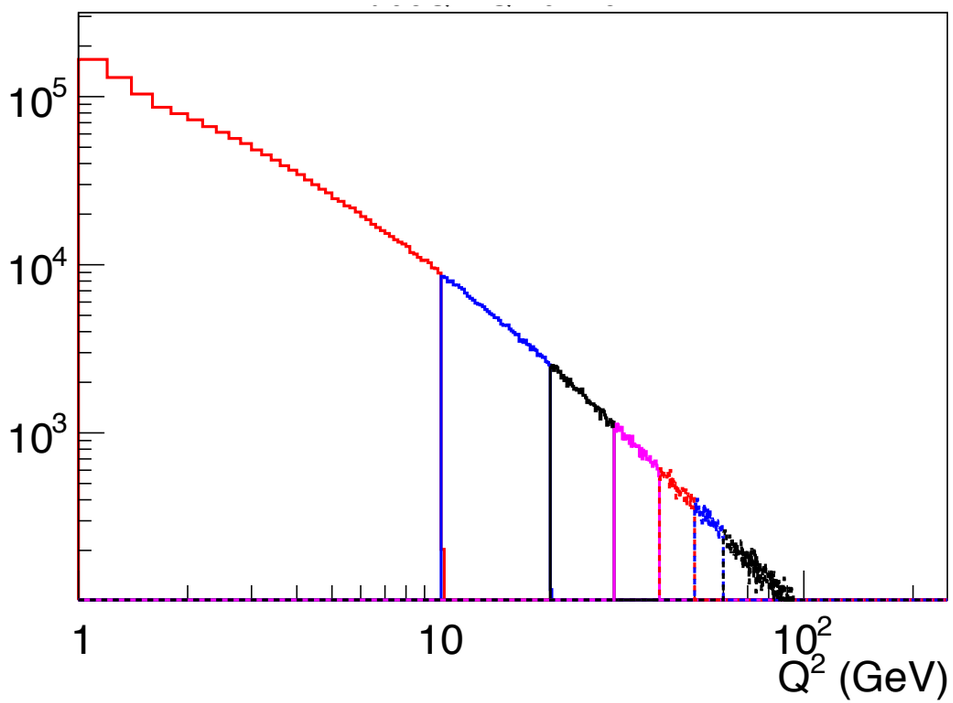


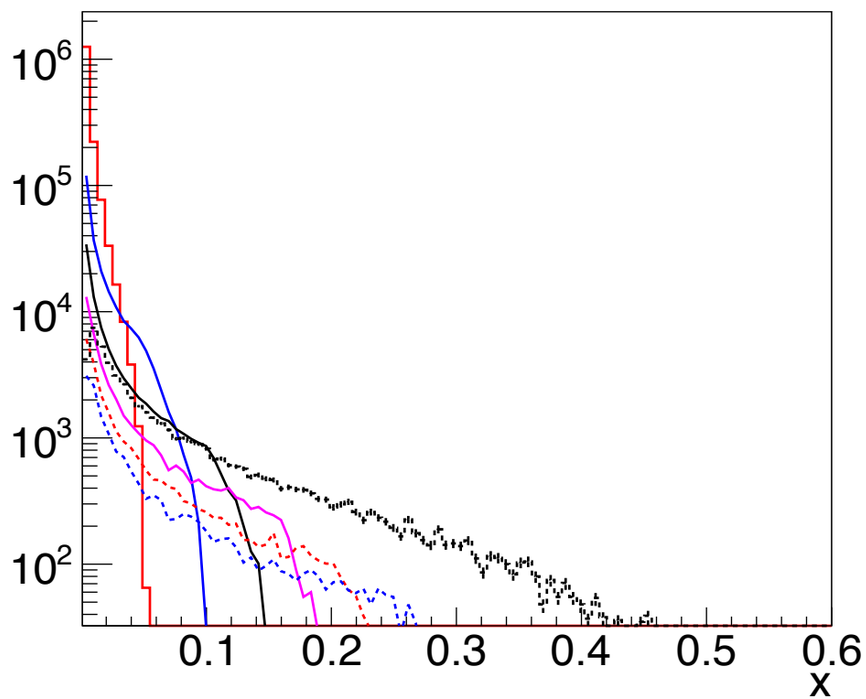




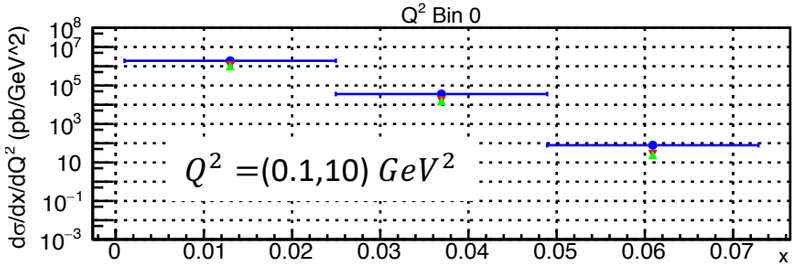
MC Generation

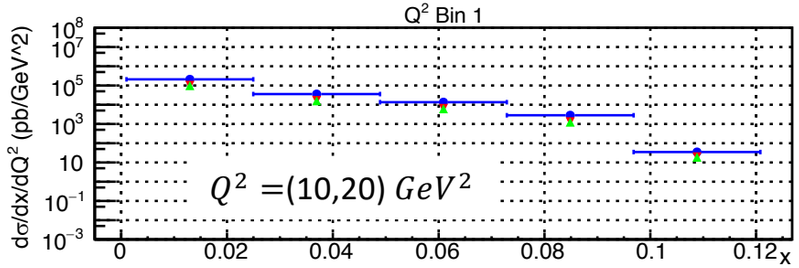
- Cuts: $W^2 > 1.96\ GeV^2, 0.01 < y < 0.95, Q^2 > 1.0\ GeV^2, id = 11$
- 7 Q^2 bins, 25 x bins: need to optimize binning
- $\frac{d\sigma}{dxdQ^2} = \frac{counts(x,Q^2)}{dxdQ^2} \times \left(\frac{\sigma_{tot}}{events}\right)$
  - Events = 1 Million
  - σ_{tot} from DJANGHO: $2.61\times10^5\ pb$ (w/o rad), $3.09\times10^5\ pb$ (w. rad)
  - $dx\ dQ^2$: x and Q^2 bin widths

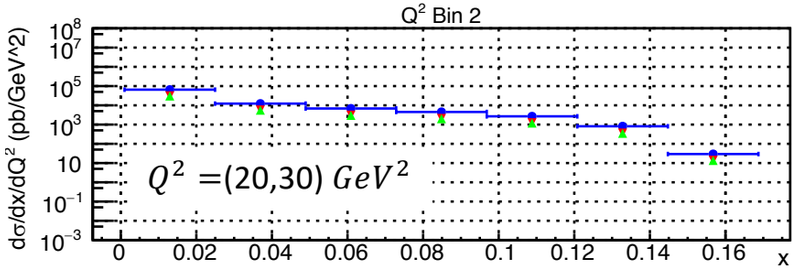


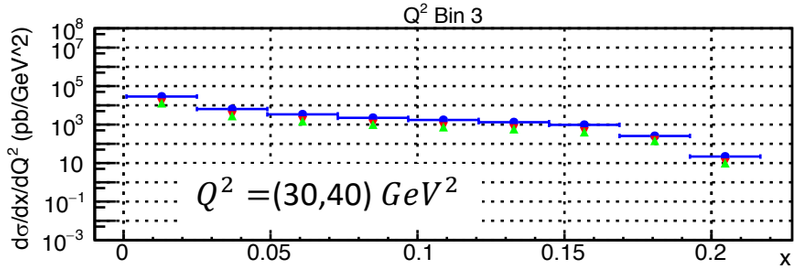


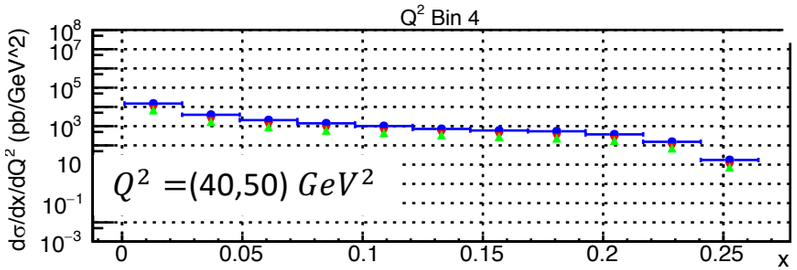
Cross Section Comparison (w/o Rad)

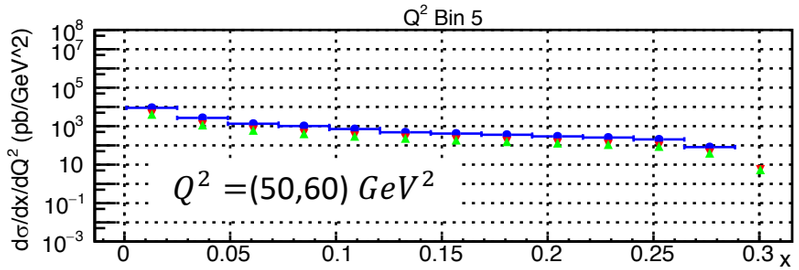


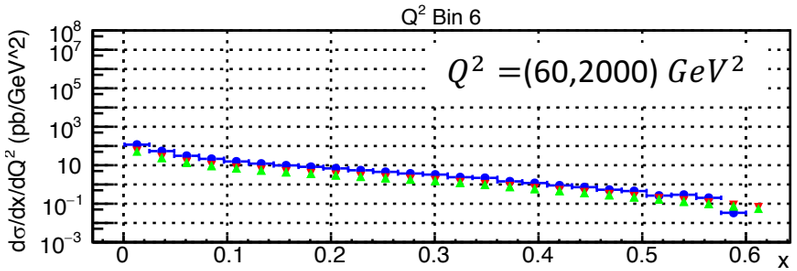












DJANGHO (w/o rad)

JAMEIC

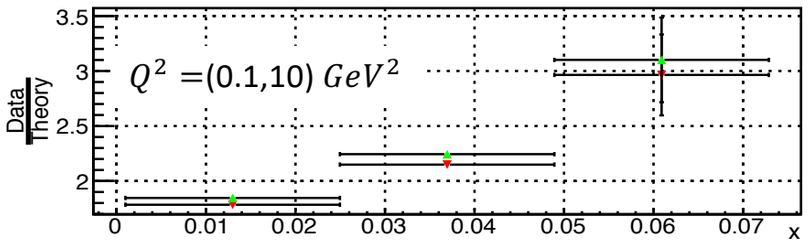
NNPDF

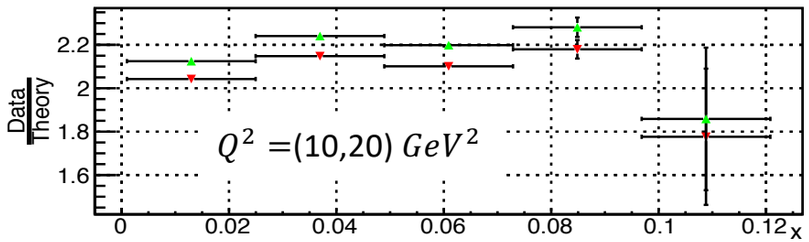
$\sigma_{tot}^{DJANGHO} = 2.61\times10^5\ pb$

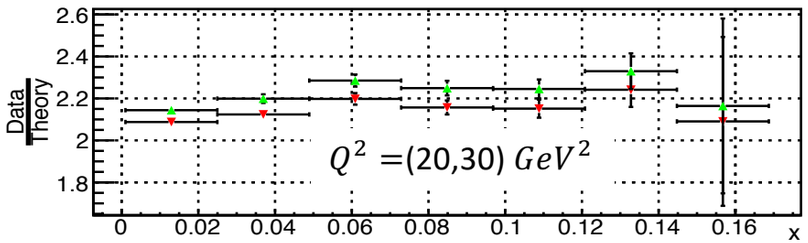
$\sigma_{tot}^{JAMEIC} = 5.54\times10^5\ pb$

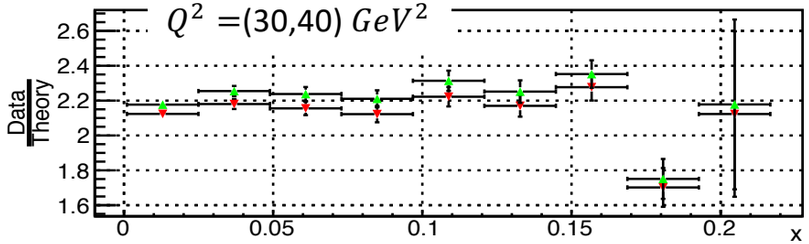
$\sigma_{tot}^{NNPDF} = 5.37\times10^5\ pb$

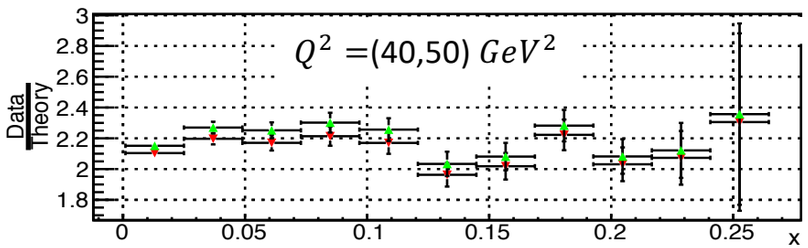
Cross Section Comparison (w/o Rad)

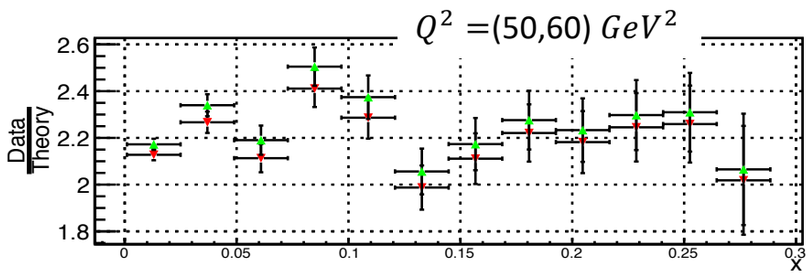


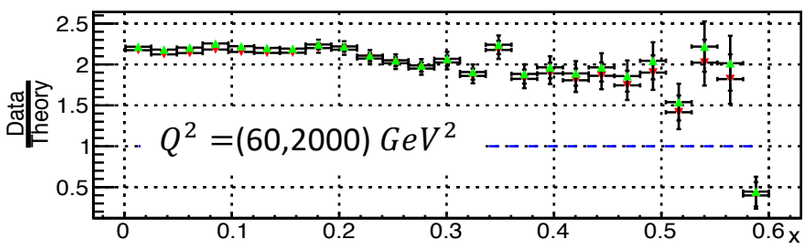












▼ DJANGHO /JAMEIC

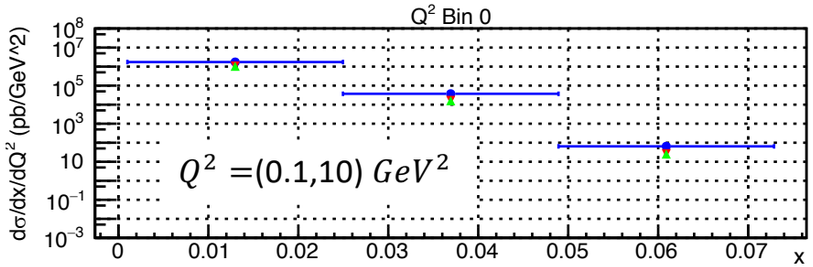
▲ DJANGHO /NNPDF

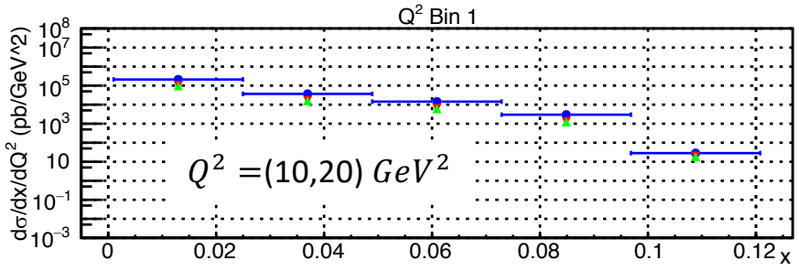
$\sigma_{tot}^{DJANGHO} = 2.61\times10^5\ pb$

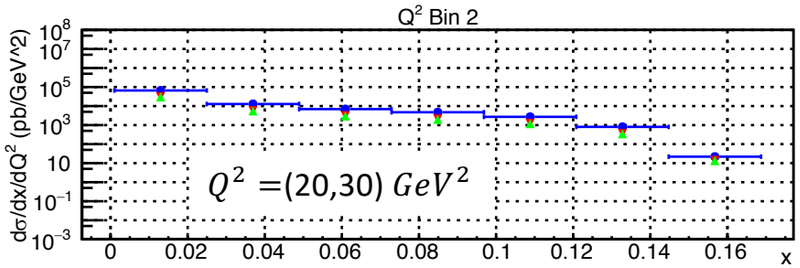
$\sigma_{tot}^{JAMEIC} = 5.54\times10^5\ pb$

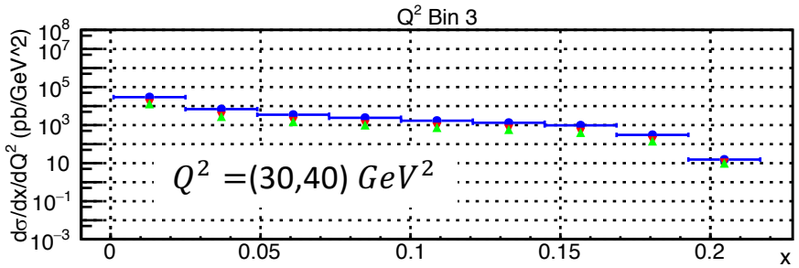
$\sigma_{tot}^{NNPDF} = 5.37\times10^5\ pb$

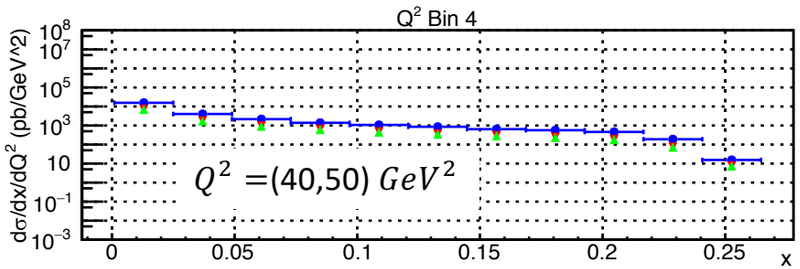
Cross Section Comparison (w. Rad)

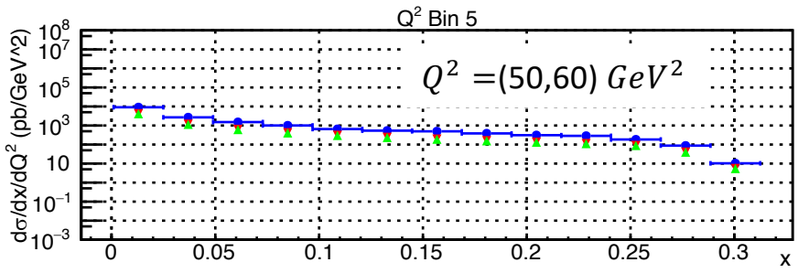


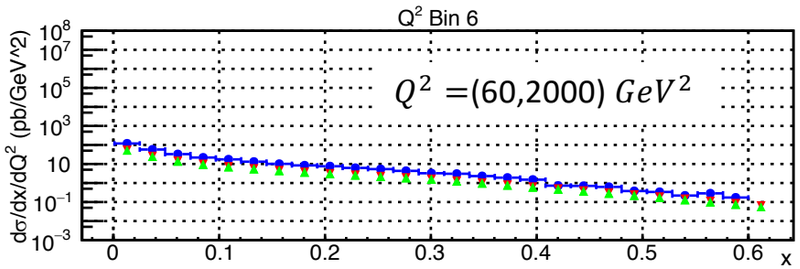












DJANGHO (w. rad)

JAMEIC

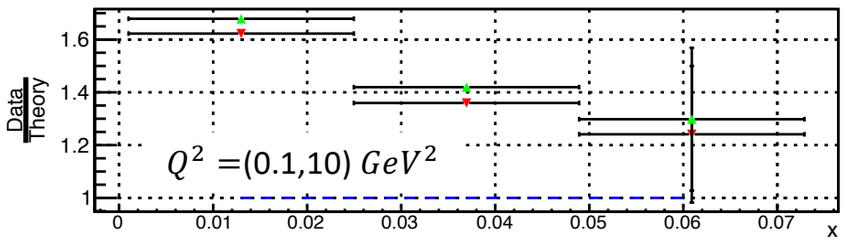
NNPDF

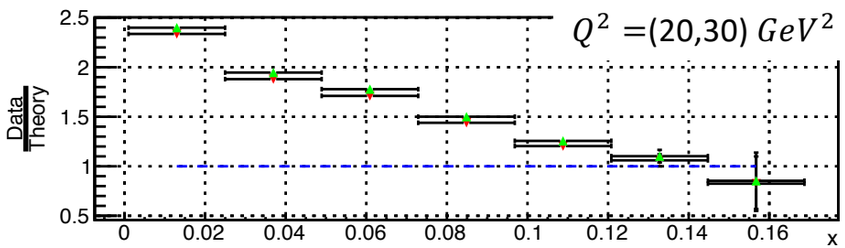
$\sigma_{tot}^{DJANGHO} = 3.09\times10^5\ pb$

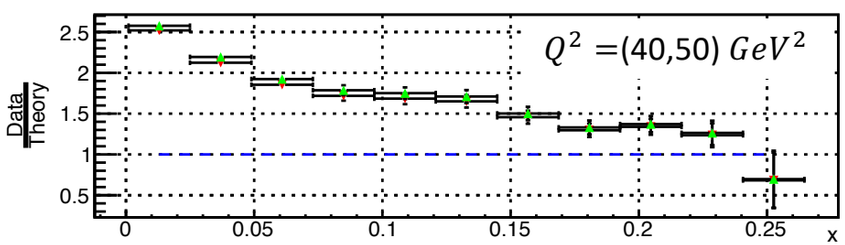
$\sigma_{tot}^{JAMEIC} = 5.54\times10^5\ pb$

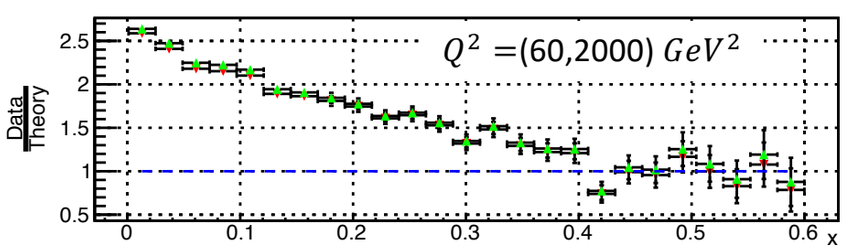
$\sigma_{tot}^{NNPDF} = 5.37\times10^5\ pb$

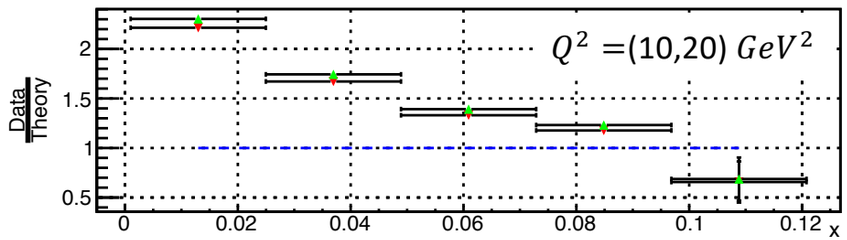
Cross Section Comparison (w. Rad)

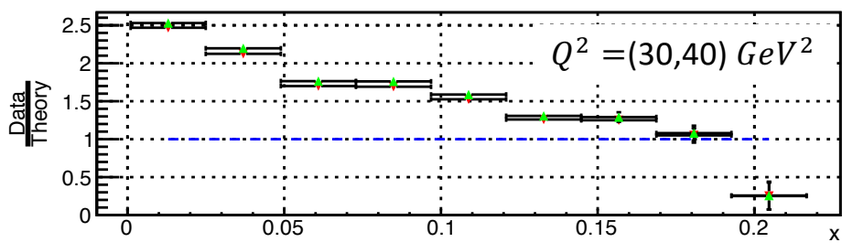


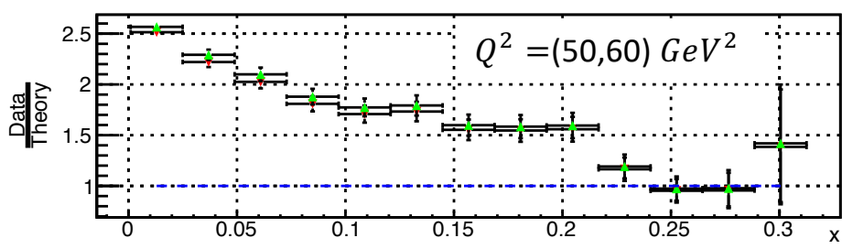












DJANGHO/JAMEIC

DJANGHO/NNPDF

$\sigma_{tot}^{DJANGHO} = 3.09\times10^5\ pb$

$\sigma_{tot}^{JAMEIC} = 5.54\times10^5\ pb$

$\sigma_{tot}^{NNPDF} = 5.37\times10^5\ pb$

Summary

- Comparison between Djangho (with radiative corrections) and theory differ by about a factor of 2
  - Largest disagreement at low x
- Currently applying a reweighting procedure to Djangho cross sections based on updated theory cross sections