

Model independent Odderon results

based on new TOTEM data at 8 TeV

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Statistically Significant Observations of Odderon in 2021

Hungarian-Swedish Odderon:

Significance $\geq 6.26 \sigma$

Hungarian-Polish Odderon:

Significance $\geq 7.08 \sigma$

D0-TOTEM Odderon:

Significance $\geq 5.2 \sigma$

New in 2022:

TOTEM data at 8 TeV published

Hungarian-Polish Odderon: a certainty

Hungarian-Swedish Odderon: confirmed

New relation between R and ρ

The logo for MATE KRC, featuring the word "MATE" in a stylized, green, blocky font.The logo for Wigner RCP, featuring the word "WIGNER" in a bold, black, sans-serif font with a stylized red and black graphic element above the letters.

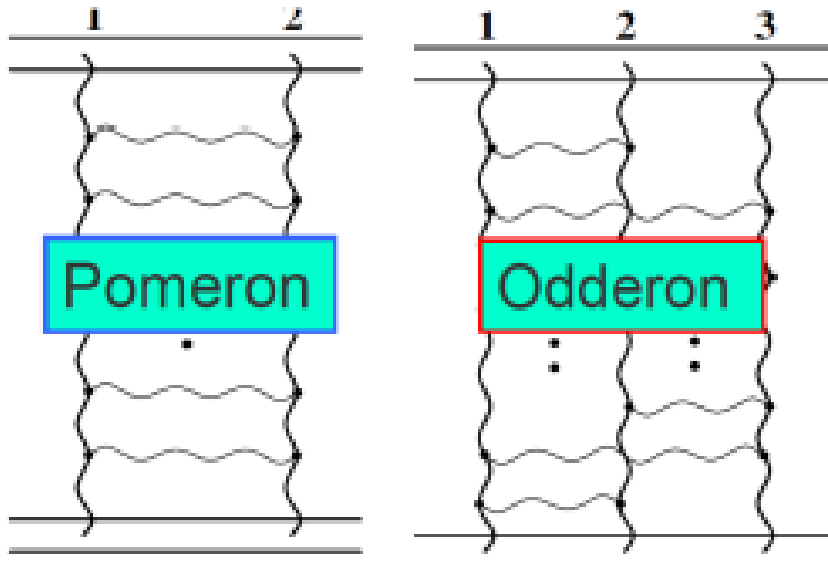
Supported by NKFIH:
K 74458, Hungary



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



СООБЩЕНИЯ
ОБЪЕДИНЕННОГО
ИНСТИТУТА
ЯДЕРНЫХ
ИССЛЕДОВАНИЙ
Дубна



E2-6350

A.V.Efremov, R.Peschanski

EVIDENCE FOR NEW SINGULARITIES
IN REGGE PHENOMENOLOGY

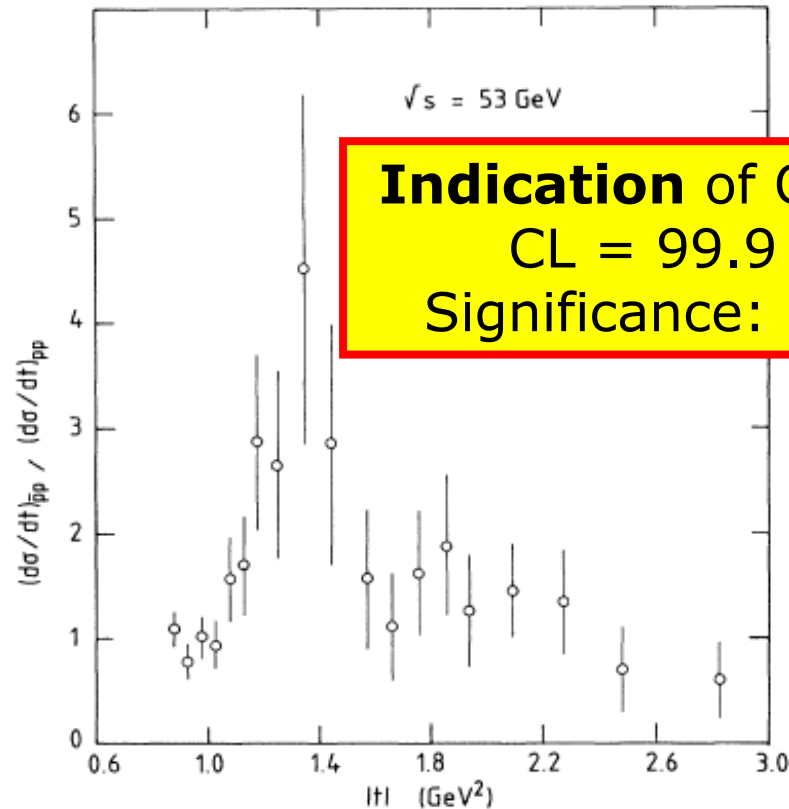
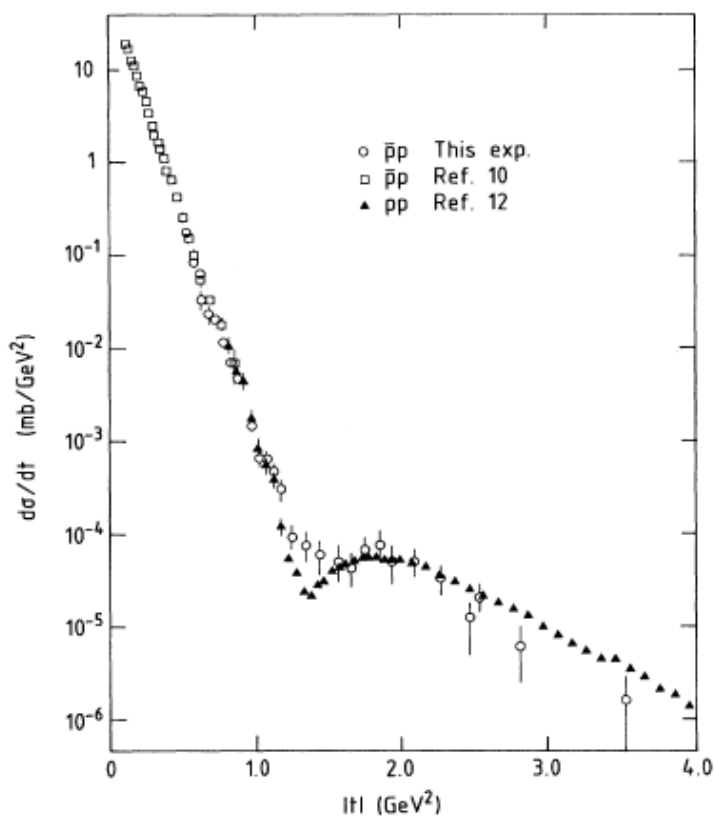
1972

ЛАБОРАТОРИЯ ТЕОРЕТИЧЕСКОЙ ФИЗИКИ

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: 3.35σ

Terminology for **this** talk:

Agreement if statistical significance is $< 3 \sigma$

Indication of signal if $3 \sigma \leq \text{significance} < 5 \sigma$

Evidence or observation of signal if $5 \sigma \leq \text{significance}$

Discovery of signal if $5 \sigma \leq \text{significance}$ **for the first time.**

2021 observations of Odderon with $> 5 \sigma$

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

T. Csörgő (Wigner RCP, Budapest and CERN), T. Novák (Unlisted, HU), R. Pasechnik (Lund U., Dept. Theor. Phys.), A. Szei (Wigner RCP, Budapest), J. 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
15 news outlets
3 Mendeley
4 blogs
4 Wikipedia page
2 Facebook pages

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*

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

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

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

Online attention



3 tweeters
1 Mendeley
1 Wikipedia page

Hungarian-Polish Odderon:

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

6 citations

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: 2012.03401 [hep-ph]



SUMMARY	News	Blogs	Twitter	Wikipedia	Dimensions citations
Title	Odderon Exchange from Elastic Scattering Differences between pp and pp Data at 1.96 TeV and from pp Forward Scattering Measurements				
Published in	Physical Review Letters, August 2021				
DOI	10.1103/PhysRevLett.127.062003				
Pubmed ID	34420329				
Authors	V. M. Abazov, B. Abbott, B. S. Acharya, M. Adams, T. Adams, J. P. Aghew, G. D. Alexeev, G. Alkhazov, ... [show]				
TWITTER DEMOGRAPHICS					
MENDELEY READERS					

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 $> 5 \sigma$

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

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



1367

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

University of Debrecen: 1538

...oots of higher education and culture the *gerundium*, a tool 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 Loránd University: 1635

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

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), J. Nyak (Unlisted, HU), R. Pasechnik (Lund U., Dept. Theor. Phys.), A. Ster (Wigner RCP, Budapest), J. Szanyi (Wigner RCP, Budapest) (Dec 26, 2019)

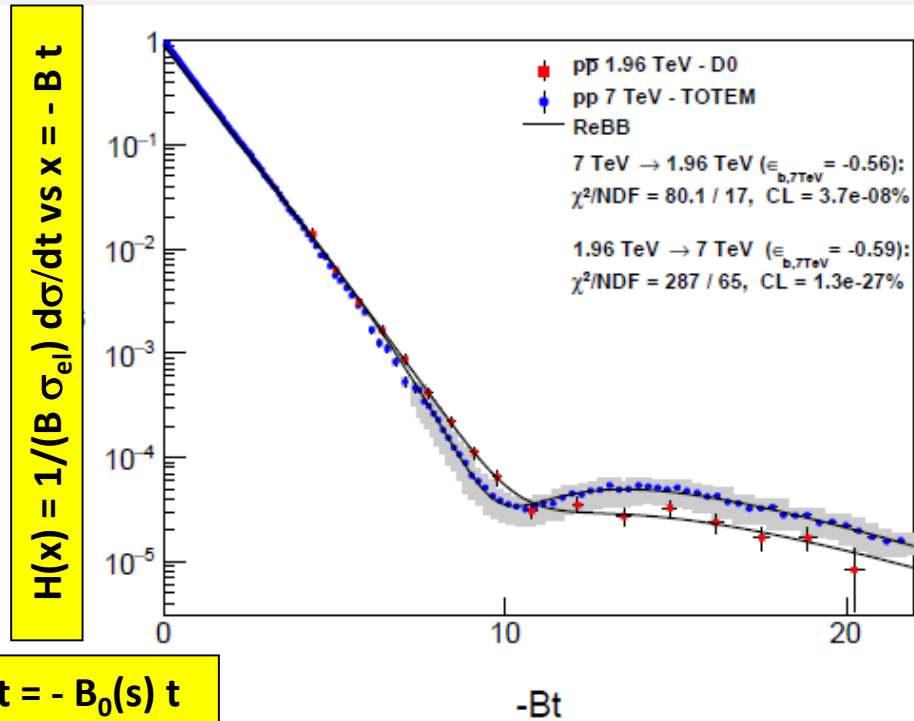
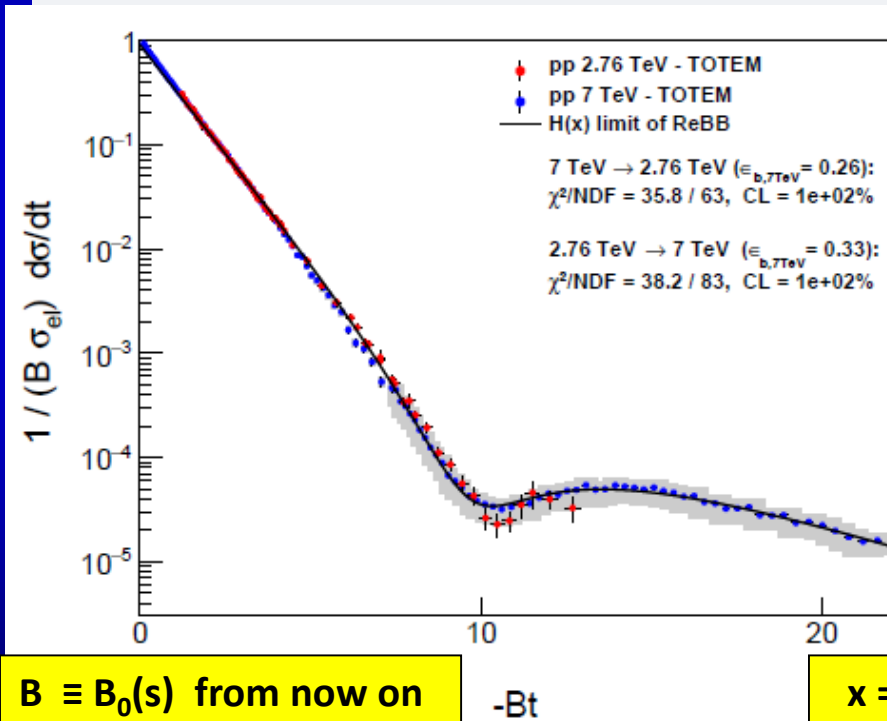
Published in: *Eur.Phys.J.C* 81 (2021) 2, 180 • e-Print: 1912.11968 [hep

Eur. Phys. J. C (2021) 81: 180, published February 2021

<https://doi.org/10.1140/epjc/s10052-021-08867-6>

pdf DOI cite

15 citations



S: Model independent Odderon significance $\geq 6.26 \sigma$

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.

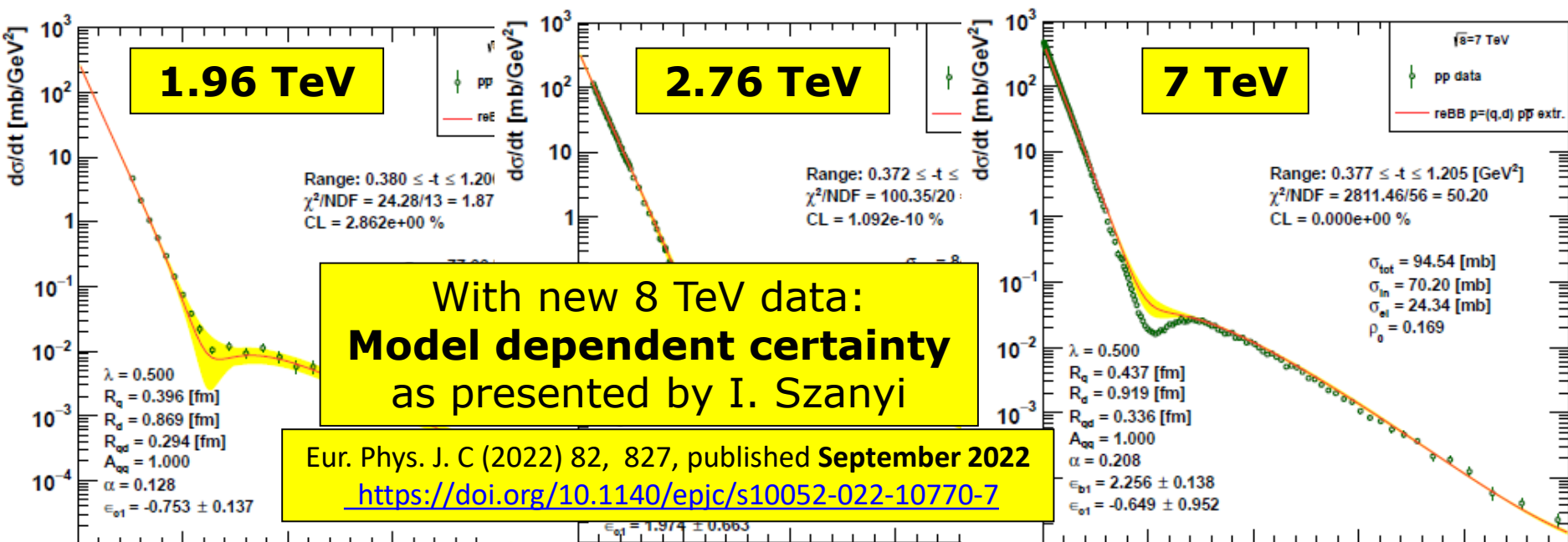
Hungarian-Polish Odderon, 2020-

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

T. Csorgo (Wigner RCP, Budapest and EKI 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>



S: Model dependent Odderon significance $\geq 7.08 \sigma$

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 $\geq 7.08 \sigma$, from 1.96 and 2.76 TeV data only

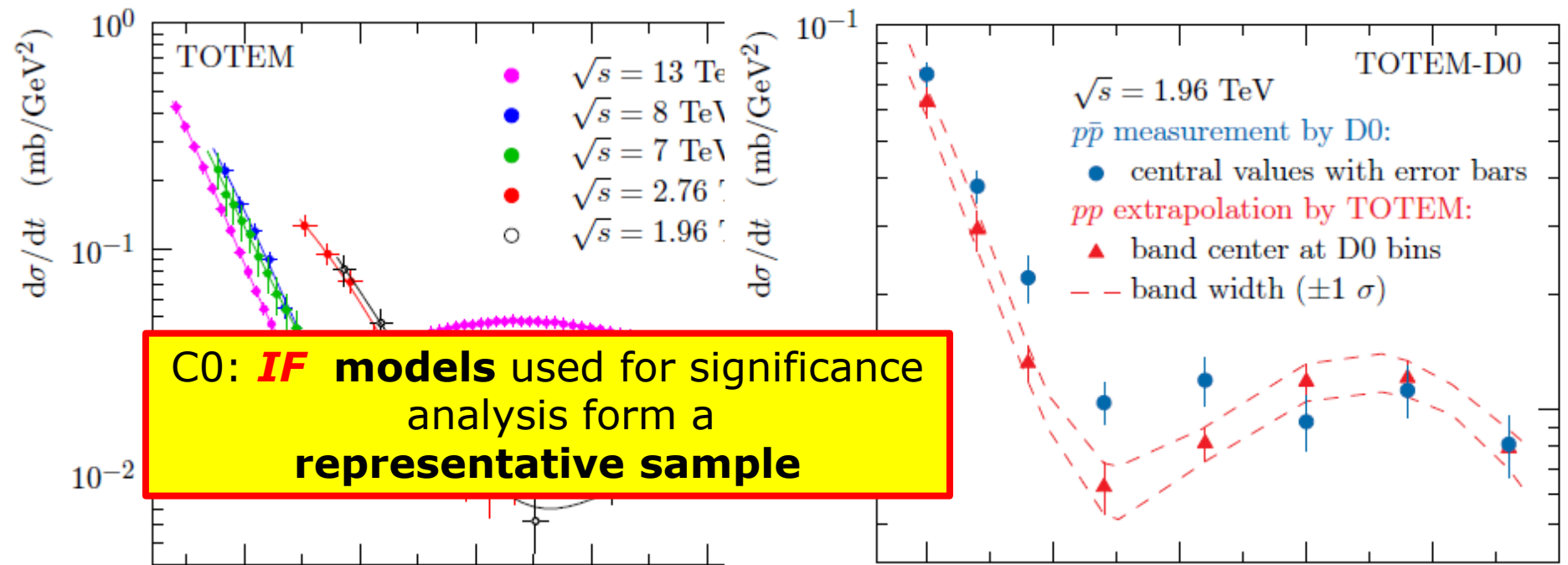
D0-TOTEM Odderon, 2020-

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) et al.
Published in: *Phys.Rev.Lett.* 127 (2021) 6, 062003 • e-Print: 2008.08111

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 $\geq 5.2 \sigma$, 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

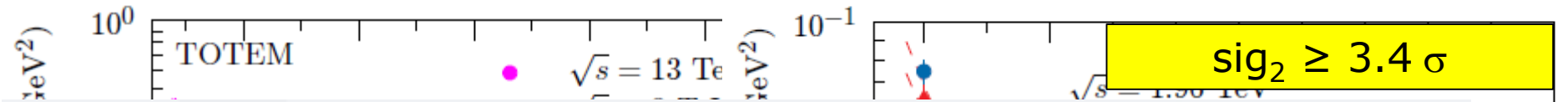
C4: if D0 $p\bar{p}$ data and TOTEM pp extrap.data are assumed to be equal at $t=0$

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

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)
<https://doi.org/10.1103/PhysRevLett.127.062003>



$\text{sig}_2 \geq 3.4 \sigma$

Lack of evidence for an odderon at small t

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

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

TOTEM: $\text{sig}_1(13 \text{ TeV}, t = 0) \geq 4.2 \sigma$

TOTEM: combined $(\text{sig}_1 + \text{sig}_2)/\sqrt{2} \geq 5.2 \sigma$

3 citations

Donnachie-Landshoff [arxiv:2203.00290](https://arxiv.org/abs/2203.00290),

Phys. Lett. B 831 (2022) 137199: $\text{sig}_1(13 \text{ TeV}, t = 0) \sim 0$ (!!)

Petrov-Tkachenko, [arxiv:2204.08815](https://arxiv.org/abs/2204.08815),

Phys. Rev. D 106 (2022) 5, 054003 : $\text{sig}_1(13 \text{ TeV}, t = 0) \leq 1$ (!!)

$\rho = 0.10 \pm 0.04$,

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

Coulomb-nuclear inte

Vladimir A. Petrov (Serpukhov)

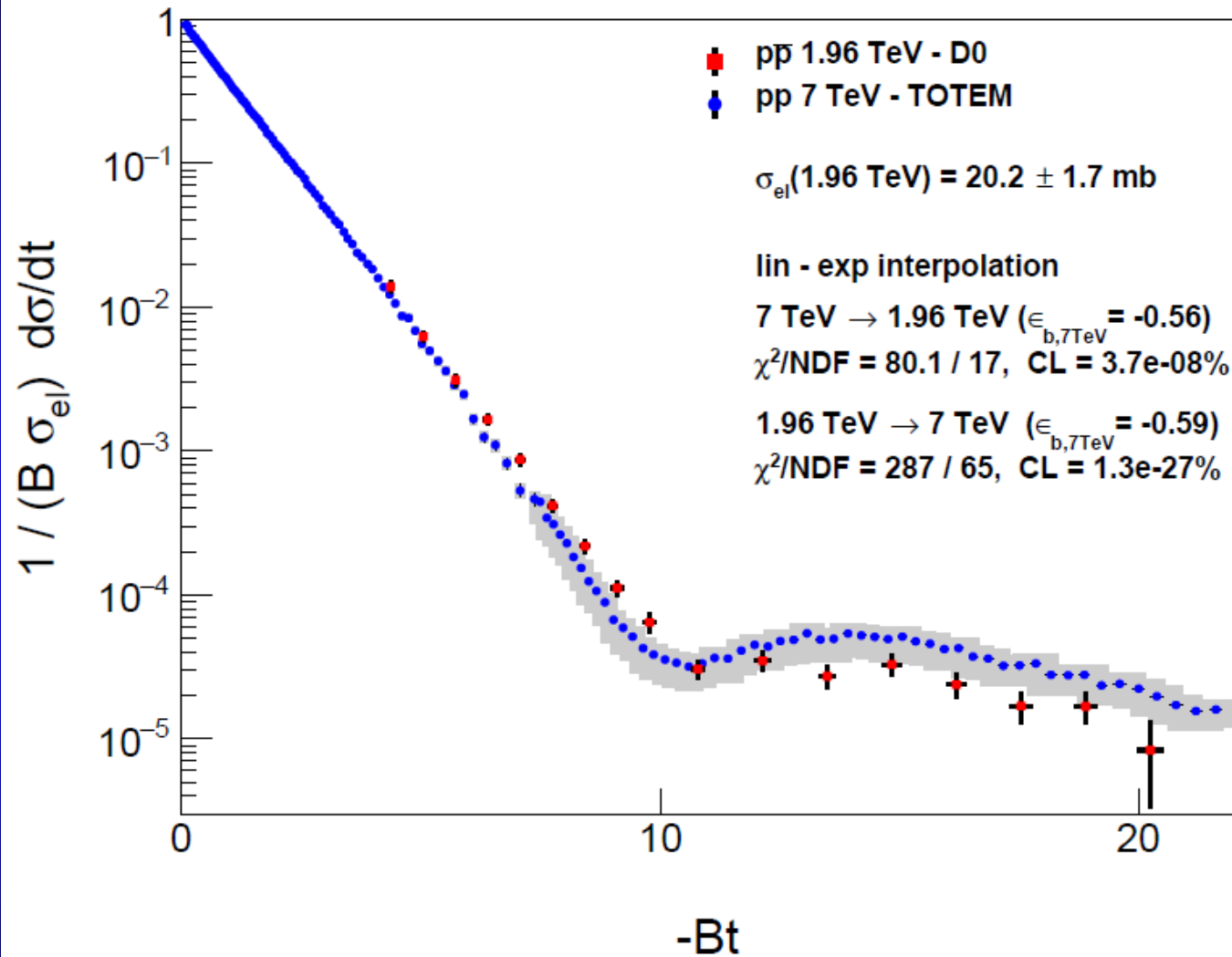
Published in: *Phys.Rev.D* 106 (2022) 5, 054003 • e-Print: [2204.08815](https://arxiv.org/abs/2204.08815) [hep-ph]

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

pdf DOI cite

0 citations

Back to Scaling: Model independently



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

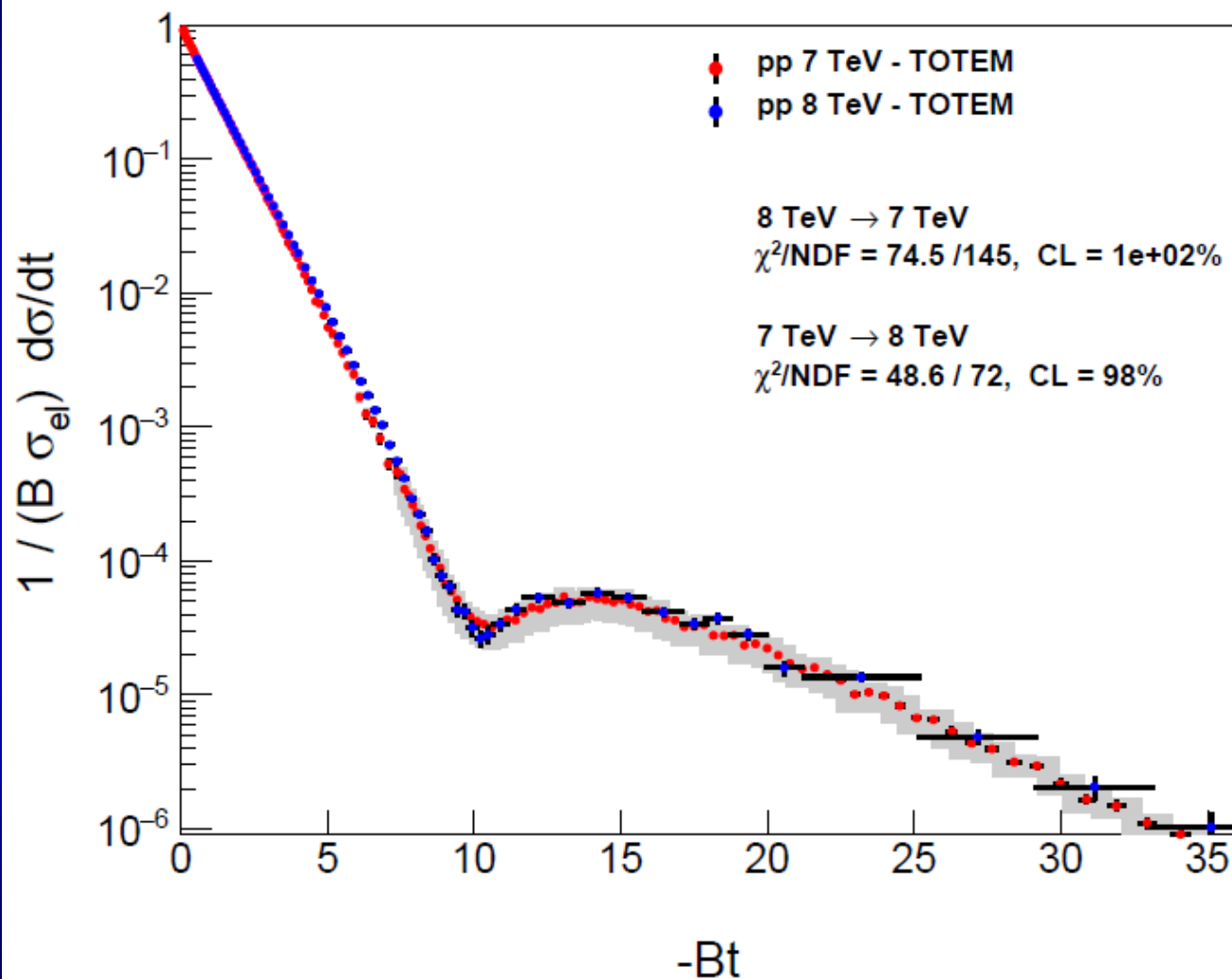
$H(x|pp, 7 \text{ TeV})$
 \neq
 $H(x|pbarp, 1.96)$

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

6.26 σ
Odderon effect

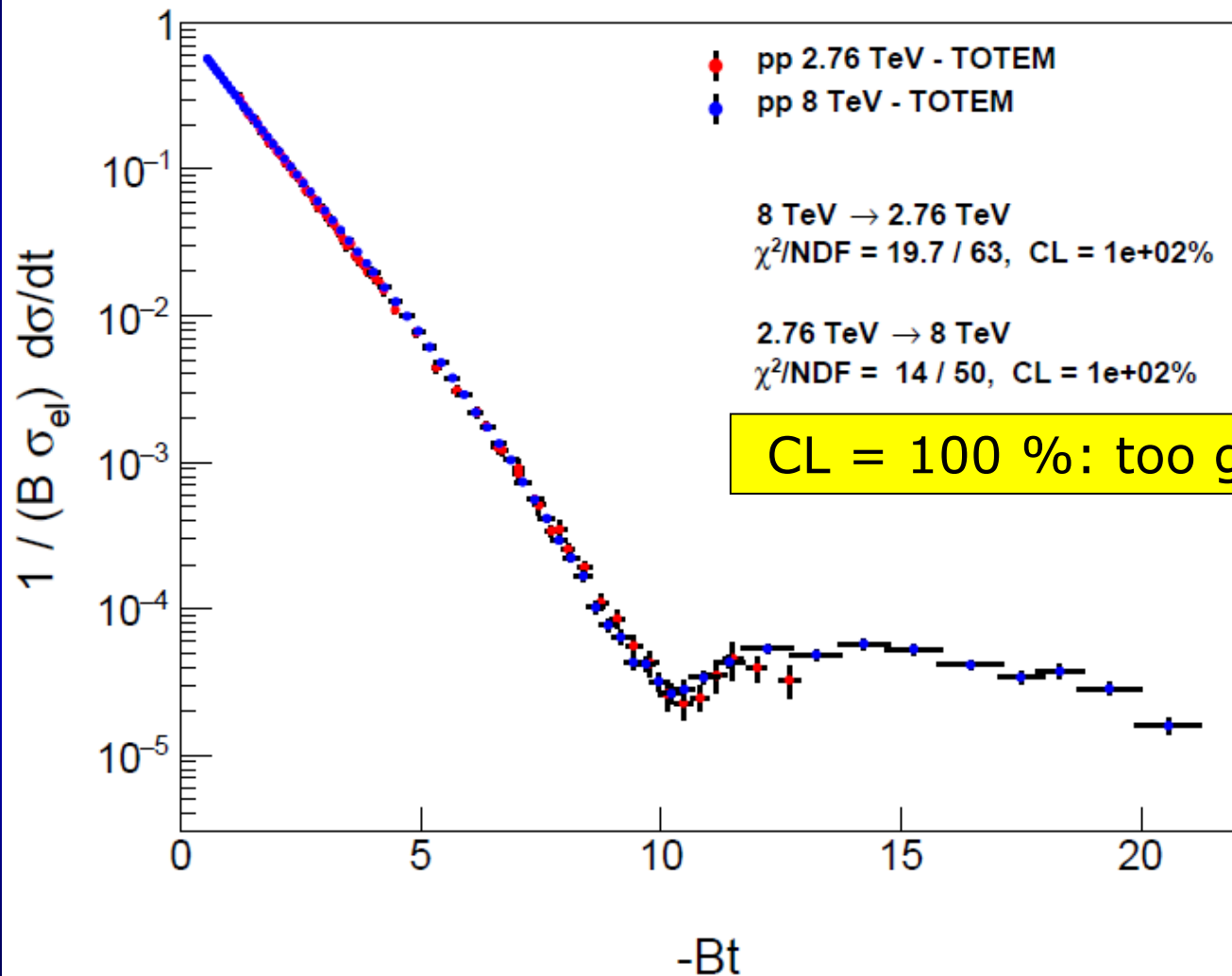
Energy range: tested **both** model independently and with modelling.
 Modelling is useful, but model independent tests more important!

H(x) scaling of 7 and 8 TeV data



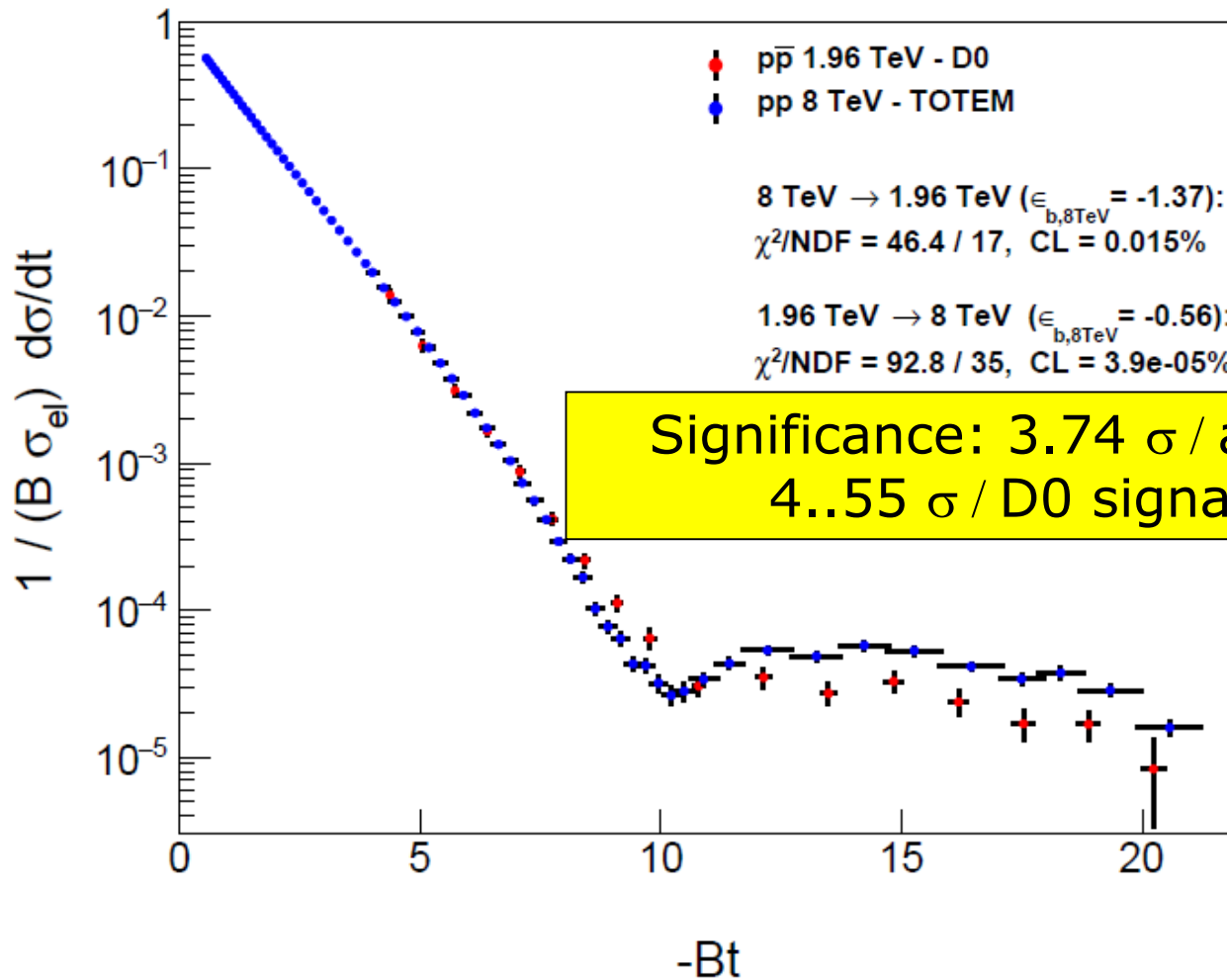
Energy range: H(x) scaling model independently up to $\sqrt{s} = 8$ TeV.
Uses final, published TOTEM $d\sigma/dt$ data at 8 TeV

H(x) scaling of 2.76 and 8 TeV data



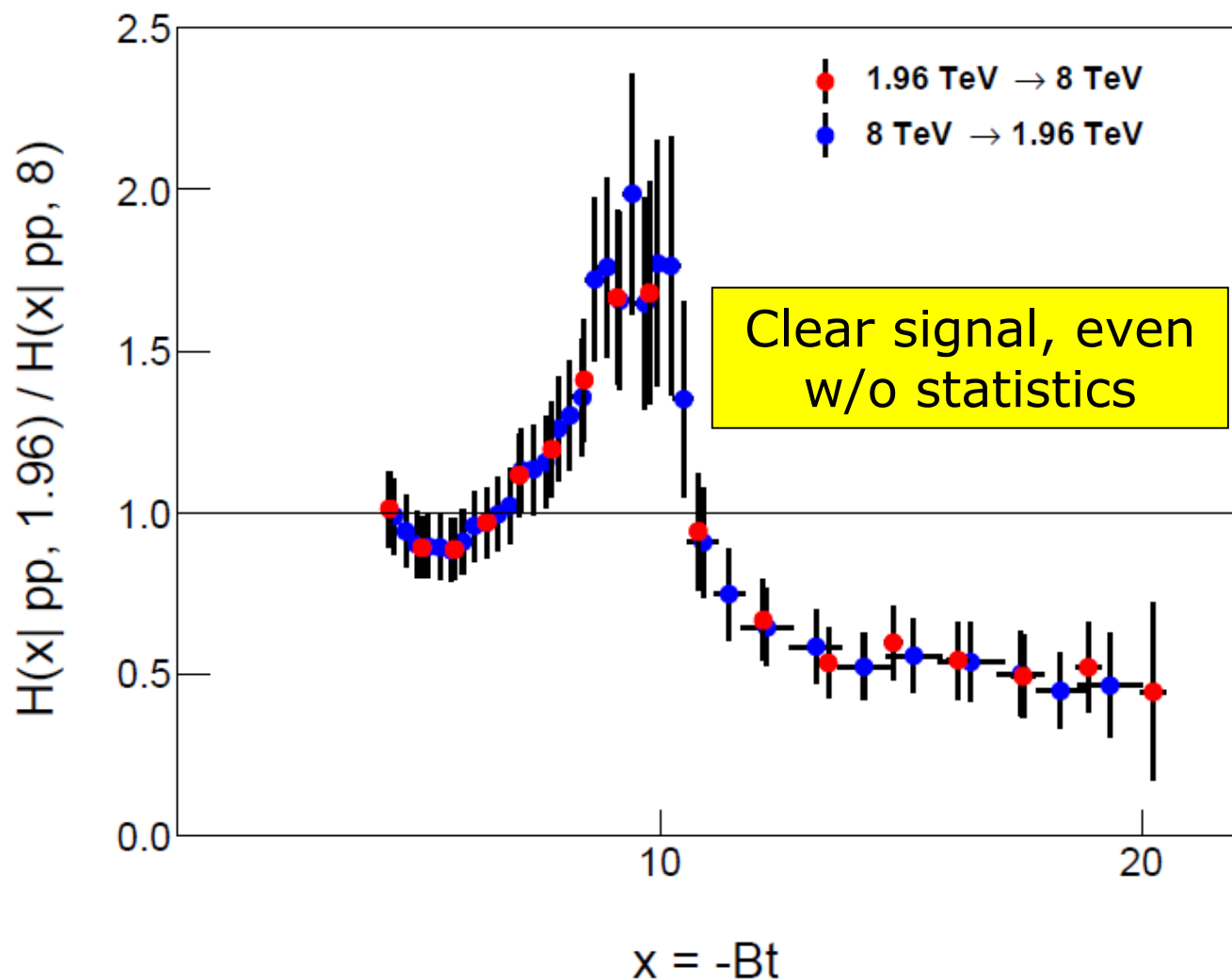
Energy range: H(x) scaling valid between $\sqrt{s} = 8$ and 2.76 TeV.
Uses final, published TOTEM $d\sigma/dt$ data at 8 TeV

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



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 $d\sigma/dt$ data at 8 TeV. Model independently.

$H(x|p\bar{p})/H(x|pp)$: Odderon peak



$H(x)$ scaling is violated between $\sqrt{s} = 8 \text{ TeV}$ pp and 1.96 TeV p \bar{p} . TOTEM $d\sigma/dt$ data at 8 TeV. Odderon exchange, as a peak.

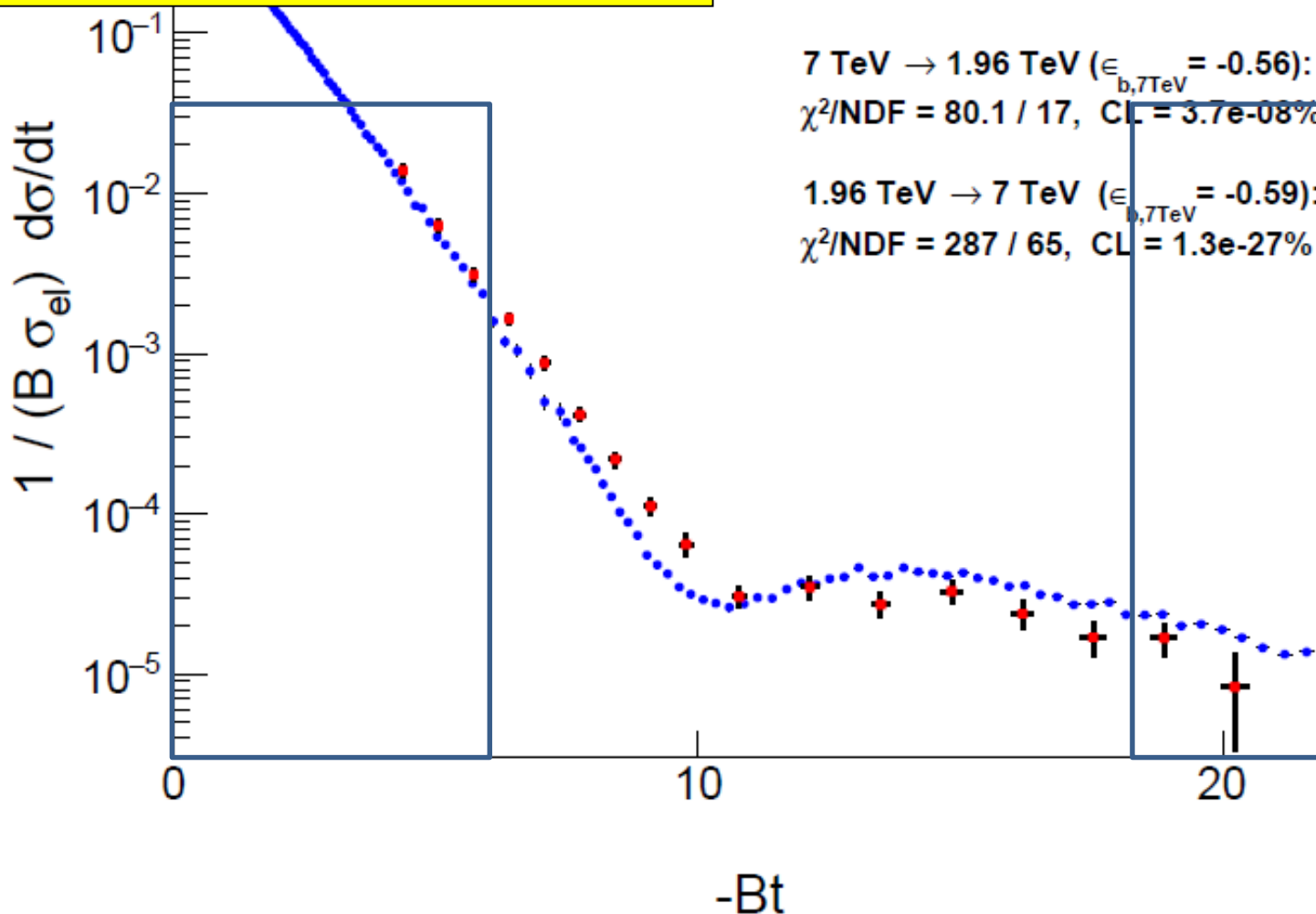
7 TeV: CLOSING DOORS/GATES

7 TeV data shifted

by $\epsilon_{B7,TeV}$ 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 INDEPENDENT RESULT 1:

In best window, optimized Odderon signal is 6.33 σ

MODEL INDEPENDENT RESULT 2:

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

MODEL INDEPENDENT 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
<u>Colours</u>	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=2.29	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=3.30	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=3.32	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=3.31	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=3.29	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 right=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

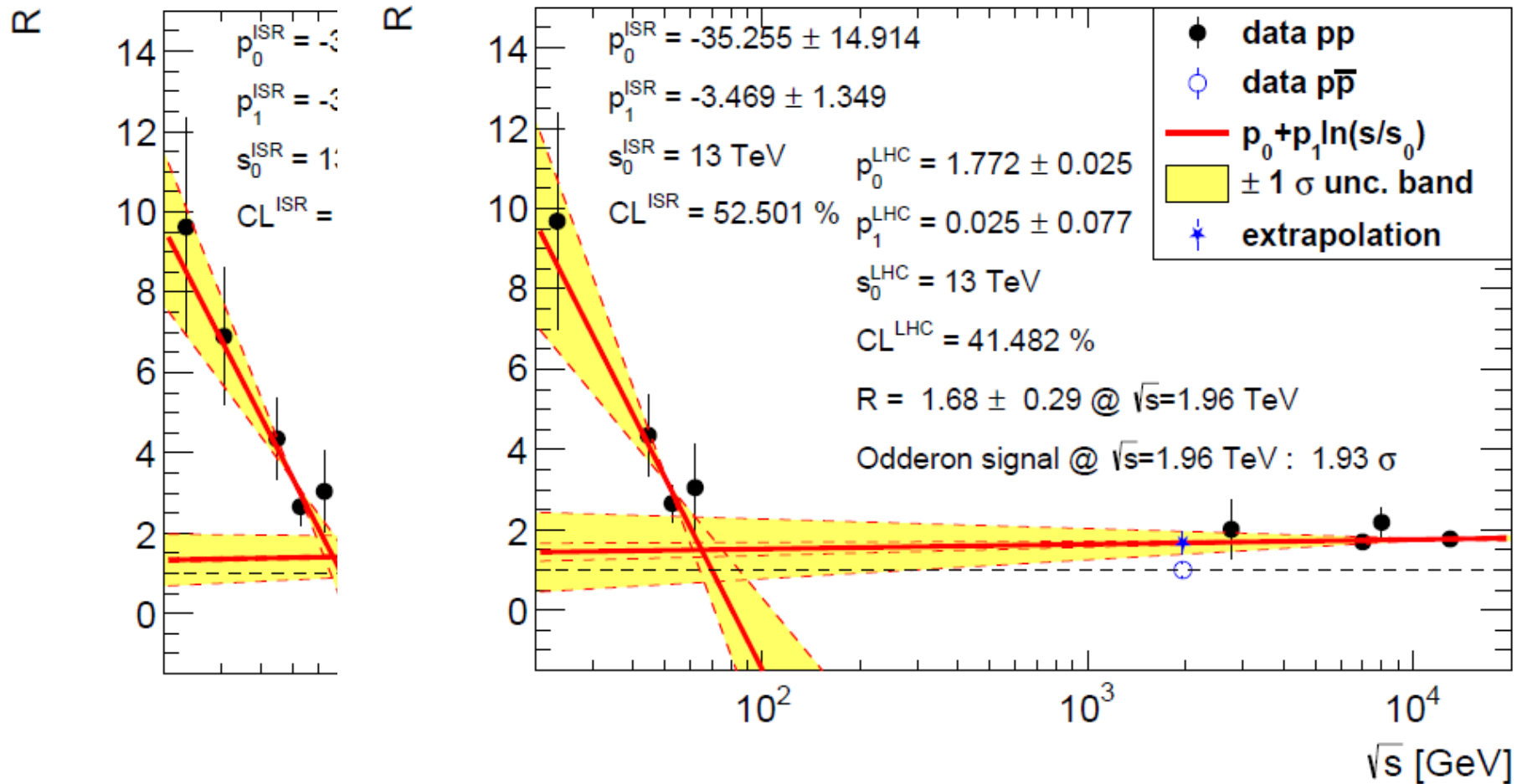
Color code:

- Best signal 4.55σ
- $5.0 \geq \text{signal} \geq 4.0 \sigma$
- $4.0 \geq \text{signal} \geq 3.0 \sigma$

A model-independent relation: $R \sim \rho$

#1

Lack of evidence for an odderon at small t

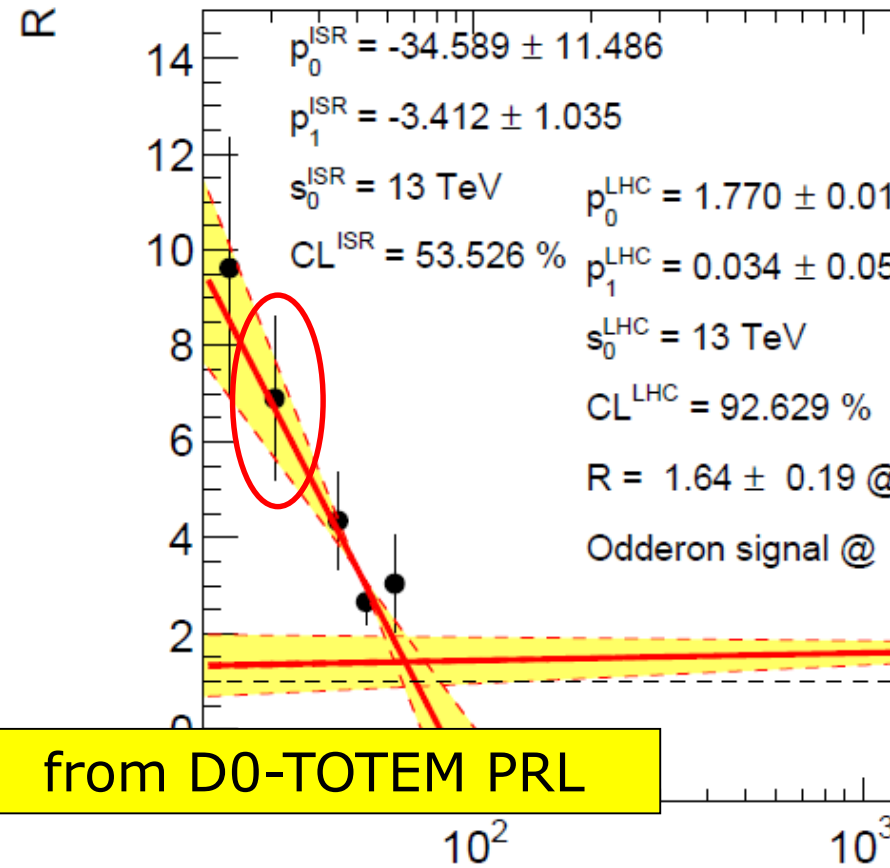
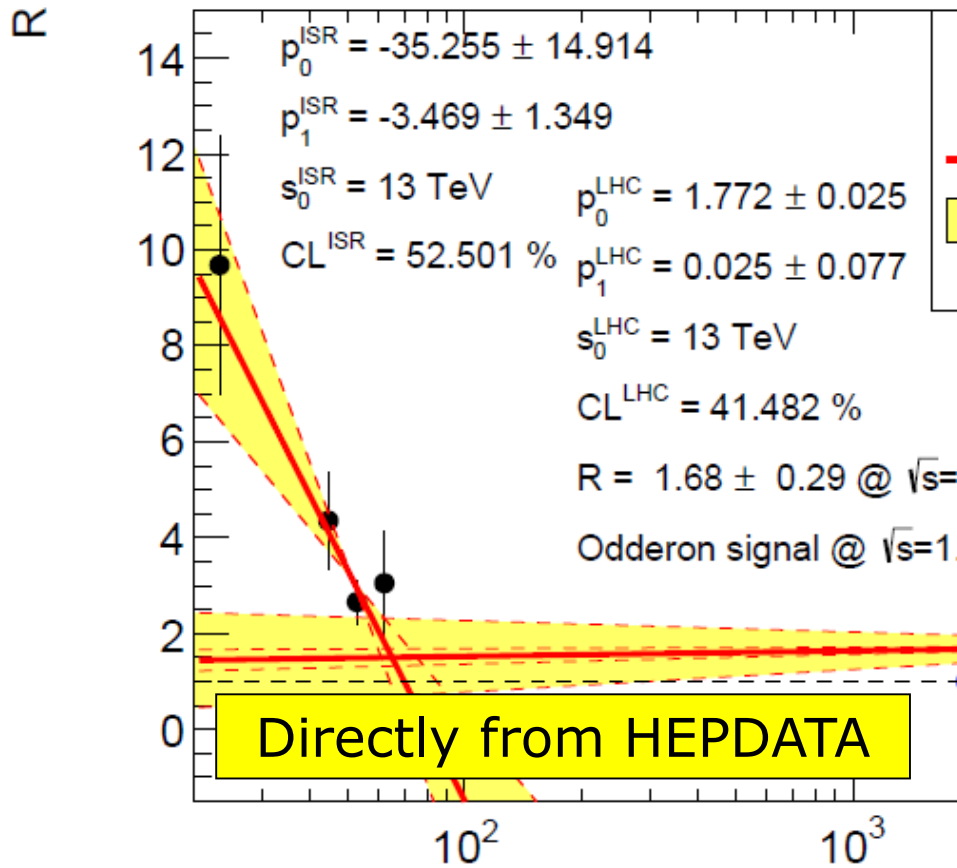


In the ReBB model: $\rho = \rho_0 + \rho_1 \ln(s/s_0)$

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

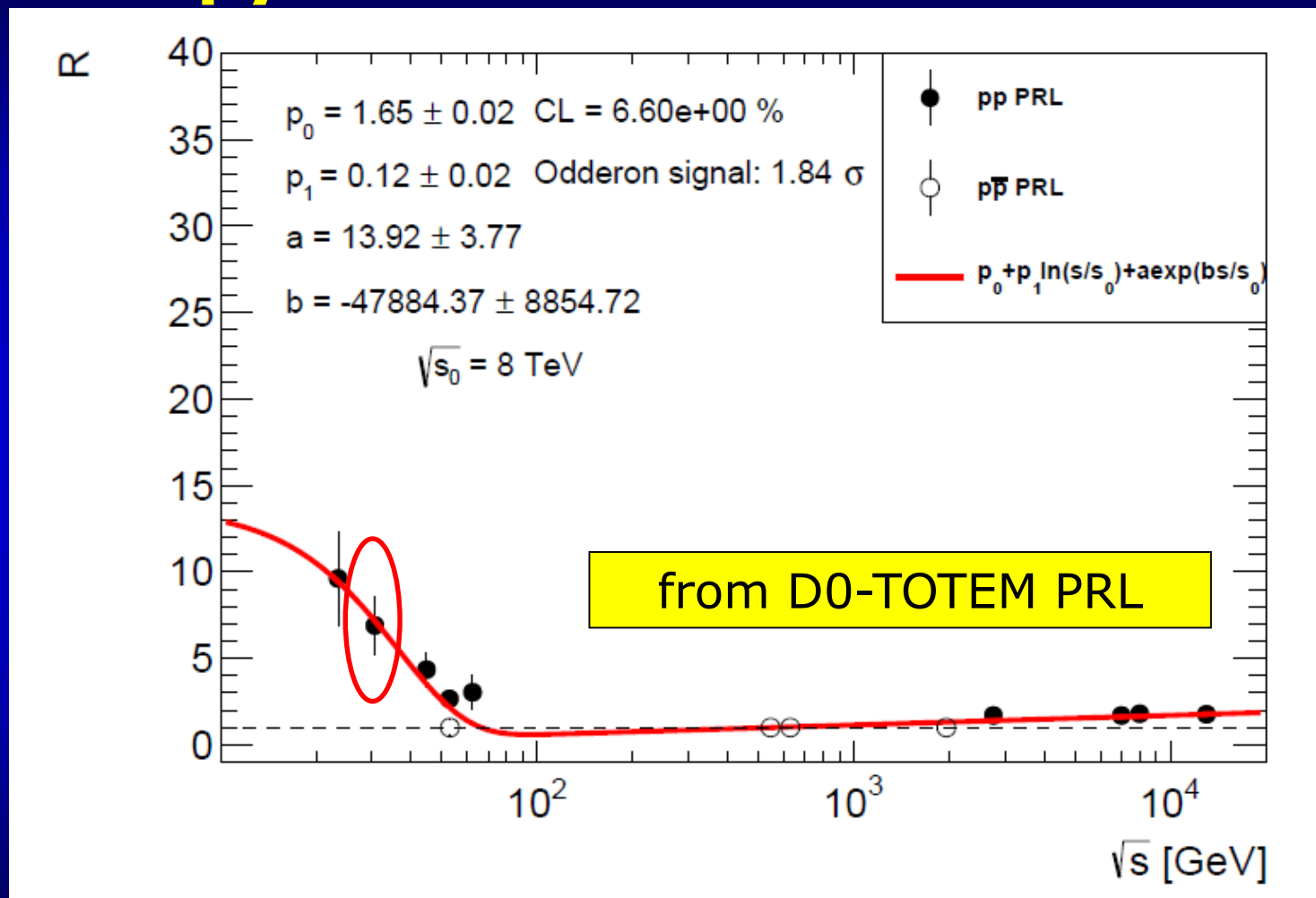
Thus $\rho(R) = A + B R$: connects large t and small t signals!!

Scientific statements and conditions: philosophy and the evidence for odderon



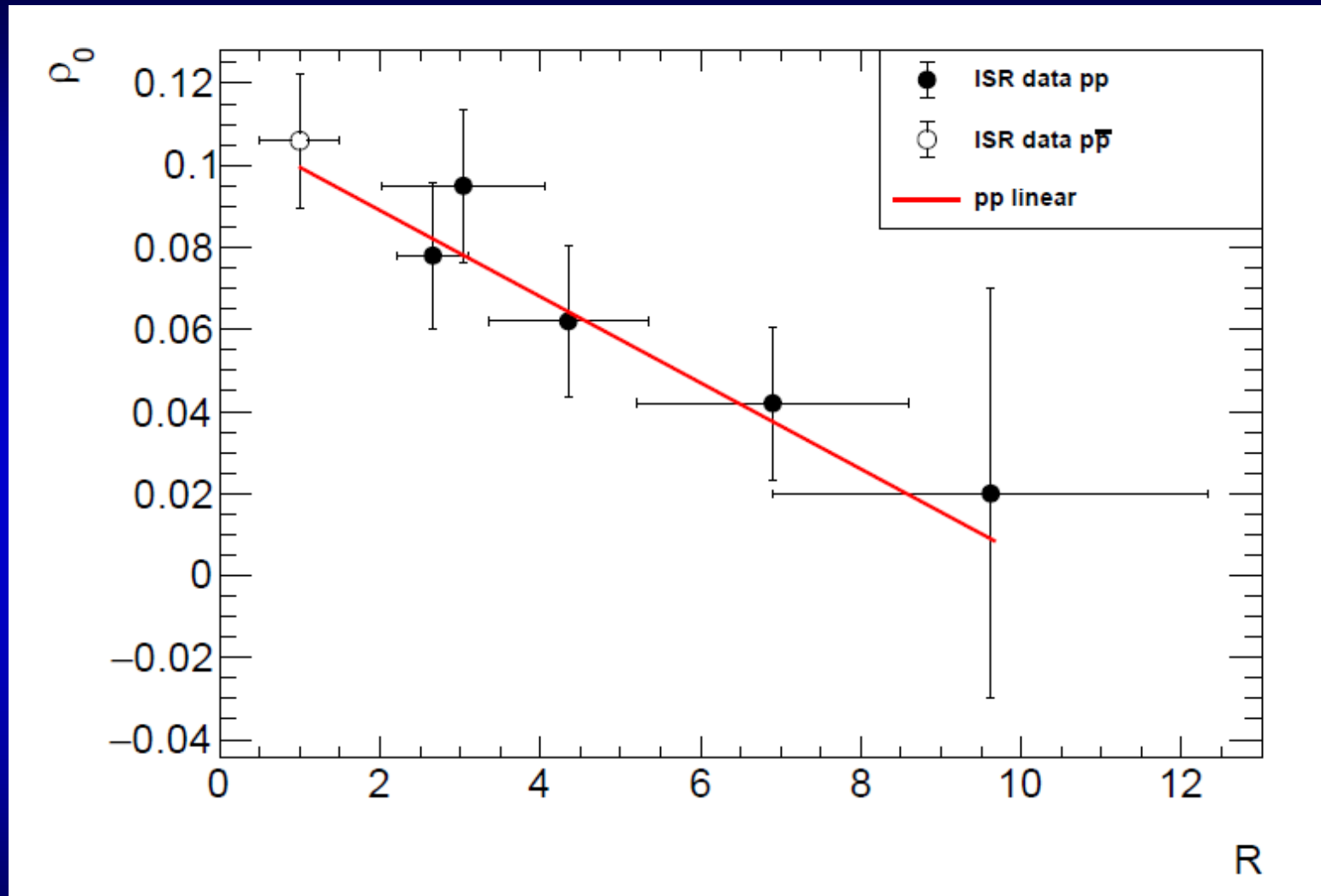
If we just take data on R, both pp and pbarp, without any conditions
 R values in D0-TOTEM PRL are different from available HEPDATA:
 signal changes, too, but only slightly...

Scientific statements and conditions: philosophy and the evidence for odderon



If we just take data on R , both pp and p \bar{p} , without any conditions
 R values are consistent with a combined fit, given in the plot
(using D0-TOTEM PRL values): CL = 6.6 % OK

Cross-check: $R \sim \rho$



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!!

OBSERVATION OF ODDERON

Model-independent $H(x)$ signal confirmed at 8 TeV


**THANK YOU FOR YOUR
ATTENTION**

BACKUP SLIDES

Hungarian-Swedish Odderon: CORDIS

→ ↻ cordis.europa.eu/article/id/429667-particle-physics-milestone-achieved-at-cern

Alkalmazások  CERN  ET  Wigner  Conf  Stabil-Invest Kft.  Szanyi István

 Follow the latest news and projects about COVID-19 and the European Commission's coronavirus response.

 European

CORDIS

English 

For most of us, physics terms such as odderon are – and will always remain – firmly lodged in the science fiction realm. Not so for the scientific community, whose determined members spent nearly half a century searching (without much success) for this mythical particle.

Now, a research team including physicists from Hungary and Sweden has discovered the odderon by analysing experimental data from the [Large Hadron Collider \(LHC\)](#) at Switzerland's European Organization for Nuclear Research, better known as CERN. Supported by the EU-funded MorePheno project, the physicists have published a [paper](#) describing their findings in the 'The European Physical Journal C'.

Particle physics milestone achieved at CERN

After 50 years of research, physicists have found evidence that the elusive subatomic quasiparticle called odderon actually exists.

D0-TOTEM odderon: Nature, CERN

Check for updates

Nature Reviews Physics

CERN Accelerating science



ABOUT

NEWS

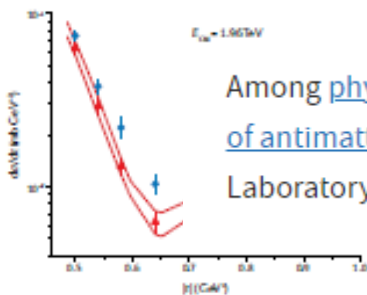
News › News › Topic: Knowledge sharing

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



Credits: CERN, for the DØ and TOTEM collaborations, under a Creative Commons License: CC BY 4.0

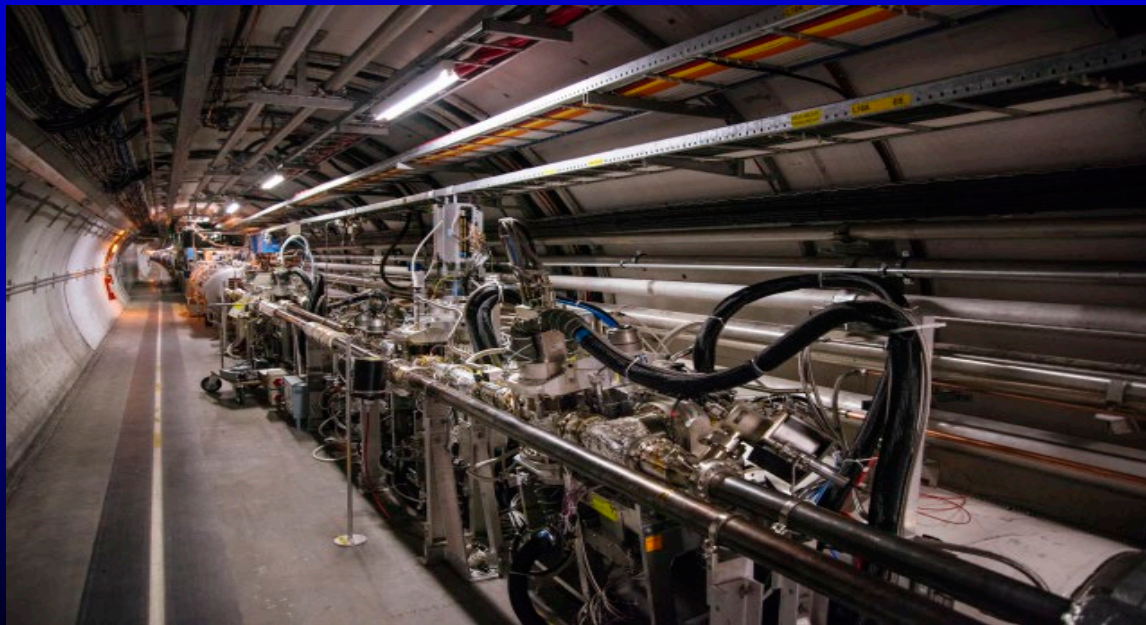
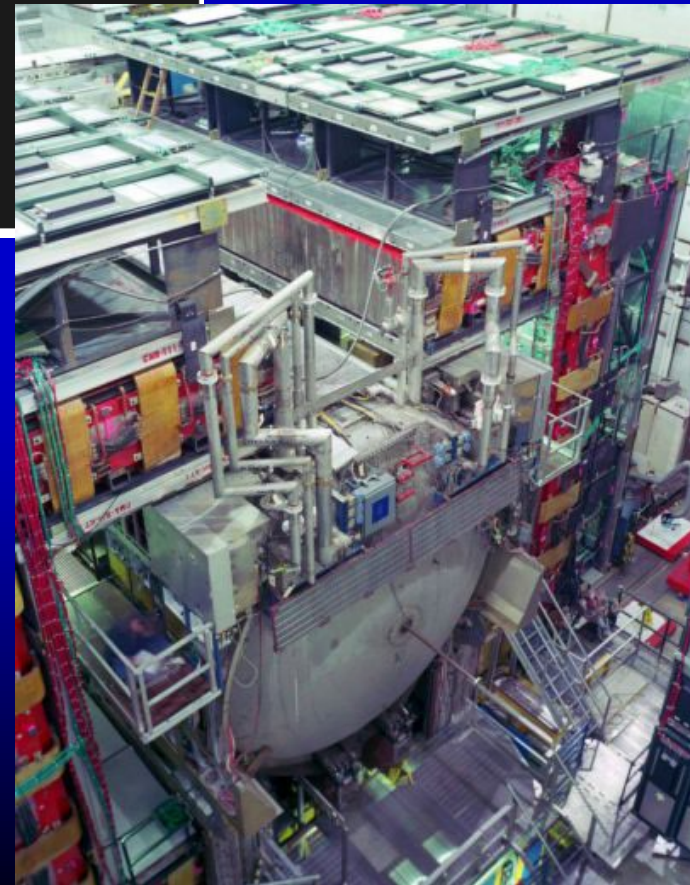
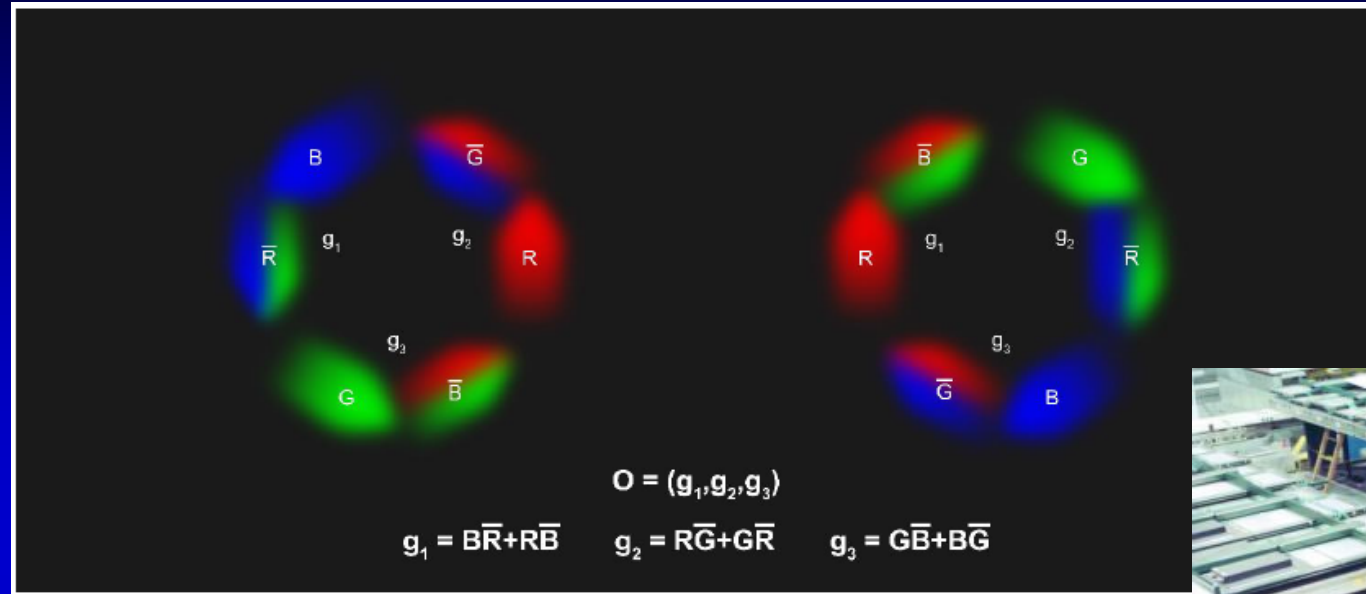
community was that this was not of differential cross-sections

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.

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

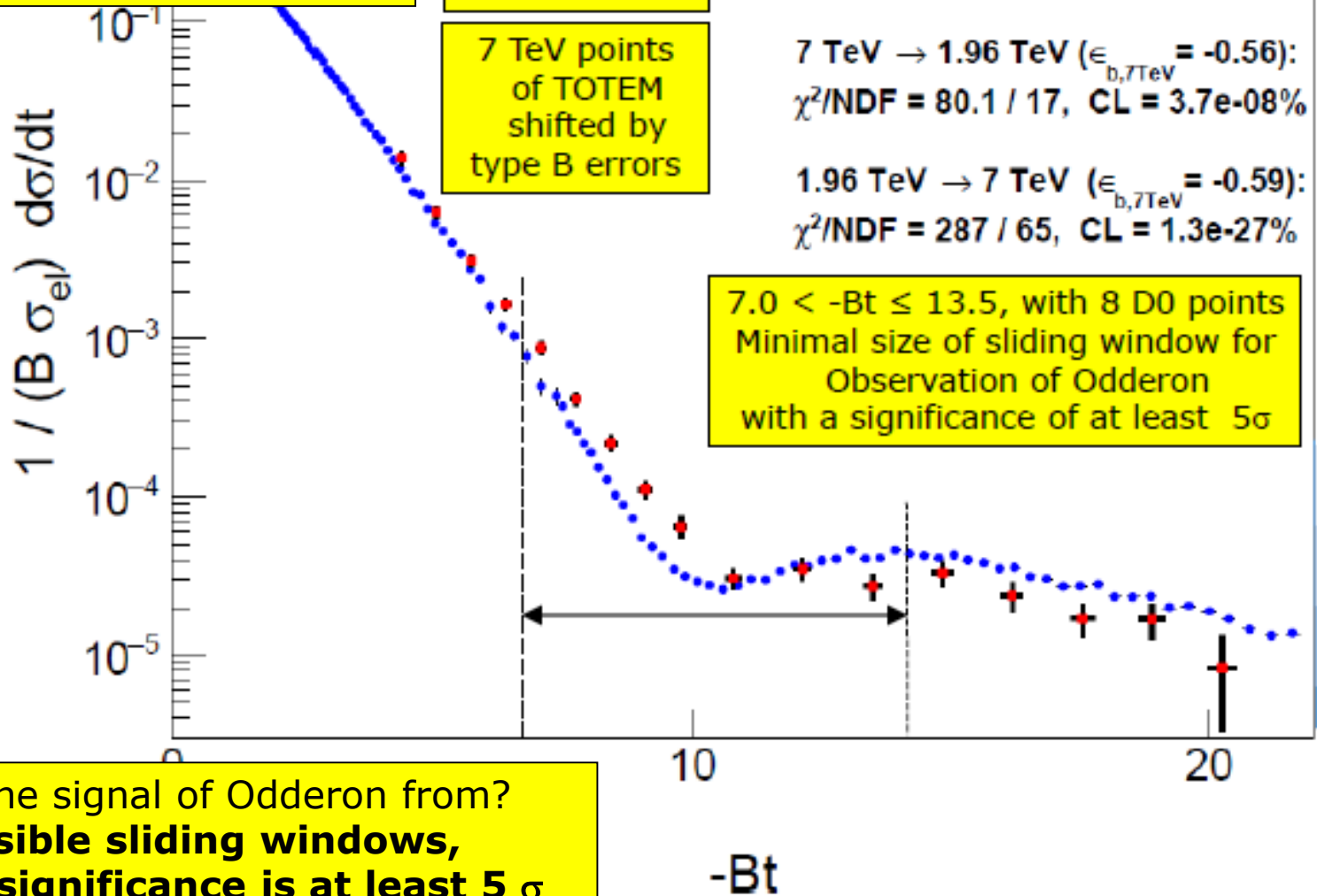
RELATED ARTICLES: [Alessio V.M. et al. Odderon exchange from elastic scattering differences in proton-proton collisions at 1.96 TeV and heavy p-forward scattering measurements. Phys. Rev. Lett. 127, 092001 \(2021\)](#)

Illustrations: Odderon, TOTEM, D0



7 TeV: SLIDING WINDOW for 5σ

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



BEST SIGNAL AT 7 TeV

n\m	0	1	2	3	4	5	6	7
0	eps= 0.56 chi2= 77.074 sigma= 6.26 left= -1.7 right= 6.99	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= 0.53 chi2= 77.8 sigma= 6.25 left= -1.95 right= 6.65	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= 0.59 chi2= 76.3 sigma= 6.25 left= -1.7 right= 6.67	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= 0.61 chi2= 74.4 sigma= 6.29 left= -1.7 right= -2.50	eps= 0.57 chi2= 71.823 sigma= 6.26 left= -1.7 right= -1.07	eps= 0.52 chi2= 70.644 sigma= 6.33 left= -1.7 right= 6.66	eps= 0.38 chi2= 63.331 sigma= 5.98 left= -1.58 right= -7.32	eps= 0.19 chi2= 54.859 sigma= 5.52 left= -1.468 right= 5.27	eps= 0.22 chi2= 48.024 sigma= 5.15 left= -1.369 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 6.36σ
- Safe signal $\geq 5.5 \sigma$
- $5.5 \geq \text{signal} \geq 5.0 \sigma$
- signal $\leq 5.0 \sigma$

Passion for Discovery: Odderon

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

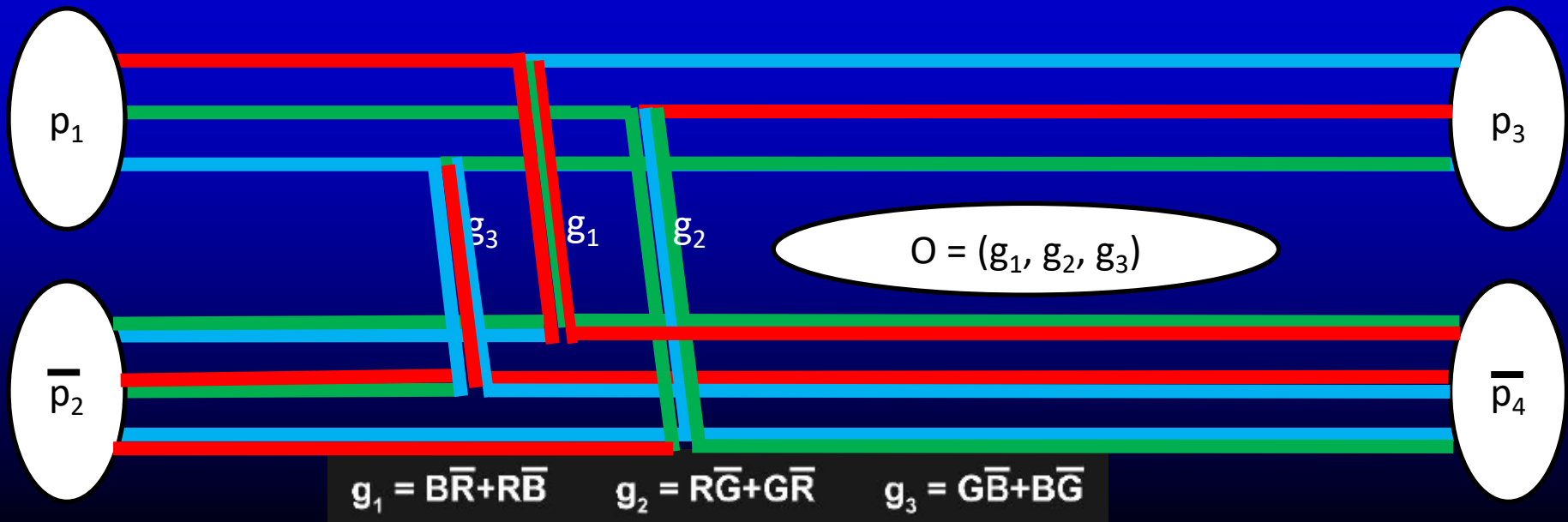
$$(RGB) + (\bar{R}\bar{B}\bar{G}) \rightarrow (BRG) + (\bar{B}\bar{G}\bar{R})$$

-

$$p + p \rightarrow p + p$$

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

30



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:

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

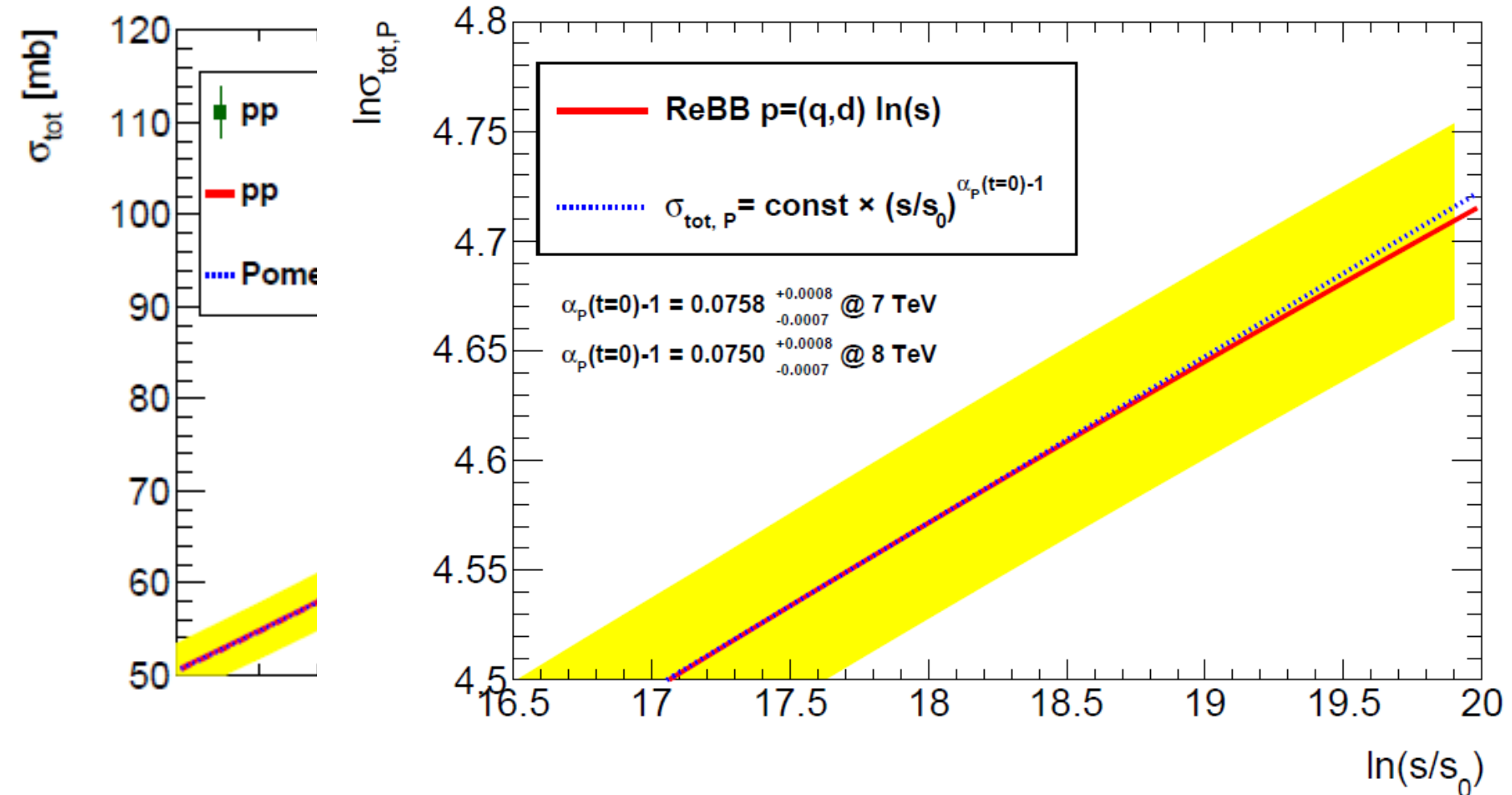
MATE: 2021 (or, from 1787)

POMERON PROPERTIES

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

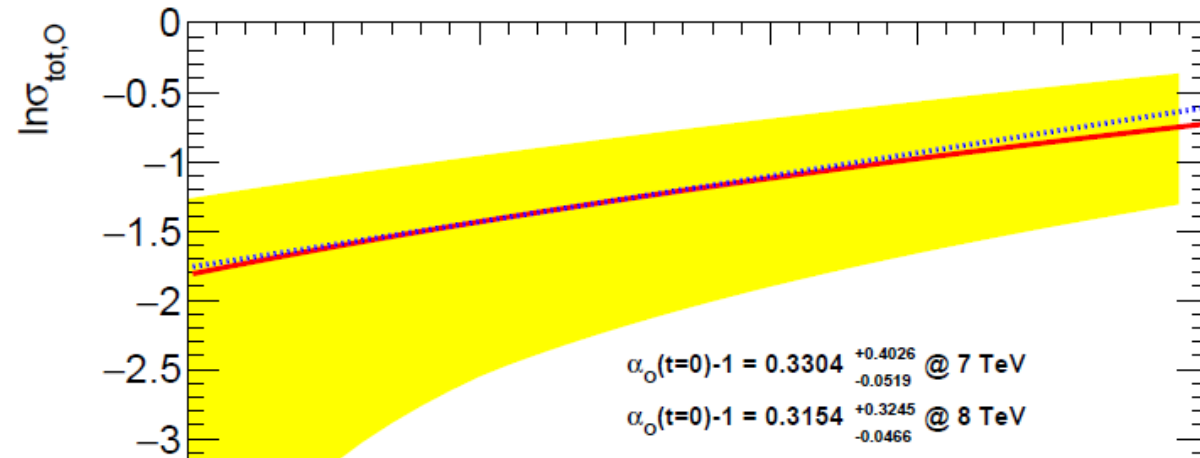
1st property:

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



ODDERON PROPERTIES

EPJC 81 (2021) 7, 611



1st property:

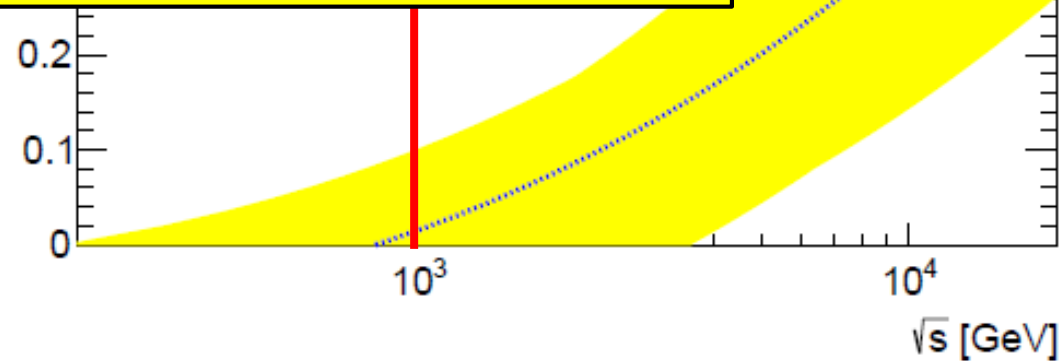
Odderon intercept is large, $\alpha_o(0)-1 = 0.32^{+0.32}_{-0.06}$

Threshold effect, slowly decreases with s , but

Pomeron intercept normal: $\alpha_p(0)-1 = 0.075 \pm 0.001$

2nd property:

1 TeV \sim threshold energy



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

**Bialas-Bzdak $p = (q,d)$ model: certain Odderon effect
statistical significance $\gg 5 \sigma$**

**Odderon first discovered in three published papers:
three different analysis, each with a statistical significance $> 5 \sigma$**

**(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 $-t > 0.37 \text{ GeV}^2$ 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, $> 5 \sigma$

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

T. Csorgo (Wigner RCP, Budapest and Eszterhazy Karoly U., Eger), [T. Novák](#) (EKU KRC, Gyongyos), R. Pasechnik (Lund U. and Rez, Nucl. Phys. Inst.), [A. Steer](#) (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: 2004.07305 [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. Steer](#) (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>