Model independent Odderon results

based on new TOTEM data at 8 TeV

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] University of Lund, Lund, Sweden
[4] Eötvös University, Budapest, Hungary

Statistically Significant Observations of Odderon in 2021

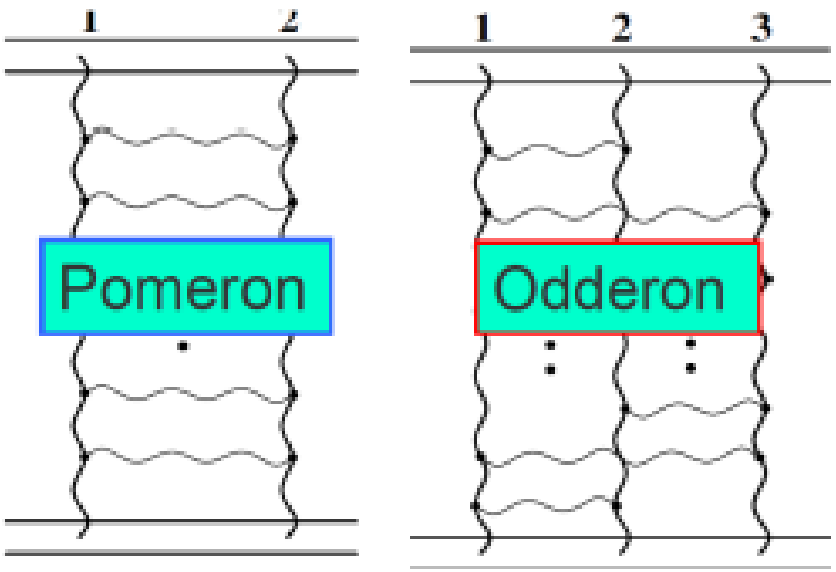
Hungarian-Swedish Odderon:
Significance ≥ 6.26 σ
Hungarian-Polish Odderon:
Significance ≥ 7.08 σ
D0-TOTEM Odderon:
Significance ≥ 5.2 σ
New in 2022:
TOTEM data at 8 TeV published
Hungarian-Polish Odderon: a certainty
Hungarian-Swedish Odderon: confirmed
New relation between R and ρ

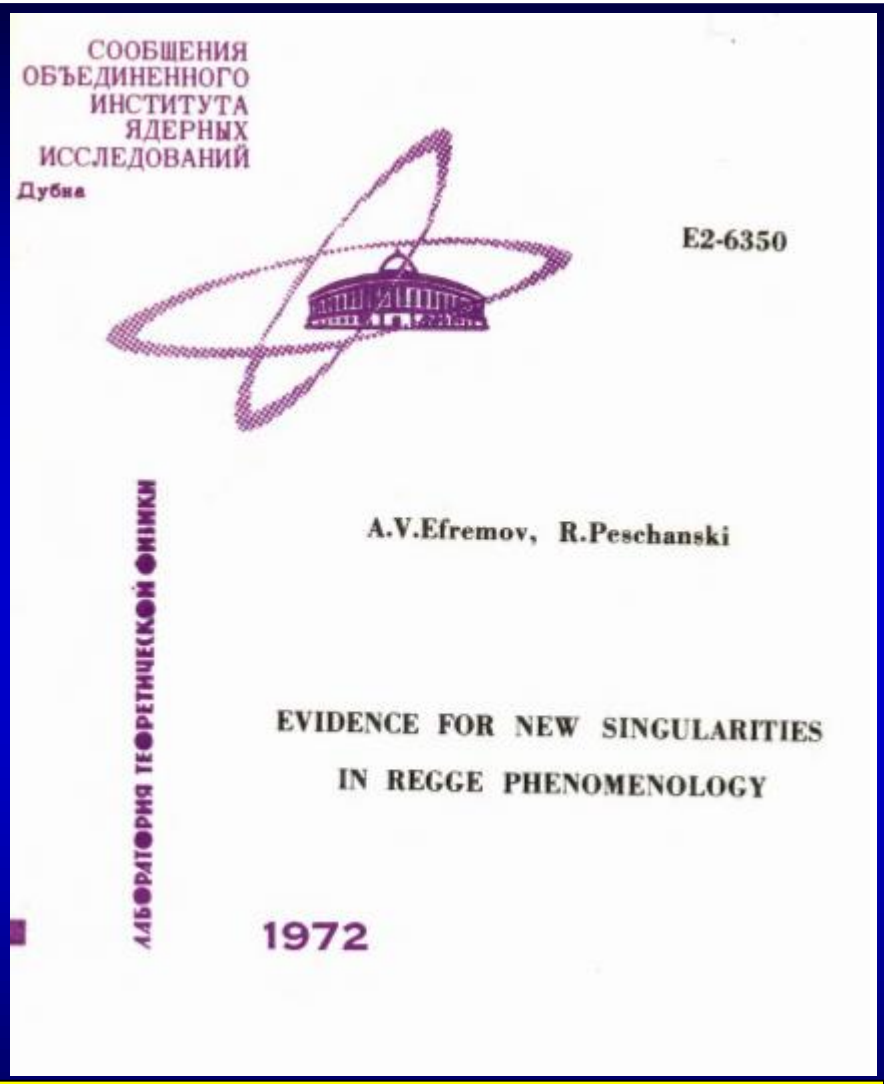
Supported by NKFIH:
K 74458, Hungary

Odderon: 48 years old scientific puzzle

Odderon: L. Lukaszuk, B. Nicolescu, Lett. Nuovo Cim. 8, 405 (1973)
Received: **31 July 1973**

Odderon is an odd component of elastic scattering:
Changes sign for crossing

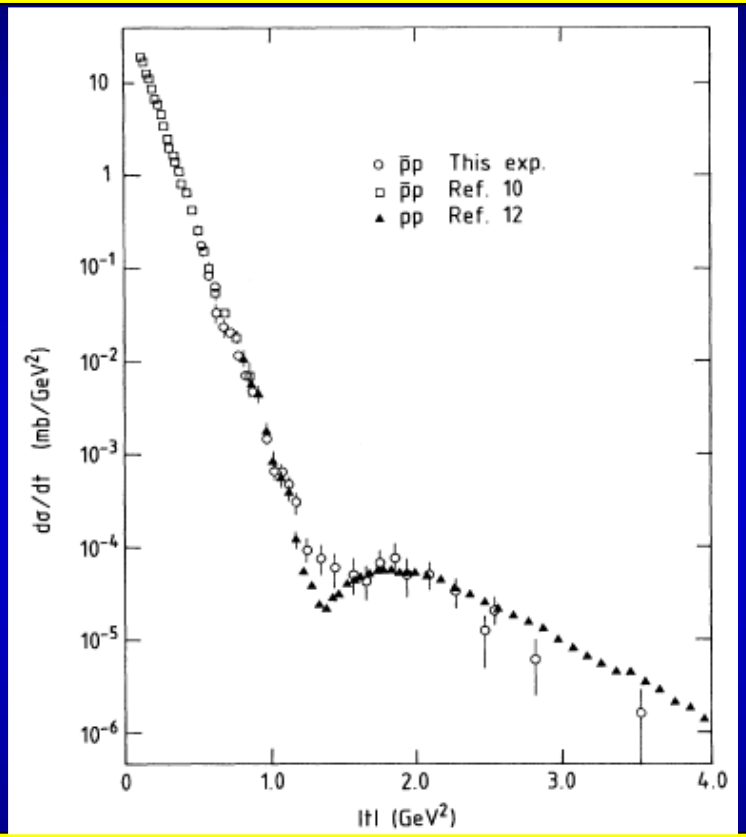


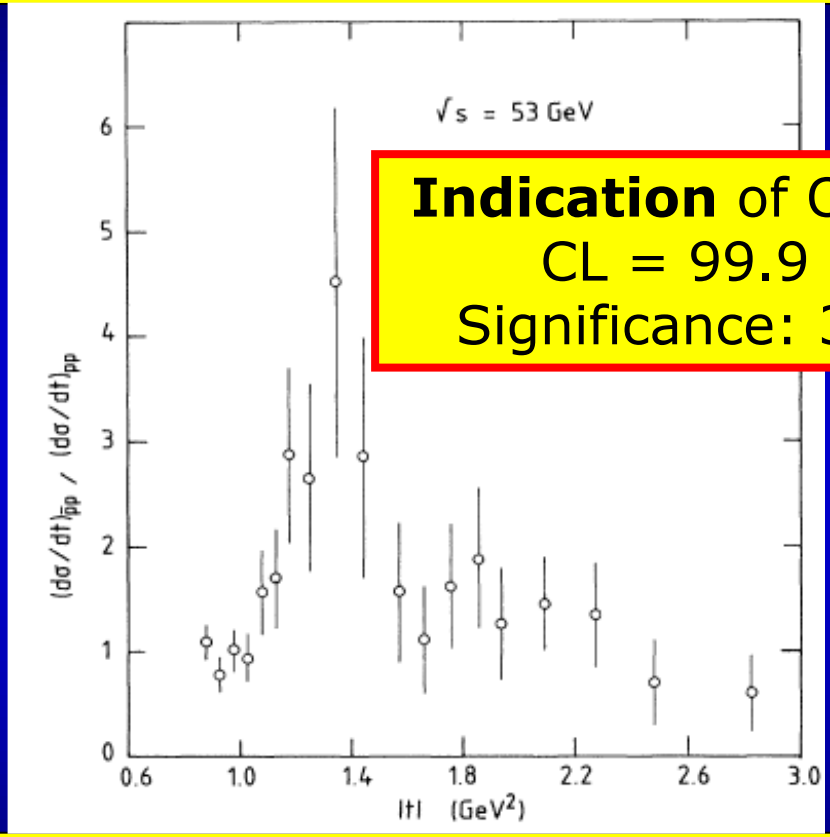


Odderon name coined: D. Joynson, E. Leader, B. Nicolescu, C. Lopez, Nuovo Cim. 30A, 345 (1975) - Well established in QCD by now !
Honorable mention: A. V. Efremov, R. Peschanski, JINR-E2-6350 (1972)

Odderon: elusive experimentally

Odderon search at ISR: indication but no conclusive result
Breakstone et al, Phys. Rev. Lett. 54, 2180 (**1985**): CL = 99.9 %





Indication of Odderon
CL = 99.9 %,
Significance: 3.35 σ

Terminology for **this** talk:
Agreement if statistical significance is < **3** σ
Indication of signal if **3** σ ≤ significance < **5** σ
Evidence or observation of signal if **5** σ ≤ significance
Discovery of signal if **5** σ ≤ significance **for the first time**.

2021 observations of Odderon with > 5 σ

Evidence of Odderon-exchange from scaling properties of elastic scattering at TeV energies

#5

T. Csörgő (Wigner RCP, Budapest and CERN), T. Novak (Unlisted, HU), R. Pasechnik (Lund U., Dept. Theor. Phys.), A. Ster (Wigner RCP, Budapest), I. Szanyi (Wigner RCP, Budapest) (Dec 26, 2019)

Published in: *Eur.Phys.J.C* 81 (2021) 2, 180 • e-Print: 1912.11968 [hep-ph]

Online attention

26 tweeters · 4 blogs · 2 Facebook pages · 15 news outlets · 4 Wikipedia page · 3 Mendeley

This article is in the 98th percentile (ranked 6,037th) of the 428,075 tracked articles of a similar age in all journals and the 99th percentile (ranked 1st) of the 231 tracked articles of a similar age in *The European Physical Journal C*

Hungarian-Swedish Odderon:
Eur. Phys. J. C (2021) **81**: 180, Published: 23 February 2021
https://doi.org/10.1140/epjc/s10052-021-08867-6

a real extended Bialas–Bzdak model study

#2

anyi (Eotvos U. and Wigner RCP, Budapest) (May 28, 2020)

Published in: *Eur.Phys.J.C* 81 (2021) 7, 611 • e-Print: 2005.14319 [hep-ph]

6 citations

Online attention

3 tweeters · 1 Wikipedia page · 1 Mendeley

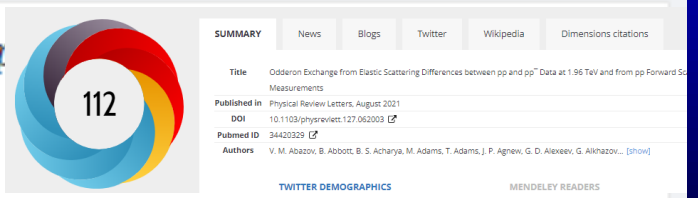
Hungarian-Polish Odderon:
Eur. Phys. J. C (2021) **81**:611 , Published: 13 July 2021
https://doi.org/10.1140/epjc/s10052-021-09381-5

Odderon Exchange from Elastic Scattering Differences between *pp* from pp Forward Scattering Measurements

TOTEM and D0 Collaborations • V.M. Abazov (Dubna, JINR) et al. (Dec 7, 2020)

Published in: *Phys.Rev.Lett.* 127 (2021) 6, 062003 • e-Print: 20

pdf · links · DOI · cite



D0-TOTEM Odderon:
Phys. Rev. Lett. **127** (2021) 6, 062003, Published: 4 August 2021
https://doi.org/10.1103/PhysRevLett.127.062003

2022 observations of Odderon with > 5 σ

Characterisation of the dip-bump structure observed in proton–proton elastic scattering at $\sqrt{s}$ = 8 TeV #1

TOTEM Collaboration • G. Antchev (Pilsen U.) et al. (Nov 23, 2021)

Published in: *Eur.Phys.J.C* 82 (2022) 3, 263 • e-Print: 2111.11991 [hep-ex]

Online attention

This article is in the 1st percentile (ranked 279,419th) of the 343,918 tracked articles of a similar age in all journals and the 1st percentile (ranked 73rd) of the 114 tracked articles of a similar age in *The European Physical Journal C*

8 TeV: EPJ C (2022) 82, 263 (2022).Published: March 26, 2022
https://doi.org/10.1140/epjc/s10052-022-10065-x
Publishes final data for D0-TOTEM PRL published in 2021

The ReBB model and its H(x) scaling version at 8 TeV: Odderon exchange is a certainty #1

I. Szanyi (Eotvos U. and Wigner RCP, Budapest and Karoly Robert U. Coll.), T. Csörgő (Wigner RCP, Budapest and Karoly Robert U. Coll.) (Apr 21, 2022)

Published in: *Eur.Phys.J.C* 82 (2022) 9, 827, *Eur.Phys.J.C* 82 (2022) 827 • e-Print: 2204.10094 [hep-ph]

Online attention

This article is in the 64th percentile (ranked 57,525th) of the 166,532 tracked articles of a similar age in all journals and the 99th percentile (ranked 1st) of the 1 tracked articles of a similar age in *The European Physical Journal C*

New TOTEM 8 TeV data vs ReBB model predictions:
EPJ C 82 (2022) 9, 827. Published: Sept 19, 2022
In the ReBB model, Odderon exchange is a certainty
Presented at Diffraction-Low-X'22 by I. Szanyi

What about model independent results?

Three Oldest Hungarian Universities

UP Story - 650 years

Home » University » UP Story 650 years

University of Pécs: 1367

The history of higher education in Pécs dates back to 1367, when Louis th
episcopal city of Pécs. As a result of an integration proc
d, which has become one of the most famous, prestigiou
n. It has ten faculties which cover the full spectrum of h
1367

University of Pécs:
S: Oldest, C: in Hungary

ALMA MATER STUDIORUM A.D. 1088

University of Debrecen: 1538

recen, the oldest institution of higher education in the country operated continuously in the same city, is one of the research
l excellence in Hungary offering the widest spectrum of educational programs in 14 faculties and 24 doctoral schools.

oots of higher ed
e Reformed Col
education and culture
the *gerundium*, a too
showing respect for ar

University of Debrecen:
S: Oldest, C: in Hungary,
operating continuously and in the *same city*

(S,C) structure evident,
S: statement, valid if
C: condition is satisfied
See talk of R. Dardashti at ISMD21
C changes → S changes, examples follow

Eötvös University:
S: Oldest, C: in Hungary,
teaching continuously

in Nagyszombat in 1635 (sixteen thirty-five) by Archbishop of Esztergom, Péter Pázmány, and it is the oldest Hungarian university where the teaching has continued uninterrupted since its inception. More than sixty years

Eötvös Loránd University: 1635

Hungarian-Swedish Odderon, 2019 -

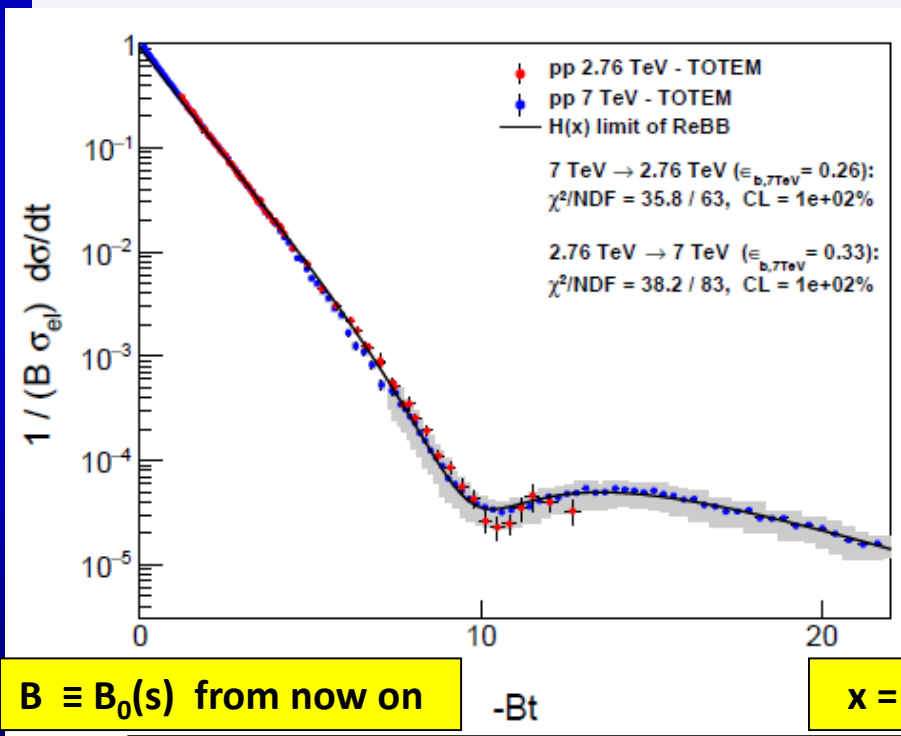
Evidence of Odderon-exchange from scaling properties of elastic scattering at TeV energies #5

T. Csörgő (Wigner RCP, Budapest and CERN), T. Novak (Unlisted, HU), R. Pasechnik (Lund U., Dept. Theor. Phys.), A. Ster (Wigner RCP, Budapest), I. Szanyi (Wigner RCP, Budapest) (Dec 26, 2019)

Published in: *Eur.Phys.J.C* 81 (2021) 2, 180 • e-Print: 1912.11968 [hep-

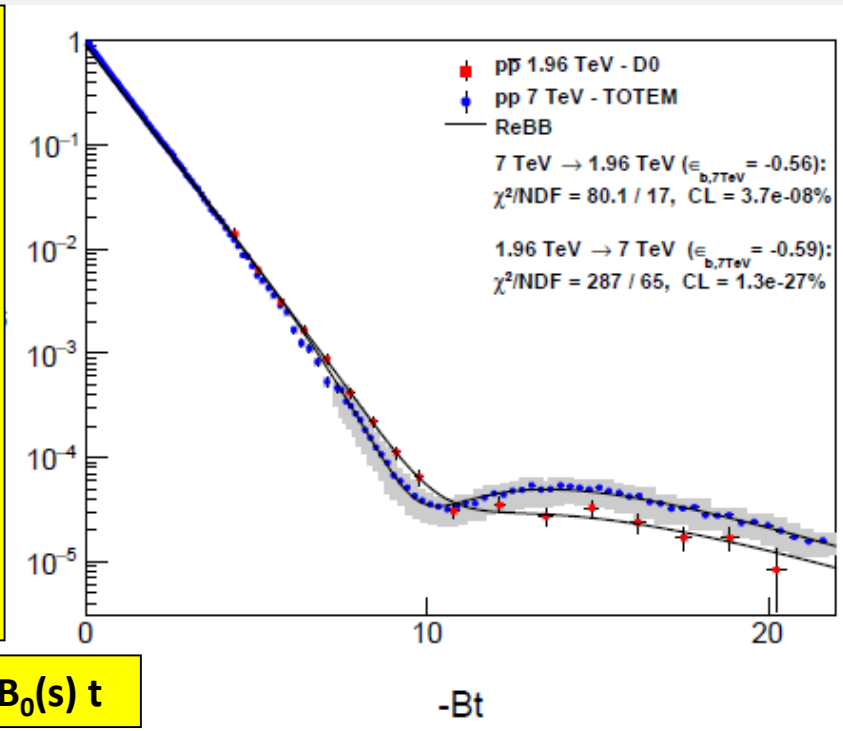
pdf DOI cite 15 citations

Eur. Phys. J. C (2021) **81**: 180, published February 2021
https://doi.org/10.1140/epjc/s10052-021-08867-6



B ≡ $B_0(s)$ from now on

H(x) = 1/(B σ_{el}) dσ/dt vs x = - B t



x = - B t = - $B_0(s)$ t

S: Model independent Odderon significance ≥ 6.26 σ
C1: All D0 and TOTEM published data at 1.96, 2.76 and 7.0 TeV
C2: domain of validity is still determined **model dependently**.

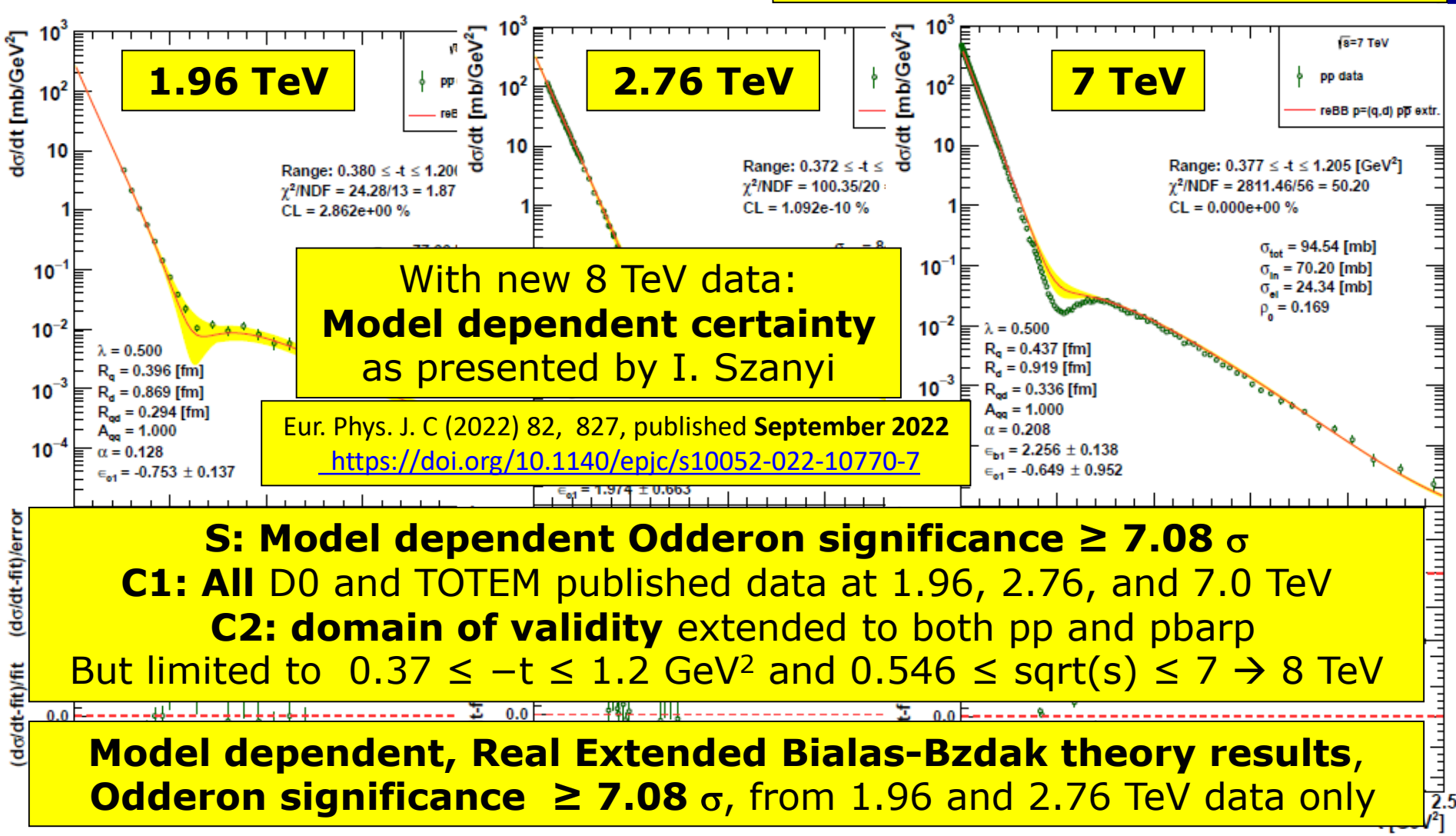
Hungarian-Polish Odderon, 2020-

Observation of Odderon Effects at LHC energies -- A Real Extended Bialas-Bzdak Model Study #2

T. Csorgo (Wigner RCP, Budapest and EKU KRC, Gyongyos), I. Szanyi (E

e-Print: 2005.14319 [hep-ph]

Eur. Phys. J. C (2021) **81**:611, published July 2021
https://doi.org/10.1140/epjc/s10052-021-09381-5



With new 8 TeV data:
Model dependent certainty
as presented by I. Szanyi

Eur. Phys. J. C (2022) 82, 827, published **September 2022**
https://doi.org/10.1140/epjc/s10052-022-10770-7

S: Model dependent Odderon significance ≥ 7.08 σ
C1: All D0 and TOTEM published data at 1.96, 2.76, and 7.0 TeV
C2: domain of validity extended to both pp and pbarp
But limited to $0.37 \leq -t \leq 1.2$ GeV² and $0.546 \leq \sqrt{s} \leq 7 \rightarrow 8$ TeV

Model dependent, Real Extended Bialas-Bzdak theory results,
Odderon significance ≥ 7.08 σ, from 1.96 and 2.76 TeV data only

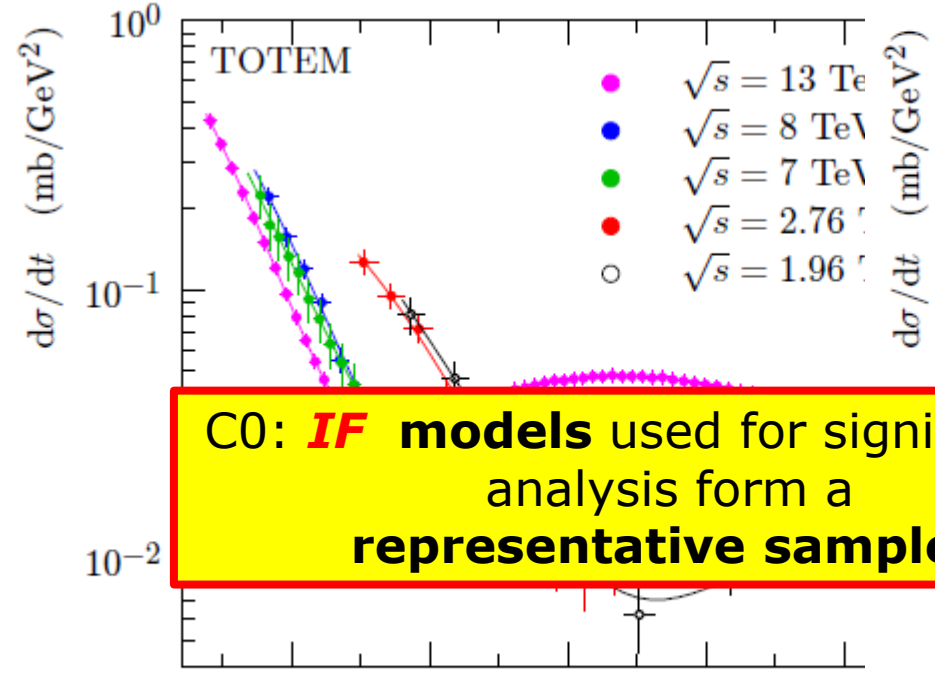
D0-TOTEM Odderon, 2020-

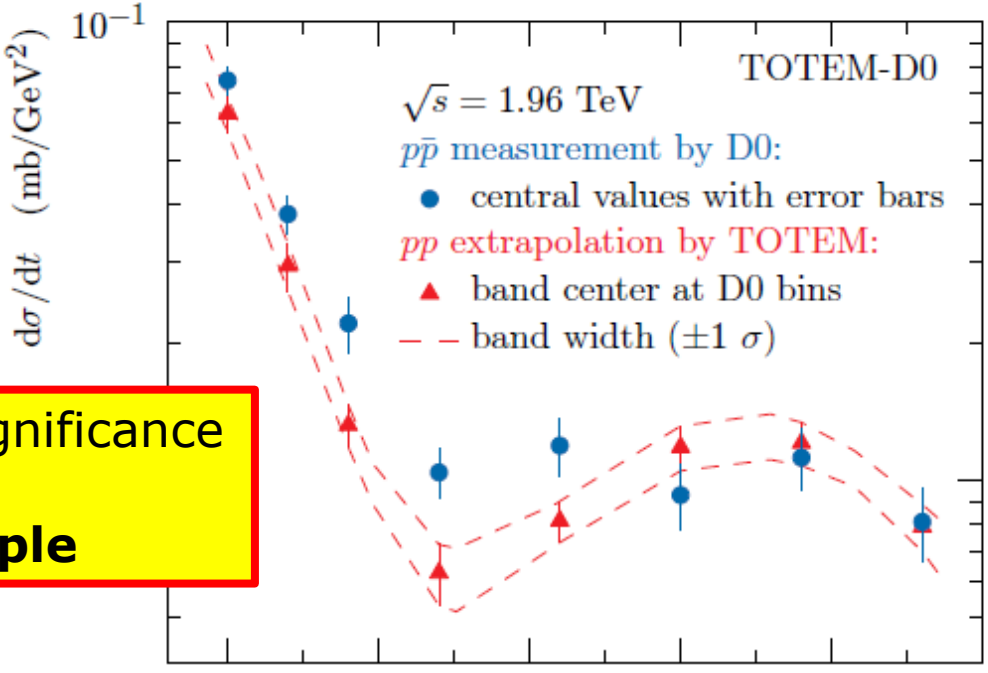
Odderon Exchange from Elastic Scattering Differences between pp and $p\bar{p}$ Data at 1.96 TeV and from pp Forward Scattering Measurements #1

TOTEM and D0 Collaborations • V.M. Abazov (Dubna, JINR) e

Published in: *Phys.Rev.Lett.* 127 (2021) 6, 062003 • e-Print: 20

Phys. Rev. Lett. **127** (2021) 6, 062003, Published: 4 August 2021
https://doi.org/10.1103/PhysRevLett.127.062003





C0: ***IF*** **models** used for significance analysis form a **representative sample**

S: Odderon significance ≥ 5.2 σ, *IF*

C1: ***if*** **almost model independently combined** with $\sqrt{s}$ = 13 TeV data **at t = 0:** σ_{tot} and ρ_0

C2: ***if*** a **new pp dataset** at 8 TeV and **a new data point** at 2.76 TeV,

C3: ***if*** **only 8 out of the 17 D0 points are used**

C4: ***if*** D0 pbarp data and TOTEM pp extrap.data are **assumed** to be **equal at t=0**

Status of D0-TOTEM Odderon search

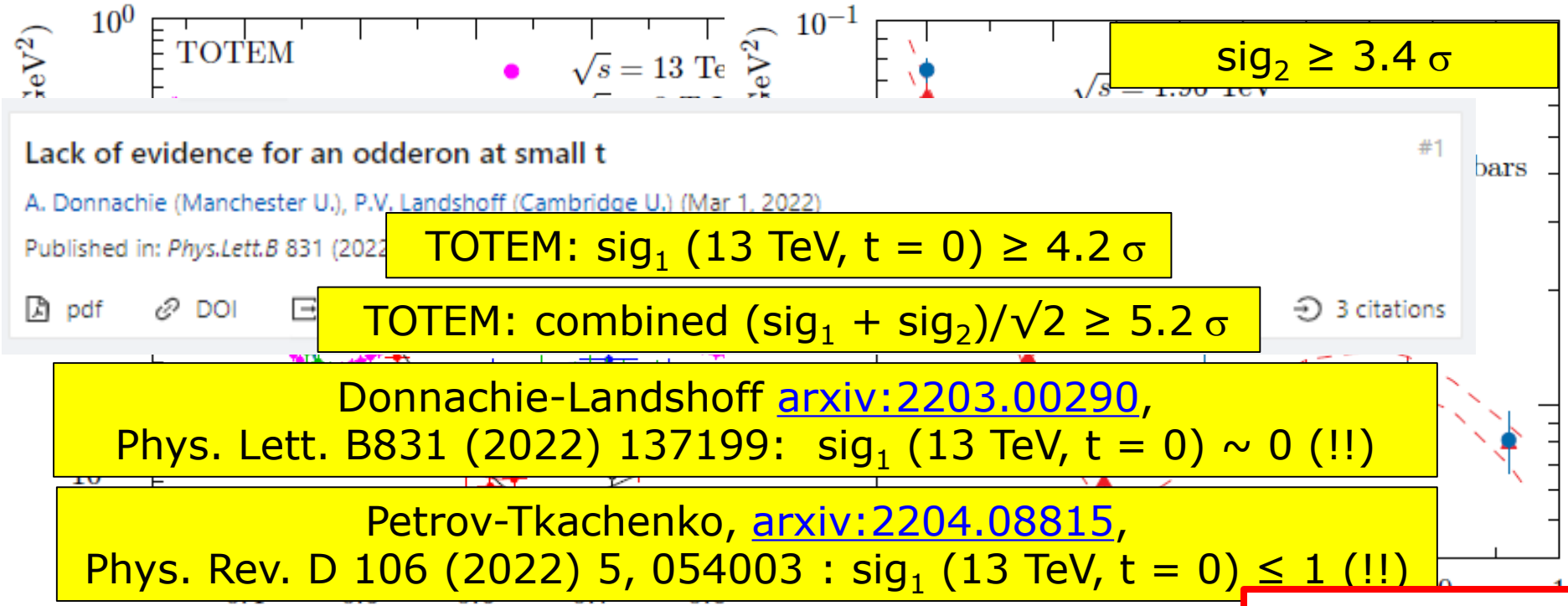
Odderon Exchange from Elastic Scattering Differences between pp and $p\bar{p}$ Data at 1.96 TeV and from pp Forward Scattering Measurements

#1

TOTEM and D0 Collaborations • V.M. A

Published in: *Phys.Rev.Lett.* 127 (2021)

Phys. Rev. Lett. **127** (2021) 6, 062003, Published: 4 August 2021
https://doi.org/10.1103/PhysRevLett.127.062003



$sig_2 \geq 3.4\,\sigma$

Lack of evidence for an odderon at small t

#1

A. Donnachie (Manchester U.), P.V. Landshoff (Cambridge U.) (Mar 1, 2022)

Published in: *Phys.Lett.B* 831 (2022

pdf DOI 3 citations

TOTEM: sig_1 (13 TeV, t = 0) $\geq 4.2\,\sigma$

TOTEM: combined $(sig_1 + sig_2)/\sqrt{2} \geq 5.2\,\sigma$

Donnachie-Landshoff arxiv:2203.00290,
Phys. Lett. B831 (2022) 137199: sig_1 (13 TeV, t = 0) ~ 0 (!!)

Petrov-Tkachenko, arxiv:2204.08815,
Phys. Rev. D 106 (2022) 5, 054003 : sig_1 (13 TeV, t = 0) ≤ 1 (!!)

$\rho = 0.10 \pm 0.04,$

$0.01 \lesssim |t| \lesssim 0.05\ \mathrm{GeV}^2.$

Coulomb-nuclear inte

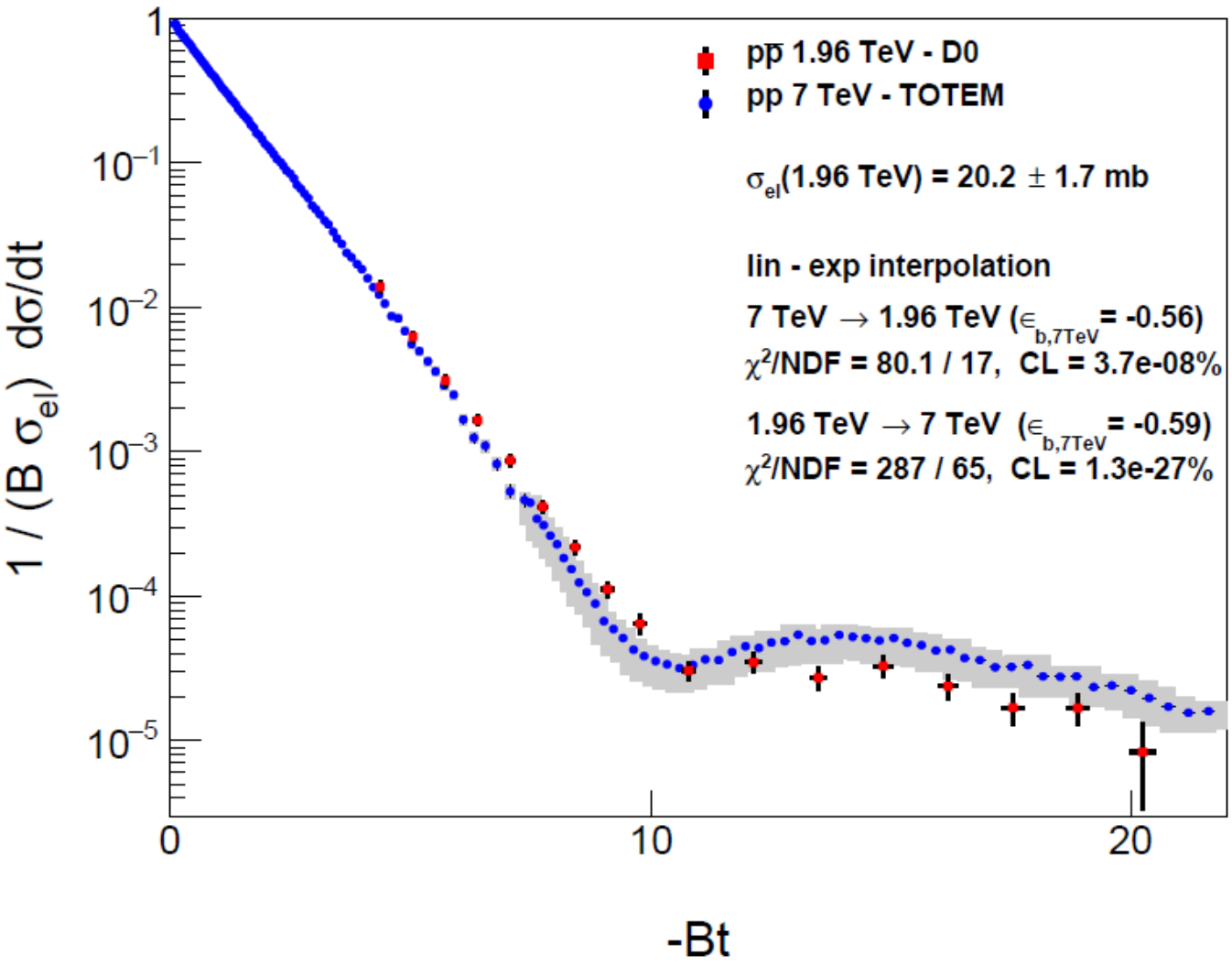
Vladimir A. Petrov (Serpukho

Published in: *Phys.Rev.D* 106 (2022) 5, 054003 • e-Print: 2204.08815 [hep-ph]

pdf DOI cite 0 citations

TOTEM – D0 detailed response :
in preparation, see K. Österberg's talk

Back to Scaling: Model independently



H(x|pp)
s-independent:
2.76 – 7(8) TeV

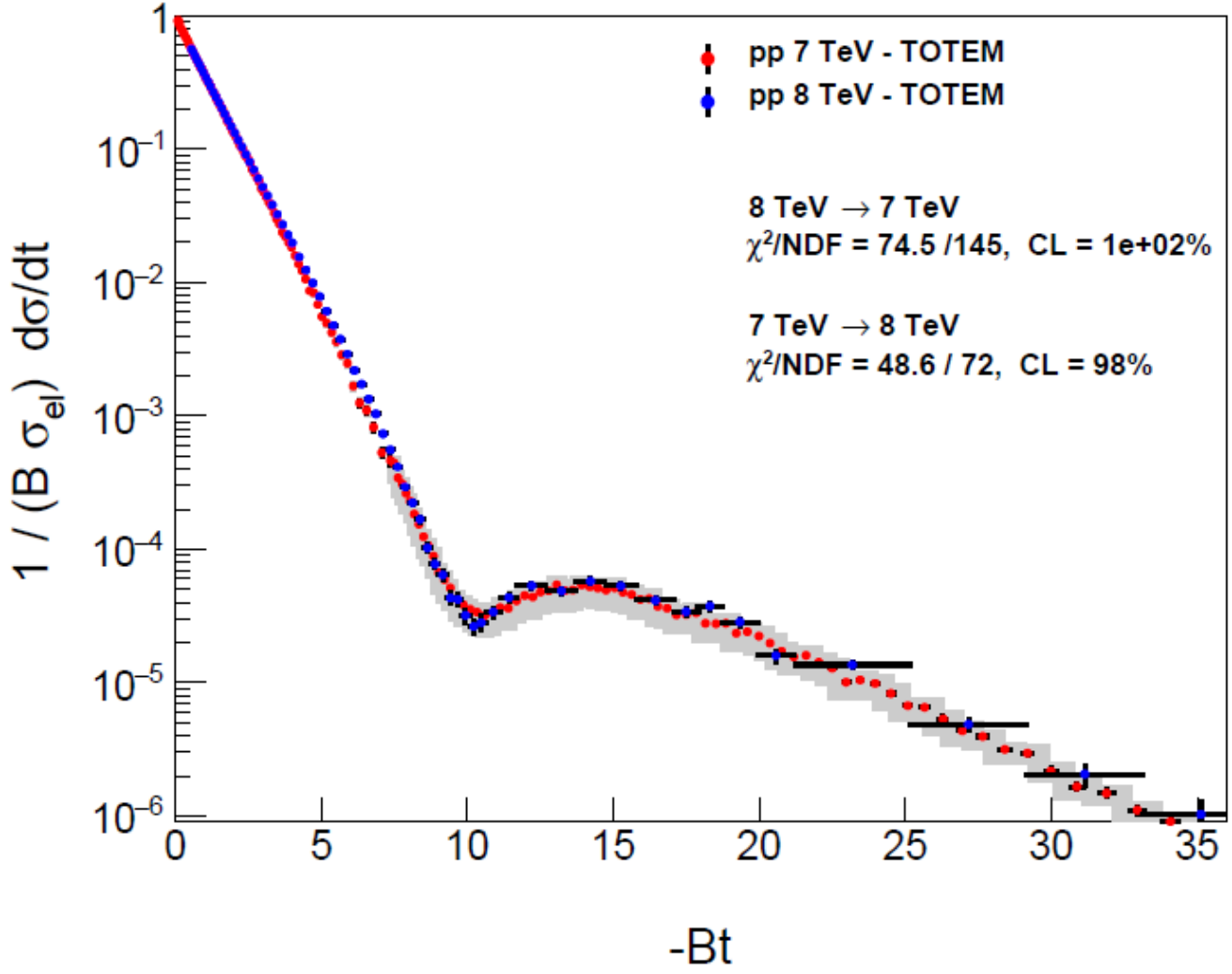
H(x|pp, 7 TeV)
≠
H(x|pbarp, 1.96)

Odderon,
IF scaling holds
in pp down to
1.96 TeV
Domain of validity:
ReBB model
dependent

6.26 σ
Odderon effect

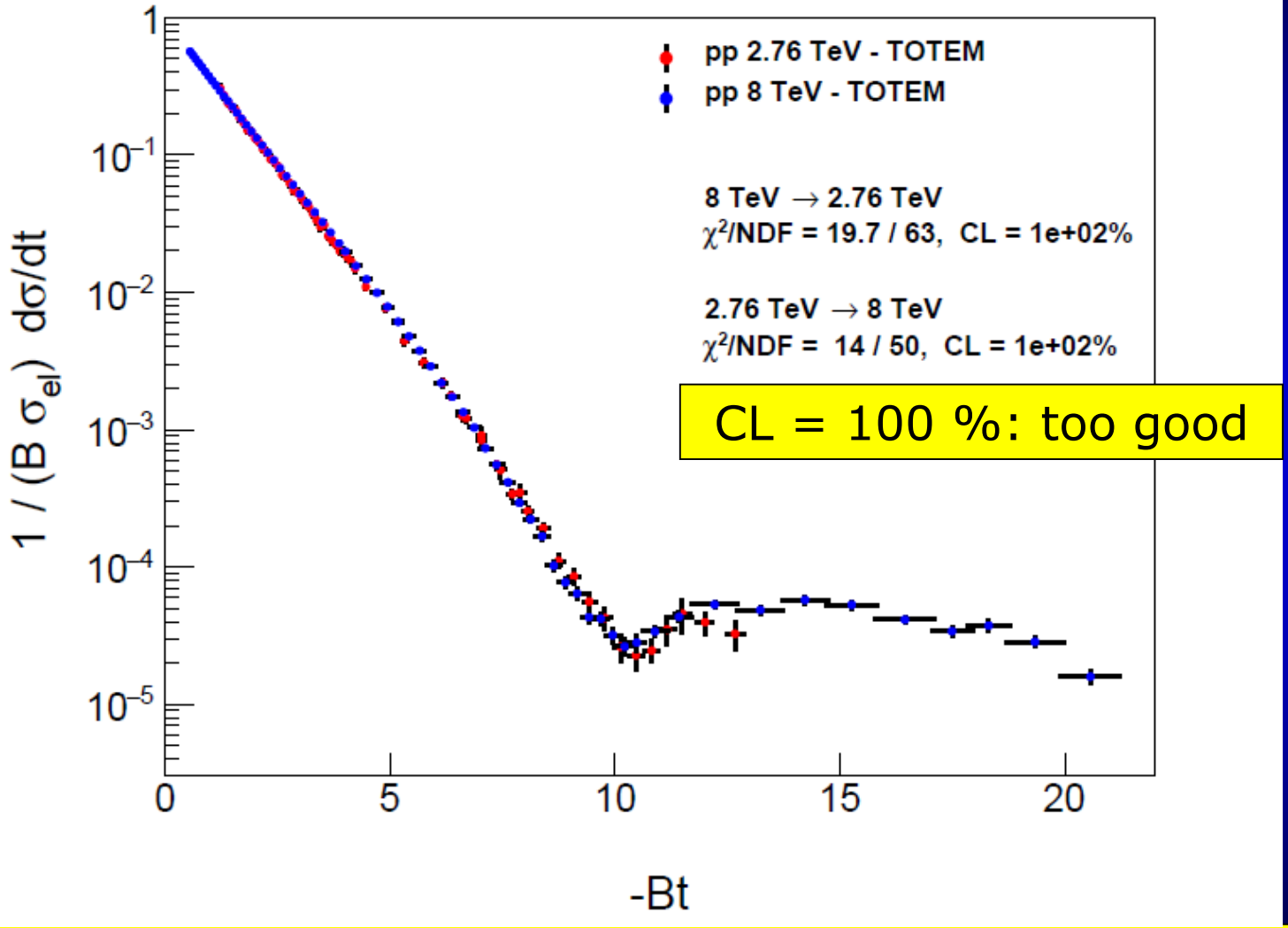
Energy range: tested **both** model independently and with modelling.
Modelling is useful, but model independent tests more important!

H(x) scaling of 7 and 8 TeV data



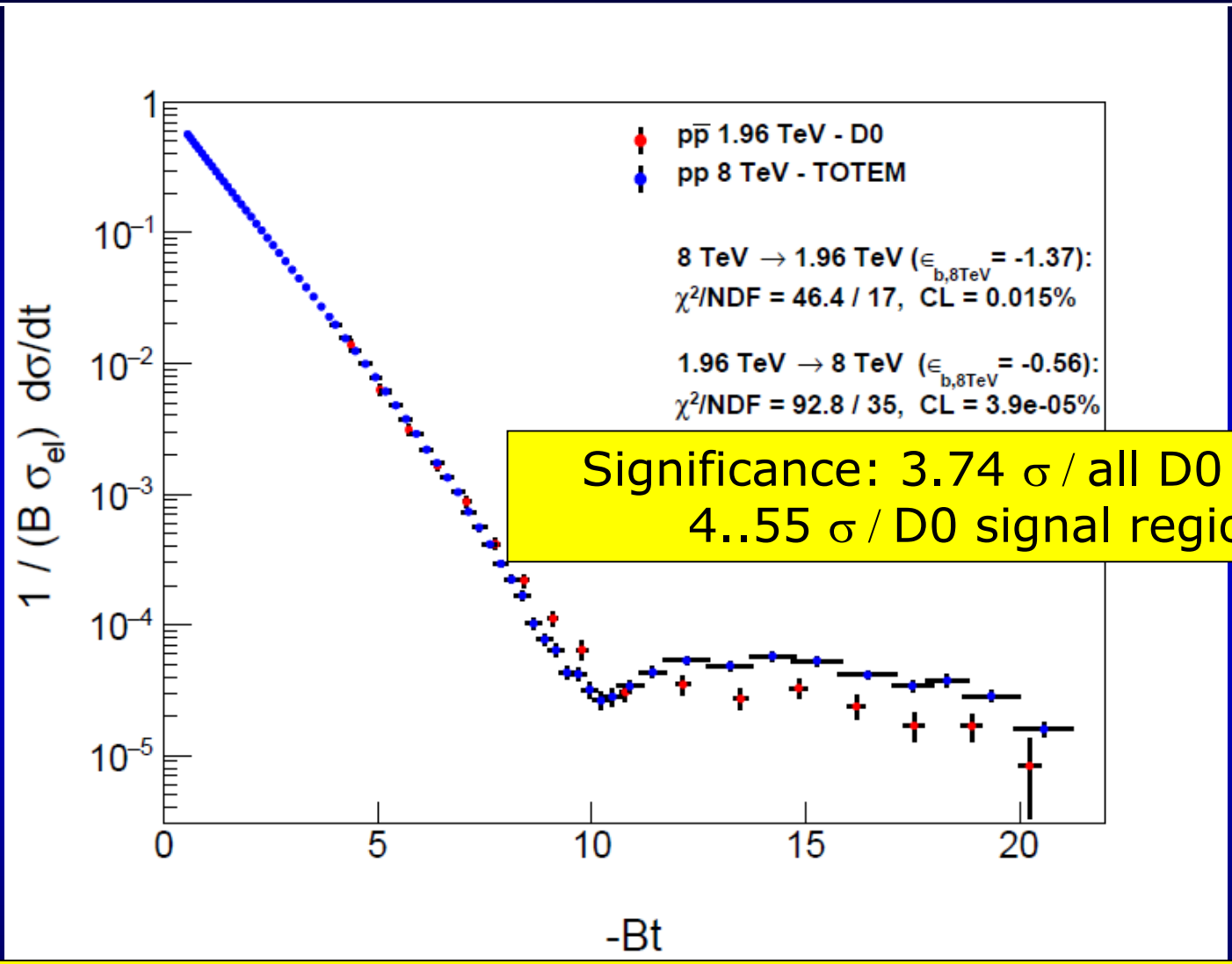
Energy range: H(x) scaling model independently up to √s= 8 TeV.
Uses final, published TOTEM dσ/dt data at 8 TeV

H(x) scaling of 2.76 and 8 TeV data



Energy range: H(x) scaling valid between √s= 8 and 2.76 TeV.
Uses final, published TOTEM dσ/dt data at 8 TeV

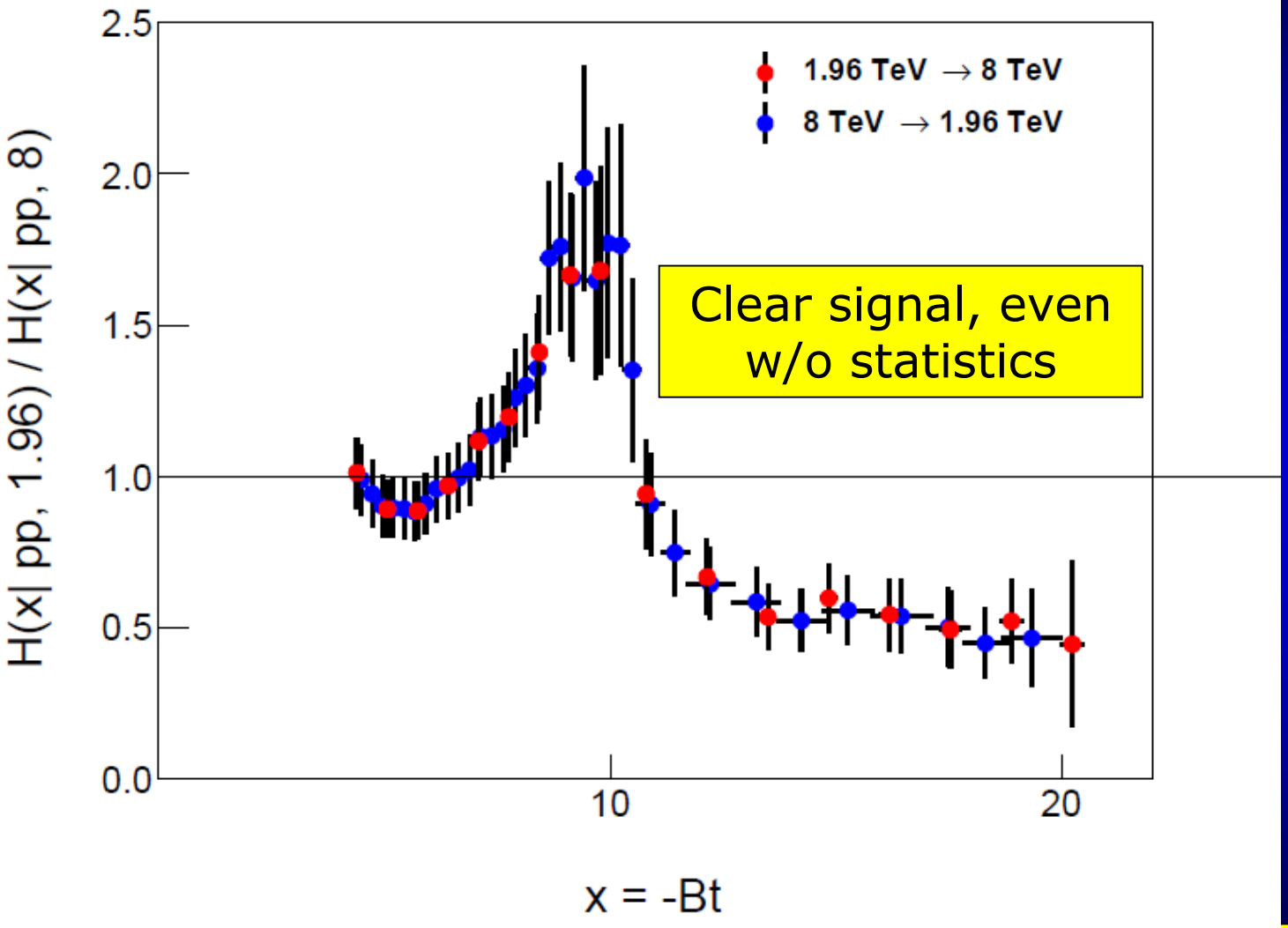
H(x): Odderon signal, new 8 TeV data



Significance: 3.74 σ / all D0 points
4..55 σ / D0 signal region

H(x) scaling is violated between $\sqrt{s}$= 8 TeV pp and 1.96 TeV pbarp. Hungarian-Swedish Odderon signal confirmed with final, published TOTEM dσ/dt data at 8 TeV. Model independently.

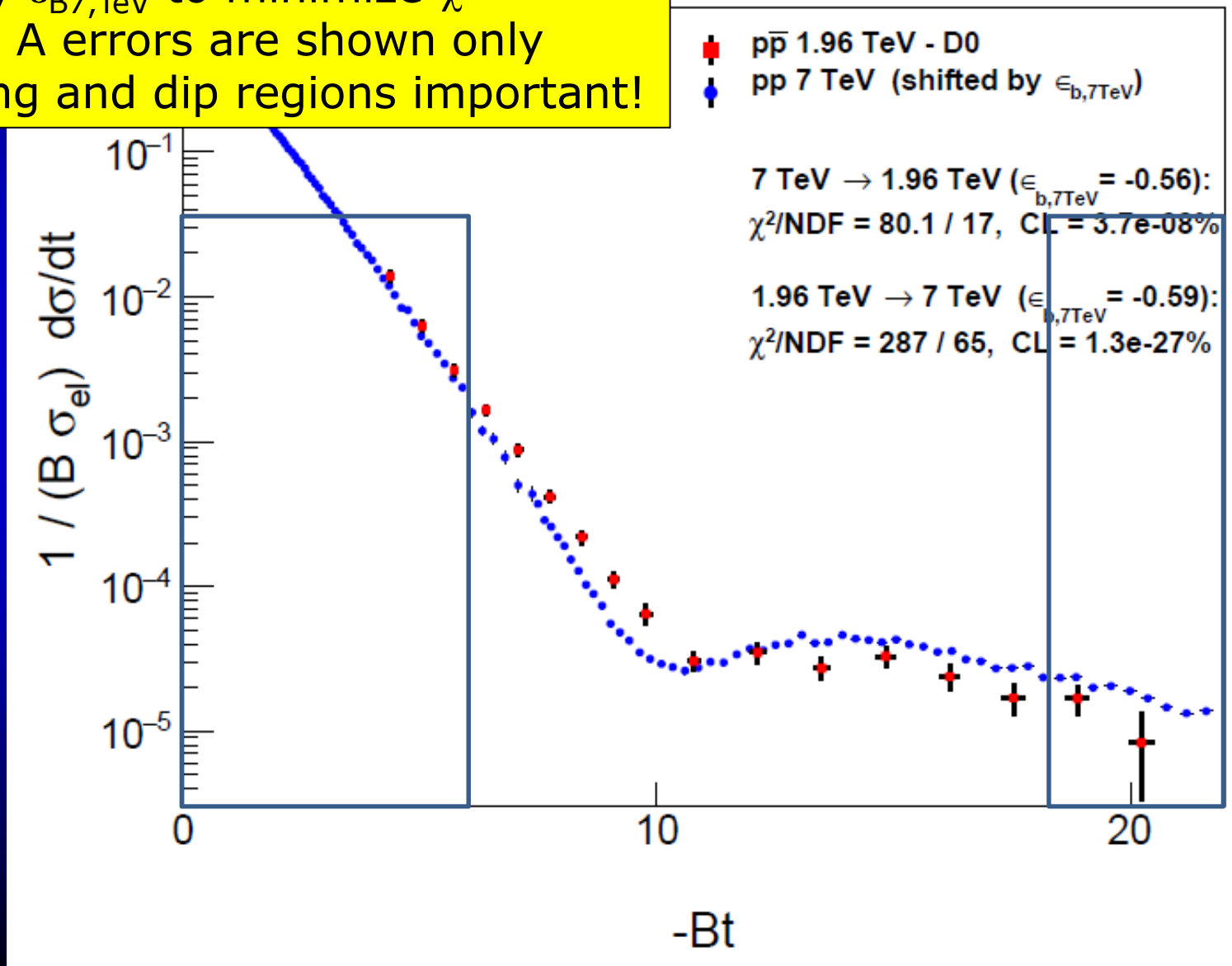
H(x|pbarp)/H(x|pp): Odderon peak



H(x) scaling is violated between √s= 8 TeV pp and 1.96 TeV pbarp. TOTEM dσ/dt data at 8 TeV. Odderon exchange, as a peak.

7 TeV: CLOSING DOORS/GATES

7 TeV data shifted
by $\varepsilon_{B7,TeV}$ to minimize χ^2
Type A errors are shown only
Both swing and dip regions important!



7 TeV RESULTS, CLOSING GATES

Two sliding gates of size n and size m:
(n,m): Leaving out the first n and last m D0 point

Sliding door technique with two wings (n,m)
Left door excludes the first n, right door excludes the last m D0 points

n	m	Odderon signal	Background
2	2	6.27 σ	1.68 σ
3	2	6.33 σ	1.70 σ
4	2	6.21 σ	2.37 σ

MODEL INDEPENT RESULT 1:
In best window, optimized Odderon signal is 6.33 σ

MODEL INDEPENT RESULT 2:
Best window: leaving out first 3 and last 2 D0 point

MODEL INDEPENT RESULT 3:
Outside the best window: H(x|pp) = H(x,pbarp)
pp and pbarp backgrounds agree within 1.7 σ

CROSS-CHECK: SIGNAL AT 8 TeV

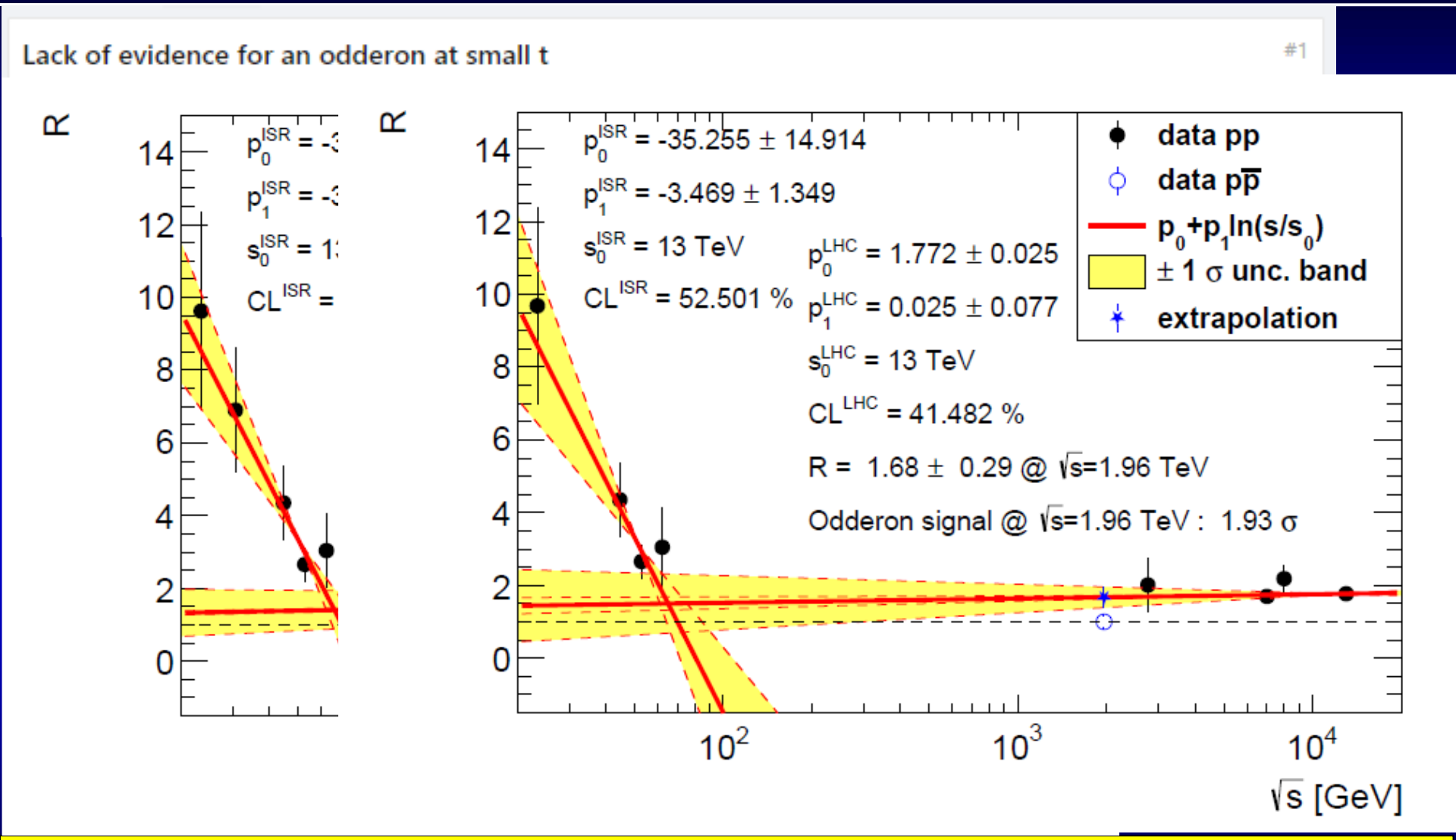
	n=left m=right			
	n\m	0	1	2	3
Colours	0	eps=-1.26 chi2=45.854 sigma=3.74 left=0.1384 right=1.31	eps=-1.20 chi2=44.541 sigma=3.77 left=0.1275 right=3.5	eps=-1.05 chi2=41.006 sigma=3.60 left=0.1023 right=6.44	
Greatest σ in the row	1	eps=-1.33 chi2=45.709 sigma=3.87 left=0.073 right=29	eps=-1.26 chi2=44.408 sigma=3.90 left=0.082 right=3.47	eps=-1.11 chi2=40.898 sigma=3.74 left=0.103 right=6.38	
Greatest σ in the column	2	eps=-1.29 chi2=45.633 sigma=4.01 left=0.115 right=30	eps=-1.21 chi2=44.323 sigma=4.04 left=0.128 right=3.50	eps=-1.07 chi2=40.792 sigma=3.88 left=0.153 right=6.42	
Greatest σ in the table	3	eps=-1.22 chi2=45.512 sigma=4.15 left=0.018 right=32	eps=-1.15 chi2=44.191 sigma=4.19 left=0.014 right=3.53	eps=-0.99 chi2=40.631 sigma=4.03 left=0.006 right=6.50	
	4	eps=-1.26 chi2=45.492 sigma=4.30 left=0.436 right=31	eps=-1.18 chi2=44.175 sigma=4.34 left=0.415 right=3.51	eps=-1.02 chi2=40.624 sigma=4.19 left=0.374 right=6.47	
	5	eps=-1.36 chi2=45.044 sigma=4.42 left=0.899 right=29	eps=-1.28 chi2=43.748 sigma=4.46 left=0.866 right=3.46	eps=-1.10 chi2=40.241 sigma=4.32 left=0.794 right=6.39	
	6	eps=-1.52 chi2=44.113 sigma=4.50 left=2.29 right=1.26	eps=-1.40 chi2=42.850 sigma=4.55 left=2.24 =3.39	eps=-1.26 chi2=39.416 sigma=4.42 left=2.13 right=6.23	
	7	eps=-1.78 chi2=41.738 sigma=4.46 left=6.08 right=1.20	eps=-1.68 chi2=40.527 sigma=4.52 left=5.97 right=3.28	eps=-1.51 chi2=37.211 sigma=4.41 left=5.80 right=5.98	

Two sliding gates of size n and m:
(n,m): Leaving out first n and last m D0 point

(n+1,m): pull vs (n,m+1) pull
Go direction of greater signal

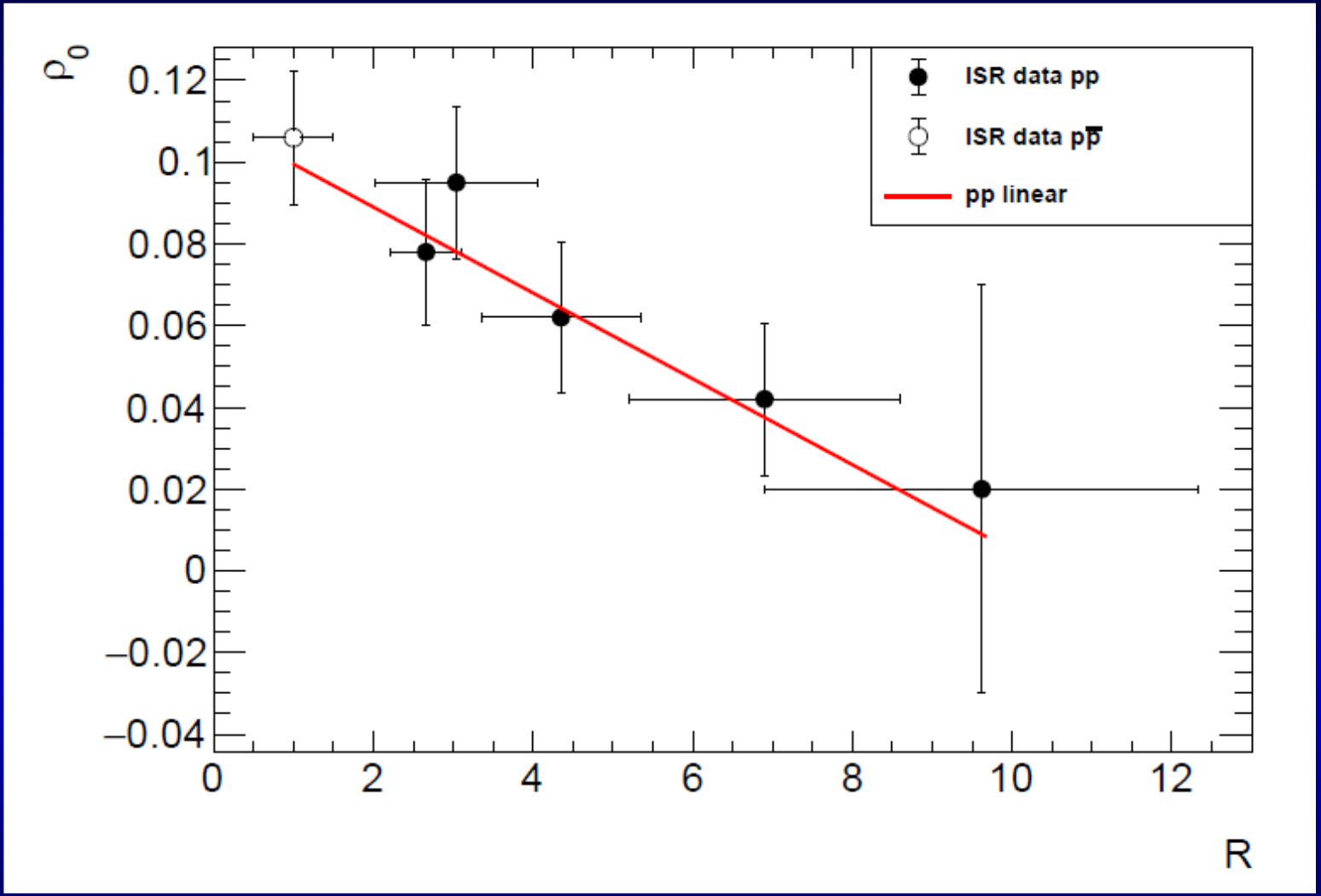
Color code:
Best signal 4.55 σ
5.0 ≥ signal ≥ 4.0 σ
4.0 ≥ signal ≥ 3.0 σ

A model-independent relation: R~ρ



In the ReBB model: $\rho = \rho_0 + \rho_1 \ln(s/s_0)$
In the TeV range: $R = R_0 + R_1 \ln(s/s_0)$
Thus $\rho\,(R) = A + B\,R$: connects large t and small t signals!!

Cross-check: R~ρ



In the ReBB model: $\rho = \rho_0 + \rho_1 \ln(s/s_0)$

In the TeV range: $R = R_0 + R_1 \ln(s/s_0)$

Thus ρ (R) = A + B R : connects large t and small t signals!!

OBSERVATION OF ODDERON

Model-indepent H(x) signal confirmed at 8 TeV

THANK YOU FOR YOUR ATTENTION

BACKUP SLIDES

Hungarian-Swedish Odderon: CORDIS

D0-TOTEM odderon: Nature, CERN

Nature Reviews Physics

CERN Accelerating science

CERN

ABOUT NEWS

News › News › Topic: Knowledge sharing

Voir en français

Relive 2021 at CERN

Highlights of the year at CERN, from exciting particle physics results to accelerator milestones and much more

21 DECEMBER, 2021

Among physics results, the discovery of the odderon by the TOTEM and DØ collaborations, the first laser-cooling of antimatter at ALPHA and first candidate collider neutrinos at FASER are only a few that generated awe at the Laboratory. CLOUD, BASE, AMS, LHCb, CMS, ATLAS, ALICE, ISOLDE and NA64 also had exciting news in store.

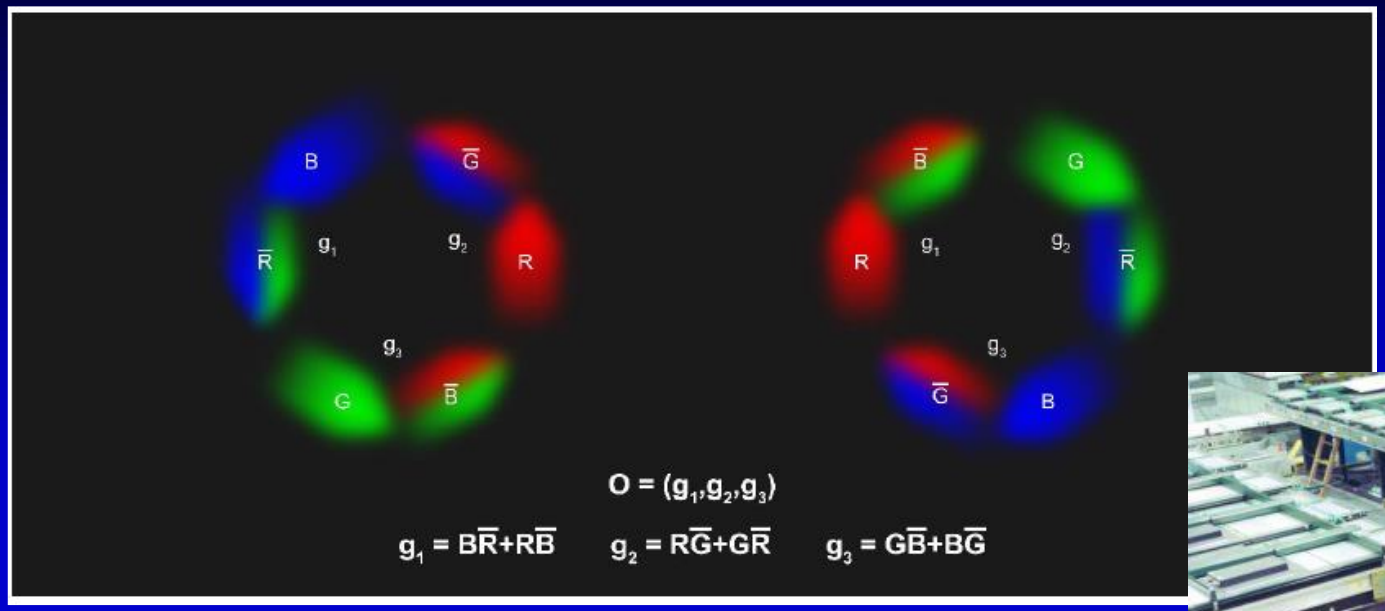
community was that this was not of differential cross-sections

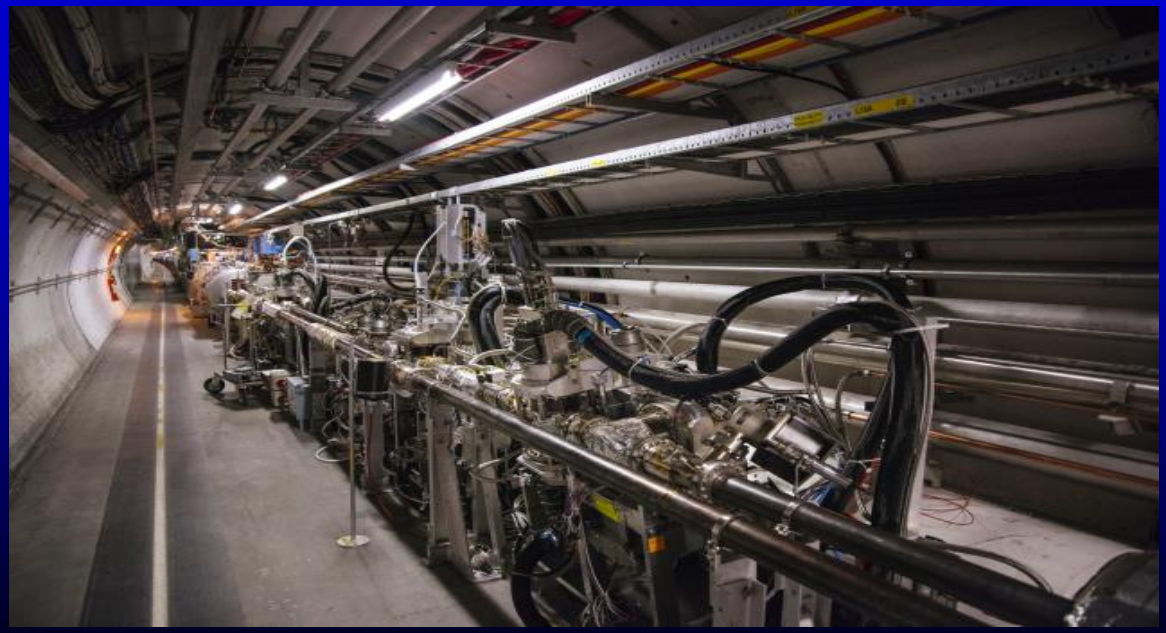
process.

The most direct way to demonstrate the existence of the odderon is to compare $\sigma_{\bar{p}p}$ and σ_{pp} at equal and sufficiently high

NATURE REVIEWS | PHYSICS

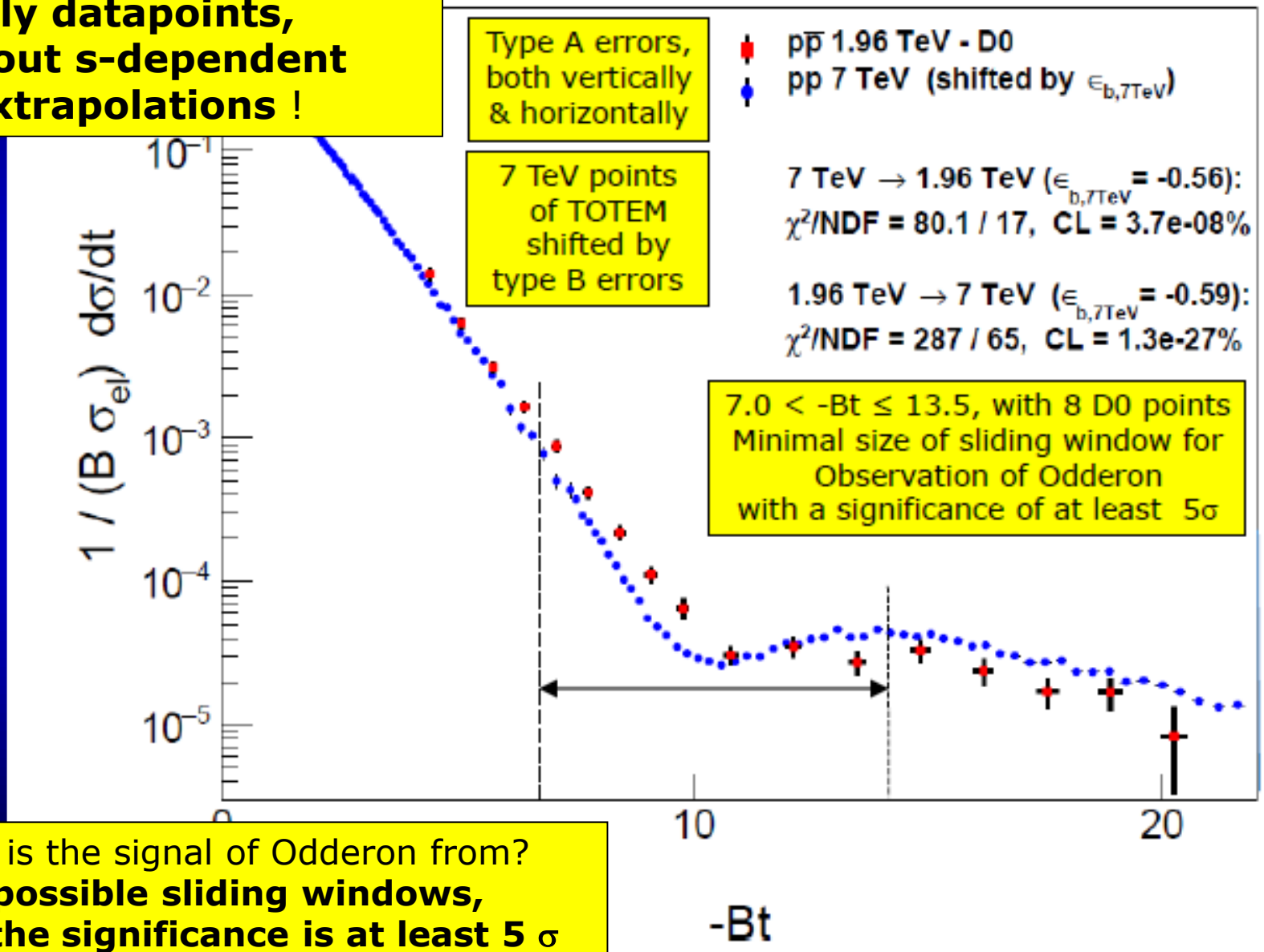
Illustrations: Odderon, TOTEM, D0





7 TeV: SLIDING WINDOW for 5 σ

Model independent results: only datapoints, without s-dependent extrapolations !



Where is the signal of Odderon from?
All possible sliding windows, where the significance is at least 5 σ

BEST SIGNAL AT 7 TeV

n=left m=right

n\m	0	1	2	3	4	5	6	7
0	eps= 0.56 chi2=[illegible]074 sigma=[illegible]26 left=[illegible] right=[illegible]9	eps= 0.51 chi2=77.278 sigma=6.21 left=2.17 right=1.34	eps= 0.46 chi2=75.842 sigma=6.25 left=2.08 right=7.23	eps= 0.32 chi2=67.834 sigma=5.85 left=1.83 right=8.09	eps= 0.13 chi2=58.513 sigma=5.33 left=1.52 right=5.94	eps=0.35 chi2=50.046 sigma=4.83 left=0.87 right=21.2		
1	eps=[illegible] chi2=77.8 sigma=[illegible]25 left=[illegible] right=[illegible]6	eps= 0.53 chi2=75.082 sigma=6.20 left=1.95 right=1.25	eps= 0.48 chi2=73.740 sigma=6.25 left=1.86 right=7.00	eps= 0.34 chi2=65.983 sigma=5.86 left=1.63 right=7.83	eps= 0.15 chi2=56.974 sigma=5.36 left=1.35 right=5.71	eps=0.3 chi2=49.150 sigma=4.91 left=0.79 right=20.6		
2	eps=[illegible]9 chi2=[illegible]63 sigma=6.25 left=[illegible] right=[illegible]7	eps= 0.55 chi2=73.115 sigma=6.21 left=1.28 right=1.16	eps= 0.50 chi2=71.858 sigma=6.26 left=1.2 right=6.78	eps= 0.36 chi2=64.330 sigma=5.9 left=0.98 right=7.57	eps= 0.17 chi2=55.605 sigma=5.42 left=0.73 right=5.49	eps=0.25 chi2=48.339 sigma=5.01 left=0.30 right=19.9	eps=0.98 chi2=23.631 sigma=2.81 left=0.001 right=7.36	
3	eps=[illegible]1 chi2=[illegible]4 sigma=[illegible]29 left=[illegible] right=2.50	eps= 0.57 chi2=71.823 sigma=6.26 left=[illegible] right=[illegible]1.07	eps= 0.52 chi2=70.644 sigma=6.33 left=[illegible] right=[illegible]6.96	eps= 0.38 chi2=63.331 sigma=5.98 left=5.18 right=7.32	eps= 0.19 chi2=54.859 sigma=5.52 left=4.68 right=5.27	eps=0.22 chi2=48.024 sigma=5.15 left=3.69 right=19.5	eps=0.97 chi2=23.630 sigma=3.00 left=2.20 right=7.30	
4	eps= 0.64 chi2=68.538 sigma=6.04 left=8.14 right=2.38	eps= 0.60 chi2=66.074 sigma=6.02 left=8.03 right=0.95	eps= 0.55 chi2=65.028 sigma=6.09 left=7.89 right=6.24	eps= 0.42 chi2=58.101 sigma=5.76 left=7.53 right=6.83	eps= 0.23 chi2=50.123 sigma=5.15 left=7.03 right=4.84	eps=0.11 chi2=44.210 sigma=5.02 left=3.69 right=19.5	eps=0.87 chi2=21.344 sigma=2.94 left=4.48 right=6.66	
5	eps= 0.67 chi2=60.359 sigma=5.61 left=8.34 right=2.27	eps= 0.63 chi2=58.006 sigma=5.59 left=7.93 right=0.84	eps= 0.58 chi2=57.084 sigma=5.68 left=7.52 right=5.82	eps= 0.45 chi2=50.529 sigma=5.35 left=6.18 right=6.47	eps= 0.27 chi2=53.034 sigma=4.74 left=4.66 right=4.43	eps= 0.09 chi2=37.706 sigma=4.64 left=3.36 right=14.8		
6	eps= 0.78 chi2=51.452 sigma=5.09 left=13.7 right=1.88	eps= 0.74 chi2=49.510 sigma=5.10 left=13.1 right=0.48	eps= 0.71 chi2=48.99 sigma=5.23 left=12.7 right=4.64	eps= 0.58 chi2=43.744 sigma=4.98 left=11.1 right=5.03				
7	eps= 0.94 chi2=36.690 sigma=3.99 left=14.7 right=1.38	eps= 0.9 chi2=35.255 sigma=4.03 left=14.3 right=0.13	eps= 0.88 chi2=35.114 sigma=4.21 left=14.1 right=3.2					

Two sliding gates of size n and m:
(n,m): Leaving out first n and last m D0 point

(n+1,m): pull vs (n,m+1) pull
Go direction of greater signal

Color code:
Best signal 6.36 σ
Safe signal ≥ 5.5 σ
5.5 ≥ signal ≥ 5.0 σ
signal ≤ 5.0 σ

Passion for Discovery: Odderon

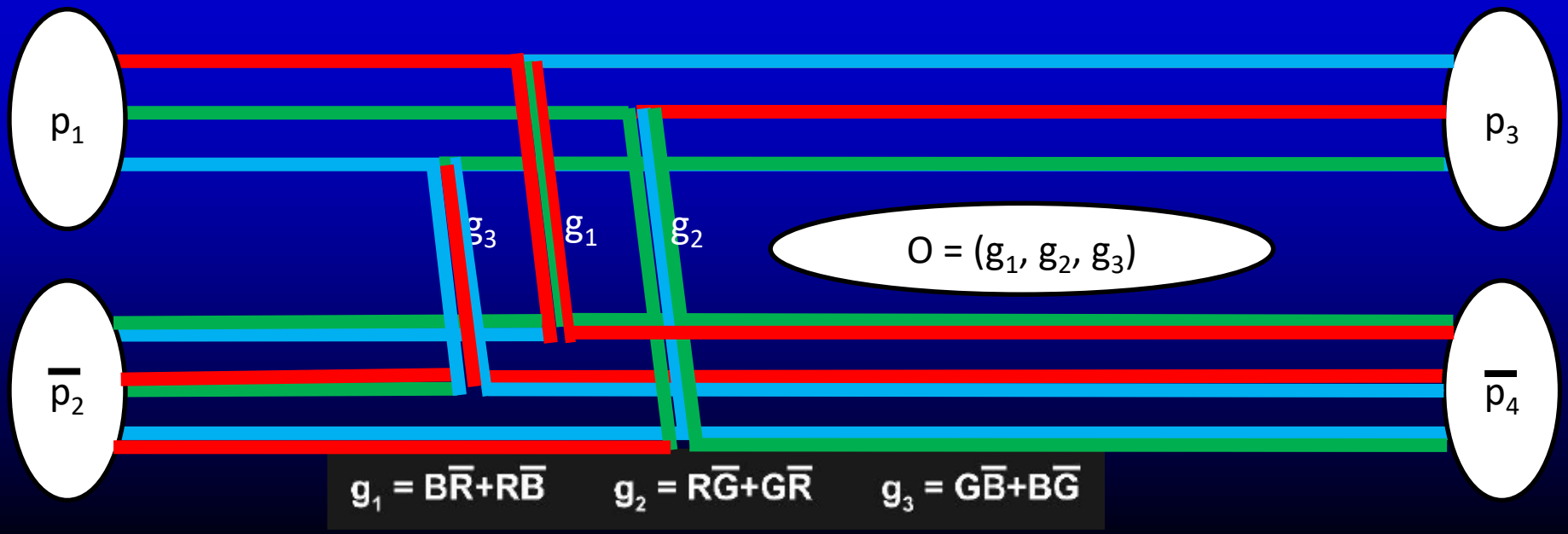
$p+\bar{p} \rightarrow p+\bar{p}$

$(RGB) + (\bar{R}\bar{B}\bar{G}) \rightarrow (BRG) + (\bar{B}\bar{G}\bar{R})$

-

$p+p \rightarrow p+p$

$(RGB) + (RGB) \rightarrow (GBR) + (GBR)$



3+2 Oldest Hungarian Universities

Why Eszterházy Károly Catholic University (EKCU)?

Eszterházy Károly Catholic University is one of the oldest higher educational institutions in Hungary. Opened in 1774 it has served the Northern Hungarian region for nearly three centuries. Now the university offers potential students the opportunity to work towards their BA, BSc, MA, MSc or doctorate

Eszterházy Károly Catholic University: 1774 (or, 2020?)

History of MATE

With the foundation Hungarian University of Agriculture and Life Sciences (MATE), one of the largest agricultural-focused, multi- disciplinary higher education institutions in Europe was established on 1 February 2021.

With such a long history and legacy of excellence, Hungarian University of Agriculture and Life Sciences stands as a central pillar of higher education in Hungary and throughout the region.

Milestones in the history of MATE:

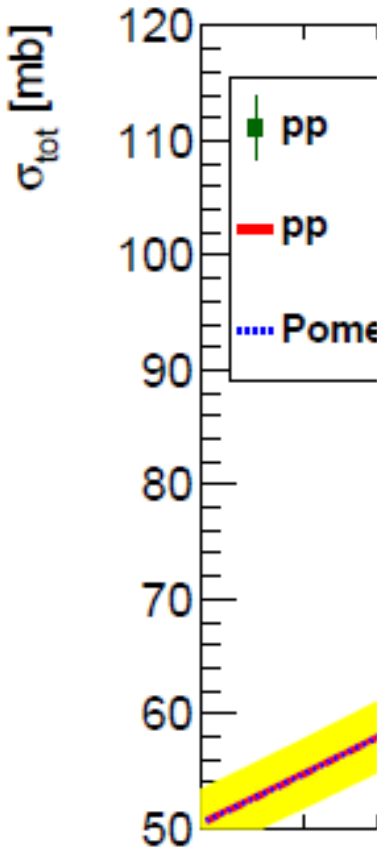
MATE: 2021 (or, from 1787)

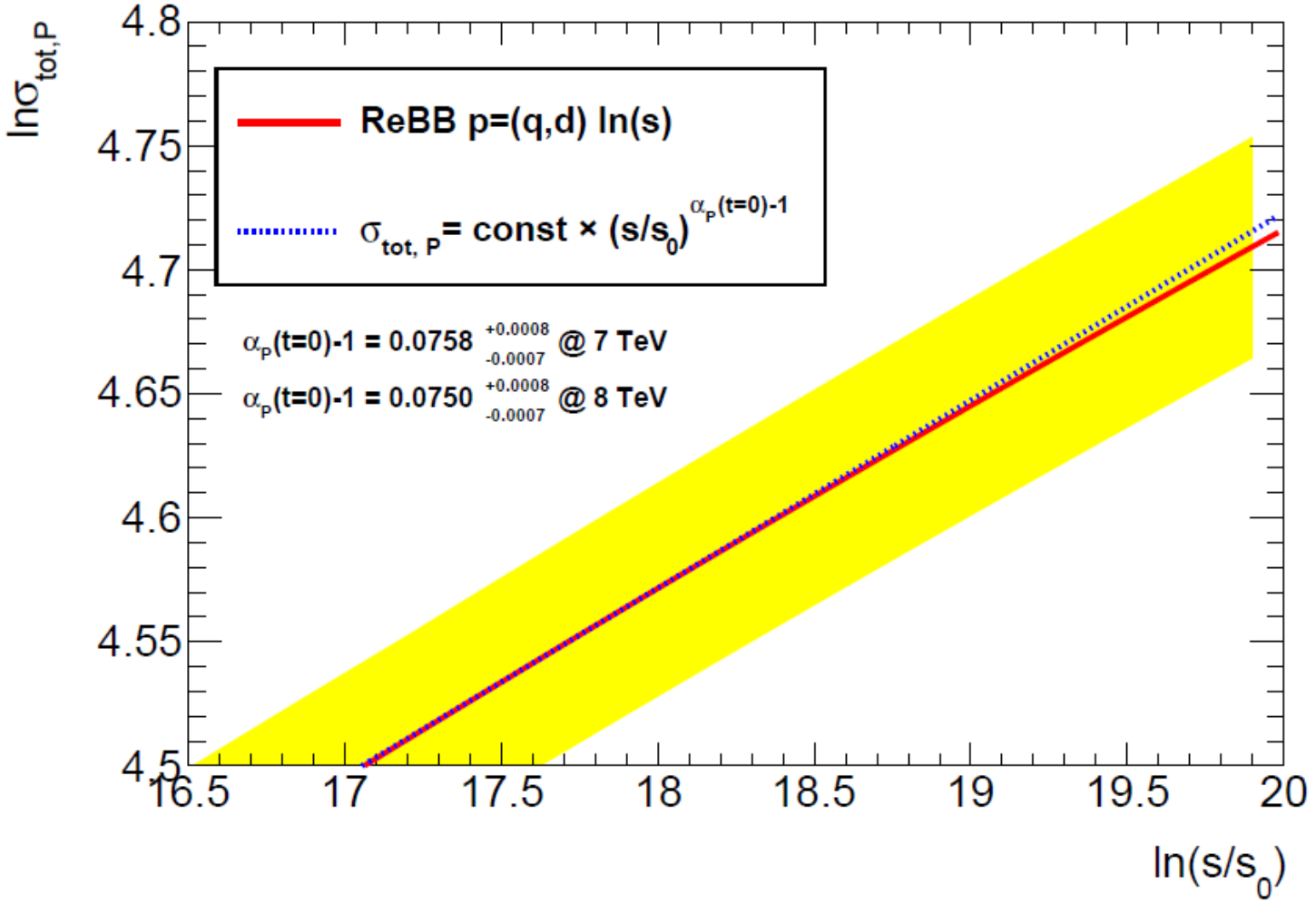
1787 Faculty of Veterinary Medicine founded
1880 Ybl Miklós Technical College founded
1917 Teacher Training College, Jászberény founded
1920 University of Agriculture was founded in Budapest
1950 University of Agriculture moved to Gödöllő
2000 Szent István University founded
2011 institutional integration to 7 faculties
2016 integration of 3 faculties (Food Science, Horticultural Science and Landscape Architecture and Urbanism) of Corvinus University of Budapest; and the disintegration of the Faculty of Veterinary Medicine
2020 integration of Kaposvár University, Eszterházy University's Károly Róbert Campus (Gyöngyös) and Pannon University's Georgikon Faculty in Keszthely

POMERON PROPERTIES

MODEL RESULT BASED ON EPJC 81 (2021) 7, 611

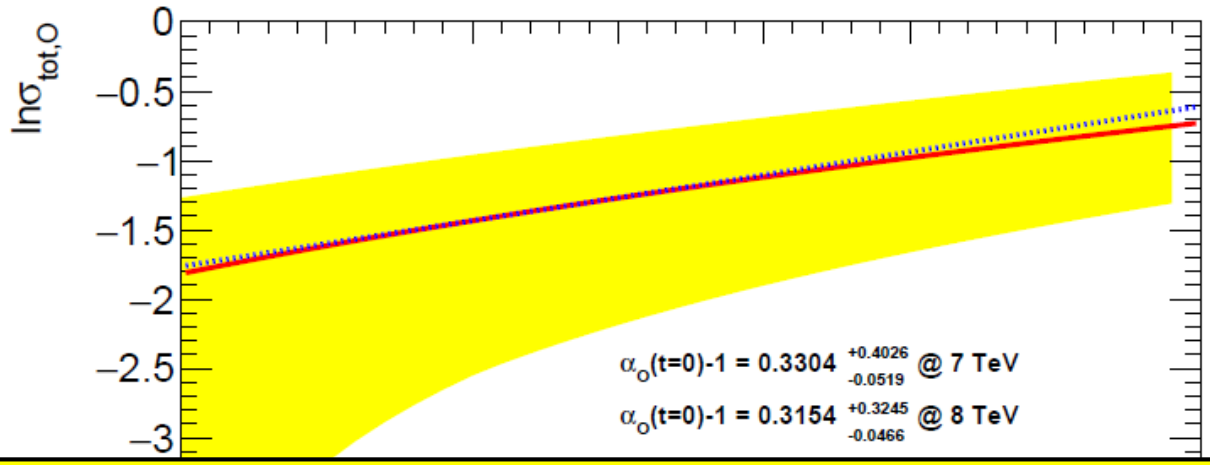
1st property:
Pomeron intercept normal: $\alpha_P(0)-1 = 0.075 \pm 0.001$





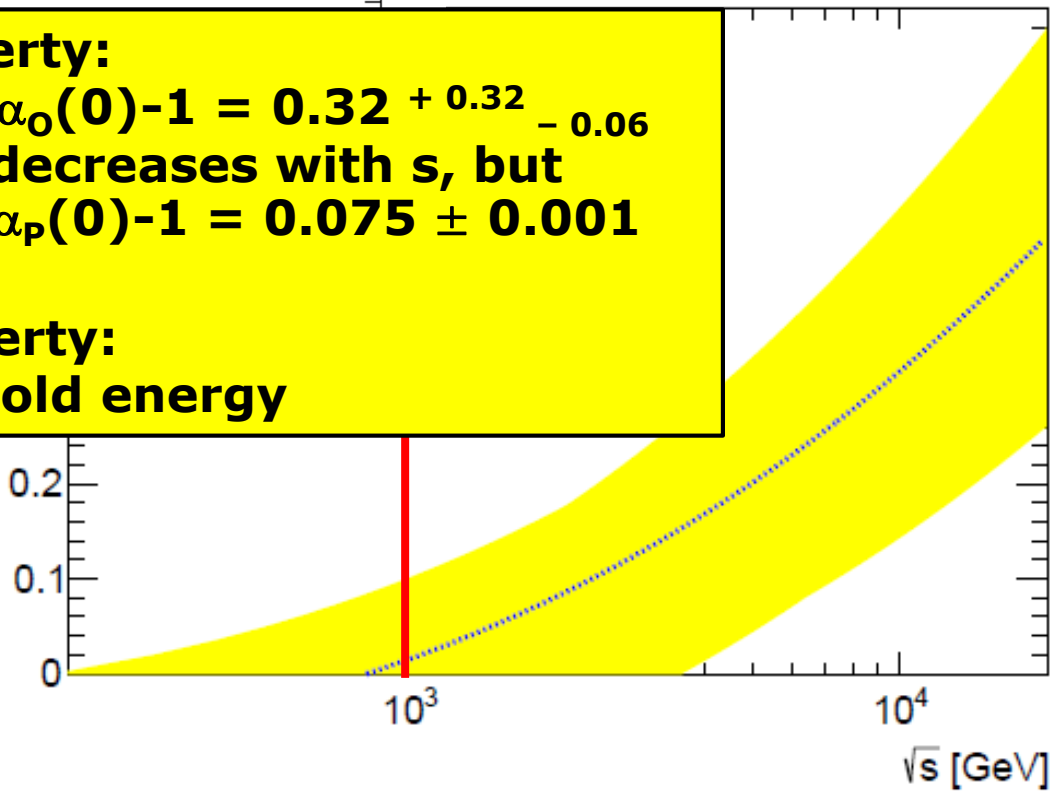
ODDERON PROPERTIES

EPJC 81 (2021) 7, 611



1st property:
Odderon intercept is large, $\alpha_O(0)-1 = 0.32\ ^{+0.32}_{-0.06}$
Threshold effect, slowly decreases with s, but
Pomeron intercept normal: $\alpha_P(0)-1 = 0.075 \pm 0.001$

2nd property:
1 TeV ~ threshold energy



SUMMARY: ODDERON DISCOVERED IN 3 PAPERS, NEW: FOCUS ON ITS PROPERTIES

Bialas-Bzdak p = (q,d) model: certain Odderon effect statistical significance » 5 σ

Odderon first discovered in three published papers:
three different analysis, each with a statistical significance > 5 σ

(S,C) structure evident,
Scientific Statement S is valid if Condition C is satisfied

0th property: Odderon exists! (Questioned: where, at 13 TeV and t=0?)

Odderon properties: from Bialas-Bzdak model, so far valid in a limited s and $-t > 0.37$ GeV^2 range only

Odderon intercept is large, $\alpha_O(0)-1 = 0.32\ ^{+0.32}_{-0.06}$
Pomeron intercept normal: $\alpha_P(0)-1 = 0.075 \pm 0.001$

1.96 TeV – 8 TeV:
Threshold effect, just appearing

Ongoing debate: what is the significance of the D0-TOTEM PRL?
Is there any evidence for Odderon at t= 0? Response is coming…

First three Odderon Proceedings, > 5 σ

Proton Holography -- Discovering Odderon from Scaling Properties of Elastic Scattering #2

T. Csorgo (Wigner RCP, Budapest and Eszterhazy Karoly U., Eger), T. Novak (EKU KRC, Gyongyos), R. Pasechnik (Lund U. and Rez, Nucl. Phys. Inst.), A. Ster (Wigner RCP, Budapest), I. Szanyi (Wigner RCP, Budapest and Eotvos U.) (Apr 15, 2020)

Published in: *EPJ Web Conf.* 235 (2020) 06002 • Contribution to: ISMD 2019 • e-Print: 2004.07095 [hep-ph]

pdf DOI cite

EPJ Web Conf. 235 **(2020)** 06002, proc. **ISMD 2019**
https://doi.org/10.1051/epjconf/202023506002

Scaling of high-energy elastic scattering and the observation of Odderon #1

T. Csörgő (Wigner RCP, Budapest and Eszterhazy Karoly U., Eger), T. Novák (EKU KRC, Gyongyos), R. Pasechnik (Lund U., Dept. Theor. Phys.), A. Ster (Wigner RCP, Budapest), I. Szanyi (Wigner RCP, Budapest and Eotvos U.) (Apr 15, 2020)

Published in: Gribov-90 Memorial Volume, pp. 69-80 (2021) (World Scientific, Singapore, ed. Yu. Dokshitzer, P. L\'evai, \'A. Luk\'acs and J. Nyiri) • e-Print: 2004.07318 [hep-ph]

pdf DOI cite

Gribov'90 Memorial Volume, pp. 69-80 (2021)
https://doi.org/10.1142/9789811238406_0012

Comparison of differential elastic cross sections in pp and $p\bar{p}$ collisions as evidence of the existence of the colourless C-odd three-gluon state #1

D0 and Totem Collaborations • Christophe Royon (Kansas U.) for the collaborations. (Dec 5, 2020)

Published in: *PoS* ICHEP2020 (2021) 496 • Contribution to: ICHEP2020, 496 • e-Print: 2012.03150 [hep-ex]

pdf DOI cite

PoS **ICHEP 2020** (2021)
https://doi.org/10.22323/1.390.0496