RC Model Comparison

March 7, 2019

Nuclei structure function:

- Get F_{2d}, F_{2p} from models;
- Get EMC ratio $\frac{F_2(^3He)}{F_{2d}}$, $\frac{F_2(^3H)}{F_{2d}}$ or $\frac{F_2(A=3)}{F_{2d}}$ from model;
- For $\frac{F_2(A=3)}{F_{2d}}$, need to remove the isoscalar correction, which need F_{2n}/F_{2p} input:

$$\frac{F_2(A)_{iso}}{F_{2d}} = \frac{F_2(A)}{F_{2d}} \frac{\frac{1}{2}(1 + F_2^n/F_2^p)}{\frac{1}{A}(Z + (A-Z)F_2^n/F_2^p)} \tag{1}$$

- $F_2(^3He) = F_{2d} \times \frac{F_2(^3He)}{F_{2d}}$, $F_2(^3H) = F_{2d} \times \frac{F_2(^3H)}{F_{2d}}$

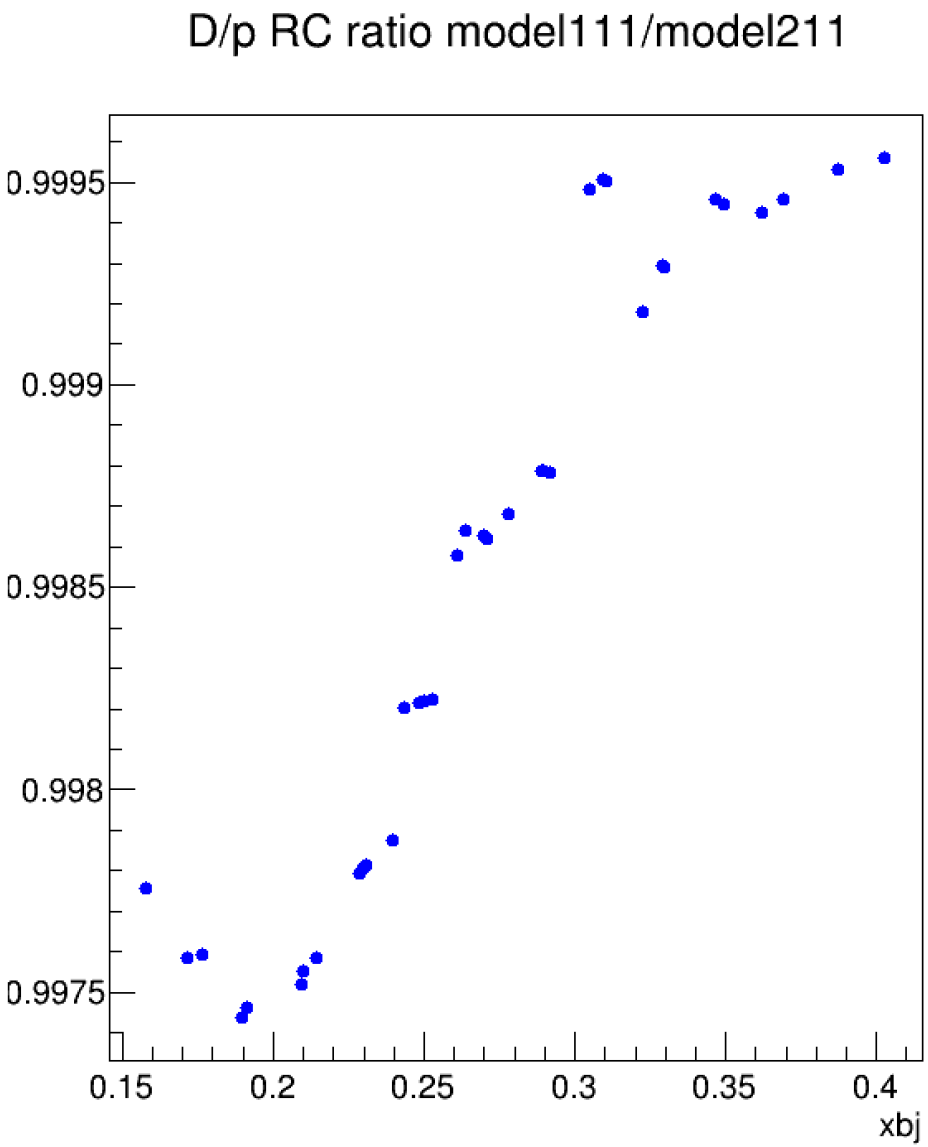
- F_{2d}:
  1. Bodek;
  2. NMC 1995 (Phys. Lett. B364 107-115,1995)
- EMC ratio $\frac{F_2(A=3)}{F_{2d}}$
  1. K&P (no isoscalar correction);
  2. SLAC EMC (isoscalar nuclei)
- F_{2n}/F_{2p}
  1. linear: $F_{2n}/F_{2p} = 1 - 0.8 * x$
  2. CJ15;
  3. NMC 1992 (Nucl. Physics. B 371(1992) 3-31)

model111: Bodek + K&P;
model211: NMC + K&P;
model121: Bodek + SLAC EMC + linear F_{2n}/F_{2p};
model122: Bodek + SLAC EMC + CJ15;
model123: Bodek + SLAC EMC + NMC1992;

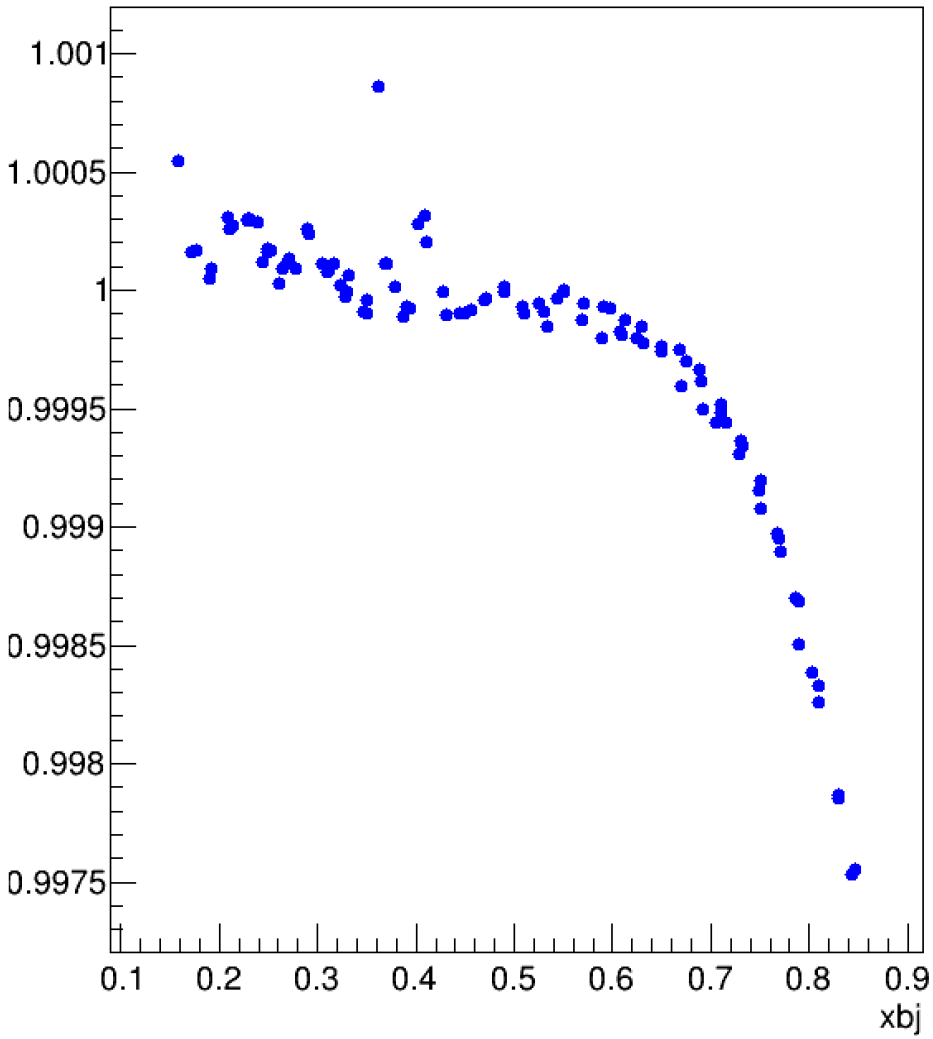
$$\frac{\sigma(^3H)}{\sigma(^3He)} = \frac{Yield(^3H) * RC(^3H)}{Yield(^3He) * RC(^3He)} \tag{2}$$

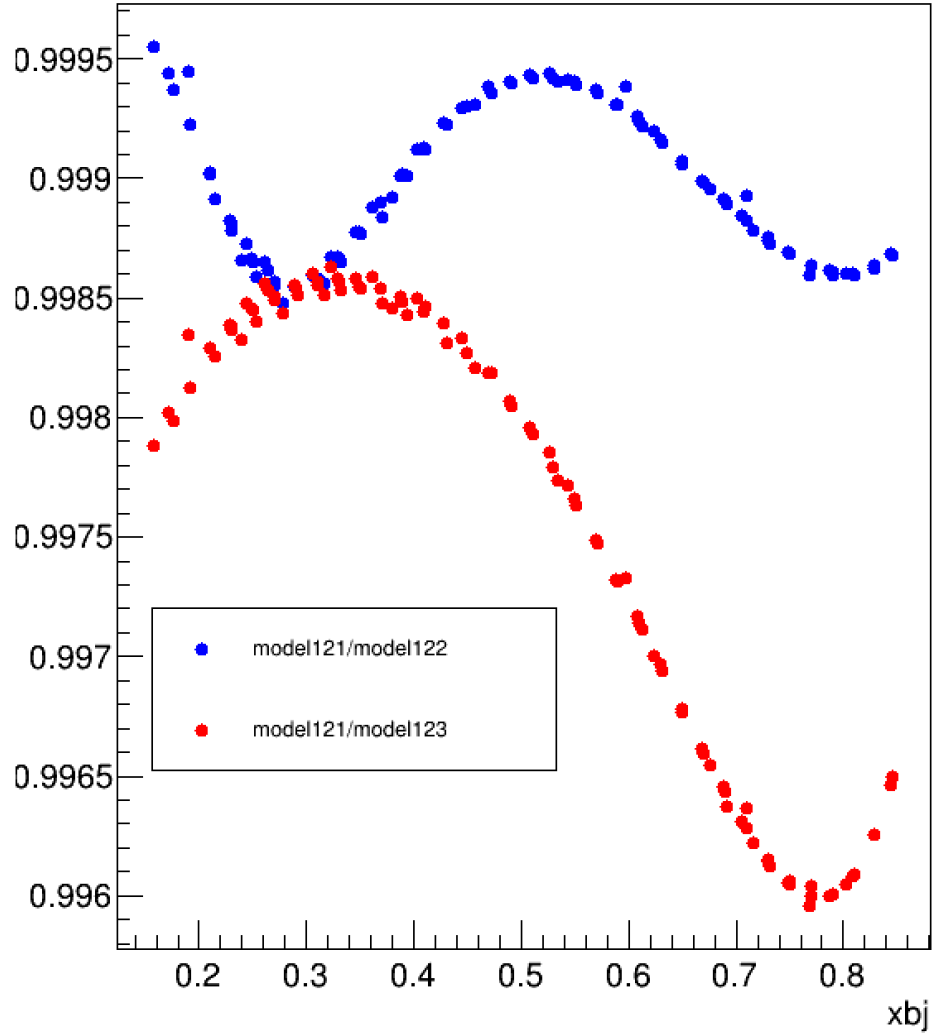
$\frac{RC(^3H)}{RC(^3He)}$ would affect the measured ratio.

Following shows the $\frac{RC(^3H)}{RC(^3He)}$ model dependence.



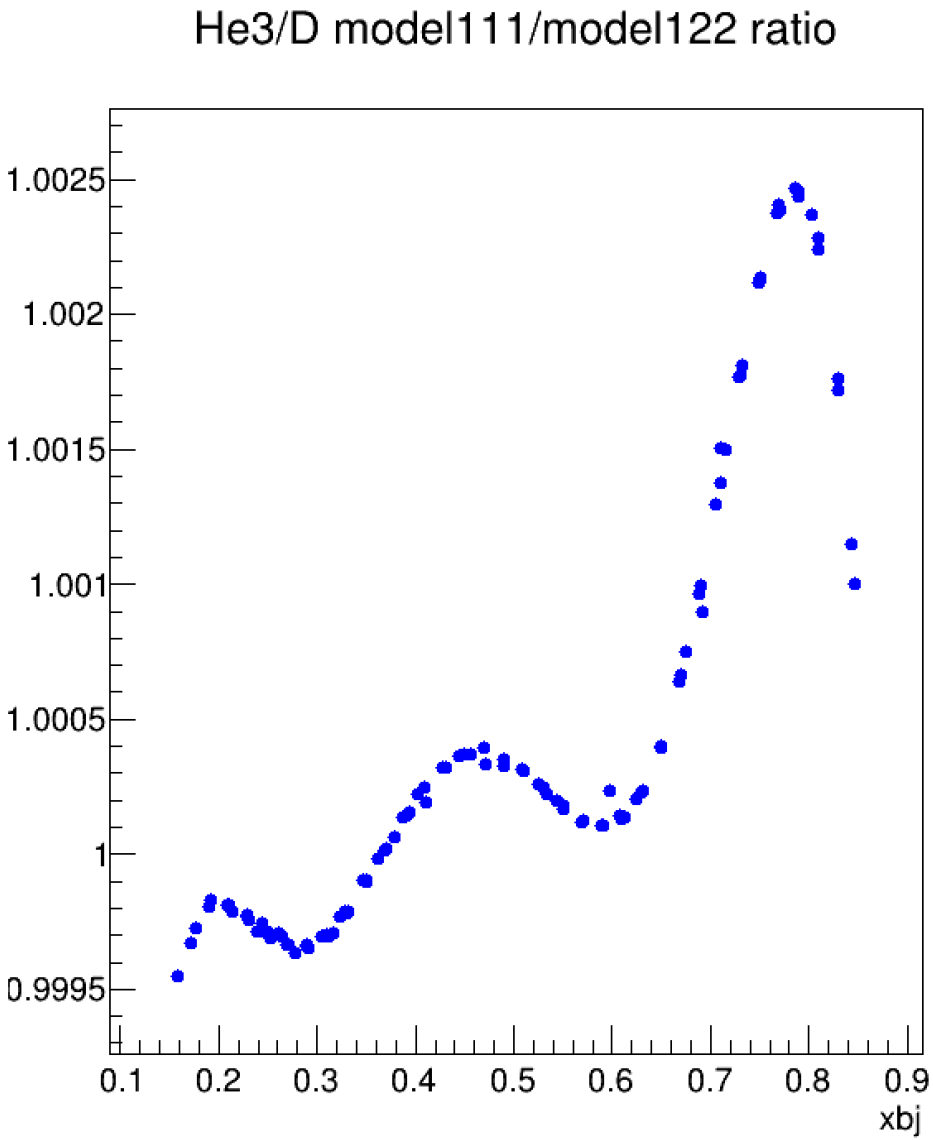
The difference between model111 and model211 is within 0.26%



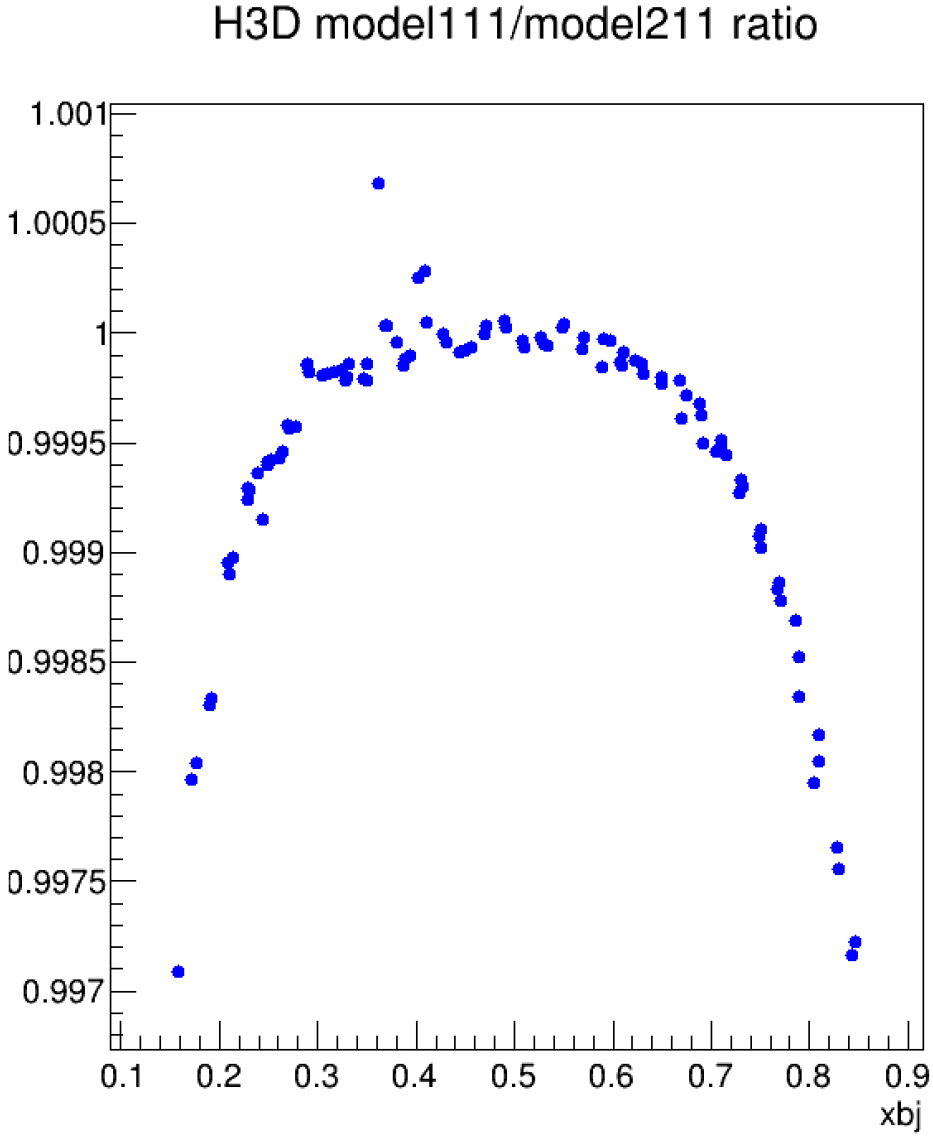


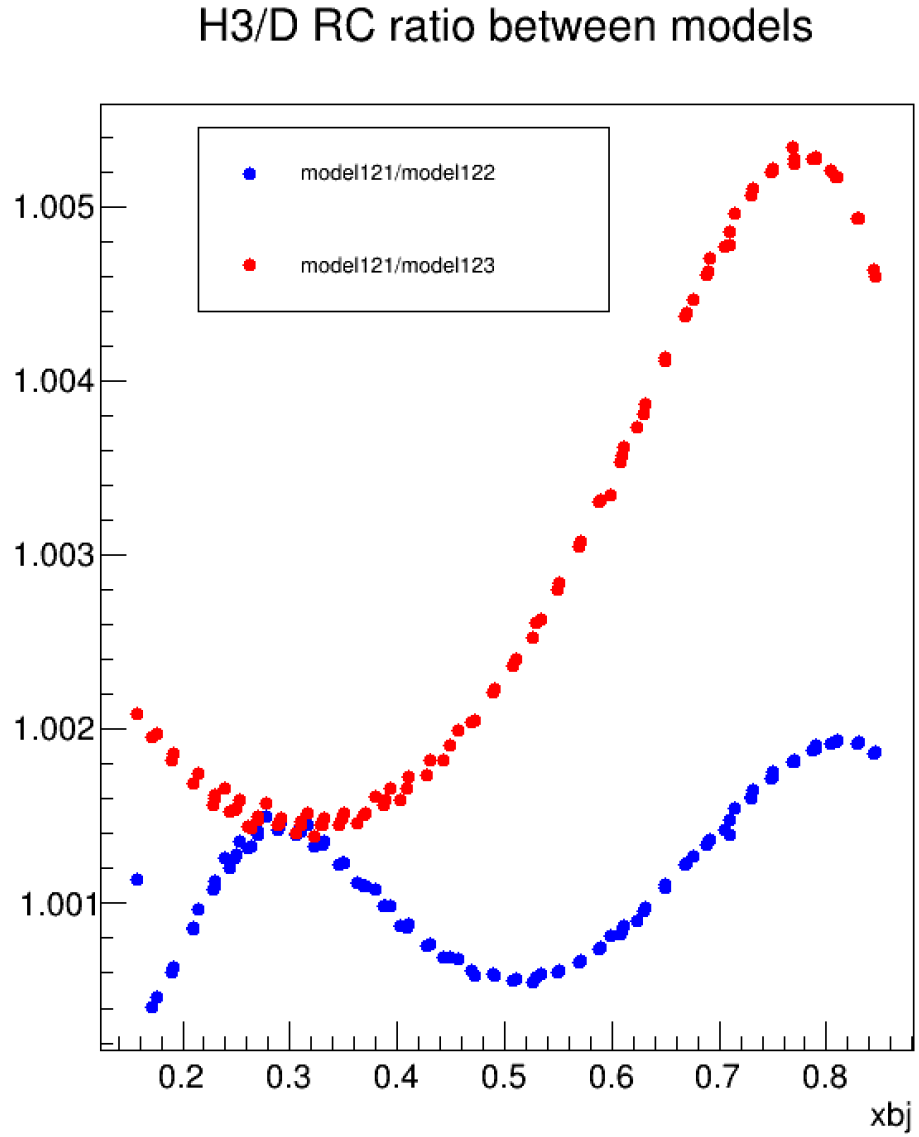
The difference due to using different F_2^d models is within 0.25%.

The difference due to using different F_2^n/F_2^p models is within 0.42%.



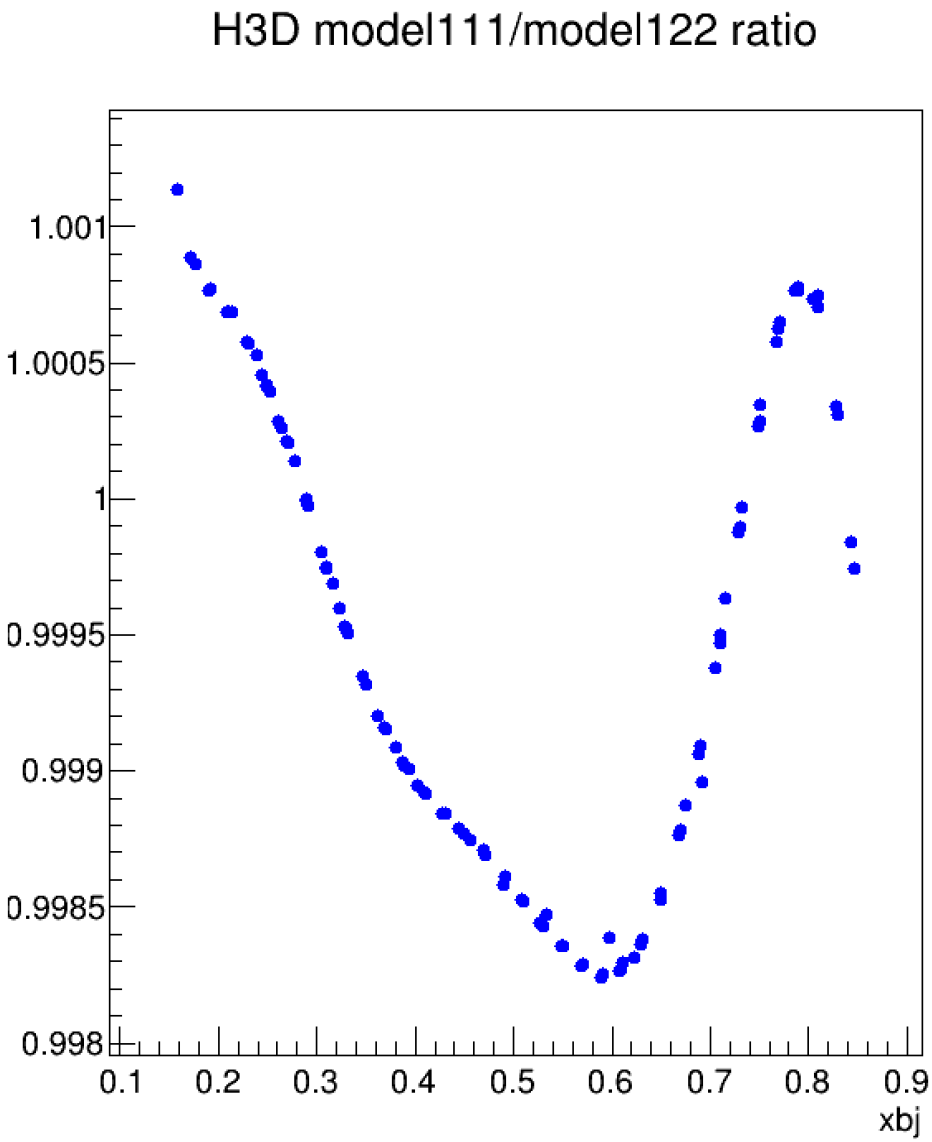
The difference due to using different EMC model is within 0.25%



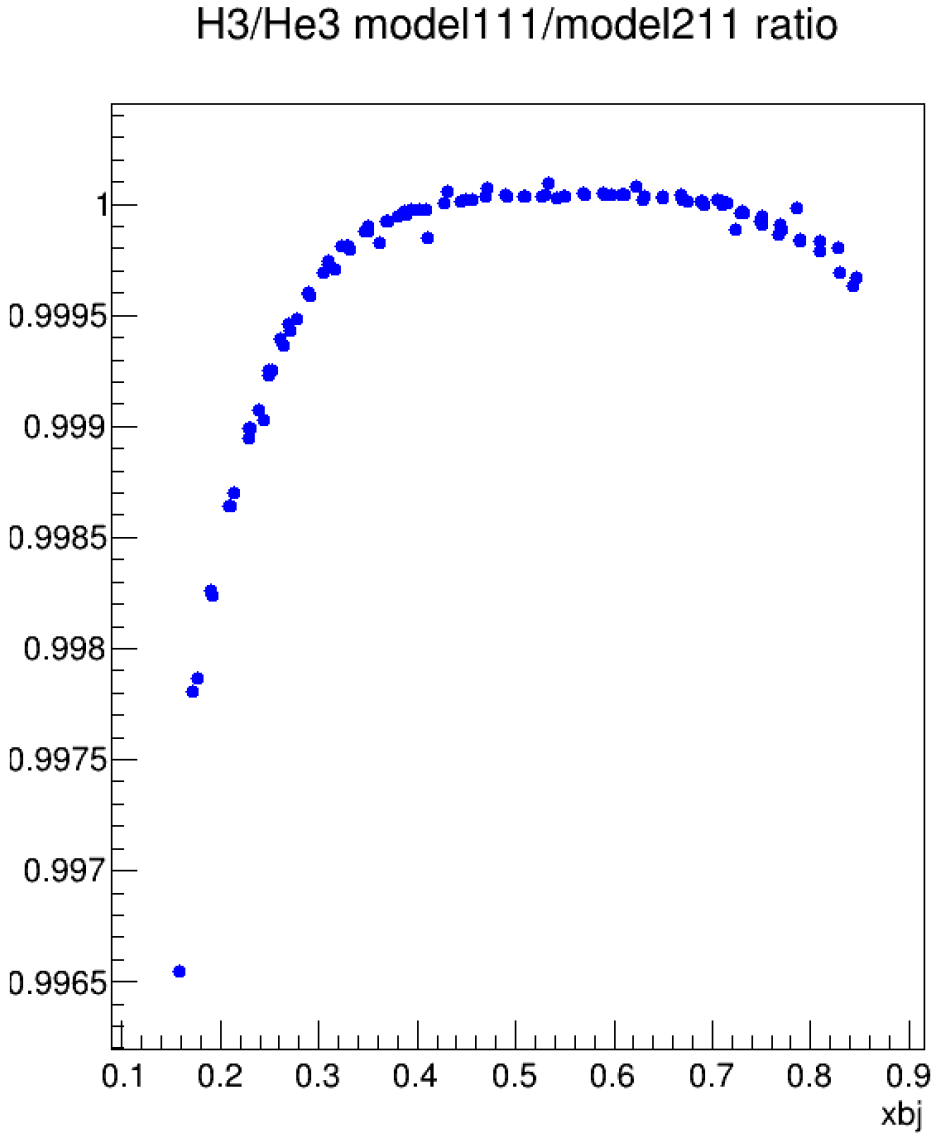


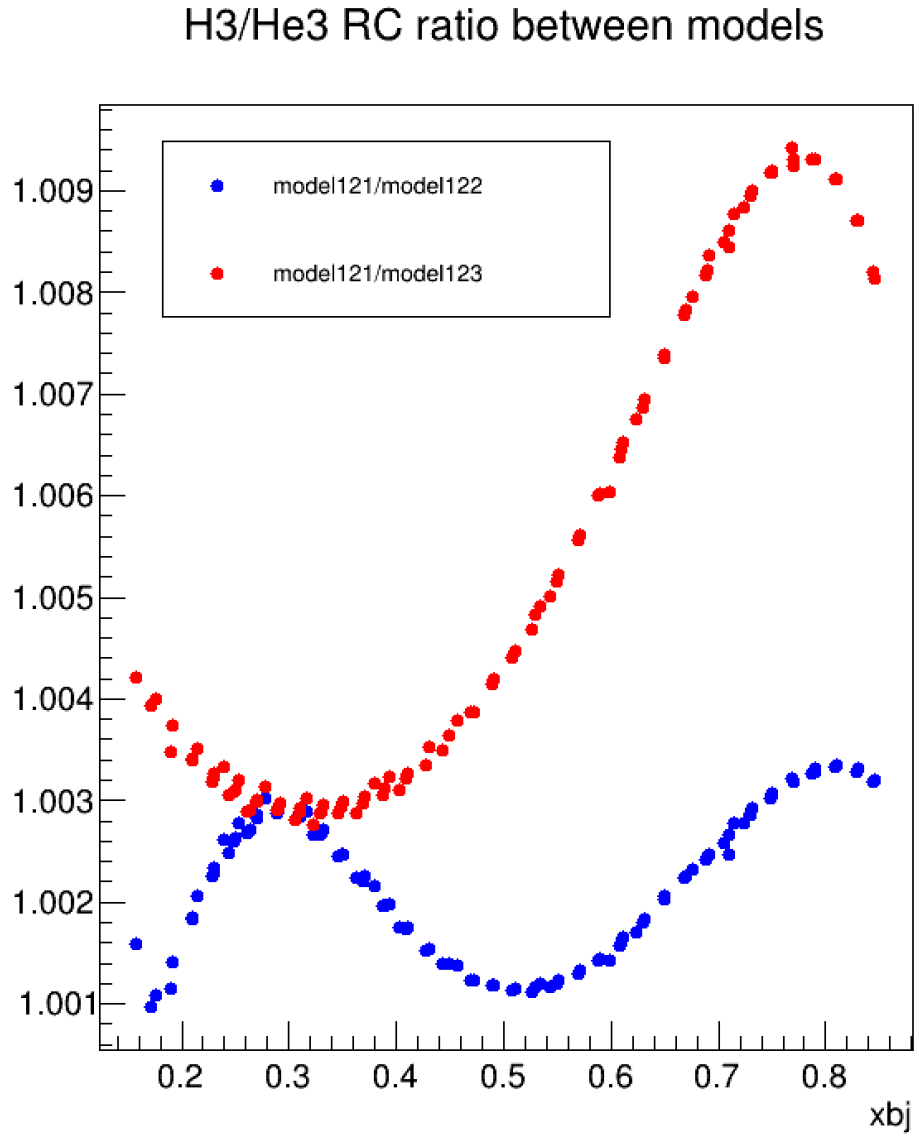
The difference due to using different F_2^d models is within 0.3%.

The difference due to using different F_2^n/F_2^p models is within 0.54%.



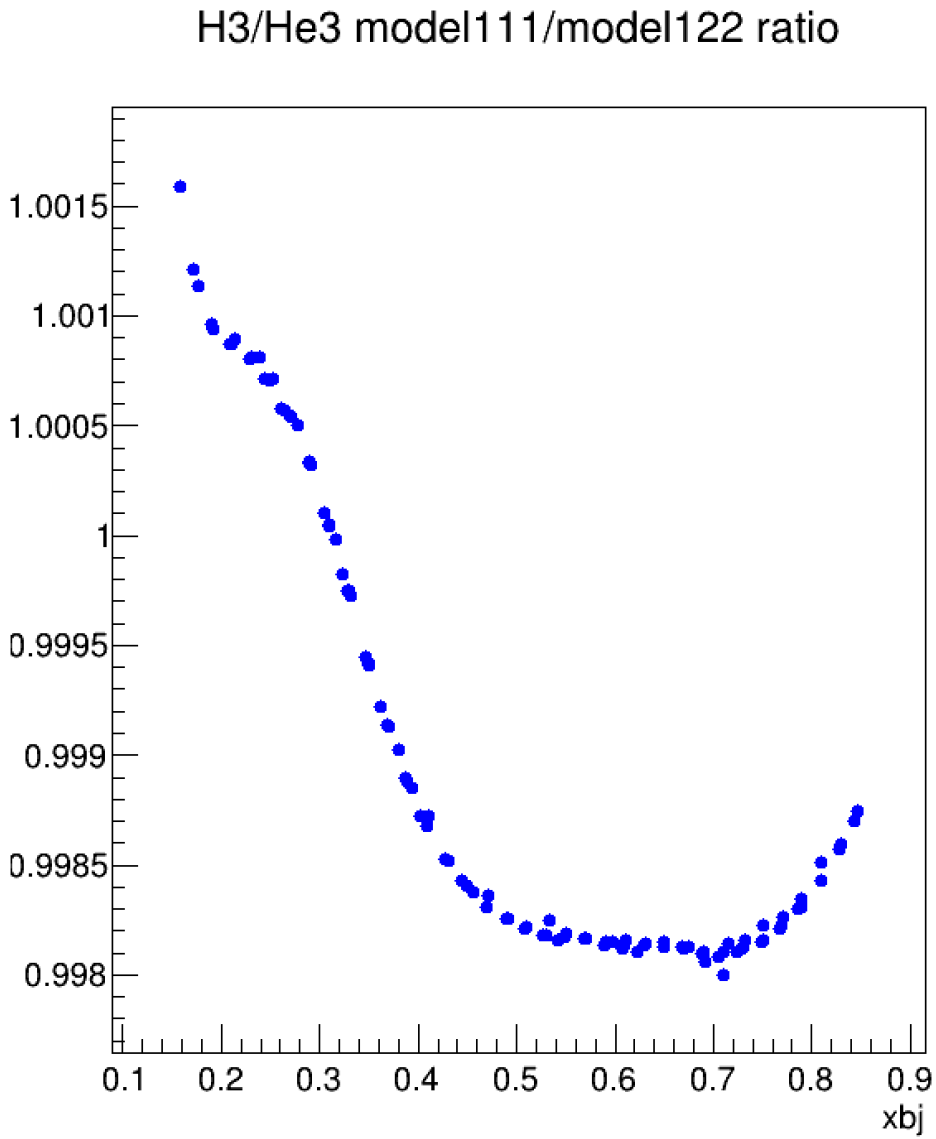
The difference due to using different EMC model is within 0.2%



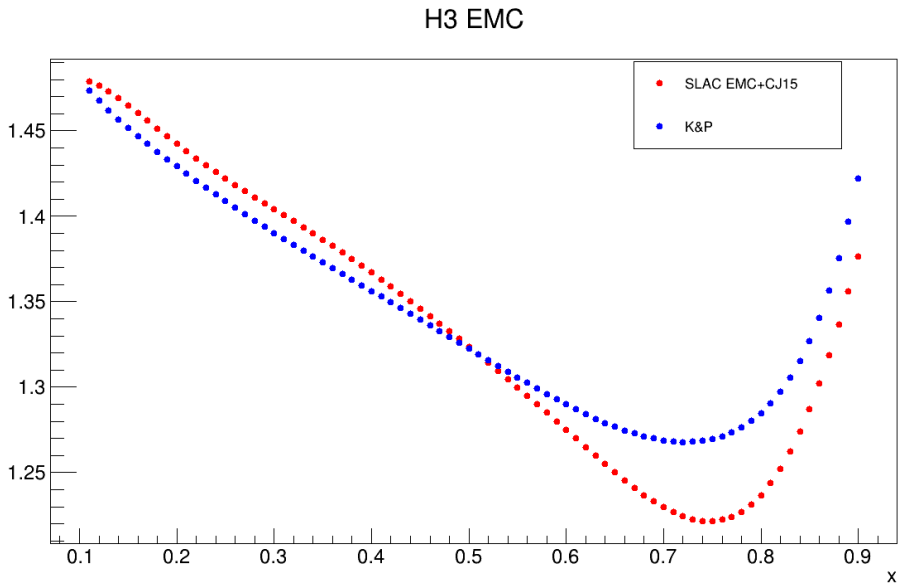


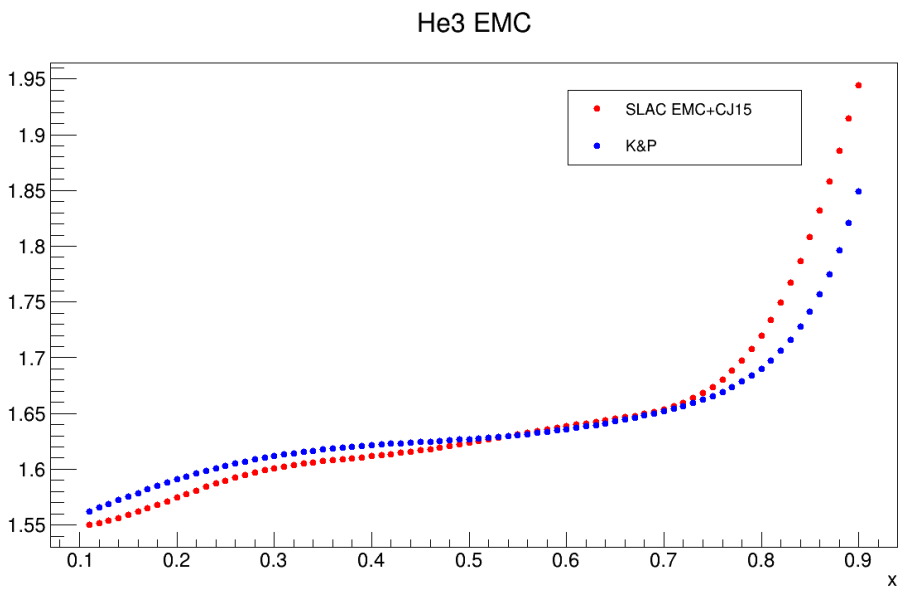
The difference due to using different F_2^d models is within 0.35%.

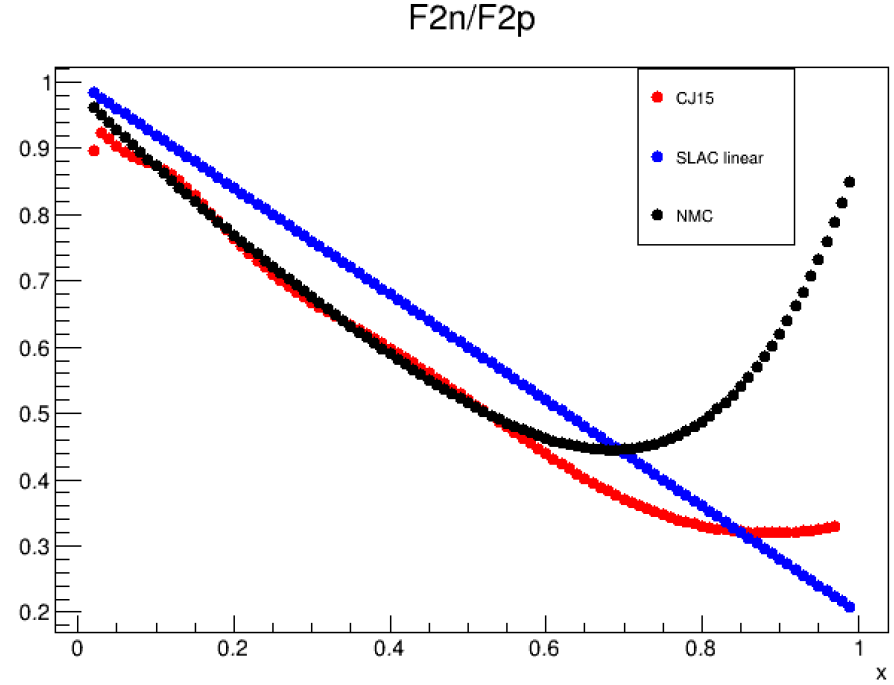
The difference due to using different F_2^n/F_2^p models is within 1%.



The difference due to using different EMC model is within 0.2%







The plots show H3 EMC ratio, He3 EMC ratio and F_2^n/F_2^p from models with x from 0.1 to 0.9 with step 0.01 and Q2=14*x

Conclusions

- The maximum difference is 1% on H3/He3 with NMC F_2^n/F_2^p.
- We know that the NMC F_2^n/F_2^p is definitely not correct at high x. After excluding NMC F_2^n/F_2^p, the maximum difference is 0.35%. So the maximum systematic error for radiative correction should be less than 0.5%.
- https://github.com/hanjie1/Radiative-correction/tree/master/T2_externals_clean
  In TARG file:

```
Nuc Tail Method     1
Nuc FormFac Mdl     1
DIS_model         111   <-- change model here
```