

DIS cross-section analysis

DVCS collaboration meeting

Feb 04, 2019

DIS cross-section status

OU Simulation

- 1) GEANT4 modified from Standard DVCS simulation to generate DIS events
- 2) Radiative correction: sampling the radiative tail
- 3) Generate events in some phase and see if it can pass the HRS acceptance window

Alexa's Simulation

- 1) Simple DIS event generator
- 2) Radiative Correction: Similar as in OU
- 3) Generate events in some phase and see if it can pass the HRS acceptance window

Eric Simulation (SIMC)

- 1) Standard Hall A/C DIS event generator
- 2) Radiative Correction: radiative tail is integrated
- 3) particle swims through magnet

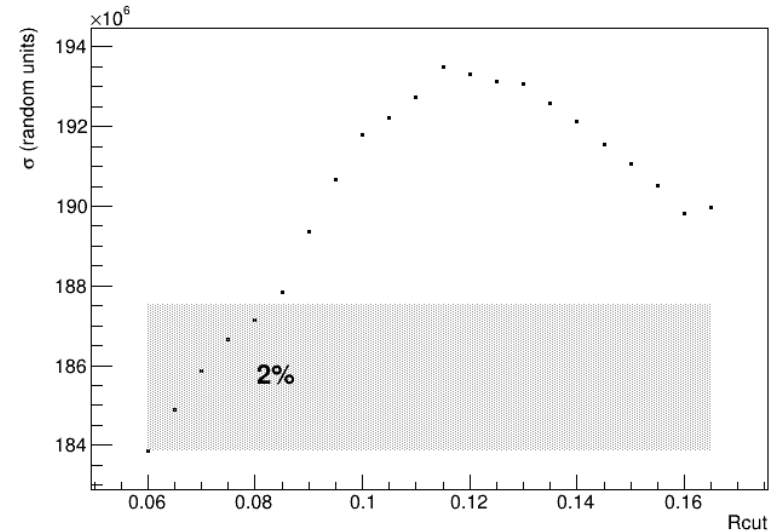
New in cross-section analysis

- 1) Cross-section model in Eric's simulation (same as in our simulation)
- 2) Radiative correction in Eric's simulation (done in correct way)
- 3) Alexa's R-Function in all simulation (previously my analysis was based on Gula's R-Function)

Differential cross-section

$$\sigma = \frac{N}{L} \times \left(\frac{1}{\eta_{effi} \times \Gamma_{DIS} \times r_{ci} \times \alpha} \right)$$

$$\alpha = \sum_i \frac{\sigma_i \times \Gamma_i}{\Gamma_i \times \sigma_{central}}$$



Gula's R-Function has bug at its current version

Differential cross-section at central kinematics

Kin	Run period	E_{beam} (GeV)	P_0 (GeV)	θ_{HRS} (deg)	Q1 status	$(\sigma_M/\sigma_D)_{\text{OU}}$	$(\sigma_M/\sigma_D)_E$	$(\sigma_M/\sigma_D)_A$
481	Sp '16	4.48	1.48	37.14	Unsat.	1.00	1.06	1.03
361	F '14	7.38	2.71	22.83	Unsat.	0.98	1.01	0.99*
362	F '16	8.52	3.19	20.98	SOS (1%)	1.03	1.06	1.07
363	F'16	10.62	3.99	18.67	SOS (7%)	1.04	1.07	1.06
601	F '16	8.52	3.59	24.56	SOS (4%)	1.01	1.07	1.08
603	F '16	10.62	3.15	29.00	SOS (1%)	0.97	1.01	1.01
482	Sp '16	8.82	3.996	26.27	detuned	1.04	--	1.05
483	Sp '16	8.82	2.920	26.27	detuned	1.05	--	1.08
484	Sp '16	10.97	3.360	24.92	detuned	1.08	--	1.10

- Analysis is for single run in each kinematics
- Eric's simulation has different HRS model for Spring and Fall 2016 run period
- Result using Eric's simulation are systematically 4% higher than with OU simulation
- DIS cross-section are within 2% agreement between different runs in same kinematics
- Up to 2% uncertainty in model cross-section from fitting (private chat with E. Christy)

*Kin 361 new result from Alexa with correct charge

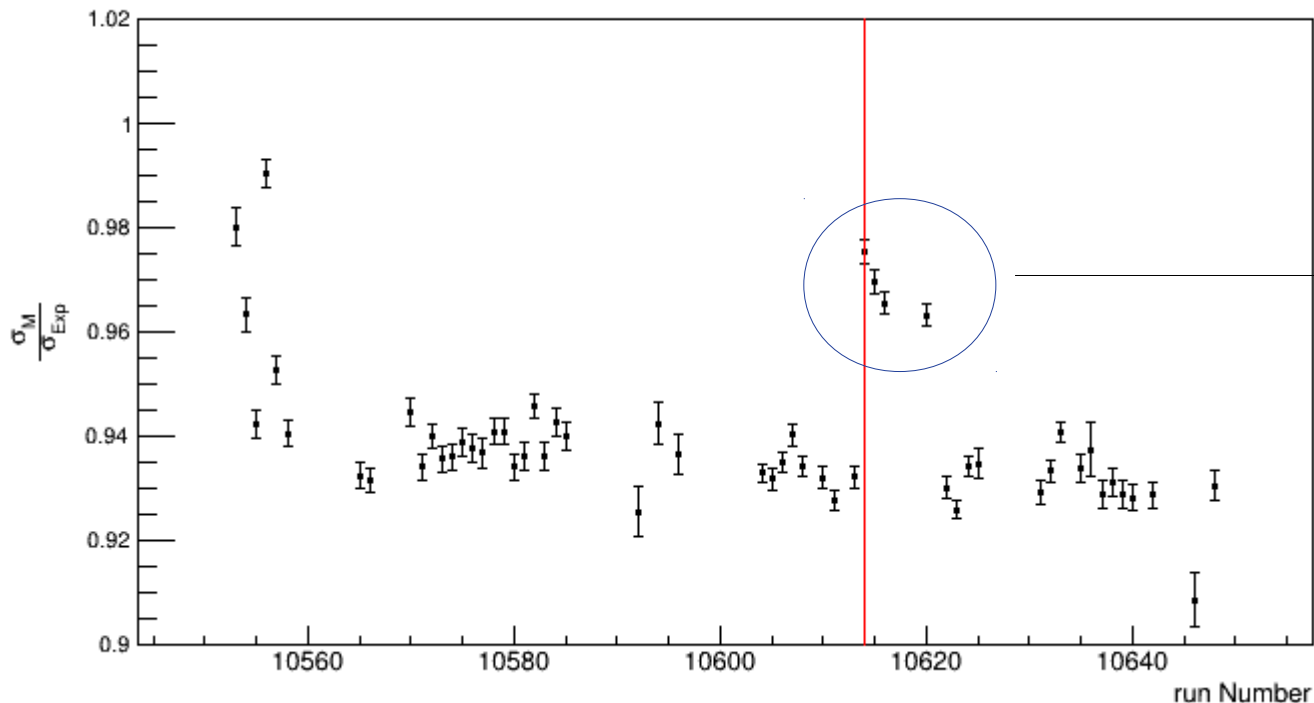
Cross-section Central bin vs averaged over bin

Kin	Run period	E_{beam} (GeV)	P_0 (GeV)	θ_{HRS} (deg)	Q1 status	$(\sigma_M/\sigma_D)_{\text{OU}}$	$(Y_{\text{sim}}/Y_{\text{data}})_{\text{OU}}$
481	Sp '16	4.48	1.48	37.14	Unsat.	1.00	1.01
361	F '14	7.38	2.71	22.83	Unsat.	0.98	0.98
362	F '16	8.52	3.19	20.98	SOS (1%)	1.03	1.04
363	F '16	10.62	3.99	18.67	SOS (7%)	1.04	1.04
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484	Sp '16	10.97	3.360	24.92	detuned	1.09	1.10

- Cross-section at central bin and averaged over bin are in agreement within 1%
- Same argument holds for Eric's simulation

Comparison of extracted cross-section with reference Kin 361

Differential cross-section Kin 361



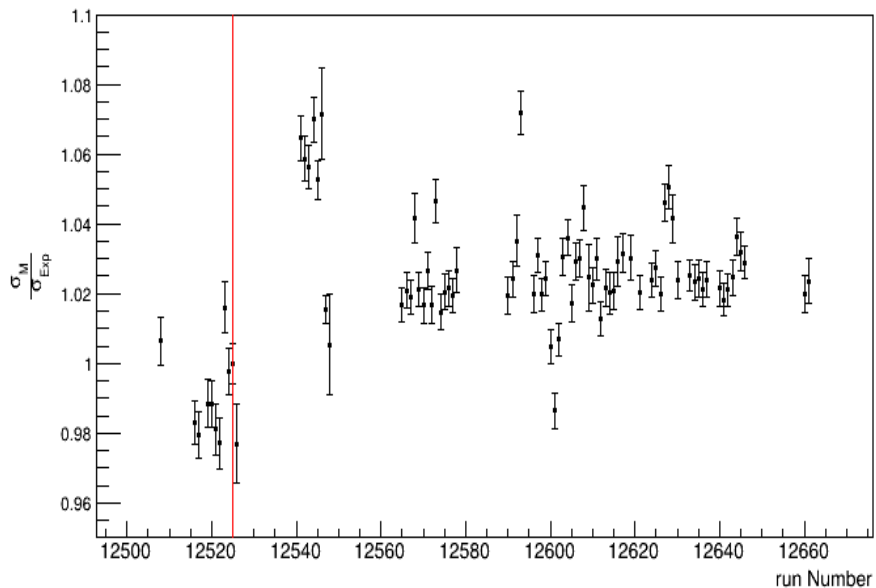
“db_L_beam.dat” linking this file to other raster file

Kin 361 (Fall 2014) I need to re-compute cross-section with new files.

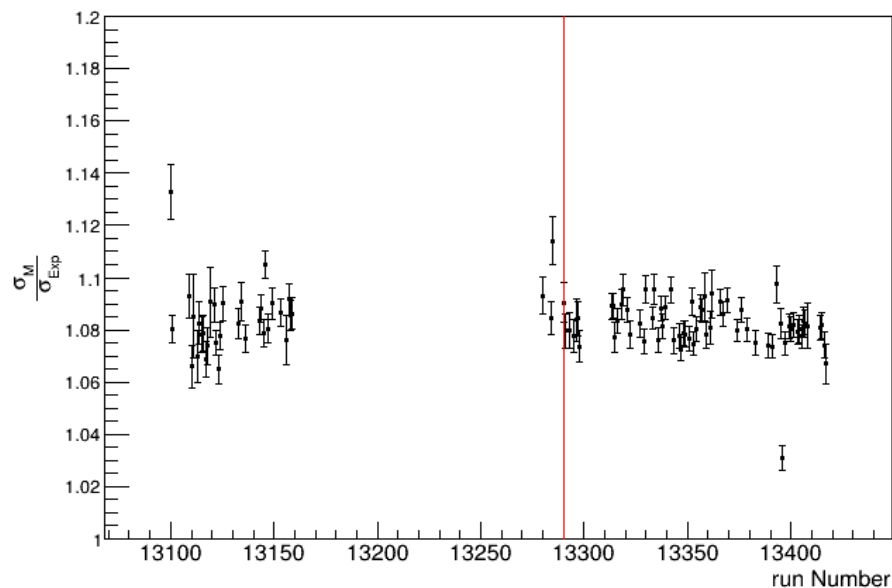
Comparison of extracted cross-section with reference

Kin 481 & Kin 484

Differential cross-section Kin 481



Differential cross-section Kin 484

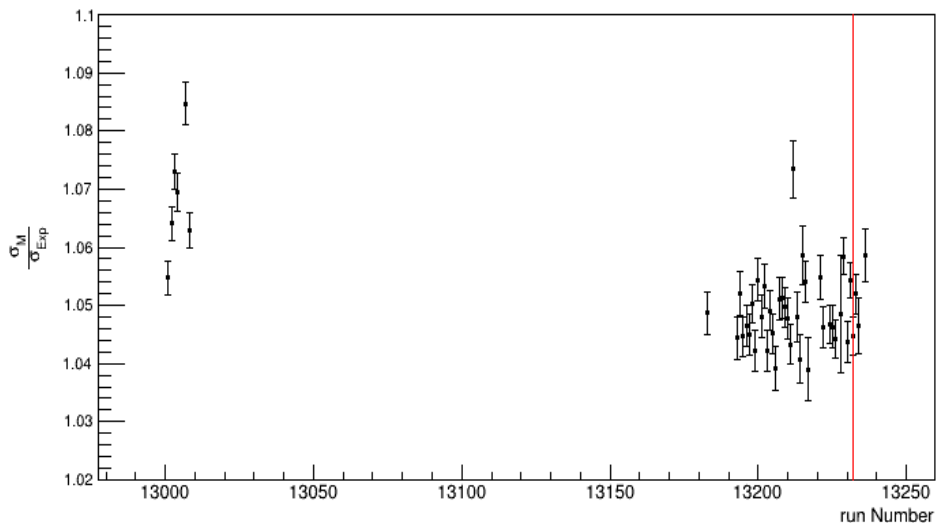


- Multiple trigger configuration DIS events are corrected with missing DIS events (S0&CER exclusive events)
- Cross-section is stable within 2%

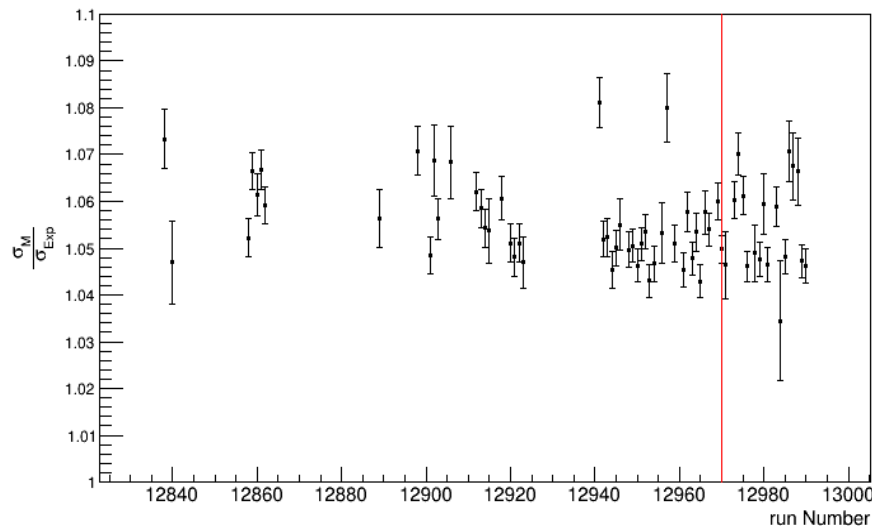
Comparison of extracted cross-section with reference

Kin 482 & Kin 483

Differential cross-section Kin 482



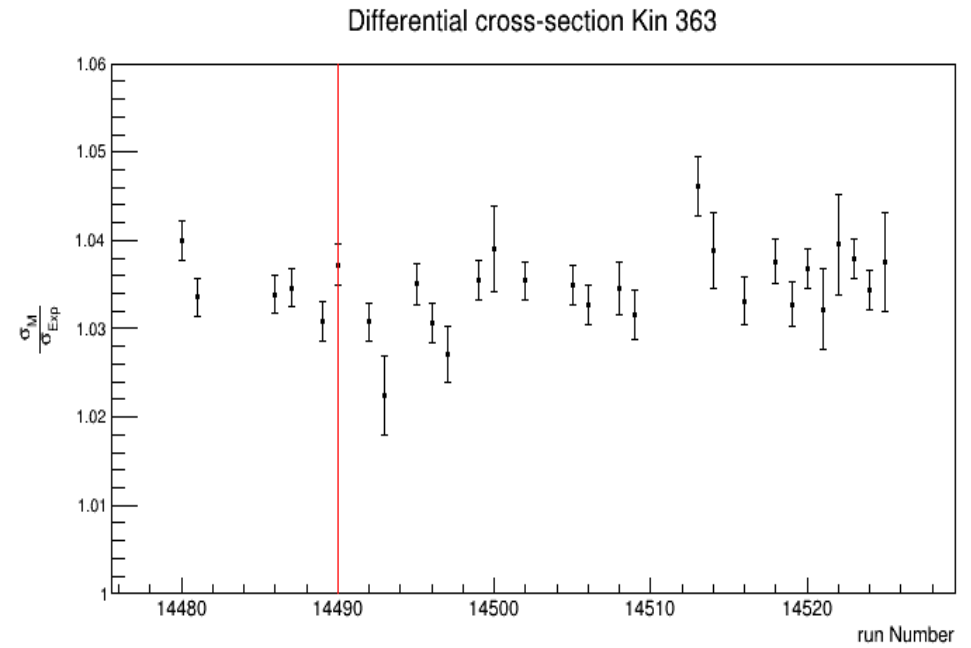
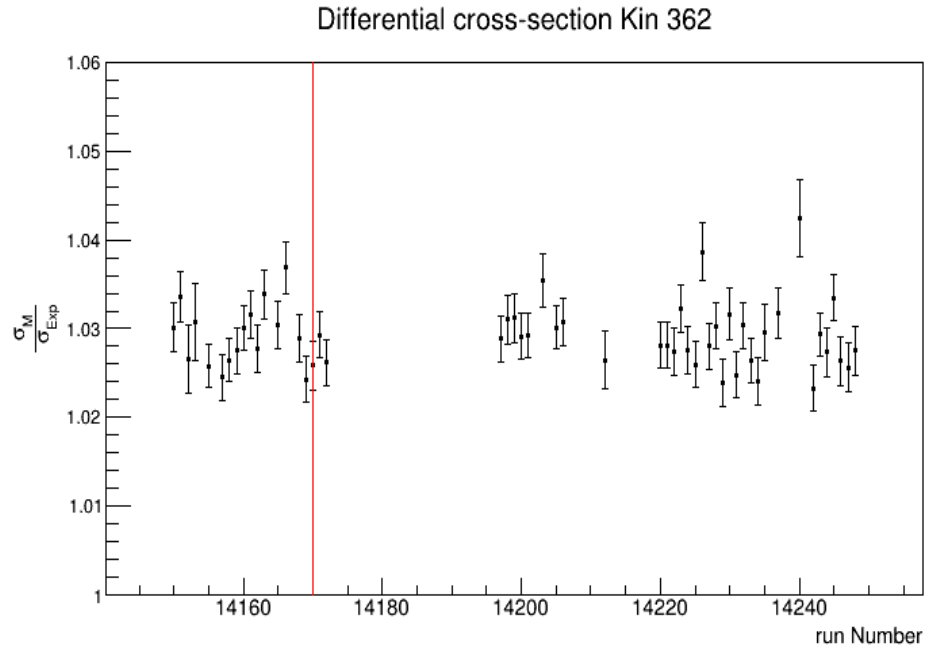
Differential cross-section Kin 483



- Multiple trigger configuration DIS events are corrected with missing DIS events (S0&CER exclusive events)
- Cross-section is stable within 2%

Comparison of extracted cross-section with reference

Kin 362 & Kin 363

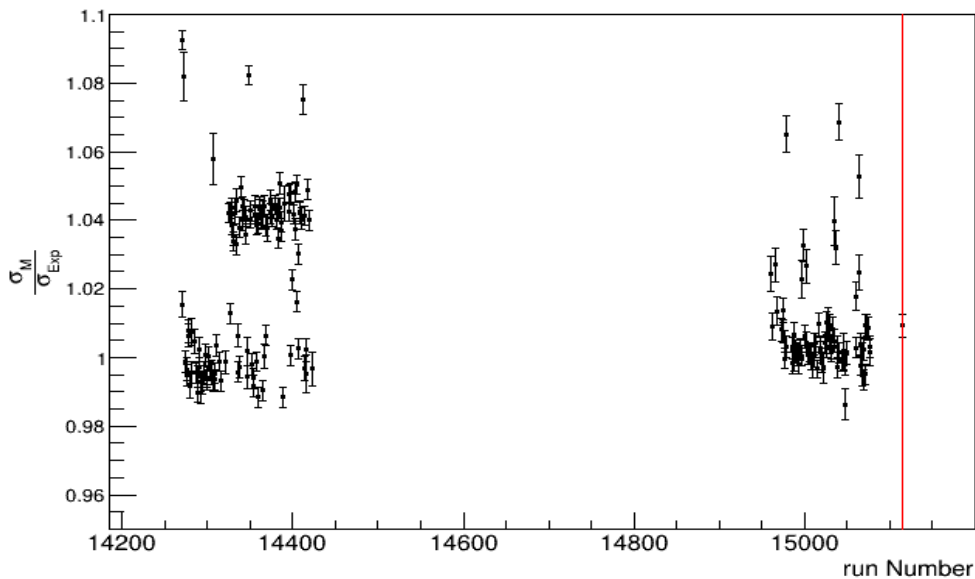


Cross-section is stable within 1% for Kin 362 and Kin 363

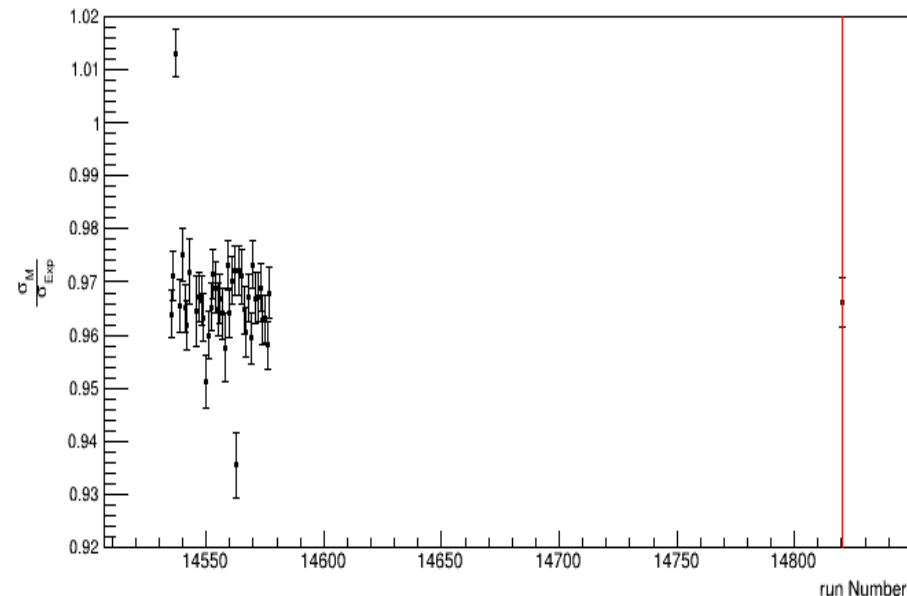
Comparison of extracted cross-section with reference

Kin 601& Kin 603

Differential cross-section Kin 601



Differential cross-section Kin 603

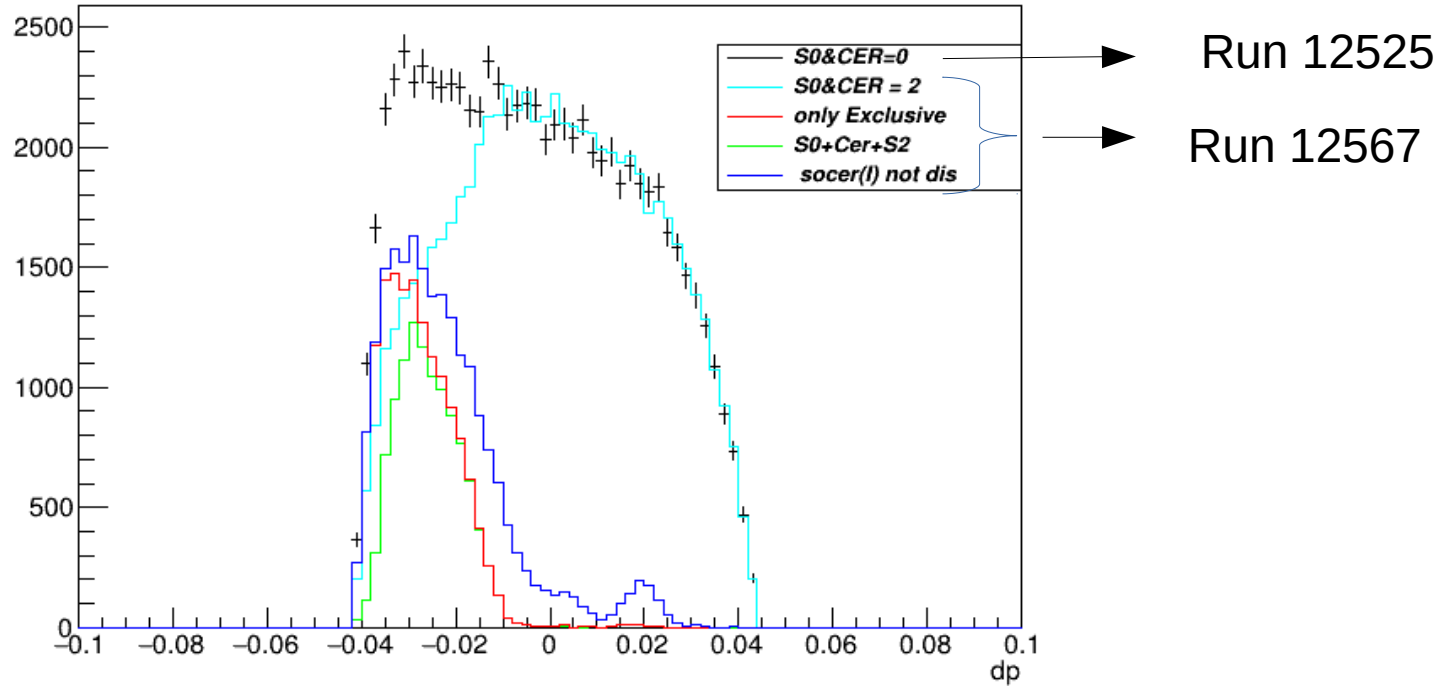


- Kin 603 cross-section is stable within 1% between the runs
- Need to investigate Kin601

Missing DIS Spring 2016

DIS missing event selection

Kin 481



Corrected DIS events = Missing DIS + (DIS x prescale/LT)

No any missing DIS from $S0 \& S2$ exclusive events

Effect of missing DIS event correction

Kin 481

Run	S0&CER	$d\sigma$ (10^{-6}) GeV ⁻⁴
12508	0	19.06
12516	0	19.51
12520	0	19.52
12525	0	19.09
12567	2	18.73
12574	2	18.78
12575	2	18.76

Kin 484

Run	S0&CER	$d\sigma$ (10^{-6}) GeV ⁻⁴
13122	2	2.36
13123	2	2.39
13125	4	2.34
13101	4	2.36
13290	128	2.35
13295	128	2.36
13116	32	2.36

Kin 483

Run	S0&CER	$d\sigma$ (10^{-6}) GeV ⁻⁴
12980	128	4.33
12987	2	4.30
12988	2	4.30
12990	128	4.39

DIS cross-section can be recovered within 2% between the runs with different prescale setting

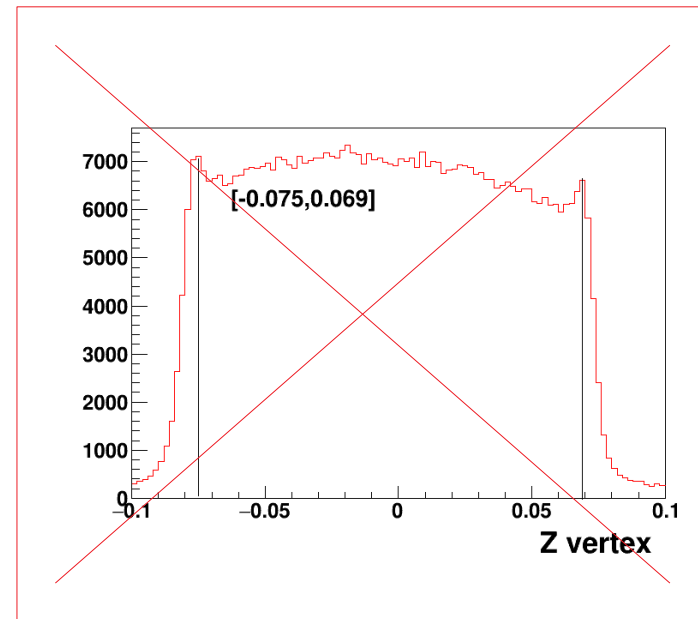
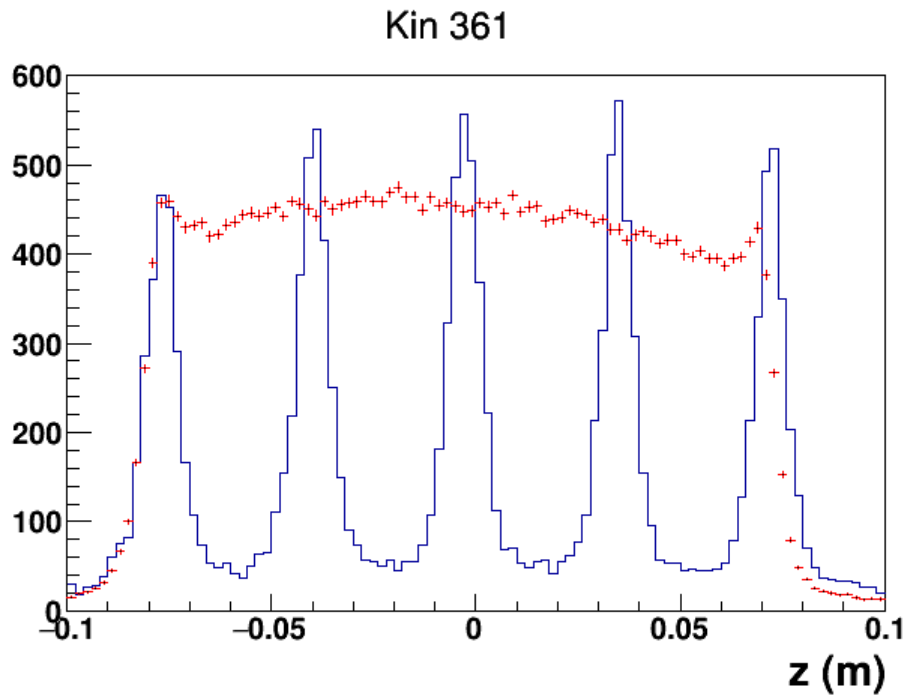
Conclusions

- 1) For kin 481, 361, 482, 483, and 484 two analysis (OU & Alexa are in fair agreement)
- 2) For rest kinematics 362, 363, 603 and 601 Alexa and Eric are in good agreement but OU analysis is systematically 3% below (Kin 601 huge disagreement 6%)
- 3) For kinematic 361 re-do the analysis with new files
- 4) For all kinematics DIS cross-section is stable within 2% except kin 601
- 5) Missing events correction from exclusive S0&Cer can reproduce DIS cross-section up to 2% for different trigger configuration

Spring 2016
Prescale setting (DIS, S0&CER, S0&S2M)

Kin	Prescale	Prescale	Prescale	Prescale	
481	4,0,0 (13%)	2,2,2 (87%)	--	--	--
482	2,8,8 (19)	3,4,4 (2%)	3,8,8 (79%)	--	--
483	2,8,8 (97%)	2,7,6 (1%)	2,2,2 (2%)	--	--
484	2,6,6 (65%)	3,8,8 (11%)	2,2,4 (14%)	3,2,4 (9%)	2,3,3 (1%)

Reconstructed target length Kin 361 (Fall 2014)

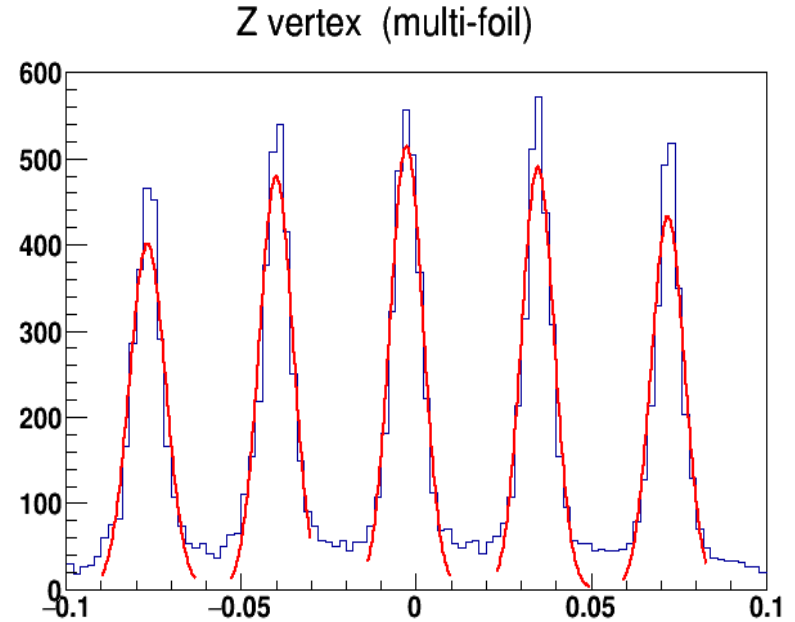


Multi-foil and LH2 have same length

Reconstructed target length

Kin 361 (Fall 2014)

Target Length (cm)	14.87
1 st foil sigma	5.16
5 th foil sigma	4.76
Distance foils 1-2 (cm)	3.68
Distance foils 2-3 (cm)	3.73
Distance foils 3-4 (cm)	3.75
Distance foils 4-5 (cm)	3.72

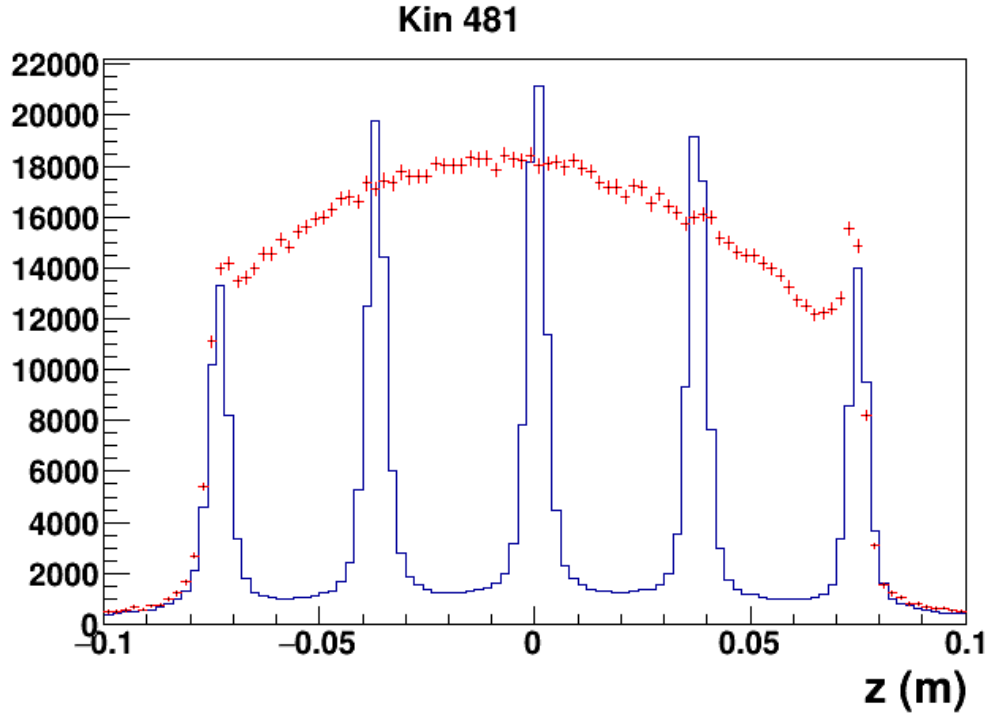


Expected distance between the foil is 3.75 cm

Target length looks good

Reconstructed target length

Kin 481 (Spring 2016)



Target Length (cm)	14.84
1 st foil sigma (mm)	3.23
5 th foil sigma (mm)	2.93
Distance foils 1-2 (cm)	3.65
Distance foils 2-3 (cm)	3.72
Distance foils 3-4 (cm)	3.74
Distance foils 4-5 (cm)	3.73

Expected distance between the foil is 3.75 cm

Target length looks good

