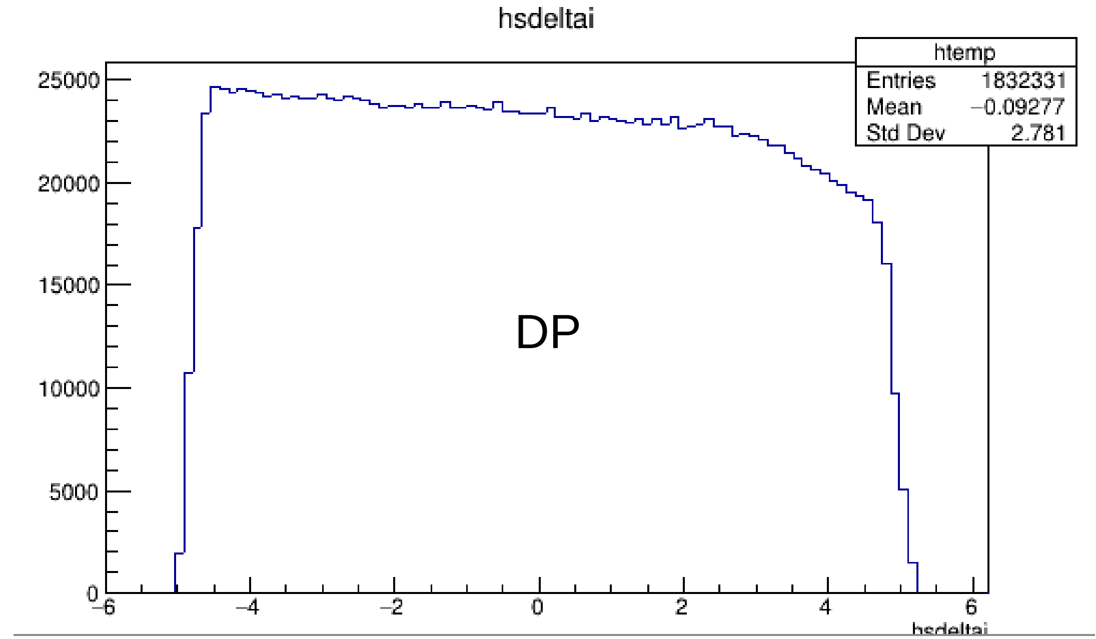
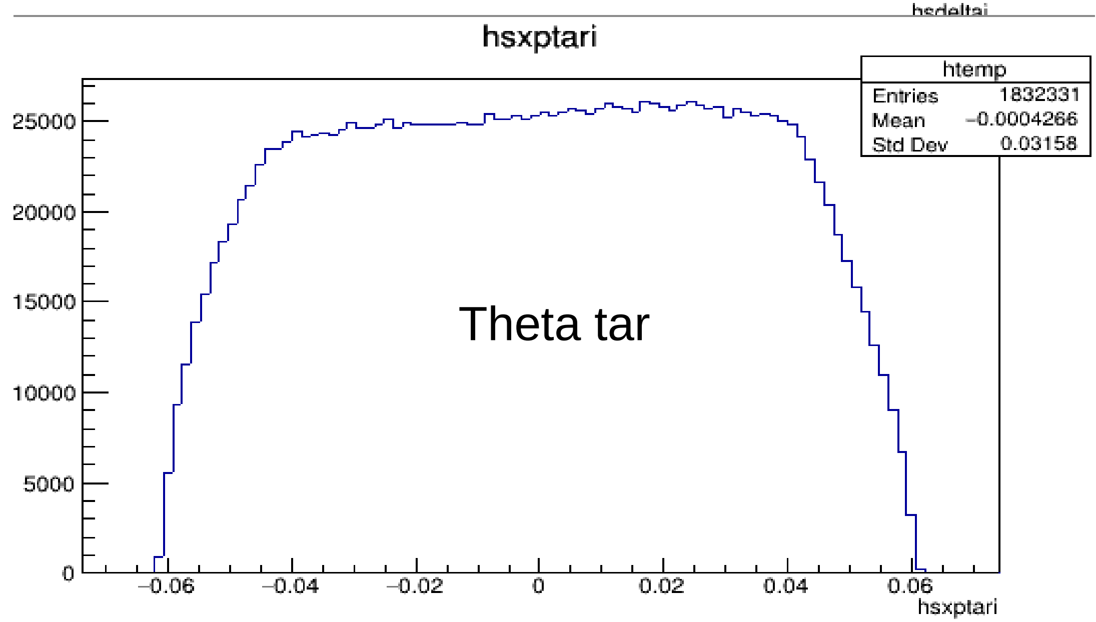
Extracting the yield for Monte carlo and data

- Monte carlo
  - Generating Monte Carlo events
  - Create Cross section table
  - Weight Monte Carlo events
  - Compare monte carlo to Data for acceptance comparison
  - Extract yield of monte carlo in bins of X_{bj}
- Data
  - Calculate effs
  - Calculate BG
  - Calculate luminosity
  - Extract normalized corrected yield in bins of X_{bj}

Generate events

- Generate events using mc_hrs_single.f
- Barak/Shuji https://github.com/JeffersonLab/halla-xem-analysis
- Events are generated in a large phase space
  - + or - 10 dp
  - + or - 100 mr theta and phi
- Spectrometer offsets are read from db_run.dat for the run
  - This entry in db_run is create via scripts by Javier
- Offsets in beam pos, and size of beam are calculate via the data root file and the rastered beam class
- Offsets in target z are set via monte carlo to data comparison for carbon foil targets for the kinematic.





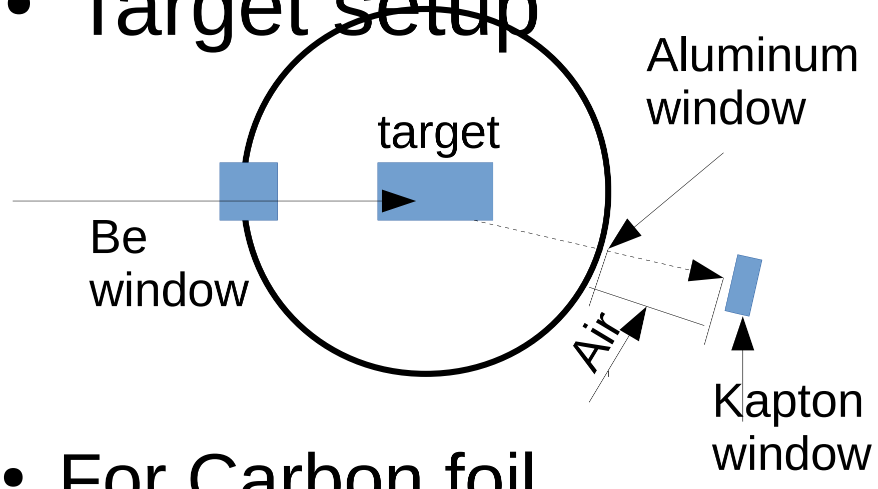
Generate Cross section table

- Using T2_externals to generate born and radiated cross section
- From Dave Gaskell
- One table is created per target per kinematic

Every target:

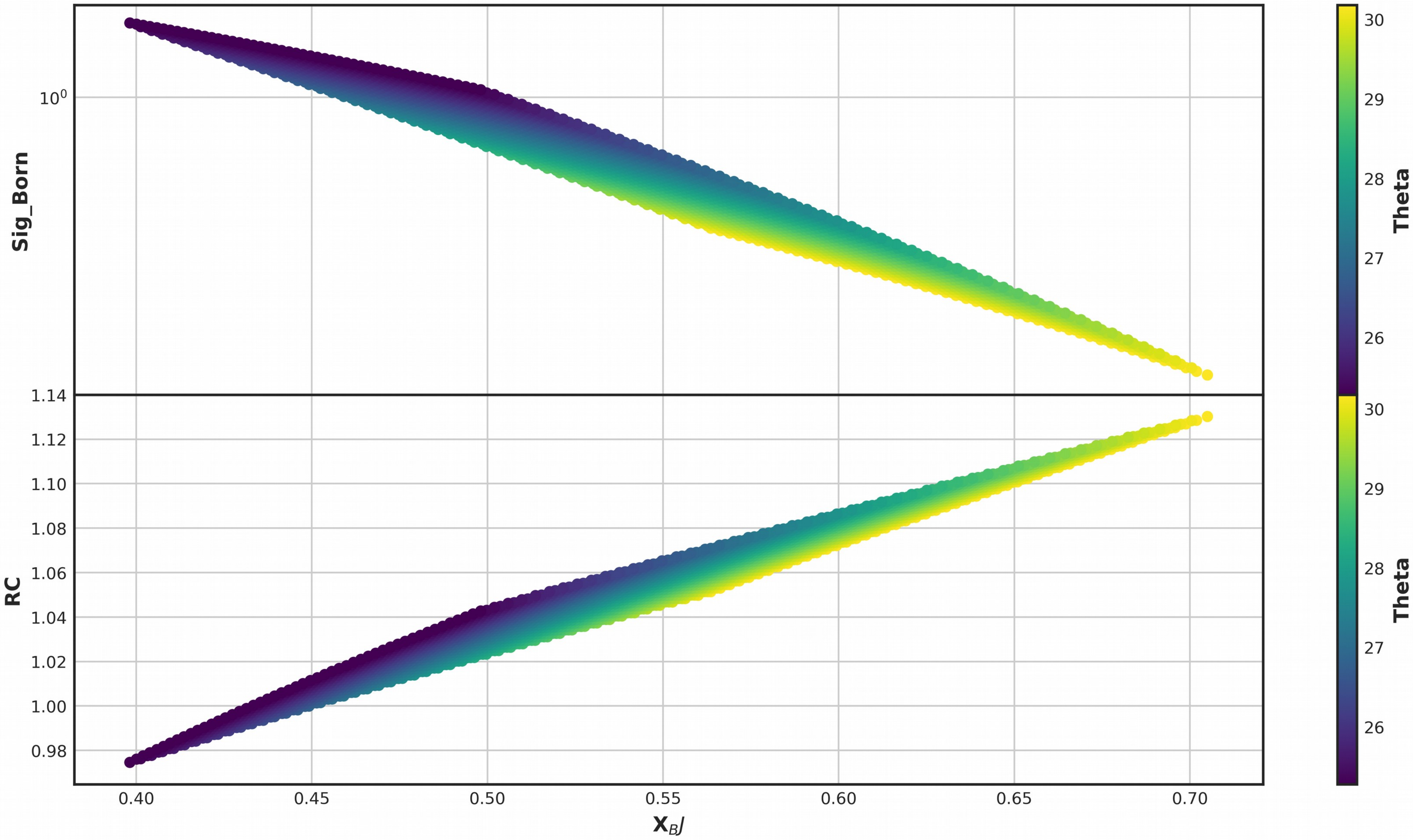
- Upstream Be window
  - 0.2003 mm with Rad. Len. Of 35.28 cm
    - 0.000568
- Downstream
  - Al window 0.03556 cm Rad len 8.897 cm
    - 0.003997
  - Air 81.5974 cm rad len 30390 cm
    - 0.00288
  - Kapton 0.01778 cm rad len 28.5775cm
    - 0.000622
  - Total of 0.007299

- Target setup

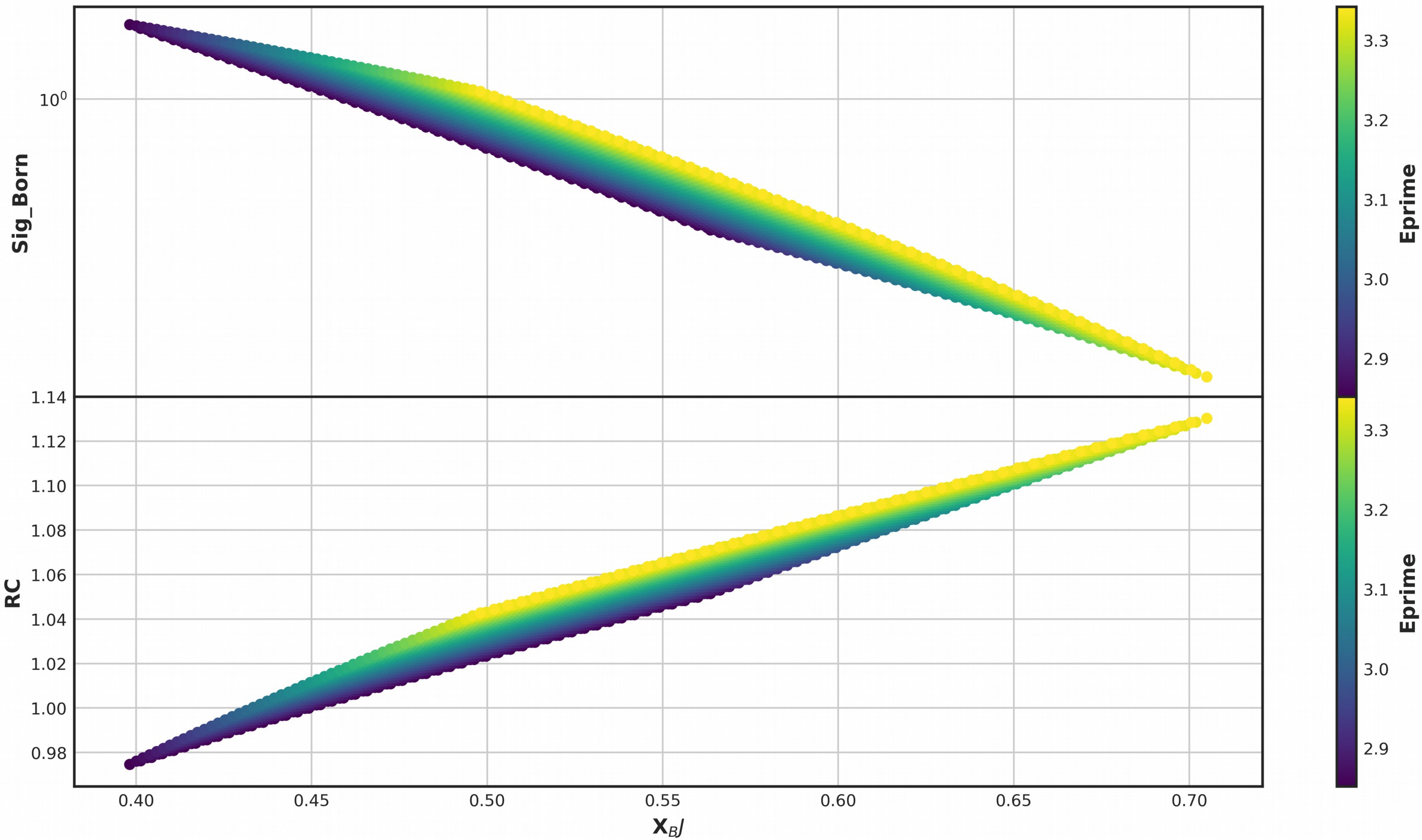


- For Carbon foil
  - Upstream → Be
  - Downstream Al, air, Kapton
  - Target → 0.0883 g/cm^2 rad len 42.70 g/cm^2
    - 0.00207

Cross section for C12 kin 9



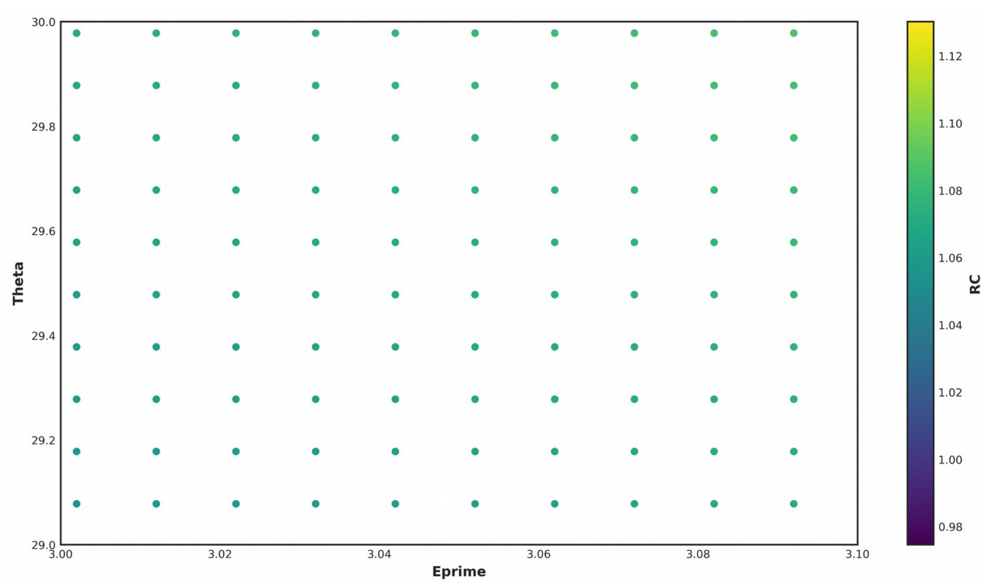
Cross section for C12 kin 9

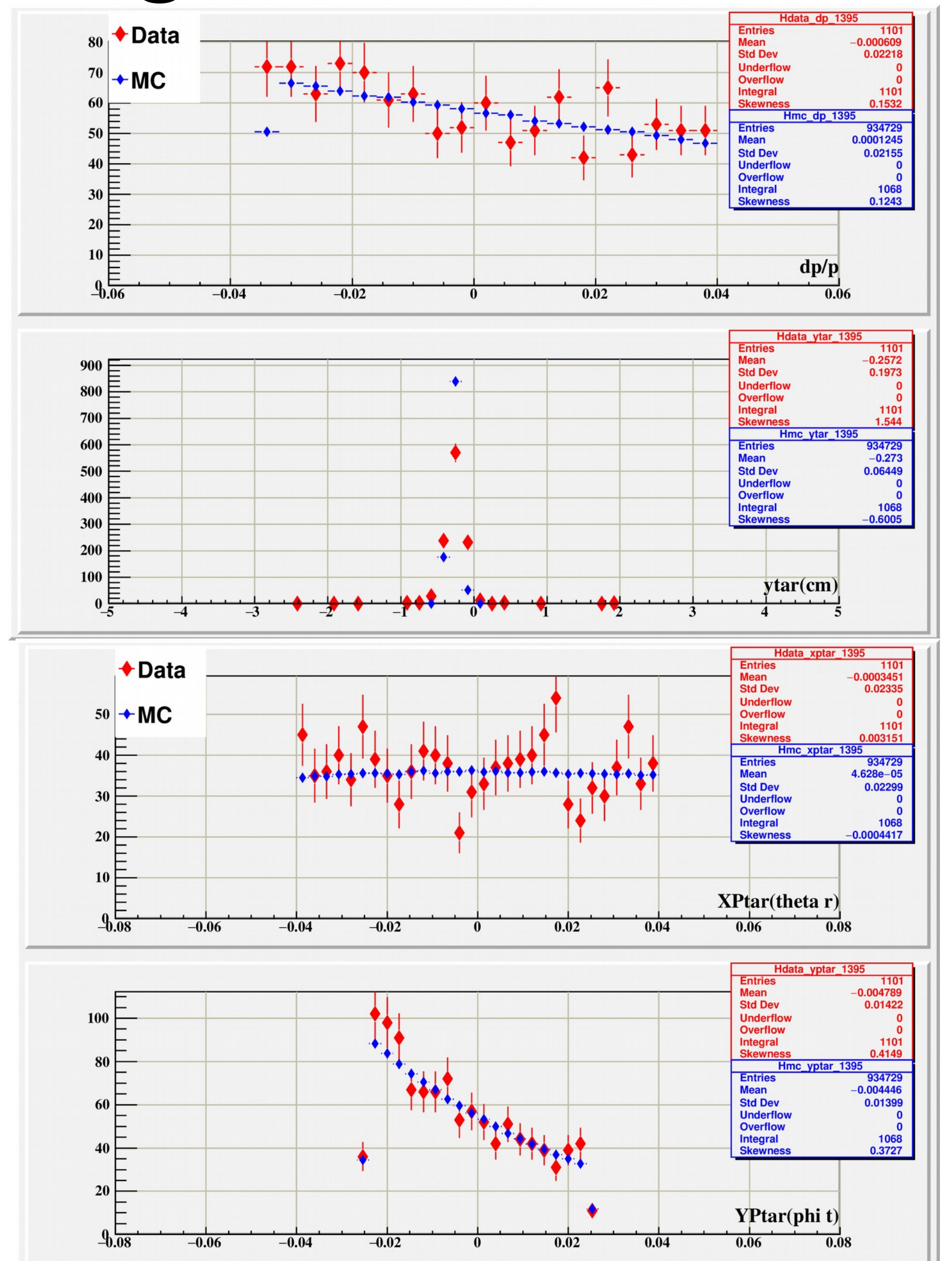


Weighting

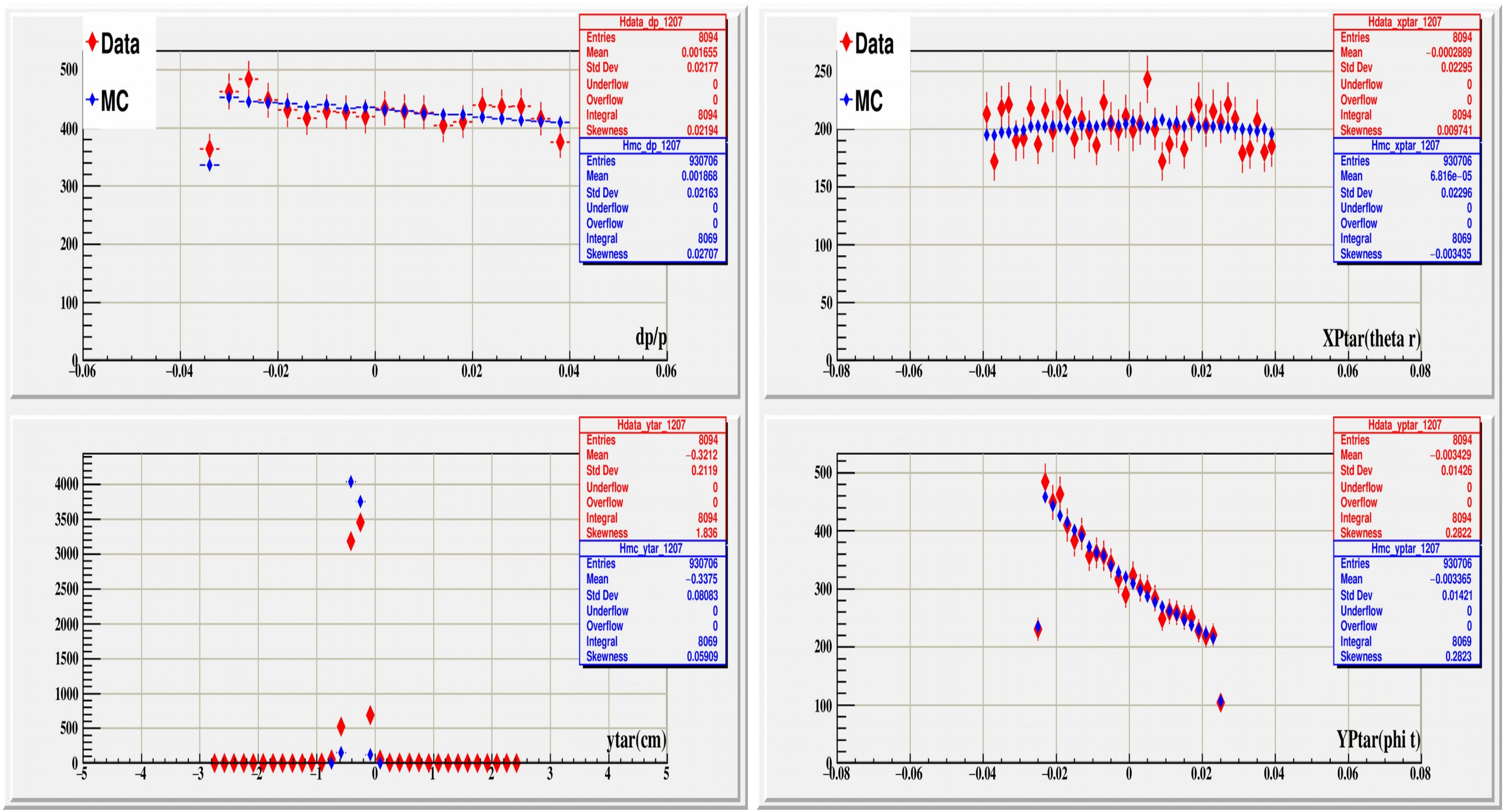
Run 1395 C12 kin 9

- Using Eprime and theta
  - Pick out the Born cross sections and Radiative correction factors that surround the event
  - Use interpolation to calculated the corrected value





Carbon foil run 1207 kin 1



Extract MC yield

- If an event falls into a bin
- Accumulate that event weighted by
  - Born cross section
  - 1/ Radiative correction factor
  - Phase space of generation
    - phi *theta * E`
    - 200 mr * 200mr * 0.20*3. 1(GeV) = 24.8 sr MeV
  - 1 / Number of Generated events
  - 1 / Number of Runs added together
    - Has been reduced to one run

Kin9

	Xbjc	Q2	MC_Ne	MC_Yield	MC_Error
23	0.47	6.74314	28988.0	0.000167	9.782120e-07
24	0.49	6.95108	98248.0	0.000493	1.574130e-06
25	0.51	7.18661	159590.0	0.000685	1.715390e-06
26	0.53	7.45142	173497.0	0.000619	1.487250e-06
27	0.55	7.73269	169783.0	0.000496	1.203320e-06
28	0.57	7.99745	152808.0	0.000368	9.411440e-07
29	0.59	8.23392	99802.0	0.000201	6.372050e-07
30	0.61	8.46025	46887.0	0.000079	3.666450e-07
31	0.63	8.63759	5126.0	0.000008	1.052020e-07

Kin11

	Xbjc	Q2	MC_Ne	MC_Yield	MC_Error
26	0.53	7.67598	1856.0	5.584990e-06	1.296380e-07
27	0.55	7.84783	43652.0	1.166020e-04	5.580900e-07
28	0.57	8.07546	99578.0	2.260210e-04	7.162540e-07
29	0.59	8.31263	149440.0	2.847370e-04	7.365630e-07
30	0.61	8.57609	161806.0	2.525460e-04	6.278320e-07
31	0.63	8.85740	160099.0	2.009210e-04	5.021470e-07
32	0.65	9.12272	145145.0	1.473500e-04	3.867660e-07
33	0.67	9.36010	100401.0	8.353350e-05	2.636280e-07
34	0.69	9.59172	56592.0	3.853620e-05	1.619910e-07
35	0.71	9.79528	15949.0	9.062860e-06	7.176260e-08
36	0.73	9.98782	3.0	1.433530e-09	8.276510e-10

Data!!

- Calculate eff.

name	PID_cer	PID_ps	PID_sh	PID_NE	Tracking	Trigger	livetime	Total
eff	0.99715	0.993401	0.992158	0.999498	0.987526	0.999902	0.964162	0.936138
err	8.6e-05	0.000388	0.000344	0.006364	0.000237	0	0.000374	0.006401

  - Eff = product(eff.) * 1/ineff.
- Calculate BG
  - Positron
    - Fit function and parameters supplied by Tong.
    - 1-exp(par1+par2*xbj)
  - End cap
    - Table provided by Tong

Kin	H3	He3	D2	H
0	0.02342	0.027100	0.018600	0.02922
1	0.02185	0.025120	0.011380	0.02380
2	0.02028	0.022940	0.010200	0.02090
3	0.01630	0.018390	0.008206	0.01780
4	0.01540	0.017270	0.009348	0.01760
5	0.01445	0.015738	0.008640	0.00000
7	0.01177	0.012500	0.008310	0.00000
9	0.00900	0.009740	0.005700	0.00000
11	0.00690	0.007150	0.005121	0.00000

    - Currently being rechecked, by Tong and Tyler H.

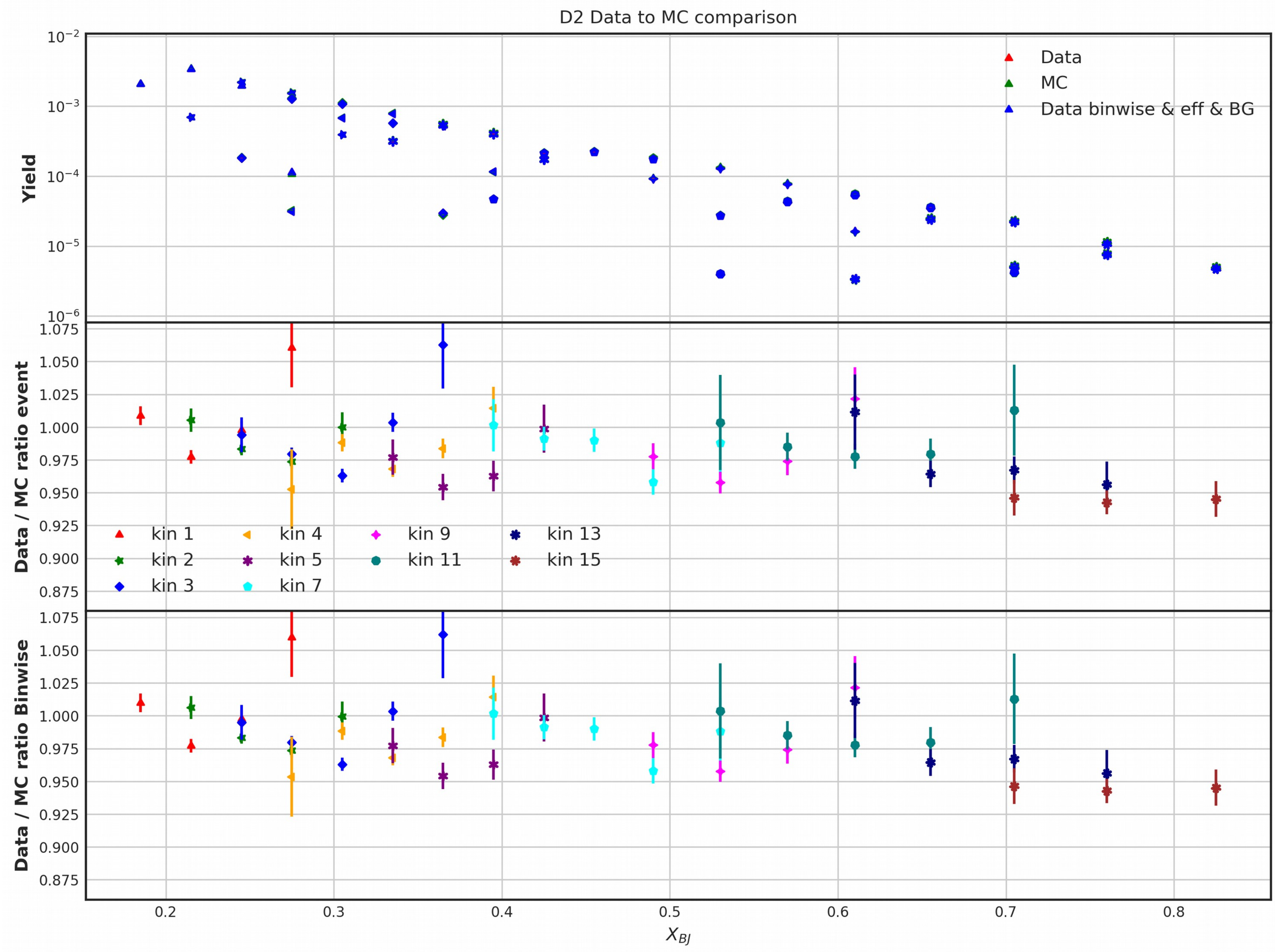
Luminosity

- L = ($charge_{num\ of\ ele}$ * tgt_thickness(g/cm^2) * density correction factor * N_a/atomic mass)
  - Convert from cm^2 to nBarns
- Density correction =par0 + par1*current + par2*$current^2$
- The Luminosity for kinematic is calculated by adding up the luminosity from all the runs in the kinematic.

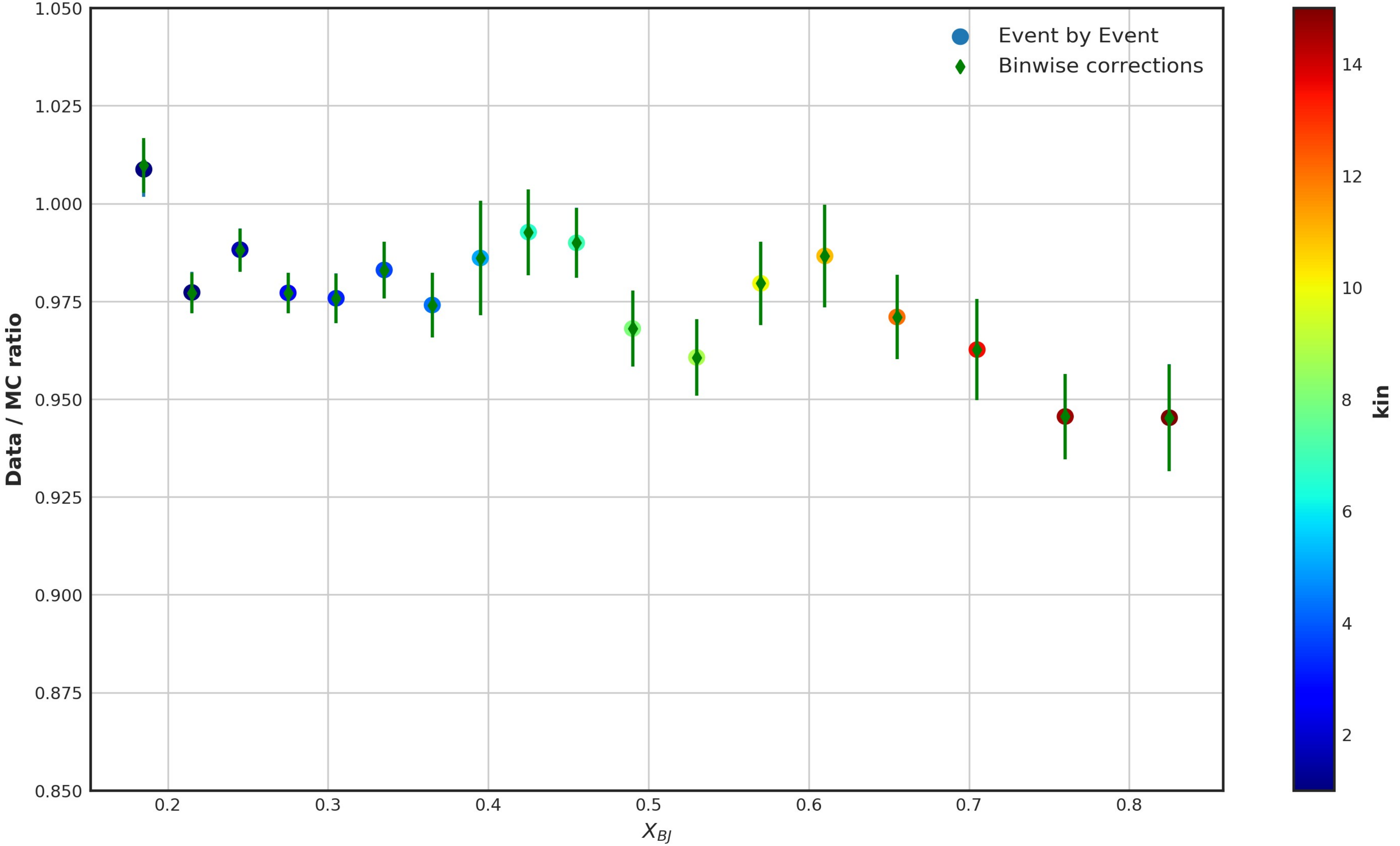
Calculate yield

- Event by event
  - If an event falls into a bin
    - Accumulate that event weighted by
      - 1/Eff. → Calculated by run
      - BG
        - ECC → Calculated by kin
        - PC → Calculated by event
  - After all runs
    - Normalize by Luminosity of the kinematic
- Bin wise
  - Weight a bin by
    - Eff → Luminosity weighted average
    - ECC → Calculated by kin
    - PC → Calculated using the center of the bin
    - Luminosity

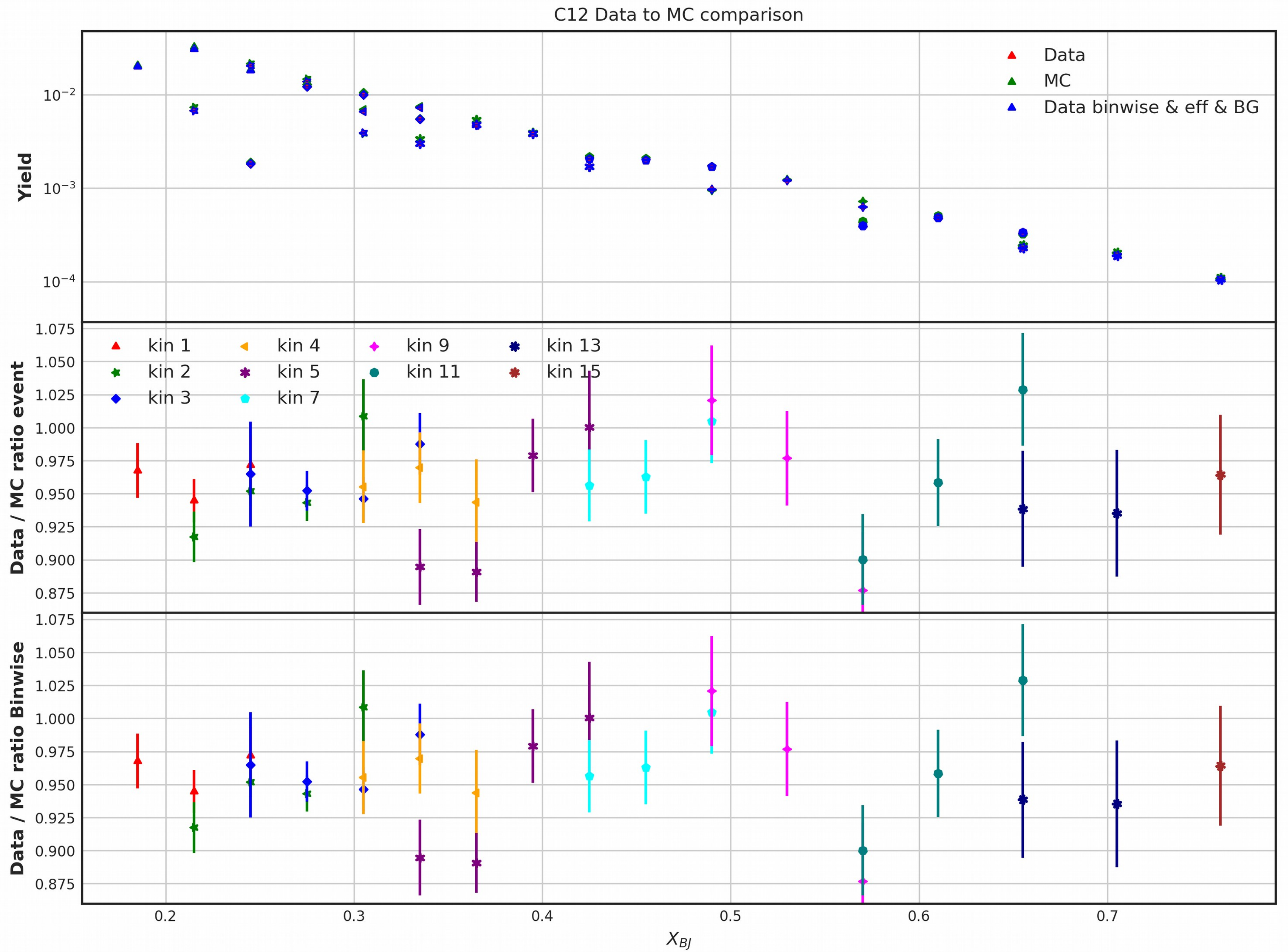
Data to monte carlo comparison D2



Merge Kinematics together using a weighting by Number of electrons

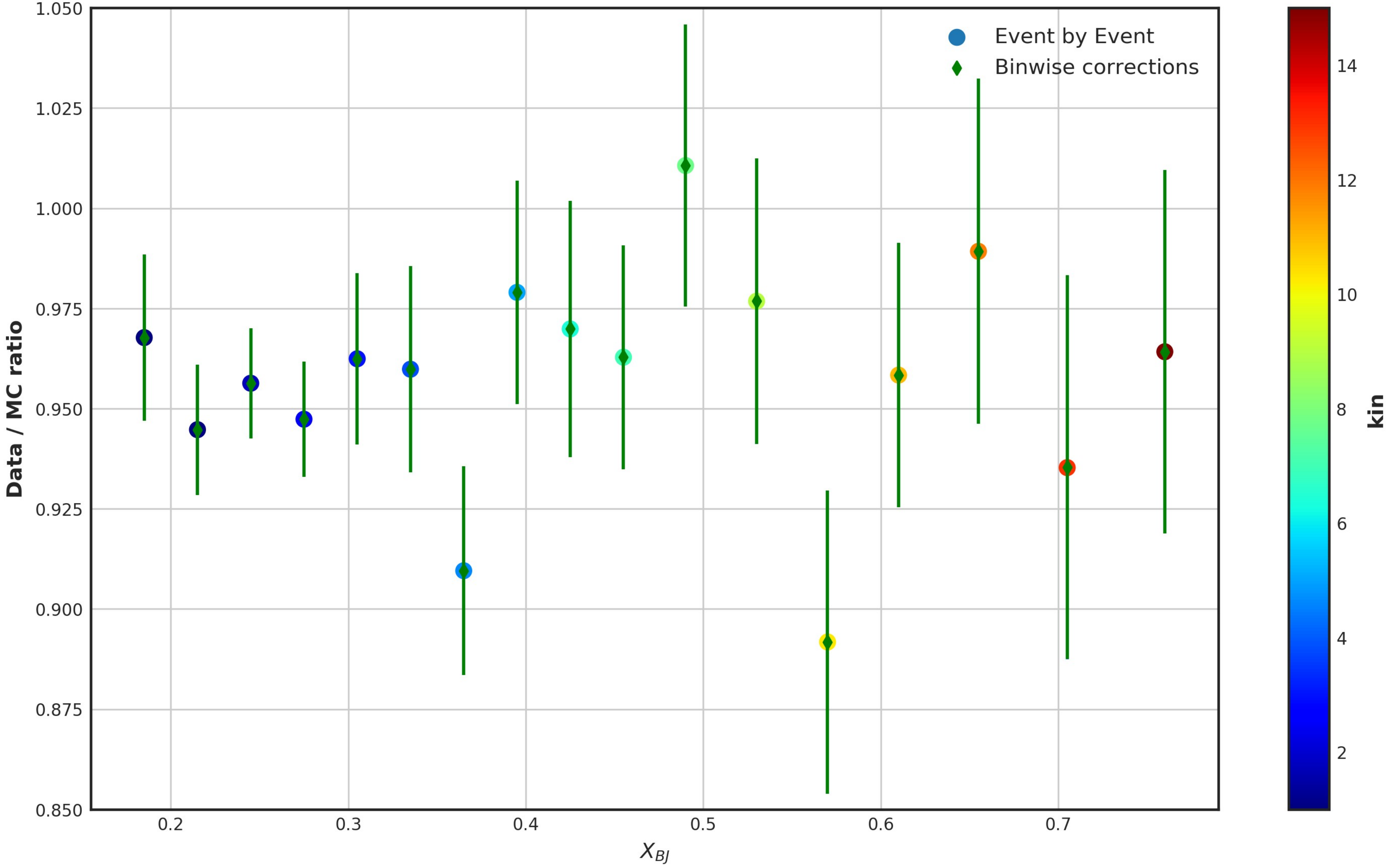


C12

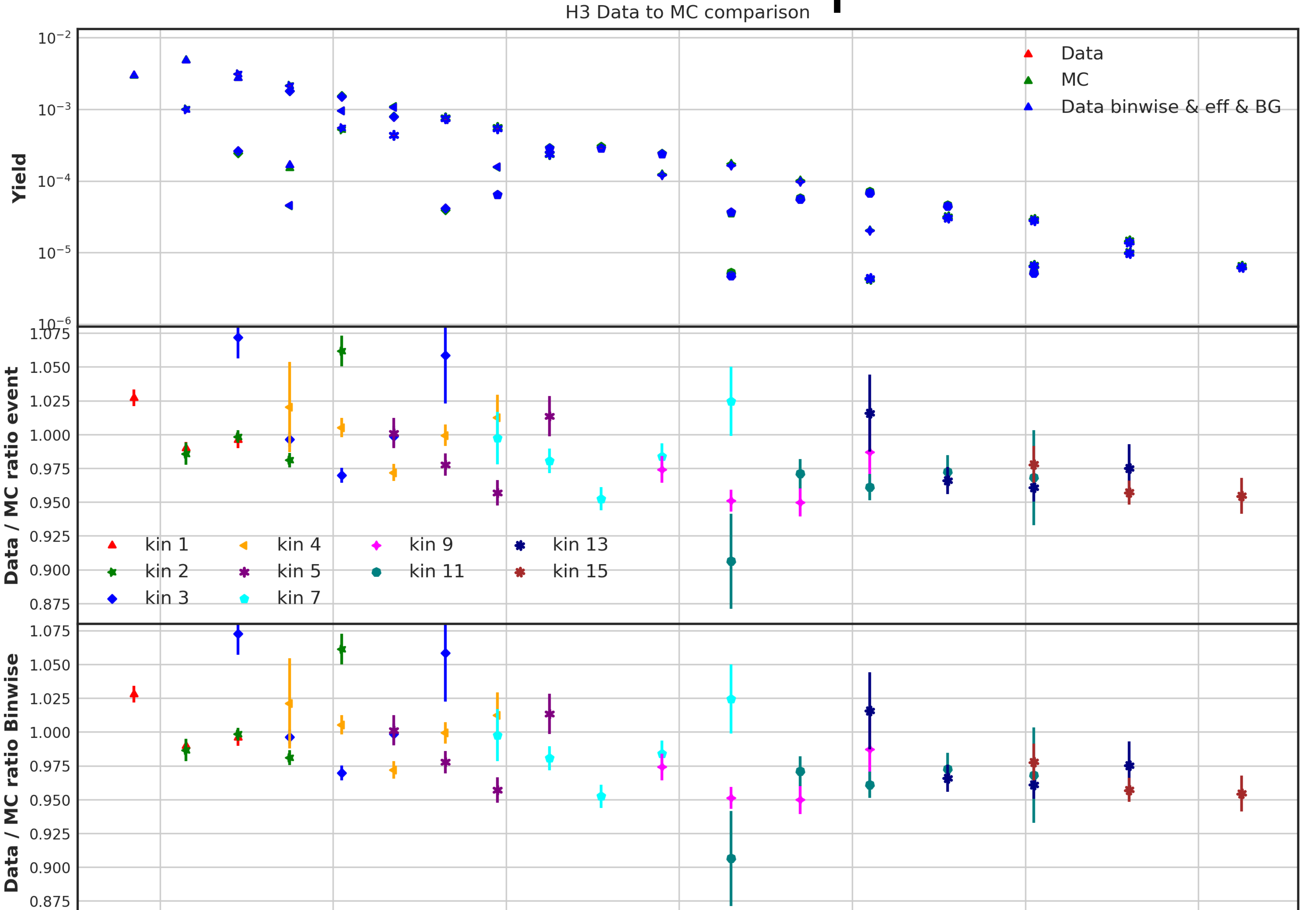


C12 Data to MC comparison
Data
MC
Data binwise & eff & BG
Yield
kin 1
kin 2
kin 3
kin 4
kin 5
kin 7
kin 9
kin 11
kin 13
kin 15
Data / MC ratio event
Data / MC ratio Binwise
X_BJ

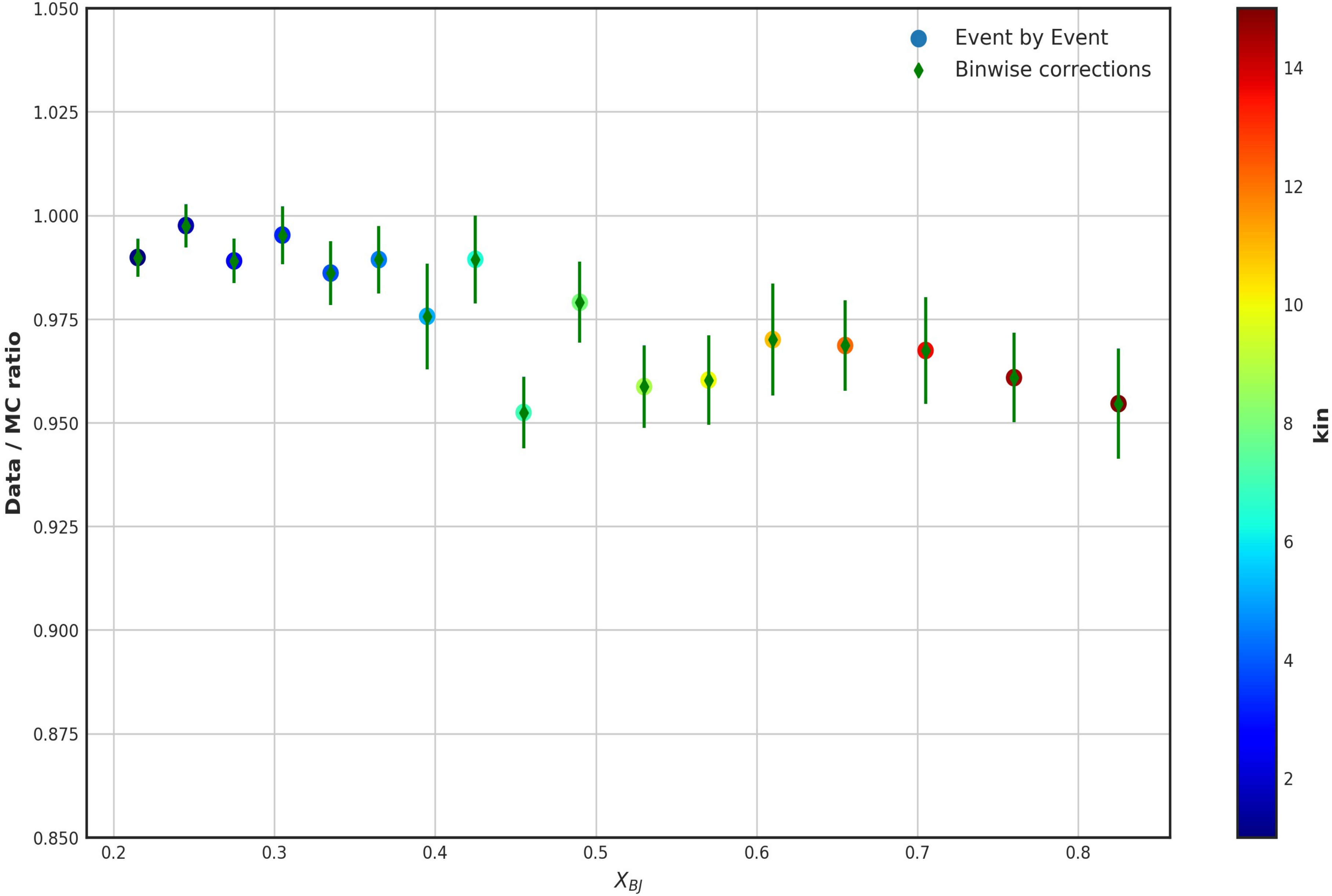
Merge Kinematics together using a weighting by Number of electrons



Data to monte carlo comparison H3



Merge Kinematics together using a weighting by Number of electrons for H3



Cross section ratio