LHRS Analysis for d_2^n

Radiative Correction Systematic Errors and Cross Section Models

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3/15/12

Outline

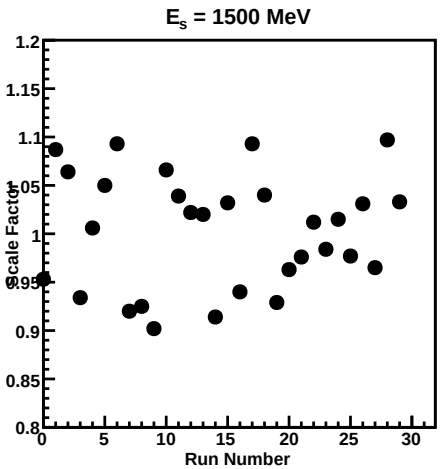
Systematic Errors (1)

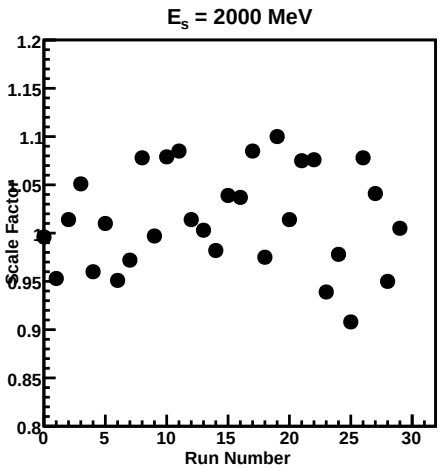
Method: QFS Model

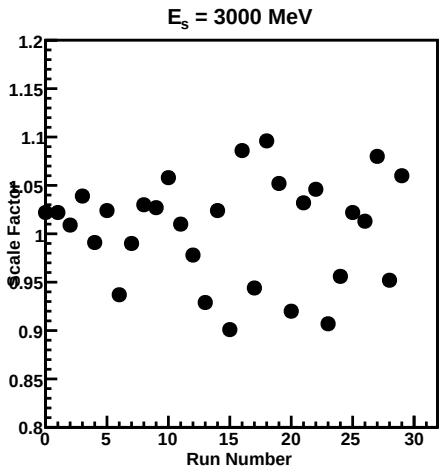
- We used QFS to model our cross sections at our kinematics and those that we need to unfold the data
  - Was accurate to $\sim$ 10%
- To study the systematic error of the model, we vary the model by $\pm$ 10% at random for each spectrum needed for the procedure
  - Carry this out for 30 runs

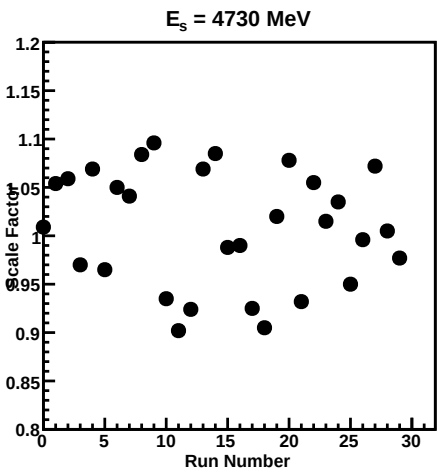
Systematic Errors (2)

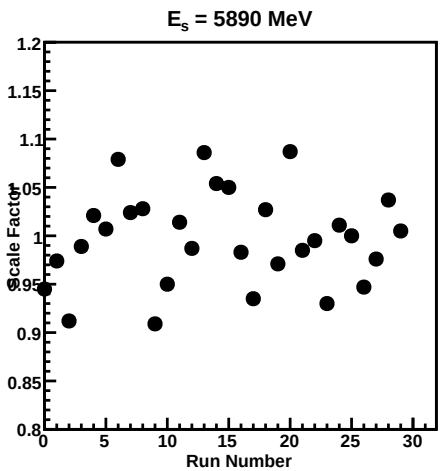
QFS Model: Random-Scaling of Input Spectra





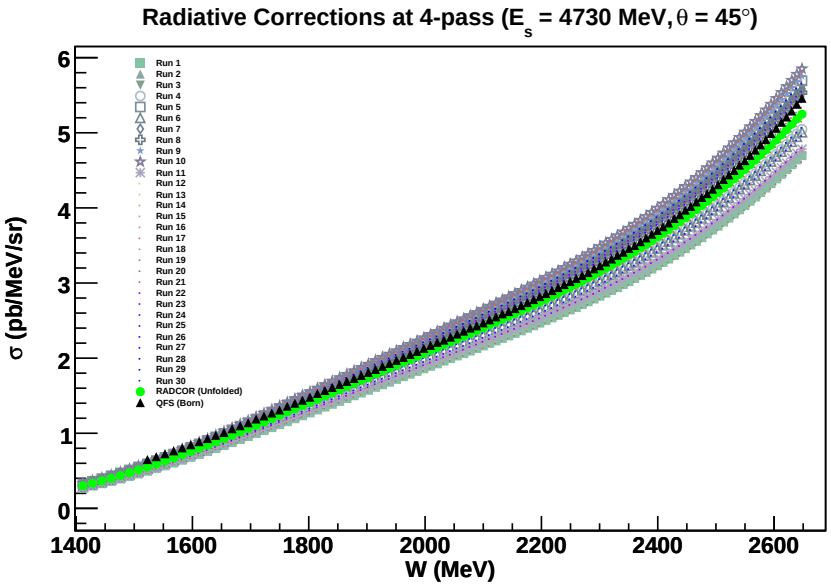


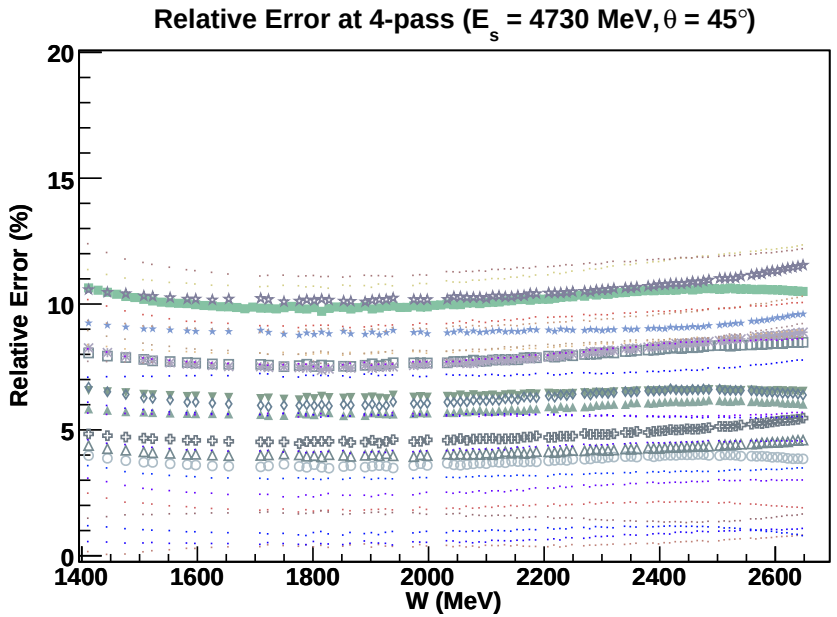




Systematic Errors (3)

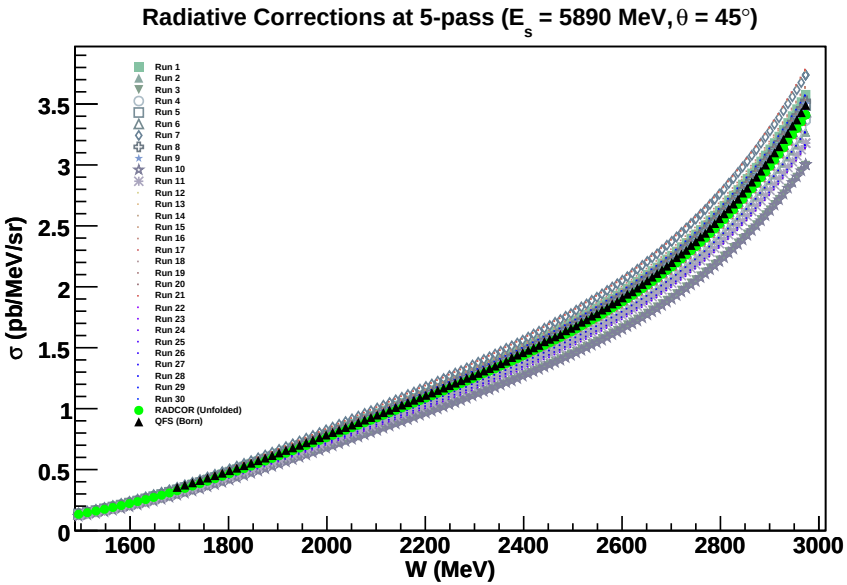
QFS Model (E_s = 4.73 GeV)

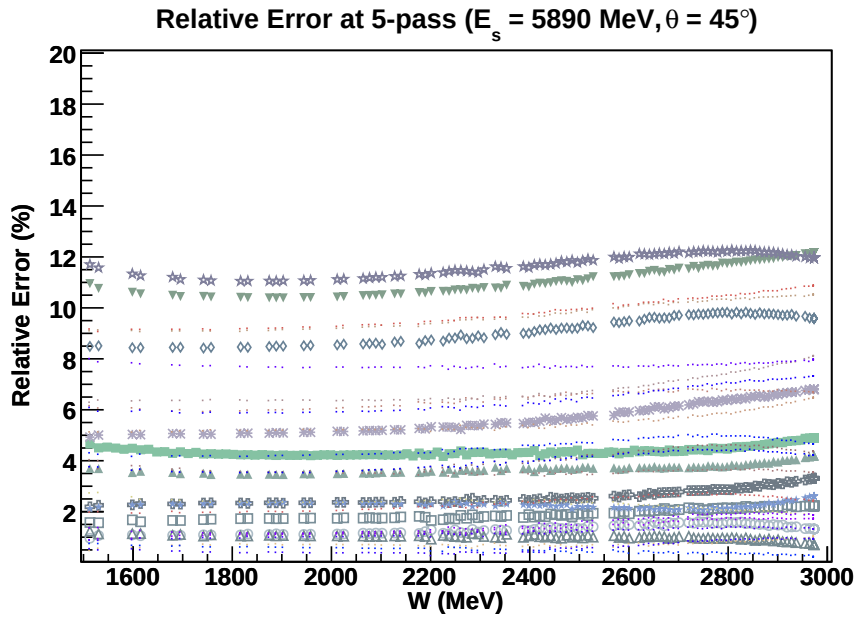




Systematic Errors (4)

QFS Model (E_s = 5.89 GeV)





Systematic Errors (5)

Method: Varying the Radiation Lengths

- Vary the radiation lengths t_b and t_a by $\pm$ 10% and see how it changes our unfolded result
  - From Yawei: thickness of glass cell wall is good to $\sim$3.6%
- In the plots that follow, the following convention is used:
  - Run 1: t_b increased by 10%
  - Run 2: t_b decreased by 10%
  - Run 3: t_a increased by 10%
  - Run 4: t_a decreased by 10%
- Radiation lengths are shown on the next slide
  - Values for before scattering (Be and ^{4}He) and after (^{4}He, Air and Kapton) taken from Chiranjib's thesis

Systematic Errors (6)

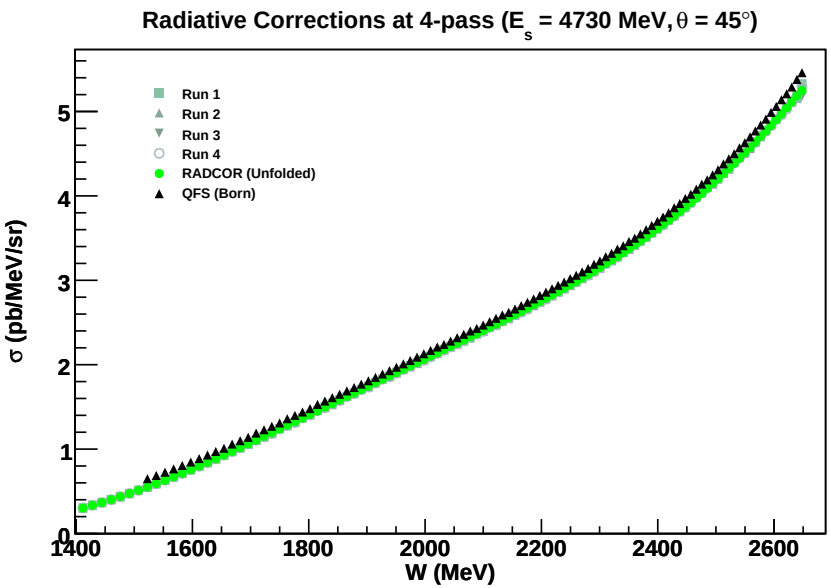
Radiation Lengths Before and After Scattering

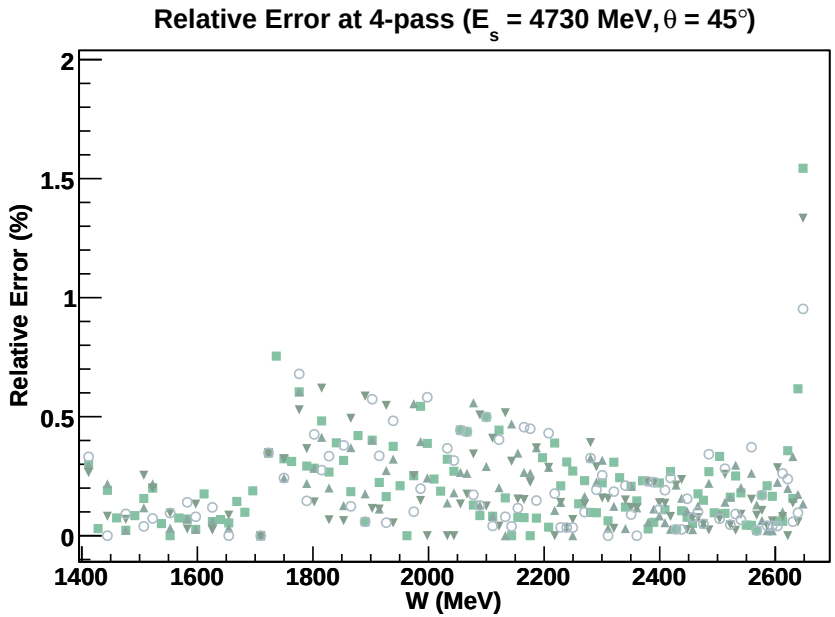
Radiation Lengths: Before Scattering				
Material	ρ (g/cm^3)	X_0 (g/cm^2)	L (cm)	T (#X_0)
Be	1.85	65.19	0.025	7.20E-04
^{4}He	1.66E-03	876.66	22.86	4.33E-05
Glass (GE-180)	2.77	19.42	0.012	1.73E-03
^{3}He	1.25E-03	54.28	19.05	4.39E-04
Total	–	–	–	**2.93E-03**

Radiation Lengths: After Scattering				
Material	ρ (g/cm^3)	X_0 (g/cm^2)	L (cm)	T (#X_0)
^{3}He	1.25E-03	54.28	1.34	3.08E-05
Glass (GE-180)	2.77	19.42	0.24	3.35E-02
^{4}He	1.66E-03	876.66	79.05	1.49E-04
Air	1.20E-03	36.81	51.23	1.67E-03
Kapton	1.42	40.61	0.025	8.88E-04
Total	–	–	–	**3.62E-02**

Systematic Errors (7)

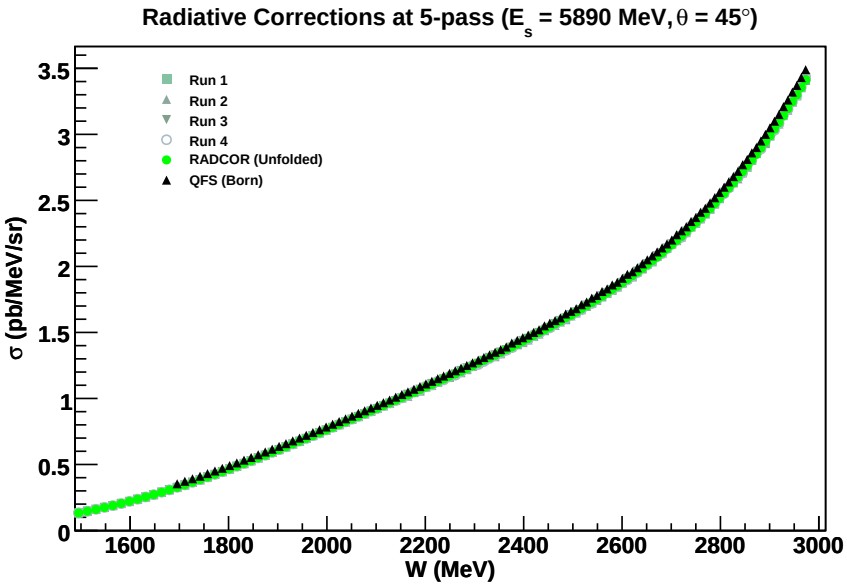
Varying the Radiation Lengths (E_s = 4.73 GeV)

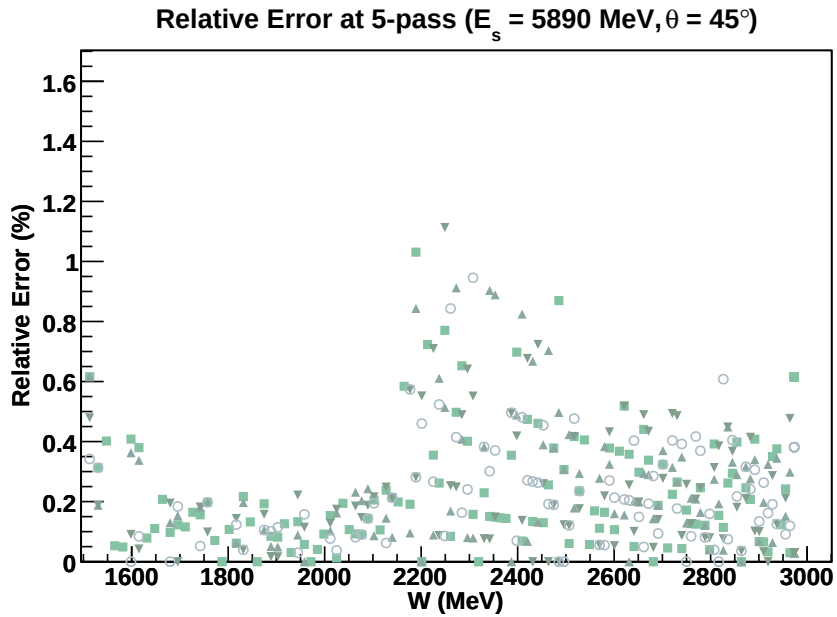




Systematic Errors (8)

Varying the Radiation Lengths (E_s = 5.89 GeV)





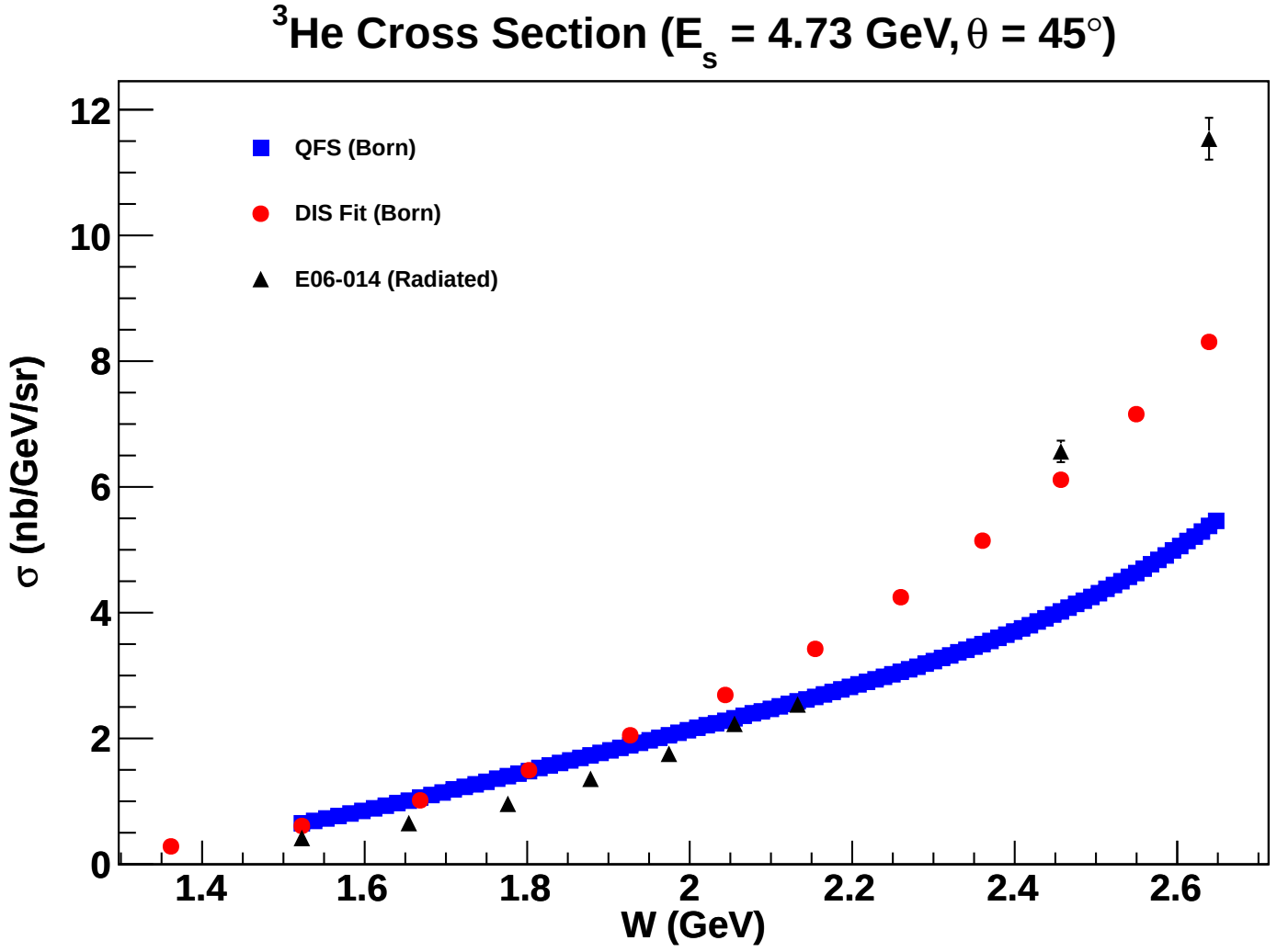
Cross Section Models (1)

Motivation

- Given the inaccuracy of QFS, we should consider other models
  - Xiao Chao has a DIS parameterization based on the NMC95 fit for F_1 and F_2 on the proton and deuteron to build up ^{3}He
    - Good coverage: $0.5 < Q^2 < 75\ \mathrm{GeV}^2$, $0.006 < x < 0.9$
    - Will refer to it as the 'DIS Fit'

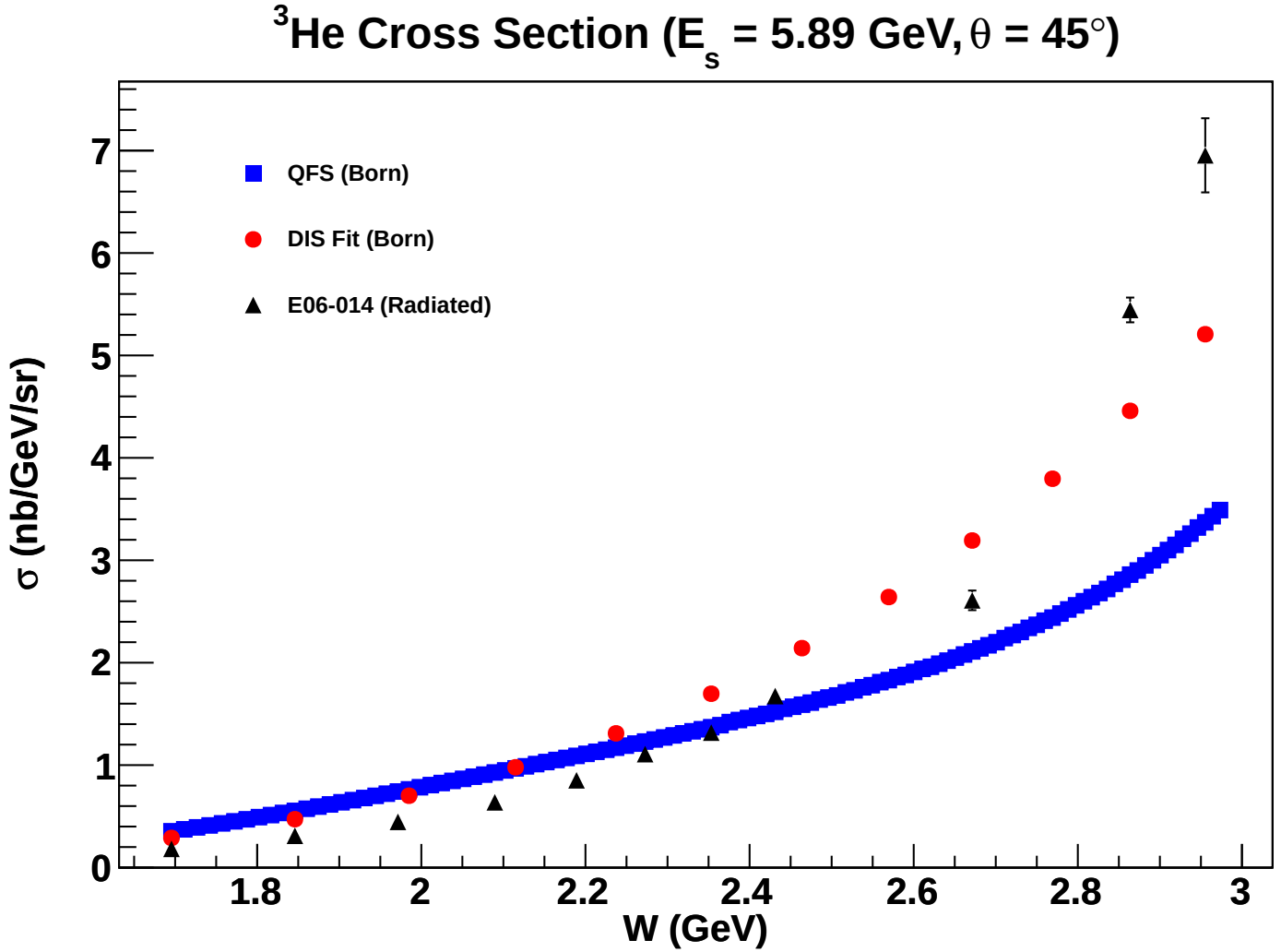
Cross Section Models (2)

DIS Fit: E_s = 4.73 GeV



Cross Section Models (3)

DIS Fit: E_s = 5.89 GeV



Summary

- Systematic Errors
  - Systematic error in the QFS model is quite large while the error in the radiation lengths is well-behaved
    - QFS model: $\sim$12% (!)
    - Radiation lengths: $\lesssim$ 1%
- Cross Section Model
  - DIS Fit: Agrees to some extent with QFS
    - At minimum, gives some idea of the true size of the radiative corrections and that we are close
    - Reinforces the idea that the QE, Δ tail subtractions need to be carefully treated

What's Next?

- Continue work on cross section fits
  - Use models of F_1 and F_2 (from fortran code of Xiao Chao and separately P. Bosted)
- Continue investigation of QE and Δ tail subtractions before radiative corrections