$$
\begin{cases}
\sigma_{pp} &= 9B\ln^2\left(\dfrac{s}{s_0}\right) + 9Y_1^{pp}s^{-\eta_1} - 5Y_2^{\pi p}s^{-\eta_2},\\
\sigma_{\bar{p}p} &= 9B\ln^2\left(\dfrac{s}{s_0}\right) + 9Y_1^{pp}s^{-\eta_1} + 5Y_2^{\pi p}s^{-\eta_2},\\
\sigma_{\pi^+p} &= 6\lambda_m B\ln^2\left(\dfrac{s}{s_0}\right) + 6\lambda_{m1}Y_1^{pp}s^{-\eta_1} - Y_2^{\pi p}s^{-\eta_2},\\
\sigma_{\pi^-p} &= 6\lambda_m B\ln^2\left(\dfrac{s}{s_0}\right) + 6\lambda_{m1}Y_1^{pp}s^{-\eta_1} + Y_2^{\pi p}s^{-\eta_2},\\
\sigma_{K^+p} &= 3\lambda_m(1+\lambda_s)B\ln^2\left(\dfrac{s}{s_0}\right) + 3\lambda_{m1}(1+\lambda_{s1})Y_1^{pp}s^{-\eta_1} - 2Y_2^{\pi p}s^{-\eta_2},\\
\sigma_{K^-p} &= 3\lambda_m(1+\lambda_s)B\ln^2\left(\dfrac{s}{s_0}\right) + 3\lambda_{m1}(1+\lambda_{s1})Y_1^{pp}s^{-\eta_1} + 2Y_2^{\pi p}s^{-\eta_2},\\
\sigma_{\gamma p} &= 6\lambda_m\delta B\ln^2\left(\dfrac{s}{s_0}\right) + 6\lambda_{m1}\delta Y_1^{pp}s^{-\eta_1},\\
\sigma_{\gamma\gamma} &= 4\lambda_m^2\delta^2 B\ln^2\left(\dfrac{s}{s_0}\right) + 4\lambda_{m1}^2\delta^2 Y_1^{pp1}s^{-\eta_1},\\
\sigma_{\Sigma^-p} &= (6+3\lambda_s)B\ln^2\left(\dfrac{s}{s_0}\right) + (6+3\lambda_{s1})Y_1^{pp}s^{-\eta_1} - Y_2^{\Sigma p}s^{-\eta_2}.
\end{cases}
$$

$$
\begin{cases}
\rho_{pp}\sigma_{pp} &= 9\pi B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{9Y_1^{pp}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} - \dfrac{5Y_2^{\pi p}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},\\
\rho_{\bar{p}p}\sigma_{\bar{p}p} &= 9\pi B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{9Y_1^{pp}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} + \dfrac{5Y_2^{\pi p}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},\\
\rho_{\pi^+p}\sigma_{\pi^+p} &= 6\pi\lambda_m B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{6\lambda_{m1}Y_1^{pp}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} - \dfrac{Y_2^{\pi p}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},\\
\rho_{\pi^-p}\sigma_{\pi^-p} &= 6\pi\lambda_m B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{6\lambda_{m1}Y_1^{pp}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} + \dfrac{Y_2^{\pi p}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},\\
\rho_{K^+p}\sigma_{K^+p} &= 3\pi\lambda_m(1+\lambda_s)B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{3\lambda_{m1}(1+\lambda_{s1})Y_1^{pp}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} - \dfrac{2Y_2^{\pi p2}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},\\
\rho_{K^-p}\sigma_{K^-p} &= 3\pi\lambda_m(1+\lambda_s)B\ln\left(\dfrac{s}{s_0}\right) - \dfrac{3\lambda_{m1}(1+\lambda_{s1})Y_1^{pp}s^{-\eta_1}}{\tan\left[\dfrac{1-\eta_1}{2}\pi\right]} + \dfrac{2Y_2^{\pi p2}s^{-\eta_2}}{\cot\left[\dfrac{1-\eta_2}{2}\pi\right]},
\end{cases}
$$

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 12 parameters used:

$\eta_1, \eta_2, \delta, \lambda_m, \lambda_s, \lambda_{m1}, \lambda_{s1}$ – dimensionless
s_0 – [GeV^2]
$B, Y_1^{pp}, Y_2^{\pi p}, Y_2^{\Sigma p},$ – [mb]

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

E_{cm}^{min} [GeV]	3	4	5	6	7	8	9	10
N_{dof}: ρ excluded	714	569	495	422	357	319	273	218
N_{dof}: ρ included	892	730	636	557	486	441	385	317
χ^2/dof: ρ excluded	2.39	1.38	1.03	0.89	0.90	0.89	0.91	0.91
χ^2/dof: ρ included	2.38	1.44	1.16	1.07	1.07	1.01	0.98	0.98

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
pp:	9.02958	74
$\bar{p}p$:	9.02958	35
π^+p:	9.23822	24
π^-p:	9.23822	49
K^+p:	9.2506	22
K^-p:	9.2506	28
Σ^-p:	11.922	8
γp:	9.12473	25
$\gamma\gamma$:	9.	20
Breakdown of the CS data sample		
pp:	9.02958	59
$\bar{p}p$:	11.5382	11
π^+p:	9.94262	7
π^-p:	9.28583	23
K^+p:	9.9541	7
K^-p:	11.5102	5

χ^2/dof	=	**0.97**
CL[%]	=	65.79
Name of value	Numerical value	Error value
η_1	0.2722584	0.011413449
η_2	0.55494024	0.011591606
λ_s	0.81868653	0.0099211065
λ_m	0.99090423	0.0048304066
δ	0.0048475309	7.8785275E-06
B	0.016080647	0.0008444799
s_0	0.00045002716	0.00024455049
Y_{pp1}	7.4402016	0.12274107
$Y_{\pi p2}$	7.1370767	0.42528539
$Y_{\Sigma p2}$	34.384692	2.704391
λ_{s1}	0.32675709	0.020441243
λ_{m1}	0.71886442	0.008313214

Model quality indicators:

	A^M	C_1^M	C_2^M	U^M	R_1^M	R_2^M	S_1^M	S_2^M
$R^{qc}R_cL2^{qc}(12)$	1.726	61.5	61.5	11.58	30.54	0.939	0.159	1.692

Repository:

computer - **NPT1**

`directory - d:\MathemD\Kolja\Evela\Gauron\(RqcRc)L2qc(12)`

	CS data								
Reaction	pp	$\bar{p}p$	π^+p	π^-p	K^+p	K^-p	Σ^-p	γp	$\gamma\gamma$
χ^2/NoP	1.03	1.2	0.47	1.04	0.45	0.75	0.49	0.74	0.84

	ρ data					
Reaction	pp	$\bar{p}p$	π^+p	π^-p	K^+p	K^-p
χ^2/NoP	1.27	0.42	2.0	0.76	0.68	1.88

	η_1	η_2	λ_s	λ_m	δ	B	s_0	Y_{pp1}	$Y_{\pi p2}$	$Y_{\Sigma p2}$	λ_{s1}	λ_{m1}
η_1	100	24	-67.6	-71.9	3.15	**-90.8**	**-93.8**	75	23.4	10.5	-68.1	-86.8
η_2	24	100	-19.1	16.6	3.51	-10.9	-12.1	46.6	**99**	73.6	-6.9	-38.3
λ_s	-67.6	-19.1	100	29.3	-1.77	61.7	63.7	-50.4	-18.3	-15.1	-1.54	74.1
λ_m	-71.9	16.6	29.3	100	-1.37	78.6	79.5	-25.2	17.3	16	70.9	36
δ	3.15	3.51	-1.77	-1.37	100	-2	-2.22	4.05	4.07	4.7	0.942	-6.87
B	**-90.8**	-10.9	61.7	78.6	-2	100	**99.6**	-42.2	-10.2	-1.67	72.7	81.4
s_0	**-93.8**	-12.1	63.7	79.5	-2.22	**99.6**	100	-48.4	-11.4	-2.35	72.9	82.8
Y_{pp1}	75	46.6	-50.4	-25.2	4.05	-42.2	-48.4	100	46.7	29.3	-34.6	-68.2
$Y_{\pi p2}$	23.4	**99**	-18.3	17.3	4.07	-10.2	-11.4	46.7	100	73.4	-6.93	-38.7
$Y_{\Sigma p2}$	10.5	73.6	-15.1	16	4.7	-1.67	-2.35	29.3	73.4	100	8.26	-23.2
λ_{s1}	-68.1	-6.9	-1.54	70.9	0.942	72.7	72.9	-34.6	-6.93	8.26	100	48.9
λ_{m1}	-86.8	-38.3	74.1	36	-6.87	81.4	82.8	-68.2	-38.7	-23.2	48.9	100

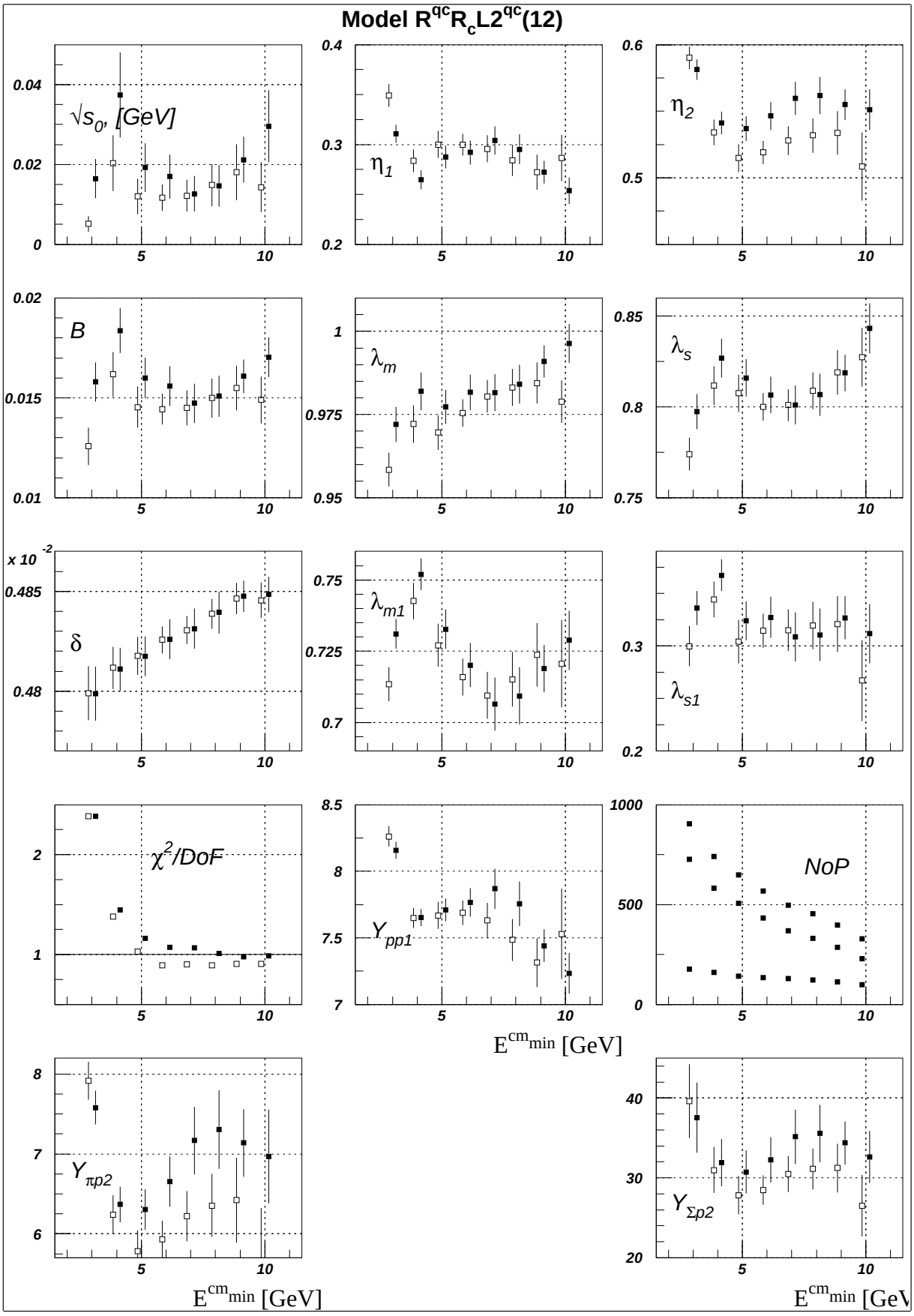
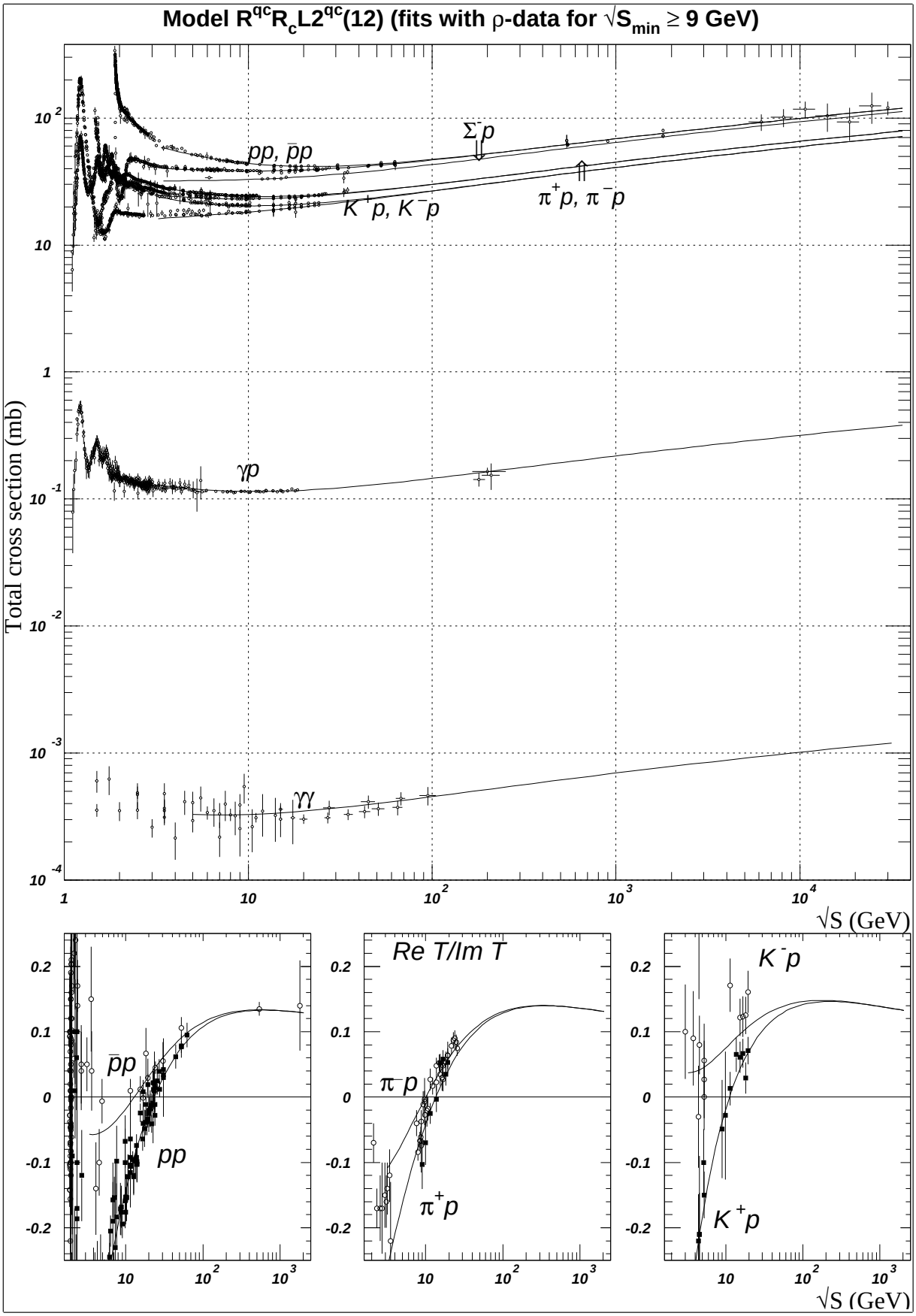


Figure 23: Bold (empty) symbol marks fits with (without) $\boldsymbol{\rho}$ data and are shifted to the right (left) in energy slightly for the clearness


Model $R^{qc}R_cL2^{qc}(12)$ (fits with ρ-data for $\sqrt{S_{min}} \geq 9$ GeV)
Total cross section (mb)
pp, p̄p
Σ⁻p
K⁺p, K⁻p
π⁺p, π⁻p
γp
γγ
√S (GeV)
p̄p
pp
Re T/Im T
π⁻p
π⁺p
K⁻p
K⁺p
√S (GeV)