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THE POMERON IN EXCLUSIVE VECTOR MESON PRODUCTION

Alexei Prokudin

Università Di Torino,
Via Pietro Giuria 1, 10125 Torino, ITALY
and
Sezione INFN di Torino, ITALY
and
IHEP, Protvino, Russia

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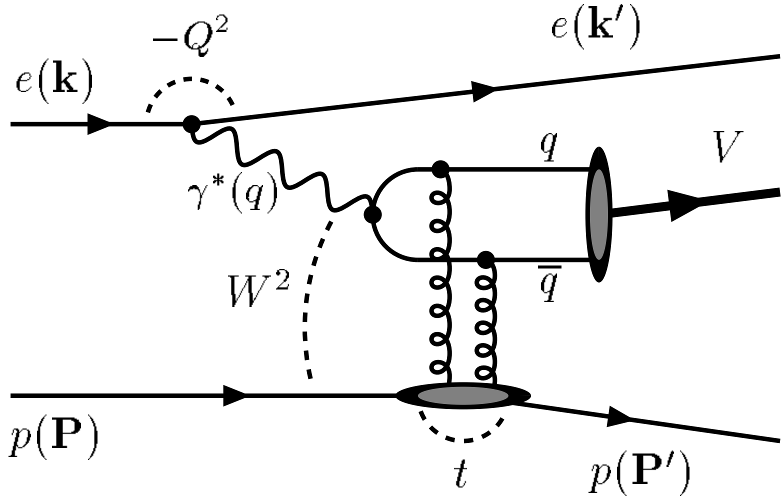
Work is done in collaboration with
R. FIORE, L.L. JENKOVSZKY, F. PACCANONI



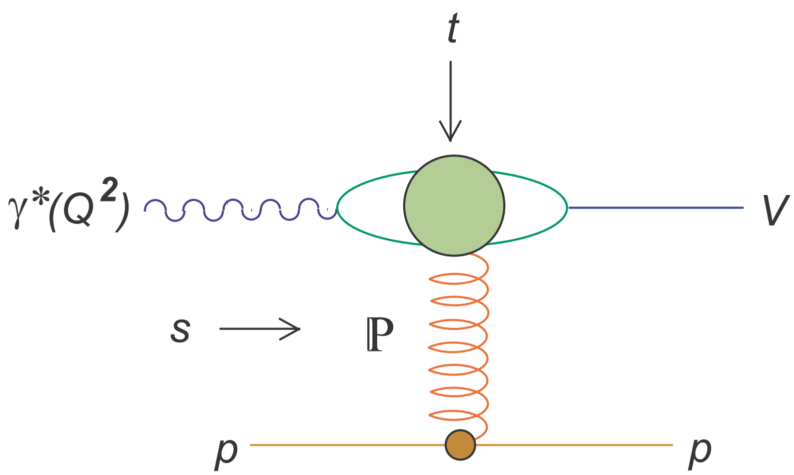
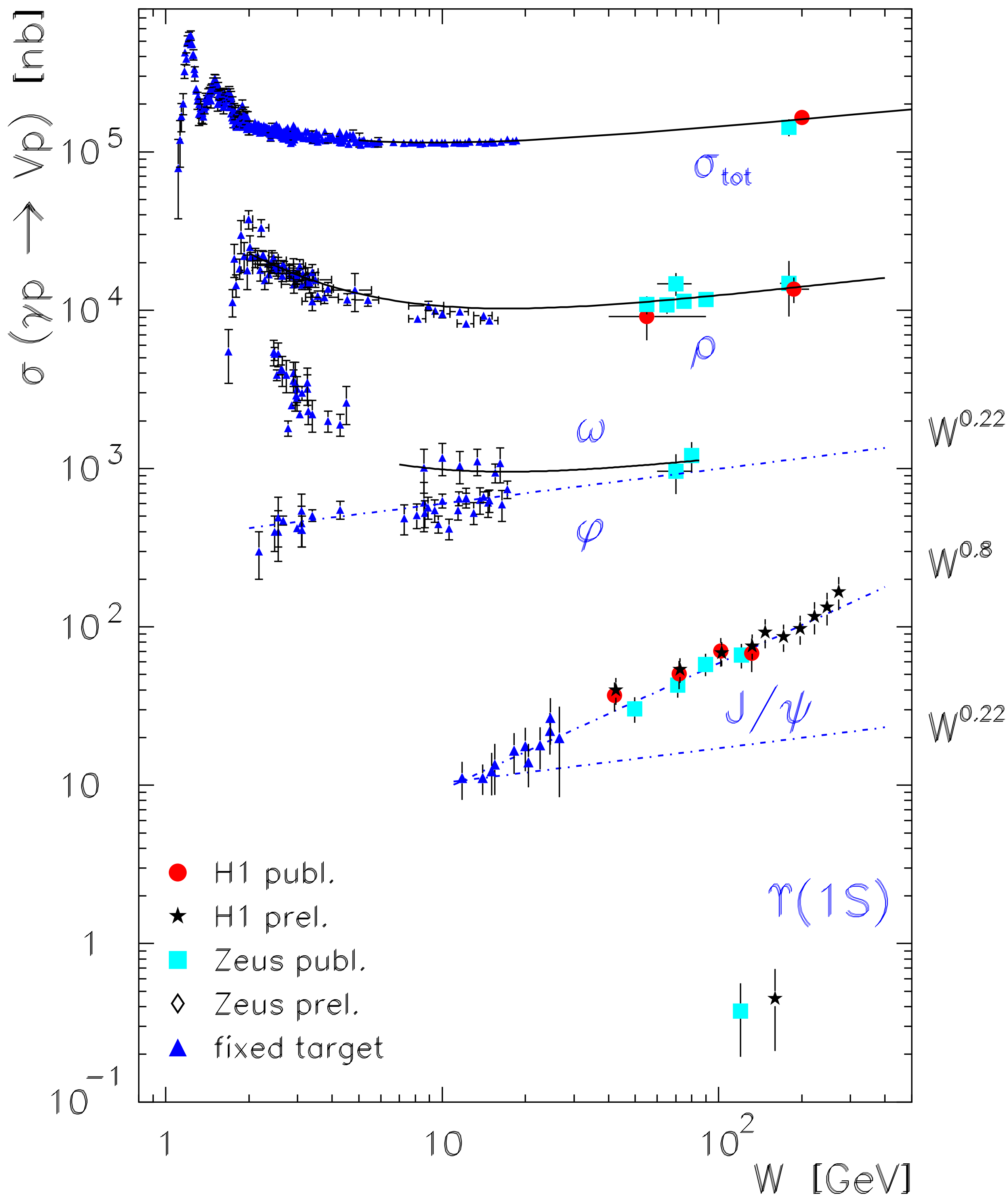


Table 1: Kinematical Quantities.

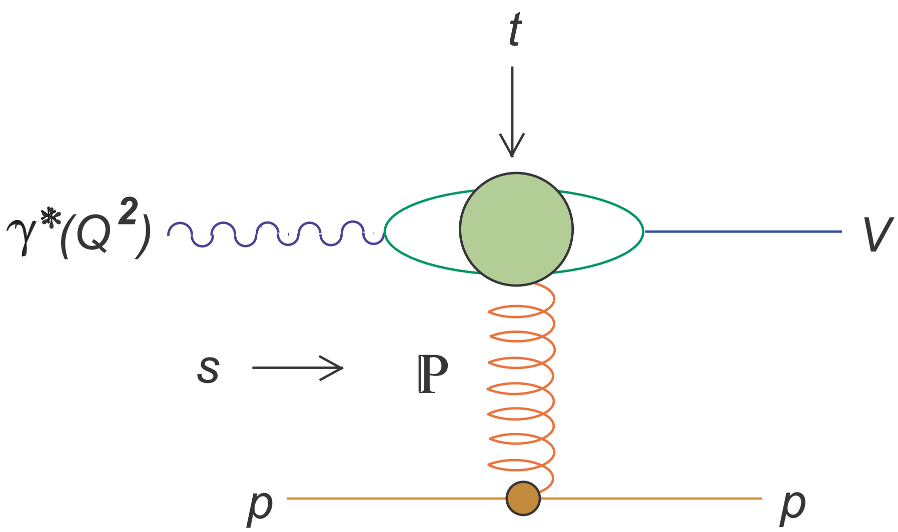
neg. momentum transfer squared	$Q^2 = -q^2 = -(k - k')^2$
$\gamma\, p$ c.m. energy squared	$s \equiv W^2 = (p + q)^2$
momentum transfer proton	$t = (p - p')^2$

$\gamma p \to V\, p$, where $V = \rho, \omega, \varphi, J/\psi, \Upsilon$



Experimental data on VM exclusive photoproduction.

Photoproduction of a vector meson



The Amplitude $\gamma p \to V p$

$$A(s,t)_{s\to\infty} \approx i f(t) \left(-i\frac{s}{s_0}\right)^{\alpha_{I\!P}(t)} \left[\ln\left(-i\frac{s}{s_0}\right) + g(t)\right]$$

$$s \equiv W^2$$

$$f(t) = (\alpha_P(t) - 1) f_1(t) + (\alpha_P(t) + 1) f_2(t)$$

EPJ direct C **4** (2002) 1

$$f(t) = a\, e^{bt} + ct\, e^{dt} \quad ; g(t) \equiv g \quad .$$

The Dipole Pomeron

$$\alpha_{I\!P}(t) = 1 + \gamma(\sqrt{t_0} - \sqrt{t_0 - t}\,)$$

$$t_0 = 4m_\pi^2 \quad , \gamma = m_\pi / 1\, GeV^2$$
$$\alpha_{I\!P}(0) = 1$$
$$\alpha'_{I\!P}(0) \simeq 0.25\; GeV^{-2}$$

Eur. Phys. J. A**10** (2001) 217, Phys. Rev. D **65** (2002) 077505

The cross section $\gamma^* p \to J/\psi p$

$$\sigma_{tot}^{\gamma^* p \to J/\psi\, p} \propto \frac{1}{(1 + Q^2/M_{J/\psi}^2)^n} \quad ,$$

$n \sim 1.75$ **ZEUS** Eur. Phys. J. C **6**, 603 (1999),
$n \sim 2.38$ **H1** Phys. Lett. B**483** (2001) 63.

$$\frac{d\sigma}{dt} = 4\pi \left(1 + \frac{Q^2}{M_{J/\psi}^2}\right)^{-\beta} \left[a\, e^{bt} + ct\, e^{dt}\right]^2 \left(\frac{s}{s_0}\right)^{2\alpha_P(t)-2} \times$$
$$\left(\left[\ln\left(\frac{s}{s_0}\right) + g\left[1 + Q^2/(Q^2 + M_{J/\psi}^2)\right]^\gamma\right]^2 + \frac{\pi^2}{4}\right)$$

J/ψ and $\phi(1020) \to$ only the Pomeron exchange.

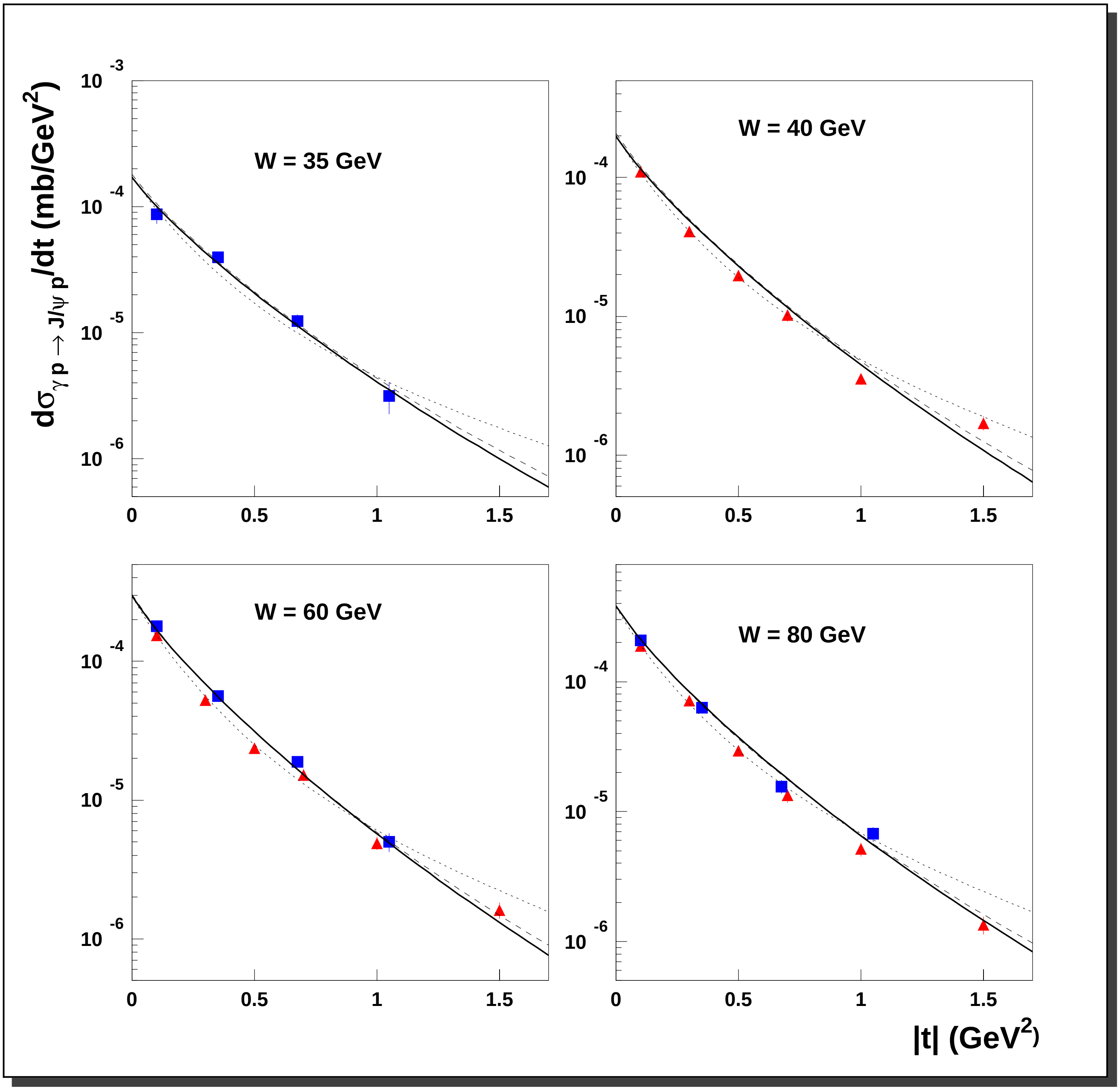
Parameters for $\gamma p \to J/\psi p$

Photoproduction		
	e^+e^- channel $W < 160$ GeV	$\mu^+\mu^-$ channel $W < 160$ GeV
a $[\mathrm{GeV}^{-2}]$	$(1.8 \pm 0.1) \cdot 10^{-3}$	$(1.83 \pm 0.09) \cdot 10^{-3}$
b $[\mathrm{GeV}^{-2}]$	1.55 ± 0.49	2.25 ± 0.24
c $[\mathrm{GeV}^{-4}]$	$(-0.48 \pm 0.54) \cdot 10^{-3}$	$(-0.97 \pm 0.19) \cdot 10^{-3}$
d $[\mathrm{GeV}^{-2}]$	0.851	0.851
g	-4.23 ± 0.37	-4.25 ± 0.22
$\chi^2/\mathrm{d.o.f.}$	1.5	1.0

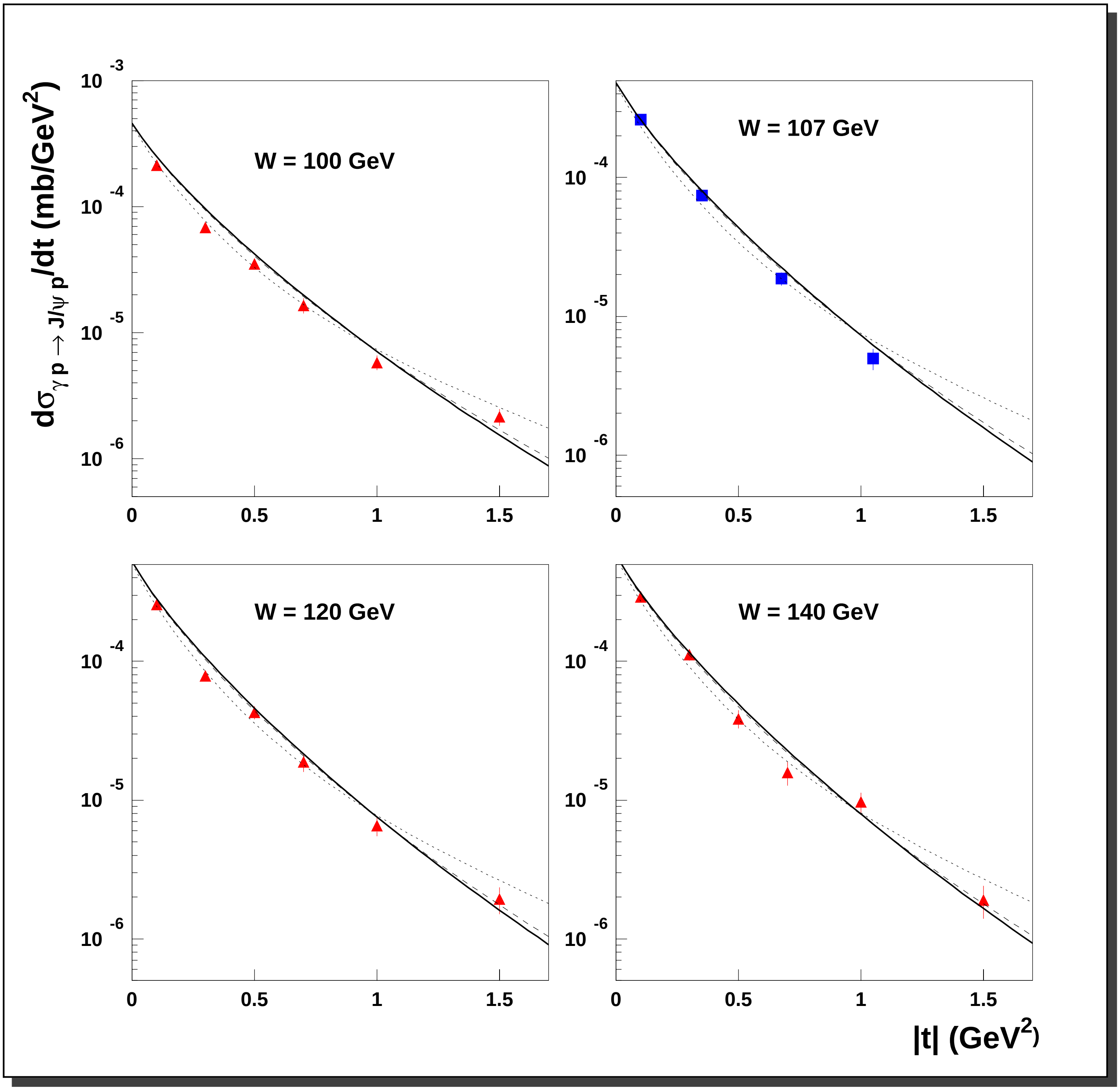
Table 2: Values of parameters obtained by fitting J/ψ photoproduction data $W < 160$ GeV.

Photoproduction	
	e^+e^- channel $W < 300$ GeV
a $[\mathrm{GeV}^{-2}]$	$(1.97 \pm 0.13) \cdot 10^{-3}$
b $[\mathrm{GeV}^{-2}]$	1.40 ± 0.51
c $[\mathrm{GeV}^{-4}]$	$(-0.35 \pm 0.67) \cdot 10^{-3}$
d $[\mathrm{GeV}^{-2}]$	0.851
g	-4.58 ± 0.29
$\chi^2/\mathrm{d.o.f.}$	1.2

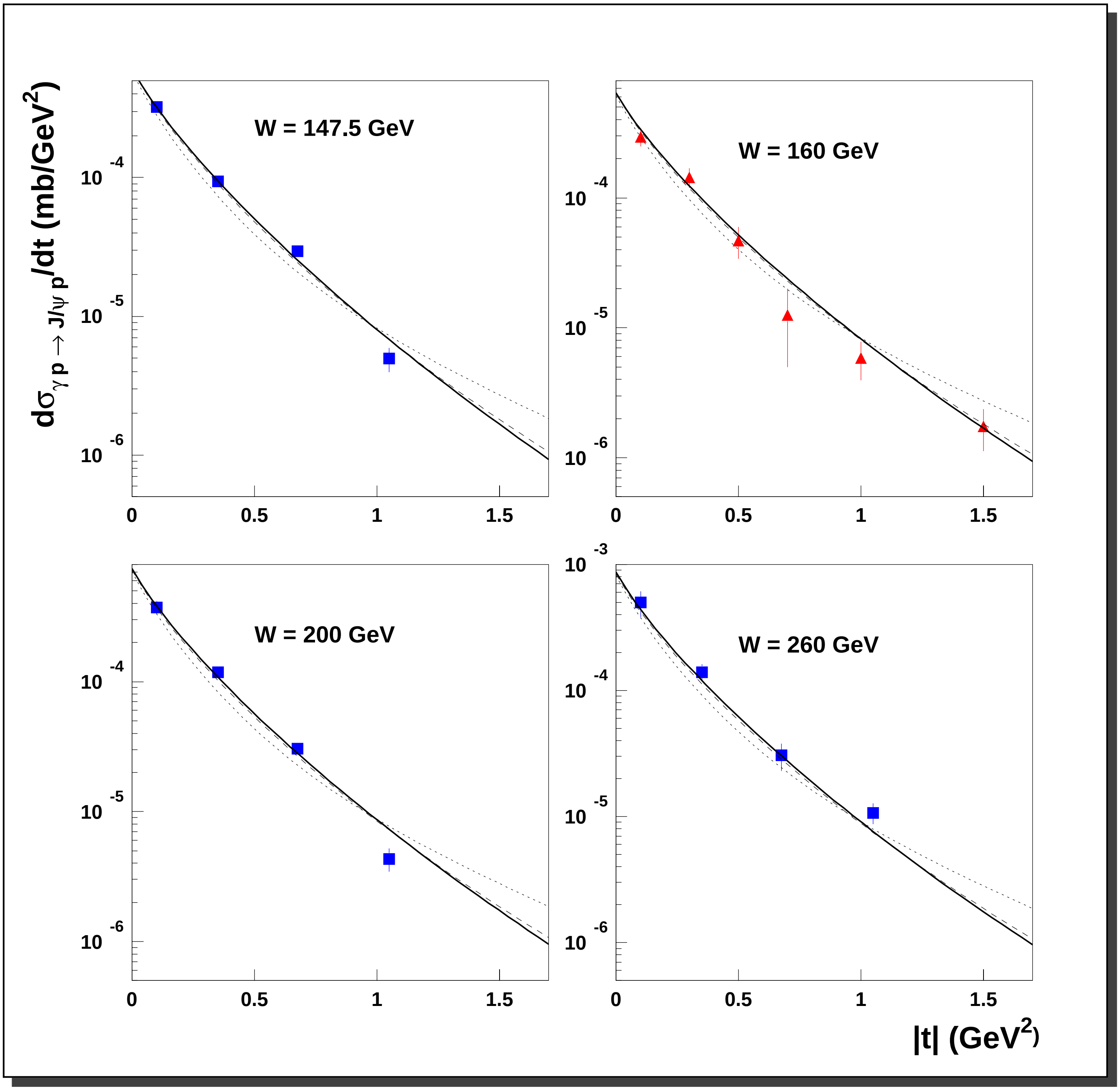
Table 3: Values of parameters obtained by fitting J/ψ photoproduction data $W < 300$ GeV.



Differential cross section of exclusive J/ψ photoproduction for 35$\leq W \leq$80 GeV. The dashed line corresponds to $J/\psi \rightarrow e^+e^-$ channel fit (Column 2 of Table 2). The dotted line corresponds to $J/\psi \rightarrow \mu^+\mu^-$ channel fit (Column 3 of Table 2). The solid line corresponds to $J/\psi \rightarrow e^+e^-$ channel fit (Column 4 of Table 2).

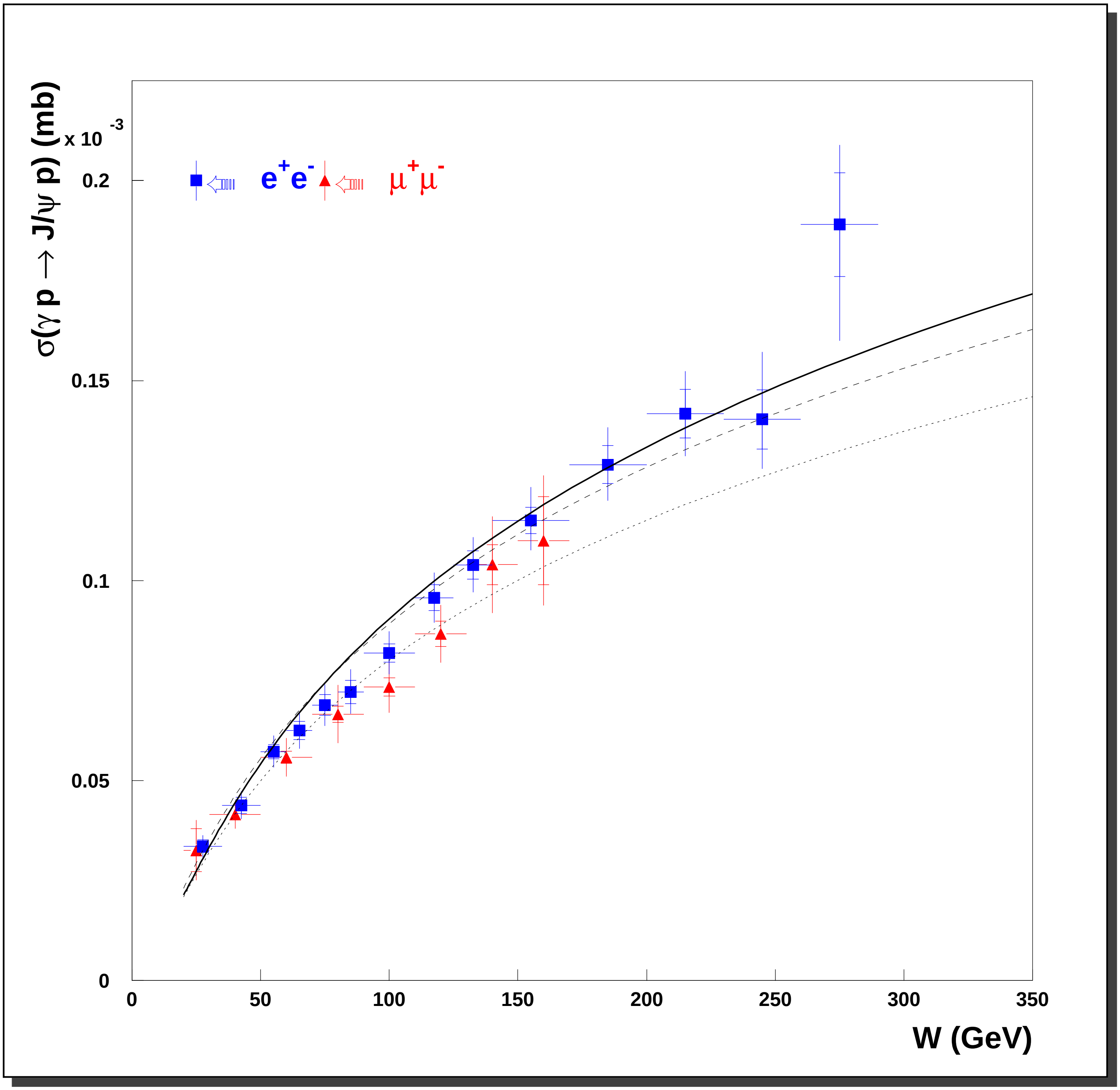


Differential cross section of exclusive J/ψ photoproduction for $100 \leq W \leq 140$ GeV.

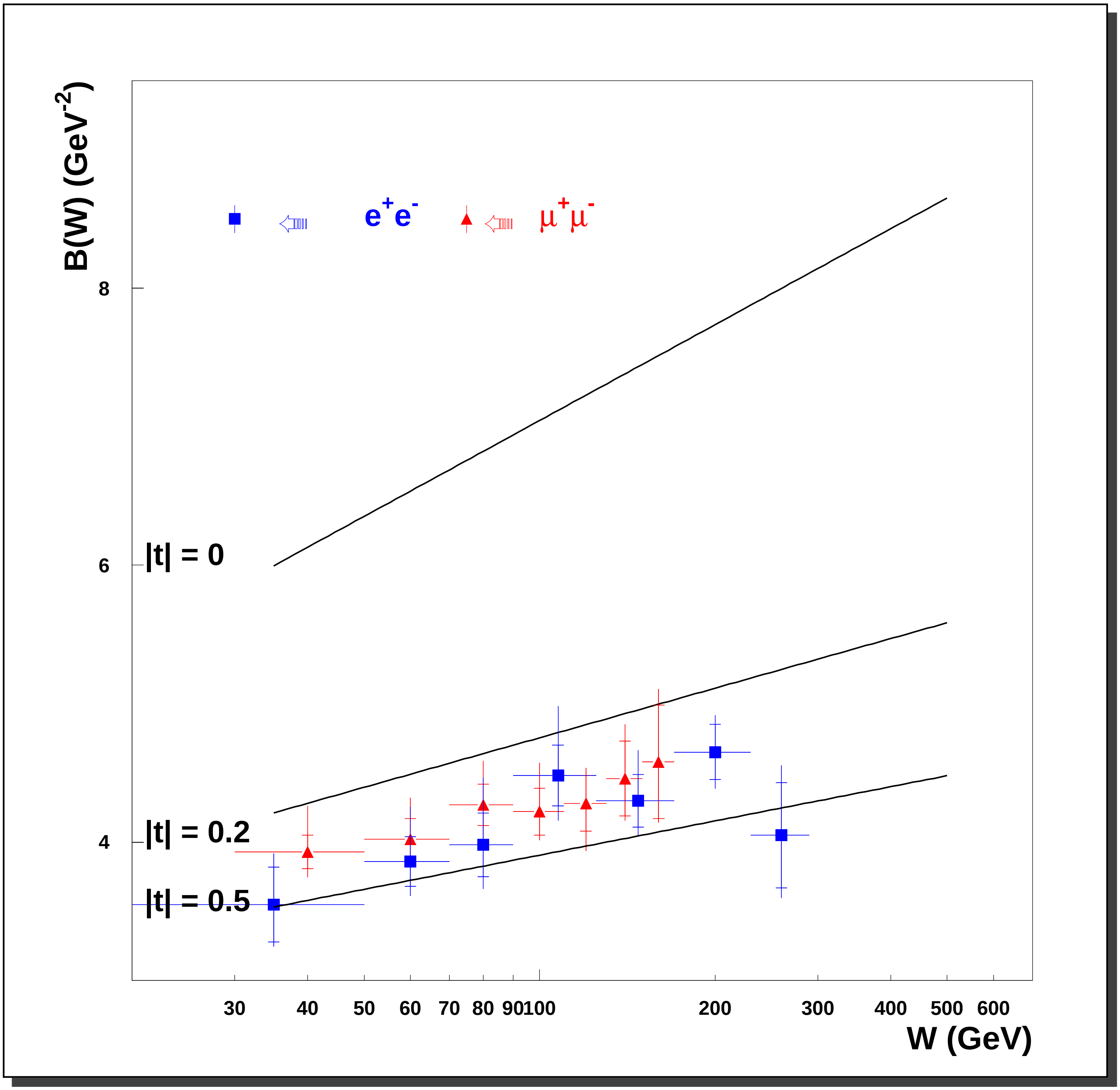


Differential cross section of exclusive J/ψ photoproduction for $147 \leq W \leq 260$ GeV.

ELASTIC CROSS SECTION



Elastic cross section of exclusive J/ψ meson photoproduction.



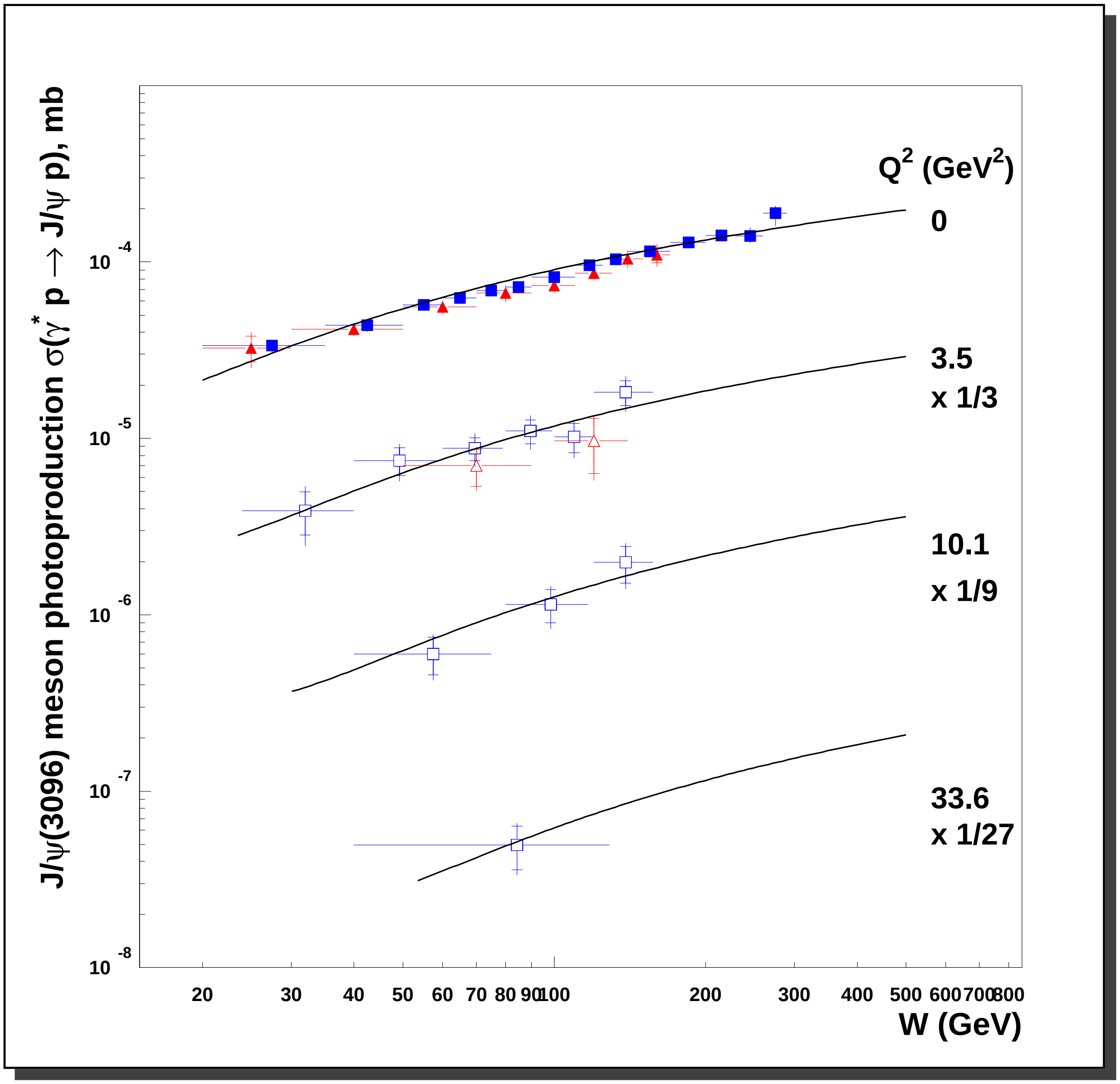
The slope of differential cross section of exclusive J/ψ photoproduction.

$$B(W) = \frac{d}{dt}(\ln \frac{d\sigma}{dt})$$

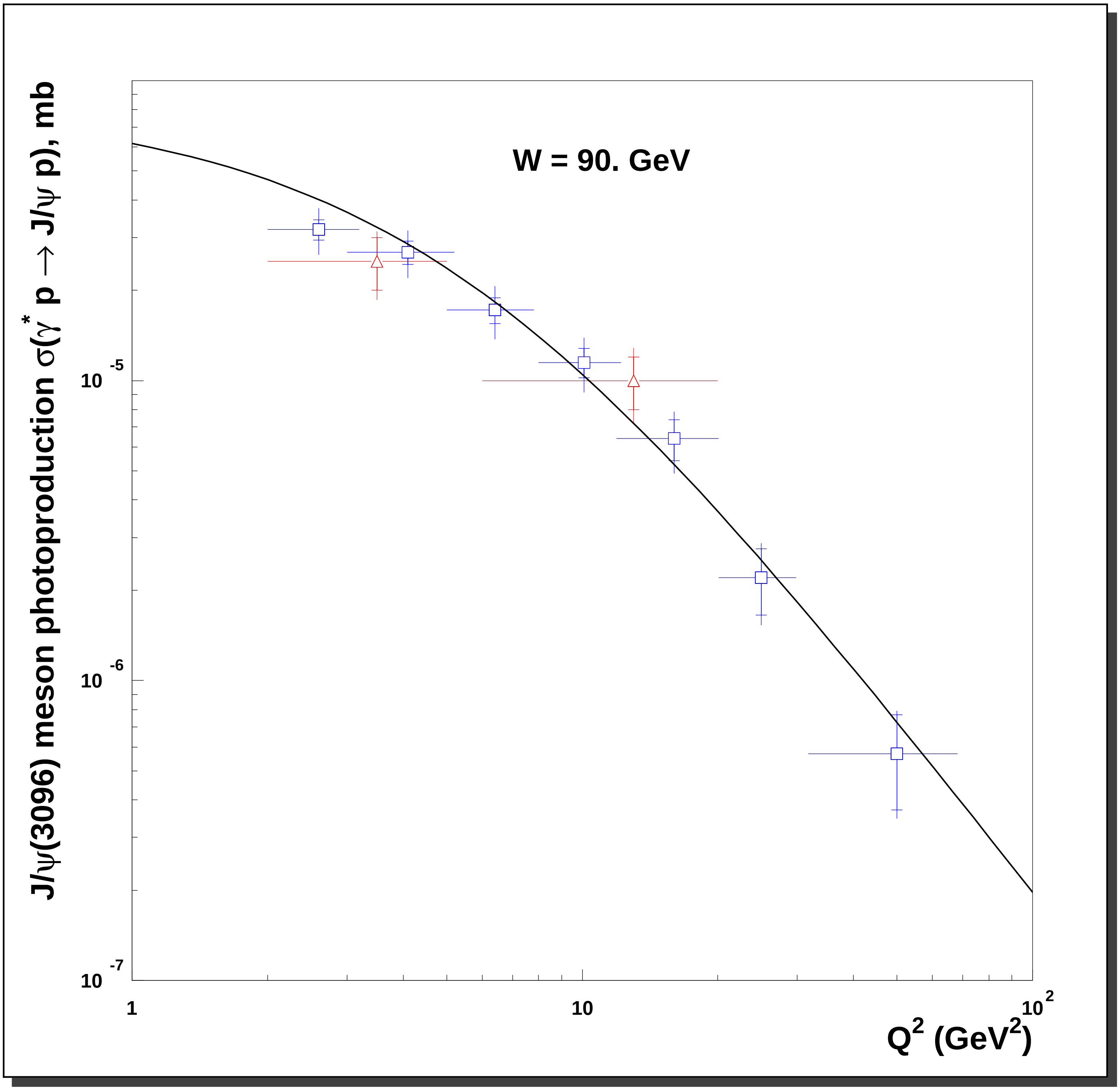
Photoproduction of J/ψ by virtual photons ($Q^2 > 0$).

$\gamma \neq 0$: $\beta = 1.94 \pm 0.42$, $\gamma = 0.69 \pm 0.24$ and $\chi^2/\text{d.o.f.} = 0.81$.

$\gamma = 0$: $\beta = 2.86 \pm 0.09$ and $\chi^2/\text{d.o.f.} = 1.07$.



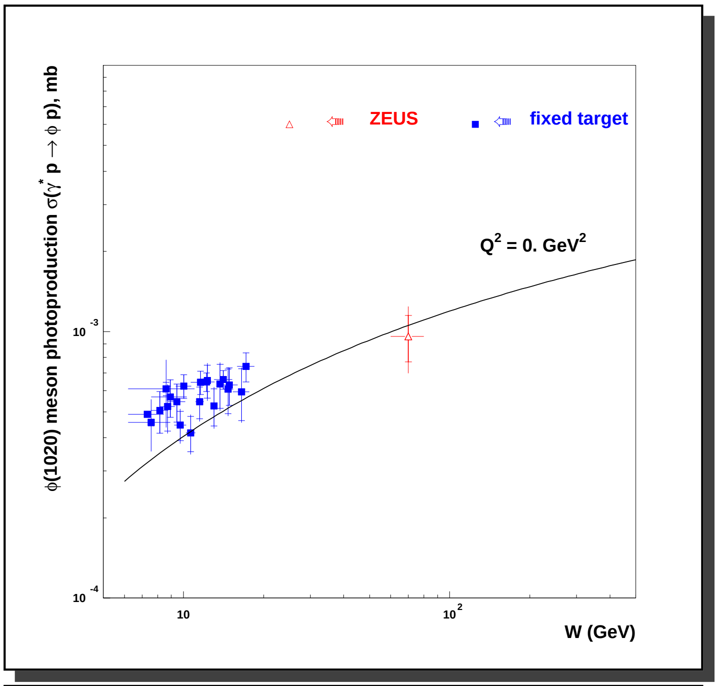
Cross section of exclusive J/ψ electroproduction as a function of W.

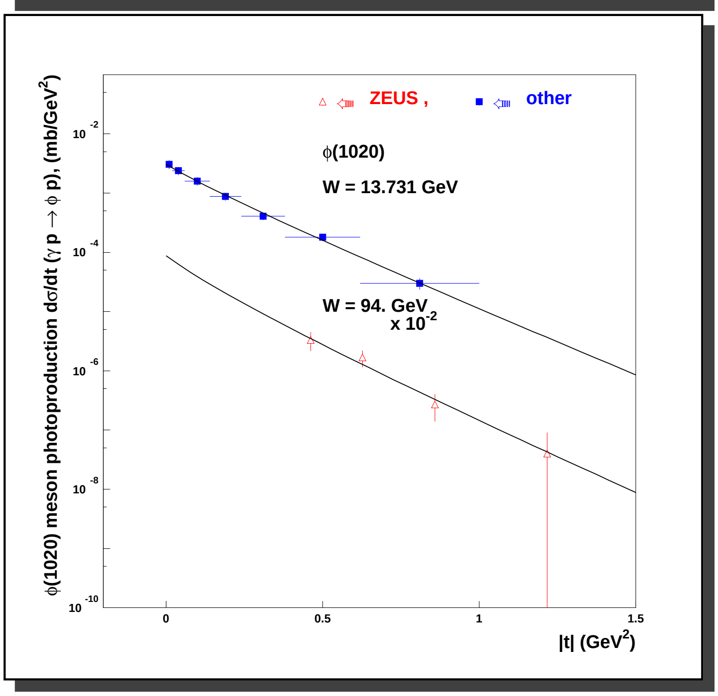


Cross section of exclusive J/ψ electroproduction as a function of Q^2.

a =	$(0.46 \pm 0.12) \cdot 10^{-2}$ [GeV^{-2}],
b =	2.26 ± 0.12 [GeV^{-2}],
c =	$0.0 \pm 0.68 \cdot 10^{-2}$ [GeV^{-4}],
d =	0.851 [GeV^{-2}],
g =	-0.08 ± 1.5.
χ^2/d.o.f. =	0.34

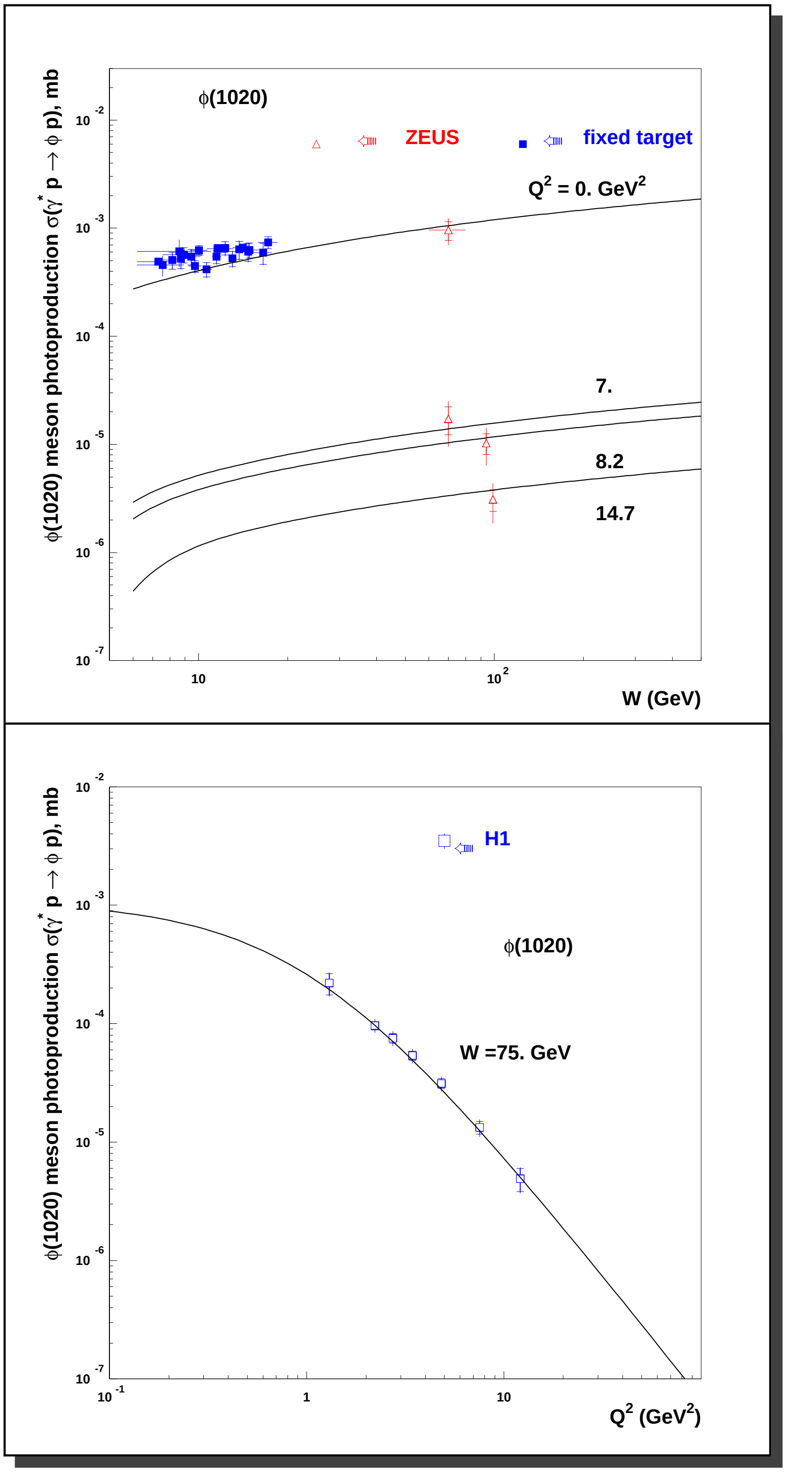
Table 4: Values of parameters obtained by fitting $\phi(1020)$ photoproduction data.





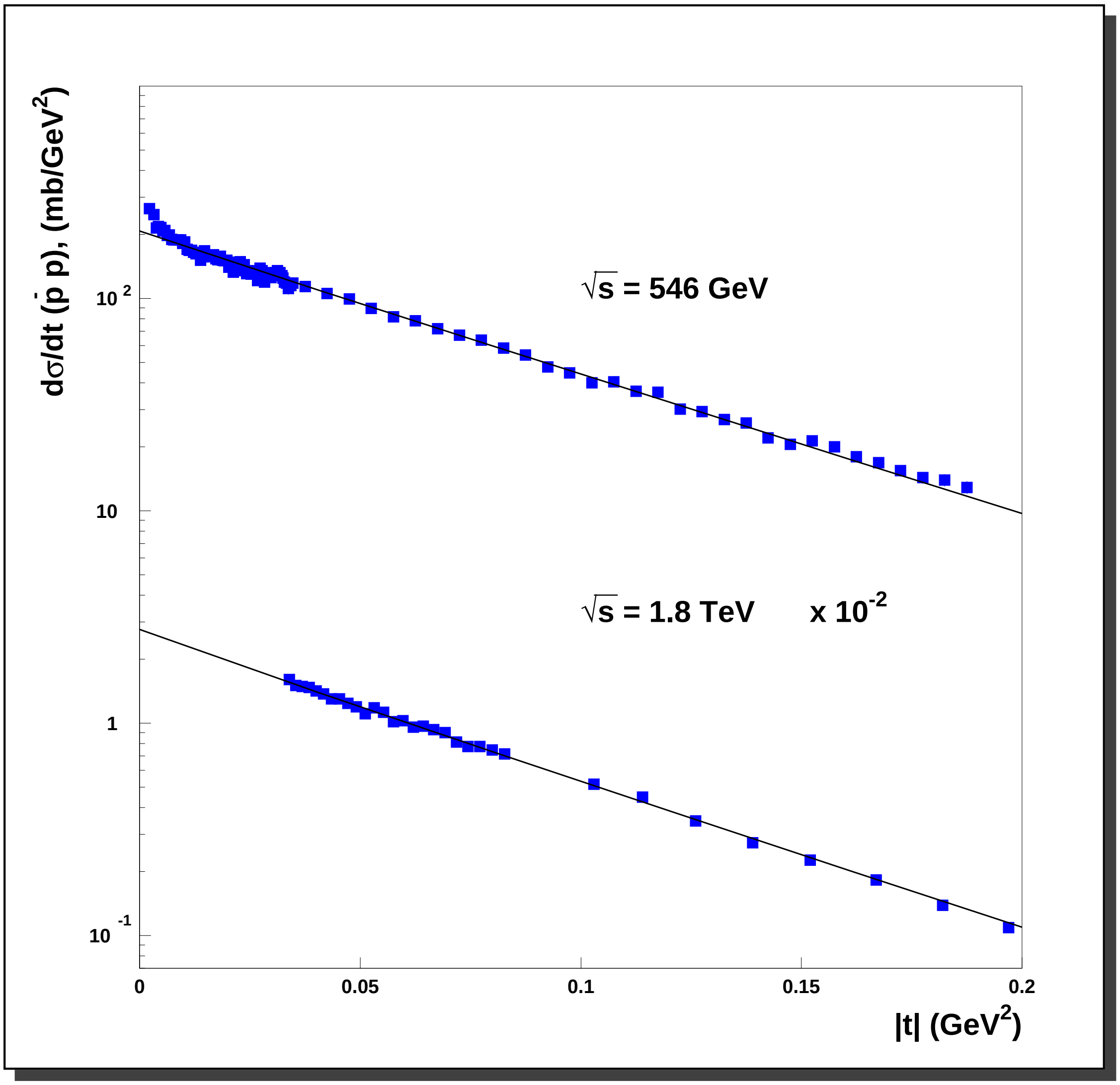
β =	2.12 ± 0.03,
χ^2/d.o.f. =	0.3

Table 5: Values of parameters obtained by fitting $\phi(1020)$ electroproduction data.

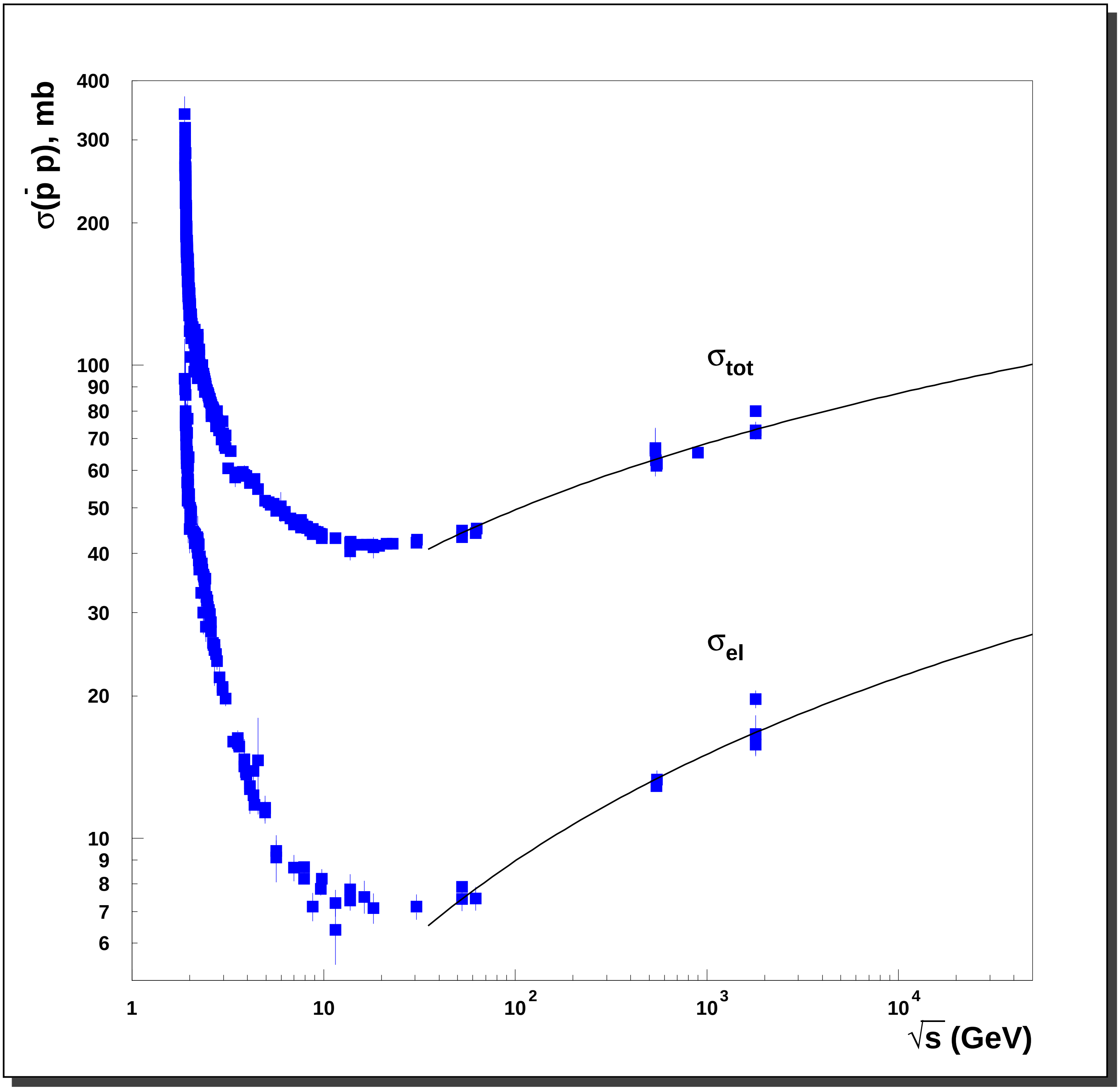


a =	0.41 ± 0.01 [GeV^{-2}],
b =	7.61 ± 3.36 [GeV^{-2}],
c =	-1.12 ± 1.40[GeV^{-4}],
d =	7.72 ± 0.52 [GeV^{-2}],
g =	2.86 ± 0.41.
χ^2/d.o.f. =	1.04

Table 6: Values of parameters obtained by fitting $p\bar{p}$ data at energies $\sqrt{s} = 546$ GeV and 1.8 TeV.

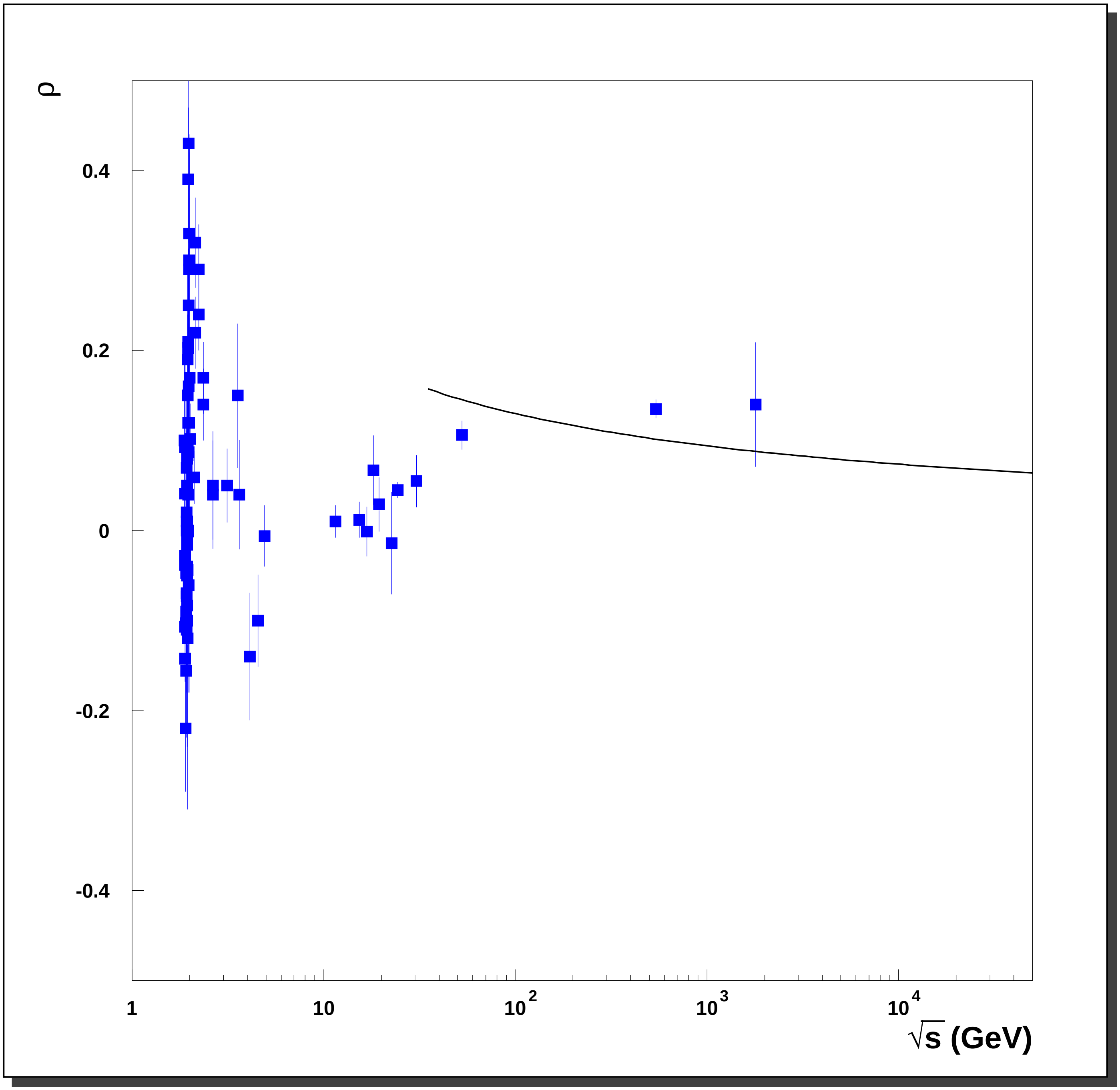


Differential cross section of elastic $\bar{p}p$ scattering at the energies $\sqrt{s} = 546$ GeV and 1.8 TeV.

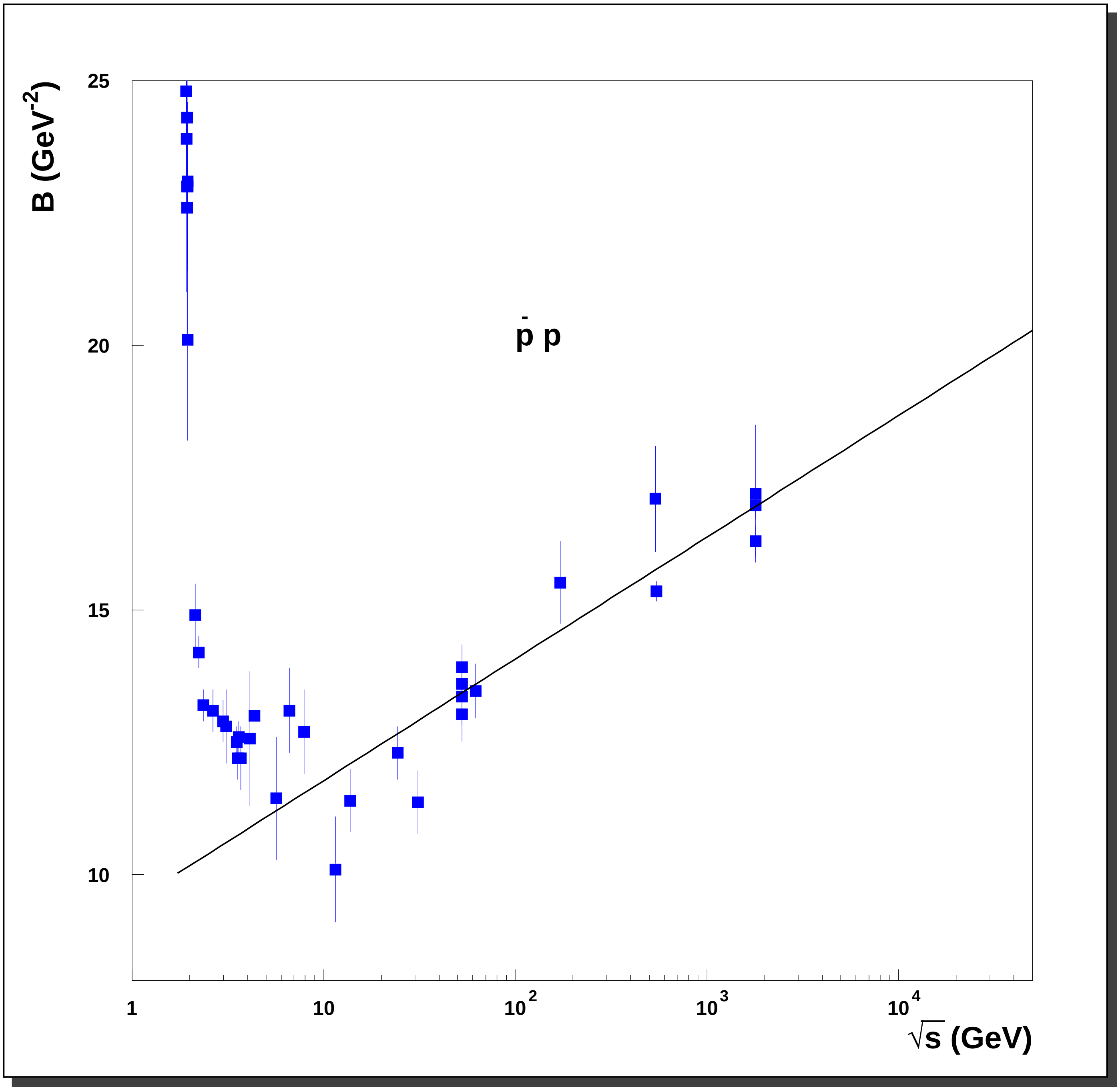


Elastic and total cross sections of $\bar{p}p$ scattering.

RATIO ρ=RE(A)/IM(A)



Ratio of real to imaginary part of the $\bar{p}p$ scattering amplitude.



The slope of differential cross section of $\bar{p}p$ scattering.

$$B(W) = \frac{d}{dt}(\ln \frac{d\sigma}{dt})$$

CONCLUSIONS

- The main properties of the model:
  - The trajectory $\alpha_{I\!P}(t) = 1 + \gamma\left(\sqrt{4m_\pi^2} - \sqrt{4m_\pi^2 - t}\right)$
  - The Pomeron intercept is equal to one
  - The Pomeron is a double pole in the complex j-plane

- The aim was to study the Pomeron exchange in reactions where non leading contributions are absent or negligible. We have chosen J/ψ and $\phi(1020)$ photoproduction and electroproduction as Pomeron filters.

- To demonstrate the universality of the chosen trajectory we applied the model to $\bar{p}p$ scattering at sufficiently high energies where only the Pomeron contributes.The good agreement with the experimental data is an argument in favor of the chosen Pomeron trajectory.