Predictions for Hadronic Yields at 5.52 TeV Pb+Pb

B. Lukács and A. Ster
+ many, back to 1987 as

History

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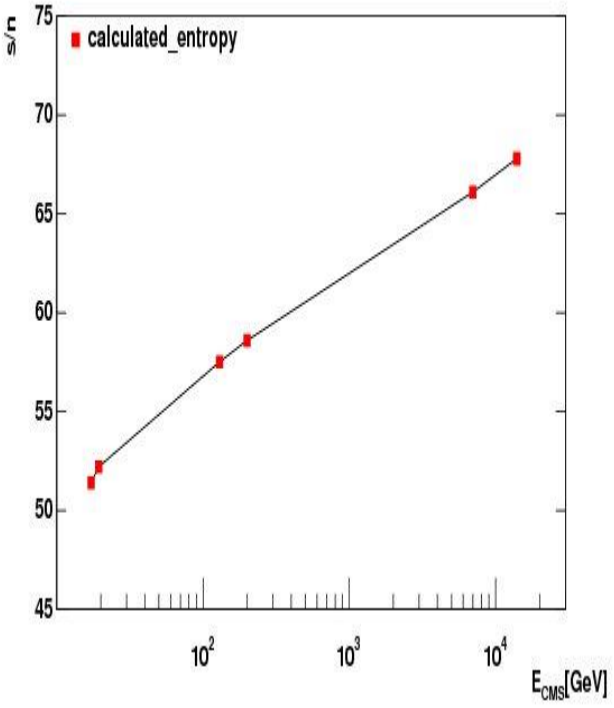
Rehadronisation Models

- #1-#8: (Gluon Fragmentation; Final Hadronic Masses; Final State Compressibility) 0: No, 1: Yes with Weight 1 as Binary +1
- #9: No Quark Phase At All
- #10: Sequential Fission
- #11: As #7 but with Maximal Possible Gluon Fragmentation (weight 1.36)

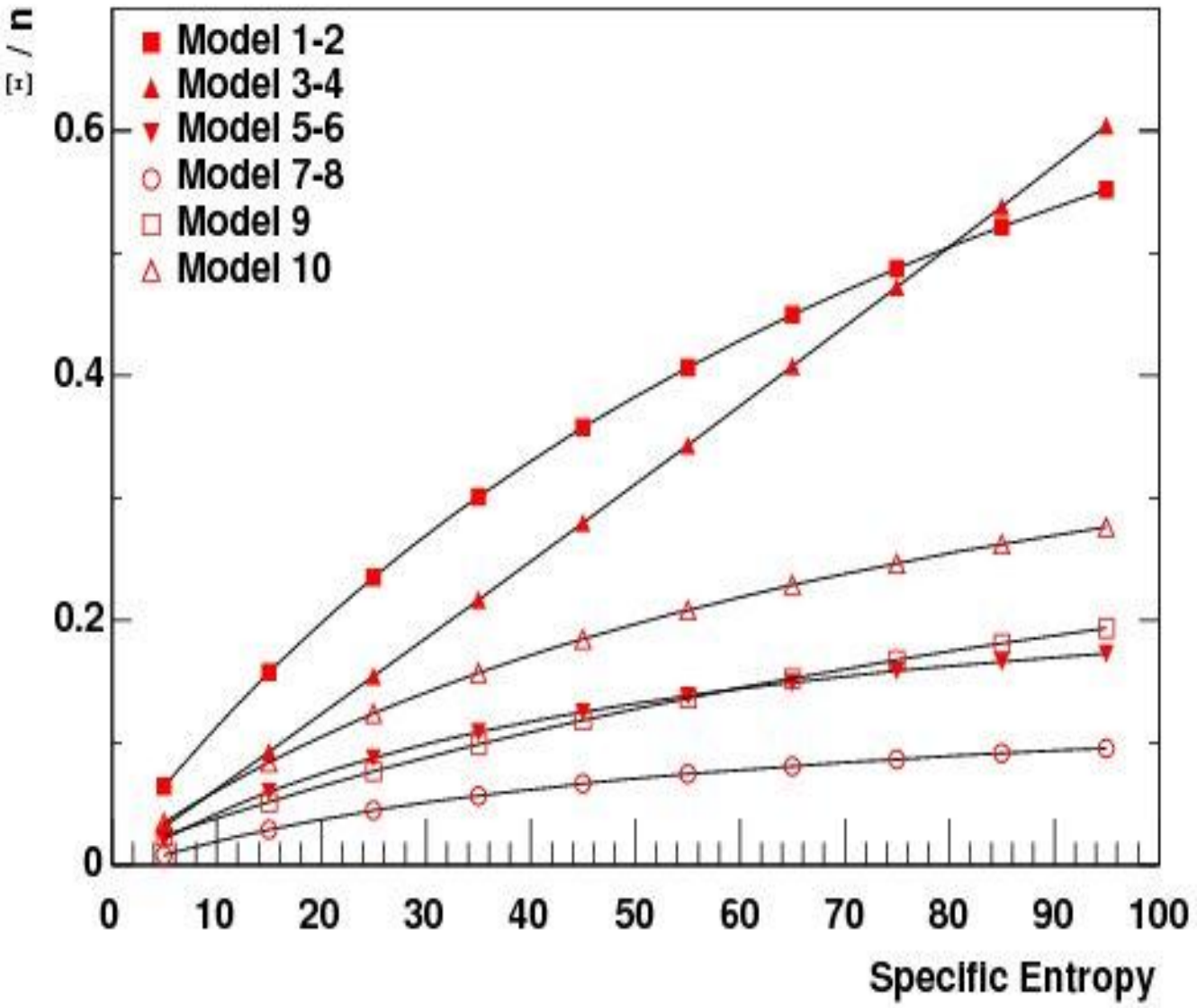
E/N vs. S/N, Pb+Pb



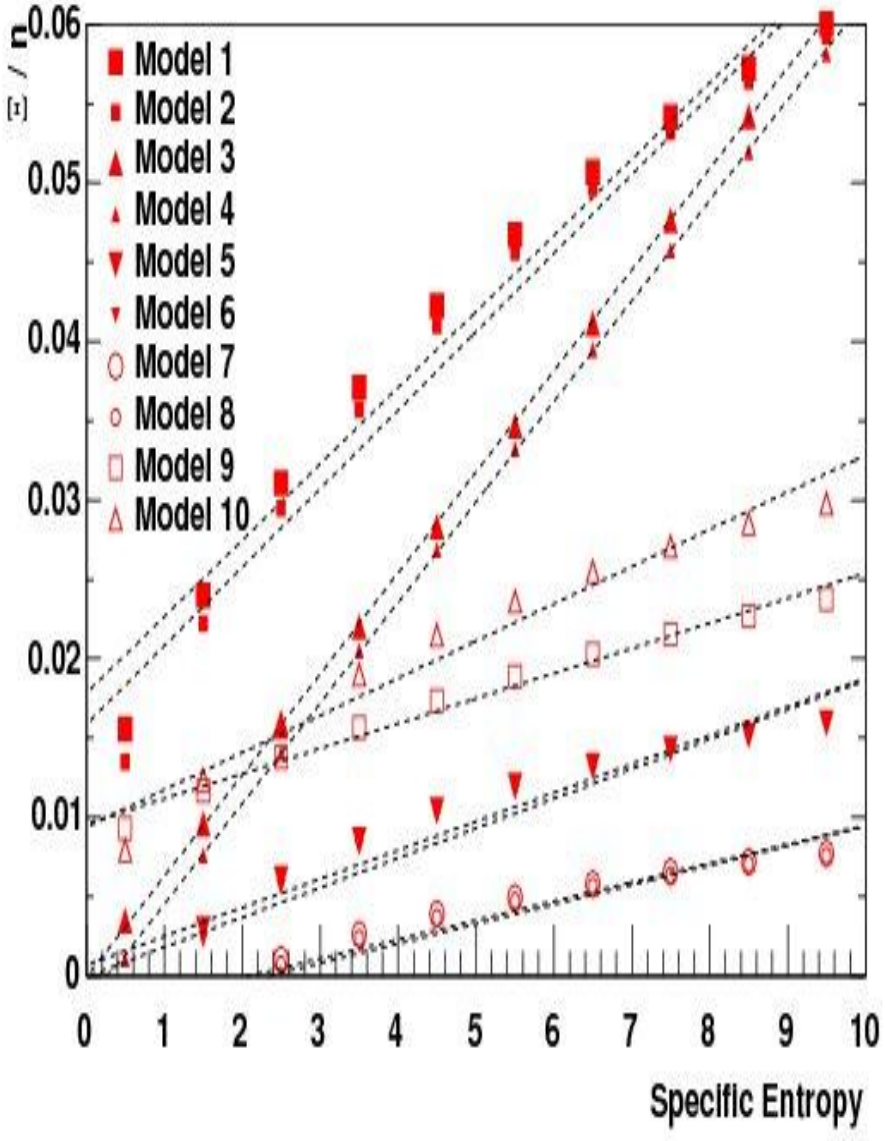
ECM [GeV]	S/N
17.3	51.4
19.4	52.2
130	57.5
200	58.6
2760	64.2
5520	65.7

Figure is direct calculation. For the upper 4 points a logarithmic fit is excellent, expected as ultrarelativistic: S/N=47.019+2.168*ln(Ecm/A, GeV)±0.14. See Table.

Rehadronisation, Xi/N



Rehadronisation, Xi/N, low S/N



Successes/failures at SPS/RHIC

Model	158 GeV SPS	200 GeV SPS	130 GeV RHIC	200 GeV RHIC
1 & 2	0.394	0.759	0.012	0.0503
3 & 4	1.326	2.819	0.009	0.0306
5 & 6	0.120	0.141	0.005	0.0330
7 & 8	0.165	0.283	0.005	0.0308
9	0.020	0.028	0.072	0.0950
10	0.084	0.176	0.054	0.1288

Notes

- These are χ^2 mean deviations for measured ratios. It seems that until SPS energies #9 is the best; for RHIC #7 is the best, #5 is close second, but simple averaging does not help.

Checks for SPS/RHIC energies; ratios used

Energy/nucl.	Ratio	Experiment	Reference	Measurement	Model 9
158 GeV SPS	Ξ^0/Λ	WA97	[27]	0.14 ± 0.02	0.14 ± 0.13
	$\overline{\Xi^0}/\overline{\Lambda}$	WA97	[27]	0.26 ± 0.05	0.19 ± 0.13
	Ω/Ξ^0	WA97	[27]	0.19 ± 0.04	0.27 ± 0.13
	$\overline{\Omega}/\overline{\Xi^0}$	WA97	[27]	0.30 ± 0.09	0.35 ± 0.13
	$\overline{\Lambda}/\Lambda$	WA97, NA49	[27]	0.145 ± 0.024	0.38 ± 0.13
	$\overline{\Xi^-}/\Xi^-$	WA97	[27]	0.27 ± 0.05	0.49 ± 0.13
	$\overline{\Omega}/\Omega$	WA97	[27]	0.42 ± 0.12	0.66 ± 0.13
	$(\Xi^- + \overline{\Xi^-})/(\Lambda + \overline{\Lambda})$	NA49	[27]	0.13 ± 0.03	0.16 ± 0.13
	$\overline{\Lambda}/\overline{p}$	NA49	[35]	1.05 ± 0.16	1.12 ± 0.13
	K^-/K^+	NA49	[28]	0.59 ± 0.05	0.77 ± 0.13
200 GeV SPS	$\overline{\Lambda}/\overline{p}$	NA35	[26]	0.80 ± 0.25	1.12 ± 0.14
	Ξ^-/Λ	WA85	[19]	0.19 ± 0.01	0.15 ± 0.14
	$\overline{\Xi^-}/\overline{\Lambda}$	WA85	[19],[26]	0.21 ± 0.02	0.19 ± 0.14
	$(\Omega + \overline{\Omega})/(\Xi^- + \overline{\Xi^-})$	NA35	[26]	0.80 ± 0.4	0.28 ± 0.14
	$\overline{\Lambda}/\Lambda$	NA35	[33]	0.18 ± 0.06	0.38 ± 0.14
					Model 7
130 GeV RHIC	$\overline{p}/p$	STAR	[28], [29]	0.64 ± 0.05	0.59 ± 0.06
	$\overline{\Omega}/\Omega$	STAR	[30]	1.00 ± 0.2	1.00 ± 0.06
	$\overline{\Lambda}/\Lambda$	STAR	[28], [29]	0.77 ± 0.05	0.65 ± 0.06
	$\overline{\Xi^-}/\Xi^-$	STAR	[28], [29]	0.81 ± 0.05	0.78 ± 0.06
	π^-/π^+	PHOBOS	[29]	0.95 ± 0.06	1.02 ± 0.06
	K^-/K^+	STAR	[29]	0.90 ± 0.05	0.82 ± 0.06
200 GeV RHIC	$\overline{p}/p$	PHOBOS, PHENIX STAR, BRAHMS	[30], [31]	0.84 ± 0.04	0.60 ± 0.16
	K^-/K^+	PHOBOS, PHENIX BRAHMS	[30], [31]	0.98 ± 0.04	0.82 ± 0.16
	π^-/π^+	PHOBOS	[31]	1.02 ± 0.02	1.02 ± 0.16
	K^-/π^-	STAR, BRAHMS	[30]	0.15 ± 0.02	0.61 ± 0.16
	$\overline{p}/\pi^-$	BRAHMS	[30]	0.08 ± 0.01	0.16 ± 0.16
	$(K^-/\overline{p}$	STAR, BRAHMS	[30]	1.87 ± 0.34	$3.81 \pm 0.16)$

Model predictions, u & d are not yet distinguished

Particle	Model 5	**Model 7**	Model 9	Model 11	Model 7 (with S/N=75)	Mass (MeV)
N	528.79	**475.95**	389.19	585.18	512.60	939
$\overline{N}$	326.50	**301.58**	152.70	365.80	350.83	939
Y	610.63	**711.38**	261.25	658.50	801.15	1174
$\overline{Y}$	412.91	**479.61**	113.76	461.67	557.46	1174
Ξ	79.09	**38.49**	59.65	26.79	44.11	1318
$\overline{\Xi}$	64.00	**30.98**	32.14	22.33	35.94	1318
Ω	19.79	**1.01**	8.03	0.35	1.17	1672
$\overline{\Omega}$	19.79	**1.01**	5.53	0.35	1.17	1672
π	3755.23	**3686.70**	1775.05	4104.40	4212.90	138
K	1285.38	**1388.59**	965.63	1273.83	1579.55	496
$\overline{K}$	1057.50	**1141.80**	757.30	1068.06	1319.53	496
η	162.89	**125.60**	358.21	96.23	144.64	549

Model deviations from conservations + efficiency of transferring the kinetic energy

Total N^o	Initial	Model 5	**Model 7**	Model 9	Model 11
Particle	-	8322.50	**8382.70**	4878.44	8653.47
Strangeness	0	0.02	**0.00**	1.68	-0.01
Baryon	414	415.10	**413.65**	413.99	420.68

Model #	$E_{tot}/414$ [GeV]	$M_{tot}/414$ [GeV]	$E_{transf}/414$ [GeV]
5	2760	9.73	13.62
7	**2760**	**9.80**	**13.72**
9	2760	5.77	7.66
11	2760	9.78	13.86

#7 is quite good for conservation; efficiency is 0.5 %.

Quark charges/spins considered

- Total starting quarks: u=578, d=664, s=0,
- Antiquarks 0. Final state masses & gluon fragmentation are u/d symmetric. Models: random u/d selection from common pool.

Taking charge into consideration; results

Particle	Model 5	**Model 7**	Model 9	Model 11	Model 7 (with S/N=75)	Model 7 (200 GeV RHIC)
p	261.53	**235.41**	190.87	289.62	253.85	221.30
$\overline{p}$	163.25	**150.79**	76.35	182.90	175.42	131.99
n	267.26	**240.54**	198.32	295.56	258.76	226.66
$\overline{n}$	163.25	**150.79**	76.35	182.90	175.42	131.99
Σ^+	74.68	**87.01**	31.42	80.65	98.23	78.45
$\overline{\Sigma^+}$	51.61	**59.95**	14.22	57.71	69.68	52.52
Σ^0	152.64	**177.82**	65.29	164.61	200.27	160.69
$\overline{\Sigma^0}$	103.23	**119.90**	28.44	115.42	139.37	105.04
Σ^-	77.99	**90.85**	33.92	83.99	102.07	82.29
$\overline{\Sigma^-}$	51.61	**59.95**	14.22	57.71	69.68	52.52
Λ	457.95	**533.51**	195.91	493.86	600.84	482.12
$\overline{\Lambda}$	309.68	**359.71**	85.32	346.25	418.10	315.13
Ξ^0	39.12	**19.04**	29.25	13.26	21.84	16.90
$\overline{\Xi^0}$	32.00	**15.49**	16.07	11.16	17.97	13.60
Ξ^-	39.97	**19.45**	30.40	13.54	22.26	17.30
$\overline{\Xi^-}$	32.00	**15.49**	16.07	11.16	17.97	13.60
Ω^-	19.79	**1.01**	8.03	0.35	1.17	0.89
$\overline{\Omega^-}$	19.79	**1.01**	5.53	0.35	1.17	0.89
π^+	928.62	**911.72**	435.26	1015.69	1043.13	811.42
π^0	1877.62	**1843.35**	887.53	2052.50	2106.45	1642.49
π^-	948.99	**931.63**	452.26	1036.51	1063.32	831.07
K^+	635.72	**686.80**	473.57	630.45	782.21	613.97
K^-	528.75	**570.90**	378.65	534.03	659.77	503.06
K_L^0	589.21	**636.35**	435.36	588.70	728.55	565.94
K_S^0	589.21	**636.35**	435.36	588.70	728.55	565.94
η	162.89	**125.6**	358.21	86.23	144.64	111.06

Various mispredictions and a 2.76 TeV/A preliminary

Experiment	Ratio	Δ	σ	Deviation/σ	Error integral
158 GeV SPS	$\overline{\Lambda}/\Lambda$	-0.235	0.13	1.85	0.06
158 GeV SPS	$\overline{\Xi^-}/\Xi^-$	-0.22	0.14	1.57	0.12
158 GeV SPS	$\overline{\Omega}/\Omega$	-0.24	0.18	1.33	0.18
158 GeV SPS	K^-/K^+	-0.18	0.14	1.28	0.20
200 GeV SPS	$\overline{\Lambda}/\overline{p}$	0.32	0.29	1.10	0.27
200 GeV SPS	$(\Omega+\overline{\Omega})/(\Xi^-+\overline{\Xi^-})$	0.52	0.42	1.24	0.22
200 GeV SPS	$\overline{\Lambda}/\Lambda$	-0.20	0.15	1.33	0.18
130 GeV RHIC	$\overline{\Lambda}/\Lambda$	0.12	0.08	1.50	0.13
200 GeV RHIC	$\overline{p}/p$	0.24	0.16	1.50	0.13
200 GeV RHIC	K^-/π^-	-0.46	0.16	2.88	0.004

Experiment	Ratio	Δ	σ	Deviation/σ
200 GeV RHIC	K^-/π^-	-0.11	0.16	0.69
200 GeV RHIC	$\overline{p}/\pi^-$	0.09	0.16	0.57

	Year-1987	Model 5	Model 7	Model 9	Model 11	Model 7
Note	14.5 GeV fixed t.	fragmentation	favourite	hadronic	enh.fragmentation	S/N=75
K^+/π^+	0.24	0.685	0.753	1.088	0.621	0.750
K^-/π^-	$\approx$0	0.557	0.613	0.837	0.515	0.620

Ratio	0.2 TeV, Model 7	2.76 TeV, preliminary measurement	5.52 TeV, Model 7
K^+/p	2.8 ± 0.34	3.2	2.9 ± 0.49
Ξ^-/p	0.078 ± 0.013	0.12	0.083 ± 0.014
Ω/p	0.004 ± 0.0007	0.02	0.004 ± 0.0007

For RHIC energies pions are overabundant; probable reason hadronosation into resonances. It seems that it was cca. 50 % for 200 GeV. For 2.76 TeV Ω yield is geometric mean of #7 & #5. Otherwise…

PROBLEMS