“Blois” in Vietnam:

Lessons from the first measurements of elastic and total cross sections at the LHC by TOTEM

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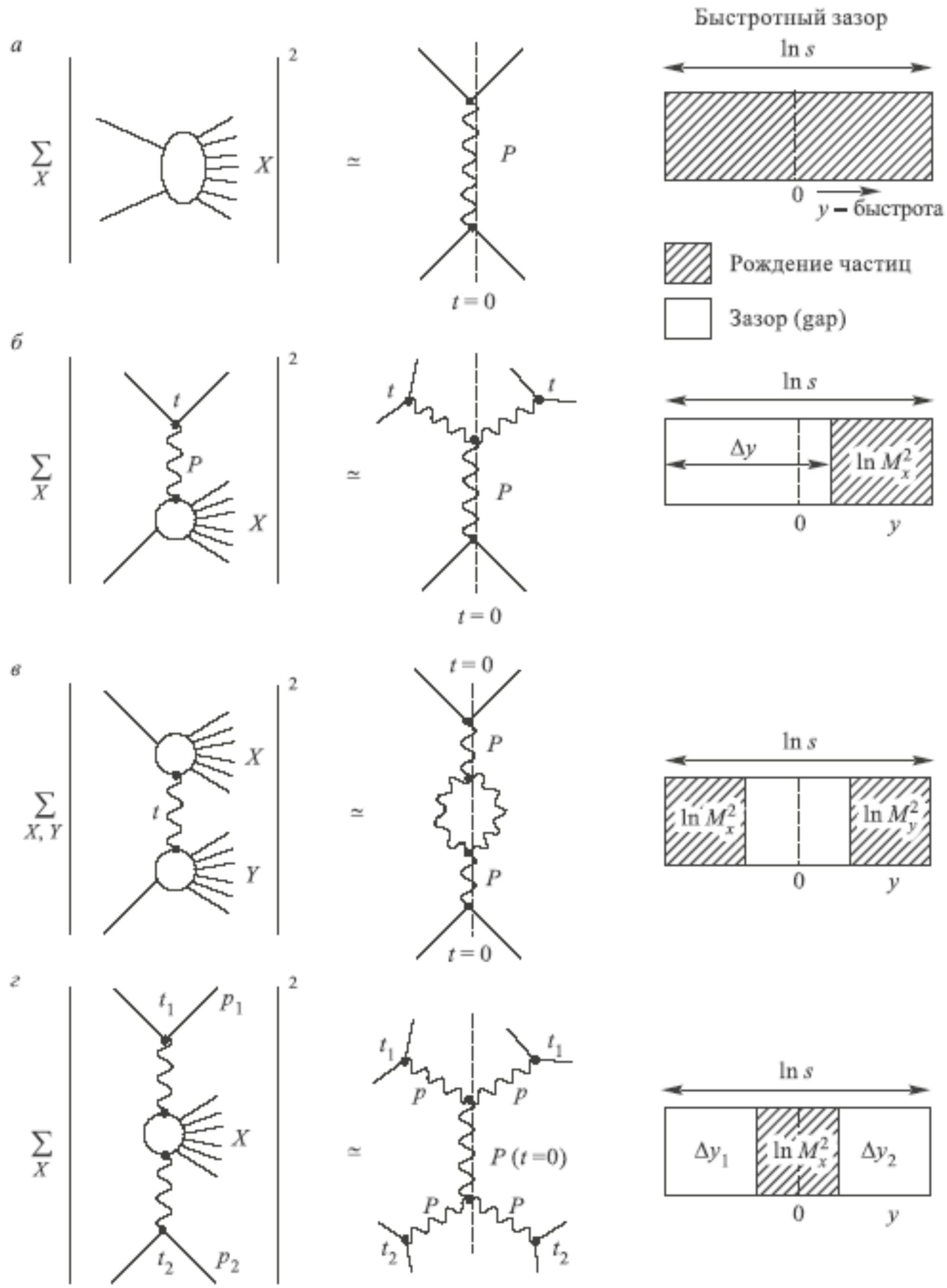
EDS, Quy Nhon, Dec. 2011



а
б
в
г
Быстротный зазор
ln s
0
y – быстрота
Рождение частиц
Зазор (gap)
P
t = 0
Δy
ln M_x^2
ln M_y^2
y
X
Y
P (t = 0)
Δy_1
Δy_2

$$\sigma_t(s) = \frac{4\pi}{s} Im A(s, t=0); \quad \frac{d\sigma}{dt} = \frac{\pi}{s^2}|A(s,t)|^2; \quad \boldsymbol{n(s)};$$

$$\sigma_{el} = \int_{t_{min\approx -s/2\approx\infty}}^{t_{thr.\approx 0}} \frac{d\sigma}{dt}; \quad \sigma_{in} = \sigma_t - \sigma_{el}; \quad B(s,t) = \frac{d}{dt}\ln\left(\frac{d\sigma}{dt}\right);$$

(and ratios: σ/B,…….).

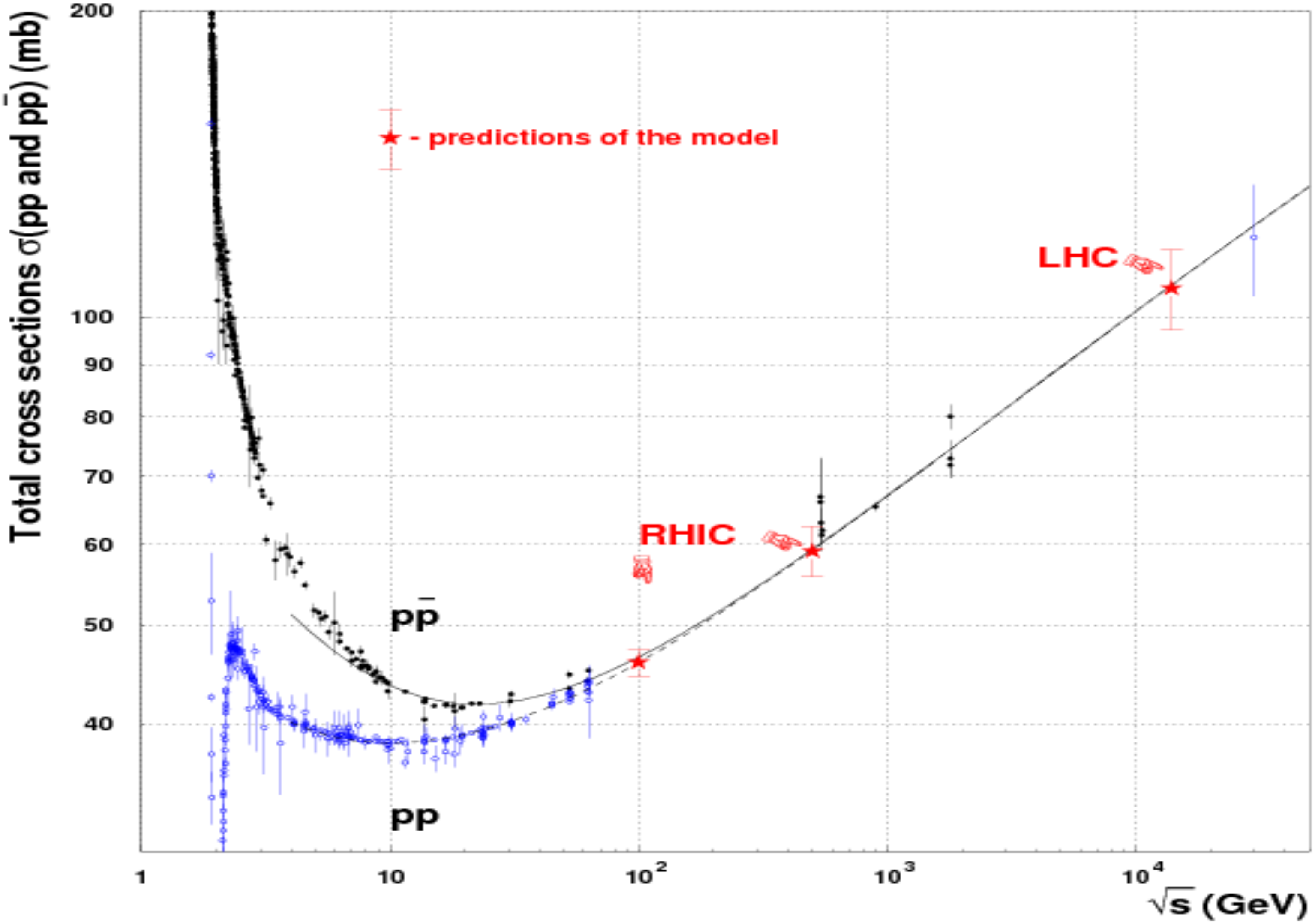
$$A_{pp}^{p\bar{p}}(s,t) = P(s,t) \pm O(s,t) + f(s,t) \pm \omega(s,t) \rightarrow_{LHC} \approx P(s,t) \pm O(s,t),$$

where P, O, f. ω are the Pomeron, odderon and non-leading Reggeon contributions.

The variaty of languages results in a Babylonic confusion

α(0)\C	+	-
1	P	O
1/2	f	ω

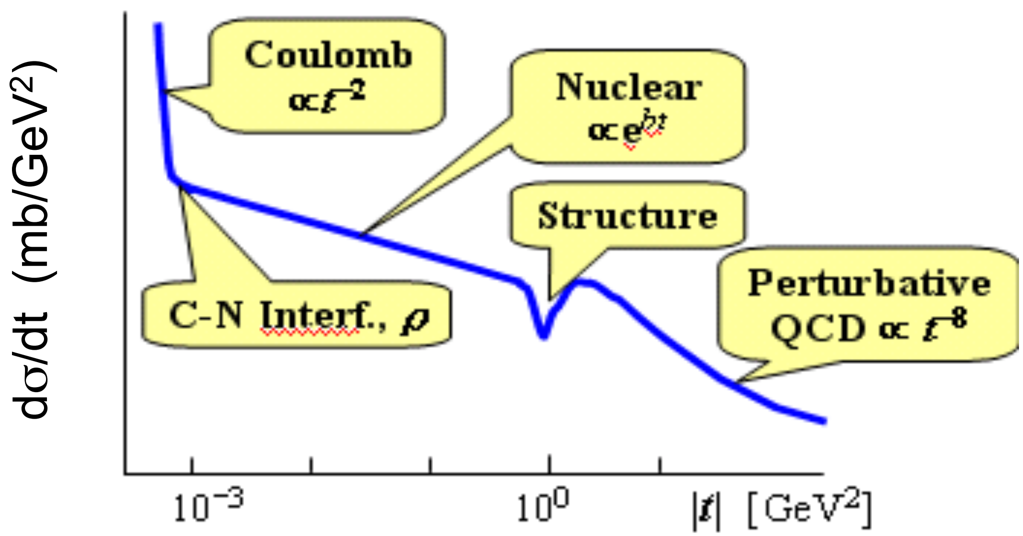
Pomeron exchange is synonim of Diffraction!



Total cross sections σ(pp and pp̄) (mb)
200
100
90
80
70
60
50
40
★ - predictions of the model
LHC
RHIC
pp̄
pp
1
10
10²
10³
10⁴
√s (GeV)

Elastic Scattering (generalities & details)

$\sqrt{s}$ = 14 TeV prediction of BSW model



momentum transfer $-t \sim (p\theta)^2$

θ = beam scattering angle

p = beam momentum

$$\rho = \left.\frac{\mathrm{Re}(f_{el}(t))}{\mathrm{Im}(f_{el}(t))}\right|_{t\to 0}$$

$$\left.\frac{dN}{dt}\right|_{t=CNI} = L\pi|f_C + f_N|^2 \approx L\pi\left|-\frac{2\alpha_{\mathrm{EM}}}{|\mathrm{t}|} + \frac{\sigma_{\mathrm{tot}}}{4\pi}(i+\rho)e^{-\frac{b|t|}{2}}\right|^2$$

L, σ_{tot}, **b**, and ρ from FIT in CNI region (UA4)

CNI region: $|f_C| \sim |f_N|$ → @ LHC: $-t \sim 6.5\ 10^{-4}$ GeV^2; θ_{min}~3.4 μrad

(θ_{min}~120 μrad @ SPS)

Basic ingredients in any model-building; no theory:

1.Undisputable: the Pomeron is supercritical, alpha(0)>1.
Question: do we need also a “hard” component in the (universal) Pomeron?

2. Input (“Born term) and unitarization (e.g. “Regge-eikonal). Problems:
a) B_2=B_1/2? b) More dips, at higher |t| are not seen.

2.Where (e.g. in t) is the transition between “soft” (exponential) and “hard” power behaviour of the differenctial croos setion (with TOTEM’s rich?)

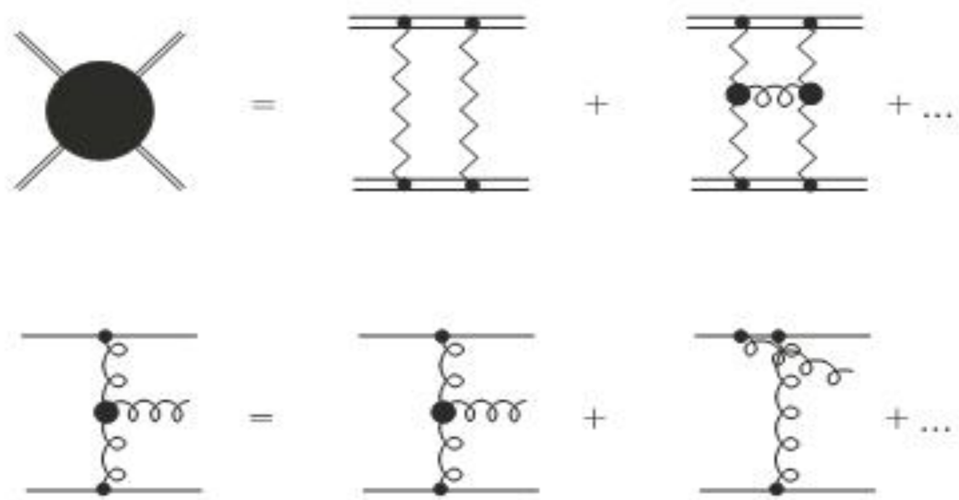
4.Geometrical models of the matter distribution (black disc or ring, Chou-Yang);

4. Is an odd-C (asymptotic!) contribution inevitable? I think so! Is the odderon part of diffraction (this is a lexical problem);

5. Spin in high-energy pp scattering

“THEORY”:

R. Fiore, L.L. Jenkovszky, E.A. Kuraev, A.I. Lengyel, ***Predictions for high-energy pp and \bar pp scattering from a finite sum of gluon ladders,*** **Phys. Rev. D81, #5 (2010) 056005; arXiv0911.2094/hep-ph**



$$\sigma_t^{(P)}(s) = \sum_{i=0}^{N} f_i\, \theta(s - s_0^i)\, \theta(s_0^{i+1} - s)\ , \qquad (1)$$

where

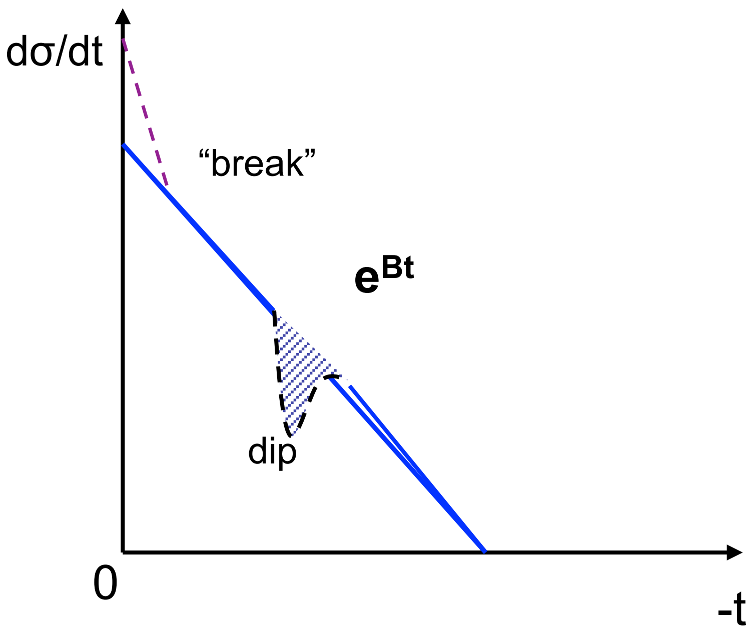
$$f_i = \sum_{j=0}^{i} a_{ij} L^j\ , \qquad (2)$$

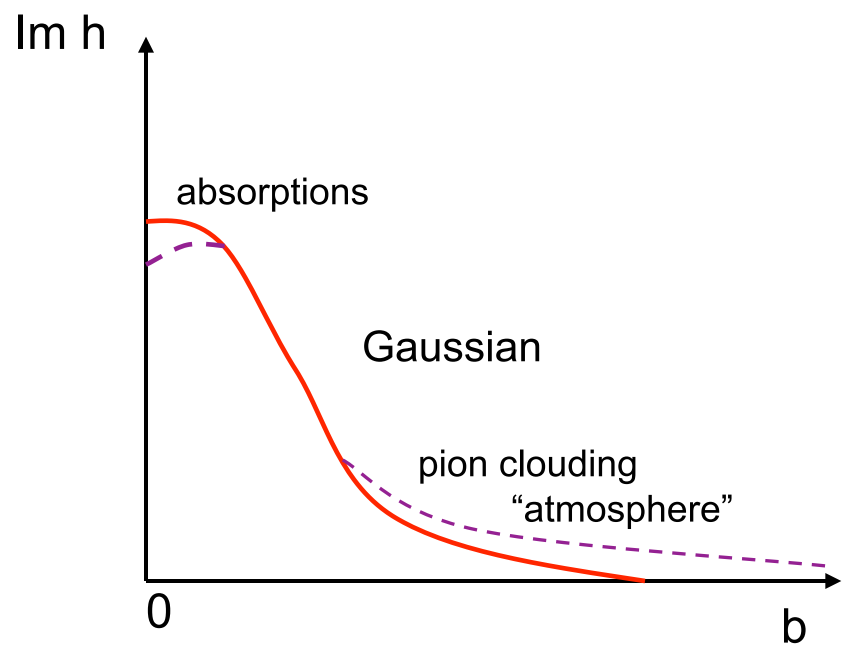
Geometrical scaling (GS), saturation and unitarity

1. On-shell (hadronic) reactions (s,t, Q^2=m^2);

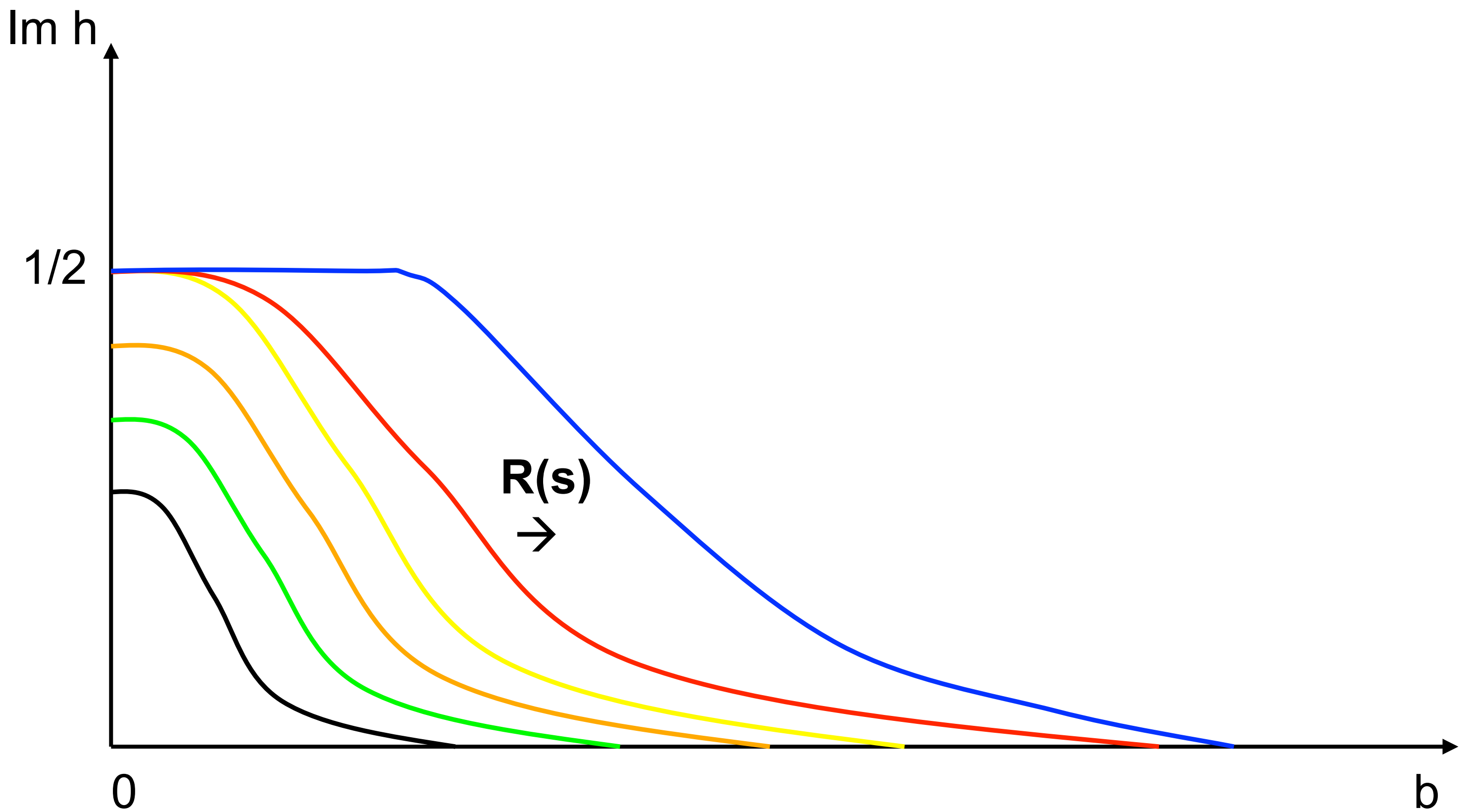
$t \leftrightarrow b$ **transformation:** $h(s,b) = \int_0^\infty d\sqrt{-t}\sqrt{-t}A(s,t)$

and dictionary:





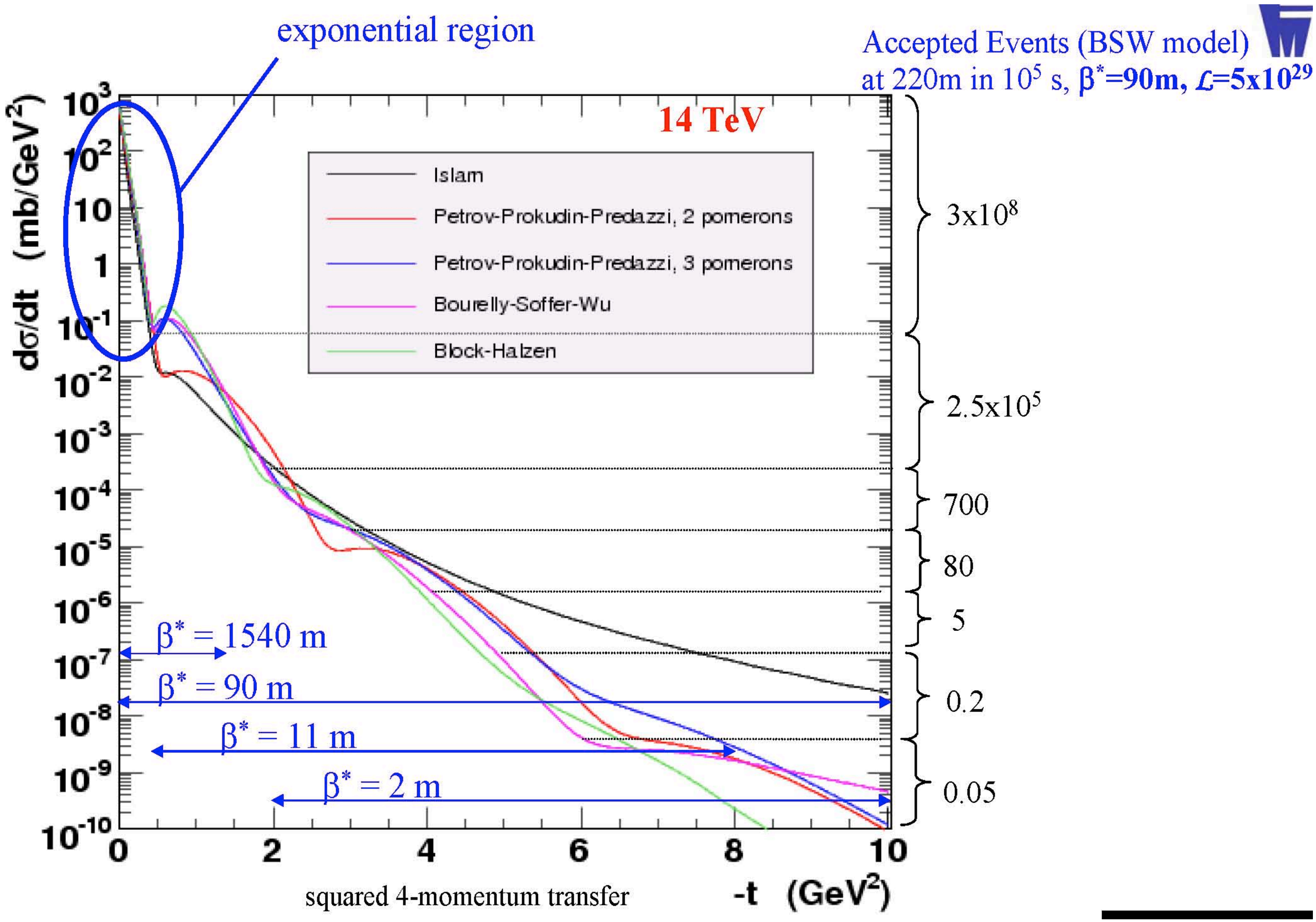
Предел черного диска, Im h=1/2? Нет угрозы!
П. Дегрола, Л.Л. Енковский, Б.В. Струминский, ЯФ, EPJ (1999).
См. также спор Трошина и Тюрина с Block*ом* и Halzen*ом* (arXiv: 21.11.2011)



Saturation of the Black Disc Limit?

$ImH(s,b) = |h(s,b)|^2 + G_{in}(s,b)$, (h is associaed with the "opacity), Here from: $0 \leq |h(s,b)|^2 \leq \Im h(s,b)) \leq 1$. The Black Disc Limit (BDL) corresponds to $\Im h(s,b) = 1/2$, provided $h(s,b) = i(1 - \exp[i\omega(s,b)]/2$, with an imaginary eikonal $\omega(s,b) = i\Omega(s,b)$.

There is an alternative solution, that with the "minus" sign in $h(s,b) = [1 \pm \sqrt{1 - 4G_{in}(s,b)}]/2$, giving (S.Troshin and N.Tyurin (Protvino)): $h(s,b) = \Im u(s,b)/[1 - iu(s,b))]$,


exponential region
Accepted Events (BSW model)
at 220m in 10^5 s, β^*=90m, $\mathcal{L}=5\times10^{29}$
14 TeV
Islam
Petrov-Prokudin-Predazzi, 2 pomerons
Petrov-Prokudin-Predazzi, 3 pomerons
Bourelly-Soffer-Wu
Block-Halzen
3×10^8
2.5×10^5
700
80
5
0.2
0.05
$\beta^* = 1540$ m
$\beta^* = 90$ m
$\beta^* = 11$ m
$\beta^* = 2$ m
$d\sigma/dt$ (mb/GeV^2)
squared 4-momentum transfer
-t (GeV^2)

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

TOTEM 2011-01
22 June 2011

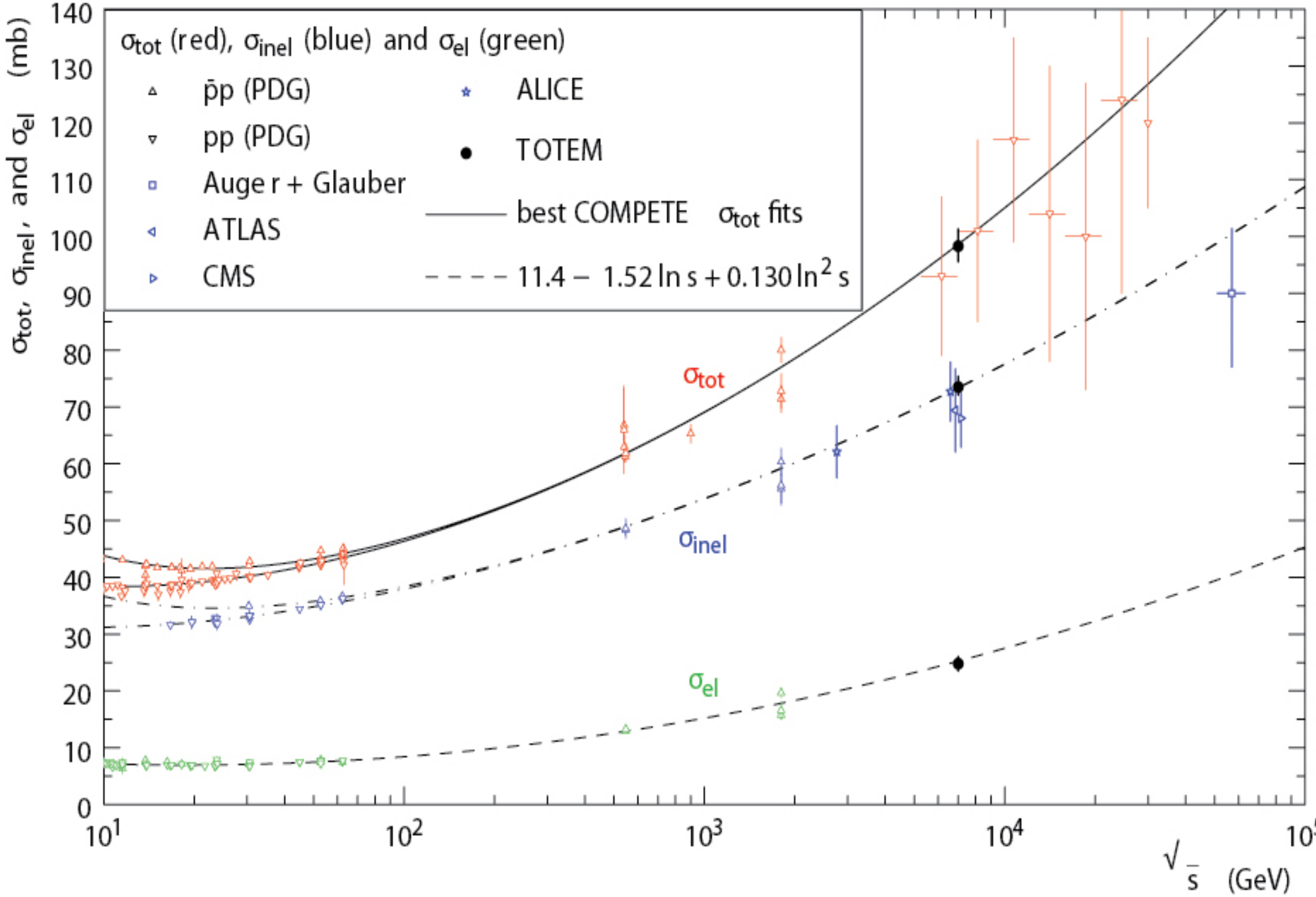
CERN-PH-EP-2011-101
26 June 2011

Elastic pp Scattering at the LHC at $\sqrt{s} = 7$ TeV.

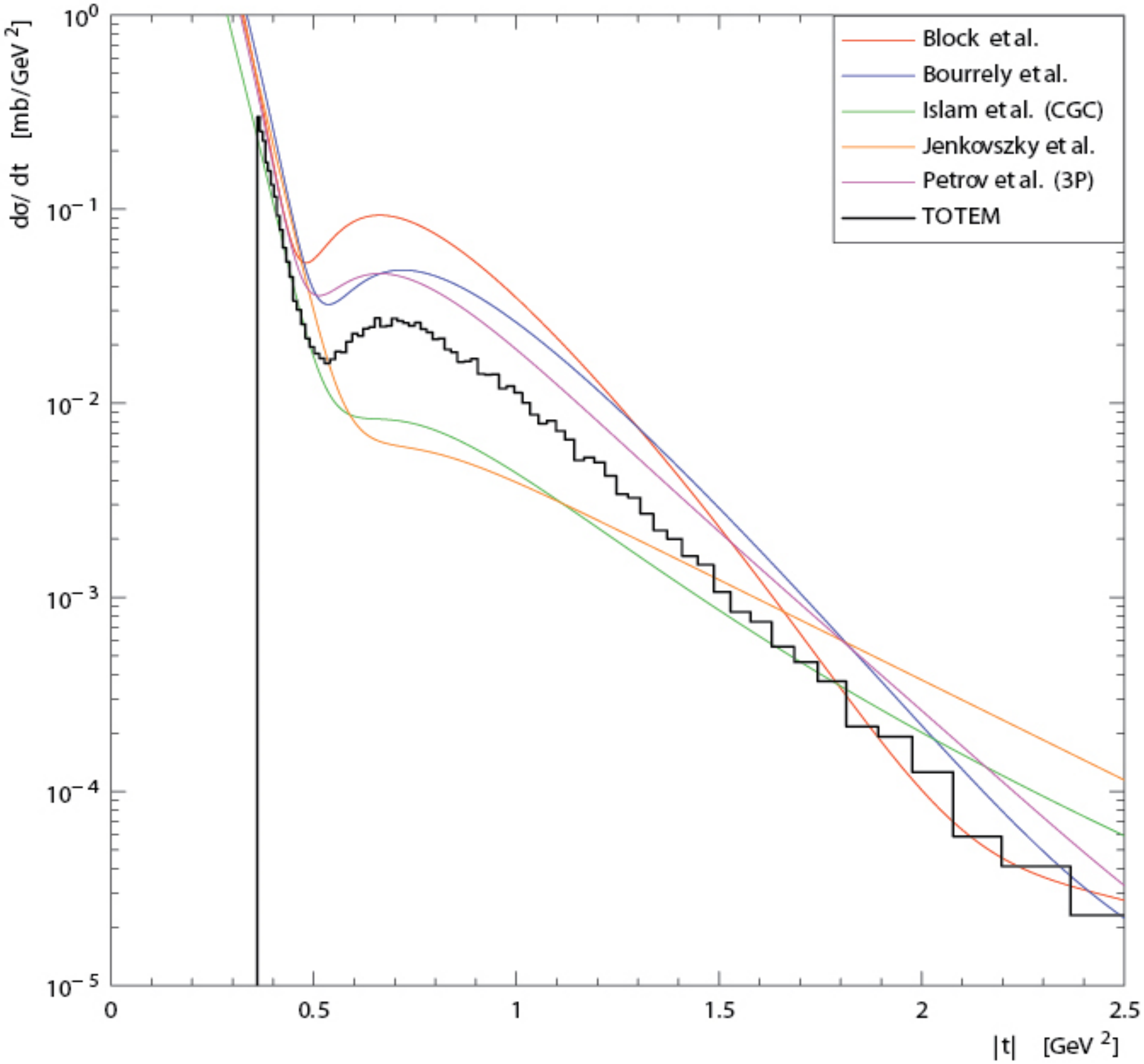
The TOTEM Collaboration
G. Antchev[*], P. Aspell[8], I. Atanassov[8,*], V. Avati[8], J. Baechler[8], V. Berardi[5b,5a], M. Berretti[7b], M. Bozzo[6b,6a], E. Brücken[3a,3b], A. Buzzo[6a], F. Cafagna[5a], M. Calicchio[5b,5a], M. G. Catanesi[5a], C. Covault[9], M. Csanád[4†], T. Csörgö[4], M. Deile[8], E. Dimovasili[8], M. Doubek[1b], K. Eggert[9], V.Eremin[‡], F. Ferro[6a], A. Fiergolski[§], F. Garcia[3a], S. Giani[8], V. Greco[7b,8], L. Grzanka[8,¶], J. Heino[3a], T. Hilden[3a,3b], M. Janda[1b], J. Kašpar[1a,8], J. Kopal[1a,8], V. Kundrát[1a], K. Kurvinen[3a], S. Lami[7a], G. Latino[7b], R. Lauhakangas[3a], T. Leszko[§] E. Lippmaa[2], M. Lokajíček[1a], M. Lo Vetere[6b,6a], F. Lucas Rodríguez[8], M. Macrí[6a], L. Magaletti[5b,5a], G. Magazzù[7a], A. Mercadante[5b,5a], M. Meucci[7b], S. Minutoli[6a], F. Nemes[4,†] H. Niewiadomski[8], E. Noschis[8], T. Novak[4,‖], E. Oliveri[7b], F. Oljemark[3a,3b], R. Orava[3a,3b], M. Oriunno[8**], K. Österberg[3a,3b], A.-L. Perrot[8], P. Palazzi[8], E. Pedreschi[7a], J. Petäjäjärvi[3a], J. Procházka[1a], M. Quinto[5a], E. Radermacher[8], E. Radicioni[5a], F. Ravotti[8], E. Robutti[6a], L. Ropelewski[8], G. Ruggiero[8], H. Saarikko[3a,3b], A. Santroni[6b,6a], A. Scribano[7b], G. Sette[6b,6a], W. Snoeys[8], F. Spinella[7a], J. Sziklai[4], C. Taylor[9], N. Turini[7b], V. Vacek[1b], J. Welti[3a,b], M. Vítek[1b], J. Whitmore[10].

P. Aspell et. al. (TOTEM Collaboaration), *Proton-proton elastic scattering at the LHC energy 7 TeV*, Europhys. Lett. {\bf 95} (2011) 41001; arXiv:1110.1385.

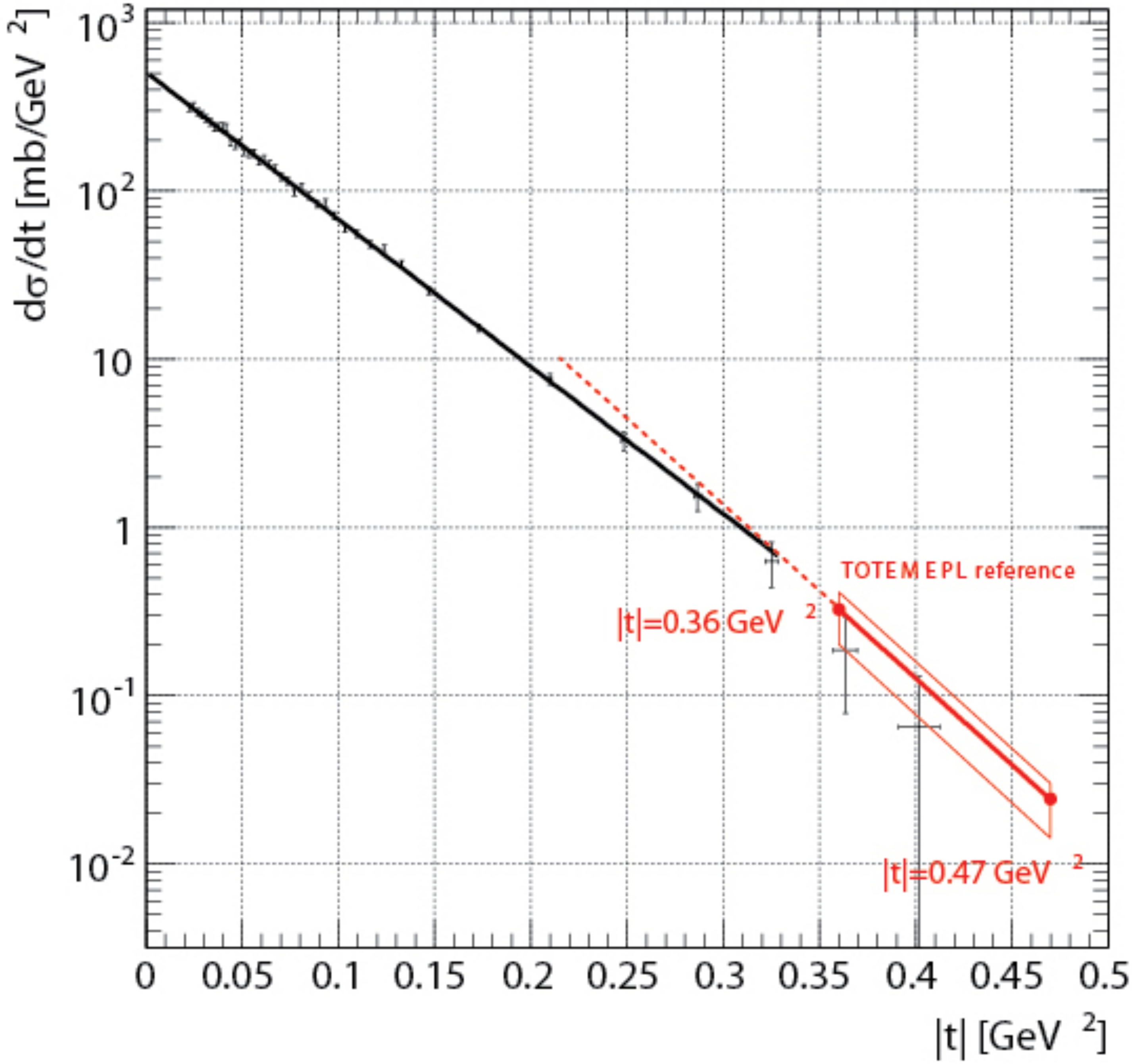
G. Antchev et al. (TOTEM Collab.), *First measurement of the total proton-proton cross section at the LHC energy of 7 TeV*, to be publ in EPL; arXiv:1110.1395.



σtot (red), σinel (blue) and σel (green)
p̄p (PDG)
pp (PDG)
Auge r + Glauber
ATLAS
CMS
ALICE
TOTEM
best COMPETE σtot fits
11.4 − 1.52 ln s + 0.130 ln2 s
σtot
σinel
σel
σtot, σinel, and σel (mb)
√s (GeV)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
10^1
10^2
10^3
10^4
10^5



L. Jenkovszky, A. Lengyel, D. Lontkovskyi, The Pomeron and Odderon in elastic, inelastic and total cross sections at the LHC, Int. J. Mod. Phys. A 26, # 26 & 27 (2011) 4755-4771, arXiv:1105.1202



dσ/dt [mb/GeV 2]
|t| [GeV 2]
TOTEM EPL reference
|t|=0.36 GeV 2
|t|=0.47 GeV 2

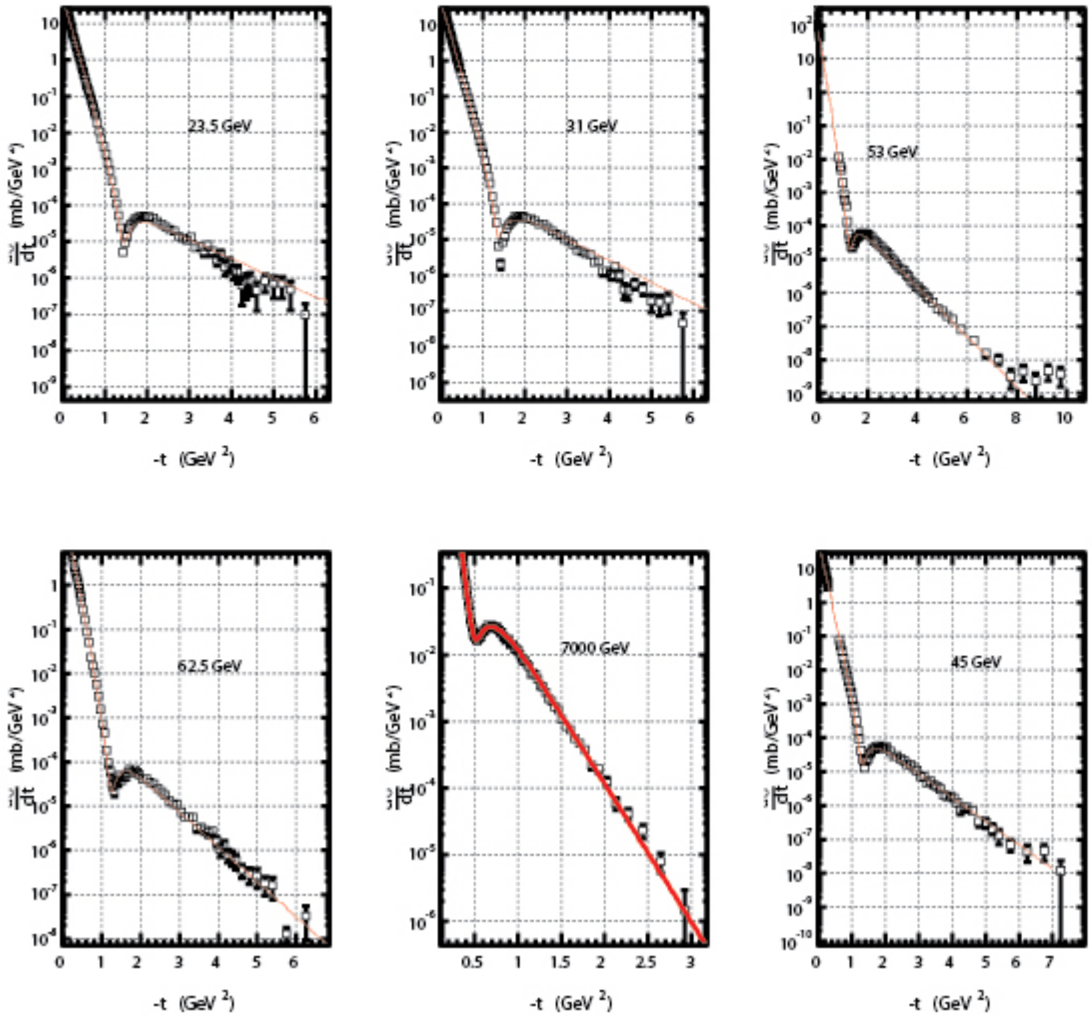
Phenomenology

R.J.J. Phillips and V. Barger, *Model independent analysis of the structure in pp scattering,* Phys. Lett. B 46 (1973) 412.

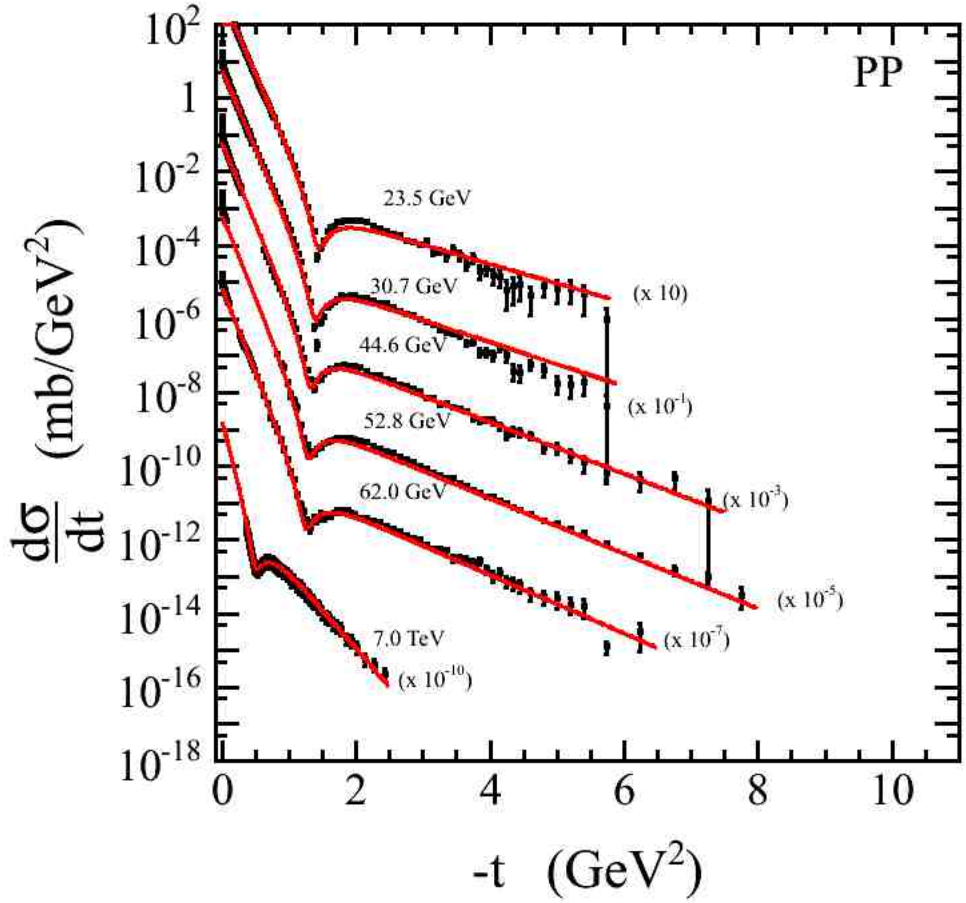
Phillips and Barger in 1973 [ ], right after its first observation at the ISR. Their formula reads

$$\frac{d\sigma}{dt} = |\sqrt{A}\exp(Bt/2) + \sqrt{C}\exp(Dt/2 + i\phi)|^2, \tag{1}$$

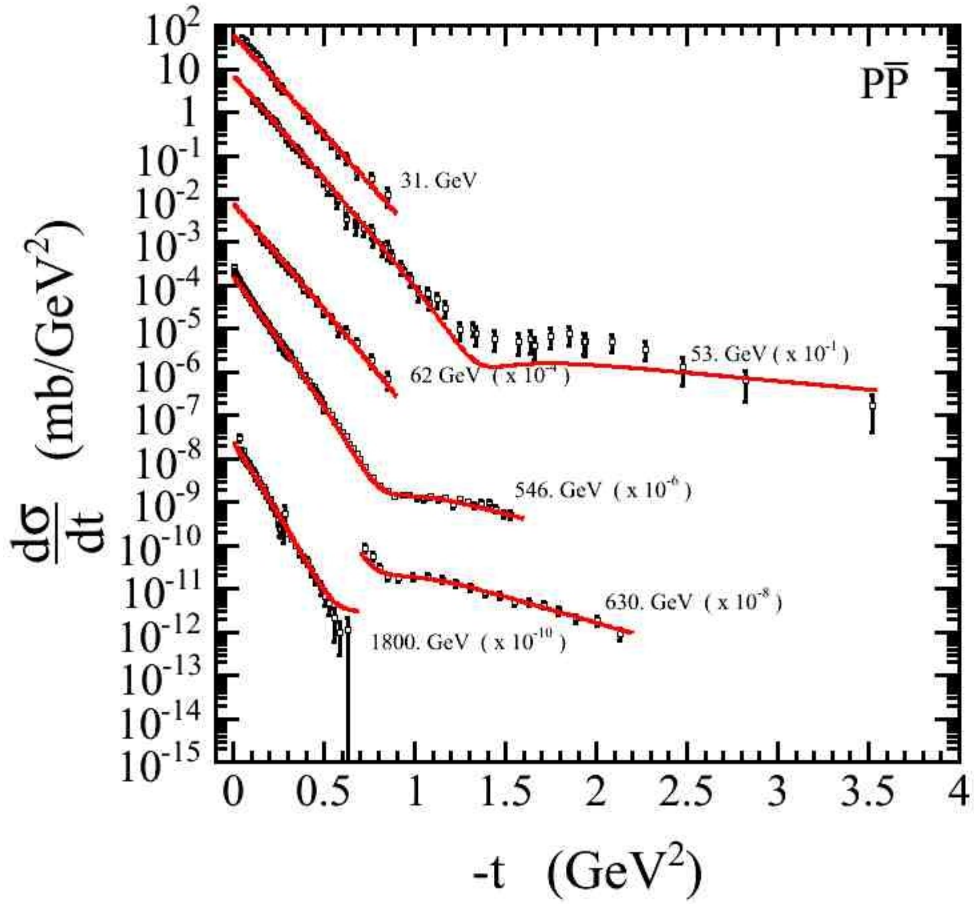
where A, B, C, D and ϕ are determined independently at each energy.

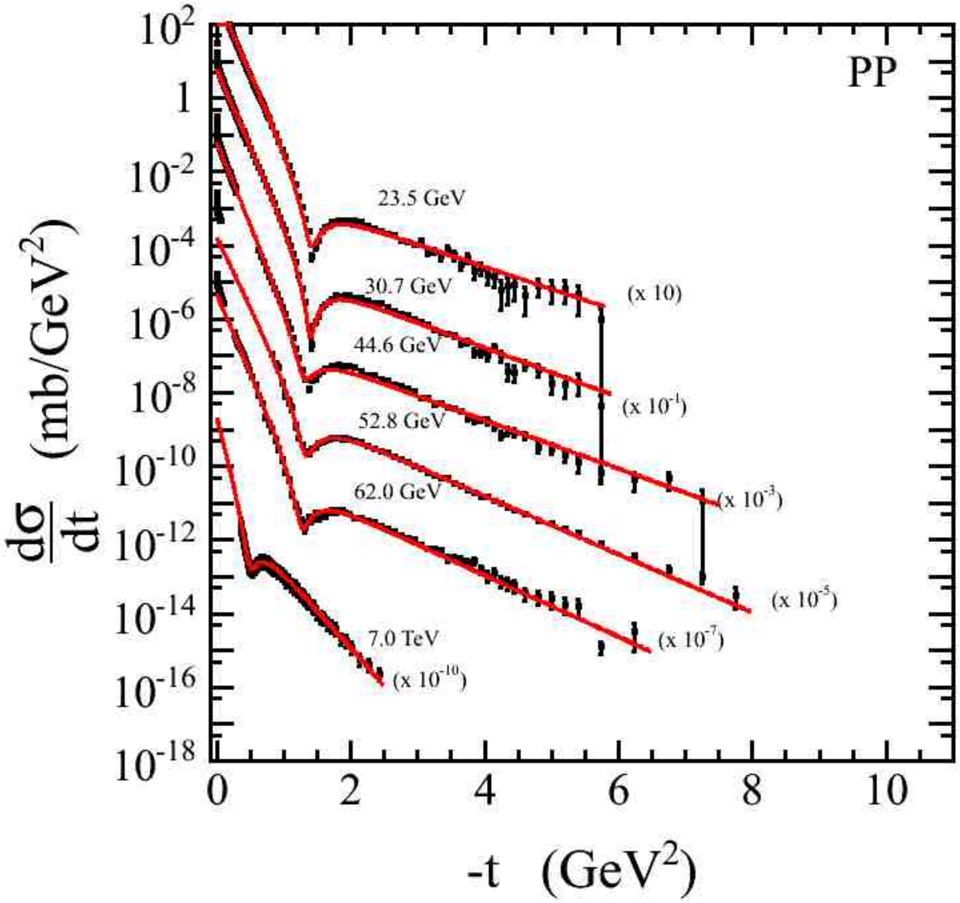


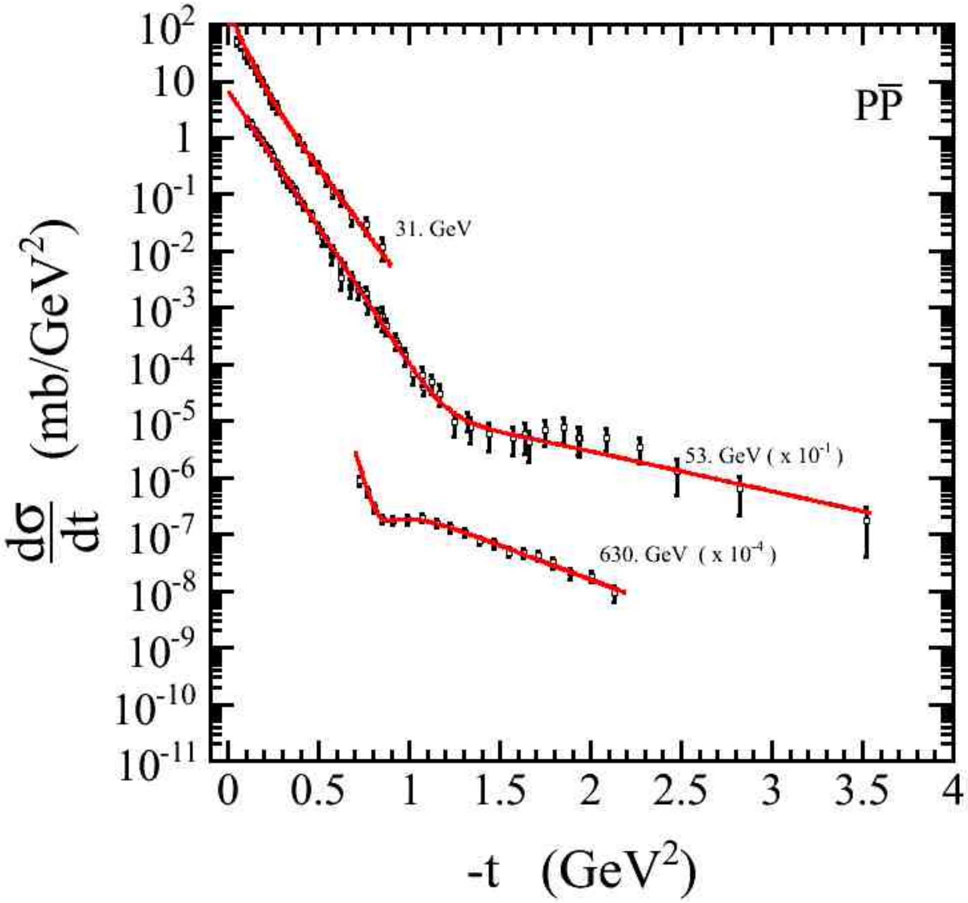
23.5 GeV
31 GeV
53 GeV
62.5 GeV
7000 GeV
45 GeV
dσ/dt (mb/GeV⁴)
-t (GeV ²)



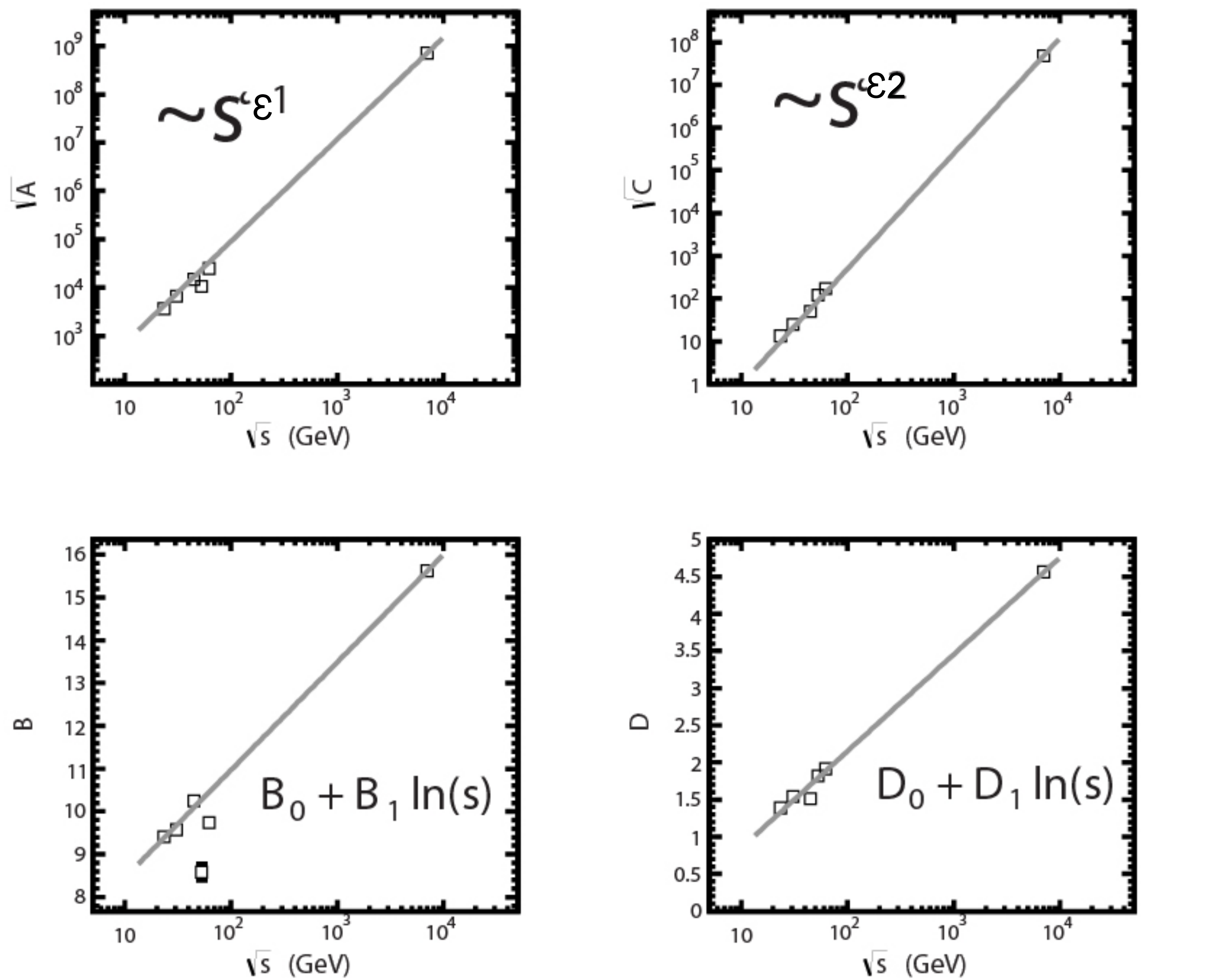
PP
23.5 GeV
(x 10)
30.7 GeV
(x 10^-1)
44.6 GeV
(x 10^-3)
52.8 GeV
(x 10^-5)
62.0 GeV
(x 10^-7)
7.0 TeV
(x 10^-10)
dσ/dt (mb/GeV^2)
-t (GeV^2)


PP̄
31. GeV
53. GeV (x 10^-1)
62 GeV (x 10^-4)
546. GeV (x 10^-6)
630. GeV (x 10^-8)
1800. GeV (x 10^-10)
dσ/dt (mb/GeV^2)
-t (GeV^2)


PP
23.5 GeV
30.7 GeV
44.6 GeV
52.8 GeV
62.0 GeV
7.0 TeV
(x 10)
(x 10^-1)
(x 10^-3)
(x 10^-5)
(x 10^-7)
(x 10^-10)
dσ/dt (mb/GeV^2)
-t (GeV^2)
10^2
1
10^-2
10^-4
10^-6
10^-8
10^-10
10^-12
10^-14
10^-16
10^-18
0
2
4
6
8
10



10^2
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
0
0.5
1
1.5
2
2.5
3
3.5
4
$\frac{d\sigma}{dt}$ (mb/GeV^2)
-t (GeV^2)
$P\bar{P}$
31. GeV
53. GeV (x 10^{-1})
630. GeV (x 10^{-4})



$\sim S^{\varepsilon 1}$
$\sqrt{A}$
$\sqrt{s}$ (GeV)
$\sim S^{\varepsilon 2}$
$\sqrt{C}$
$\sqrt{s}$ (GeV)
B
$B_0 + B_1 \ln(s)$
$\sqrt{s}$ (GeV)
D
$D_0 + D_1 \ln(s)$
$\sqrt{s}$ (GeV)

L. Jenkovszky and D. Lontkovskiy: In the Proc. of the Crimean (2011) Conference; also presented at the Russian-Spanish Dual Meeting in Barcelona, November, 2011:

Parameter name	**Value**	**Uncertainty**
	χ^2/**NDF**	**4.60434**
$\sqrt{A}$	+2.214549e+001	+2.344779e-001
B_0	+1.391529e+000	+7.408365e-003
B_1	+3.032435e-001	+1.525472e-003
$\sqrt{C}$	+6.952456e+003	+1.596950e+001
D_0	+9.766352e+000	+1.234181e-002
D_1	+4.648188e-001	+9.965043e-003
ϵ_1	+1.358585e+000	+1.243930e-003
ϵ_2	+1.057306e+000	+1.830864e-003
ϕ	+3.511842e+000	+3.713867e-003

Table 2: Parameters obtained from the fit to the pp **data**

Model building (input + unitarazation)

(analyticity, Regge behaviour (factorization), unitarity, GS)

$$A_{pp}^{p\bar{p}}(s,t) = P(s,t) \pm O(s,t) + f(s,t) \pm \omega(s,t) \to_{LHC} P(s,t) \pm O(s,t),$$

where P is the Pomeron contribution and O is that of the Odderon.

$$P(s,t) = i\frac{as}{bs_0}(r_1^2(s)e^{r_1^2(s)[\alpha_P(t)-1]} - \epsilon r_2^2(s)e^{r_2^2(s)[\alpha_P(t)-1]}),$$

where $r_1^2(s) = b + L - \frac{i\pi}{2}$, $r_2^2(s) = L - \frac{i\pi}{2}$ with $L \equiv \ln\frac{s}{s_0}$; $\alpha_P(t)$ is the Pomeron trajectory and a, b, s_0 and ϵ are free parameters.

Is A(s,t) ractorizable? **No, it is not!** (Regge poles, 60-ies)
The inclusion of the virtuality, Q^2, or the external mass is much more tricky.

$$A_P(s,t) = \frac{d}{d\alpha_P}\left[e^{-i\pi\alpha_P/2}G(\alpha_P)\Big(s/s_0\Big)^{\alpha_P}\right] = \tag{1}$$

$$e^{-i\pi\alpha_P(t)/2}\Big(s/s_0\Big)^{\alpha_P(t)}\left[G'(\alpha_P)+\Big(L-i\pi/2\Big)G(\alpha_P)\right].$$

α= α(t)

The Pomeron is a dipole in the $j-$plane

$$A_P(s,t) = \frac{d}{d\alpha_P}\Big[e^{-i\pi\alpha_P/2}G(\alpha_P)\Big(s/s_0\Big)^{\alpha_P}\Big] = \tag{1}$$

$$e^{-i\pi\alpha_P(t)/2}\Big(s/s_0\Big)^{\alpha_P(t)}\Big[G'(\alpha_P) + \Big(L - i\pi/2\Big)G(\alpha_P)\Big].$$

Since the first term in squared brackets determines the shape of the cone, one fixes

$$G'(\alpha_P) = -a_P e^{b_P[\alpha_P - 1]}, \tag{2}$$

where $G(\alpha_P)$ is recovered by integration, and, as a consequence, the Pomeron amplitude can be rewritten in the following "geometrical" form

$$A_P(s,t) = i\frac{a_P\ s}{b_P\ s_0}[r_1^2(s)e^{r\ \ (s)[\alpha_P-1]} - \varepsilon_P r_2^2(s)e^{r\ \ (s)[\alpha_P-1]}], \tag{3}$$

where $r_1^2(s) = b_P + L - i\pi/2$, $r_2^2(s) = L - i\pi/2$, $L \equiv \ln(s/s_0)$.

By factoring out the term from the square brackets, we get:

$$A_P(s,t) = i\frac{a_P}{b_P}\frac{s}{s_0}\sqrt{R_1^4+\varepsilon_P^2R_2^4}\left[\frac{R_1^2}{\sqrt{R_1^4+\varepsilon_P^2R_2^4}}\mathrm{e}^{R_1^2\cdot[\alpha_P-1]} - \frac{\varepsilon_P^2R_2^2}{\sqrt{R_1^4+\varepsilon_P^2R_2^4}}\mathrm{e}^{R_2^2\cdot[\alpha_P-1]}\right]. \tag{1}$$

One can define

$$\cos\theta \equiv \frac{R_1^2}{\sqrt{R_1^4+\varepsilon_P^2R_2^4}} = \frac{\mathrm{e}^{i\theta}+\mathrm{e}^{-i\theta}}{2}, \qquad \sin\theta \equiv -\frac{\varepsilon_P^2R_2^2}{\sqrt{R_1^4+\varepsilon_P^2R_2^4}} = \frac{\mathrm{e}^{i\theta}-\mathrm{e}^{-i\theta}}{2i}. \tag{2}$$

$$A_P(s,t) = i\frac{a_P}{b_P}\frac{s}{s_0}\sqrt{R_1^4+\varepsilon_P^2R_2^4}\,\mathrm{e}^{-i\theta}\left[\left(\mathrm{e}^{i2\theta}+1\right)\mathrm{e}^{R_1^2\cdot[\alpha_P-1]} + \left(\mathrm{e}^{i2\theta}-1\right)\mathrm{e}^{-i\frac{\pi}{2}}\mathrm{e}^{R_2^2\cdot[\alpha_P-1]}\right]. \tag{3}$$

Or equivalently for the case of linear trajectory with unit intercept $\alpha_P\left(t\right) = 1+\alpha_P' t$

$$A_P(s,t) = i\mathrm{e}^{-\mathrm{i}\theta}\left[\sqrt{A}\mathrm{e}^{\frac{1}{2}B_1t} + \sqrt{A}\mathrm{e}^{\frac{1}{2}B_1t+i\varphi_1} + i\left(\sqrt{A}\mathrm{e}^{\frac{1}{2}B_2t} + \sqrt{A}\mathrm{e}^{\frac{1}{2}B_2t+i\varphi_2}\right)\right]. \tag{4}$$

Where

$$\sqrt{A\left(s\right)} = \sqrt{\left(\frac{1}{2}\frac{a_P}{b_P}\frac{s}{s_0}\right)^2\left(R_1^4+\varepsilon_P^2R_2^4\right)}, \tag{5a}$$

$$B_1\left(s\right) = 2R_1^2\left(s\right)\alpha_P', \qquad B_2\left(s\right) = 2R_2^2\left(s\right)\alpha_P', \tag{5b}$$

$$\varphi_1 = -2\theta, \qquad \varphi_1 = 2\theta+\pi. \tag{5c}$$

Such an amplitude can be considered as a sum of two PB-type amplitudes.

The Pomeron trajectory

The Pomeron trajectory has threshold singularities, the lowest one being due to the two-pion exchange, required by the $t-$channel unitarity. There is a constrain (Barut, Zwanziger; Gribov) from the $t-$ channel unitarity, by which

$$\Im\alpha(t) \sim (t - t_0)^{\Re\alpha(t_0)+1/2}, \quad t \to t_0,$$

where t_0 is the lightest threshold. For the Pomeron trajectory it is $t_0 = 4m_\pi^2$, and near the threshold:

$$\alpha(t) \sim \sqrt{4m_\pi^2 - t}. \tag{1}$$

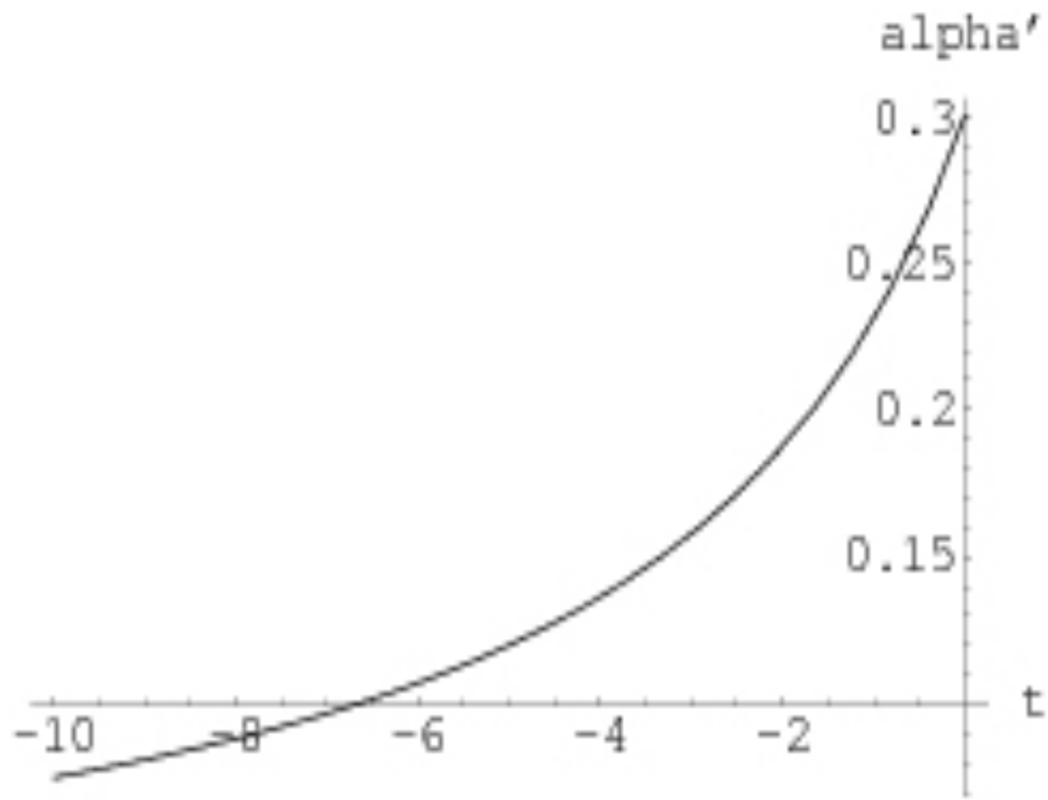
The observed nearly linear behaviour of the trajectory is promoted by higher, additive thresholds.

Asymptotically, the trajectories are logarithmic. This follows from the compatibility of the Regge behavior with the quark counting rules (Brodsky, Farrar; MMT), as well as from the solution of the BFKL equation. A simple parametrization combining the linear behaviour at small $|t|$ with its logarithmic asymptotic is:

$$\alpha(t) = \alpha_0 - \gamma \ln(1 - \beta_1 t).$$

Nearly linear at small $|t|$, it reproduces the forward cone of the differential cross section, while its logarithmic asymptotic provides for the wide-angle scaling behavior. A combined form is:

$$\alpha(t) = \alpha_0 - \gamma \ln(1 + \beta_2 \sqrt{t_0 - t}).$$

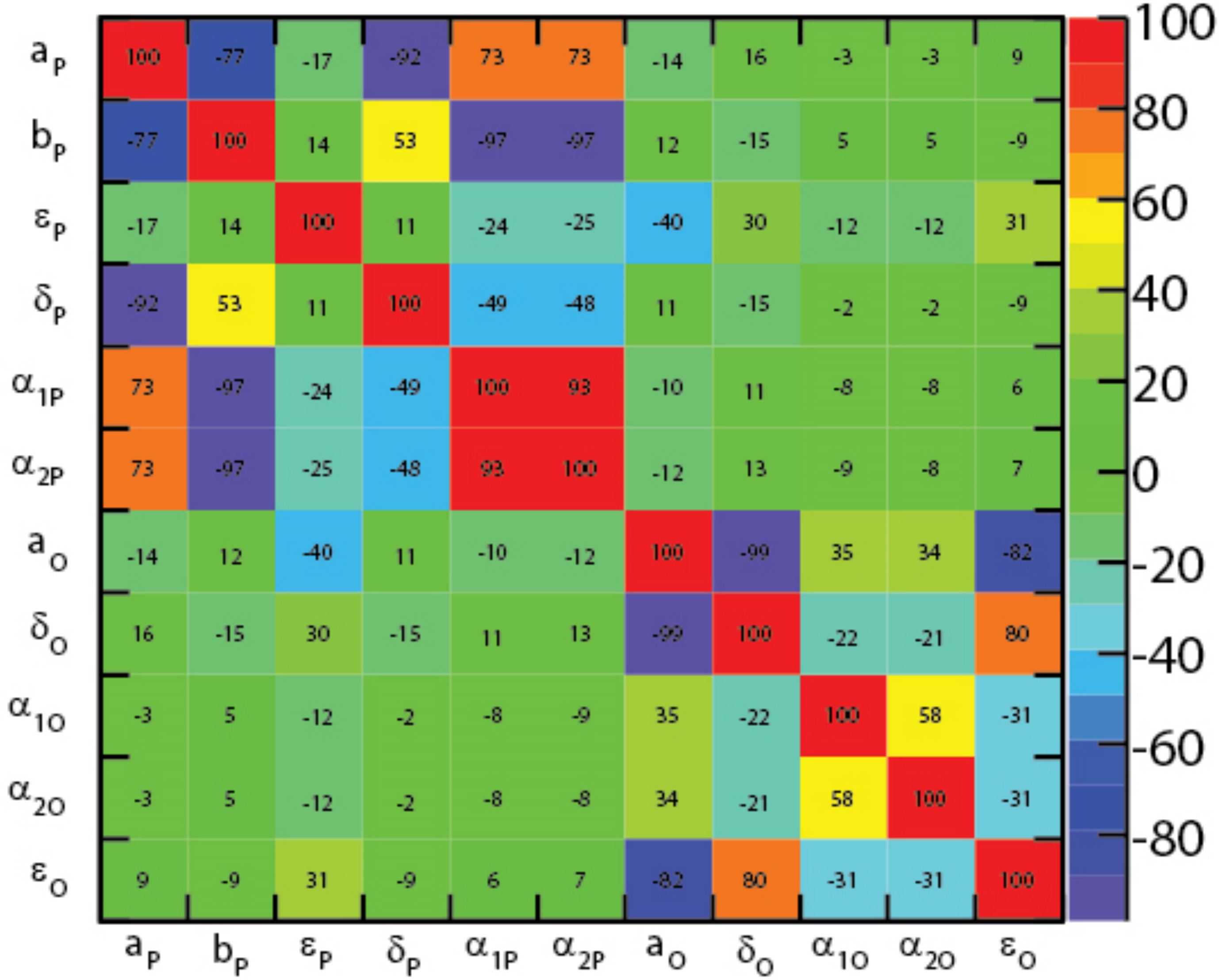

alpha'
0.3
0.25
0.2
0.15
t
-10
-8
-6
-4
-2

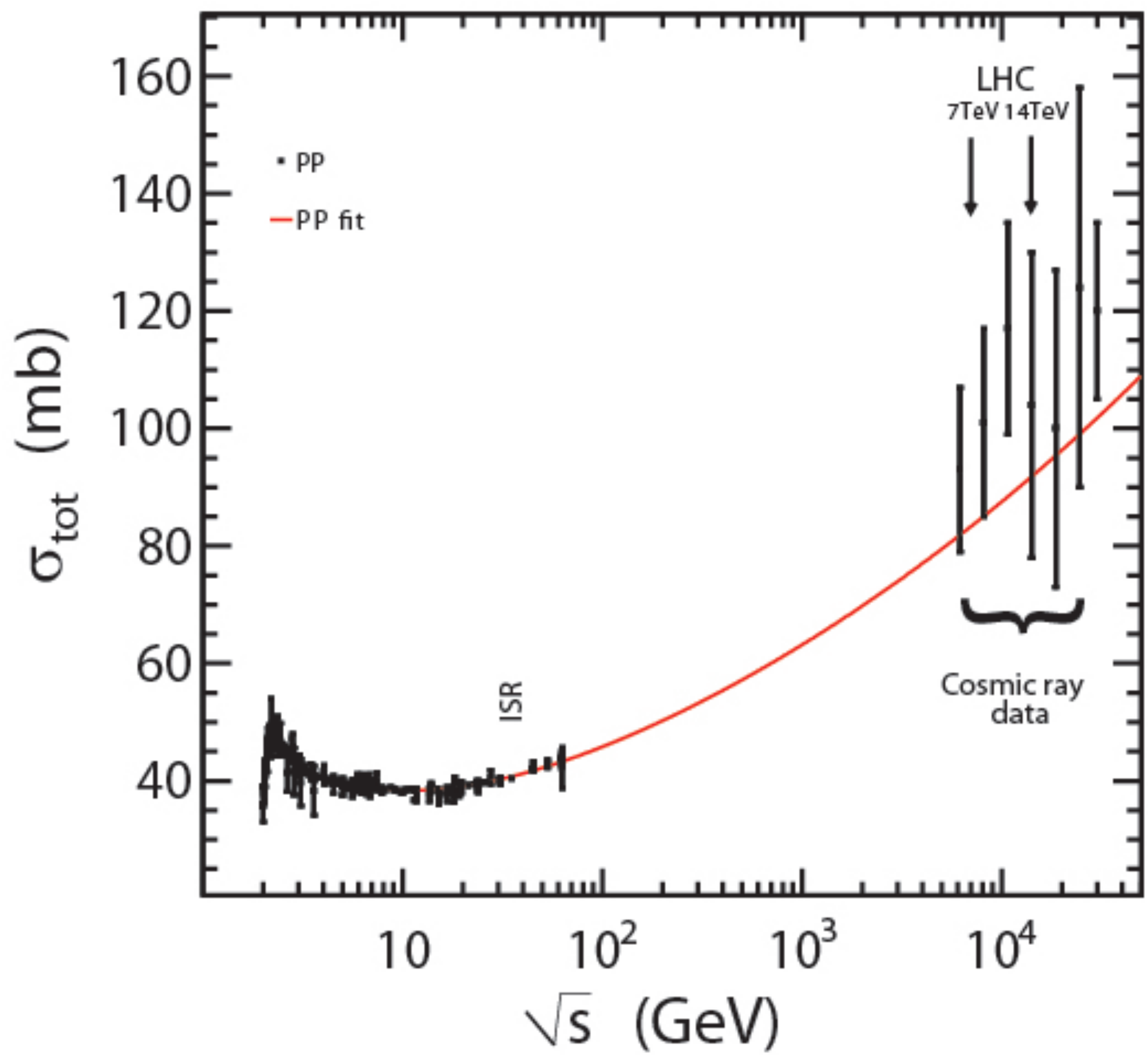
Representative examples of the Pomeron trajectories: 1) Linear; 2) With a square-root threshold, required by $t-$channel unitarity and accounting for the small-t "break" as well as the possible "Orear", $e^{\sqrt{-t}}$ behavior in the second cone; and 3) A logarithmic one, anticipating possible "hard effects" at large $|t|$ $|t| < 8$ GeV^2.

$$\alpha_P \equiv \alpha_P(t) = 1 + \delta_P + \alpha_{1P}t, \tag{TR.1}$$

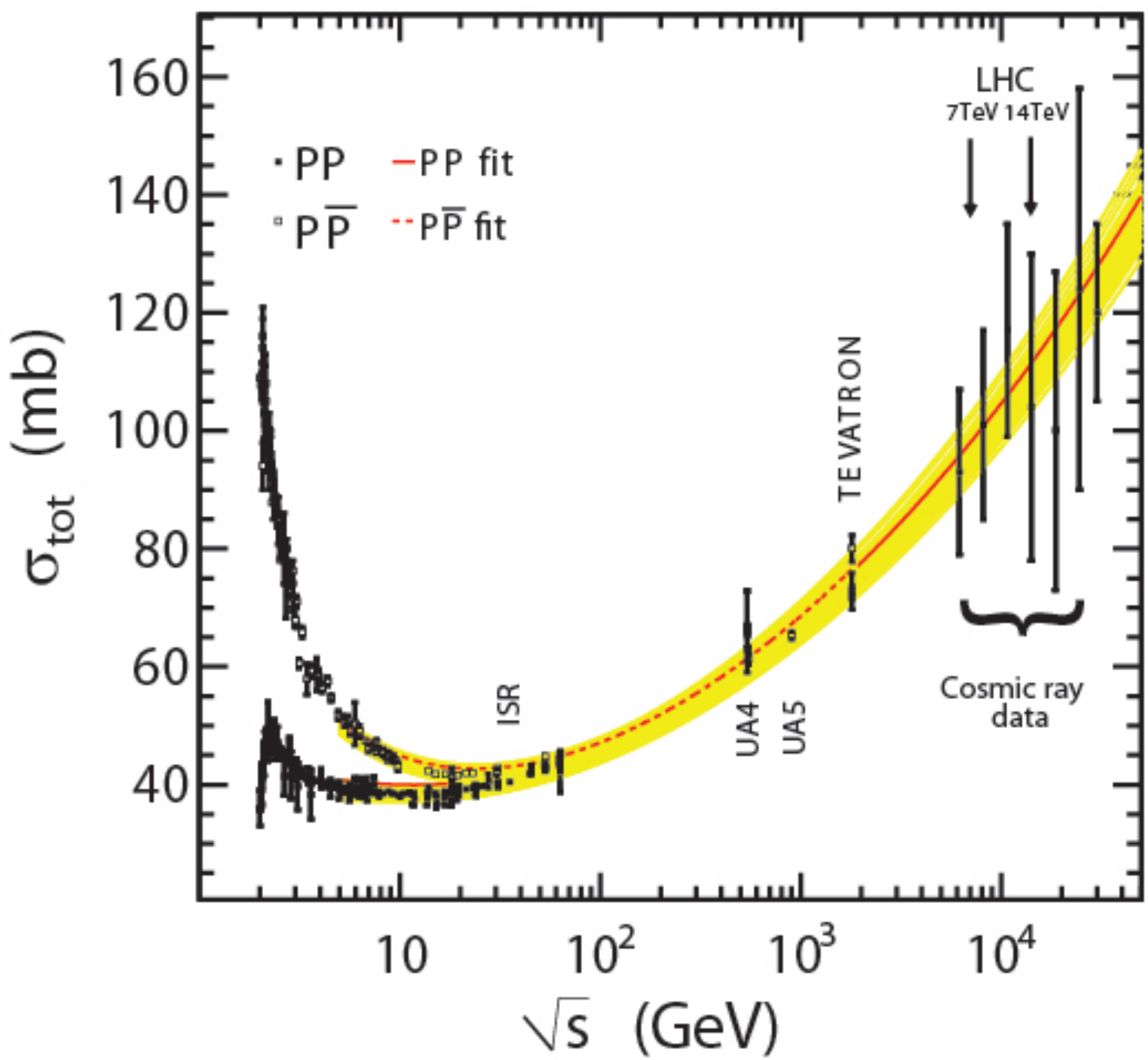
$$\alpha_P \equiv \alpha_P(t) = 1 + \delta_P + \alpha_{1P}t - \alpha_{2P}\left(\sqrt{4\alpha_{3P}^2 - t} - 2\alpha_{3P}\right), \tag{TR.2}$$

$$\alpha_P \equiv \alpha_P(t) = 1 + \delta_P - \alpha_{1P}\ln\left(1 - \alpha_{2P}t\right). \tag{TR.3}$$

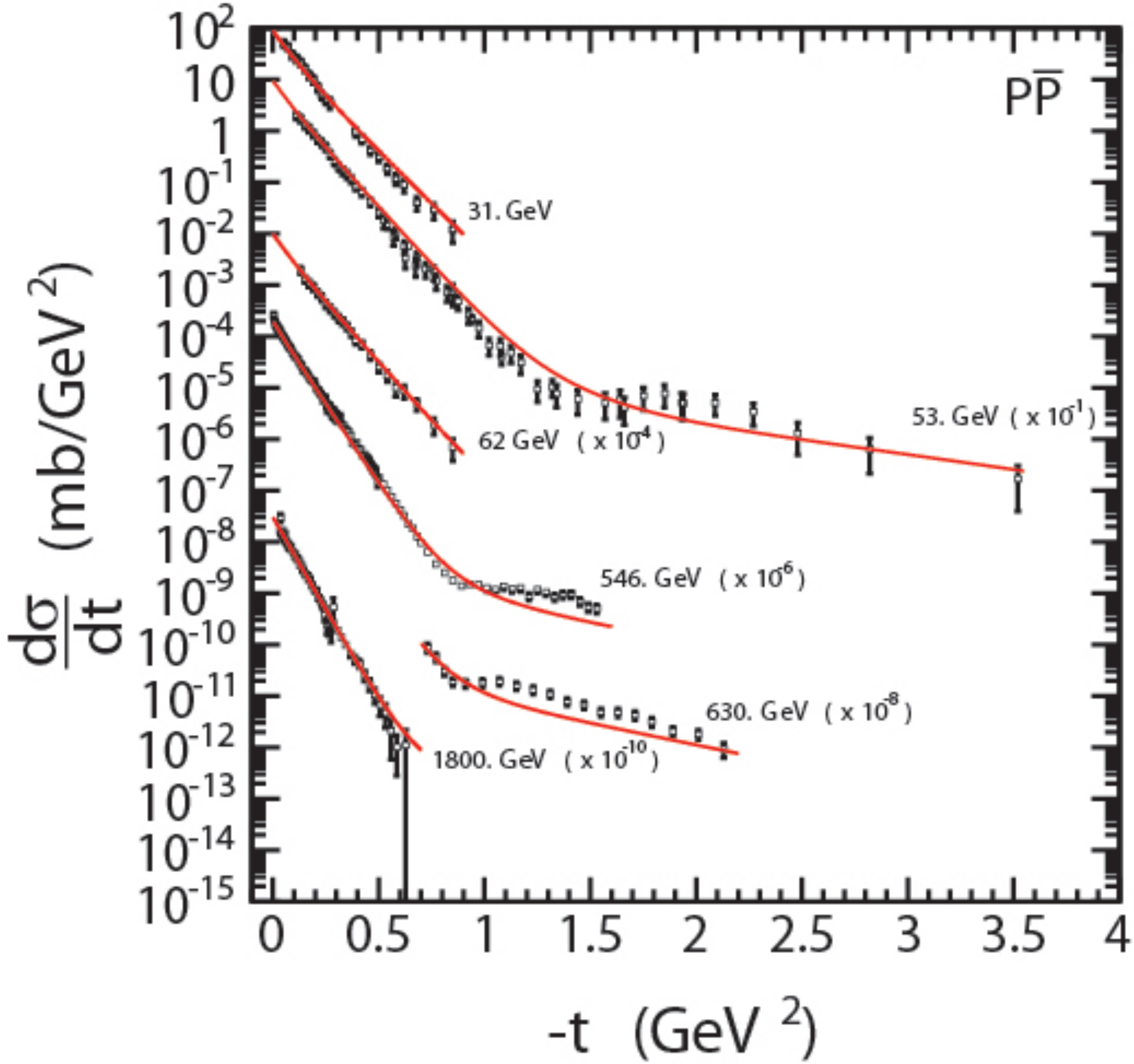

a_P 100 -77 -17 -92 73 73 -14 16 -3 -3 9
b_P -77 100 14 53 -97 -97 12 -15 5 5 -9
ε_P -17 14 100 11 -24 -25 -40 30 -12 -12 31
δ_P -92 53 11 100 -49 -48 11 -15 -2 -2 -9
α_1P 73 -97 -24 -49 100 93 -10 11 -8 -8 6
α_2P 73 -97 -25 -48 93 100 -12 13 -9 -8 7
a_O -14 12 -40 11 -10 -12 100 -99 35 34 -82
δ_O 16 -15 30 -15 11 13 -99 100 -22 -21 80
α_1O -3 5 -12 -2 -8 -9 35 -22 100 58 -31
α_2O -3 5 -12 -2 -8 -8 34 -21 58 100 -31
ε_O 9 -9 31 -9 6 7 -82 80 -31 -31 100
a_P b_P ε_P δ_P α_1P α_2P a_O δ_O α_1O α_2O ε_O
100
80
60
40
20
0
-20
-40
-60
-80



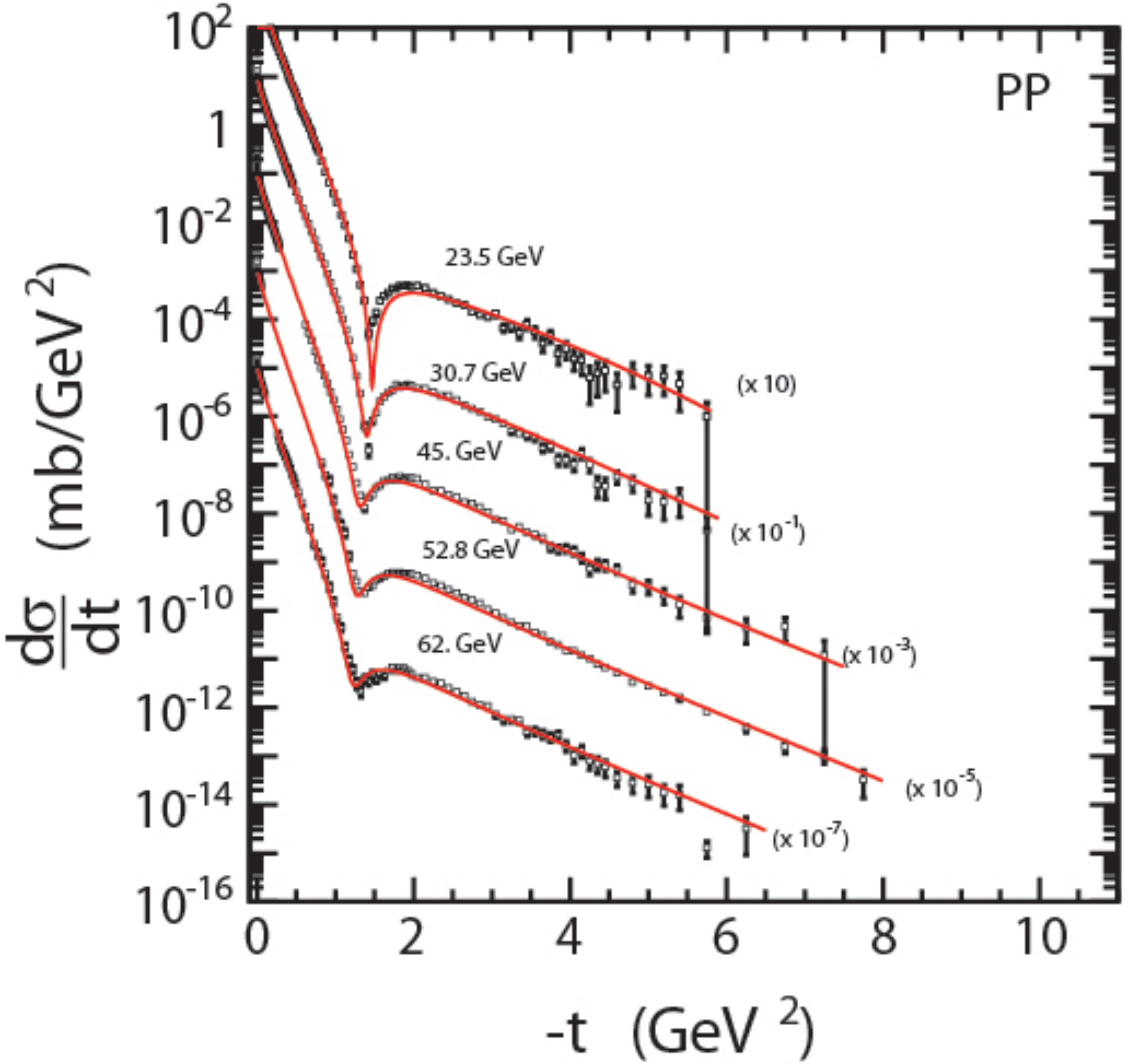
LHC
7TeV 14TeV
PP
PP fit
ISR
Cosmic ray data
160
140
120
100
80
60
40
10
10^2
10^3
10^4
σ_{tot} (mb)
$\sqrt{s}$ (GeV)



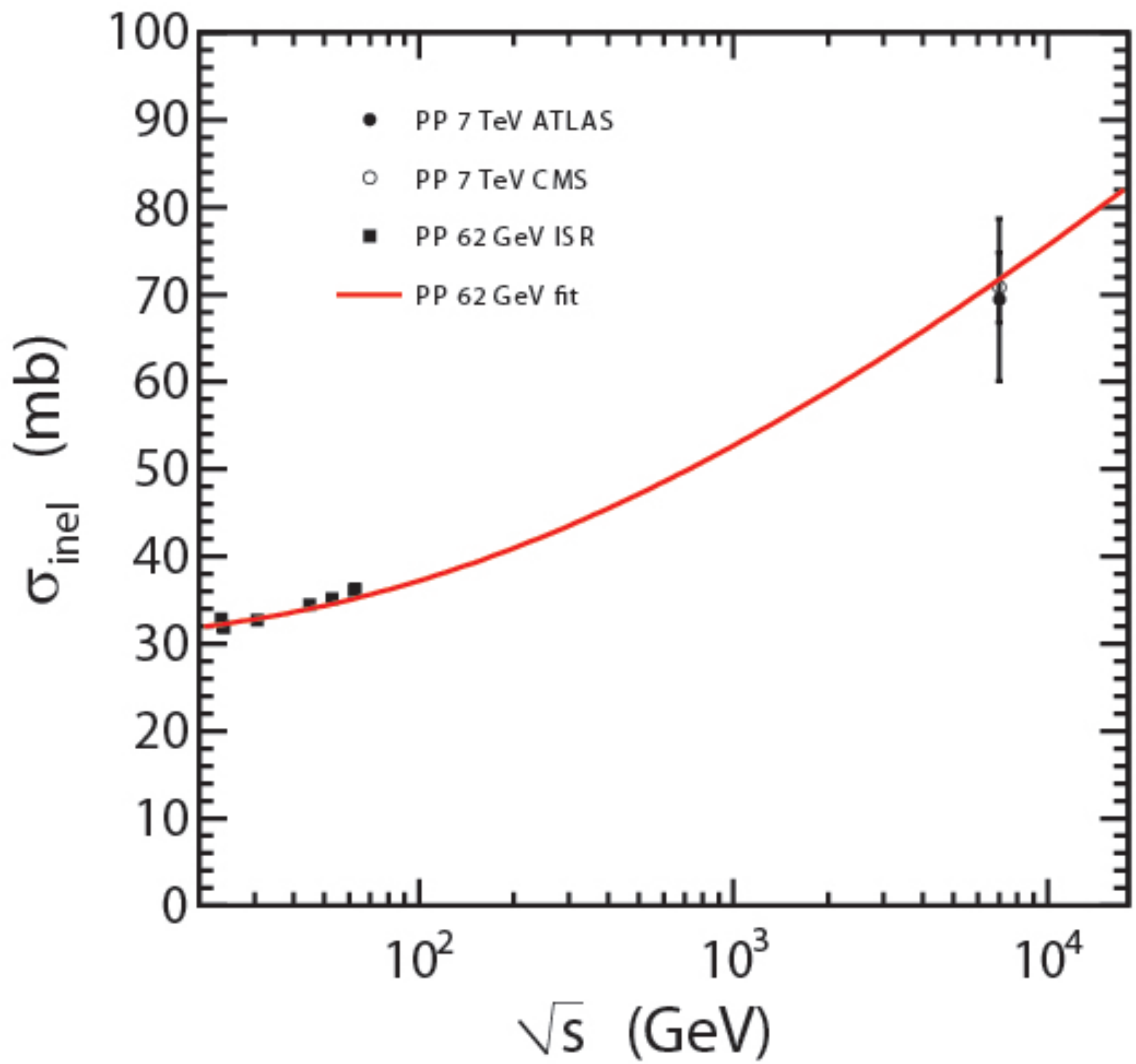
160
140
120
100
80
60
40
σ_{tot} (mb)
10
10^2
10^3
10^4
$\sqrt{s}$ (GeV)
PP
P$\overline{\text{P}}$
PP fit
P$\overline{\text{P}}$ fit
LHC
7TeV 14TeV
ISR
UA4
UA5
TEVATRON
Cosmic ray data



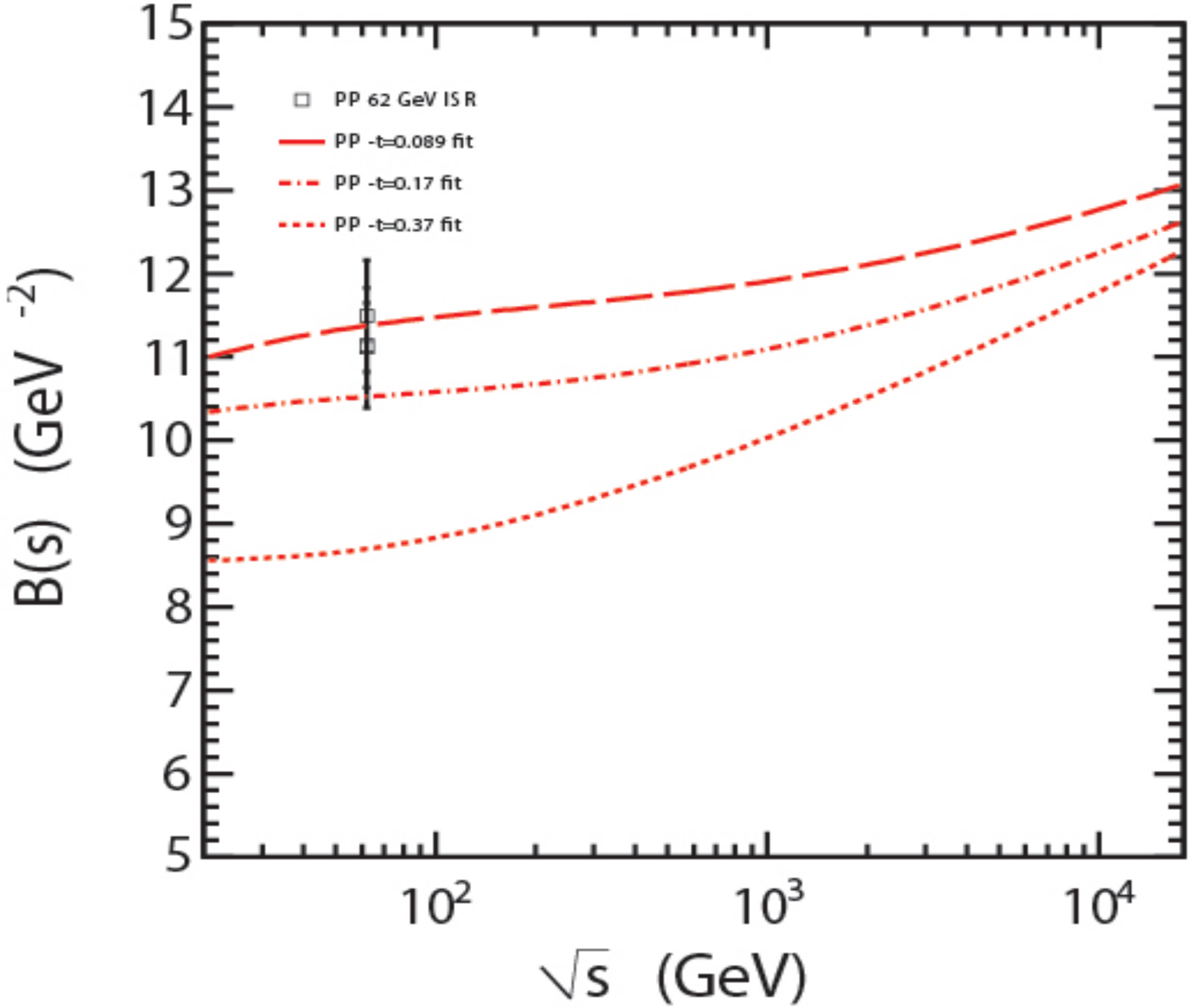
10^2
10
1
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
10^{-13}
10^{-14}
10^{-15}
$\frac{d\sigma}{dt}$ (mb/GeV ^{2})
$P\bar{P}$
31. GeV
53. GeV (x 10^{-1})
62 GeV (x 10^{-4})
546. GeV (x 10^{-6})
630. GeV (x 10^{-8})
1800. GeV (x 10^{-10})
0 0.5 1 1.5 2 2.5 3 3.5 4
-t (GeV ^{2})



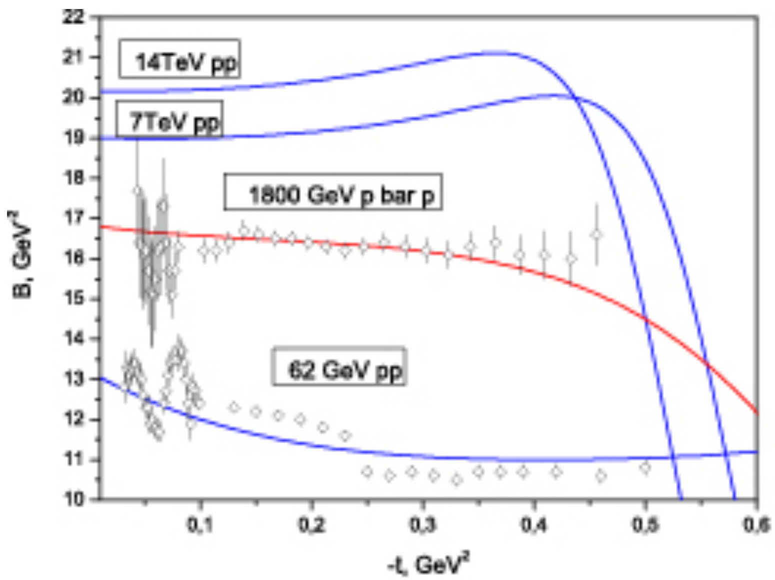
PP
23.5 GeV
30.7 GeV
45. GeV
52.8 GeV
62. GeV
(x 10)
(x 10-1)
(x 10-3)
(x 10-5)
(x 10-7)
dσ/dt (mb/GeV 2)
-t (GeV 2)

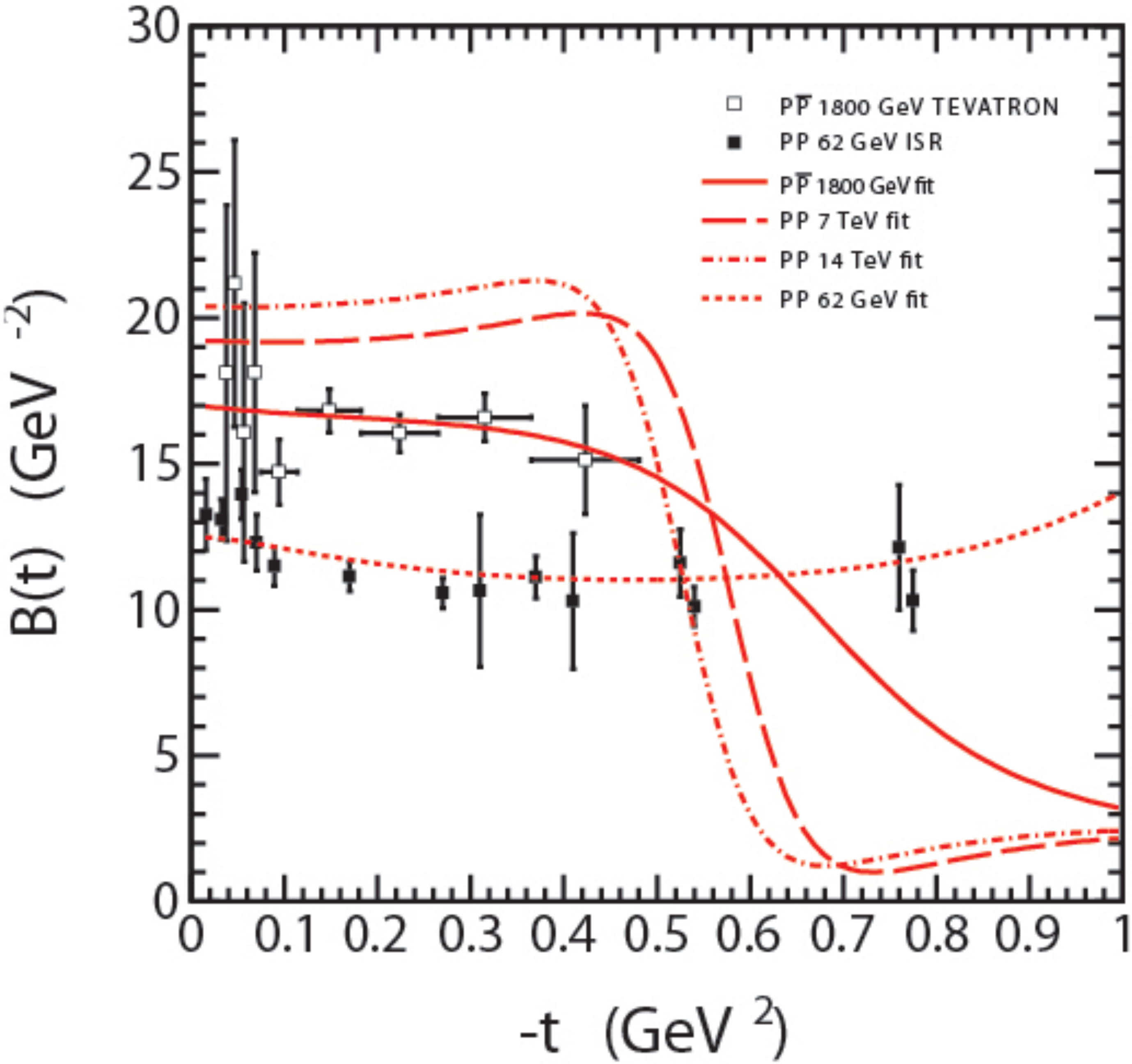


ATLAS At DIS11 http://www-atlas.lbl.gov/$\sim$tompkins/parallel.SxDNVM.tompkins.talk.pdf;
CMS at DIS11 https://wiki.bnl.gov/conferences/images/8/8c/Parallel.SxDNVM.Marone.13April.talk.pdf



15
14
13
12
11
10
9
8
7
6
5
B(s) (GeV -2)
PP 62 GeV ISR
PP -t=0.089 fit
PP -t=0.17 fit
PP -t=0.37 fit
10^2
10^3
10^4
√s (GeV)


14TeV pp
7TeV pp
1800 GeV p bar p
62 GeV pp
B, GeV^{-2}
-t, GeV^{2}



30
25
20
15
10
5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
B(t) (GeV -2)
-t (GeV 2)
PP̅ 1800 GeV TEVATRON
PP 62 GeV ISR
PP̅ 1800 GeV fit
PP 7 TeV fit
PP 14 TeV fit
PP 62 GeV fit

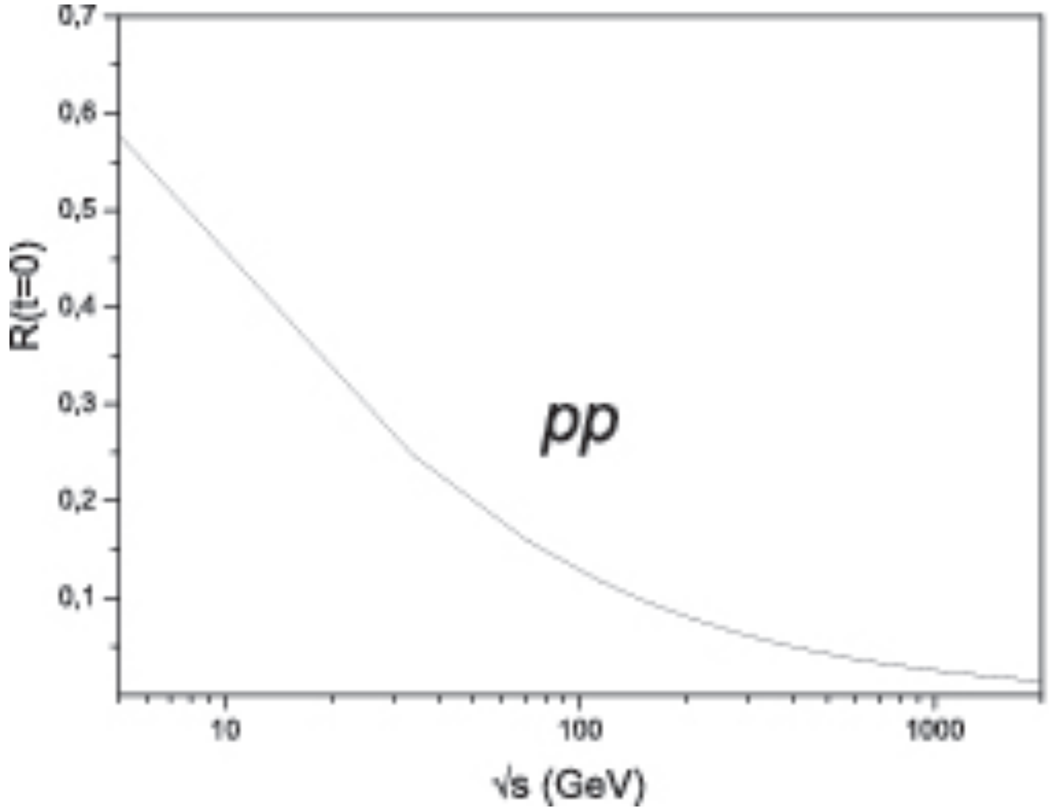
Energy variation of the relative importance of the Pomeron with respect to contributions from the secondary trajectories and the Odderon:

$$R(s,t=0) = \frac{\Im m(A(s,t) - A_P(s,t))}{\Im A(s,t)}, \tag{1}$$

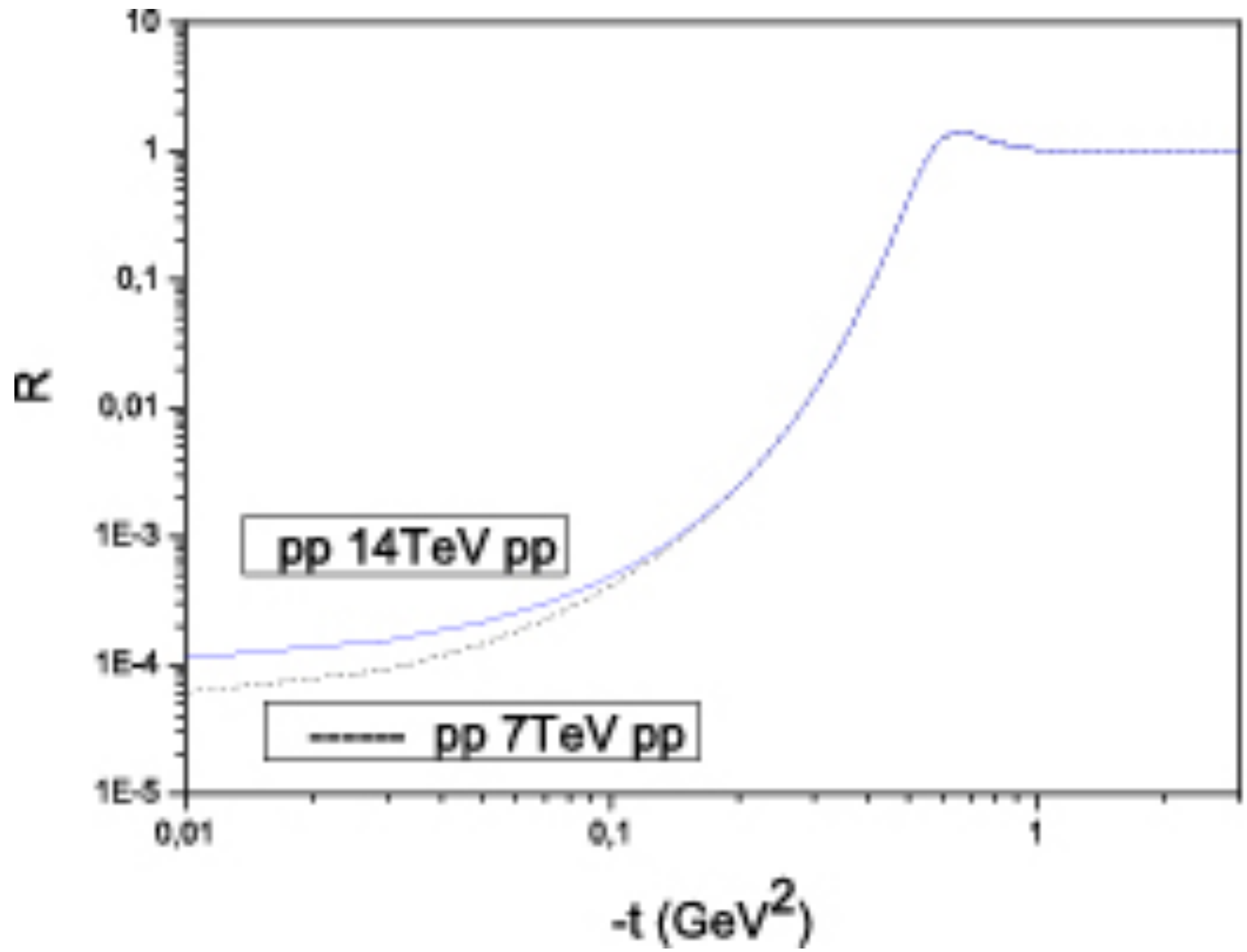
where the total scattering amplitude A includes the Pomeron contribution A_P plus the contribution from the secondary Reggeons and the Odderon.

Starting from the Tevatron energy region, the relative contribution of the non-Pomeron terms to the total cross-section becomes smaller than the experimental uncertainty and hence at higher energies they may be completely neglected, irrespective of the model used.

$$R(s,t) = \frac{|(A(s,t) - A_P(s,t)|^2}{|A(s,t)|^2}. \tag{2}$$



0,7
0,6
0,5
0,4
0,3
0,2
0,1
R(t=0)
pp
10
100
1000
√s (GeV)


10
1
0,1
0,01
1E-3
1E-4
1E-5
R
pp 14TeV pp
pp 7TeV pp
0,01
0,1
1
-t (GeV^2)

Lessons:

1.Model predictions **for integral characteristics**, on the whole, are compatible with the data within about 10% (not too interesting!),

diverging by orders of magnitudes (!) in the dip-bump region, that can be used to discriminate the existing (and future) models;

2. Any modes should describe all observables in a wide kinematical range, with a unique set of adjustable parameters;

3. For any comparison and critical assessment, a 'bank of models" should be created, in which different models would be tested on a unique set of the data. Who could do this?

4. The Oddeon has (nearly) the same status as the Pomeron;

5. Matching D0's (Ch. Royon) and TOTEM's (M.Deile) elstic data as well as DD are important:

6. The Regge pole theory and QCD are progressing paralelly, with little or no interference. Spin?

7. QCD, the official ideology, has no predictive power (at least in this field);

5.TOTEM's first results are worth more than those of the "superluminal" OPERA and "Higgs' exclusion", taken together.

Cám on !