Centrality determination in MPD at NICA

MPD PWG meeting

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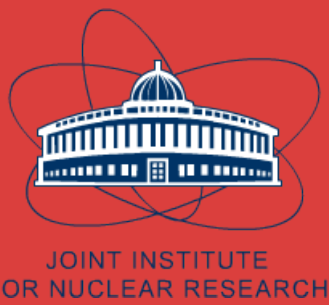

Multiplicity selection

- $p_T > 0.15$ GeV/c
- $|\eta| < 0.5$
- Only charged particles
- $N_{hits} > 16$
- Corrected DCA values with selection of primary particles [1].
- $\sim 600,000$ events.
- Bi+Bi collisions at 7.7, 9 and 9.46 GeV [2], [3] and [4] using UrQMD.

Definition

NBD (negative binomial distribution) [5]
$N_a = fN_{part} + (1 - f)N_{coll}$

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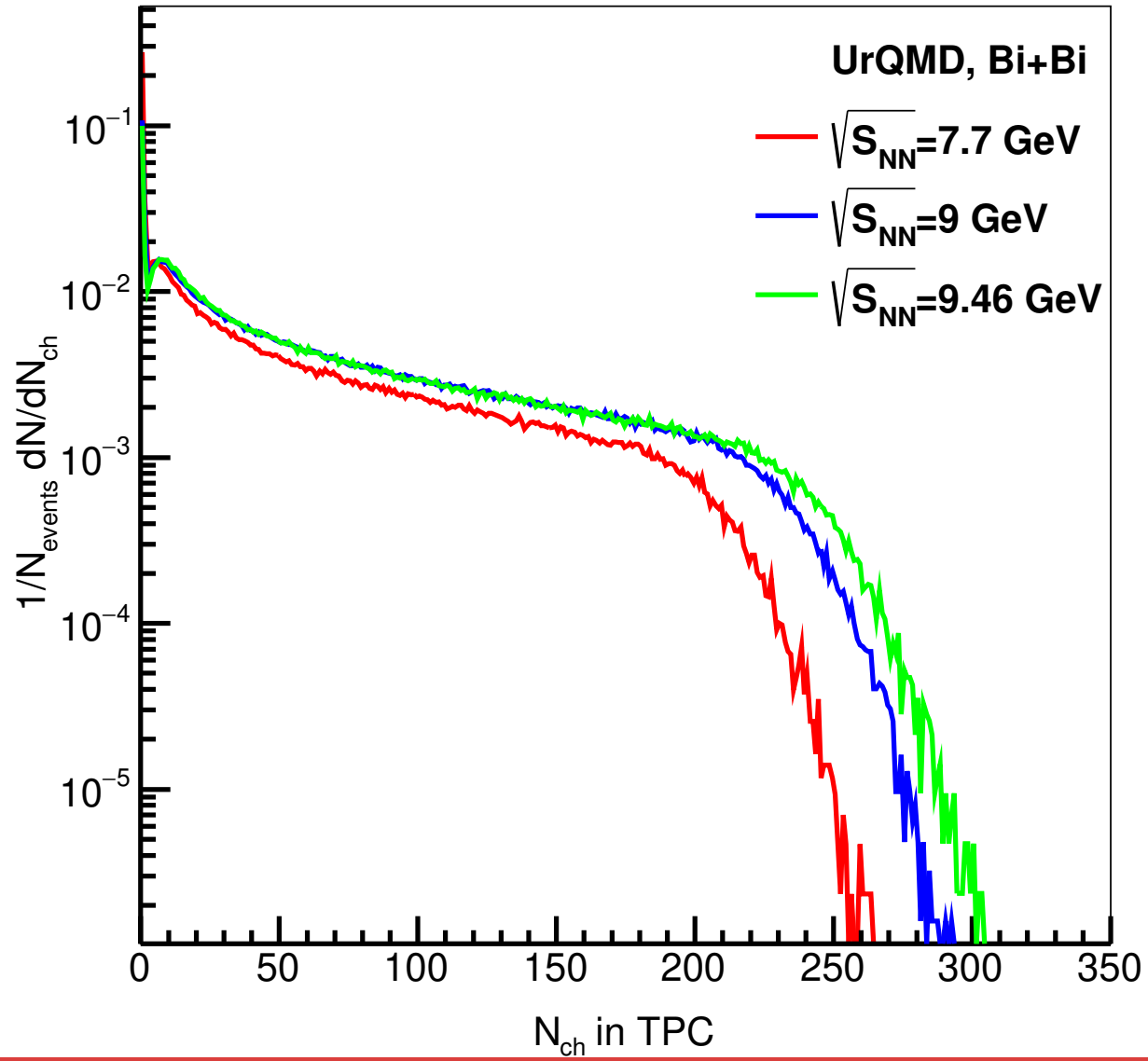
$|\eta| < 0.5$



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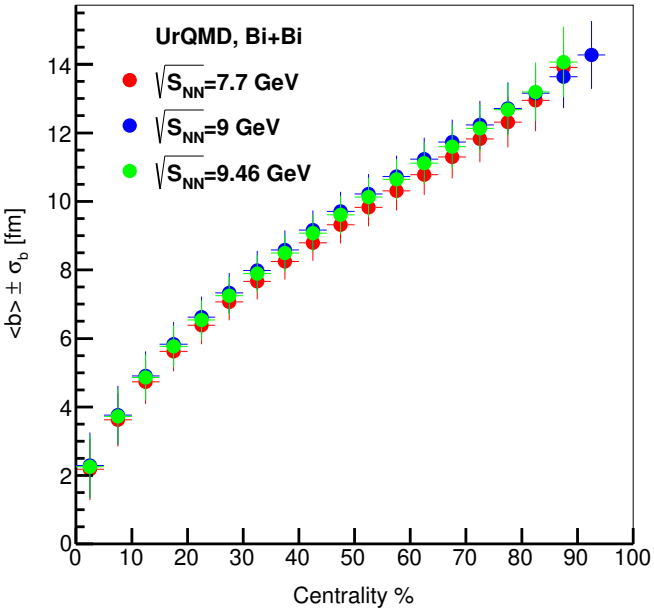

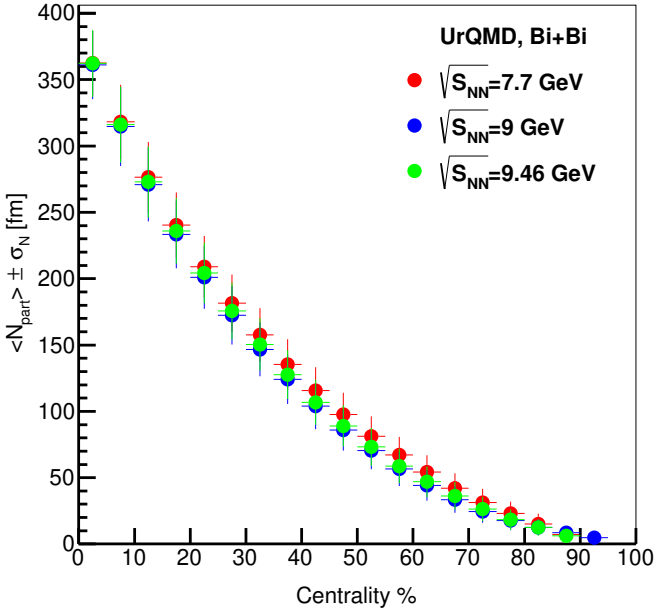

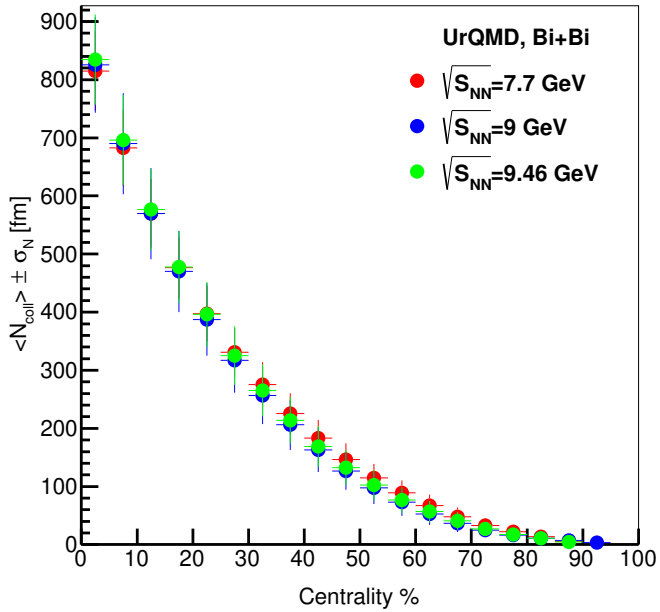

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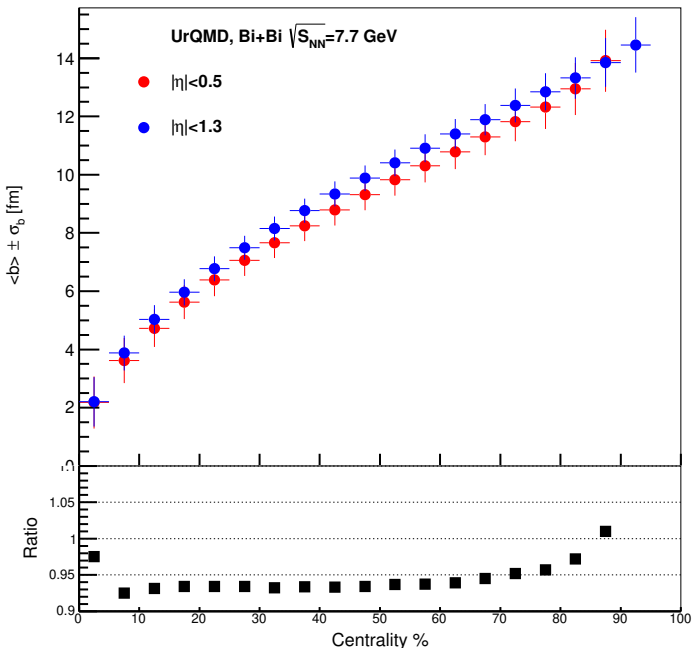

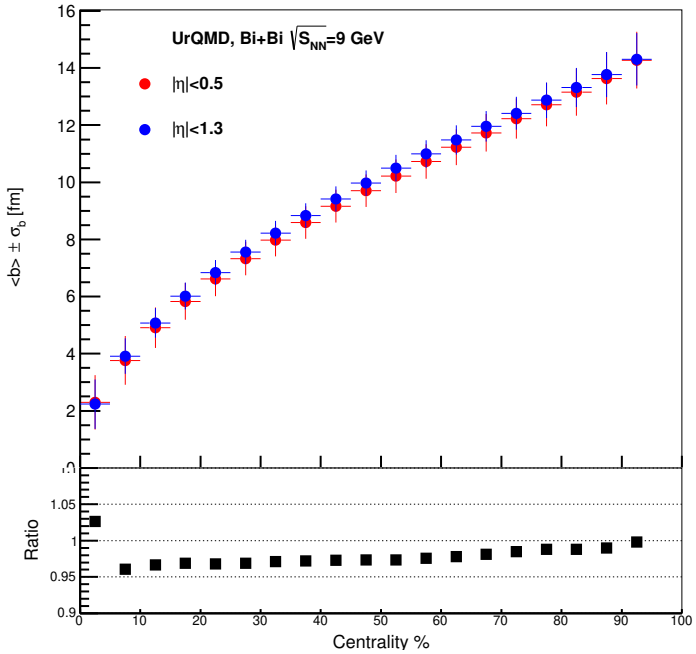

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Thank you

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References

[1] DCA correction:
https://git.jinr.ru/nica/mpdroot/-/tree/pro/macro/physical_analysis/Flow

[2] Monte-Carlo request for @7.7 GeV events of the MPD collaboration for PWG3:
https://mpdforum.jinr.ru/t/request-9-pwg3-urqmd-flow-10m-min-bias-auau-bibi-7-7-gev/297

[3] Monte-Carlo request for @9 GeV events of the MPD collaboration for PWG3:
https://mpdforum.jinr.ru/t/request4-pwg3-urqmd-min-bias-bibi-9-gev/232

[4] Monte-Carlo request for @9.46 GeV events of the MPD collaboration for PWG4:
https://mpdforum.jinr.ru/t/request5-pwg4-dielectrons-10m-minbias-bibi-9-46/235

[5] Centrality determination:
https://github.com/FlowNICA/CentralityFramework

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Backup slides

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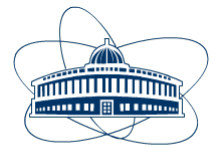
Bi+Bi 7.7 GeV $|\eta| < 0.5$

Best fit:

$f = 0.03 \pm 0.112$, $\mu = 0.23492 \pm 0.292284$, $k = 7 \pm 7.68$,

$\chi^2 = 0.881361 \pm 0.144678$

Centrality, %	N_{ch}^{min}	N_{ch}^{max}	$\langle b \rangle$, fm	RMS	b_{min}, fm	b_{max}, fm	$\langle N_{part} \rangle$	RMS	N_{part}^{min}	N_{part}^{max}	$\langle N_{coll} \rangle$	RMS	N_{coll}^{min}	N_{coll}^{max}
0 - 5	174	271	2.18	0.90	1.32	2.94	362.46	24.29	339.00	389.36	814.84	68.19	745.33	892.80
5 - 10	145	174	3.62	0.77	2.94	4.20	318.15	28.01	295.53	339.00	682.48	65.54	623.03	745.33
10 - 15	121	145	4.73	0.64	4.20	5.20	276.41	26.56	257.74	295.53	570.01	58.92	521.13	623.03
15 - 20	101	121	5.62	0.58	5.20	6.02	240.36	24.76	224.63	257.74	476.47	52.85	435.67	521.13
20 - 25	84	101	6.39	0.55	6.02	6.73	208.95	23.19	195.40	224.63	397.58	47.64	363.46	435.67
25 - 30	70	84	7.06	0.54	6.73	7.37	181.51	21.62	169.39	195.40	331.05	42.69	301.95	363.46
30 - 35	58	70	7.67	0.53	7.37	7.96	157.58	20.20	146.11	169.39	275.35	38.52	249.18	301.95
35 - 40	47	58	8.25	0.53	7.96	8.52	135.43	18.98	125.16	146.11	225.61	34.94	203.68	249.18
40 - 45	38	47	8.79	0.53	8.52	9.06	115.70	17.50	106.26	125.16	183.28	30.89	164.36	203.68
45 - 50	30	38	9.32	0.54	9.06	9.58	97.62	16.38	89.22	106.26	146.50	27.76	130.47	164.36
50 - 55	23	30	9.83	0.55	9.58	10.08	81.11	15.08	73.87	89.22	114.65	24.46	101.48	130.47
55 - 60	18	23	10.30	0.56	10.08	10.56	67.06	13.69	60.11	73.87	89.11	21.16	77.04	101.48
60 - 65	13	18	10.78	0.59	10.56	11.04	54.28	12.68	47.84	60.11	67.37	18.69	56.81	77.04
65 - 70	9	13	11.30	0.63	11.04	11.52	41.96	11.43	36.95	47.84	48.06	15.76	40.47	56.81
70 - 75	6	9	11.82	0.68	11.52	12.05	31.33	10.16	27.30	36.95	32.98	12.97	27.58	40.47
75 - 80	4	6	12.32	0.74	12.05	12.66	23.00	8.94	18.71	27.30	22.33	10.52	17.50	27.58
80 - 85	2	4	12.95	0.89	12.66	13.41	15.10	7.80	10.92	18.71	13.40	8.33	9.32	17.50
85 - 90	1	2	13.91	1.06	13.41	14.40	7.13	5.35	3.57	10.92	5.53	5.03	1.76	9.32



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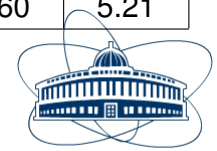
Bi+Bi 9 GeV $|\eta| < 0.5$

Best fit:

$f = 0.84 \pm 0.011$, $\mu = 0.478473 \pm 0.221256$, $k = 1 \pm 0.183$,

$\chi^2 = 1.15306 \pm 0.0730813$

Centrality, %	N_{ch}^{min}	N_{ch}^{max}	$\langle b \rangle$, fm	RMS	b_{min}, fm	b_{max}, fm	$\langle N_{part} \rangle$	RMS	N_{part}^{min}	N_{part}^{max}	$\langle N_{coll} \rangle$	RMS	N_{coll}^{min}	N_{coll}^{max}
0 - 5	195	297	2.30	0.96	1.47	3.07	361.17	25.82	336.61	389.74	825.72	82.41	754.20	907.20
5 - 10	165	195	3.76	0.85	3.07	4.34	314.73	29.80	290.93	336.61	690.01	86.96	625.83	754.20
10 - 15	140	165	4.91	0.71	4.34	5.38	270.95	27.82	251.37	290.93	569.64	78.32	517.96	625.83
15 - 20	119	140	5.83	0.64	5.38	6.25	233.40	25.61	216.83	251.37	470.07	69.83	427.14	517.96
20 - 25	101	119	6.62	0.61	6.25	7.00	201.05	23.67	186.43	216.83	387.47	62.36	350.47	427.14
25 - 30	85	101	7.33	0.59	7.00	7.67	172.39	21.94	159.50	186.43	317.12	55.72	285.60	350.47
30 - 35	71	85	7.98	0.58	7.67	8.28	146.73	20.27	135.49	159.50	256.75	49.26	230.63	285.60
35 - 40	59	71	8.59	0.57	8.28	8.86	124.17	18.64	114.04	135.49	206.08	43.20	184.06	230.63
40 - 45	48	59	9.16	0.57	8.86	9.42	103.85	17.17	94.88	114.04	162.84	37.81	144.70	184.06
45 - 50	39	48	9.71	0.57	9.42	9.96	85.96	15.56	77.82	94.88	126.80	32.25	111.66	144.70
50 - 55	31	39	10.21	0.59	9.96	10.49	70.53	14.23	62.77	77.82	97.69	27.67	84.23	111.66
55 - 60	24	31	10.73	0.61	10.49	11.00	56.51	12.87	49.65	62.77	72.93	23.25	61.87	84.23
60 - 65	18	24	11.23	0.63	11.00	11.49	44.15	11.45	38.40	49.65	52.81	19.00	44.10	61.87
65 - 70	13	18	11.73	0.66	11.49	11.97	33.47	10.00	28.98	38.40	36.86	15.03	30.46	44.10
70 - 75	9	13	12.23	0.70	11.97	12.45	24.60	8.61	21.28	28.98	24.91	11.67	20.46	30.46
75 - 80	6	9	12.72	0.76	12.45	12.92	17.60	7.17	15.15	21.28	16.39	8.74	13.48	20.46
80 - 85	4	6	13.16	0.82	12.92	13.42	12.65	5.86	10.36	15.15	10.95	6.50	8.74	13.48
85 - 90	2	4	13.64	0.91	13.42	13.96	8.63	4.69	6.56	10.36	6.95	4.75	5.21	8.74
90 - 95	1	2	14.28	0.99	13.96	14.58	4.83	3.02	3.28	6.56	3.50	2.77	1.60	5.21



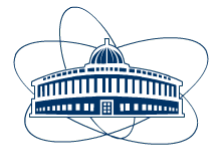
Bi+Bi 9.46 GeV $|\eta| < 0.5$

Best fit:

$f = 0.61 \pm 0.049$, $\mu = 0.399808 \pm 0.212877$, $k = 1 \pm 0.37$,

$\chi^2 = 1.0719 \pm 0.0852262$

Centrality, %	N_{ch}^{min}	N_{ch}^{max}	$\langle b \rangle$, fm	RMS	b_{min}, fm	b_{max}, fm	$\langle N_{part} \rangle$	RMS	N_{part}^{min}	N_{part}^{max}	$\langle N_{coll} \rangle$	RMS	N_{coll}^{min}	N_{coll}^{max}
0 - 5	201	309	2.26	0.93	1.41	3.04	362.21	25.11	337.92	389.10	834.59	77.48	761.80	913.53
5 - 10	169	201	3.73	0.80	3.04	4.31	316.10	28.60	293.31	337.92	696.16	77.86	634.08	761.80
10 - 15	142	169	4.86	0.67	4.31	5.33	272.90	26.82	254.26	293.31	576.44	69.97	526.44	634.08
15 - 20	120	142	5.77	0.60	5.33	6.18	235.97	24.71	219.89	254.26	477.83	62.05	435.53	526.44
20 - 25	101	120	6.54	0.57	6.18	6.92	204.30	23.06	189.51	219.89	396.29	55.97	358.58	435.53
25 - 30	84	101	7.25	0.55	6.92	7.58	175.59	21.40	162.53	189.51	325.14	50.13	293.29	358.58
30 - 35	70	84	7.89	0.54	7.58	8.19	150.40	19.81	138.50	162.53	265.40	44.60	237.84	293.29
35 - 40	57	70	8.49	0.55	8.19	8.78	127.75	18.49	117.07	138.50	213.92	39.89	190.74	237.84
40 - 45	46	57	9.08	0.55	8.78	9.34	106.87	16.98	97.95	117.07	169.01	34.91	150.84	190.74
45 - 50	37	46	9.61	0.56	9.34	9.87	89.04	15.56	80.94	97.95	132.68	30.26	117.24	150.84
50 - 55	29	37	10.12	0.57	9.87	10.39	73.34	14.28	65.87	80.94	102.59	26.28	89.22	117.24
55 - 60	22	29	10.64	0.59	10.39	10.89	58.81	12.97	52.62	65.87	76.63	22.33	66.21	89.22
60 - 65	17	22	11.12	0.61	10.89	11.37	46.88	11.58	41.07	52.62	56.80	18.50	47.70	66.21
65 - 70	12	17	11.59	0.65	11.37	11.85	36.31	10.53	31.10	41.07	40.76	15.48	33.18	47.70
70 - 75	8	12	12.13	0.70	11.85	12.36	26.39	9.14	22.56	31.10	27.09	12.13	22.11	33.18
75 - 80	5	8	12.68	0.78	12.36	12.93	18.32	7.71	15.29	22.56	17.18	9.17	13.83	22.11
80 - 85	3	5	13.20	0.86	12.93	13.63	12.44	6.22	9.05	15.29	10.71	6.67	7.48	13.83
85 - 90	1	3	14.07	1.03	13.63	14.52	6.16	4.33	3.53	9.05	4.69	4.09	2.01	7.48



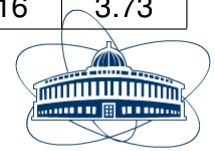
Bi+Bi 7.7 GeV $|\eta| < 1.3$

Best fit:

$f = 0.74 \pm 0.04$, $\mu = 0.926719 \pm 0.39063$, $k = 54 \pm 1.098$,

$\chi^2 = 1.11855 \pm 0.0524006$

Centrality, %	N_{ch}^{min}	N_{ch}^{max}	$\langle b \rangle$, fm	RMS	b_{min}, fm	b_{max}, fm	$\langle N_{part} \rangle$	RMS	N_{part}^{min}	N_{part}^{max}	$\langle N_{coll} \rangle$	RMS	N_{coll}^{min}	N_{coll}^{max}
0 - 5	405	564	2.20	0.85	1.38	3.10	362.73	21.93	335.09	392.41	808.72	67.89	729.32	887.09
5 - 10	338	405	3.88	0.60	3.10	4.44	309.67	21.83	286.41	335.09	658.14	59.42	598.02	729.32
10 - 15	284	338	5.04	0.49	4.44	5.52	264.42	19.33	244.83	286.41	537.89	51.09	488.83	598.02
15 - 20	238	284	5.96	0.45	5.52	6.41	226.35	17.61	209.05	244.83	440.61	45.00	398.02	488.83
20 - 25	199	238	6.77	0.42	6.41	7.16	193.25	15.91	178.04	209.05	359.08	39.60	322.44	398.02
25 - 30	165	199	7.49	0.42	7.16	7.83	164.20	14.57	150.96	178.04	290.52	34.82	259.48	322.44
30 - 35	136	165	8.15	0.41	7.83	8.45	138.73	13.23	127.17	150.96	233.04	30.35	206.99	259.48
35 - 40	111	136	8.76	0.42	8.45	9.04	116.32	12.04	106.16	127.17	184.72	26.36	163.26	206.99
40 - 45	89	111	9.34	0.43	9.04	9.60	96.38	10.98	87.60	106.16	144.16	22.83	126.91	163.26
45 - 50	71	89	9.88	0.44	9.60	10.14	79.06	9.76	71.23	87.60	110.99	19.27	96.84	126.91
50 - 55	55	71	10.41	0.46	10.14	10.67	63.83	8.83	56.89	71.23	83.66	16.38	72.23	96.84
55 - 60	42	55	10.91	0.48	10.67	11.18	50.50	7.84	44.48	56.89	61.42	13.42	52.38	72.23
60 - 65	31	42	11.40	0.50	11.18	11.67	39.11	6.93	33.92	44.48	43.99	10.85	36.77	52.38
65 - 70	22	31	11.89	0.54	11.67	12.14	29.35	6.02	25.14	33.92	30.36	8.54	24.89	36.77
70 - 75	15	22	12.38	0.58	12.14	12.60	21.29	5.12	18.05	25.14	20.18	6.47	16.26	24.89
75 - 80	10	15	12.85	0.64	12.60	13.07	15.05	4.24	12.50	18.05	13.10	4.78	10.32	16.26
80 - 85	6	10	13.32	0.72	13.07	13.57	10.30	3.47	8.28	12.50	8.28	3.50	6.43	10.32
85 - 90	3	6	13.85	0.84	13.57	14.15	6.56	2.66	5.07	8.28	4.88	2.41	3.73	6.43
90 - 95	1	3	14.46	0.95	14.15	14.85	3.72	1.65	2.44	5.07	2.52	1.40	1.16	3.73



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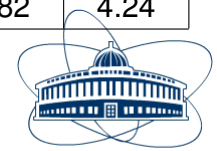
Bi+Bi 9 GeV $|\eta| < 1.3$

Best fit:

$f = 0.94 \pm 0.028$, $\mu = 1.27996 \pm 0.69941$, $k = 6 \pm 9.542$,

$\chi^2 = 1.64412 \pm 0.0748458$

Centrality, %	N_{ch}^{min}	N_{ch}^{max}	$\langle b \rangle$, fm	RMS	b_{min}, fm	b_{max}, fm	$\langle N_{part} \rangle$	RMS	N_{part}^{min}	N_{part}^{max}	$\langle N_{coll} \rangle$	RMS	N_{coll}^{min}	N_{coll}^{max}
0 - 5	464	642	2.24	0.87	1.40	3.13	363.60	22.04	335.65	393.56	830.05	75.14	748.92	911.53
5 - 10	392	464	3.91	0.62	3.13	4.49	309.94	21.80	286.45	335.65	676.01	70.06	613.20	748.92
10 - 15	333	392	5.08	0.51	4.49	5.57	264.37	19.24	244.41	286.45	551.36	60.94	500.09	613.20
15 - 20	282	333	6.02	0.47	5.57	6.46	225.66	17.36	208.26	244.41	449.71	53.71	405.93	500.09
20 - 25	238	282	6.84	0.44	6.46	7.23	192.05	15.76	176.95	208.26	364.76	47.30	327.60	405.93
25 - 30	200	238	7.56	0.43	7.23	7.90	162.89	14.25	149.64	176.95	294.16	41.27	262.47	327.60
30 - 35	167	200	8.22	0.43	7.90	8.52	137.44	12.95	125.69	149.64	235.33	35.93	208.36	262.47
35 - 40	138	167	8.83	0.43	8.52	9.11	115.02	11.76	104.61	125.69	186.07	30.96	163.51	208.36
40 - 45	112	138	9.42	0.44	9.11	9.68	94.99	10.72	86.05	104.61	144.53	26.53	126.46	163.51
45 - 50	90	112	9.97	0.45	9.68	10.22	77.44	9.55	69.76	86.05	110.25	22.01	96.05	126.46
50 - 55	71	90	10.49	0.46	10.22	10.75	62.30	8.54	55.57	69.76	82.62	18.23	71.36	96.05
55 - 60	55	71	10.99	0.48	10.75	11.26	49.26	7.53	43.37	55.57	60.61	14.71	51.63	71.36
60 - 65	41	55	11.48	0.51	11.26	11.74	38.01	6.62	33.07	43.37	43.19	11.60	36.24	51.63
65 - 70	30	41	11.96	0.53	11.74	12.20	28.61	5.64	24.59	33.07	29.90	8.82	24.63	36.24
70 - 75	21	30	12.42	0.57	12.20	12.64	21.06	4.78	17.82	24.59	20.19	6.57	16.26	24.63
75 - 80	14	21	12.87	0.62	12.64	13.07	15.00	3.94	12.59	17.82	13.22	4.76	10.54	16.26
80 - 85	9	14	13.32	0.69	13.07	13.53	10.47	3.15	8.66	12.59	8.52	3.34	6.80	10.54
85 - 90	5	9	13.77	0.79	13.53	14.04	7.07	2.49	5.68	8.66	5.36	2.36	4.24	6.80
90 - 95	2	5	14.31	0.92	14.04	14.65	4.41	1.80	3.18	5.68	3.10	1.55	1.82	4.24



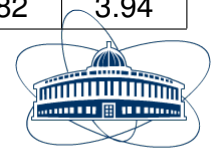
Bi+Bi 9.46 GeV $|\eta| < 1.3$

Best fit:

$f = 0.87 \pm 0.017$, $\mu = 1.22033 \pm 0.637602$, $k = 10 \pm 42.751$,

$\chi^2 = 1.63187 \pm 0.0655408$

Centrality, %	N_{ch}^{min}	N_{ch}^{max}	$\langle b \rangle$, fm	RMS	b_{min}, fm	b_{max}, fm	$\langle N_{part} \rangle$	RMS	N_{part}^{min}	N_{part}^{max}	$\langle N_{coll} \rangle$	RMS	N_{coll}^{min}	N_{coll}^{max}
0 - 5	472	654	2.22	0.85	1.40	3.12	364.01	21.74	336.04	393.82	835.18	72.76	752.73	916.69
5 - 10	397	472	3.91	0.59	3.12	4.48	310.32	21.18	286.82	336.04	678.94	65.19	615.91	752.73
10 - 15	335	397	5.08	0.49	4.48	5.57	264.61	18.81	244.69	286.82	553.38	56.66	501.92	615.91
15 - 20	282	335	6.02	0.45	5.57	6.46	225.78	16.97	208.42	244.69	450.98	49.75	407.08	501.92
20 - 25	237	282	6.83	0.42	6.46	7.23	192.19	15.34	176.99	208.42	365.81	43.73	328.25	407.08
25 - 30	198	237	7.56	0.41	7.23	7.91	163.09	13.93	149.61	176.99	295.09	38.23	262.77	328.25
30 - 35	164	198	8.22	0.41	7.91	8.53	137.46	12.69	125.62	149.61	235.64	33.39	208.45	262.77
35 - 40	134	164	8.85	0.42	8.53	9.12	114.64	11.49	104.53	125.62	185.41	28.73	163.46	208.45
40 - 45	109	134	9.42	0.42	9.12	9.68	94.80	10.30	85.99	104.53	144.16	24.37	126.34	163.46
45 - 50	87	109	9.97	0.44	9.68	10.23	77.63	9.31	69.71	85.99	110.56	20.63	95.90	126.34
50 - 55	68	87	10.49	0.46	10.23	10.76	62.35	8.35	55.52	69.71	82.71	17.17	71.18	95.90
55 - 60	52	68	11.00	0.48	10.76	11.26	49.08	7.40	43.30	55.52	60.24	13.93	51.43	71.18
60 - 65	39	52	11.49	0.50	11.26	11.75	37.94	6.44	32.95	43.30	42.99	10.95	35.99	51.43
65 - 70	28	39	11.97	0.53	11.75	12.22	28.54	5.60	24.38	32.95	29.72	8.53	24.32	35.99
70 - 75	19	28	12.45	0.57	12.22	12.67	20.60	4.73	17.50	24.38	19.60	6.34	15.88	24.32
75 - 80	13	19	12.91	0.62	12.67	13.12	14.64	3.81	12.17	17.50	12.81	4.53	10.12	15.88
80 - 85	8	13	13.35	0.70	13.12	13.58	10.19	3.13	8.21	12.17	8.25	3.28	6.39	10.12
85 - 90	4	8	13.87	0.81	13.58	14.10	6.56	2.41	5.34	8.21	4.91	2.25	3.94	6.39
90 - 95	2	4	14.35	0.92	14.10	14.71	4.21	1.67	3.17	5.34	2.93	1.43	1.82	3.94



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