$$
\begin{cases}
\sigma_{pp} &= Z_{pp} + B\ln^2\left(\dfrac{s}{s_0}\right) + Y_1^{pp}s^{-\eta_1} - Y_2^{pp}s^{-\eta_2},\\
\sigma_{\bar{p}p} &= Z_{pp} + B\ln^2\left(\dfrac{s}{s_0}\right) + Y_1^{pp}s^{-\eta_1} + Y_2^{pp}s^{-\eta_2},\\
\sigma_{\pi^+p} &= Z_{\pi p} + B\ln^2\left(\dfrac{s}{s_0}\right) + Y_1^{\pi p}s^{-\eta_1} - Y_2^{\pi p}s^{-\eta_2},\\
\sigma_{\pi^-p} &= Z_{\pi p} + B\ln^2\left(\dfrac{s}{s_0}\right) + Y_1^{\pi p}s^{-\eta_1} + Y_2^{\pi p}s^{-\eta_2},\\
\sigma_{K^+p} &= Z_{Kp} + B\ln^2\left(\dfrac{s}{s_0}\right) + Y_1^{Kp}s^{-\eta_1} - Y_2^{Kp}s^{-\eta_2},\\
\sigma_{K^-p} &= Z_{Kp} + B\ln^2\left(\dfrac{s}{s_0}\right) + Y_1^{Kp}s^{-\eta_1} + Y_2^{Kp}s^{-\eta_2},\\
\sigma_{\gamma p} &= \delta\left[Z_{\gamma p} + B\ln^2\left(\dfrac{s}{s_0}\right)\right] + Y_1^{\gamma p}s^{-\eta_1},\\
\sigma_{\gamma\gamma} &= \delta^2\left[Z_{\gamma\gamma} + B\ln^2\left(\dfrac{s}{s_0}\right)\right] + Y_1^{\gamma\gamma}s^{-\eta_1},\\
\sigma_{\Sigma^-p} &= Z_{\Sigma p} + B\ln^2\left(\dfrac{s}{s_0}\right) + Y_1^{\Sigma p}s^{-\eta_1} - Y_2^{\Sigma p}s^{-\eta_2}.
\end{cases}
$$

$$
\begin{cases}
\rho_{pp}\sigma_{pp} &= \pi B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{Y_1^{pp}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} - \dfrac{Y_2^{pp}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},\\
\rho_{\bar{p}p}\sigma_{\bar{p}p} &= \pi B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{Y_1^{pp}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} + \dfrac{Y_2^{pp}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},\\
\rho_{\pi^+p}\sigma_{\pi^+p} &= \pi B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{Y_1^{\pi p}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} - \dfrac{Y_2^{\pi p}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},\\
\rho_{\pi^-p}\sigma_{\pi^-p} &= \pi B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{Y_1^{\pi p}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} + \dfrac{Y_2^{\pi p}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},\\
\rho_{K^+p}\sigma_{K^+p} &= \pi B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{Y_1^{Kp}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} - \dfrac{Y_2^{Kp}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},\\
\rho_{K^-p}\sigma_{K^-p} &= \pi B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{Y_1^{Kp}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} + \dfrac{Y_2^{Kp}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},
\end{cases}
$$

Variable s is in the units $[GeV^2]$. The additional scale $s_1 = 1\ [GeV^2]$ in terms with $(s/s_1)^{-\eta_{1,2}}$ is omitted for brevity.

Adjustable parameters naming. In total 21 parameters used:

$$\begin{aligned} \eta_1, \eta_2, \delta &\quad - \quad \text{dimensionless} \\ Z_{pp}, Z_{\pi p}, Z_{Kp}, Z_{\Sigma p}, Z_{\gamma p}, Z_{\gamma\gamma}, B &\quad - \quad [\mathbf{mb}] \\ s_0 &\quad - \quad [\mathbf{GeV^2}] \\ Y_{1,2}^{pp}, Y_{1,2}^{\pi p}, Y_{1,2}^{Kp}, Y_{1,2}^{\Sigma p}, Y_1^{\gamma p}, Y_1^{\gamma\gamma} &\quad - \quad [\mathbf{mb}] \end{aligned}$$

Scan-fits summary. 2000 database. Without cosmic data points.

$E_{\rm cm}^{\rm min}$ [GeV]	3	4	5	6	7	8	9	10
N_{dof}: ρ excluded	692	550	481	417	359	324	278	222
N_{dof}: ρ included	859	700	612	542	479	438	384	317
χ^2/dof: ρ excluded	1.24	0.96	0.81	0.79	0.81	0.81	0.81	0.74
χ^2/dof: ρ included	1.76	1.15	0.97	0.96	0.95	0.92	0.91	0.91

Details of the fit to the data in the whole domain of applicability

	$\sqrt{s}$ of the starting point in [**GeV**]	Number of data points
Breakdown of the CS data sample		
pp:	5.00963	104
$\bar{p}p$:	5.1569	59
π^+p:	5.21275	50
π^-p:	5.02954	95
K^+p:	5.12707	40
K^-p:	5.10875	63
Σ^-p:	6.12189	9
γp:	5.01008	37
$\gamma\gamma$:	5.	38
Breakdown of the ρ data sample		
pp:	5.30542	64
$\bar{p}p$:	11.5382	11
π^+p:	8.98072	8
π^-p:	7.56285	30
K^+p:	5.21771	10
K^-p:	5.23565	8

χ^2/dof	=	**0.965**
CL[%]	=	72.6
Name of value	Numerical value	Error value
s_0	29.203742	5.3760124
η_1	0.46004023	0.016521274
η_2	0.54541822	0.0067507812
Z_{pp}	35.496563	0.47062778
$Z_{\pi p}$	20.890164	0.39450874
Z_{Kp}	17.942376	0.35727856
$Z_{\Sigma p}$	35.231439	1.4516909
$Z_{\gamma p}$	26.002362	2.0254746
$Z_{\gamma\gamma}$	16.021809	3.1594656
δ	0.004116599	0.00029200569
B	0.30763124	0.0098010848
Y_{pp1}	42.592712	1.3539773
Y_{pp2}	33.363267	1.0388395
$Y_{\pi p1}$	19.191957	1.216259
$Y_{\pi p2}$	6.027352	0.18918973
Y_{Kp1}	7.0396184	1.4988226
Y_{Kp2}	13.459375	0.40324539
$Y_{\Sigma p1}$	-205.82818	105.55272
$Y_{\Sigma p2}$	-270.72686	129.1738
$Y_{\gamma p1}$	0.043697004	0.0081636255
$Y_{\gamma\gamma 1}$	0.00039495291	0.00013551819

Repository:

computer - **NPT**

`directory - d:\MathemD\Kolja\Evela\Gauron\(RR)PL2u(21)`

Reaction	χ^2/NoP
CS data	
pp	0.839119
$\bar{p}p$	1.15438
π^+p	0.708388
π^-p	0.961569
K^+p	0.709723
K^-p	0.618971
Σ^-p	0.376497
γp	0.57831
$\gamma\gamma$	0.635391
ρ data	
pp	1.82581
$\bar{p}p$	0.518644
π^+p	1.50328
π^-p	1.10517
K^+p	1.0643
K^-p	0.994417

	s_0	η_1	η_2	Z_{pp}	$Z_{\pi p}$	Z_{Kp}	$Z_{\Sigma p}$	$Z_{\gamma p}$	$Z_{\gamma\gamma}$	δ	B	Y_{pp1}	Y_{pp2}	$Y_{\pi p1}$	$Y_{\pi p2}$	Y_{Kp1}	Y_{Kp2}	$Y_{\Sigma p1}$	$Y_{\Sigma p2}$	$Y_{\gamma p1}$	$Y_{\gamma\gamma 1}$
s_0	100	66.8	5.84	94.1	97.1	98.4	24.7	12.6	8.02	4.92	91.4	-35.9	4.84	-92.8	-5.53	-98.1	2.64	-37.5	-31.5	-64.8	-10.5
η_1	66.8	100	13.8	86.	81.3	75.9	16.9	6.06	3.4	7.76	39.1	40.1	11.1	-38.1	7.63	-63.4	10.8	-52.3	-44.7	-34.7	0.443
η_2	5.84	13.8	100	4.3	8.05	6.49	-1.42	1.48	1.19	-0.215	4.99	25.8	97.5	0.241	86.9	-3.62	95.	8.45	5.94	-2.1	0.373
Z_{pp}	94.1	86.	4.3	100	98.9	97.6	24.1	9.97	5.9	7.52	74.1	-11.4	2.54	-78.6	-5.82	-92.5	1.06	-47.8	-40.5	-57.5	-6.5
$Z_{\pi p}$	97.1	81.3	8.05	98.9	100	99.1	24.5	11.	6.68	6.76	80.5	-17.3	6.43	-84.6	-3.8	-95.2	4.63	-44.8	-37.9	-60.4	-7.8
Z_{Kp}	98.4	75.9	6.49	97.6	99.1	100	24.8	11.3	6.95	6.39	84.	-25.3	5.09	-87.8	-4.84	-98.2	3.19	-42.3	-35.7	-62.3	-8.77
$Z_{\Sigma p}$	24.7	16.9	-1.42	24.1	24.5	24.8	100	2.57	1.49	1.84	20.8	-10.1	-1.66	-23.4	-4.25	-24.8	-2.14	-87.6	-89.	-16.	-2.38
$Z_{\gamma p}$	12.6	6.06	1.48	9.97	11.	11.3	2.57	100	98.1	-98.2	15.	-5.08	1.48	-11.6	0.521	-11.5	1.16	-3.1	-2.55	-61.8	-68.3
$Z_{\gamma\gamma}$	8.02	3.4	1.19	5.9	6.68	6.95	1.49	98.1	100	-97.5	10.4	-3.15	1.22	-7.29	0.721	-7.1	1.01	-1.62	-1.31	-54.7	-77.9
δ	4.92	7.76	-0.215	7.52	6.76	6.39	1.84	-98.2	-97.5	100	-0.0855	0.971	-0.483	-3.86	-1.26	-5.69	-0.505	-4.56	-3.92	47.5	67.3
B	91.4	39.1	4.99	74.1	80.5	84.	20.8	15.	10.4	-0.0855	100	-51.6	5.03	-91.	-4.32	-87.7	2.58	-22.	-18.2	-62.3	-13.3
Y_{pp1}	-35.9	40.1	25.8	-11.4	-17.3	-25.3	-10.1	-5.08	-3.15	0.971	-51.6	100	25.1	63.8	31.1	40.2	25.4	-14.8	-13.4	33.5	11.8
Y_{pp2}	4.84	11.1	97.5	2.54	6.43	5.09	-1.66	1.48	1.22	-0.483	5.03	25.1	100	0.373	84.8	-2.67	92.7	9.51	6.88	-1.76	0.193
$Y_{\pi p1}$	-92.8	-38.1	0.241	-78.6	-84.6	-87.8	-23.4	-11.6	-7.29	-3.86	-91.	63.8	0.373	100	13.8	93.1	2.92	23.6	19.6	63.9	12.6
$Y_{\pi p2}$	-5.53	7.63	86.9	-5.82	-3.8	-4.84	-4.25	0.521	0.721	-1.26	-4.32	31.1	84.8	13.8	100	8.13	83.	10.2	7.57	5.56	1.6
Y_{Kp1}	-98.1	-63.4	-3.62	-92.5	-95.2	-98.2	-24.8	-11.5	-7.1	-5.69	-87.7	40.2	-2.67	93.1	8.13	100	-0.962	36.3	30.5	64.	10.3
Y_{Kp2}	2.64	10.8	95.	1.06	4.63	3.19	-2.14	1.16	1.01	-0.505	2.58	25.4	92.7	2.92	83.	-0.962	100	9.38	6.79	-0.154	0.577
$Y_{\Sigma p1}$	-37.5	-52.3	8.45	-47.8	-44.8	-42.3	-87.6	-3.1	-1.62	-4.56	-22.	-14.8	9.51	23.6	10.2	36.3	9.38	100	99.4	20.1	0.127
$Y_{\Sigma p2}$	-31.5	-44.7	5.94	-40.5	-37.9	-35.7	-89.	-2.55	-1.31	-3.92	-18.2	-13.4	6.88	19.6	7.57	30.5	6.79	99.4	100	16.8	0.00151
$Y_{\gamma p1}$	-64.8	-34.7	-2.1	-57.5	-60.4	-62.3	-16.	-61.8	-54.7	47.5	-62.3	33.5	-1.76	63.9	5.56	64.	-0.154	20.1	16.8	100	42
$Y_{\gamma\gamma 1}$	-10.5	0.443	0.373	-6.5	-7.8	-8.77	-2.38	-68.3	-77.9	67.3	-13.3	11.8	0.193	12.6	1.6	10.3	0.577	0.127	0.00151	42.	100

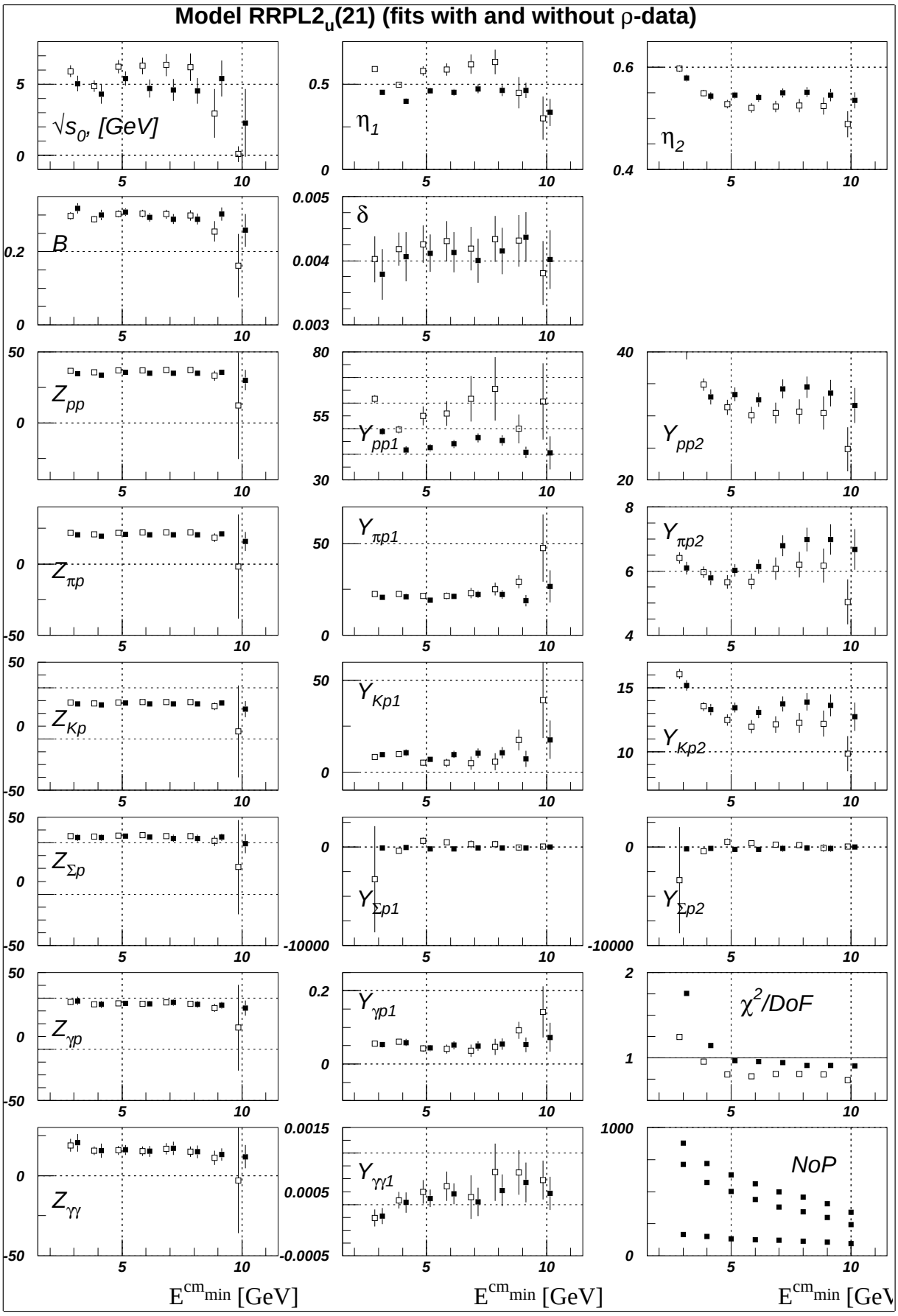
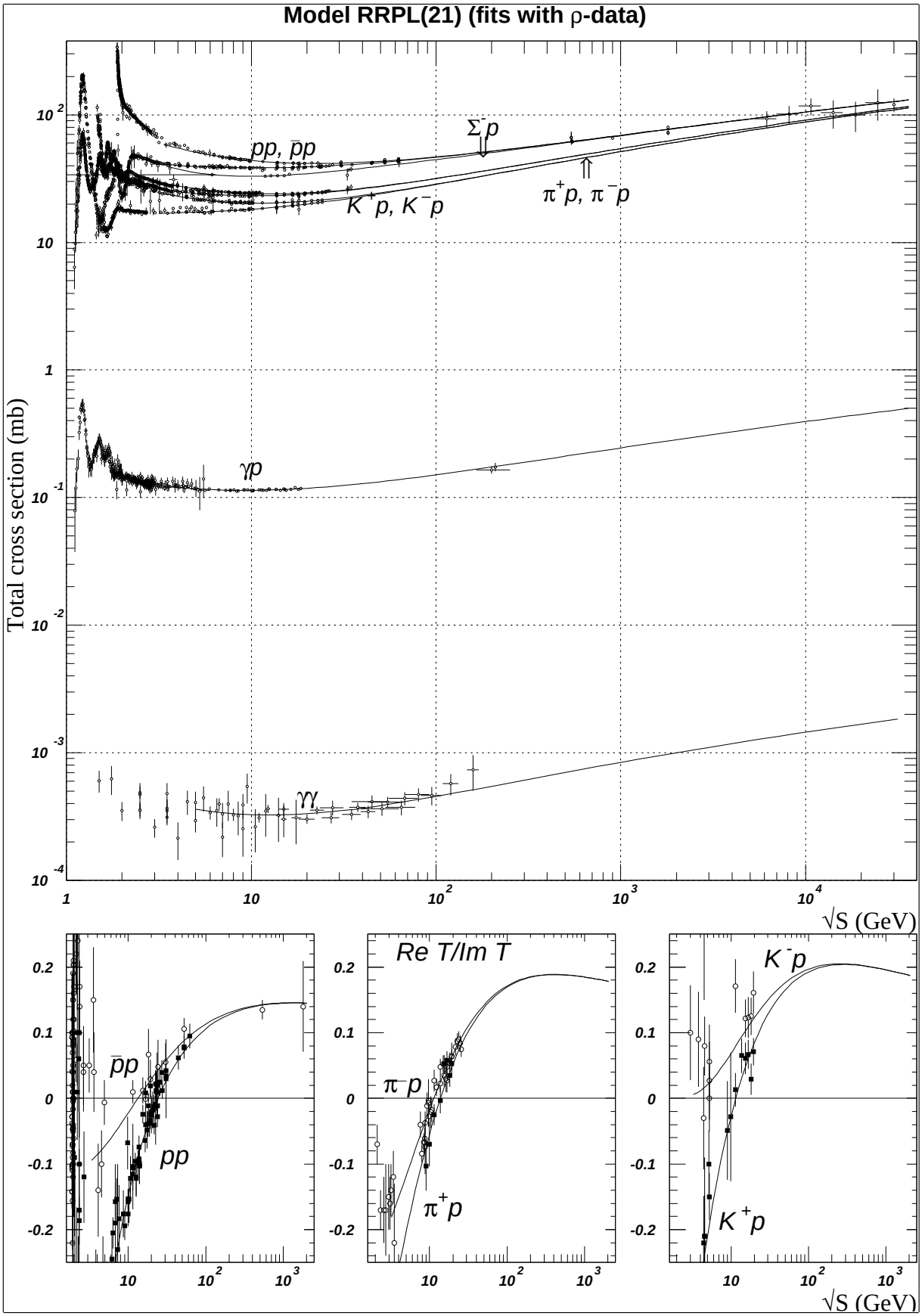


Figure 1: Bold (empty) symbol marks fits with (without) $\boldsymbol{\rho}$ data and are shifted to the right (left) in energy slightly for the cleareness


Model RRPL(21) (fits with ρ-data)
Total cross section (mb)
pp, p̄p
Σ⁻p
K⁺p, K⁻p
π⁺p, π⁻p
γp
γγ
√S (GeV)
Re T/Im T
p̄p
pp
π⁻p
π⁺p
K⁻p
K⁺p
√S (GeV)