Resonance in RC model study

February 21, 2019

Motivation

NMC

Nucl. Physics. B 371(1992) 3-31

$$F_2^{\mathrm{d}}(x, Q^2) = \left[1 - G^2(Q^2)\right]\left[F^{\mathrm{dis}}(x, Q^2) + F^{\mathrm{res}}(x, Q^2) + F^{\mathrm{bg}}(x, Q^2)\right], \quad \text{(A.1)}$$

Phys. Lett. B364 107-115,1995

$$F_2(x, Q^2) = A(x) \cdot \left(\frac{\ln(Q^2/\Lambda^2)}{\ln({Q_0}^2/\Lambda^2)}\right)^{B(x)} \cdot \left(1 + \frac{C(x)}{Q^2}\right), \qquad (2)$$

Phys. Lett. B 295 (1992) 159-168

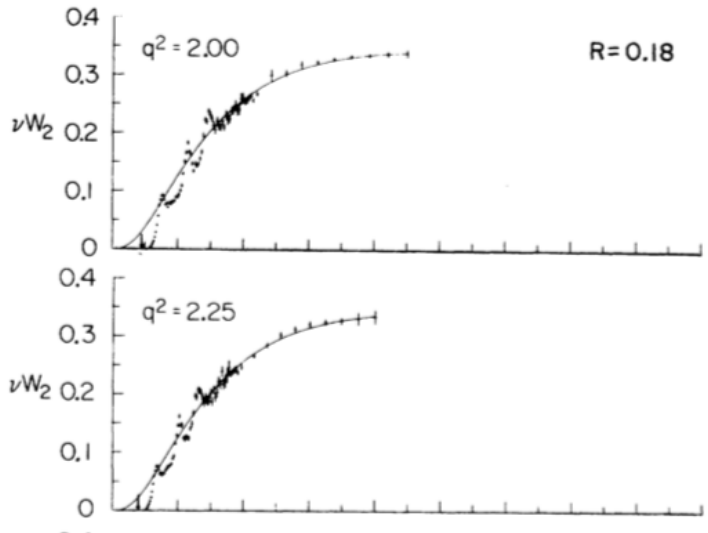
ing the 15 parameter function of ref. [13]. The differences in the resulting F_2 due to the functional form were negligible everywhere except in the lowest x bin where they were up to 2%. The differences were used point by point as an estimate of this systematic error.

Bodek fit:

$$F_2^{D2} = F_2^{dis} \times (F_2^{res} + BKG) \quad (1)$$

$$F_2^{He3} = F_2^{D2} \times EMC_{He3}, \quad F_2^{H3} = F_2^{D2} \times EMC_{H3} \quad (2)$$

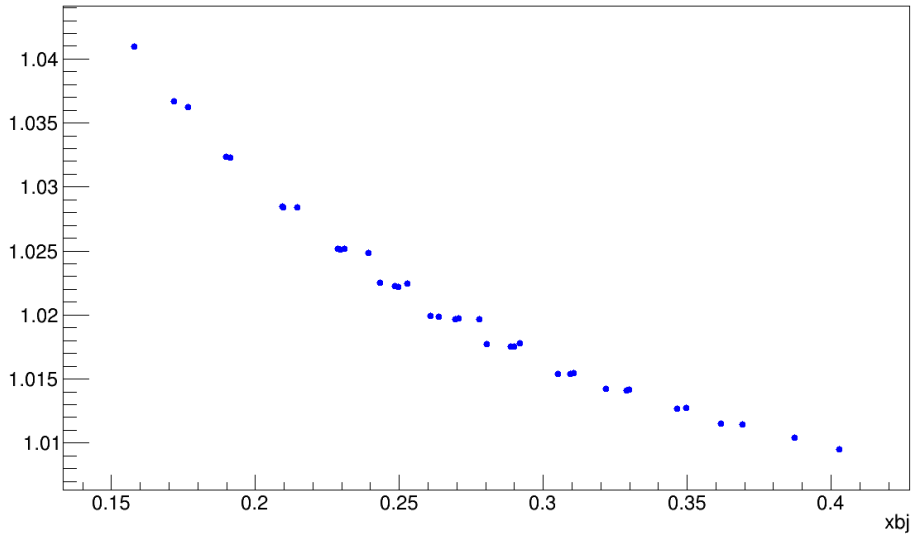
According to Bloom-Gilman sum rule (duality), the average of resonances is close to the DIS scaling-limit curve.



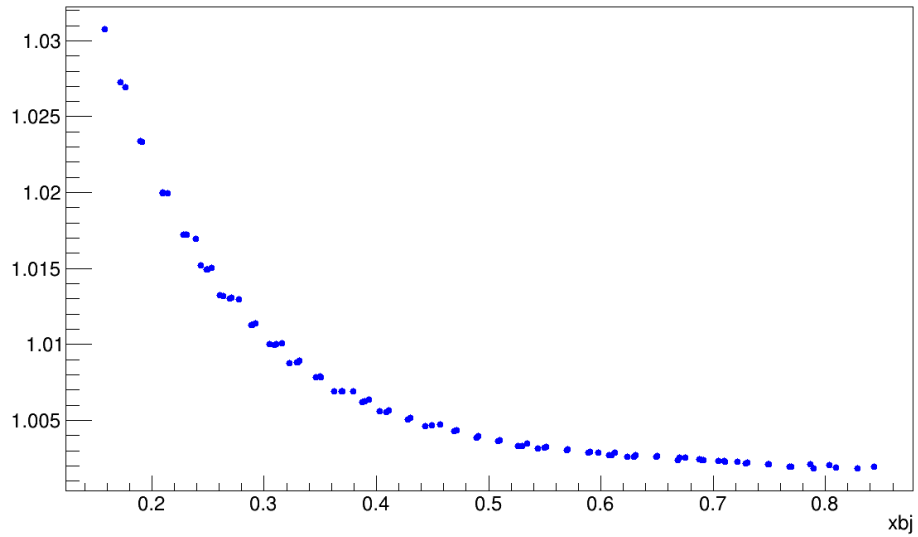
- **model111**: keep resonance in all nuclei;
- **model111_noResAll**: $F_2 = F_2^{dis}$
- **model111_ResOnlyD2H1**: only D2 and H1 have resonance. For H3 and He3, $F_2 = F_2^{dis}$

$$model111/model111\_noResAll = \frac{RC_{model111}}{RC_{model111\_noResAll}} \qquad RC = \frac{\sigma_{born}}{\sigma_{rad}}$$

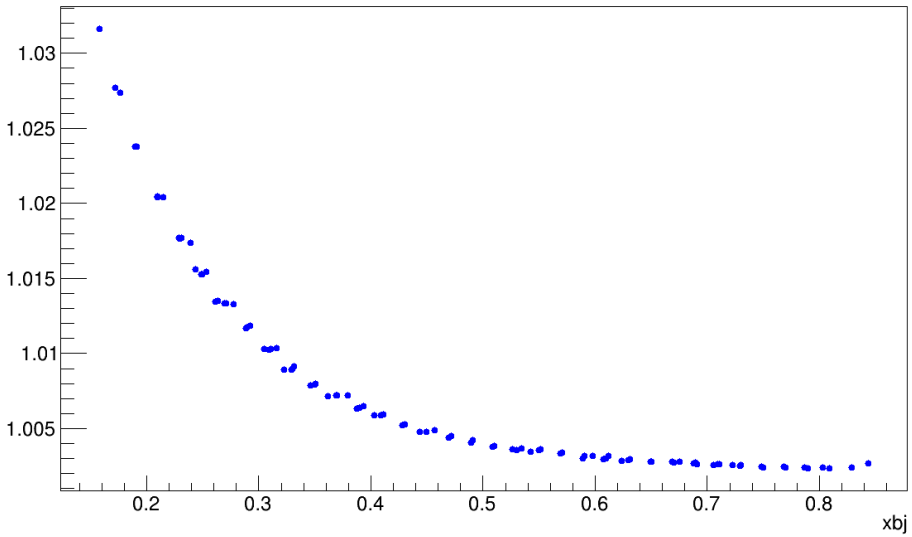
H1 model111/model11_noResAll



D2 model111/model111_noResAll



He3 model111/model111_noResAll



H3 model111/model111_noResAll

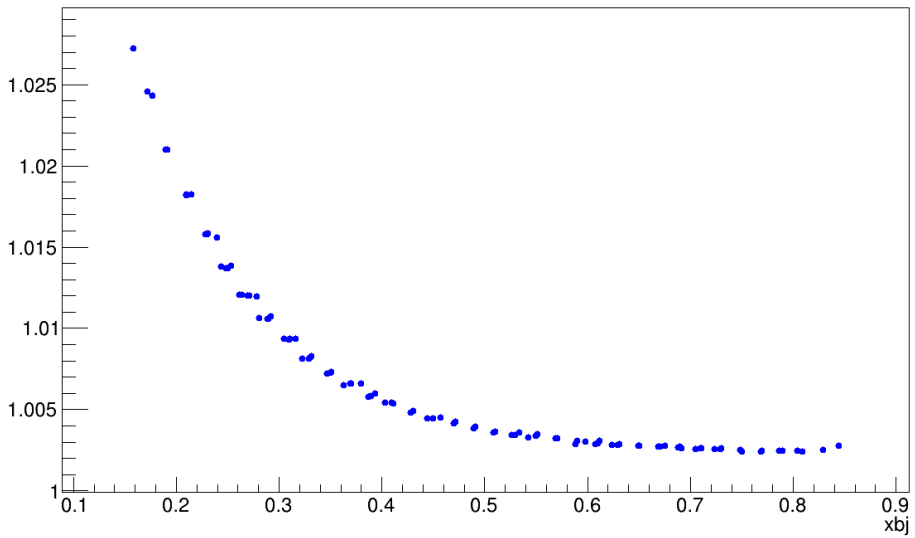
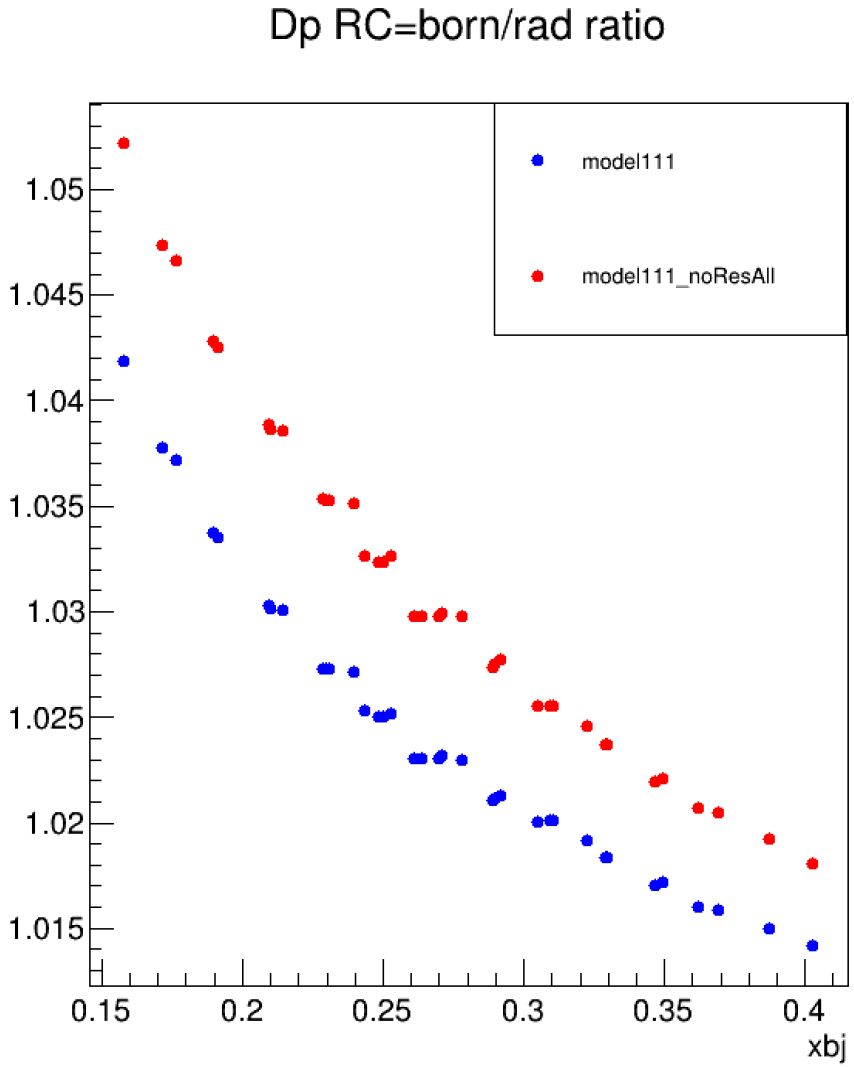
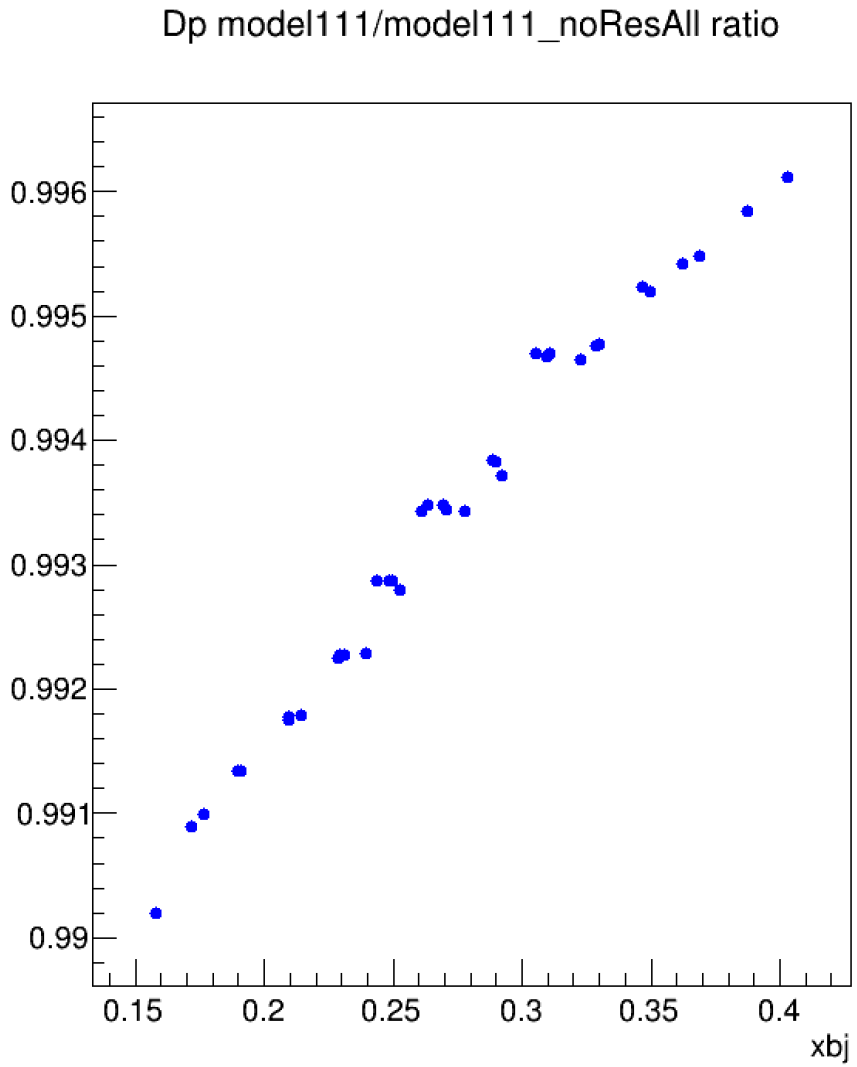


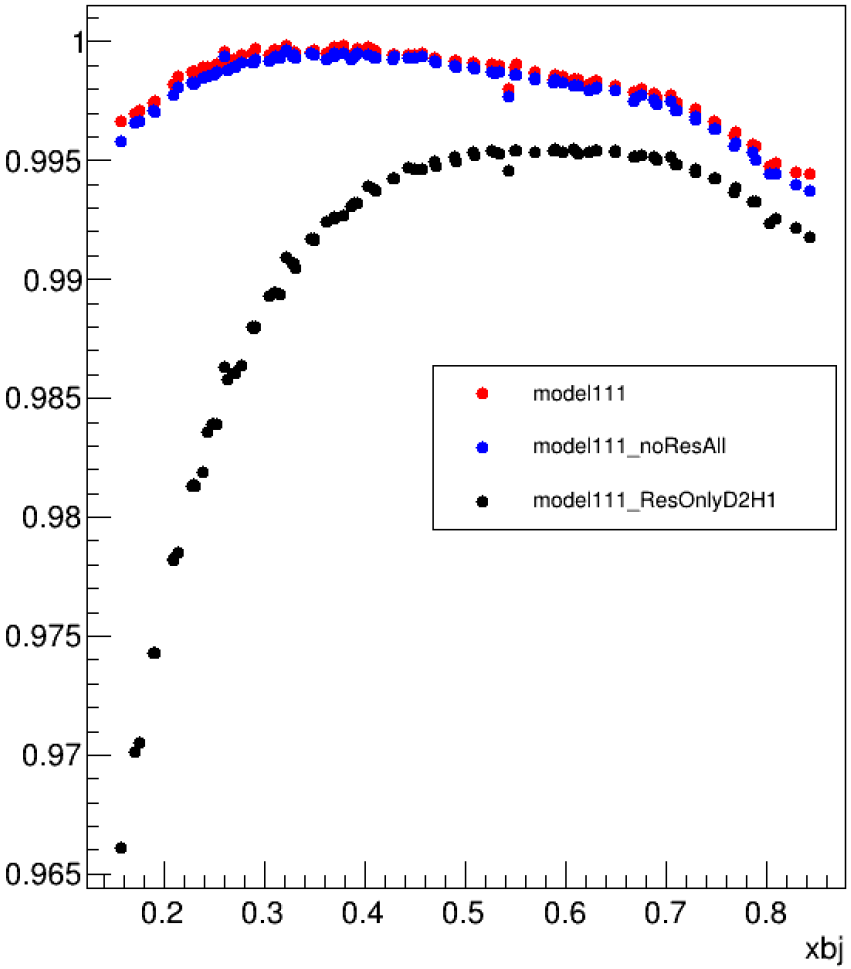
Fig 1. D/p RC ratio=$\frac{RC(D2)}{RC(H1)}$

Fig 2. RC ratio between models=$\frac{\text{RC(D2)/RC(H1) from model111}}{\text{RC(D2)/RC(H1) from model111\_noResAll}}$

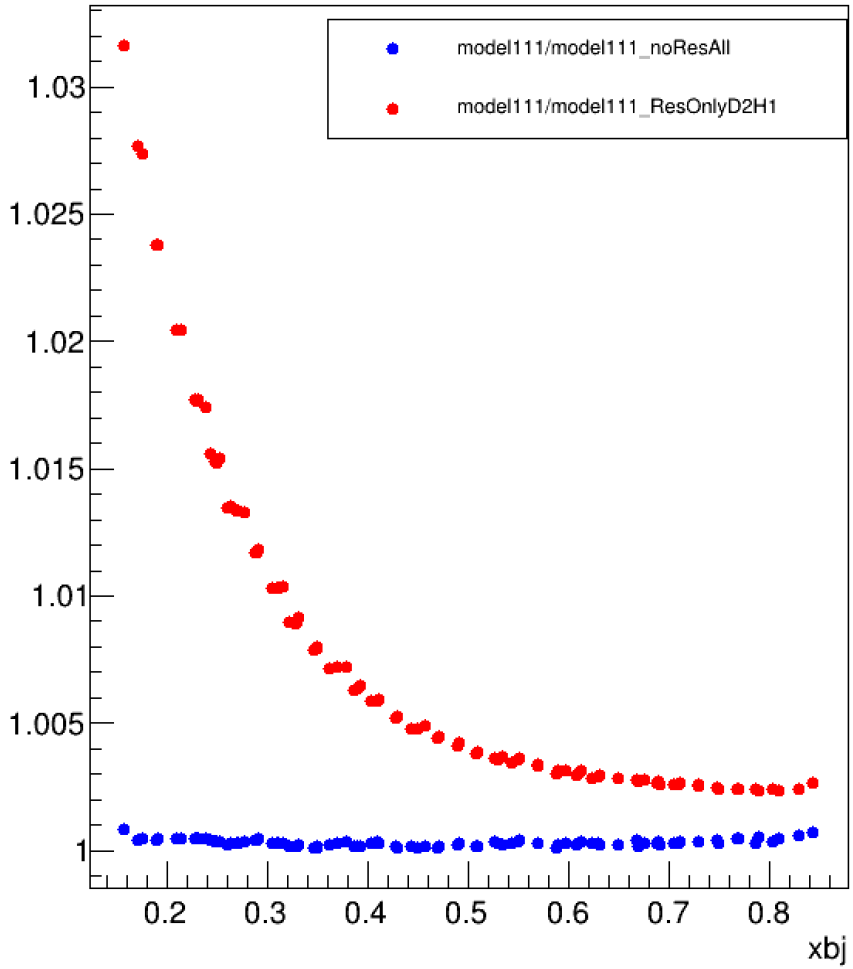


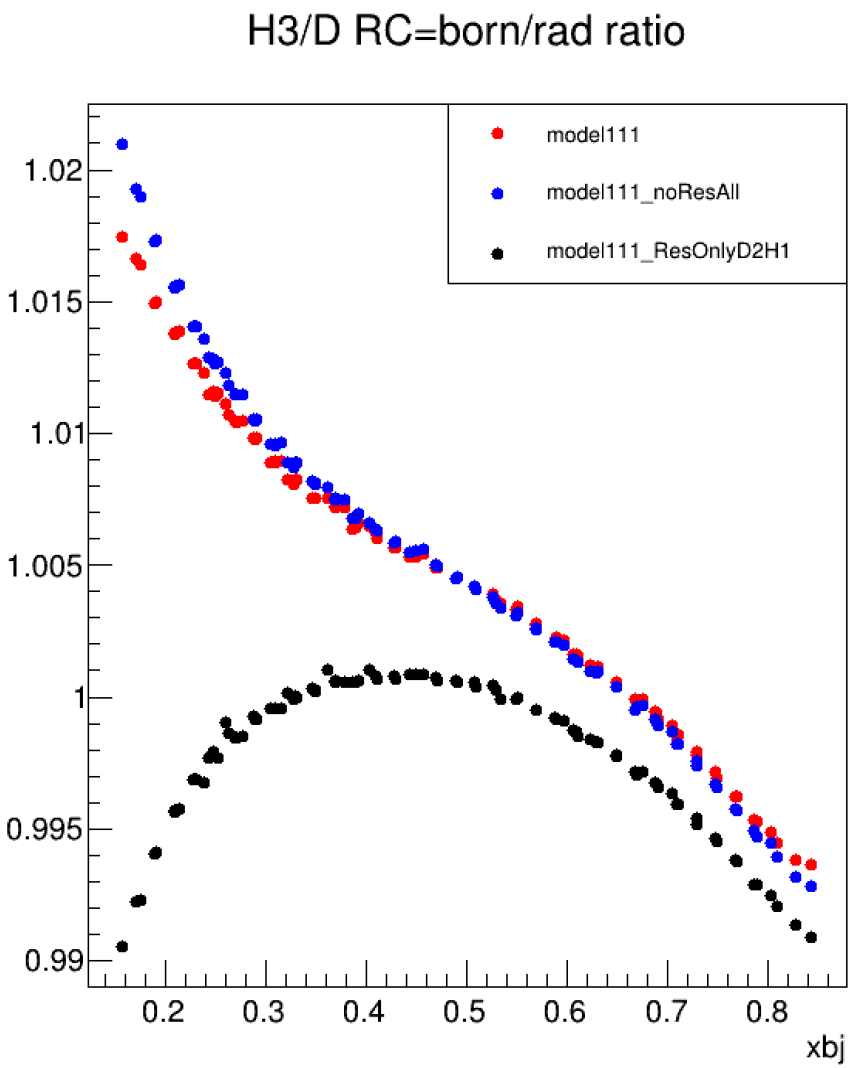


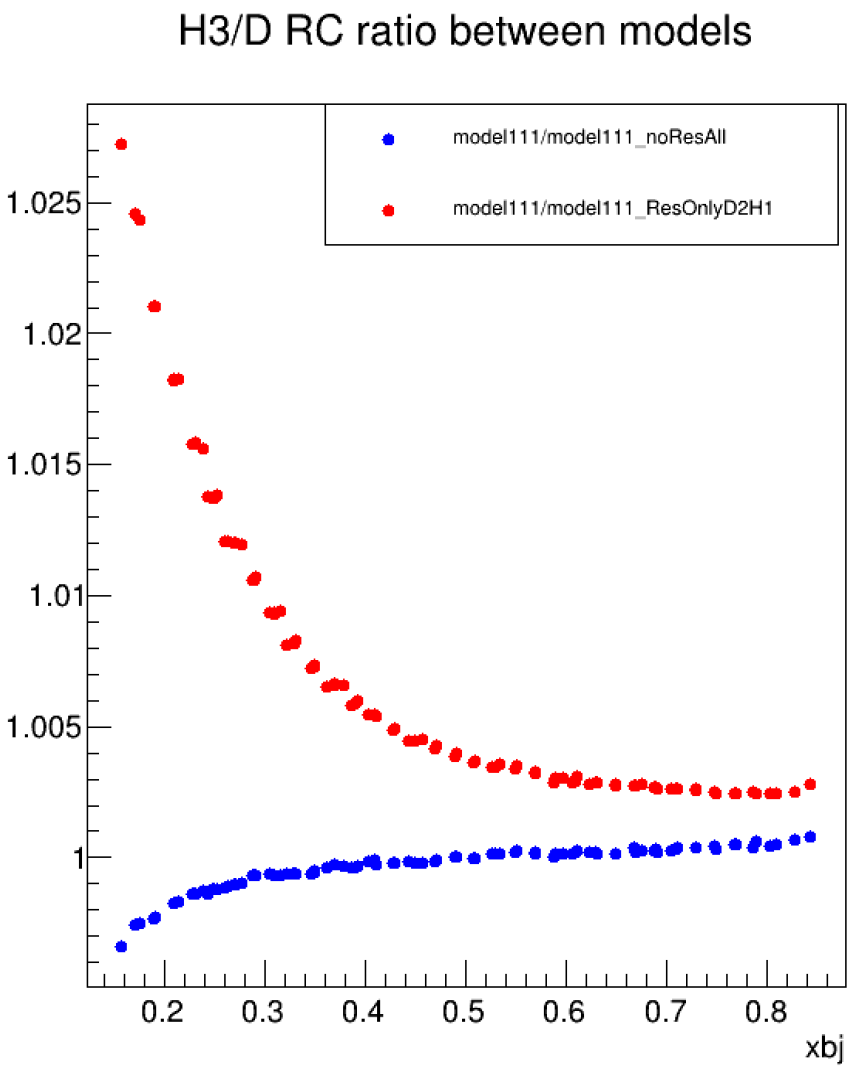
HeD RC=born/rad ratio

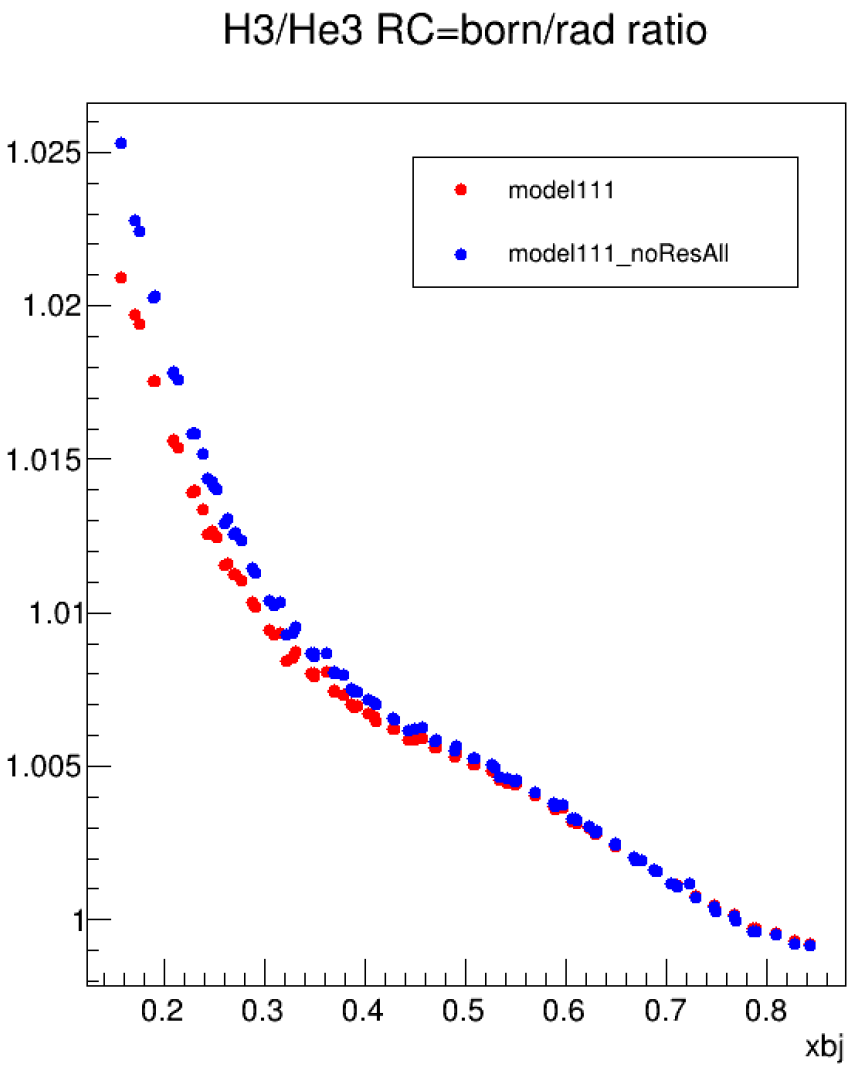


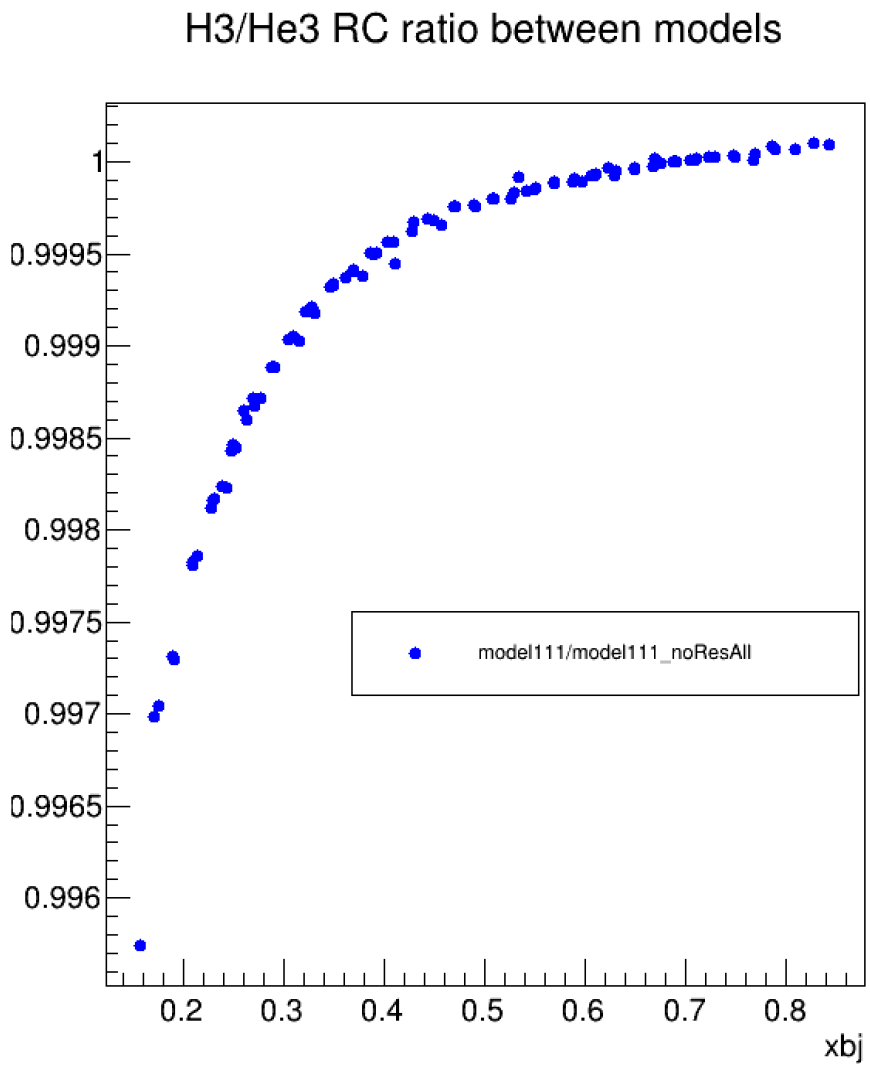
He3/D RC ratio between models




H3/D RC=born/rad ratio
model111
model111_noResAll
model111_ResOnlyD2H1
1.02
1.015
1.01
1.005
1
0.995
0.99
0.2
0.3
0.4
0.5
0.6
0.7
0.8
xbj


H3/D RC ratio between models
model111/model111_noResAll
model111/model111_ResOnlyD2H1
1.025
1.02
1.015
1.01
1.005
1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
xbj


H3/He3 RC=born/rad ratio
model111
model111_noResAll
1.025
1.02
1.015
1.01
1.005
1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
xbj


H3/He3 RC ratio between models
model111/model111_noResAll
1
0.9995
0.999
0.9985
0.998
0.9975
0.997
0.9965
0.996
0.2
0.3
0.4
0.5
0.6
0.7
0.8
xbj

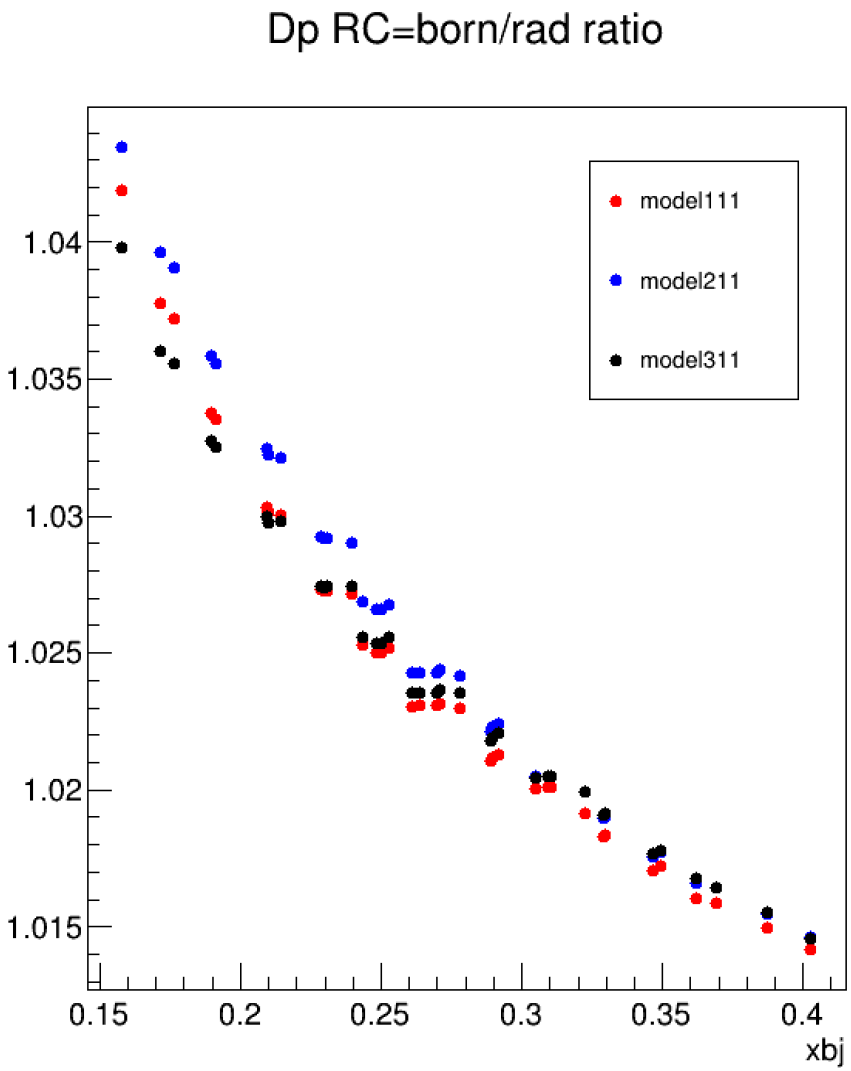
Conclusions

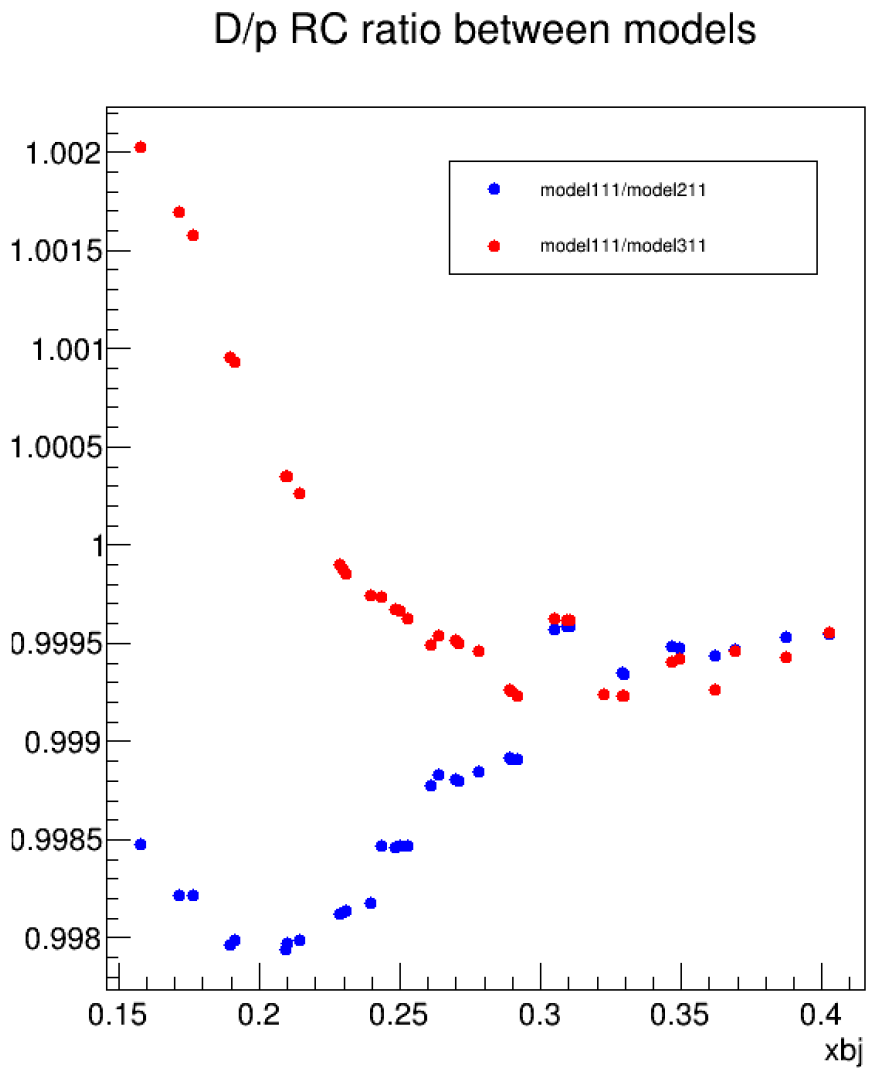
- Removing resonance would lead to 3% change in RC factors at low x for each target;
- Removing resonance would change D/p ratio up to 1%;
- Removing both the resonance in D2 and He3 (H3) almost doesn't change the D2/He3 or D2/H3
- Keeping the resonance in D2 and removing resonance in He3 (H3) will change the D2/He3 or D2/H3 around 3% at low x
  Q: Does EMC correction factor work on resonance?
- Removing resonance would change H3/He3 up to 0.45%

Two NMC F_2 equation:

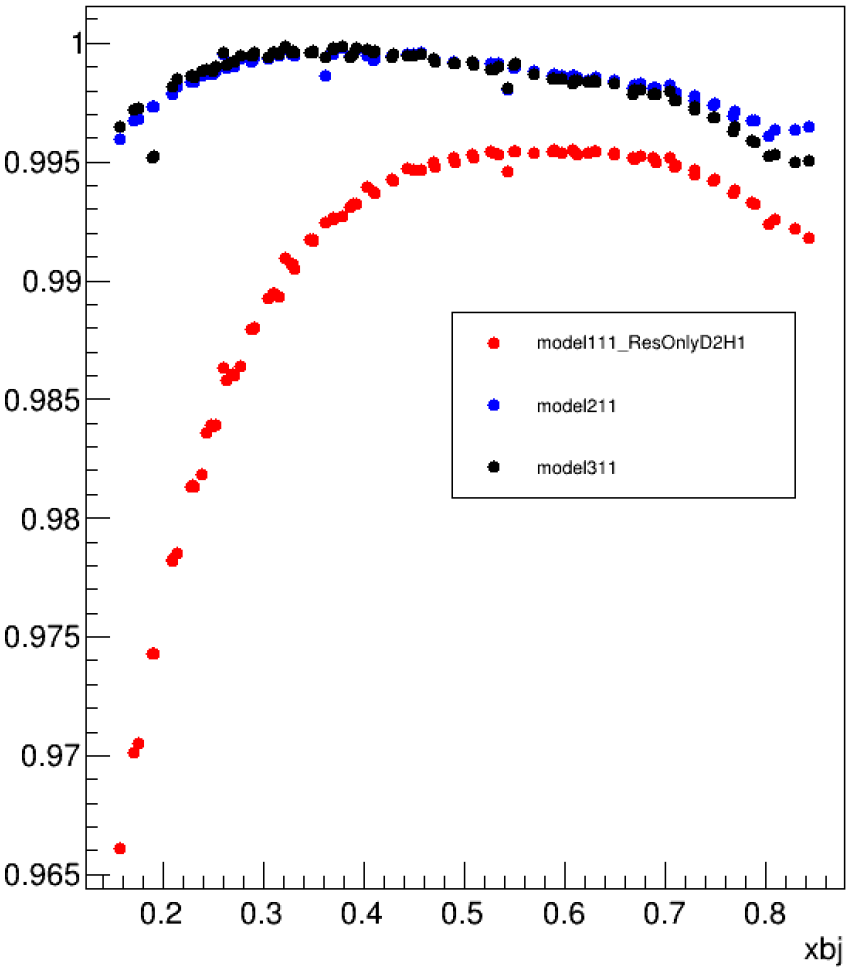
- model211: NMC 1995 (no Resonance) equation (2) in hep-ph/9509406
- model 311: NMC 1992 include Δ_{1232} in F_2: (A.1) and (B.1) in Nucl. Physics. B 371(1992) 3-31

  In principle, model 211 is similar to model111_noResAll, and model 311 is similar to model111;

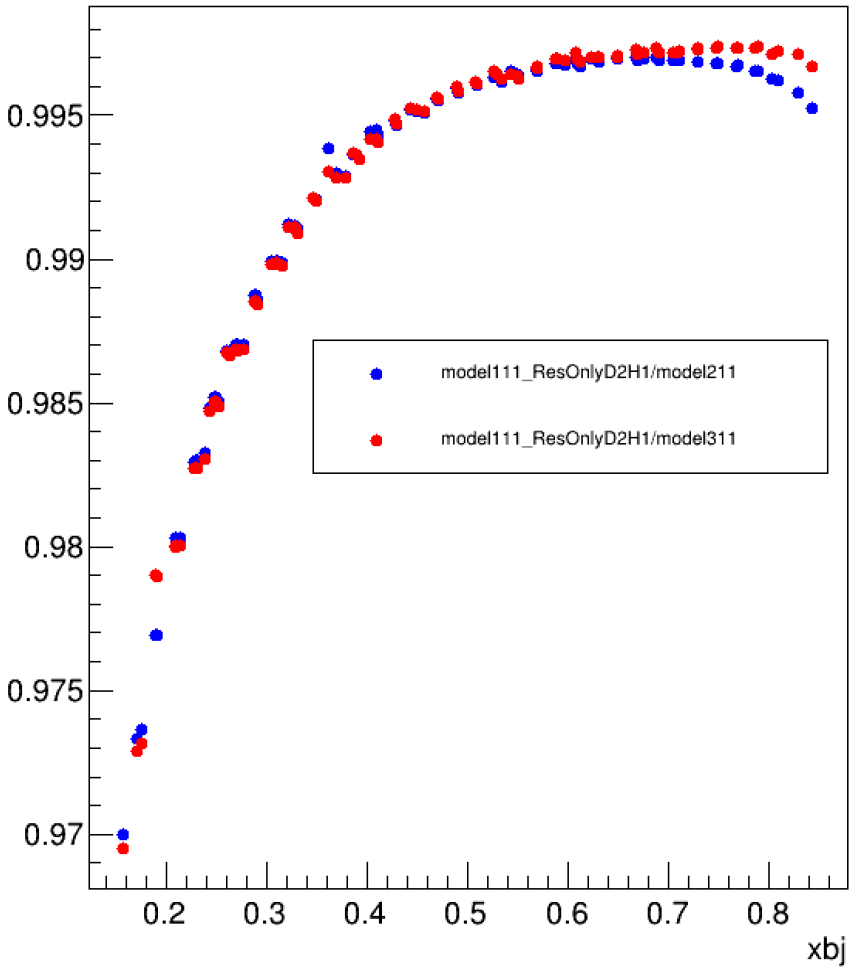

Dp RC=born/rad ratio
model111
model211
model311
1.04
1.035
1.03
1.025
1.02
1.015
0.15
0.2
0.25
0.3
0.35
0.4
xbj


D/p RC ratio between models
model111/model211
model111/model311
1.002
1.0015
1.001
1.0005
1
0.9995
0.999
0.9985
0.998
0.15
0.2
0.25
0.3
0.35
0.4
xbj

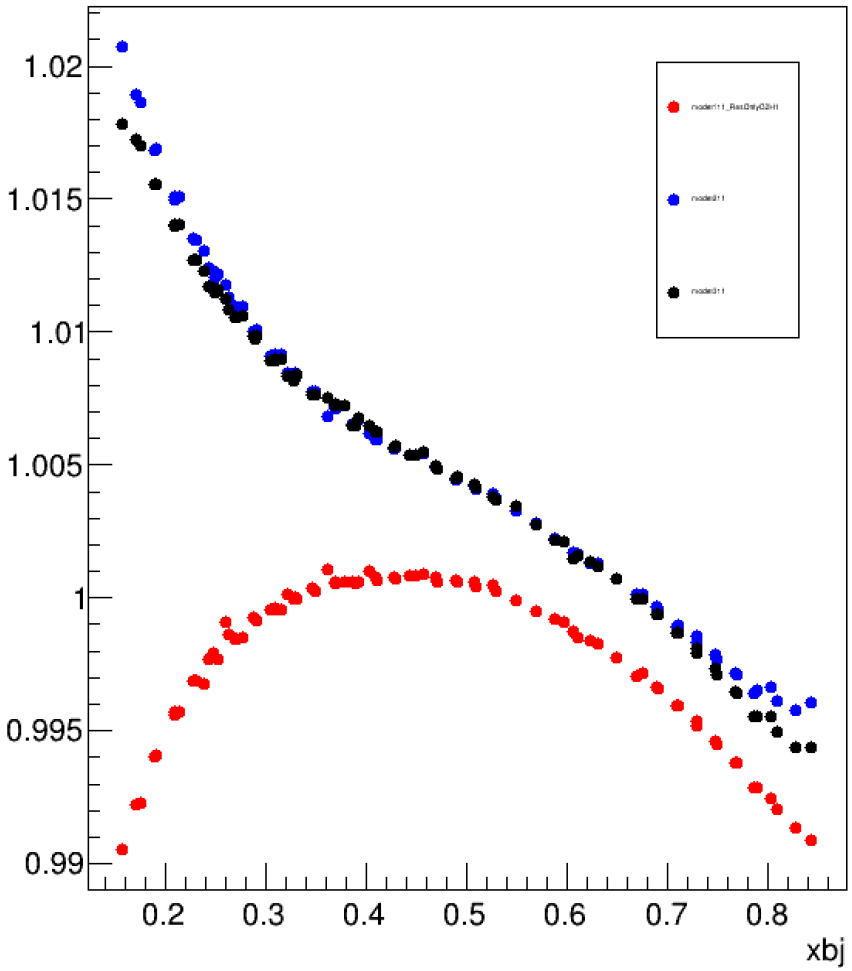
HeD RC=born/rad ratio



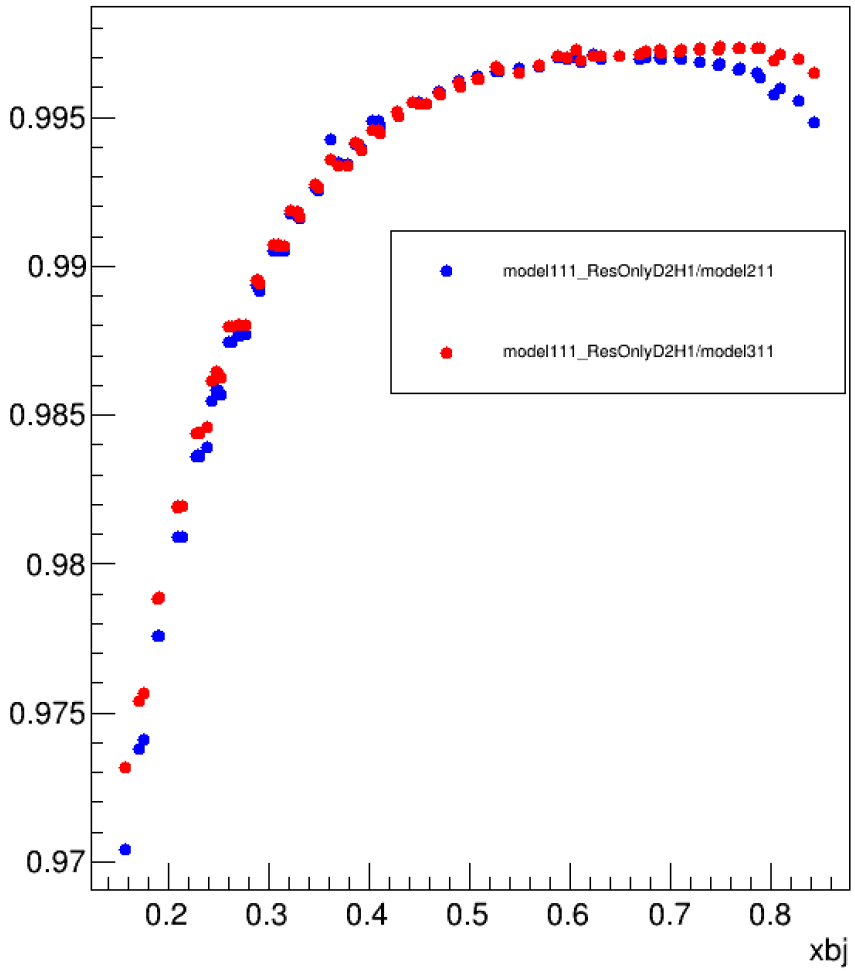
He3/D RC ratio between models

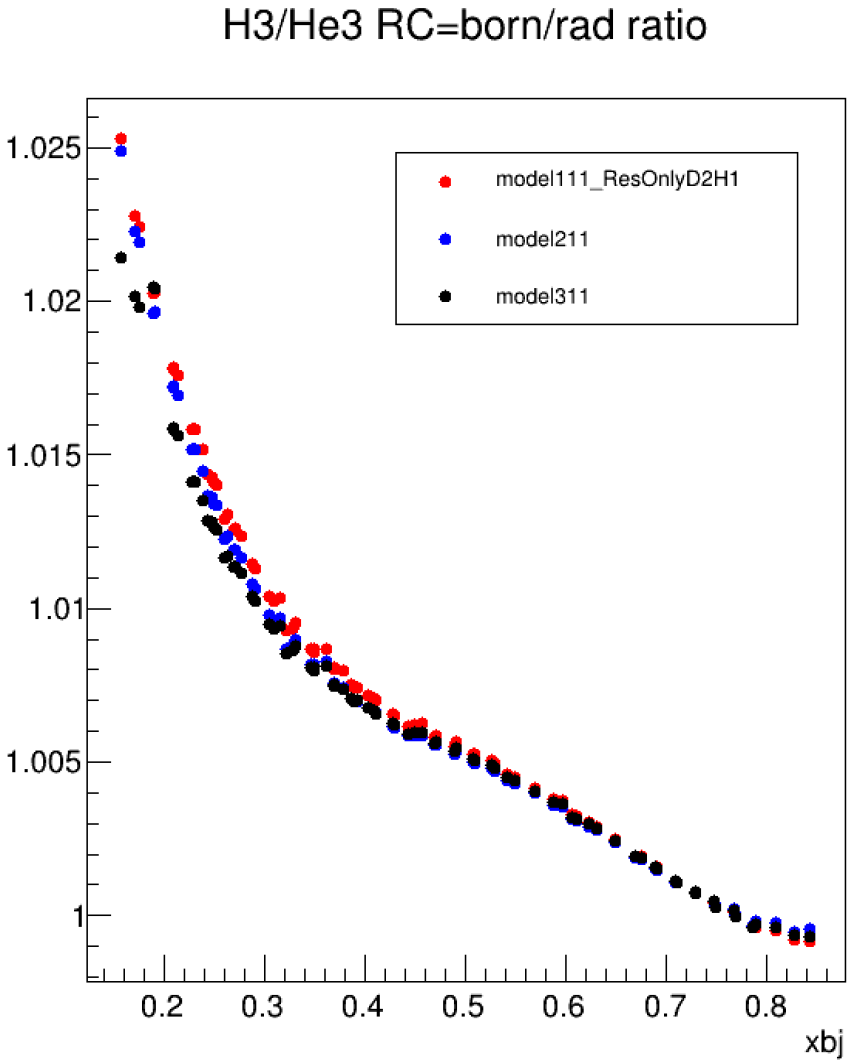


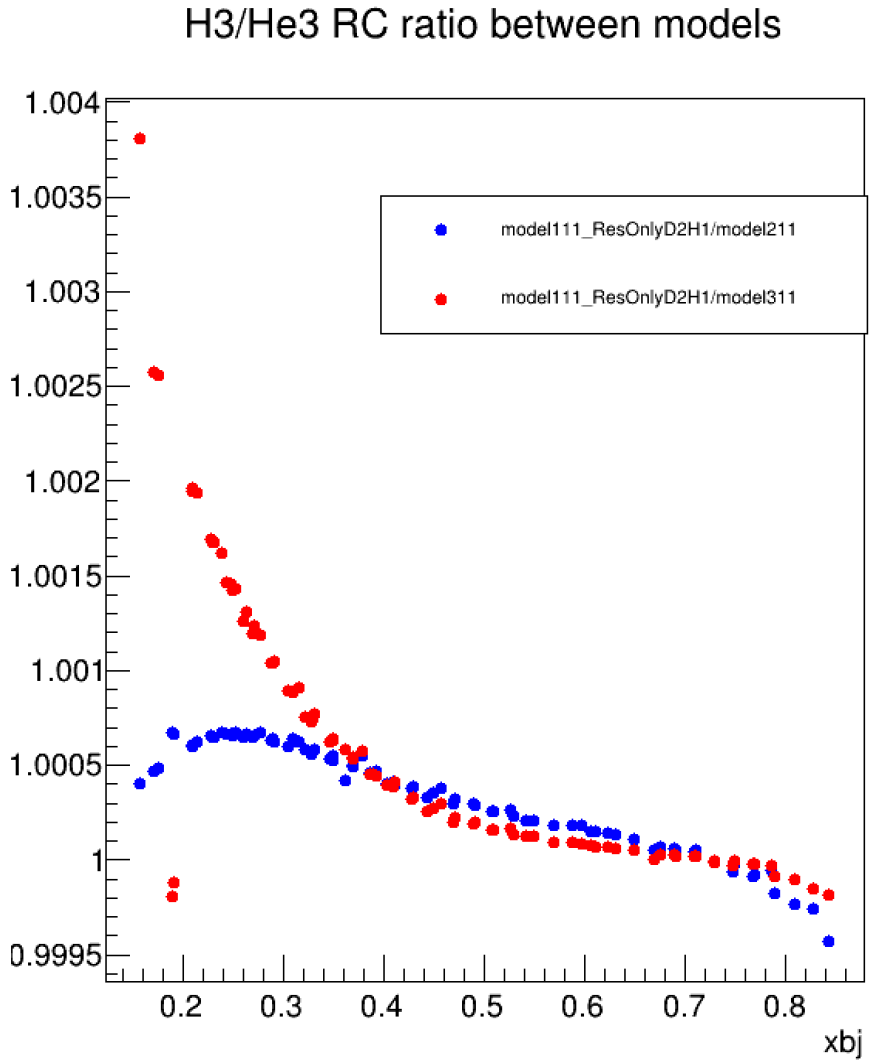
H3/D RC=born/rad ratio



H3/D RC ratio between models



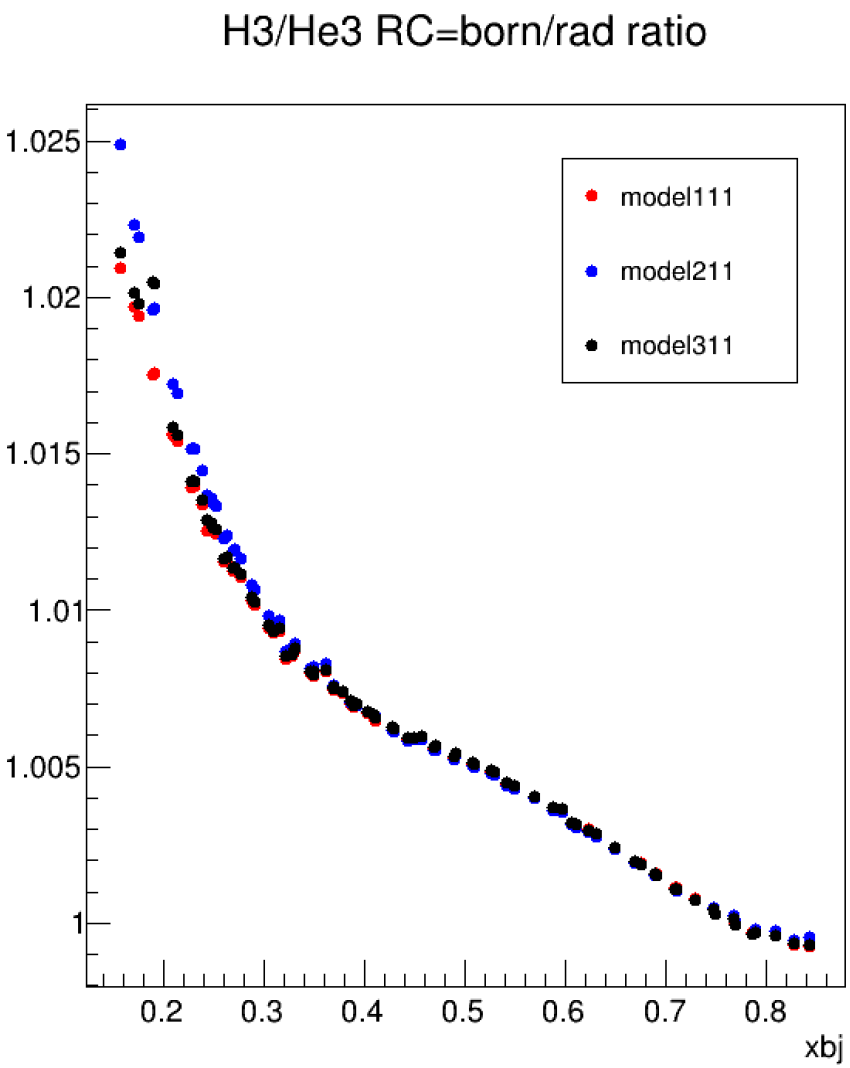

H3/He3 RC=born/rad ratio
model111_ResOnlyD2H1
model211
model311
1.025
1.02
1.015
1.01
1.005
1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
xbj

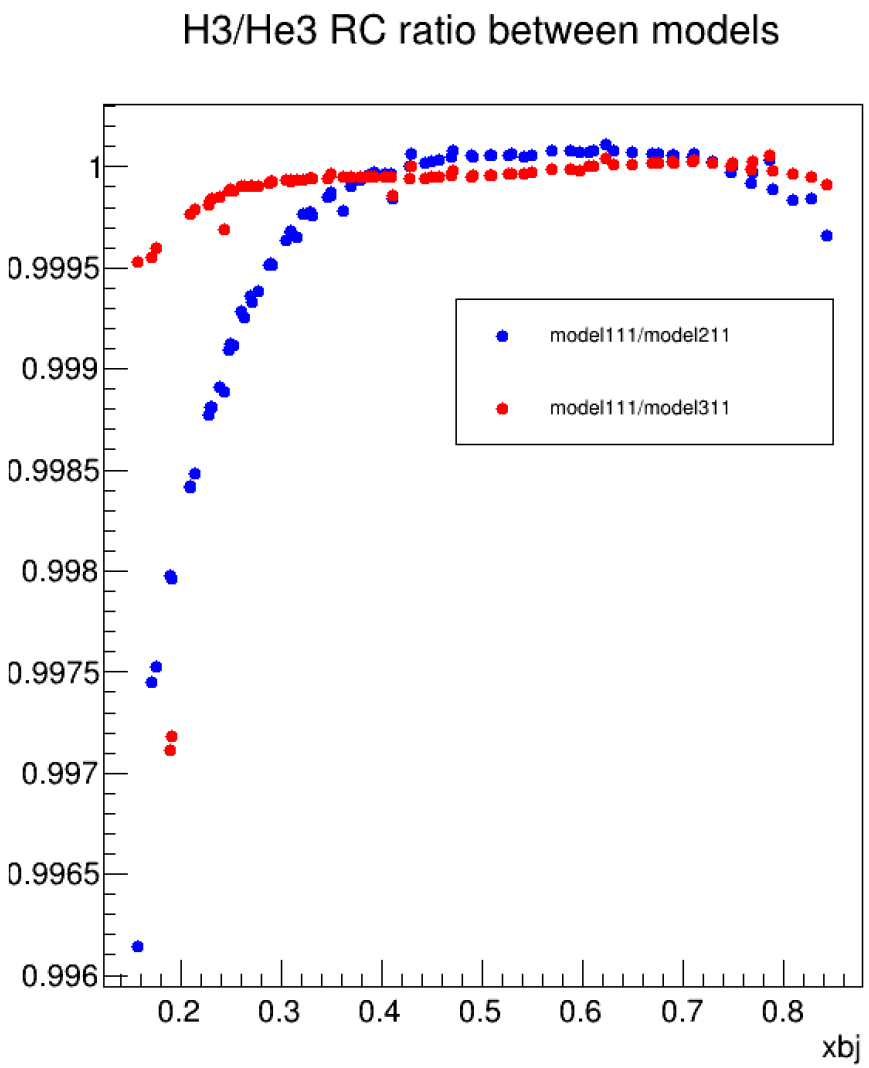

H3/He3 RC ratio between models
model111_ResOnlyD2H1/model211
model111_ResOnlyD2H1/model311
1.004
1.0035
1.003
1.0025
1.002
1.0015
1.001
1.0005
1
0.9995
0.2
0.3
0.4
0.5
0.6
0.7
0.8
xbj

Conclusions

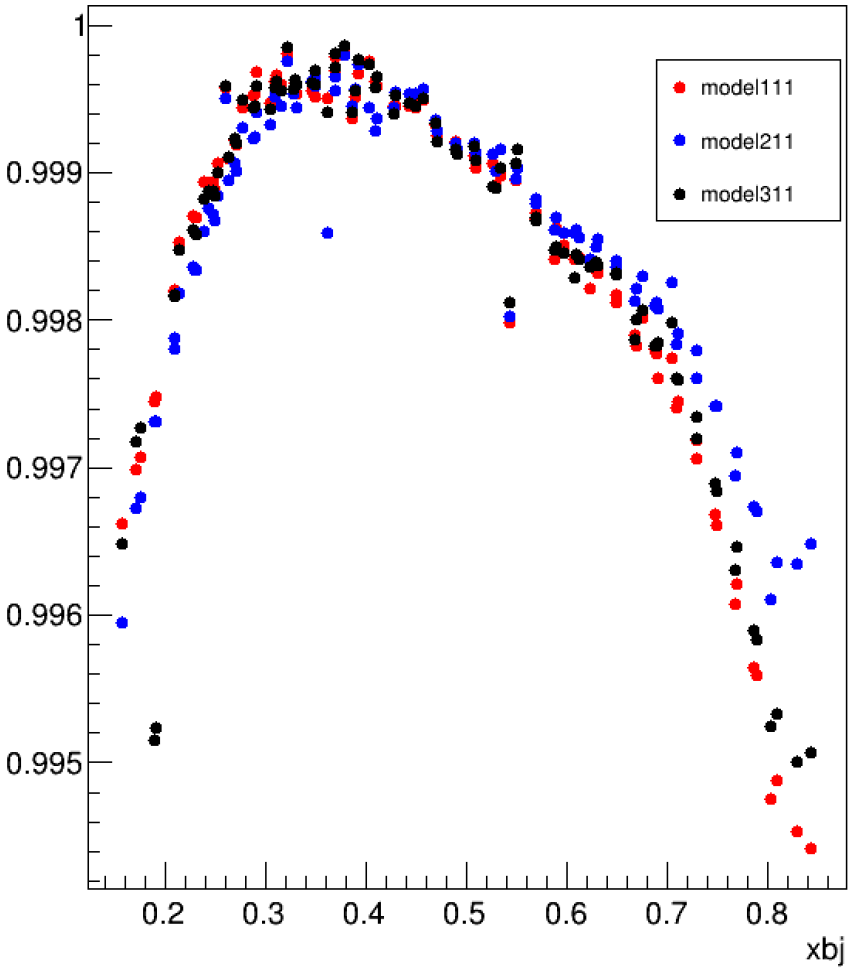
- D/p comparison between model111 and model 211 shows 0.2% difference. So including one Δ_{1232} resonance seems enough;
- Comparison on He3/D between model111_noResAll and model211 or model311 show 3% difference at low x, which consistent with previous comparison;
- In principle, the H3/He gotten from model211 and model111_noResAll should be similar. The difference on H3/He3 is within 0.1%
- **The RC from different F_2^D models cause very small deviations on ratios. But we need to make decision whether or not keep resonance in He3 and H3**

backup

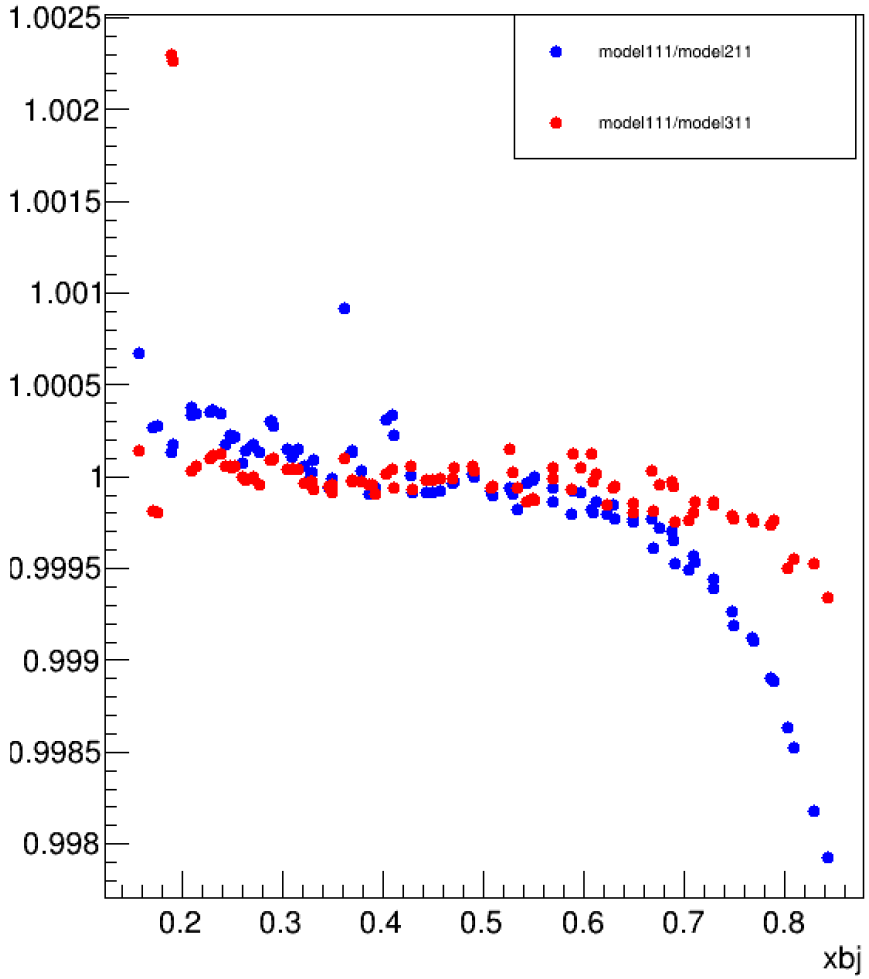

H3/He3 RC=born/rad ratio
model111
model211
model311
1.025
1.02
1.015
1.01
1.005
1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
xbj

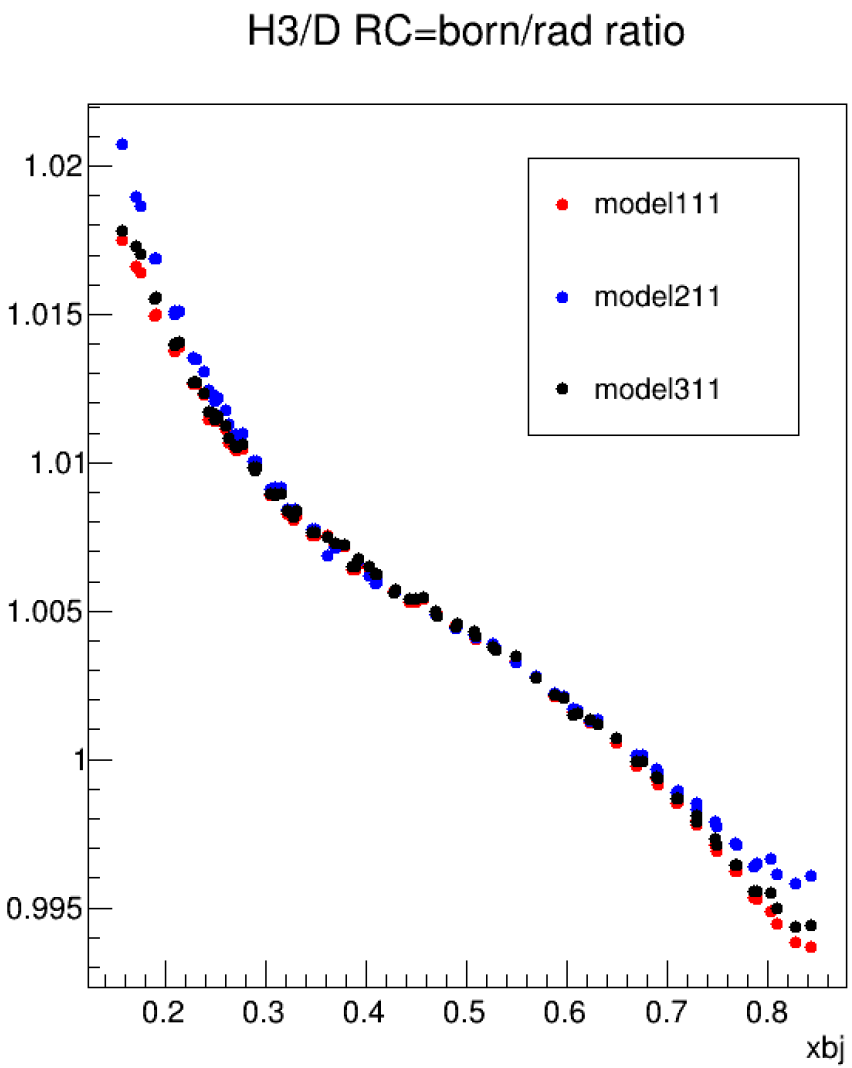

H3/He3 RC ratio between models
model111/model211
model111/model311
1
0.9995
0.999
0.9985
0.998
0.9975
0.997
0.9965
0.996
0.2
0.3
0.4
0.5
0.6
0.7
0.8
xbj

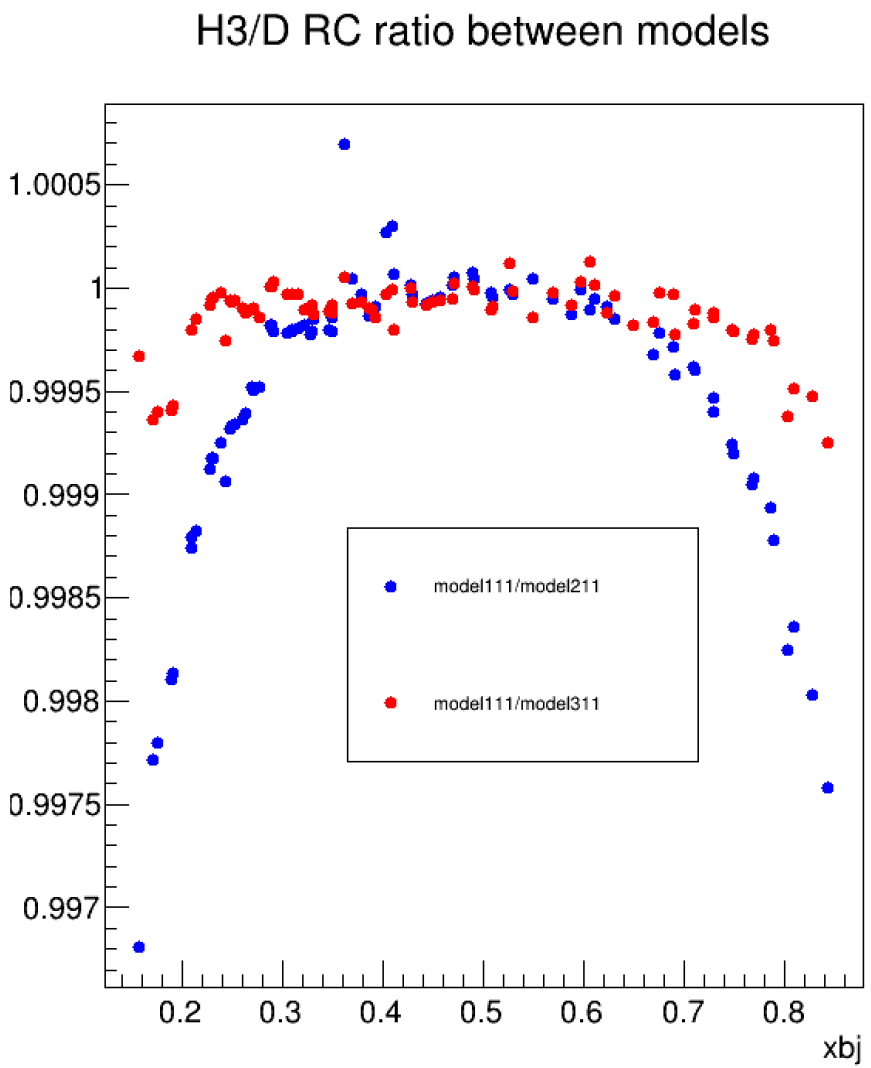
HeD RC=born/rad ratio



He3/D RC ratio between models




H3/D RC=born/rad ratio
model111
model211
model311
1.02
1.015
1.01
1.005
1
0.995
0.2
0.3
0.4
0.5
0.6
0.7
0.8
xbj


H3/D RC ratio between models
model111/model211
model111/model311
1.0005
1
0.9995
0.999
0.9985
0.998
0.9975
0.997
0.2
0.3
0.4
0.5
0.6
0.7
0.8
xbj