g4rc/externals discrepancy

Tyler Kutz

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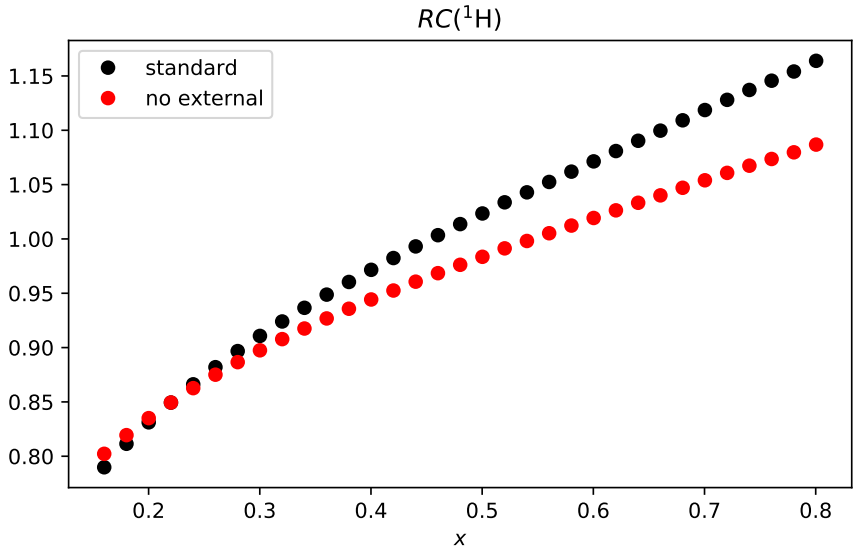
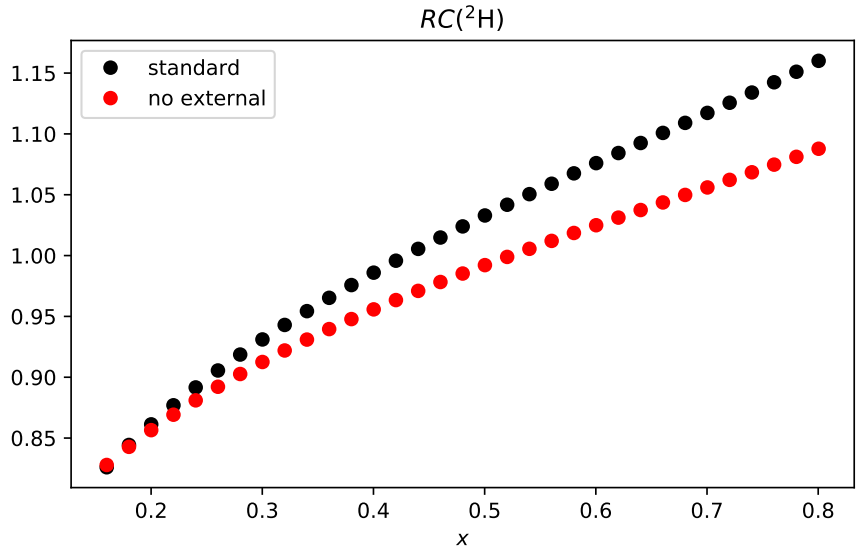
g4rc limitations

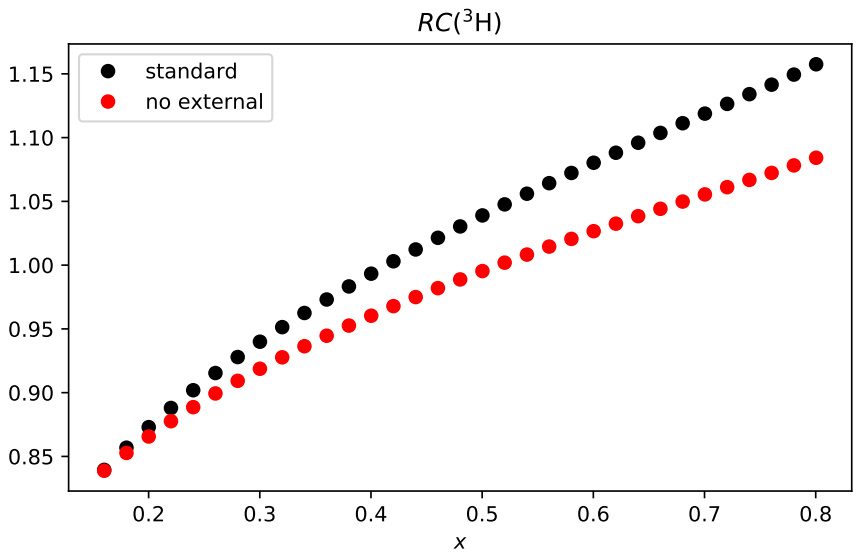
- Simulation only includes real processes causing energy loss (ionization, external/internal bremsstrahlung)
- Can show that mis-binning due to external effects is nearly identical between targets (which need not be true)
- However, it does not include virtual processes that need to be corrected (vacuum polarization, vertex/self-energy, two photon exchange)
- The virtual corrections are more important (i.e., larger) than energy loss effects and depend on Z, σ_{Born}

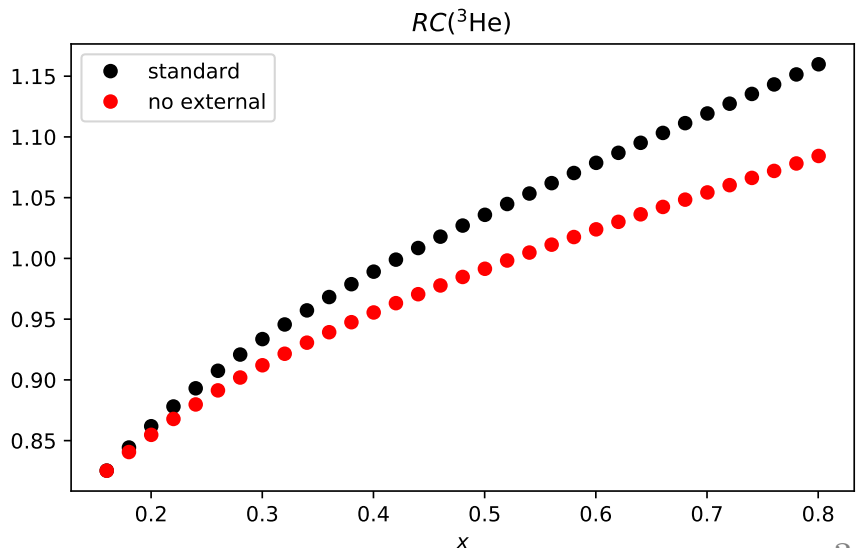
Radiative corrections from externals

Radiative correction: $RC = \frac{\sigma_{Born}}{\sigma_{rad}}$

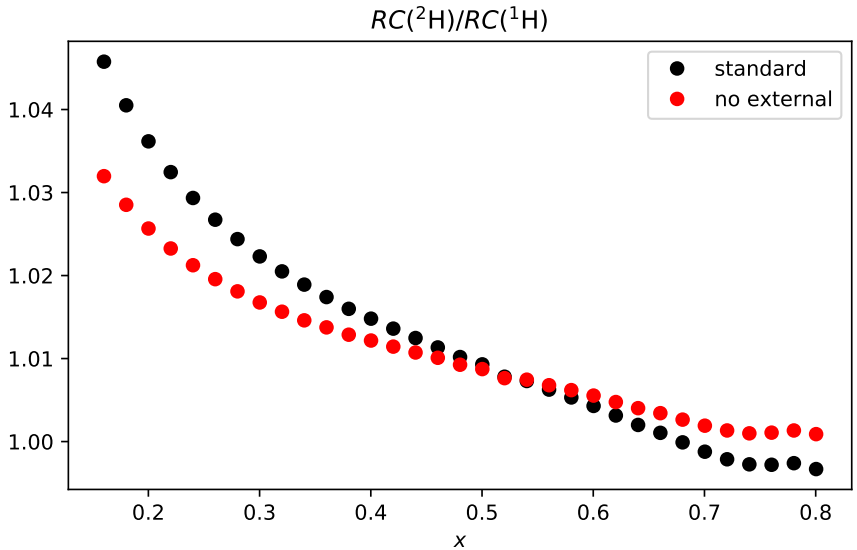


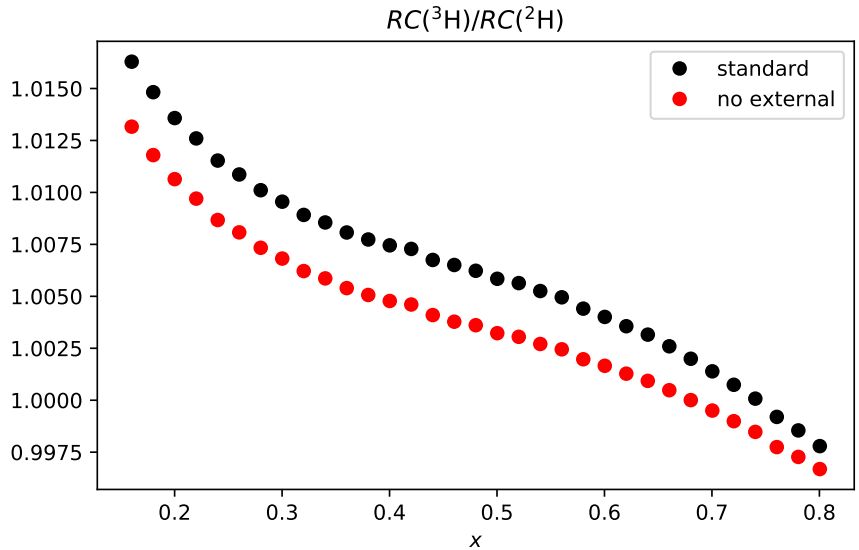


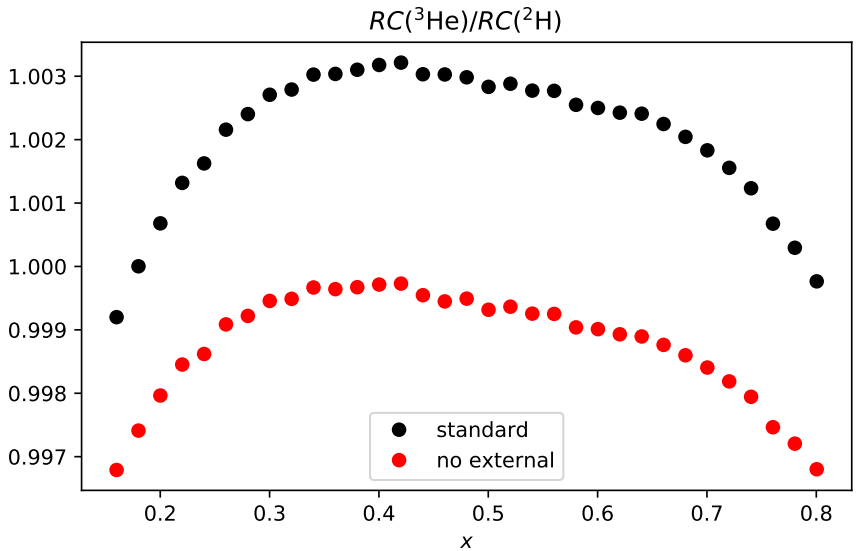


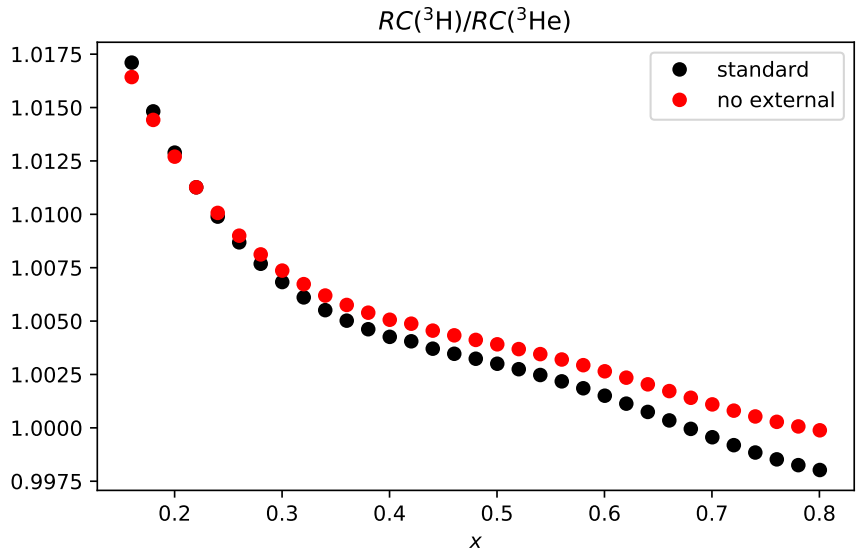


RC ratios


$RC(^2H)/RC(^1H)$
standard
no external
1.04
1.03
1.02
1.01
1.00
0.2
0.3
0.4
0.5
0.6
0.7
0.8
x


$RC(^3H)/RC(^2H)$
standard
no external
1.0150
1.0125
1.0100
1.0075
1.0050
1.0025
1.0000
0.9975
0.2
0.3
0.4
0.5
0.6
0.7
0.8
x


$RC(^3He)/RC(^2H)$
standard
no external
1.003
1.002
1.001
1.000
0.999
0.998
0.997
0.2
0.3
0.4
0.5
0.6
0.7
0.8
x


$RC(^3H)/RC(^3He)$
standard
no external
1.0175
1.0150
1.0125
1.0100
1.0075
1.0050
1.0025
1.0000
0.9975
0.2
0.3
0.4
0.5
0.6
0.7
0.8
x

External effects

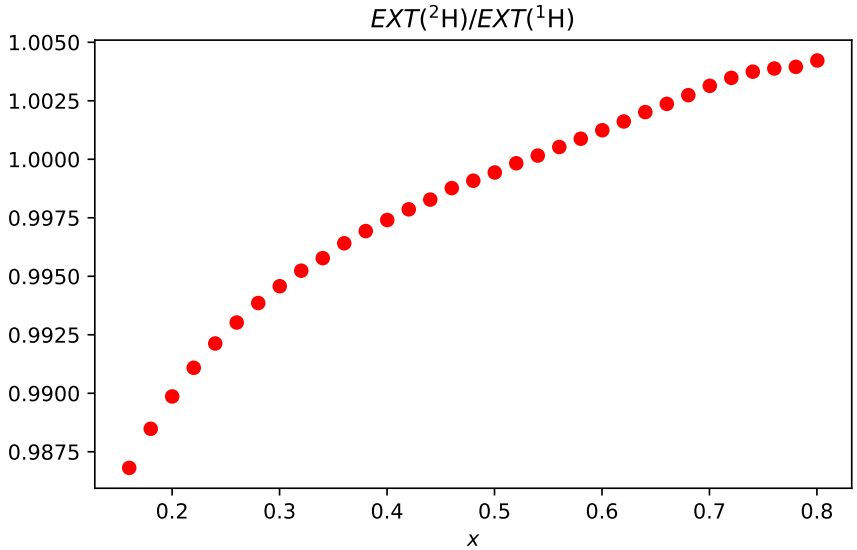
- Estimate magnitude of external effects on RC:

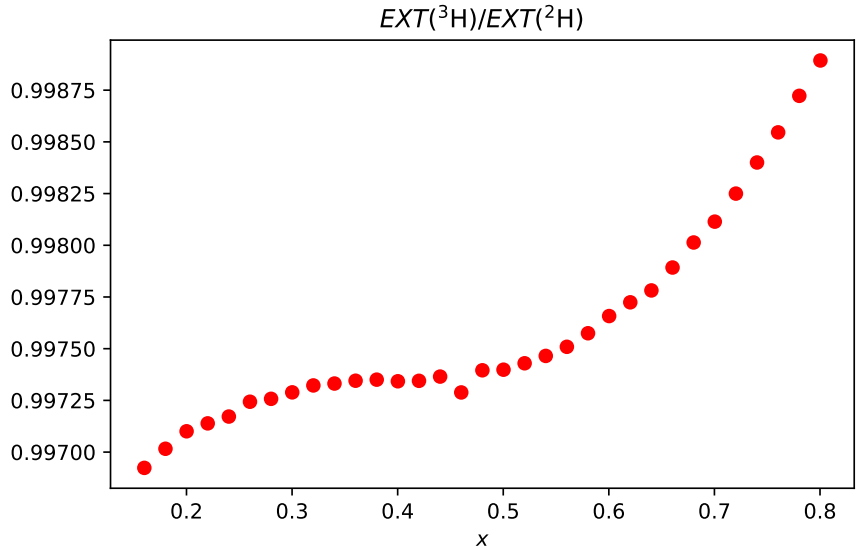
$$EXT = \frac{RC_{noext}}{RC_{standard}}$$

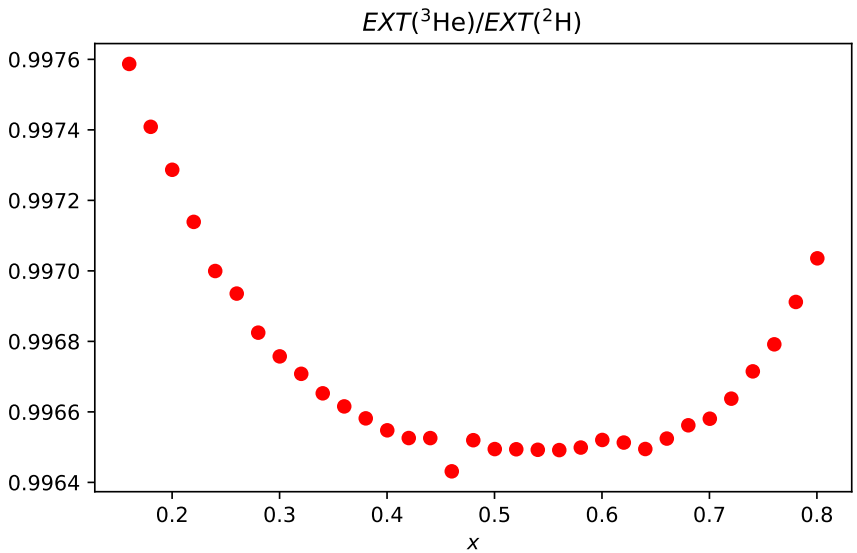
- If external energy loss effects are similar between targets, then EXT should be similar as well

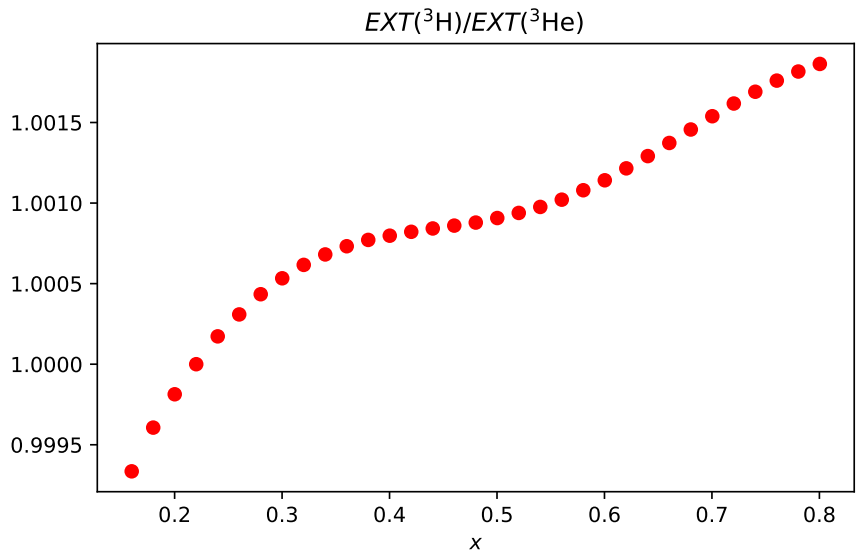
- Still not an apples-to-apples comparison with `g4rc`, which just quantified mis-binning due to external energy loss effects

EXT ratios









$^2\mathrm{H}/^1\mathrm{H} \leq 1\%$ $^3\mathrm{H}/^2\mathrm{H} \leq 0.3\%$ $^3\mathrm{He}/^2\mathrm{H} \leq 0.35\%$ $^3\mathrm{He}/^2\mathrm{H} \leq 0.2\%$

Summary

- Mis-binning due to energy loss cancels in the ratio
- Virtual corrections do not
- Results from `g4rc` are likely correct, just of limited usefulness