

$$\left\{ \begin{array}{l}
\sigma_{pp} = 9B \ln^2 \left( \frac{s}{s_0} \right) + Y_1^{pp} s^{-\eta_1} - 5Y_2^{\pi p} s^{-\eta_2}, \\
\sigma_{\bar{p}p} = 9B \ln^2 \left( \frac{s}{s_0} \right) + Y_1^{pp} s^{-\eta_1} + 5Y_2^{\pi p} s^{-\eta_2}, \\
\sigma_{\pi+p} = 6\lambda_m B \ln^2 \left( \frac{s}{s_0} \right) + Y_1^{\pi p} s^{-\eta_1} - Y_2^{\pi p} s^{-\eta_2}, \\
\sigma_{\pi-p} = 6\lambda_m B \ln^2 \left( \frac{s}{s_0} \right) + Y_1^{\pi p} s^{-\eta_1} + Y_2^{\pi p} s^{-\eta_2}, \\
\sigma_{K+p} = 3\lambda_m(1 + \lambda_s) B \ln^2 \left( \frac{s}{s_0} \right) + Y_1^{Kp} s^{-\eta_1} - 2Y_2^{\pi p} s^{-\eta_2}, \\
\sigma_{K-p} = 3\lambda_m(1 + \lambda_s) B \ln^2 \left( \frac{s}{s_0} \right) + Y_1^{Kp} s^{-\eta_1} + 2Y_2^{\pi p} s^{-\eta_2}, \\
\sigma_{\gamma p} = 6\lambda_m \delta B \ln^2 \left( \frac{s}{s_0} \right) + Y_1^{\gamma p} s^{-\eta_1}, \\
\sigma_{\gamma\gamma} = 4\lambda_m^2 \delta^2 B \ln^2 \left( \frac{s}{s_0} \right) + Y_1^{\gamma\gamma} s^{-\eta_1}, \\
\sigma_{\Sigma-p} = (6 + 3\lambda_s) B \ln^2 \left( \frac{s}{s_0} \right) + Y_1^{\Sigma p} s^{-\eta_1} - Y_2^{\Sigma p} s^{-\eta_2}. \quad \blacksquare \\
\rho_{pp}\sigma_{pp} = 9\pi B \ln \left( \frac{s}{s_0} \right) - \frac{Y_1^{pp} s^{-\eta_1}}{\tan \left[ \frac{1 - \eta_1}{2} \pi \right]} - \frac{5Y_2^{\pi p} s^{-\eta_2}}{\cot \left[ \frac{1 - \eta_2}{2} \pi \right]}, \\
\rho_{\bar{p}p}\sigma_{\bar{p}p} = 9\pi B \ln \left( \frac{s}{s_0} \right) - \frac{Y_1^{pp} s^{-\eta_1}}{\tan \left[ \frac{1 - \eta_1}{2} \pi \right]} + \frac{5Y_2^{\pi p} s^{-\eta_2}}{\cot \left[ \frac{1 - \eta_2}{2} \pi \right]}, \\
\rho_{\pi+p}\sigma_{\pi+p} = 6\pi\lambda_m B \ln \left( \frac{s}{s_0} \right) - \frac{Y_1^{\pi p} s^{-\eta_1}}{\tan \left[ \frac{1 - \eta_1}{2} \pi \right]} - \frac{Y_2^{\pi p} s^{-\eta_2}}{\cot \left[ \frac{1 - \eta_2}{2} \pi \right]}, \\
\rho_{\pi-p}\sigma_{\pi-p} = 6\pi\lambda_m B \ln \left( \frac{s}{s_0} \right) - \frac{Y_1^{\pi p} s^{-\eta_1}}{\tan \left[ \frac{1 - \eta_1}{2} \pi \right]} + \frac{Y_2^{\pi p} s^{-\eta_2}}{\cot \left[ \frac{1 - \eta_2}{2} \pi \right]}, \\
\rho_{K+p}\sigma_{K+p} = 3\pi\lambda_m(1 + \lambda_s) B \ln \left( \frac{s}{s_0} \right) - \frac{Y_1^{Kp} s^{-\eta_1}}{\tan \left[ \frac{1 - \eta_1}{2} \pi \right]} - \frac{2Y_2^{\pi p} s^{-\eta_2}}{\cot \left[ \frac{1 - \eta_2}{2} \pi \right]}, \\
\rho_{K-p}\sigma_{K-p} = 3\pi\lambda_m(1 + \lambda_s) B \ln \left( \frac{s}{s_0} \right) - \frac{Y_1^{Kp} s^{-\eta_1}}{\tan \left[ \frac{1 - \eta_1}{2} \pi \right]} + \frac{2Y_2^{\pi p} s^{-\eta_2}}{\cot \left[ \frac{1 - \eta_2}{2} \pi \right]},
\end{array} \right.$$

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 15 parameters used:

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

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

$E_{\text{cm}}^{\text{min}}$ [GeV]	3	4	5	6	7	8	9	10
$N_{\text{dof}}$ : $\rho$ excluded	711	566	492	419	354	316	270	215
$N_{\text{dof}}$ : $\rho$ included	889	727	633	554	483	438	382	314
$\chi^2/\text{dof}$ : $\rho$ excluded	2.27	1.33	0.99	0.87	0.87	0.88	0.90	0.89
$\chi^2/\text{dof}$ : $\rho$ included	2.30	1.41	1.13	1.06	1.05	1.00 <sup>+</sup>	0.97	0.97

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	$\chi^2/\text{dof}$	=	<b>0.97</b>
			CL[%]	=	65.63
Breakdown of the CS data sample			Name of value	Numerical value	Error value
$pp$ :	9.02958	74	$\eta_1$	0.2714367	0.011373472
$\bar{p}p$ :	9.02958	35	$\eta_2$	0.55573821	0.01162258
$\pi^+p$ :	9.23822	24	$\lambda_s$	0.81814918	0.0099466356
$\pi^-p$ :	9.23822	49	$\lambda_m$	0.99195866	0.0049417391
$K^+p$ :	9.2506	22	$\delta$	0.0049059028	0.000059338257
$K^-p$ :	9.2506	28	$B$	0.016178984	0.00084914046
$\Sigma^-p$ :	11.922	8	$s_0$	0.00047862371	0.0002593784
$\gamma p$ :	9.12473	25	$Y_{pp1}$	67.017688	1.0998903
$\gamma\gamma$ :	9.	20	$Y_{\pi p1}$	32.111346	0.38665906
Breakdown of the $\rho$ data sample			$Y_{\pi p2}$	7.1656375	0.42810127
$pp$ :	9.02958	59	$Y_{Kp1}$	21.35571	0.41573869
$\bar{p}p$ :	11.5382	11	$Y_{\gamma p1}$	0.15247058	0.0039351553
$\pi^+p$ :	9.94262	7	$Y_{\gamma\gamma1}$	0.00020706175	0.000052721247
$\pi^-p$ :	9.28583	23	$Y_{\Sigma p1}$	57.29074	5.2357811
$K^+p$ :	9.9541	7	$Y_{\Sigma p2}$	57.620953	22.672767
$K^-p$ :	11.5102	5			

Model quality indicators:

	$A^M$	$C_1^M$	$C_2^M$	$U^M$	$R_1^M$	$R_2^M$	$S_1^M$	$S_2^M$
RR <sub>c</sub> L2 <sup>qc</sup> (15)	1.724	65.63	65.63	11.27	24.81	0.952	1.447	2.104

Repository:

computer - NPT1

directory - d:\MathemD\Kolja\Evela\Gauron\ (RRc)L2qc(15)

Appendix RR<sub>c</sub>L2<sup>qc</sup>(15) (N<sup>o</sup>13)  $\chi^2$ /NoP by data samples

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	CS data								
Reaction	$pp$	$\bar{p}p$	$\pi^+p$	$\pi^-p$	$K^+p$	$K^-p$	$\Sigma^-p$	$\gamma p$	$\gamma\gamma$
$\chi^2$ /NoP	1.07	1.19	0.32	0.93	0.37	0.66	0.48	0.95	1.17

	$\rho$ data					
Reaction	$pp$	$\bar{p}p$	$\pi^+p$	$\pi^-p$	$K^+p$	$K^-p$
$\chi^2$ /NoP	1.3	0.59	1.73	0.94	0.64	1.48

	$\eta_1$	$\eta_2$	$\lambda_s$	$\lambda_m$	$\delta$	$B$	$s_0$	$Y_{pp1}$	$Y_{\pi p1}$	$Y_{\pi p2}$	$Y_{Kp1}$	$Y_{\gamma p1}$	$Y_{\gamma\gamma 1}$	$Y_{\Sigma p1}$	$Y_{\Sigma p2}$
$\eta_1$	100	23.7	-66.7	-71.7	-2.27	<b>-90.8</b>	<b>-93.8</b>	74.7	18.9	23.1	-41.9	4.36	-21.9	14.5	4.99
$\eta_2$	23.7	100	-19.2	17.1	-4.66	-10.5	-11.7	46.6	26.7	<b>99</b>	11.5	16.1	-4.92	5.14	11.6
$\lambda_s$	-66.7	-19.2	100	27.4	9.71	60.7	62.6	-50	3.01	-18.3	-0.618	-2.86	14.7	-20.2	-10.9
$\lambda_m$	-71.7	17.1	27.4	100	-9.68	78.5	79.4	-24.7	-0.351	17.8	56.2	13.9	16.7	-0.217	4.91
$\delta$	-2.27	-4.66	9.71	-9.68	100	0.818	1.02	-4.32	3.82	-4.74	-1.4	-86.3	-62.7	-2.35	-1.75
$B$	<b>-90.8</b>	-10.5	60.7	78.5	0.818	100	<b>99.6</b>	-41.8	20.6	-9.85	70	15.6	22.8	-7.53	-2.47
$s_0$	<b>-93.8</b>	-11.7	62.6	79.4	1.02	<b>99.6</b>	100	-48.1	13.5	-11.1	65.8	12.1	22.9	-8.8	-2.71
$Y_{pp1}$	74.7	46.6	-50	-24.7	-4.32	-41.8	-48.1	100	70.9	46.7	17	33.4	-12.6	20.4	9.04
$Y_{\pi p1}$	18.9	26.7	3.01	-0.351	3.82	20.6	13.5	70.9	100	26.3	61.3	43.2	2.21	12.4	3.54
$Y_{\pi p2}$	23.1	<b>99</b>	-18.3	17.8	-4.74	-9.85	-11.1	46.7	26.3	100	11.2	16.1	-4.77	5.06	11.5
$Y_{Kp1}$	-41.9	11.5	-0.618	56.2	-1.4	70	65.8	17	61.3	11.2	100	34.1	14.5	10.1	5.85
$Y_{\gamma p1}$	4.36	16.1	-2.86	13.9	-86.3	15.6	12.1	33.4	43.2	16.1	34.1	100	57.8	7.2	3.04
$Y_{\gamma\gamma 1}$	-21.9	-4.92	14.7	16.7	-62.7	22.8	22.9	-12.6	2.21	-4.77	14.5	57.8	100	-2.39	-1.04
$Y_{\Sigma p1}$	14.5	5.14	-20.2	-0.217	-2.35	-7.53	-8.8	20.4	7.2	5.06	10.1	7.2	-2.39	100	<b>98</b>
$Y_{\Sigma p2}$	4.99	11.6	-10.9	4.91	-1.75	-2.47	-2.71	9.04	3.54	11.5	5.85	3.04	-1.04	<b>98</b>	100

# Appendix $RR_c L2^{qc}(15)$ ( $N=13$ ) Parameters evolution

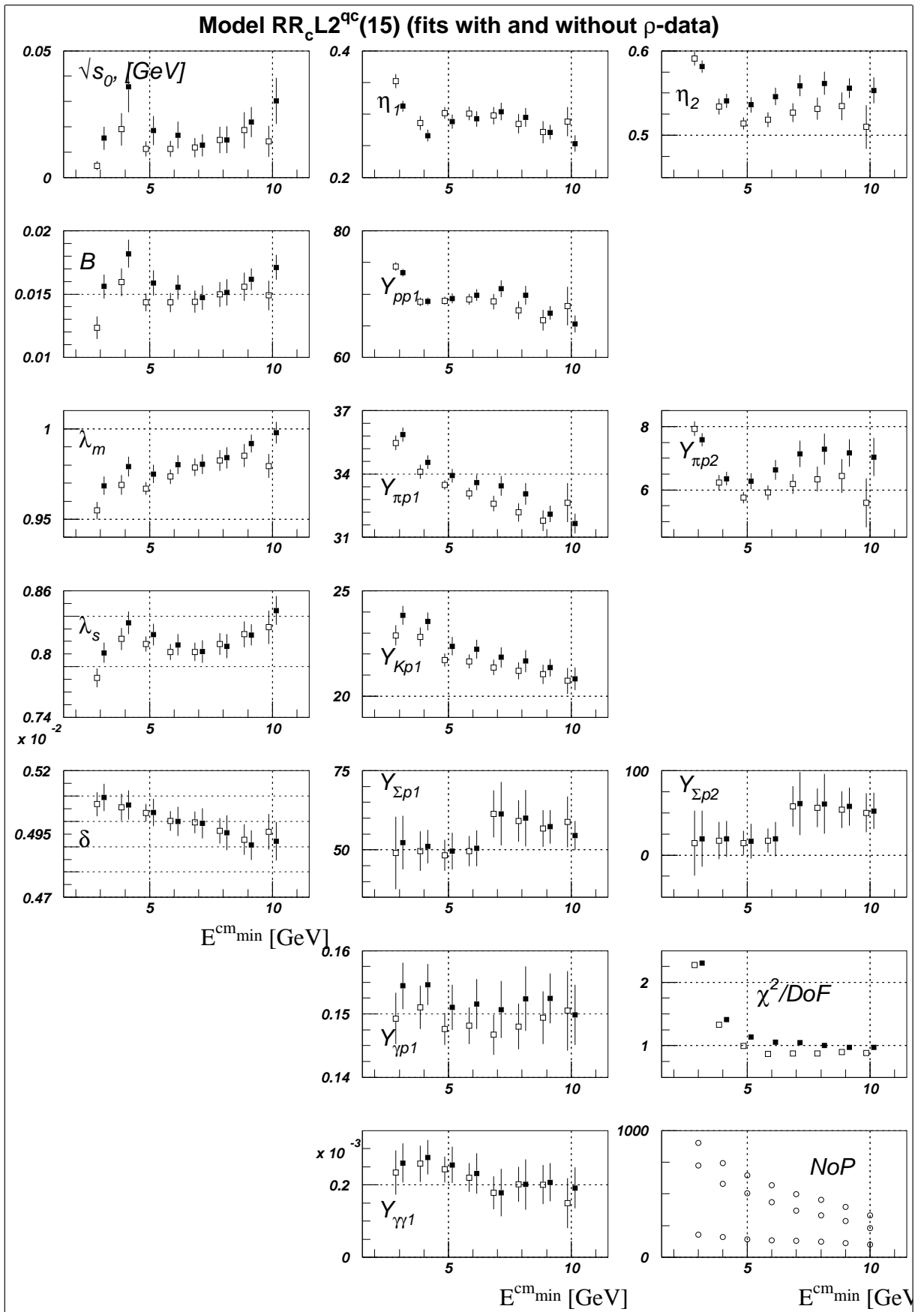


Figure 15: Bold (empty) symbol marks fits with (without)  $\rho$  data and are shifted to the right (left) in energy slightly for the cleareness

