Connection between the H(x) scaling and the D0-TOTEM results on Odderon exchange

T. Csörgő[1,2] **T. Novák**[2]**, R. Pasechnik**[3]**, A. Ster**[1]**, I. Szanyi**[1,2,4]

[1]Wigner RCP, Budapest, Hungary
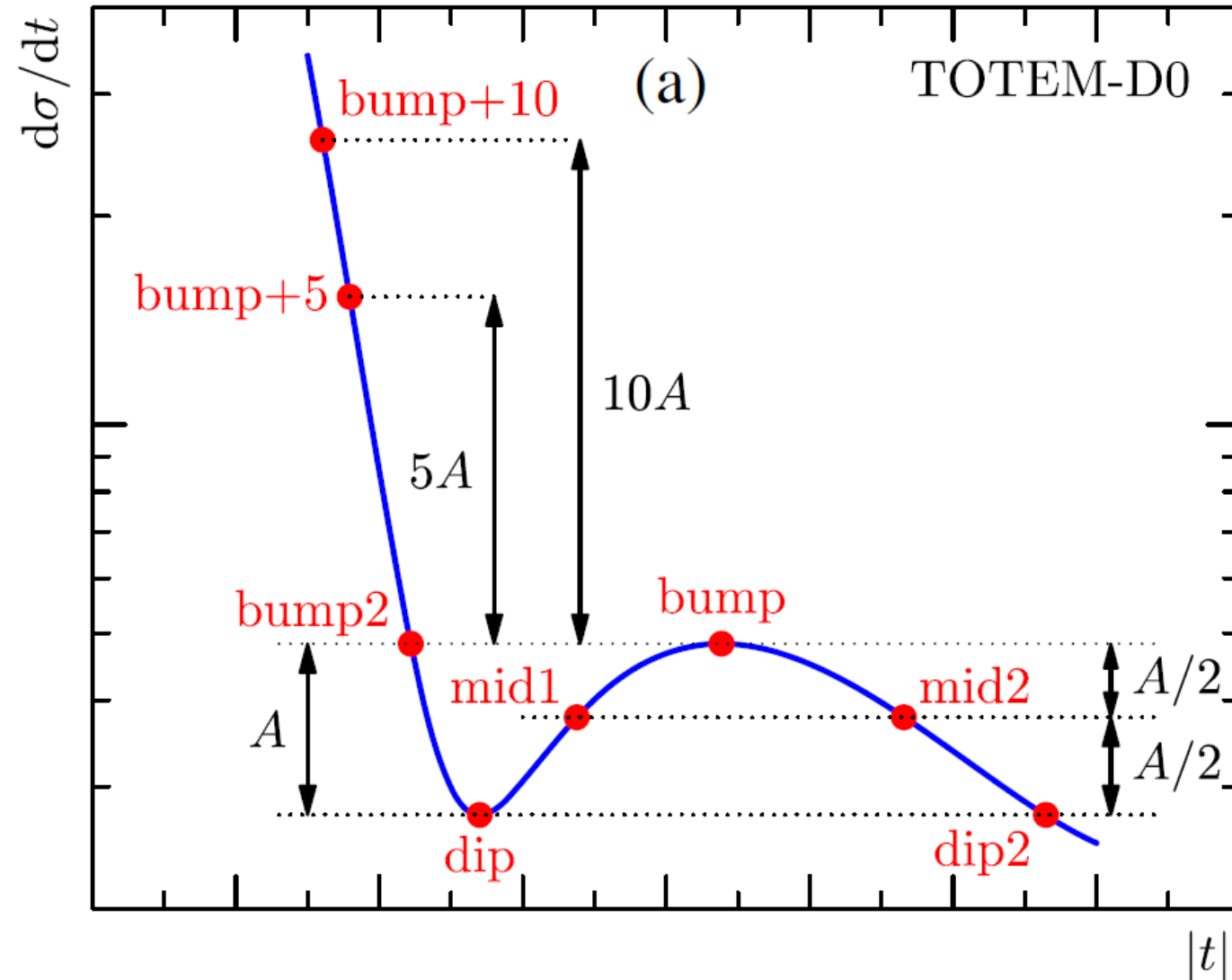[2]MATE KRC, Gyöngyös, Hungary
[3]Lund University, Lund, Sweden
[4]ELTE, Budapest, Hungary

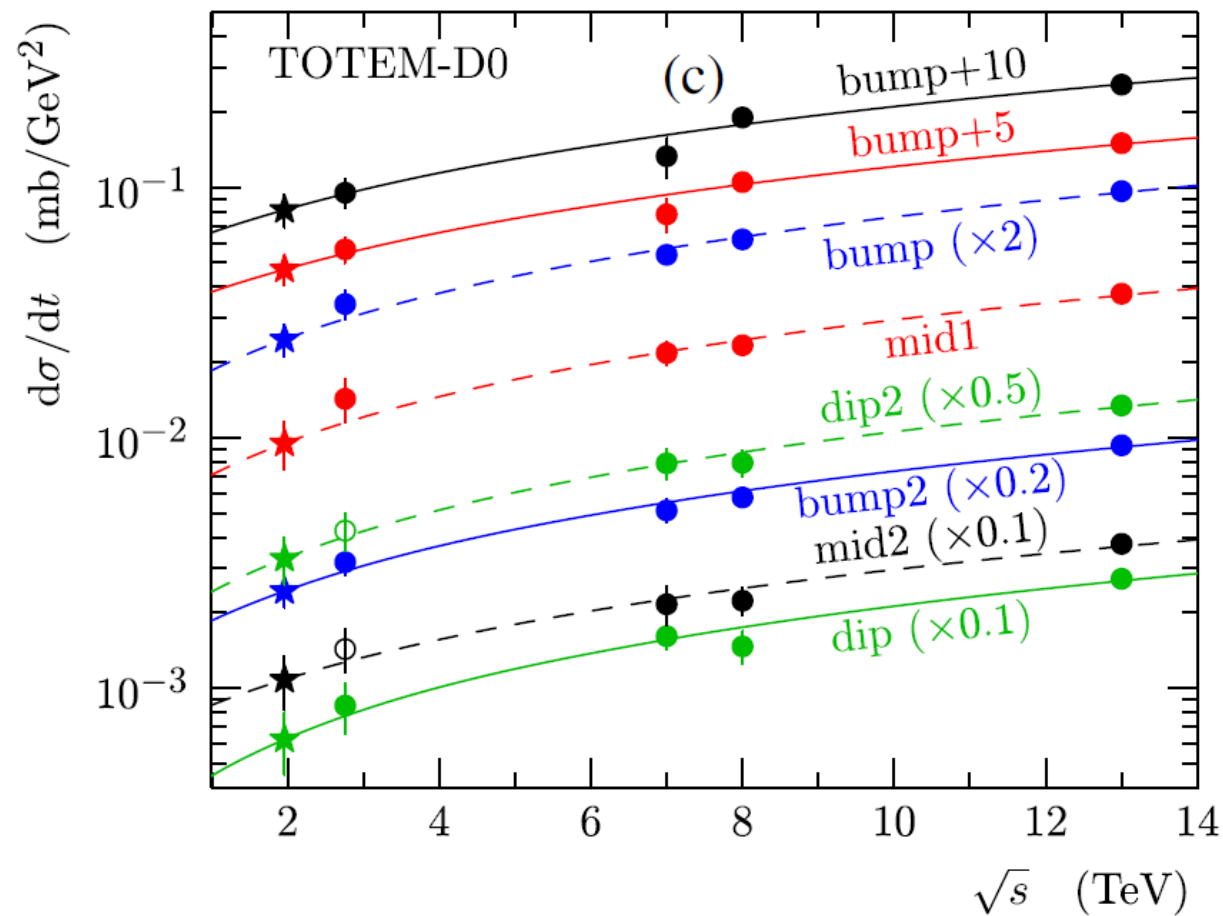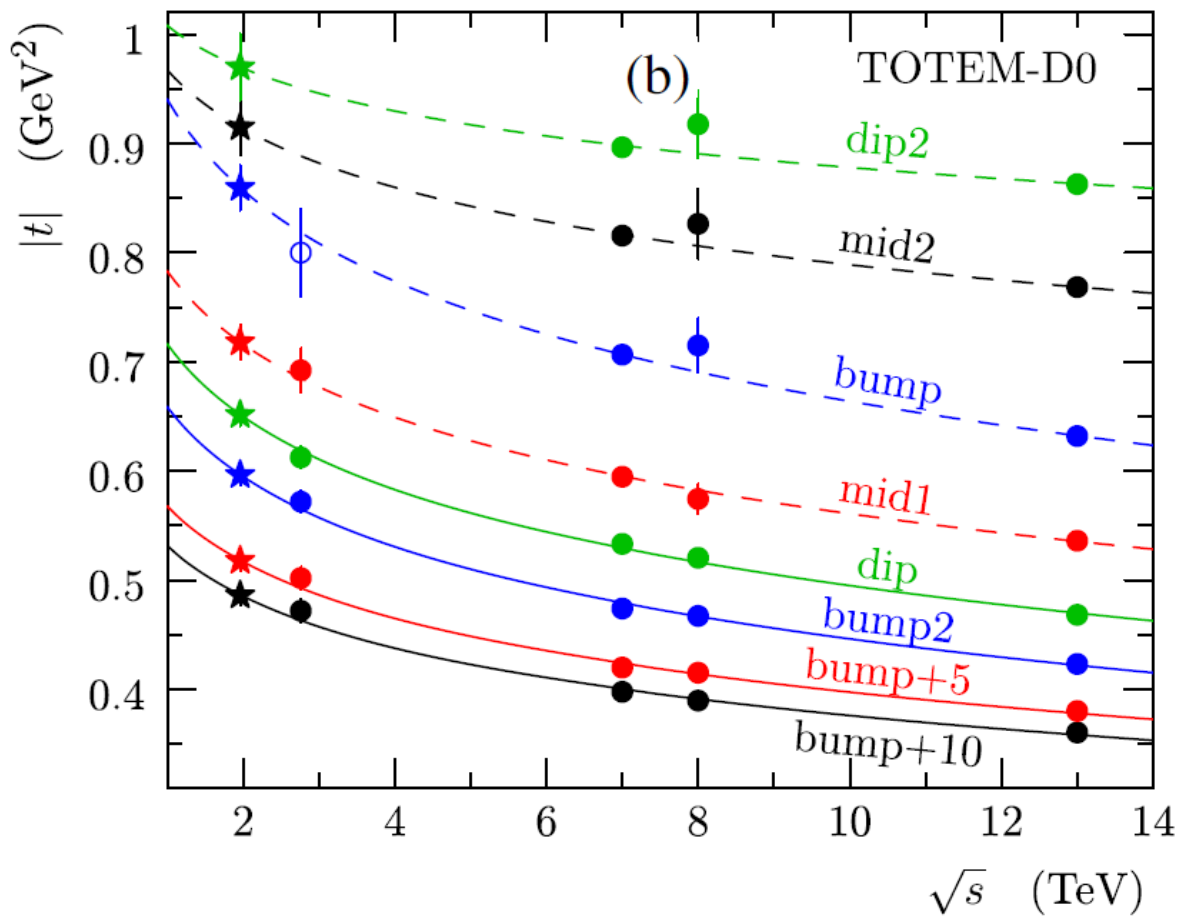**Day of Femtoscopy 2021**

October 28, 2021, Gyöngyös, Hungary

Characteristic points in pp dσ/dt defined by D0-TOTEM

V. M. Abazov et al. (D0 & TOTEM Collaboration), *Phys. Rev. Lett.* **127**, 062003 (2021)

Energy dependence of characteristic points

Validity of H(x) scaling

- **the H(x) scaling law is valid in the energy range** $\sqrt{s_1} \leq \sqrt{s} \leq \sqrt{s_2}$ **if the**

$$H(x,s) = \frac{1}{B_0(s)\sigma_{el}(s)} \left.\frac{d\sigma_{el}}{dt}\right|_{x=-tB_0(s)}$$

scaling function is energy independent in that range:
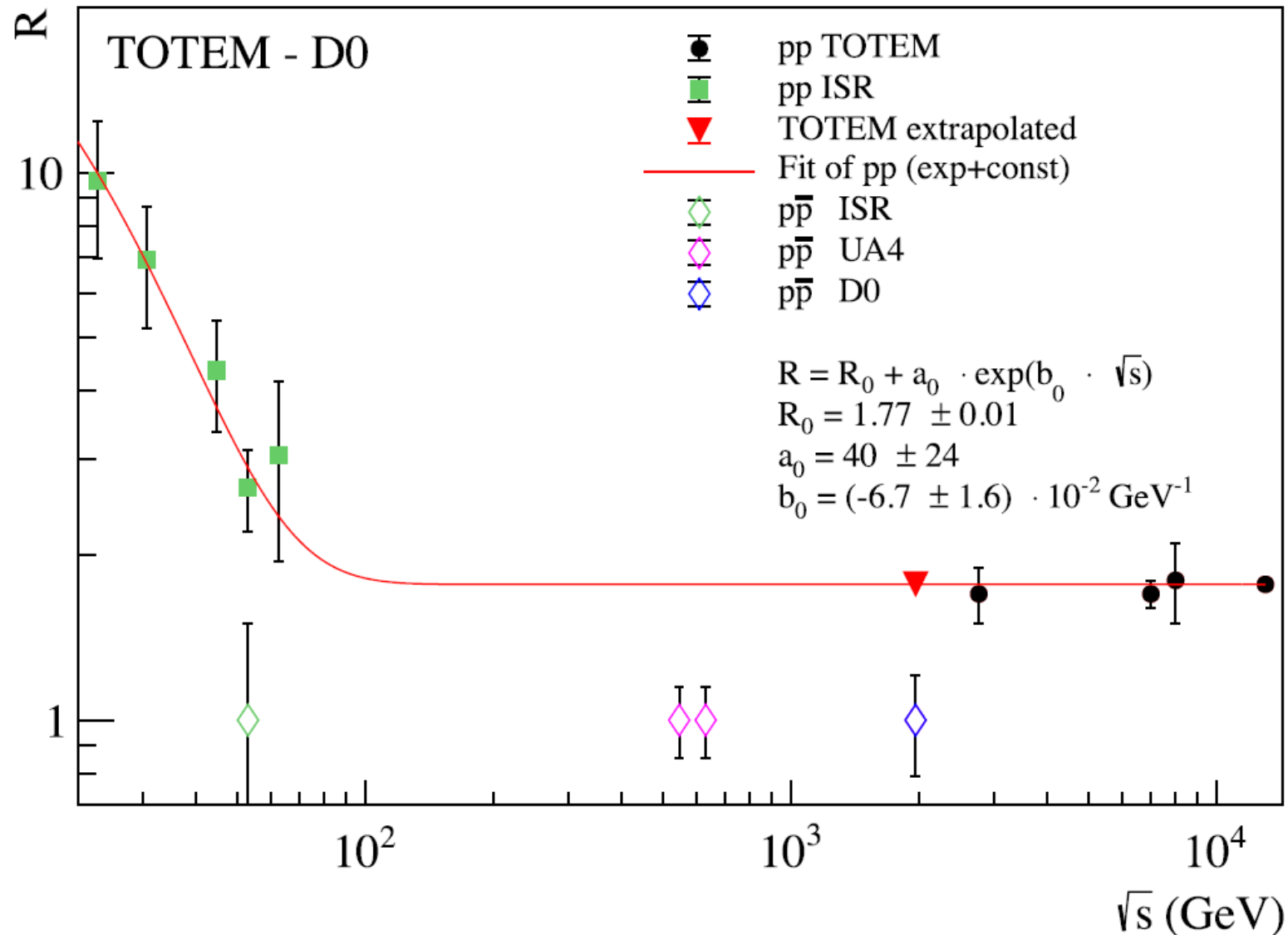
$$H(x,s_1) = H(x,s_2)$$

- **if the H(x) scaling law is valid in the** $\sqrt{s_1} \leq \sqrt{s} \leq \sqrt{s_2}$ **energy region, the ratio of any two points of the differential cross section is energy independent in that energy region**

- **if one considers the TOTEM-D0 characteristic points 28 ratios can be calculated**
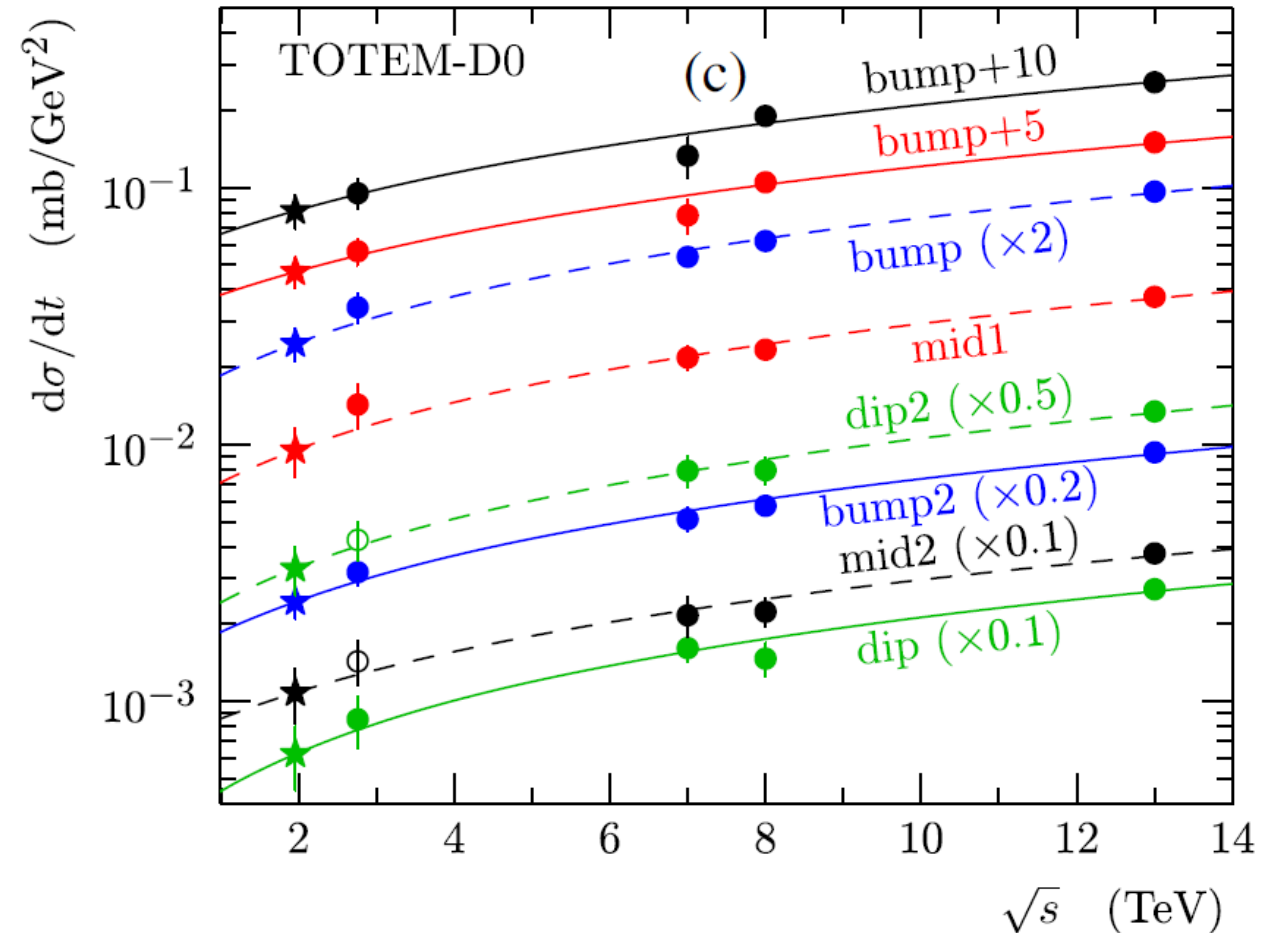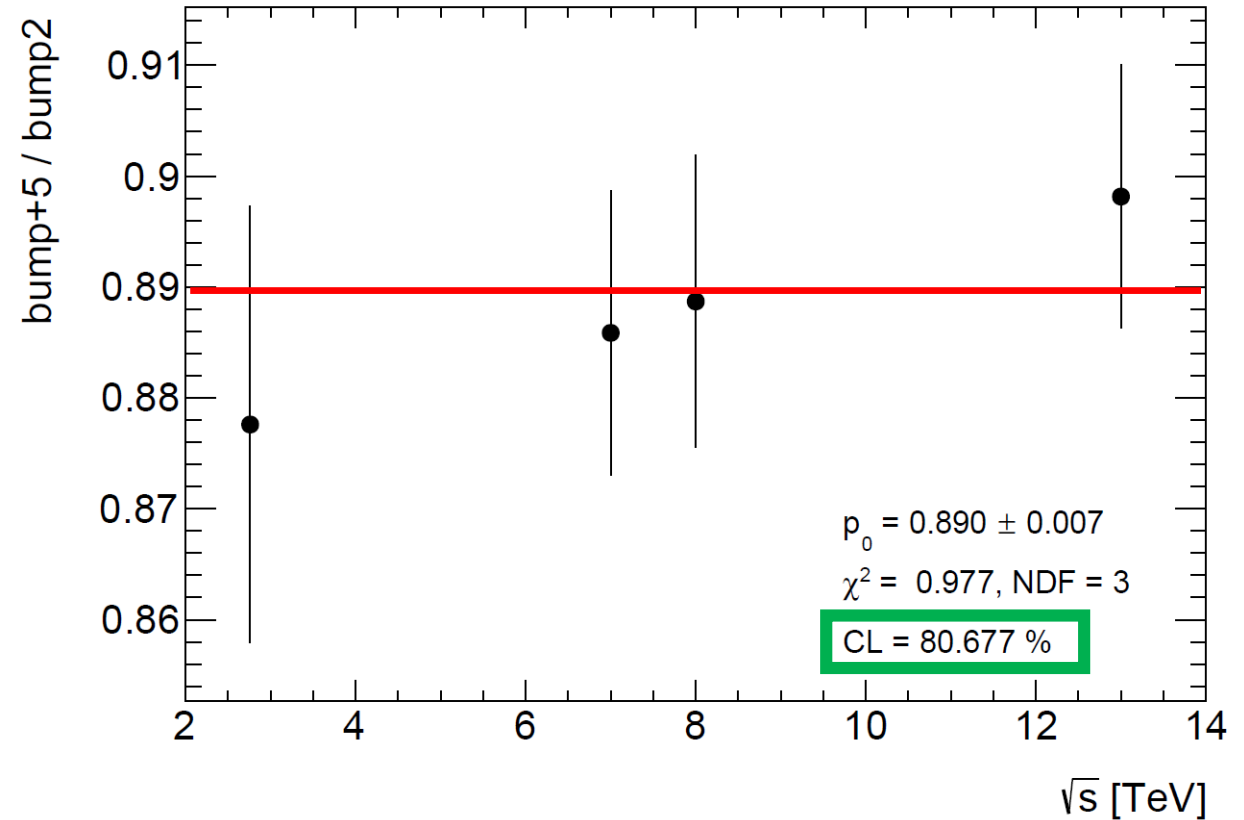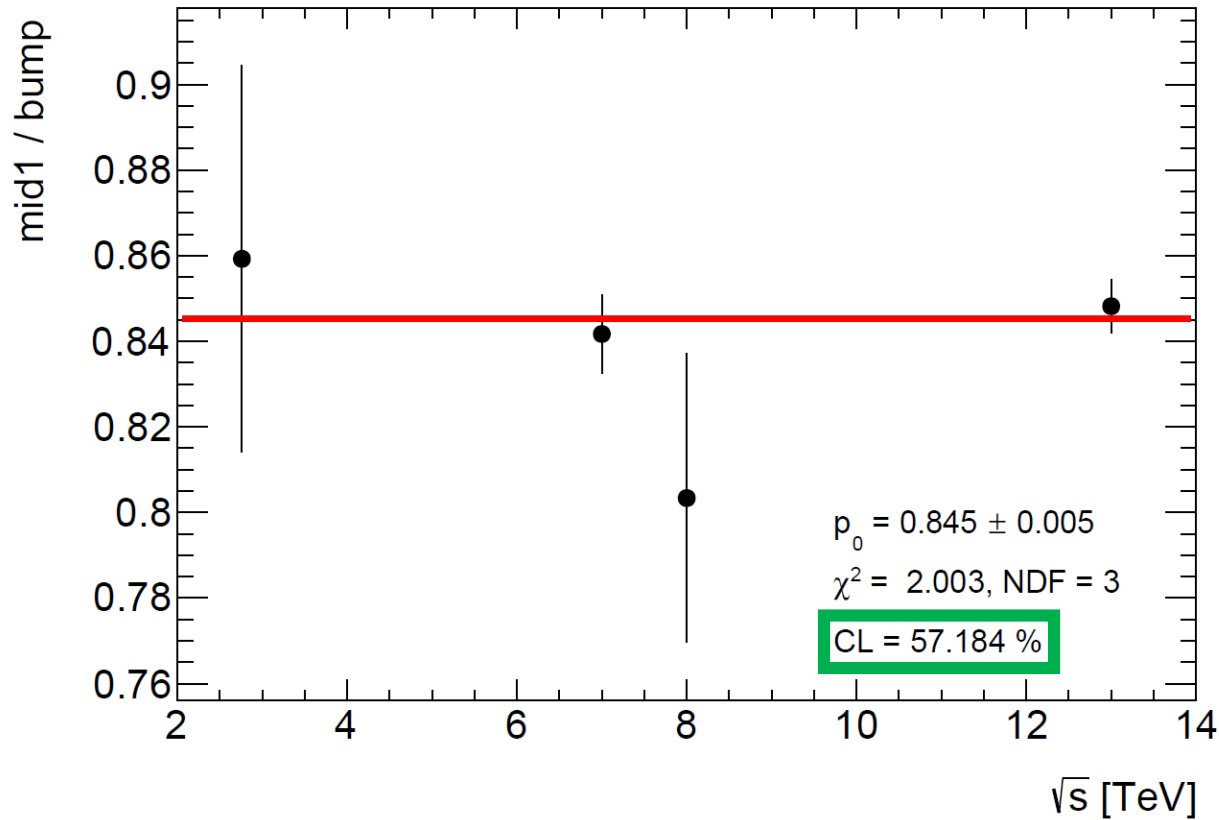
bump/dip ratio → H(x) scaling is valid

V. M. Abazov et al. (D0 & TOTEM Collaboration), *Phys. Rev. Lett.* **127**, 062003 (2021)
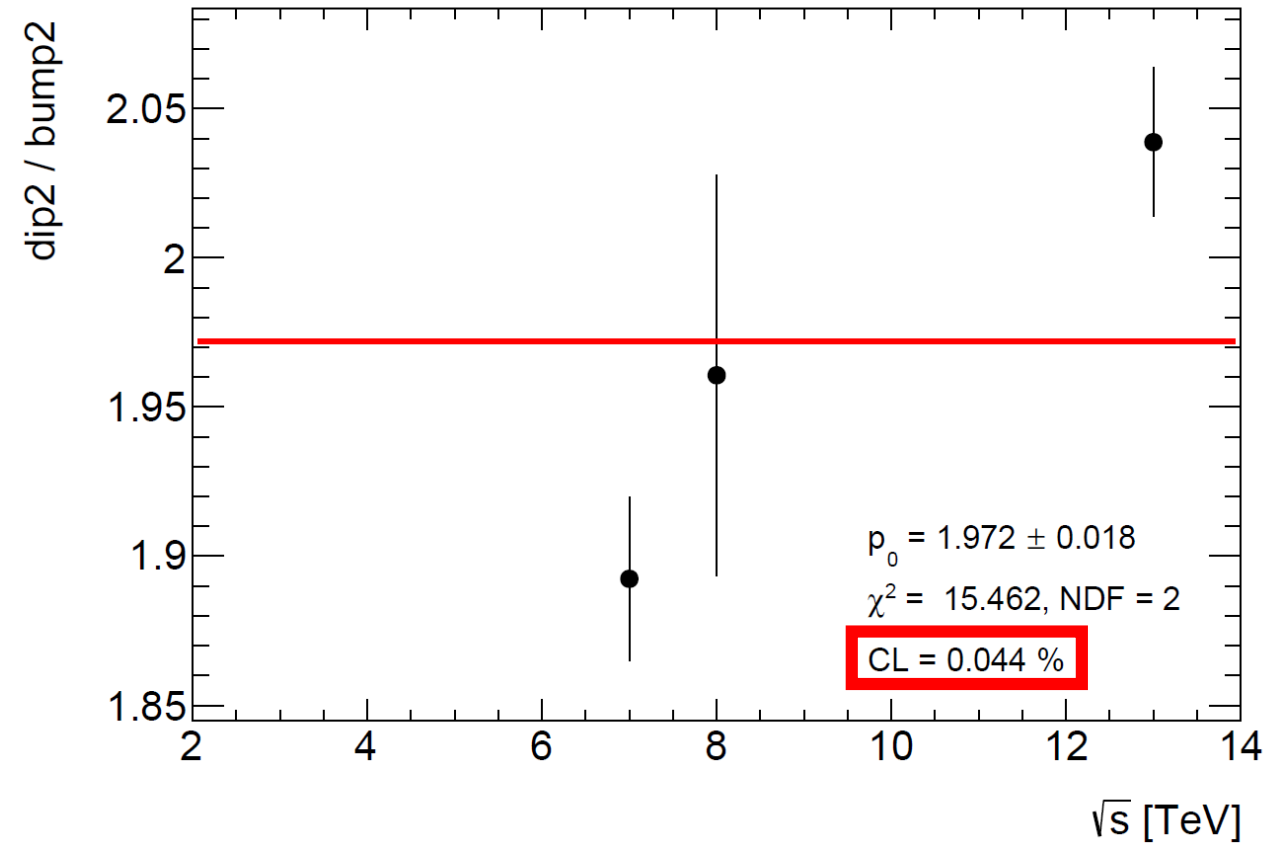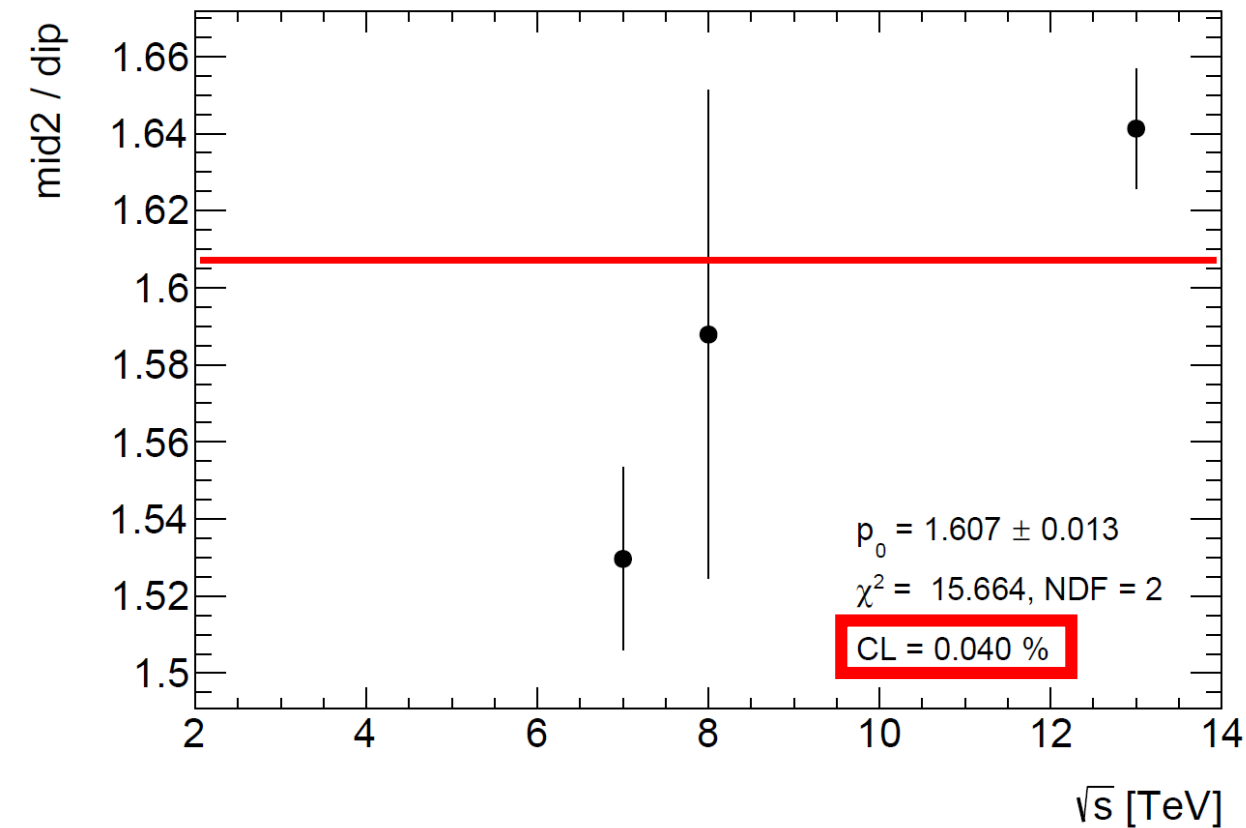
Example 1: mid1/bump & bump+5/bump2 ratio

13 TeV data point included

$p_0 = 0.845 \pm 0.005$
$\chi^2 = 2.003$, NDF = 3
CL = 57.184 %

$p_0 = 0.890 \pm 0.007$
$\chi^2 = 0.977$, NDF = 3
CL = 80.677 %

ratios are constants → H(x) is valid

Example 2a: mid2/dip & dip2/bump2 ratio

13 TeV data point included

Left panel (y-axis: mid2 / dip, x-axis: $\sqrt{s}$ [TeV]):
$p_0 = 1.607 \pm 0.013$
$\chi^2 = 15.664$, NDF = 2
CL = 0.040 %

Right panel (y-axis: dip2 / bump2, x-axis: $\sqrt{s}$ [TeV]):
$p_0 = 1.972 \pm 0.018$
$\chi^2 = 15.462$, NDF = 2
CL = 0.044 %

ratios are not constants → H(x) is not valid

1: bump+10/bump+5
2: bump+10/bump2
3: bump+10/dip
4: bump+10/mid1
5: bump+10/bump
6: bump+5/bump2
7: bump+5/dip
8: bump+5/mid1
9: bump+5/bump
10: bump2/dip
11: bump2/mid1
12: bump2/bump
13: dip/mid1
14: dip/bump

15: mid1/bump
16: mid2/bump+10
17: mid2/bump+5
18: mid2/bump2
19: mid2/dip X
20: mid2/mid1
21: mid2/bump X
22: dip2/bump+10
23: dip2/bump+5
24: dip2/bump2 X
25: dip2/dip X
26: dip2/mid1 X
27: dip2/bump X
28: mid2/dip2
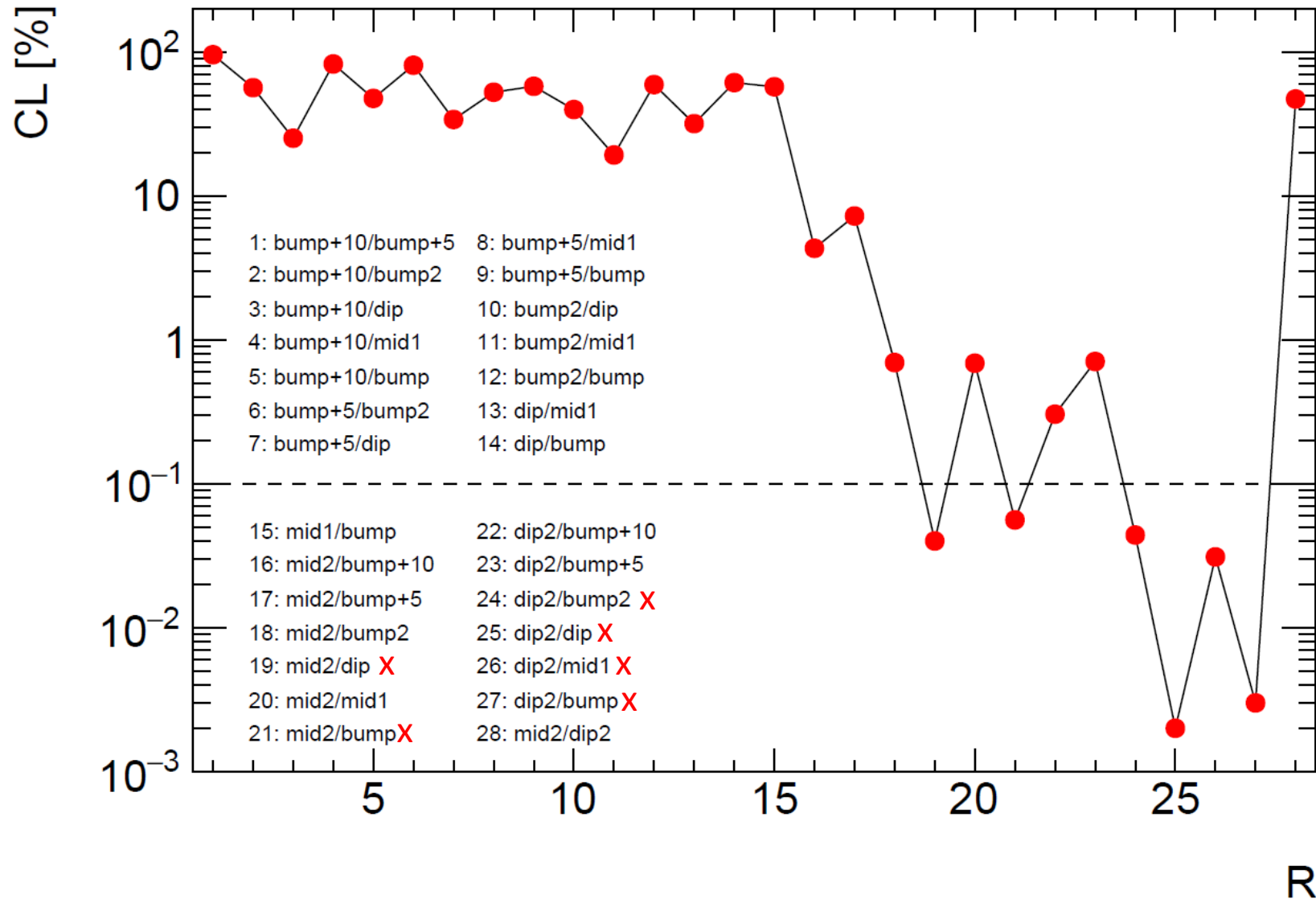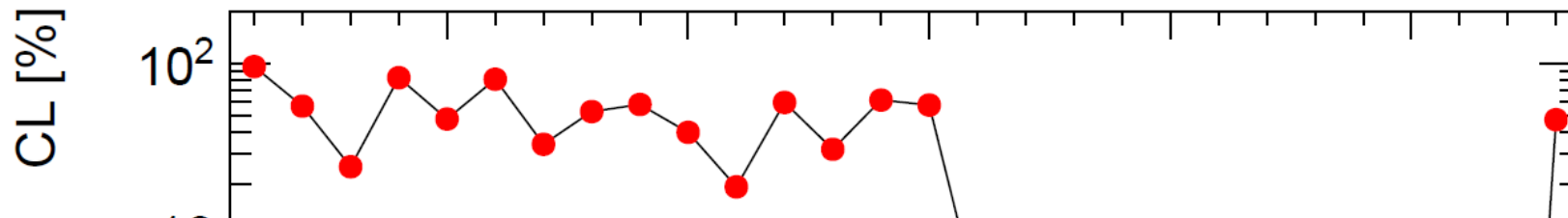
H(x) scaling is not valid up to 13 TeV
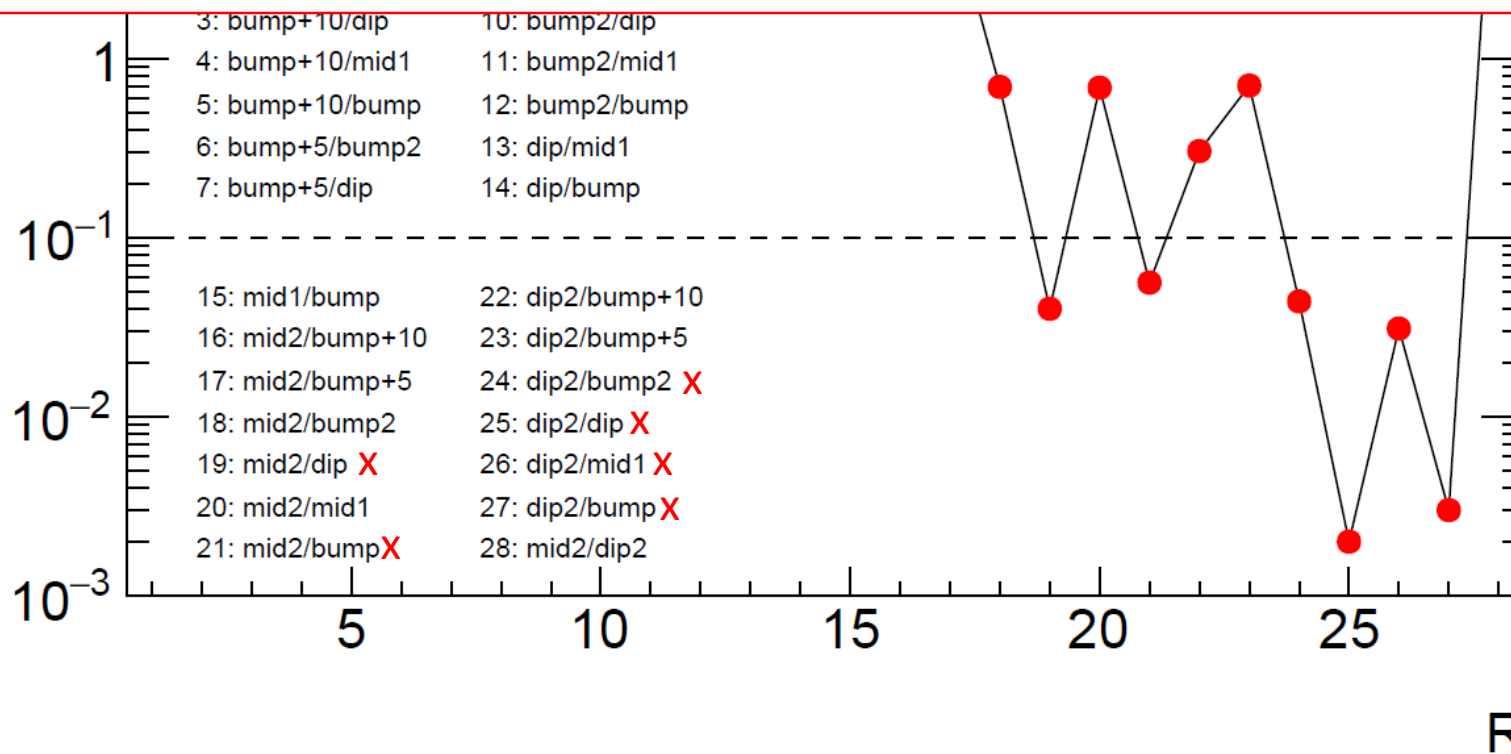
Example 2b: mid2/dip & dip2/bump2 ratio

13 TeV data point excluded

Left plot: mid2 / dip vs $\sqrt{s}$ [TeV]
- $p_0 = 1.537 \pm 0.022$
- $\chi^2 = 0.741$, NDF = 1
- CL = 38.949 %

Right plot: dip2 / bump2 vs $\sqrt{s}$ [TeV]
- $p_0 = 1.902 \pm 0.026$
- $\chi^2 = 0.883$, NDF = 1
- CL = 34.735 %
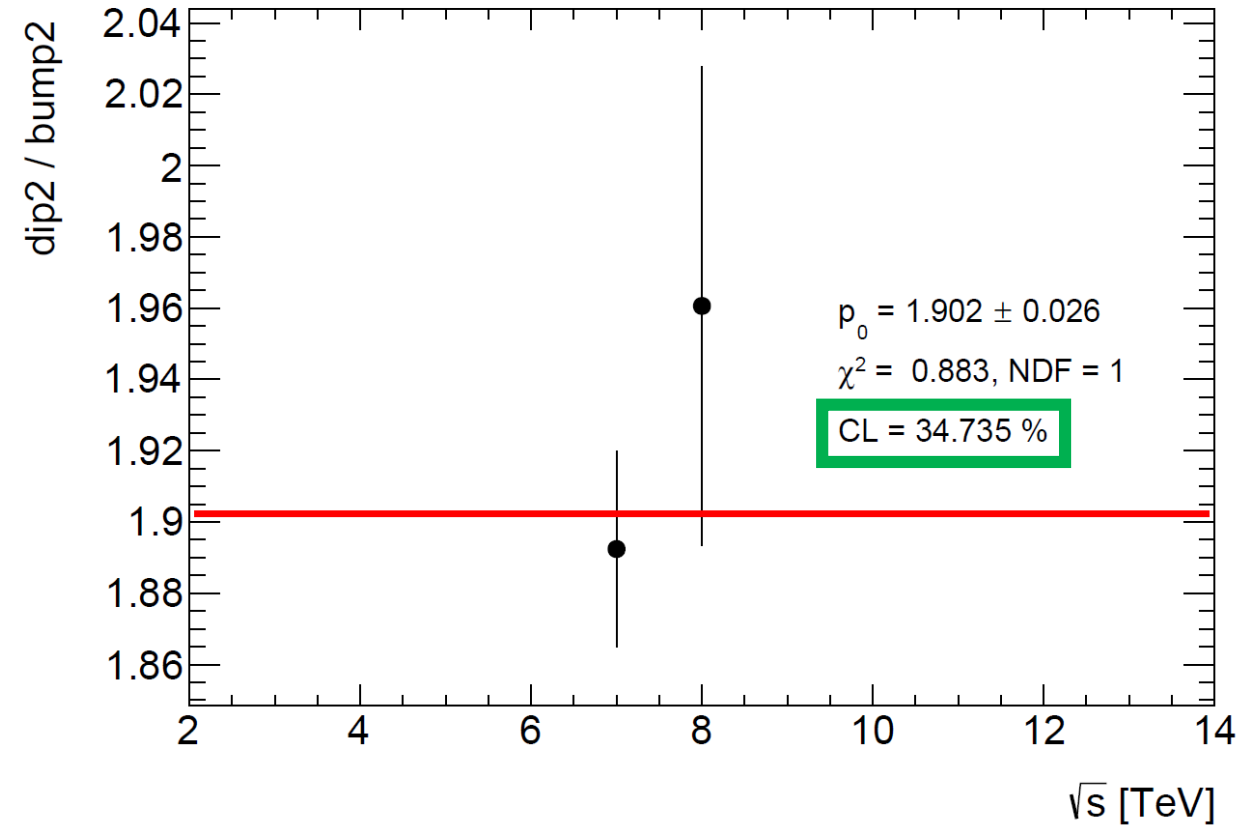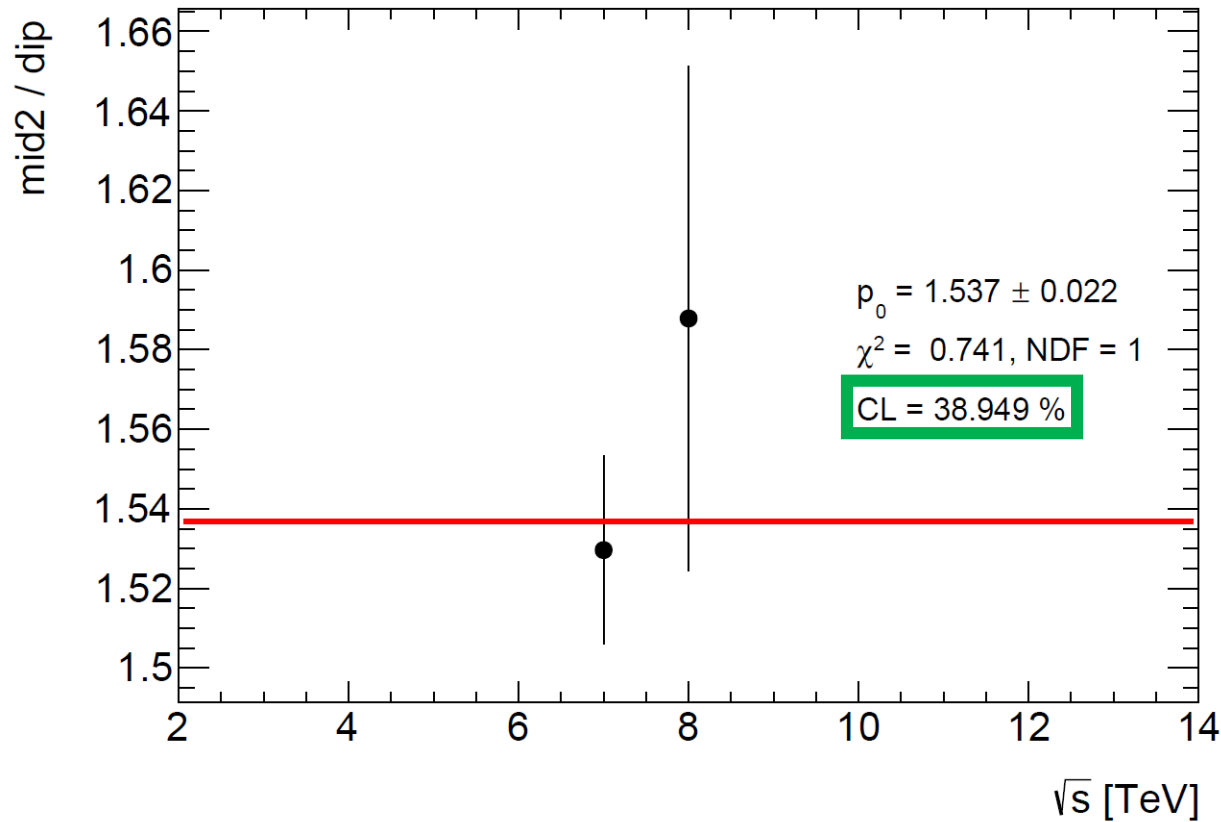
ratios are constants → H(x) is valid

Summary: **H(x) scaling is valid in** $\sqrt{s} \leq 8$ TeV
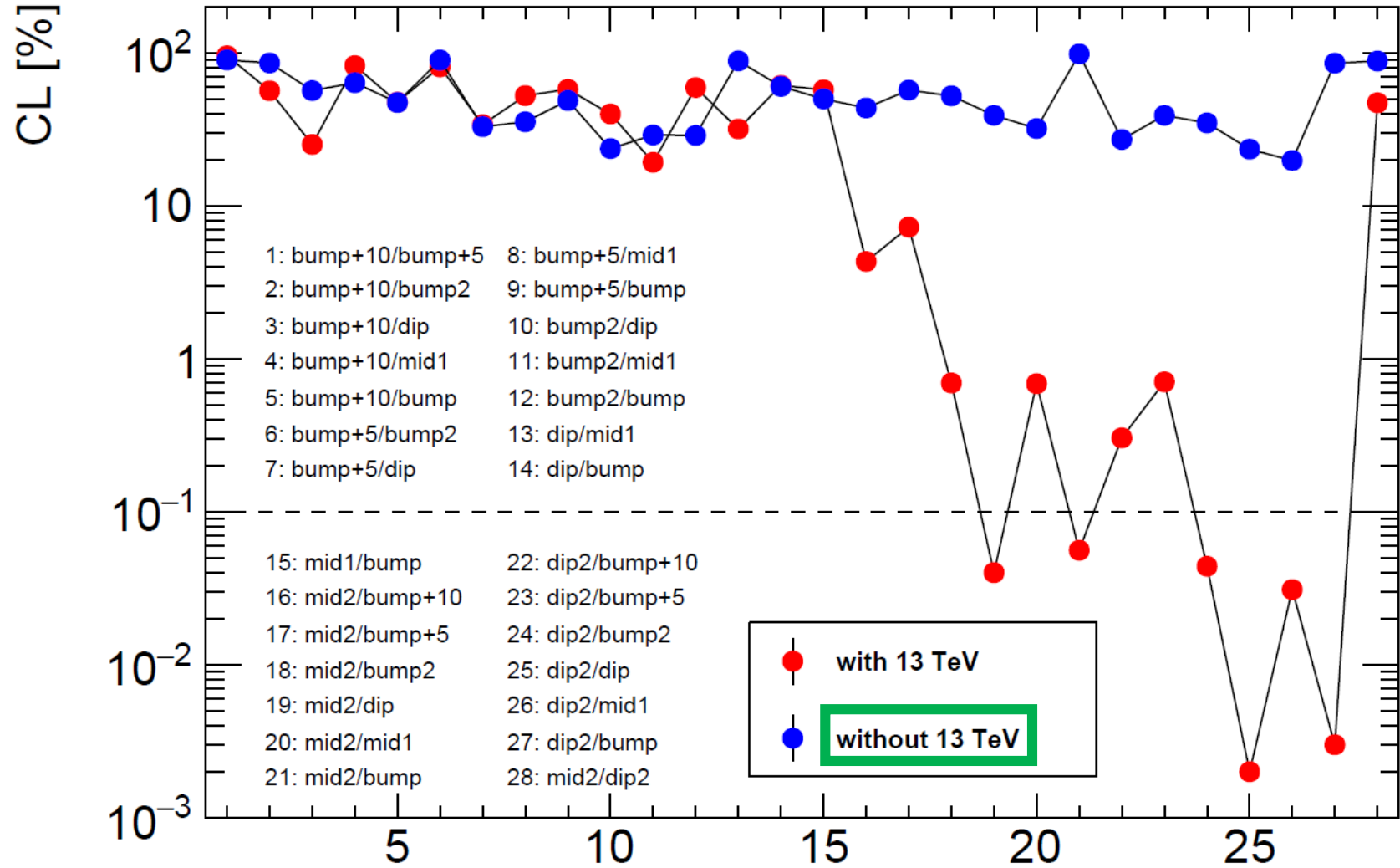
Thank you for your attention!