Radiative Correction Package: “T2_external”

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What is included:

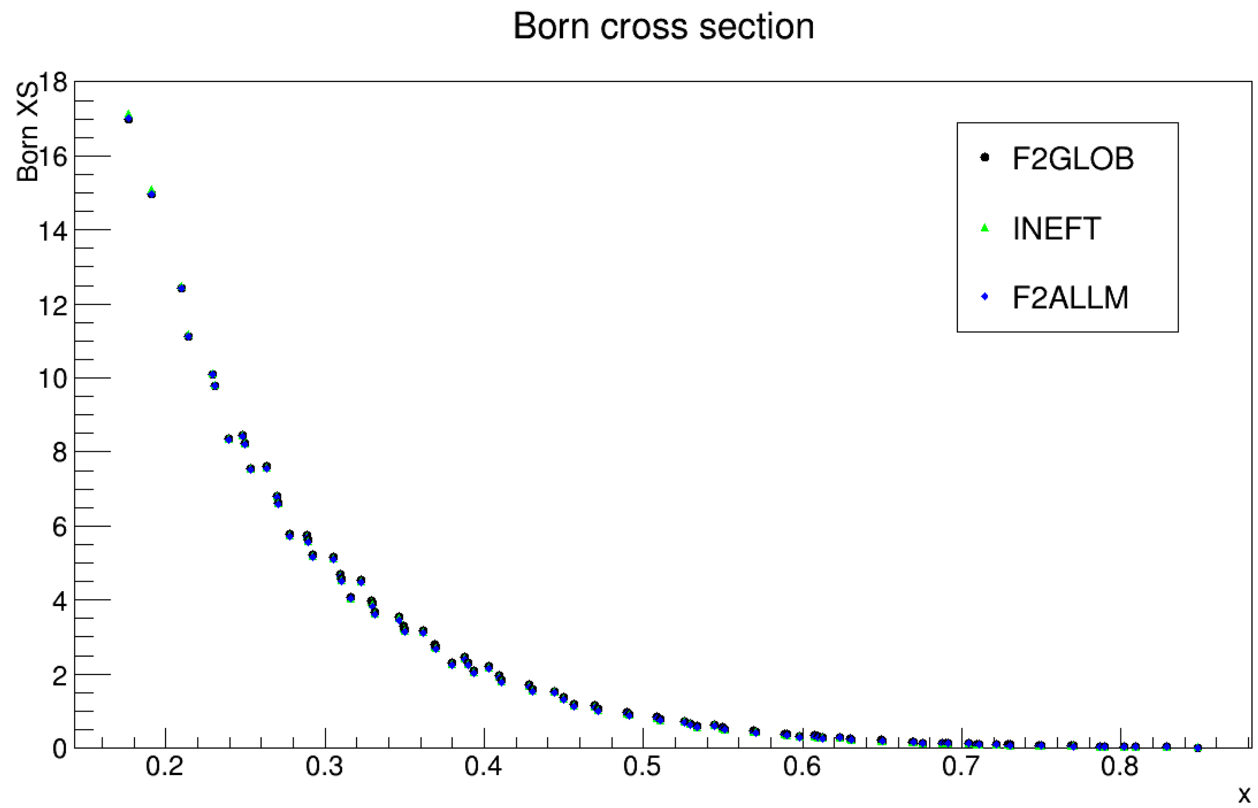
1. Coulomb correction is included: formulas in Seely's thesis;
2. EMC correction is included: SLAC EMC fit;
3. For radiative correction input F2 structure function, there are multiple models could be used:
   1). DIS models:
   - INEFT: old SLAC structure function model (Atwood, Bodek, et al.);
   - F2GLOB: Whitlow fit;
   - F2ALLM: H. Abramowicz and A. Levy, hep-ph/9712415;
   - F2NMC: F2 from NMC parametrization in Phy Lett. b295159-168;
   - F2NMC_new: F2 from NMC parametrization in CERN_PPE/95-138 Sept 4, 1995; Phys. Lett. B364: 107-115, 1995;
   - F2SMC98: F2 from SMC parametrization;
   - E665

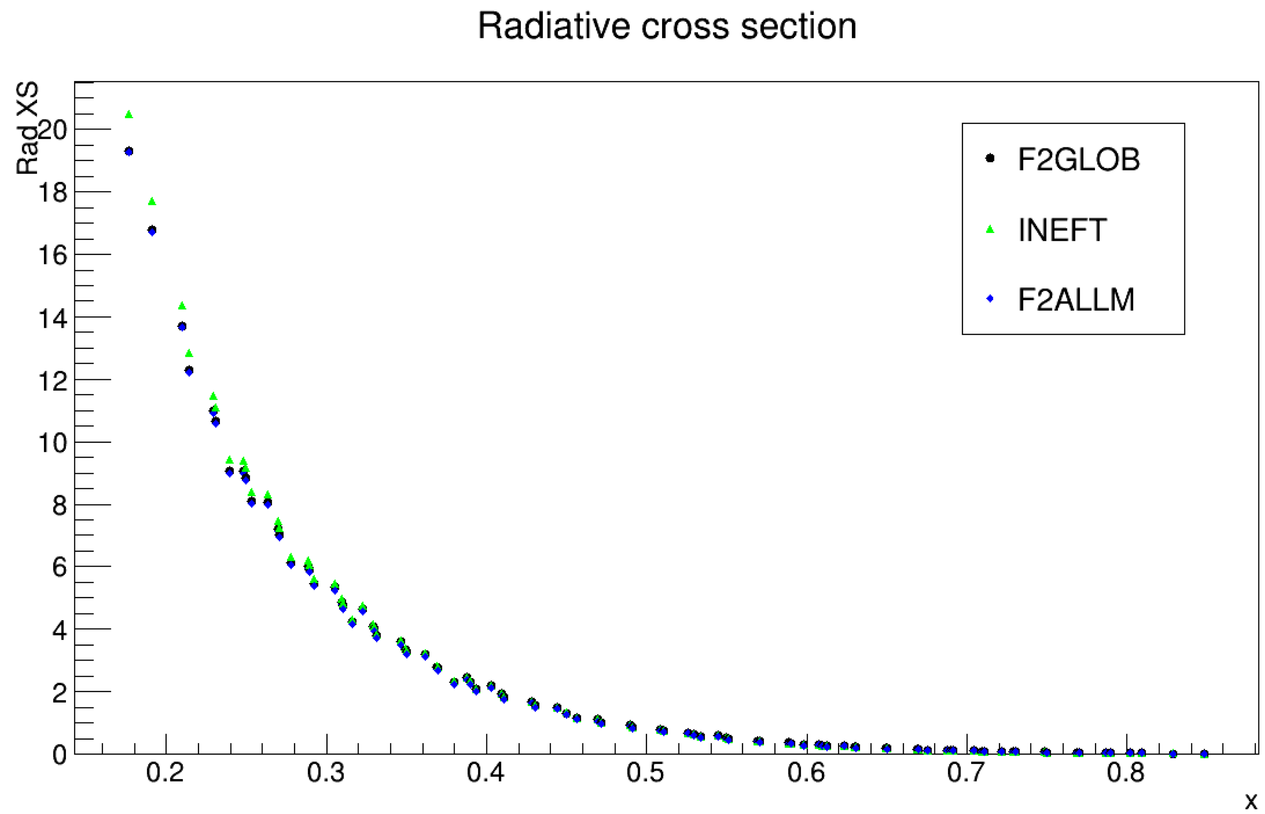
Using INEFT, F2GLOB, F2ALLM for comparison;

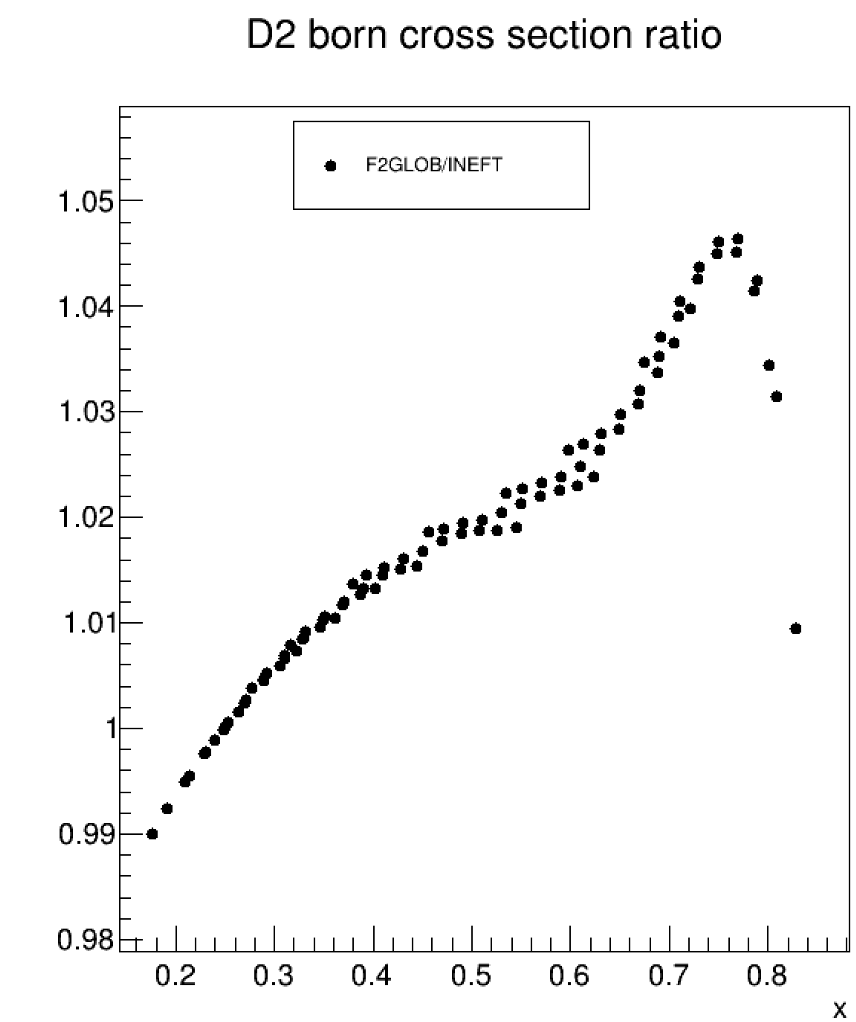
Compare three DIS models:

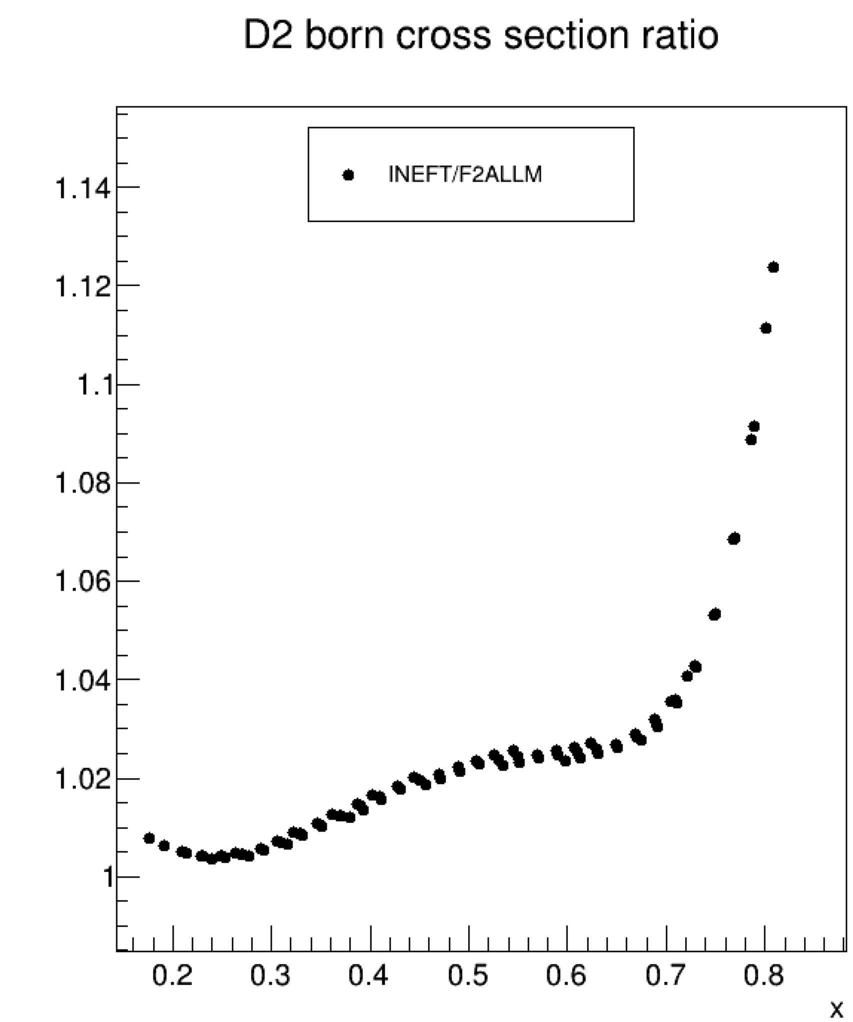
Note: INEFT can be used for both DIS and resonance region, while F2GLOB and F2ALLM are valid at $W^2 > 3\ (\mathrm{GeV})^2$;

- For inelastic tail calculation, in principle, it should be integrated from pion threshold.
- Thus when using INEFT, the W^2 cut for inelastic tail calculation is to be bigger than 1.1664 $(\mathrm{GeV})^2$ while for F2GLOB and F2ALLM, the inelastic tail W^2 cut is 3 $(\mathrm{GeV})^2$ and below 3 $(\mathrm{GeV})^2$, the cross section is set to zero.
- Quasi-elastic model uses F1F2QE09 from P. Bosted and E. Chrity.
- Compare all Deuterium kinematics with xbj range (0.16, 0.85);

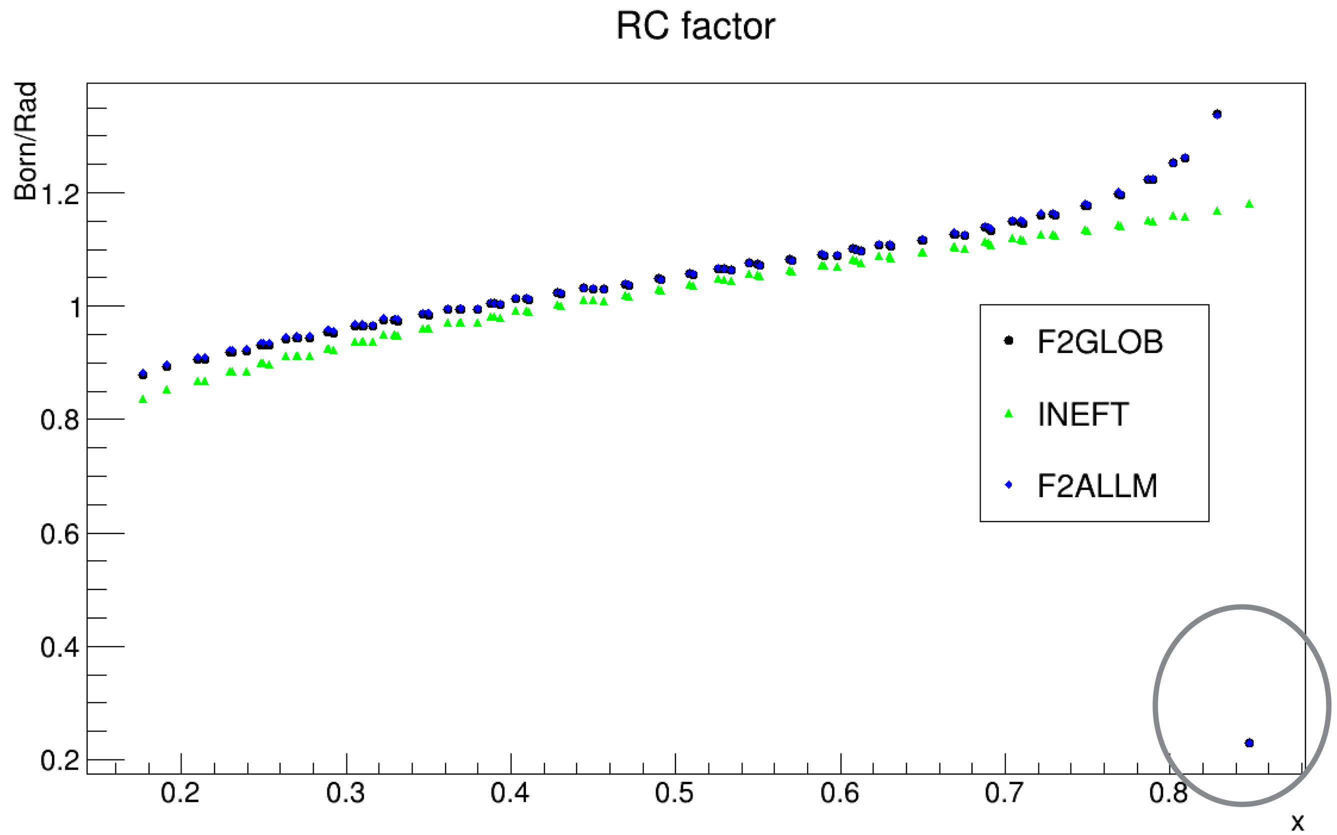






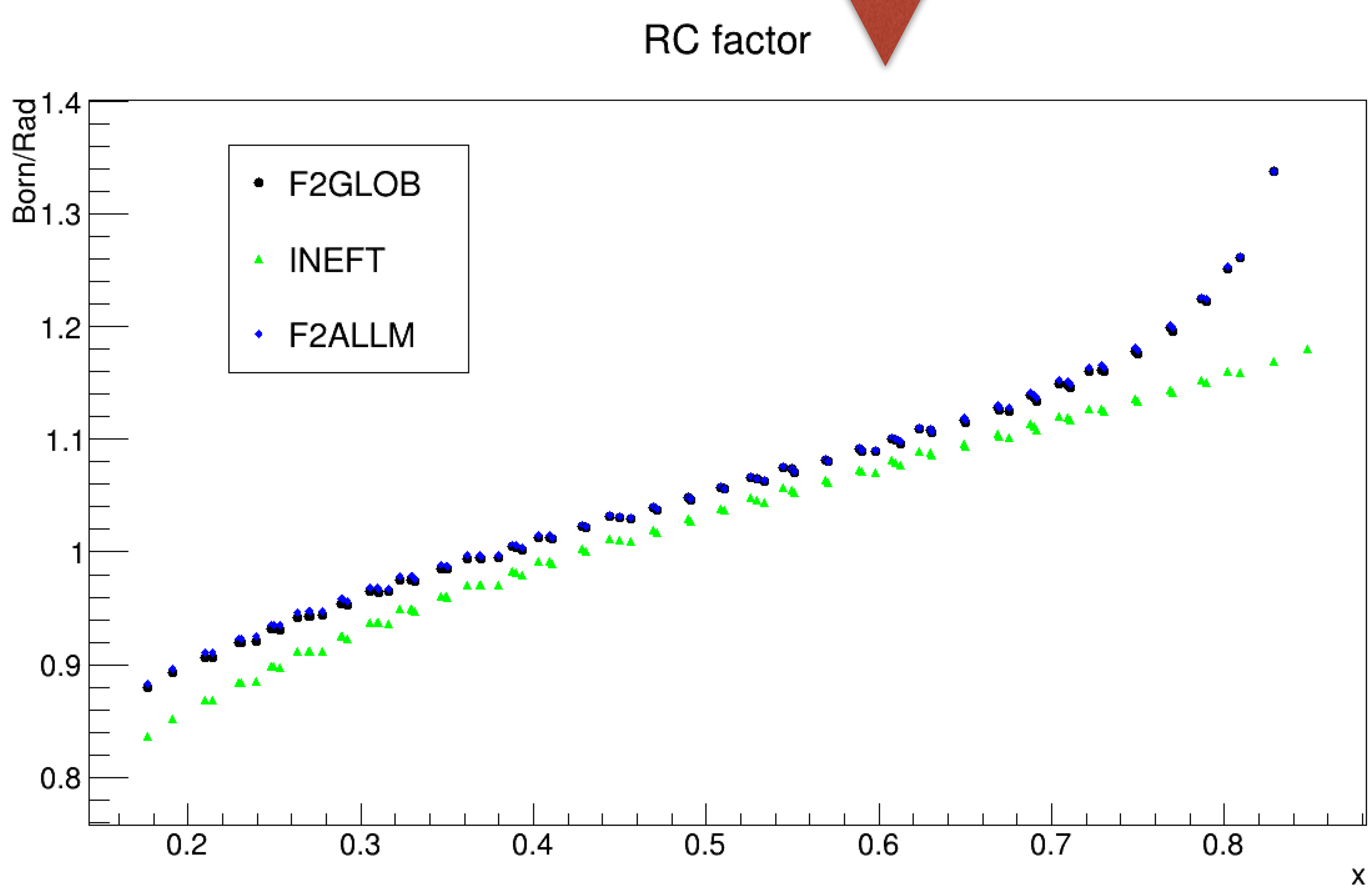


Born cross sections from three models are closed at low x

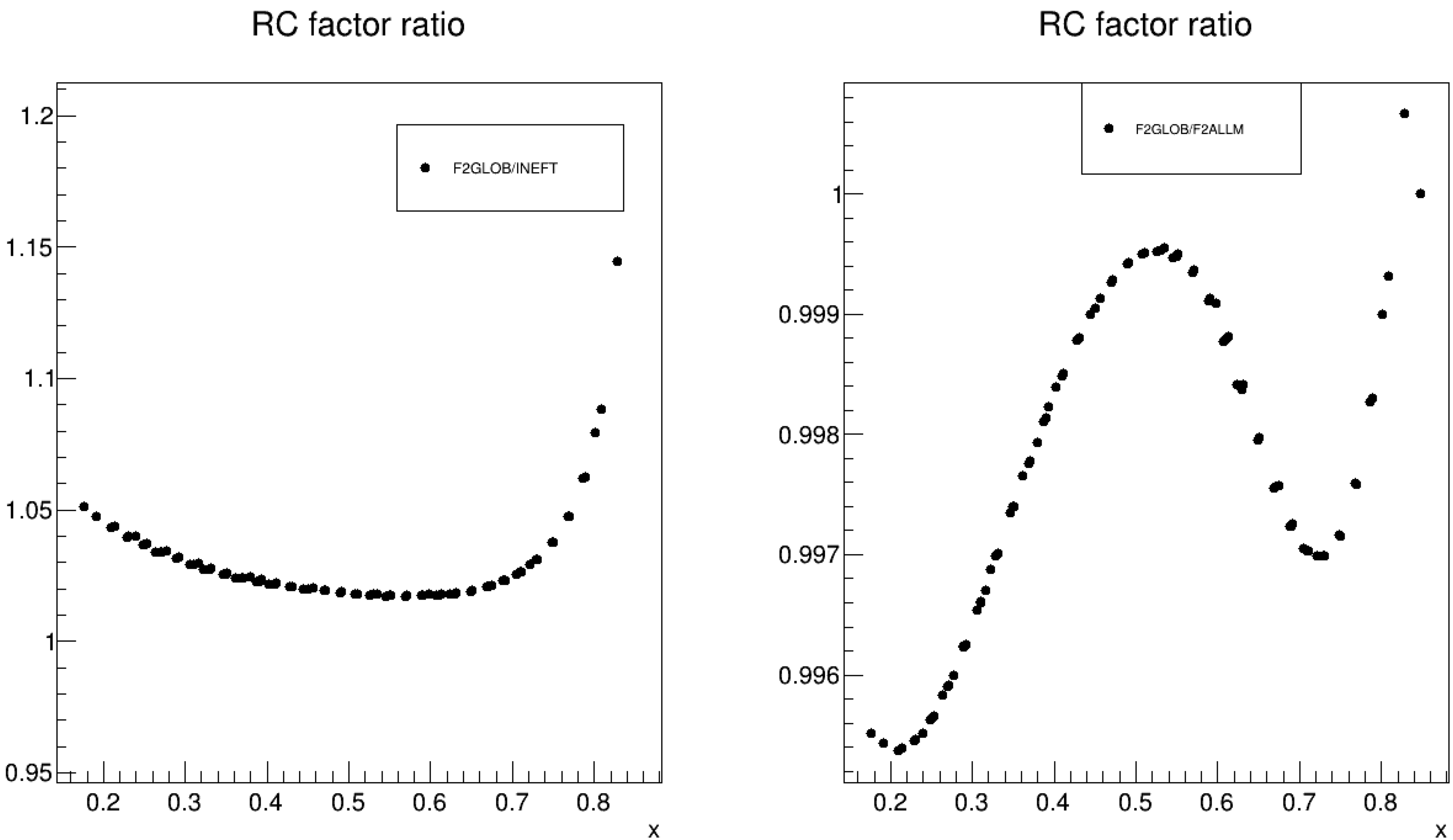


F2ALLM and F2GLOB failed at x=0.85, since the W^2 is slightly less than (3GeV)^2

drop the highest point



$$\text{RC factor ratio} = \frac{\text{F2GLOB RC factor}}{\text{INEFT RC factor}}$$



The difference between Bodek and the other two is that it includes the resonance contribution to the inelastic tail.

Conclusions 1:

1. In DIS region, the born cross sections from INEFT, F2GLOB, F2ALLM are closed;
2. When calculate inelastic tail, INEFT integrates from pion threshold ($W^2 > 1.1664\ (\mathrm{GeV})^2$) while the others are only be able to used when $W^2 > 3\ (\mathrm{GeV})^2$, which causes the RC factor difference;
3. If we want to use F2GLOB (Whitlow fit), I need to include a resonance model to cover the resonance region;

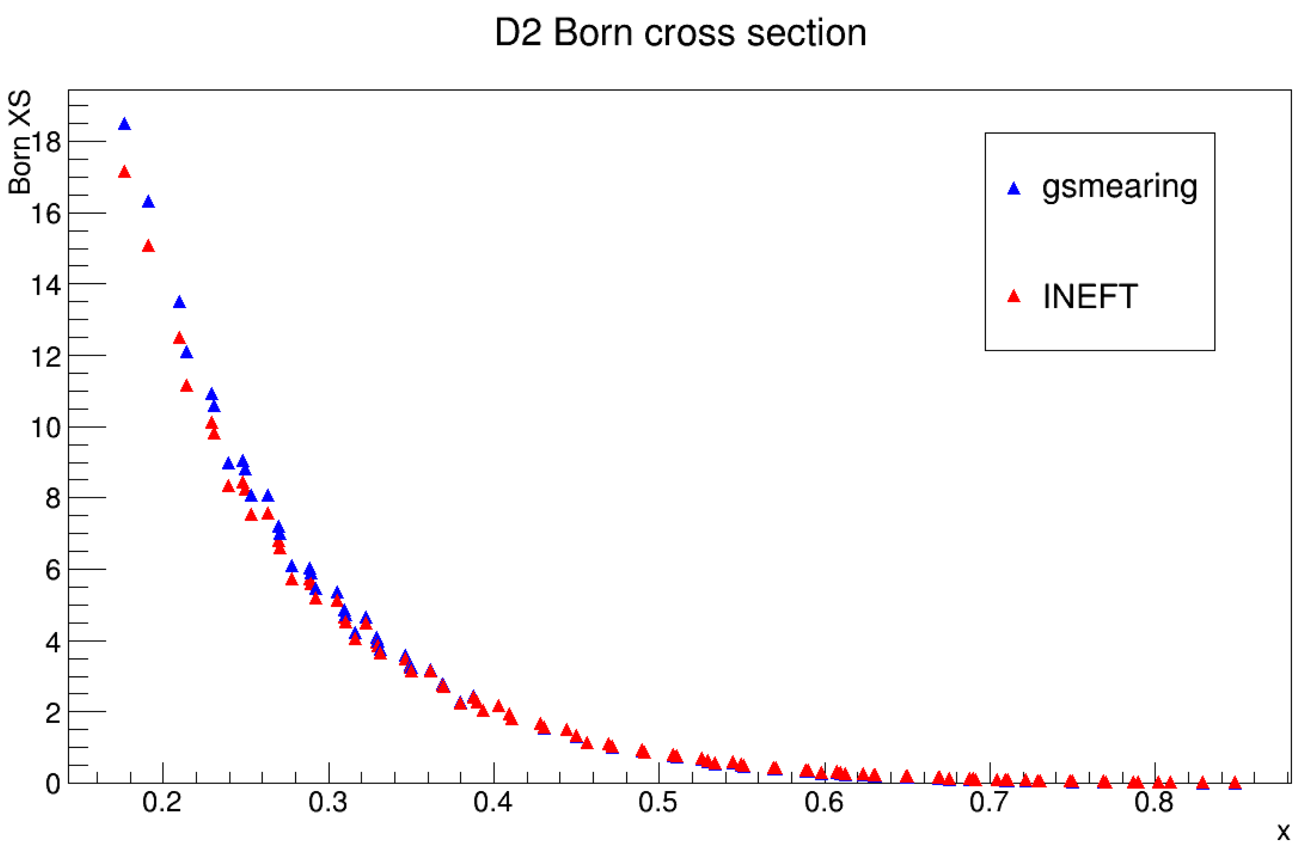
Update

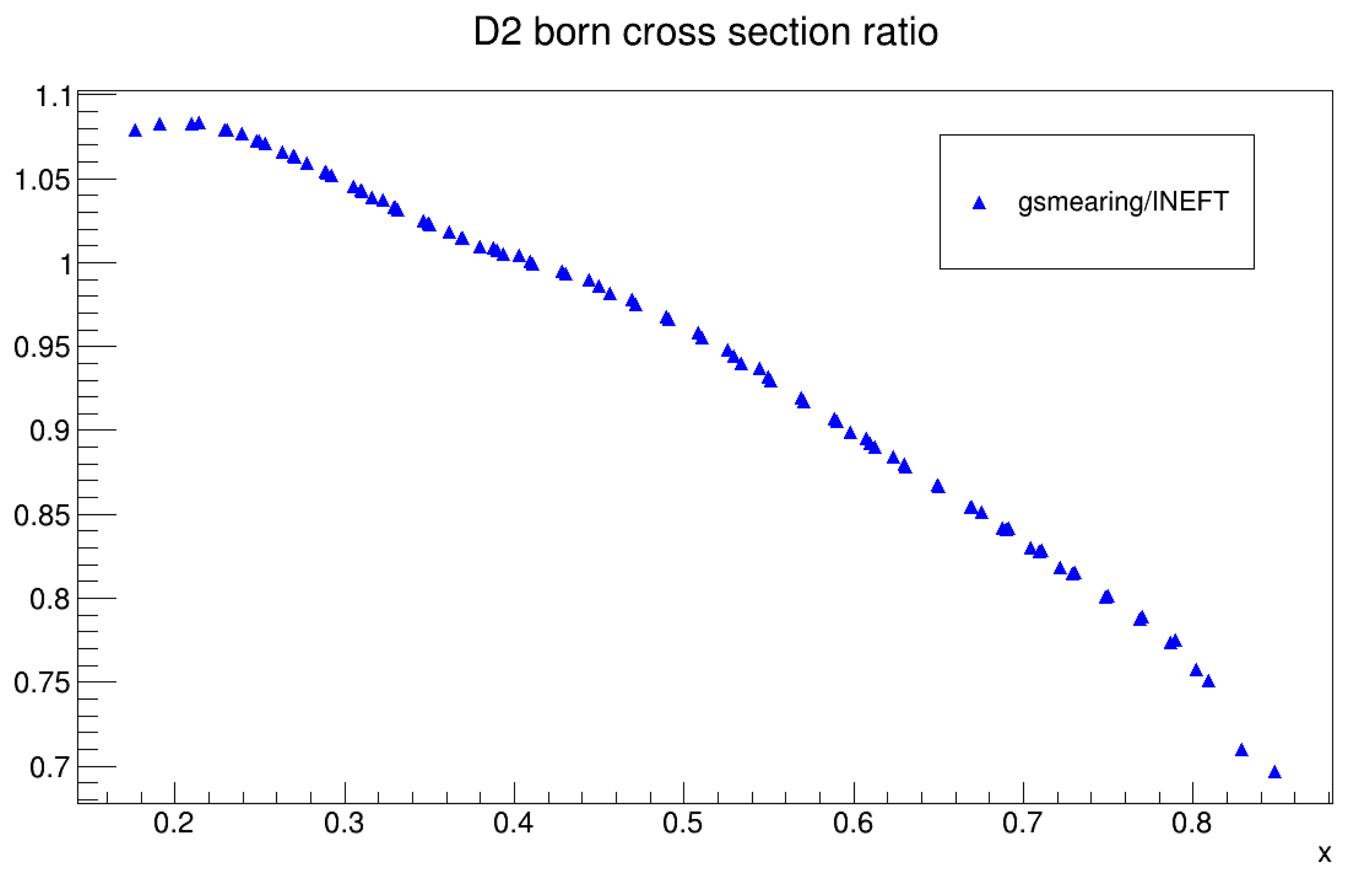
- Dave has imported gsmearing routine into T2_externals:

"gsmearing" is based on Bosted and Christy fit with extended Q2 range;

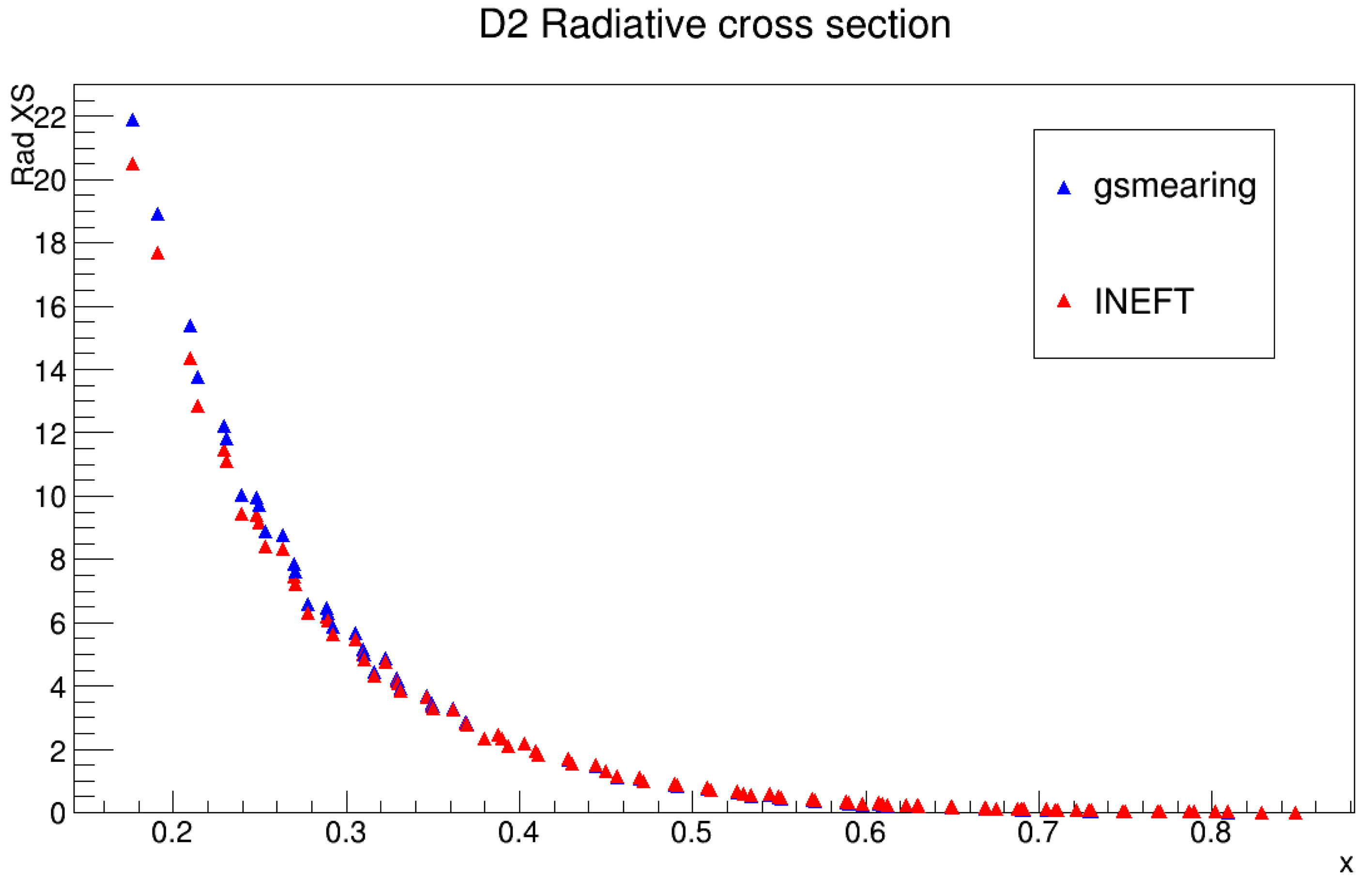
- Both gsmearing and INEFT models include resonance region. The inelastic tail is integrated from pion threshold.

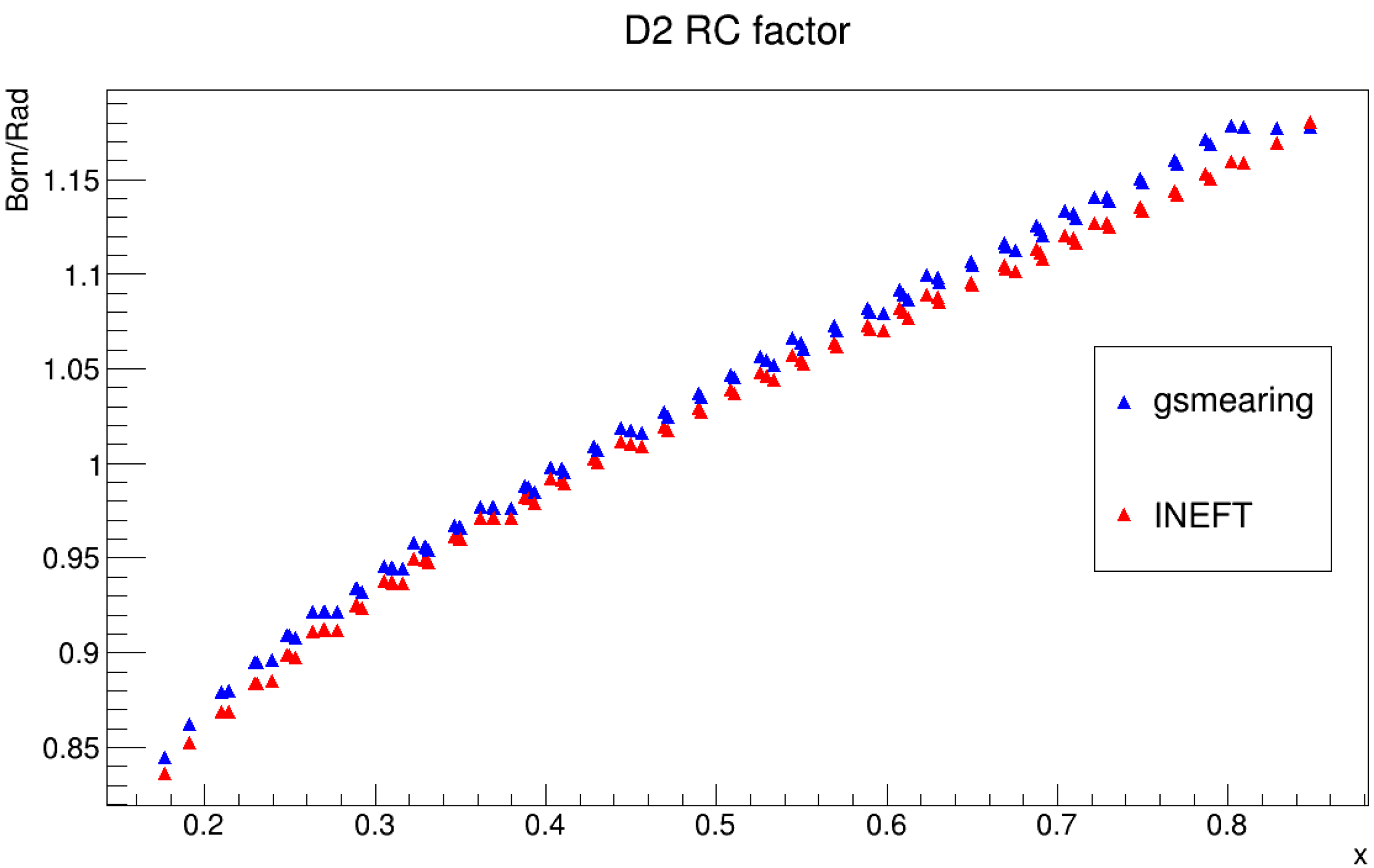
- Following is the born cross section, radiative cross section and the RC factor from "gsmearing" and "INEFT" for H1 , D2, H3, and He3 in Marathon kinematics range



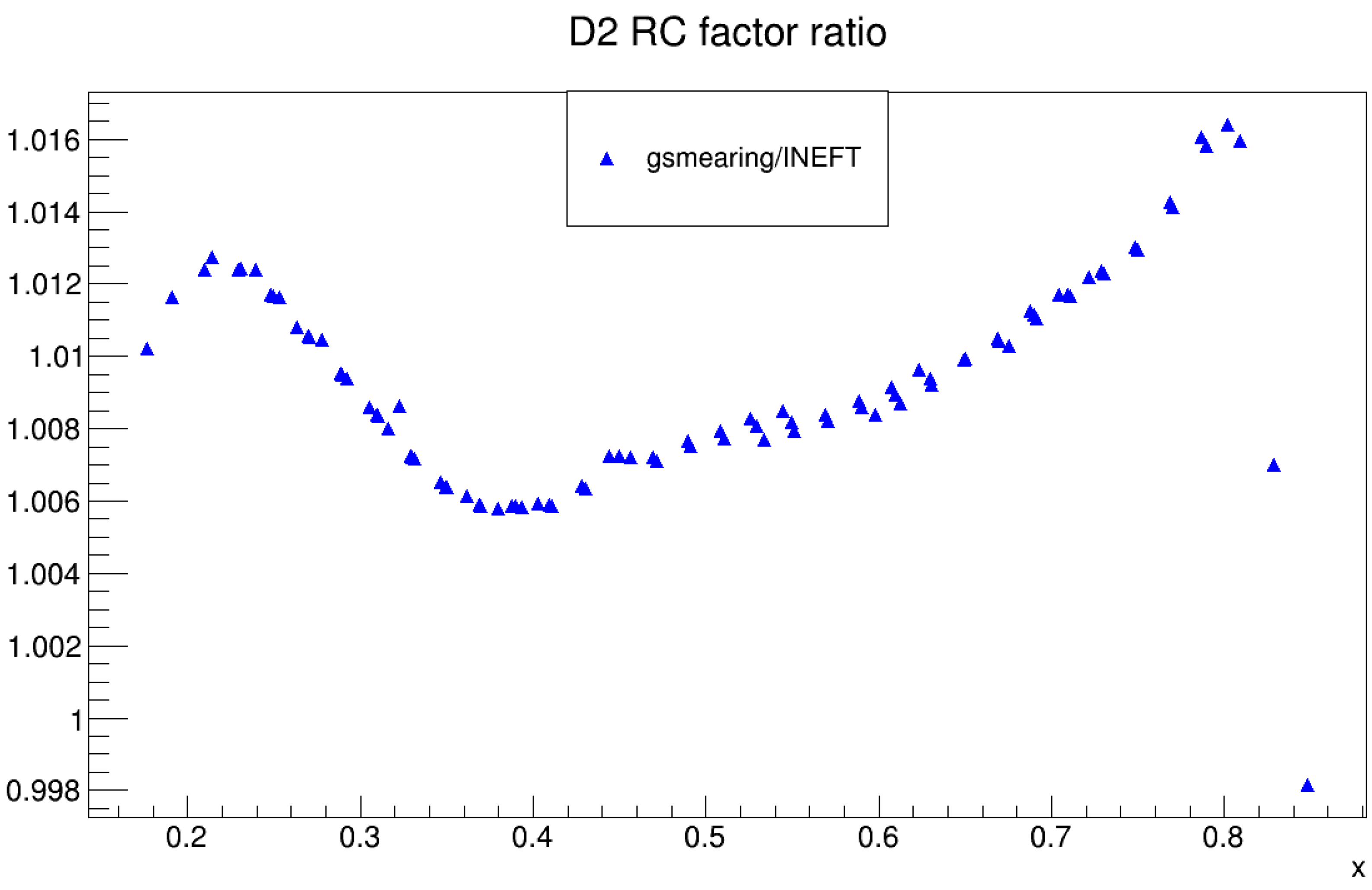


Born cross sections are more different

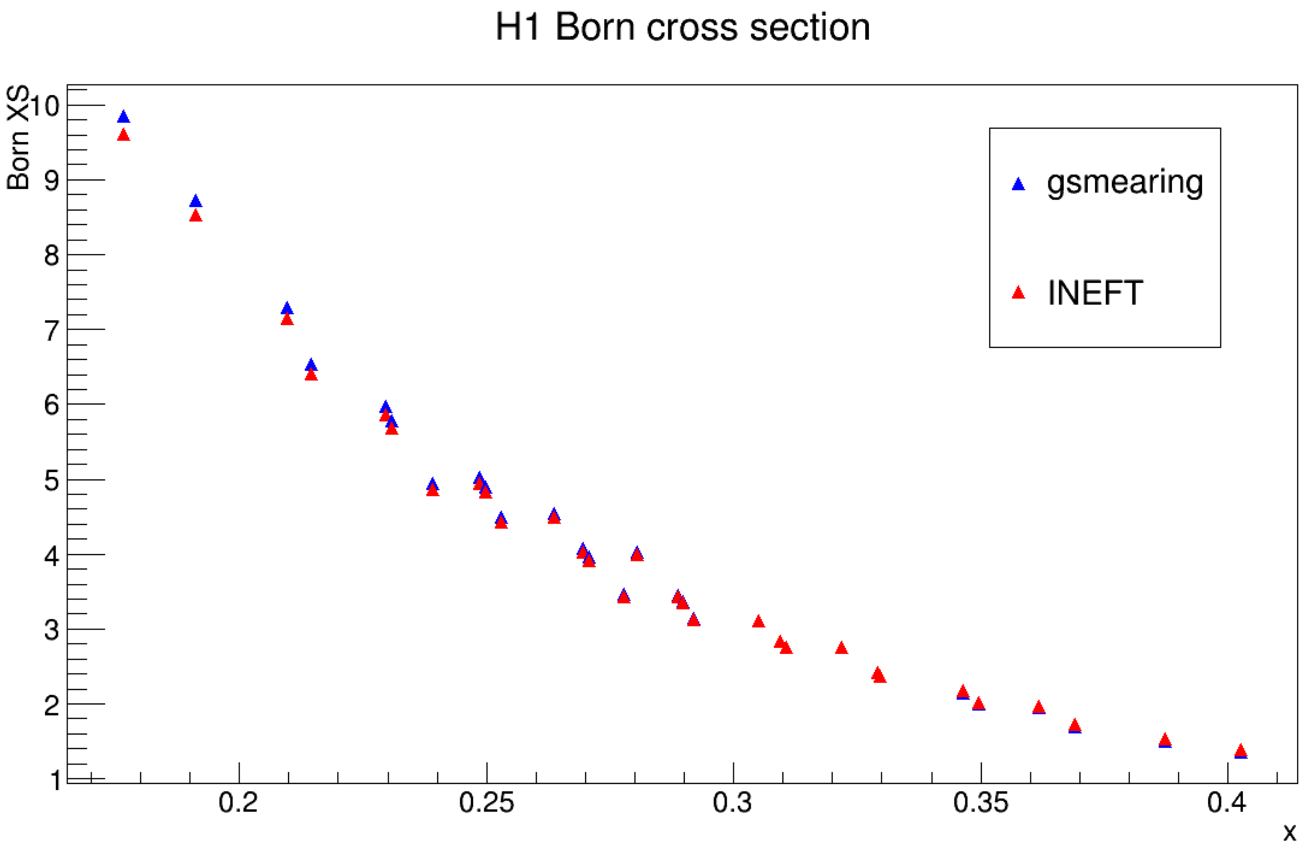


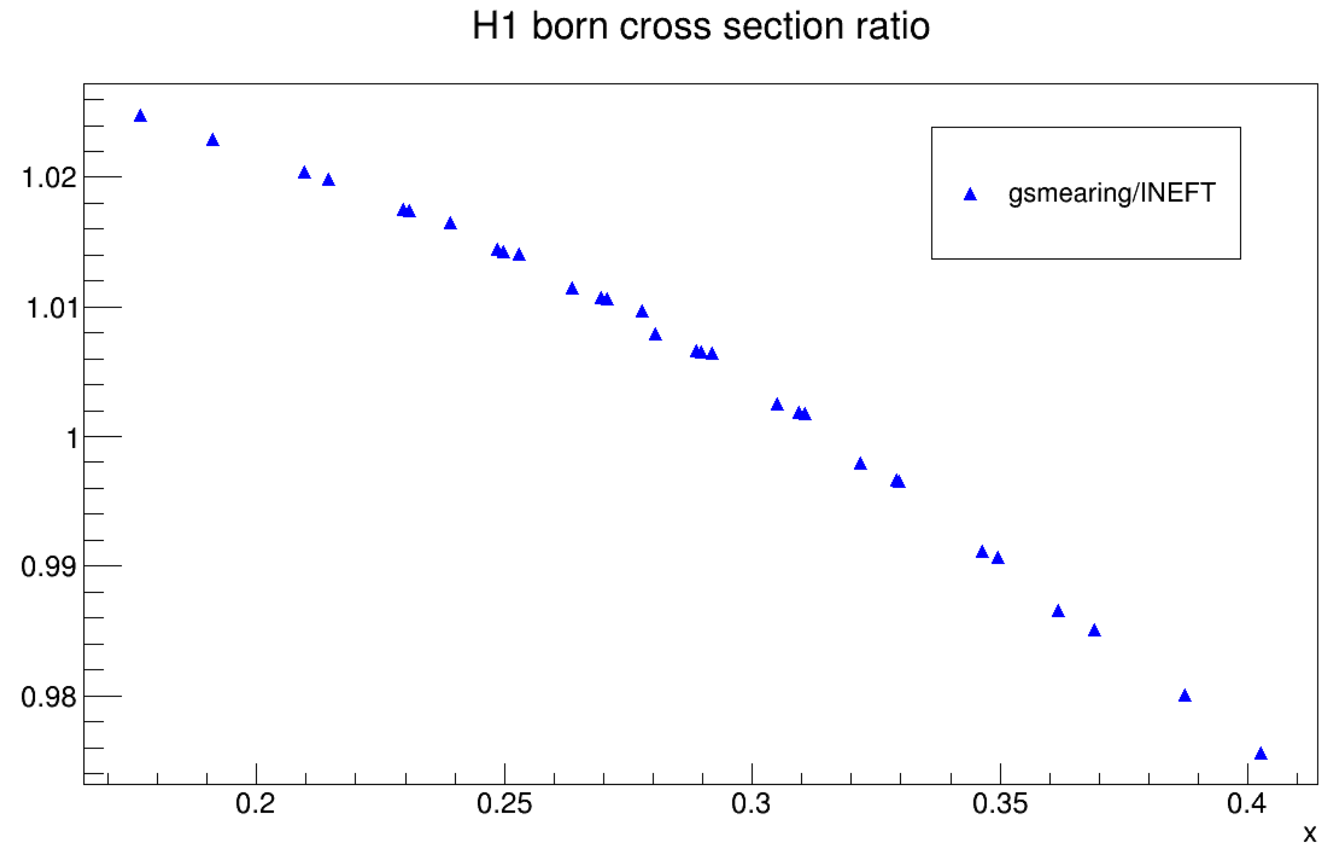


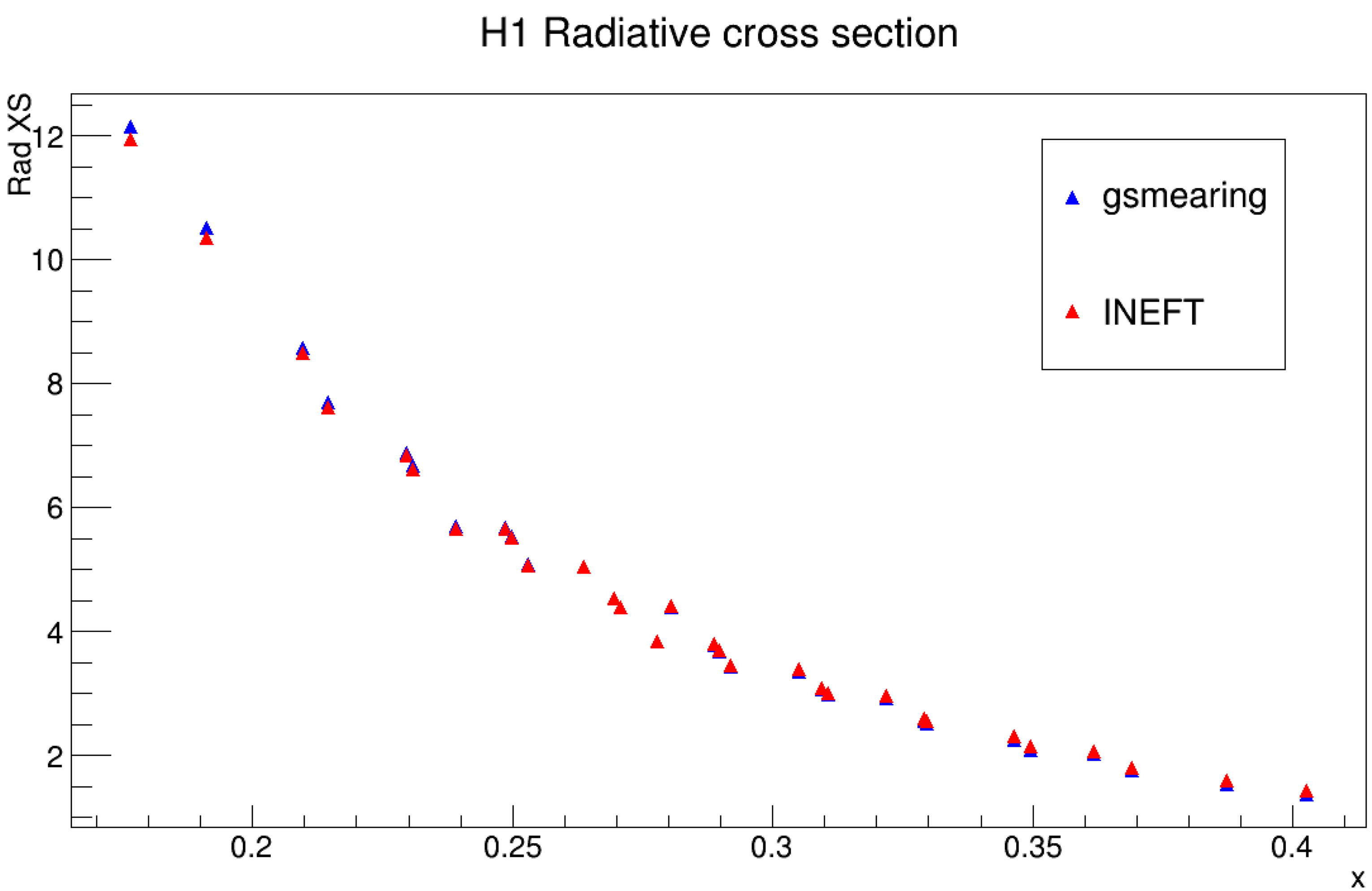
$$\text{RC factor} = \frac{\text{Born cross section}}{\text{Radiative cross section}}$$

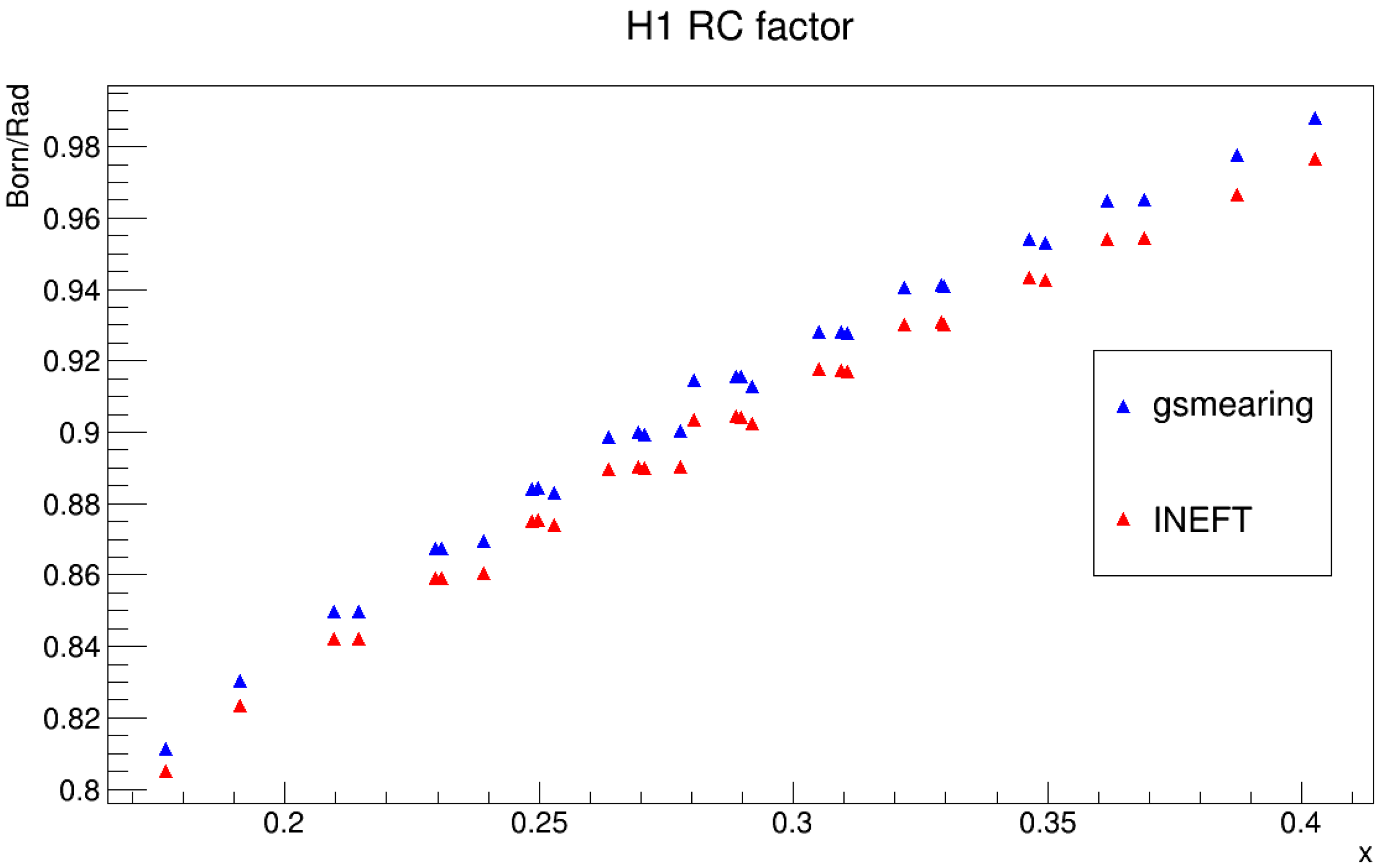


$$\text{RC factor ratio} = \frac{\text{gsmearing RC factor}}{\text{INEFT RC factor}}$$

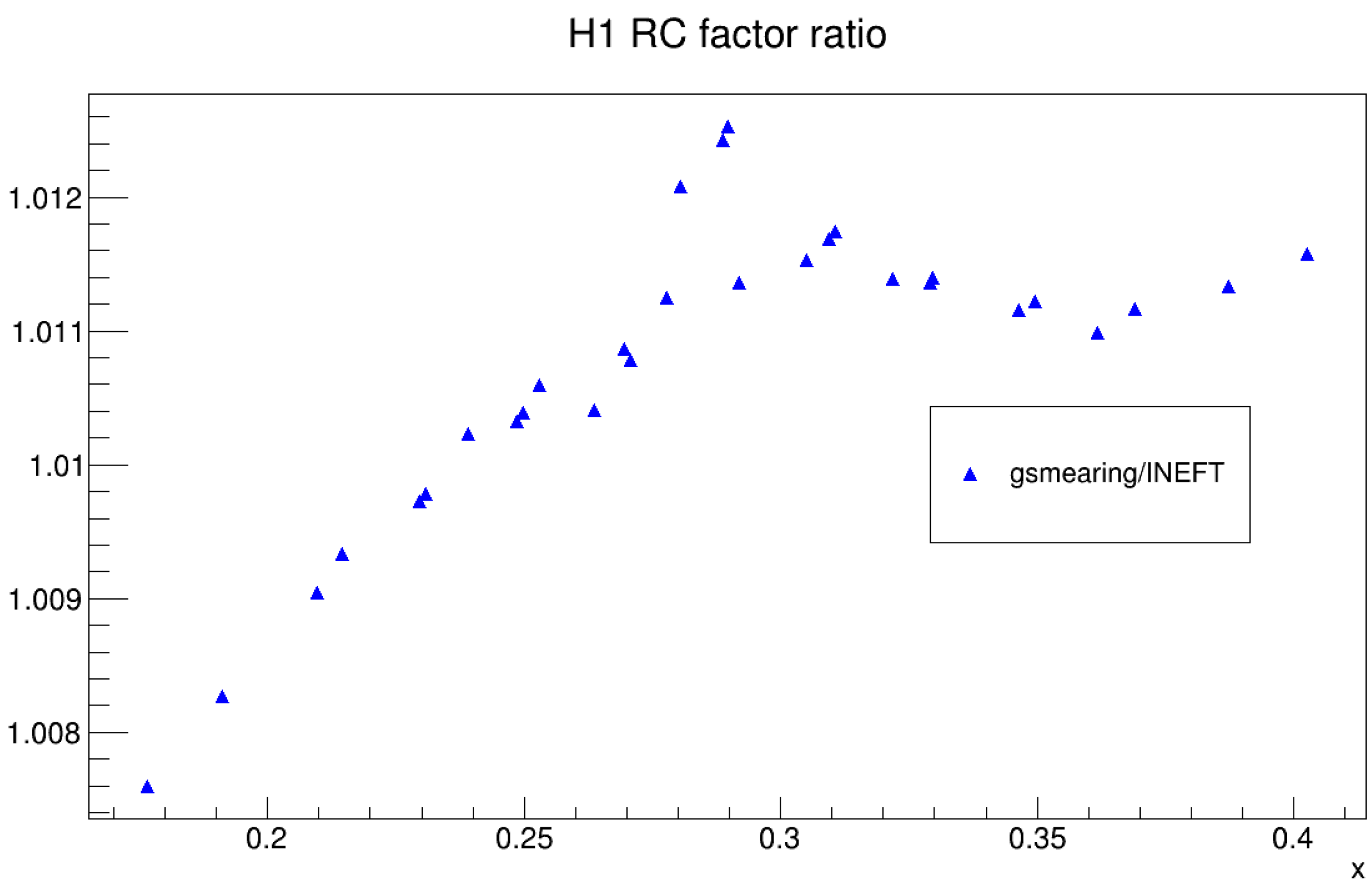

H1 Born cross section
Born XS
x
gsmearing
INEFT


H1 born cross section ratio
x
gsmearing/INEFT


H1 Radiative cross section
Rad XS
x
gsmearing
INEFT



$$\text{RC factor} = \frac{\text{Born cross section}}{\text{Radiative cross section}}$$



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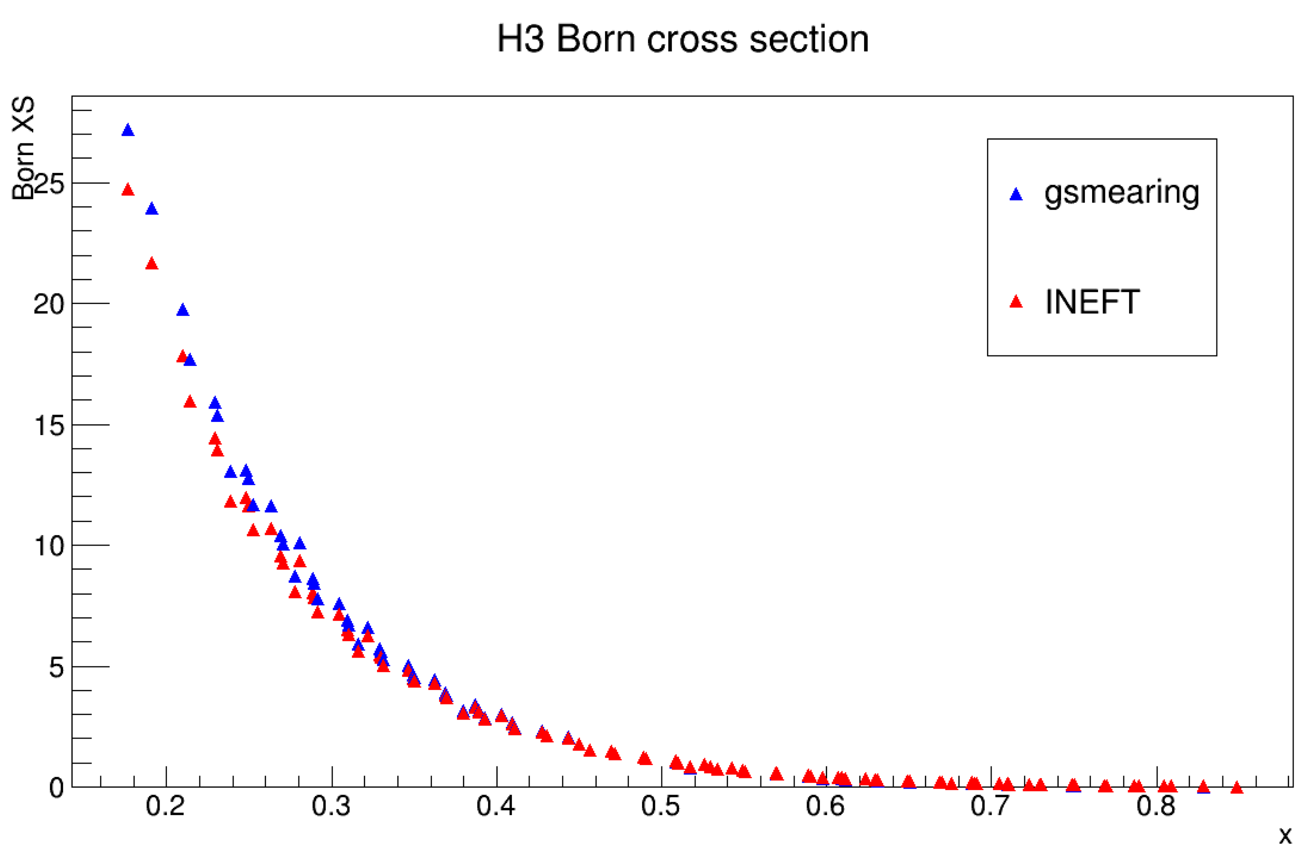
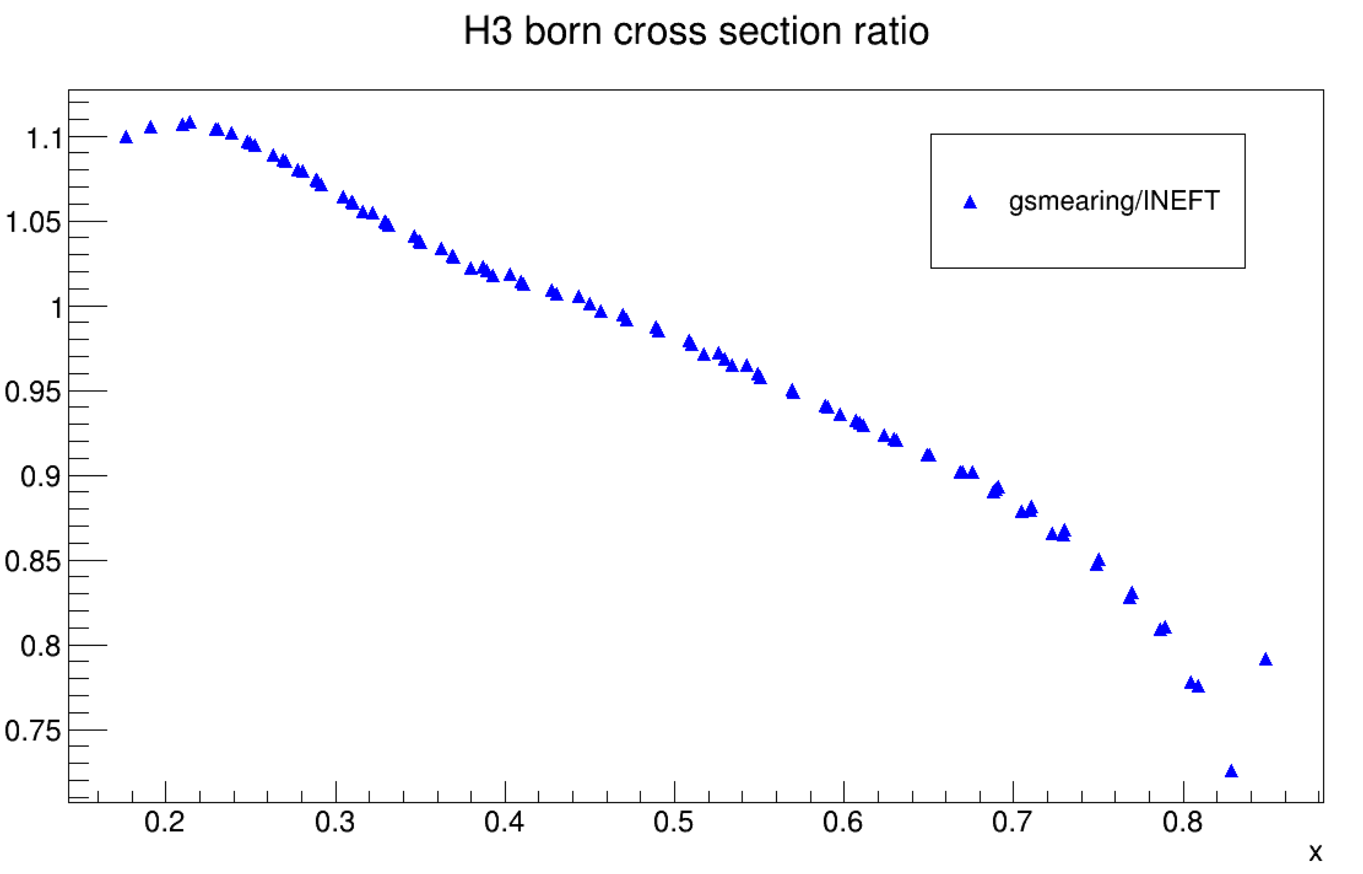
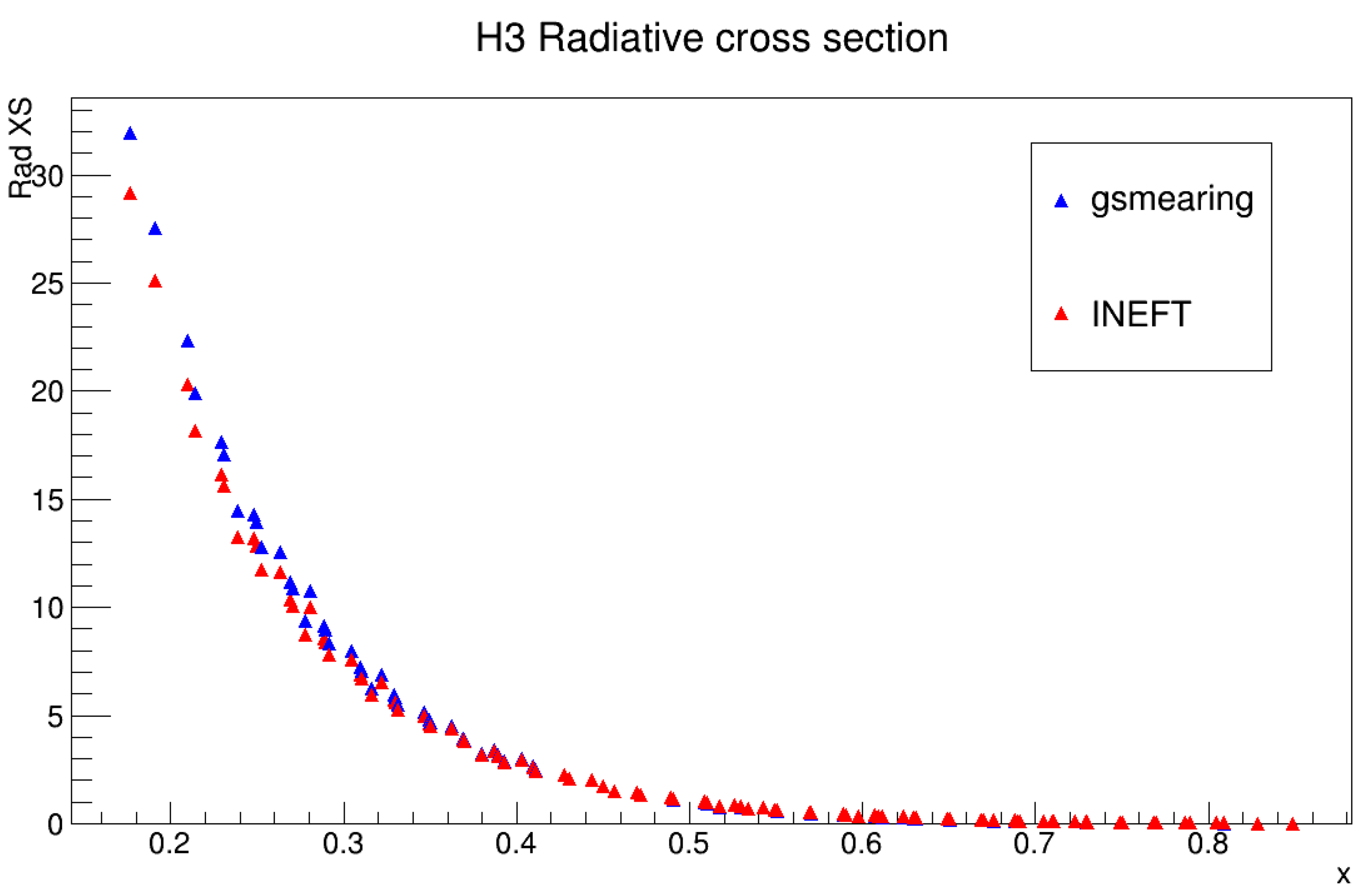
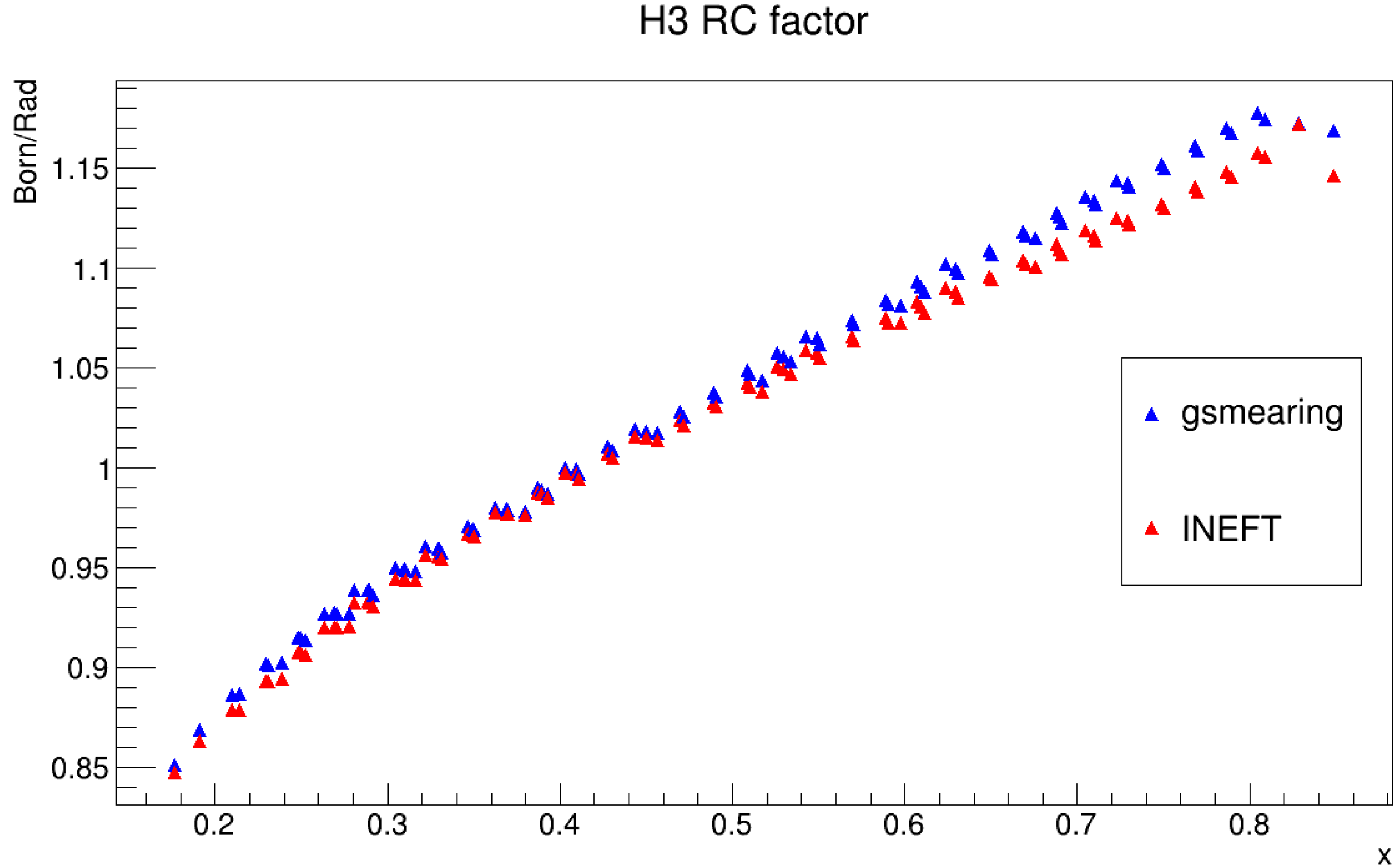

H3 Born cross section
Born XS
gsmearing
INEFT
x


H3 born cross section ratio
gsmearing/INEFT
x


H3 Radiative cross section
Rad XS
gsmearing
INEFT
x



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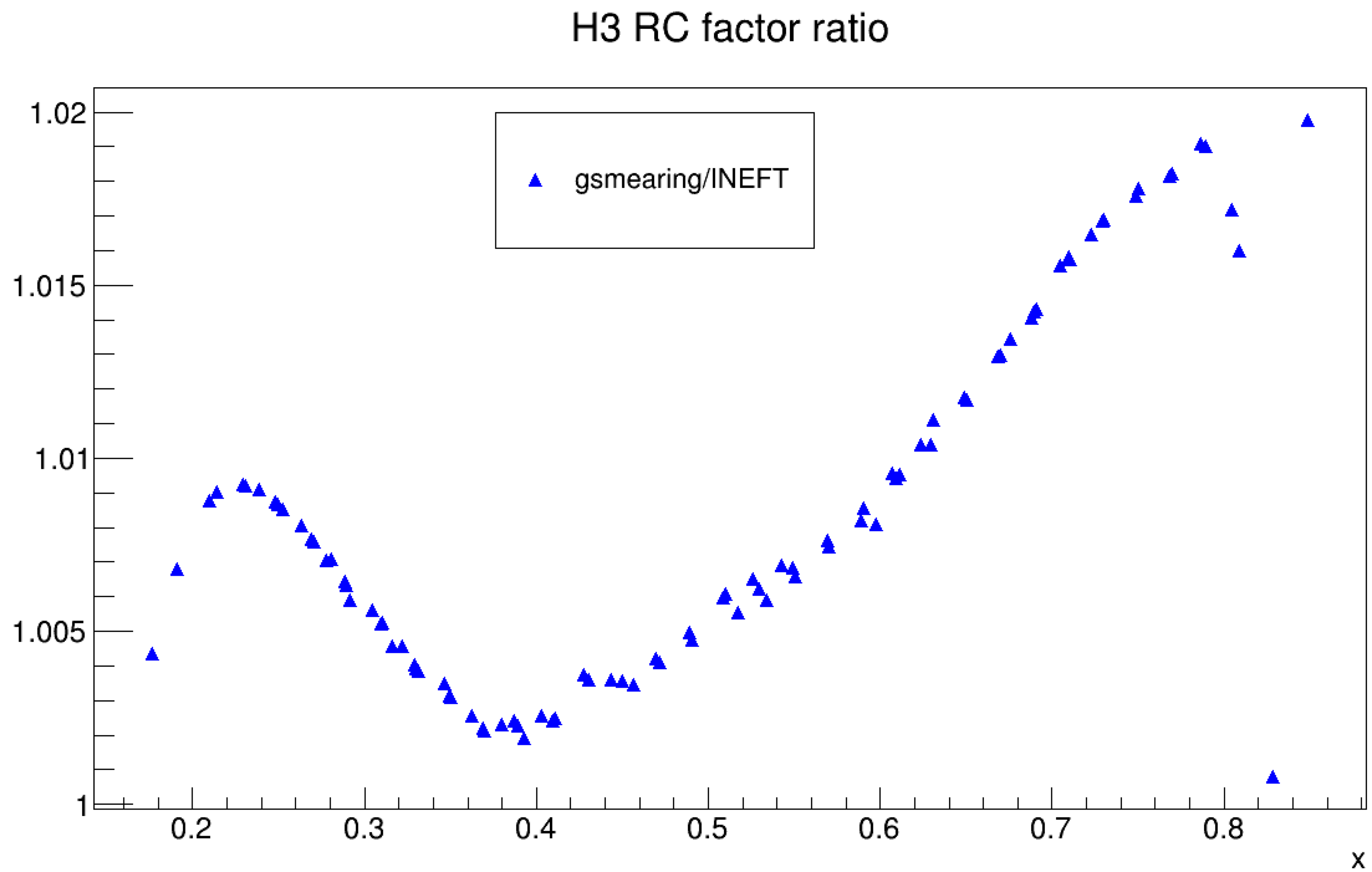

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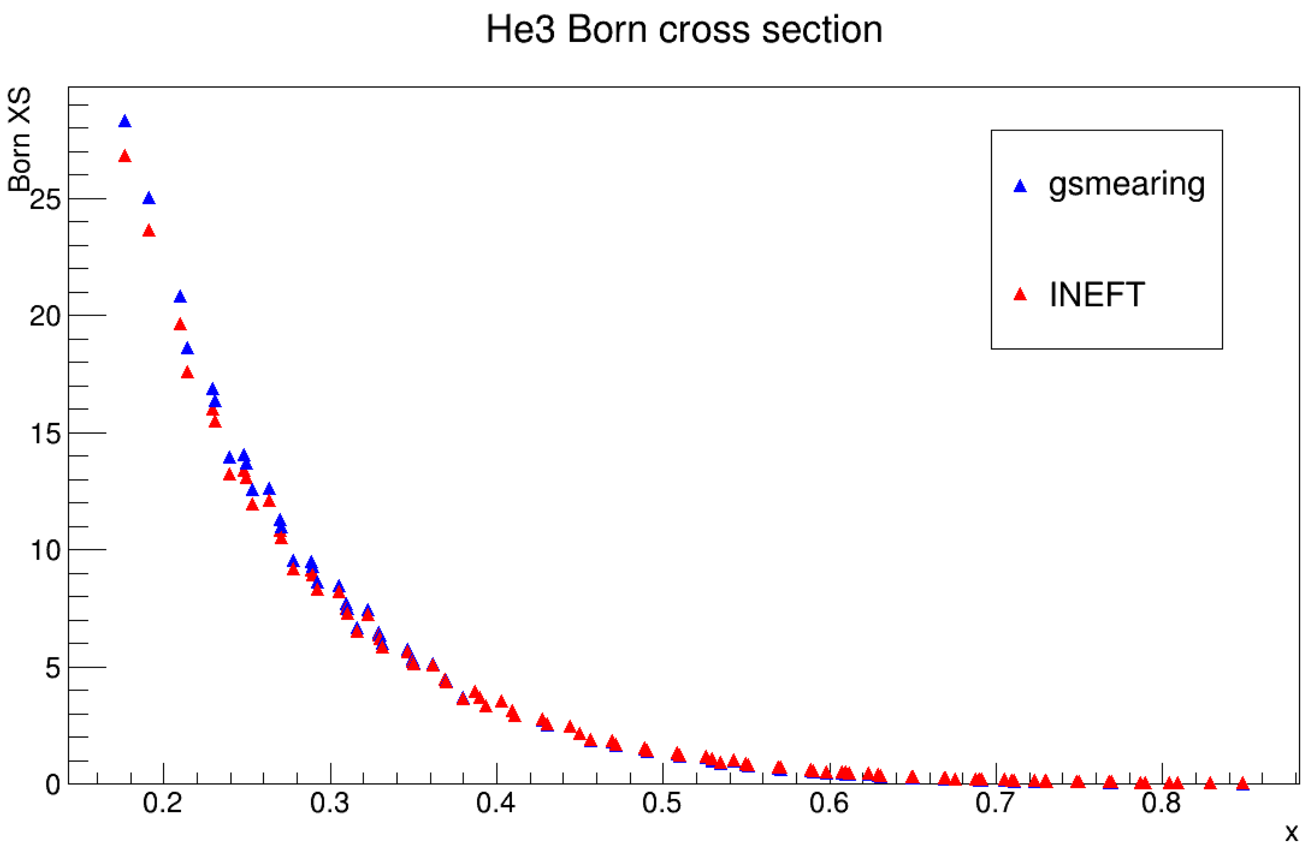
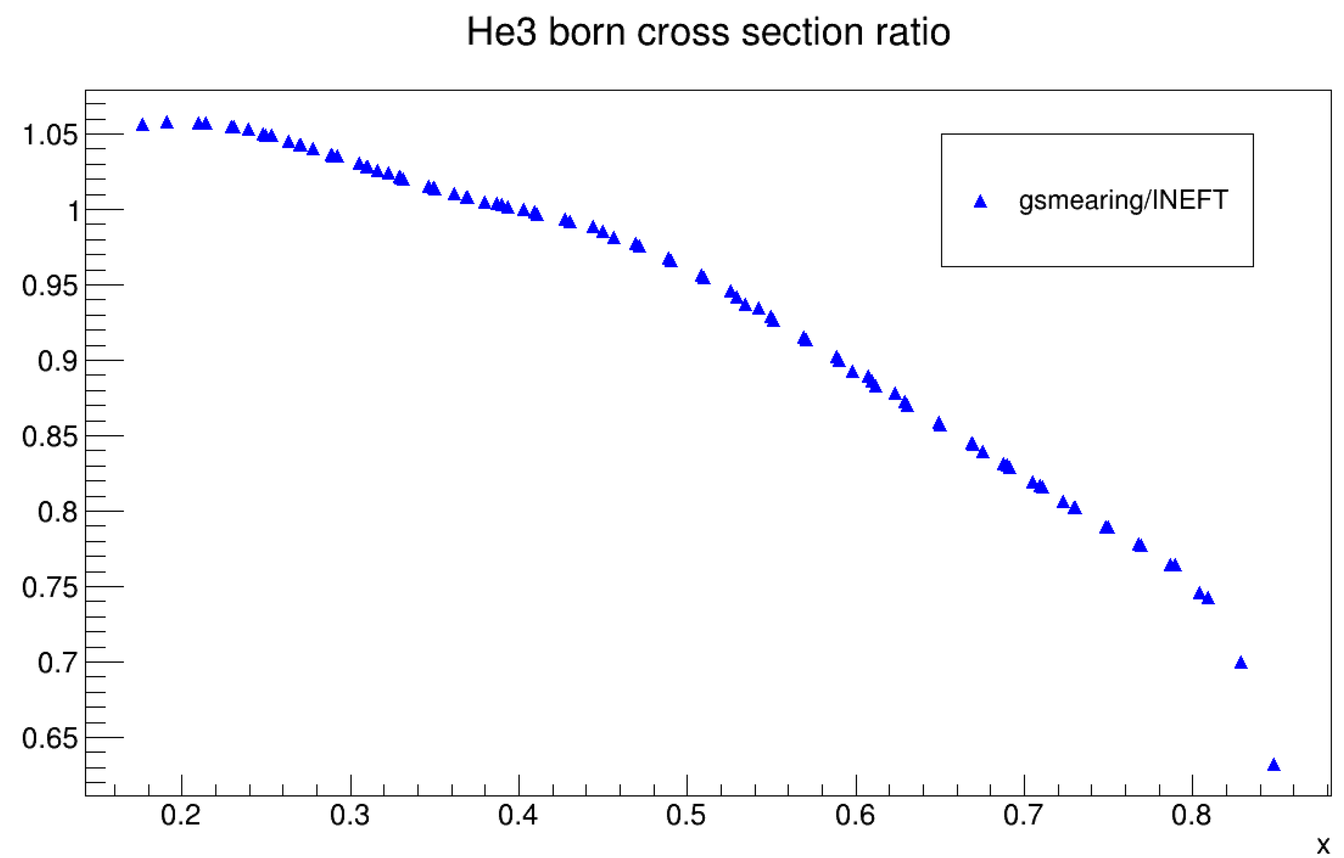
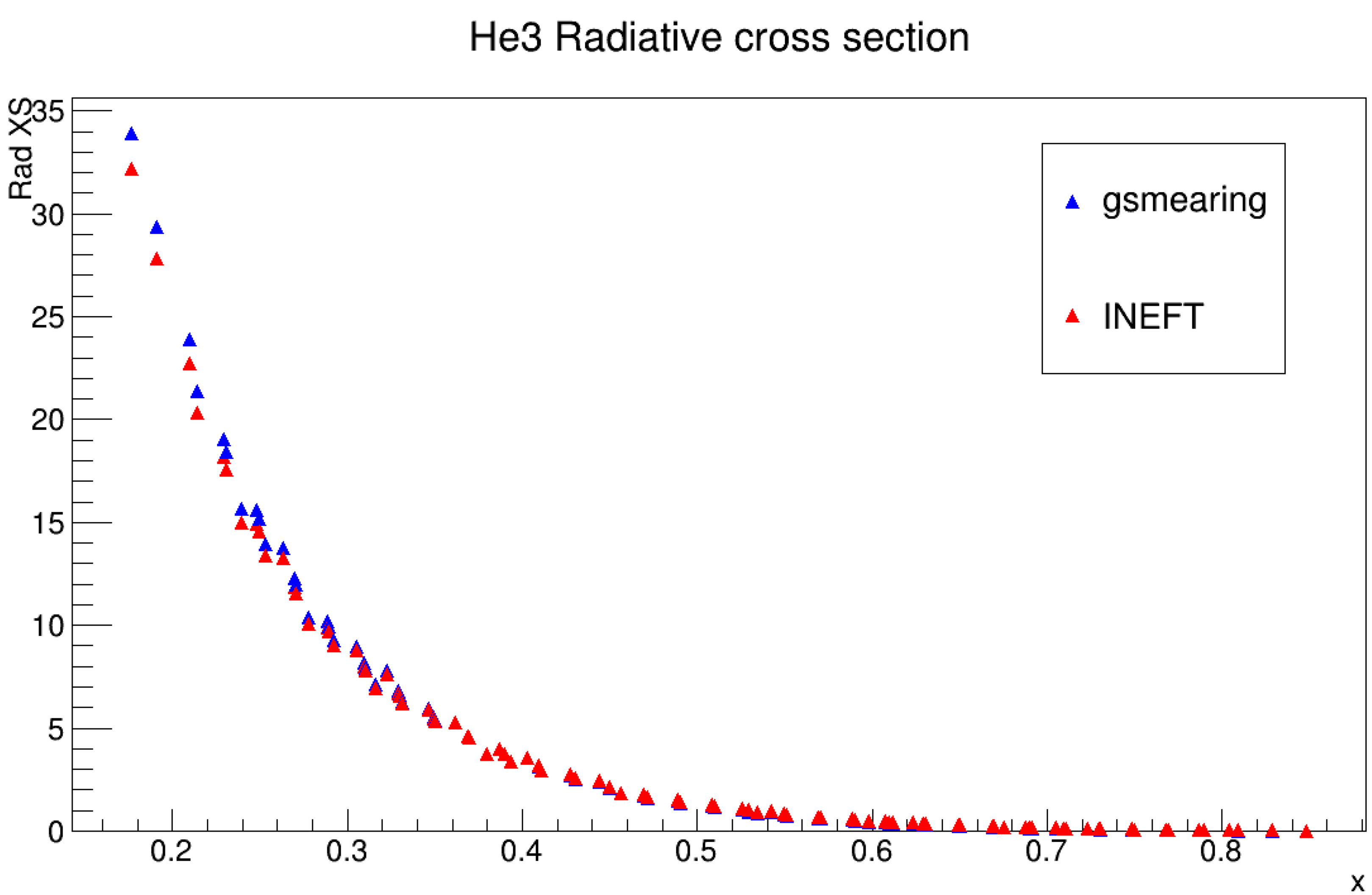
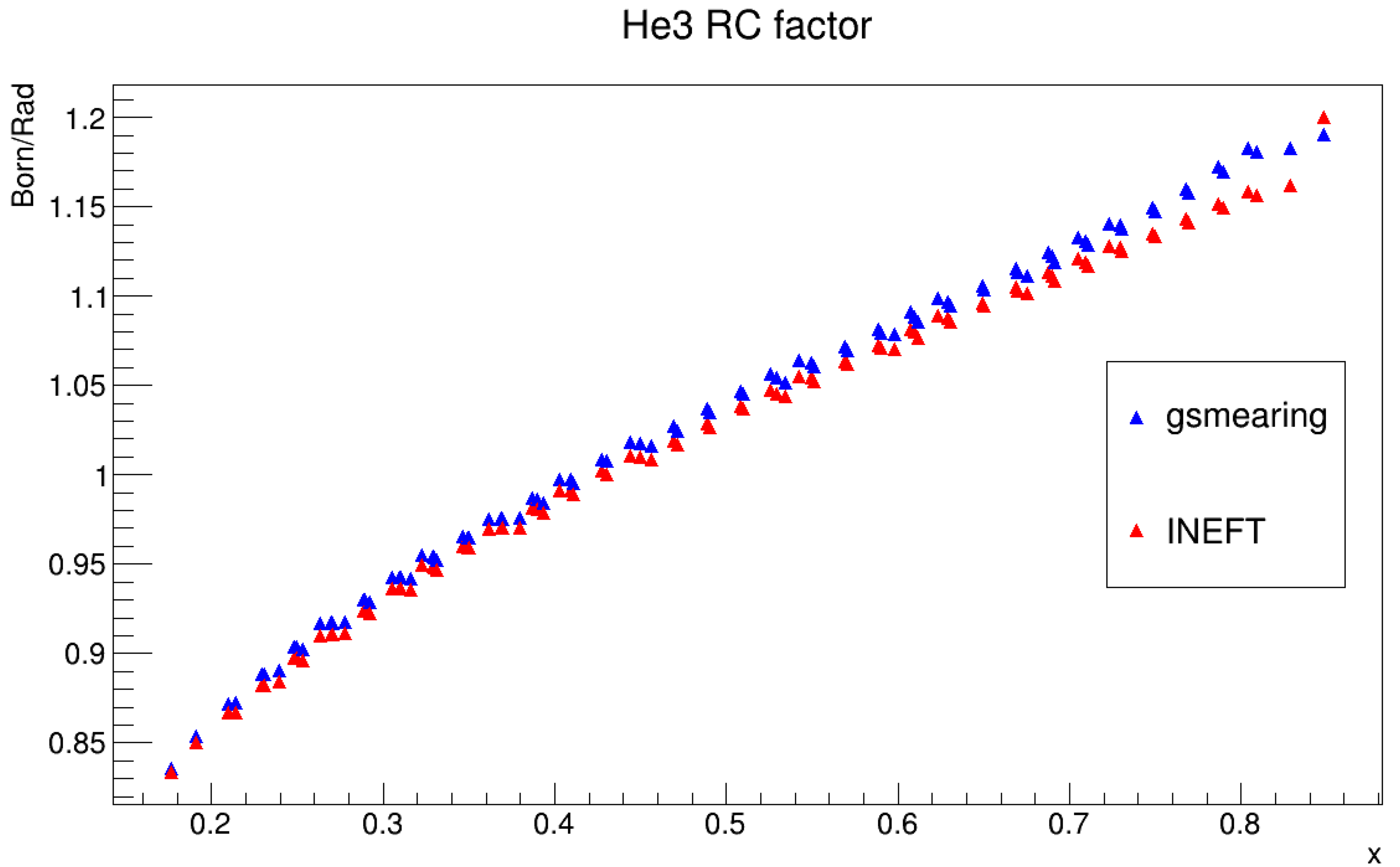

He3 Born cross section
Born XS
gsmearing
INEFT
x


He3 born cross section ratio
gsmearing/INEFT
x


He3 Radiative cross section
Rad XS
gsmearing
INEFT
x



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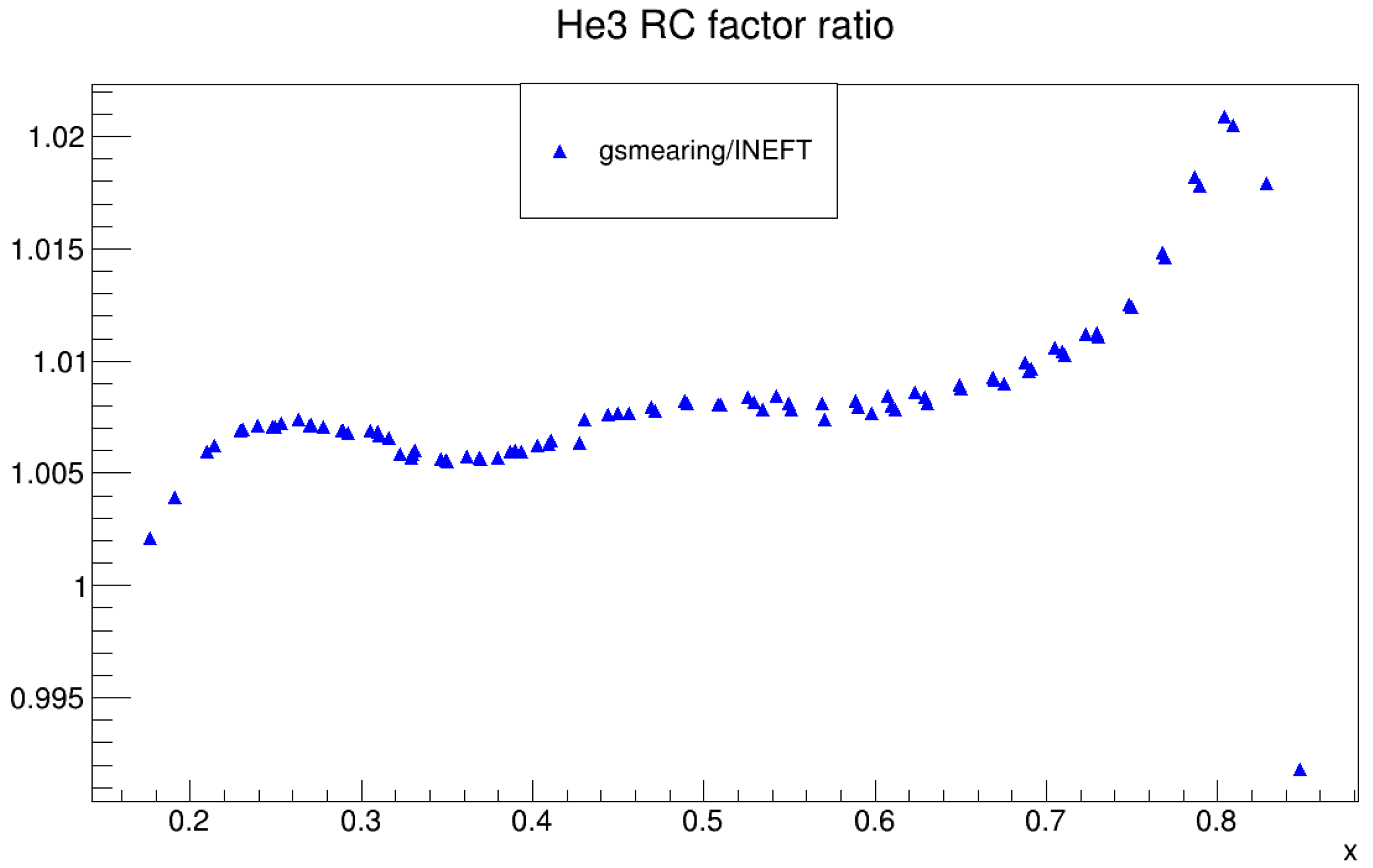

$$\text{RC factor ratio} = \frac{\text{gsmearing RC factor}}{\text{INEFT RC factor}}$$

Conclusions 2:

1. Both gsmearing and INEFT includes resonance part. They could be used for our radiative correction;
2. These two models have more different Born cross sections, but it seems don't have much affect in RC factor;
3. The difference of RC factors from gsmearing and INEFT is less than 2%;