

Implementacja modelu produkcji przypadków jet-gap-jet do generatora Pythia8

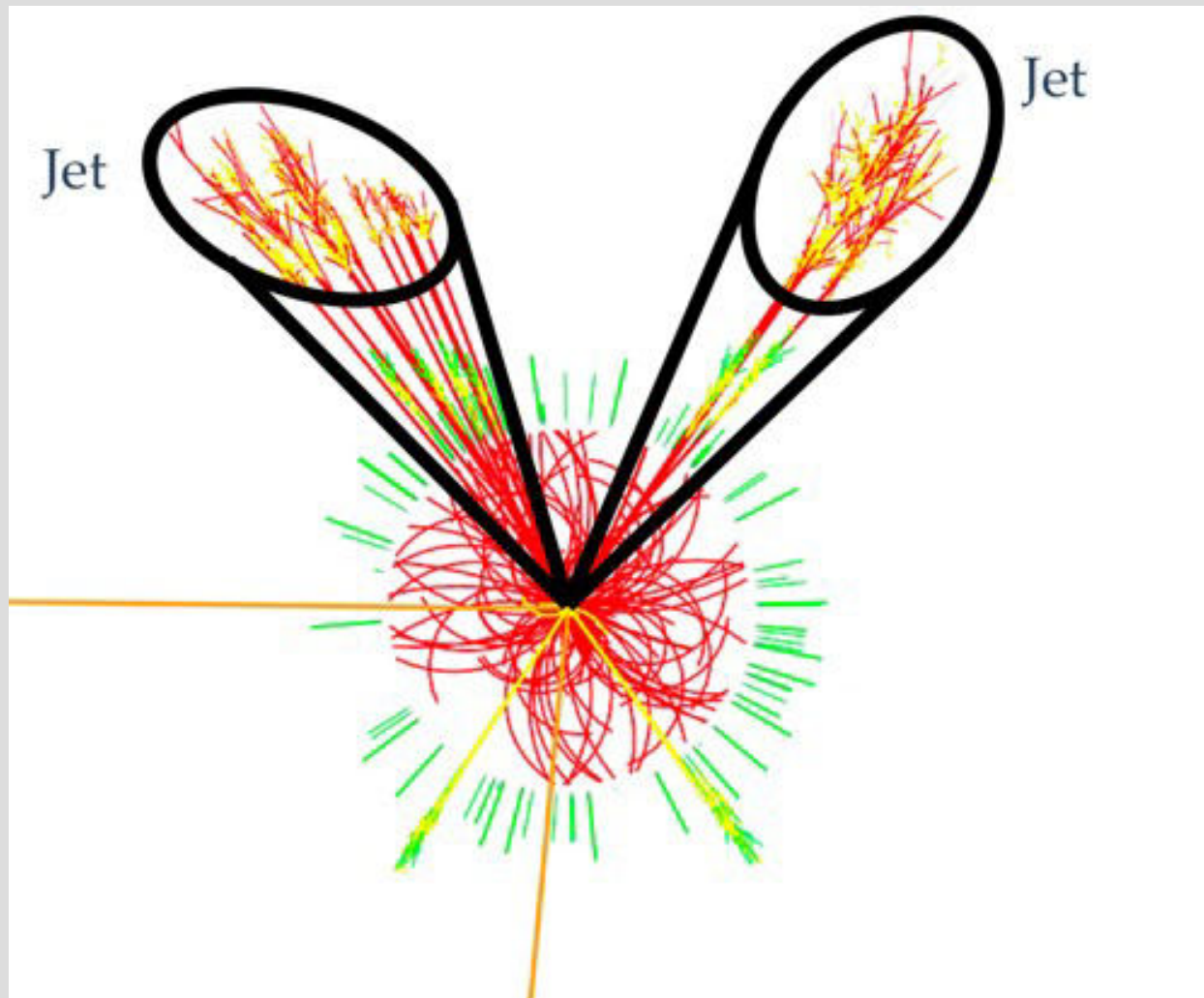
Kraków, 09.09.2016

Izabela Babiarcz
Józef Borsuk

Plan prezentacji

- 1) Cel projektu
- 2) Jety
- 3) Przepływ koloru
- 4) Jet-gap-jet
- 5) Implementacja
- 6) Wyniki i podsumowanie

Jety



Generator Pythia8

----- End PYTHIA Info Listing -----

----- PYTHIA Event Listing (hard process) -----

no	id	name	status	mothers	daughters	colours	p_x	p_y	p_z	e	m
0	90	(system)	-11	0	0	0	0.000	0.000	0.000	8000.000	8000.000
1	2212	(p+)	-12	0	0	3	0.000	0.000	4000.000	4000.000	0.938
2	2212	(p+)	-12	0	0	4	0.000	0.000	-4000.000	4000.000	0.938
3	21	(g)	-21	1	0	5	0.000	0.000	79.637	79.637	0.000
4	21	(g)	-21	2	0	5	0.000	0.000	-5.256	5.256	0.000
5	21	g	23	3	4	0	-10.626	17.235	31.106	37.115	0.000
6	21	g	23	3	4	0	10.626	-17.235	43.275	47.777	0.000
			Charge sum:	0.000	Momentum sum:		0.000	0.000	74.381	84.892	40.917

----- End PYTHIA Event Listing -----

----- PYTHIA Event Listing (complete event) -----

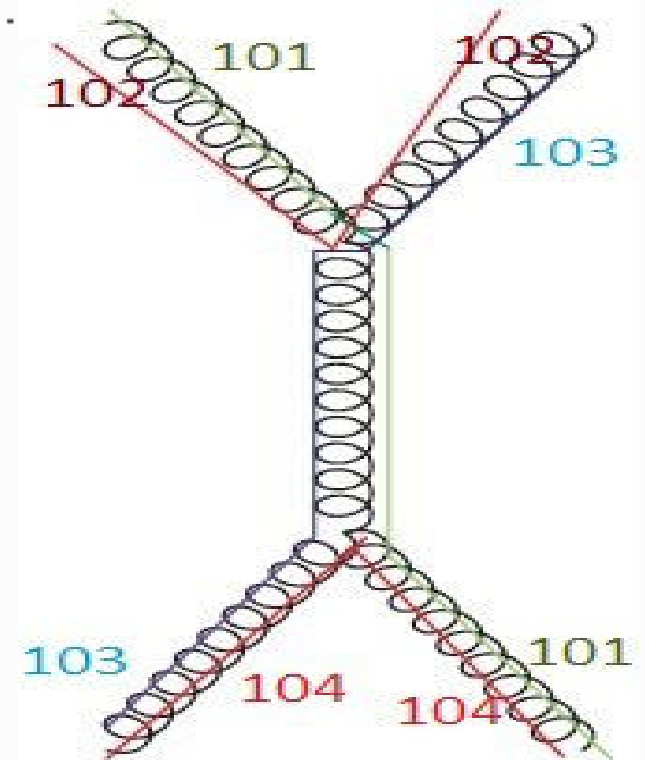
no	id	name	status	mothers	daughters	colours	p_x	p_y	p_z	e	m
0	90	(system)	-11	0	0	0	0.000	0.000	0.000	8000.000	8000.000
1	2212	(p+)	-12	0	0	171	0.000	0.000	4000.000	4000.000	0.938
2	2212	(p+)	-12	0	0	172	0.000	0.000	-4000.000	4000.000	0.938
3	21	(g)	-21	7	7	5	0.000	0.000	79.637	79.637	0.000
4	21	(g)	-21	8	0	5	0.000	0.000	-5.256	5.256	0.000
5	21	(g)	-23	3	4	9	-10.626	17.235	31.106	37.115	0.000
6	21	(g)	-23	3	4	10	10.626	-17.235	43.275	47.777	0.000
7	21	(g)	-42	12	0	3	-0.000	-0.000	79.637	79.637	0.000
8	21	(g)	-41	13	13	11	0.000	0.000	-10.654	10.654	0.000
9	21	(g)	-44	5	5	14	-6.796	22.404	35.059	42.157	0.000
10	21	(g)	-44	6	6	15	13.496	-13.361	31.246	36.565	0.000
11	21	(g)	-43	8	0	16	-6.700	-9.042	2.678	11.568	0.000
12	21	(g)	-41	30	30	17	0.000	-0.000	371.557	371.557	0.000
13	21	(g)	-42	77	77	8	0.000	0.000	-10.654	10.654	0.000
14	21	(g)	-44	9	9	20	-5.407	24.892	34.962	43.257	0.000
15	21	(g)	-44	10	10	21	14.716	-11.177	31.861	36.832	0.000
16	21	(g)	-44	11	11	23	-6.443	-8.583	3.225	11.207	0.000
17	21	(g)	-43	12	0	18	-2.866	-5.131	290.855	290.915	0.000
18	21	(g)	-51	17	0	60	-4.579	-1.375	272.957	272.998	0.000
19	21	(g)	-51	17	0	38	1.537	-2.945	19.038	19.325	0.000
20	21	(g)	-52	14	14	28	-5.231	24.081	33.824	41.849	0.000
21	21	(g)	-51	15	0	41	14.599	-10.021	26.887	32.194	0.000
22	21	(g)	-51	15	0	39	-0.433	-1.890	5.249	5.596	0.000

240	21	(g)	-71	187	187	248	301	127	105	-2.058	-2.790	1.708	3.865	0.000
241	21	(g)	-71	175	175	248	301	120	127	-3.144	-2.742	0.865	4.261	0.000
242	21	(g)	-71	182	182	248	301	104	120	-0.768	-2.386	0.658	2.592	0.000
243	21	(g)	-71	217	217	248	301	134	104	0.207	-2.992	6.046	6.767	0.489
244	21	(g)	-71	181	181	248	301	108	134	2.045	-0.524	3.714	4.272	0.000
245	21	(g)	-71	174	174	248	301	131	108	10.756	-7.862	20.635	24.562	0.000
246	21	(g)	-71	191	191	248	301	103	131	1.082	-0.184	0.997	1.483	0.000
247	-2	(ubar)	-71	193	193	248	301	0	103	1.758	1.129	-69.281	69.313	0.330
248	2212	p+	83	222	247	0	0	0	0	-0.678	-0.955	185.429	185.435	0.938
249	221	(eta)	-83	222	247	378	380	0	0	0.485	-0.085	38.750	38.757	0.548
250	-2112	nbar0	83	222	247	0	0	0	0	-0.244	-0.508	31.511	31.530	0.940
251	-211	pi-	83	222	247	0	0	0	0	-0.333	0.358	2.173	2.231	0.140
252	321	K+	83	222	247	0	0	0	0	0.451	0.498	3.022	3.135	0.494
253	-311	(Kbar0)	-83	222	247	332	332	0	0	-0.742	0.182	9.791	9.833	0.498
254	221	(eta)	-83	222	247	381	383	0	0	0.155	0.875	1.932	2.196	0.548
255	3112	(Sigma-)	-83	222	247	384	385	0	0	-0.331	1.532	4.247	4.683	1.197
256	211	pi+	83	222	247	0	0	0	0	0.288	0.385	0.684	0.847	0.140
257	-3322	(Xibar0)	-83	222	247	386	387	0	0	-0.942	2.464	5.208	5.984	1.315
258	-323	(K*-)	-83	222	247	333	334	0	0	-0.491	3.932	5.805	7.089	0.921
259	113	(rho0)	-83	222	247	335	336	0	0	-1.820	4.187	7.574	8.882	0.818
260	211	pi+	83	222	247	0	0	0	0	0.125	1.672	2.099	2.689	0.140
261	223	(omega)	-83	222	247	388	390	0	0	-1.813	6.876	8.878	11.402	0.784
262	-211	pi-	83	222	247	0	0	0	0	0.023	0.006	1.920	1.926	0.140
263	111	(pi0)	-83	222	247	391	392	0	0	0.107	0.159	-0.086	0.250	0.135
264	221	(eta)	-83	222	247	393	395	0	0	-0.110	-0.230	0.730	0.948	0.548
265	211	pi+	83	222	247	0	0	0	0	0.500	-0.353	9.269	9.290	0.140
266	113	(rho0)	-83	222	247	337	338	0	0	0.167	0.622	8.118	8.202	0.981
267	-213	(rho-)	-83	222	247	339	340	0	0	0.150	-1.487	21.200	21.266	0.762
268	321	K+	83	222	247	0	0	0	0	-0.400	0.102	6.299	6.332	0.494
269	-311	(Kbar0)	-83	222	247	341	341	0	0	-0.129	-0.448	7.301	7.332	0.498
270	221	(eta)	-84	222	247	396	398	0	0	-1.096	-0.200	123.965	123.971	0.548
271	-211	pi-	84	222	247	0	0	0	0	-0.205	-0.105	38.334	38.335	0.140
272	211	pi+	84	222	247	0	0	0	0	-0.418	-0.175	19.702	19.708	0.140
273	-213	(rho-)	-84	222	247	342	343	0	0	-1.543	0.267	159.958	159.968	0.813
274	113	(rho0)	-84	222	247	344	345	0	0	-0.503	-0.116	54.712	54.723	0.982
275	221	(eta)	-84	222	247	399	400	0	0	-0.149	0.088	26.735	26.742	0.548
276	211	pi+	84	222	247	0	0	0	0	0.203	-0.192	29.680	29.682	0.140
277	-211	pi-	84	222	247	0	0	0	0	-0.063	0.144	6.523	6.526	0.140
278	213	(rho+)	-84	222	247	346	347	0	0	0.082	0.182	2.239	2.344	0.667
279	223	(omega)	-84	222	247	401	403	0	0	0.095	-0.832	22.912	22.941	0.786
280	-213	(rho-)	-84	222	247	348	349	0	0	-0.344	0.205	3.388	3.478	0.677
281	213	(rho+)	-84	222	247	350	351	0	0	0.684	-0.007	2.782	3.011	0.929
282	211	pi+	84	222	247	0	0	0	0	0.201	0.485	1.824	1.816	0.140

Przeptyw koloru

----- PYTHIA Event Listing (hard process) -----

no	id	name	status	mothers	daughters	colours	p_x
0	90	(system)	-11	0	0	0 0	0.000
1	2212	(p+)	-12	0	3	0 0	0.000
2	2212	(p+)	-12	0	4	0 0	0.000
3	21	(g)	-21	1	5	102 101	0.000
4	21	(g)	-21	2	5	104 103	0.000
5	21	g	23	3	4	104 101	-1.832
6	21	g	23	3	4	102 103	1.832
			Charge sum:	0.000		Momentum sum:	0.000



----- End PYTHIA Event Listing -----

Jet-gap-jet

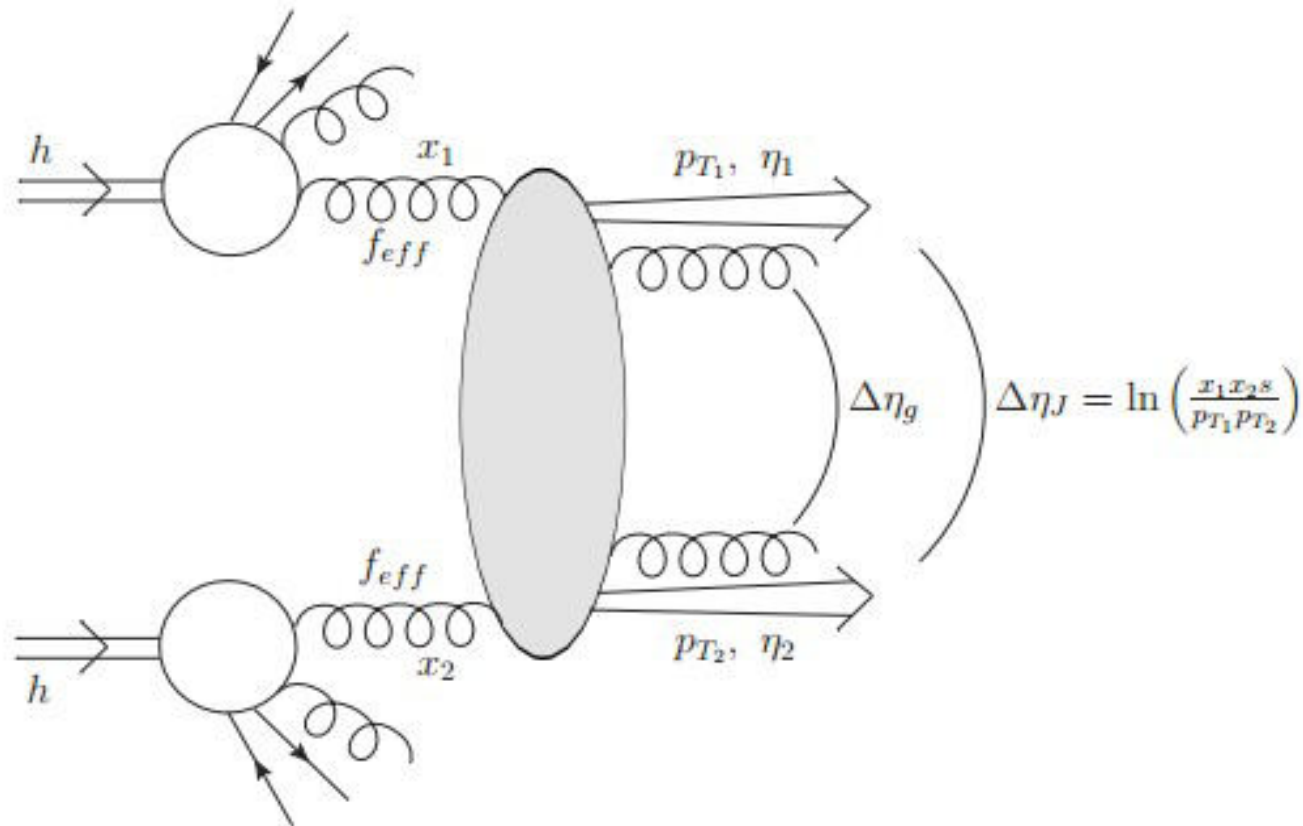


FIG. 1: Production of two jets surrounding a large rapidity gap in a hadron-hadron collision. \sqrt{s} denotes the collision energy, p_{T1} (η_1) and p_{T2} (η_2) the transverse momenta (rapidities) of the jets and x_1 and x_2 are their longitudinal momentum fraction with respect to the incident hadrons. The rapidity interval between the jets $\Delta\eta_J$ is bigger than the rapidity gap $\Delta\eta_g$.

Brak przepływu koloru

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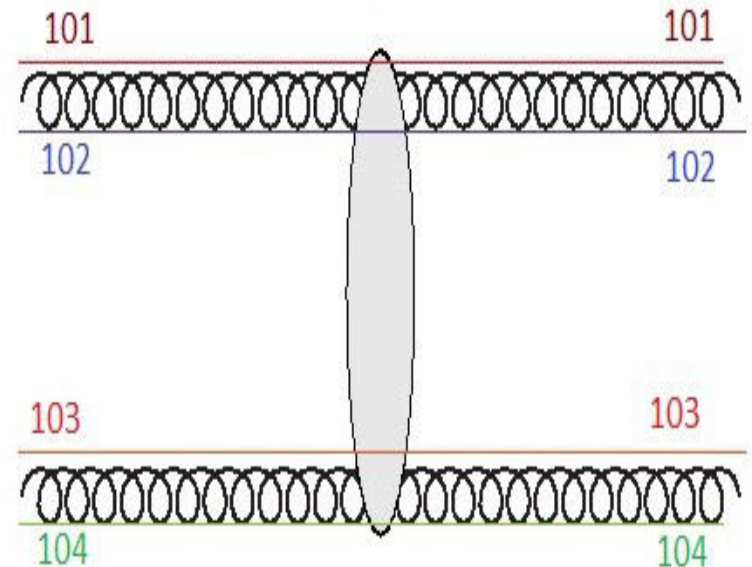
----- PYTHIA Event Listing (hard process) -----

no      id  name      status  mothers  daughters  colours
0       90  (system)  -11     0         0           0  0
1      2212  (p+)     -12     0         3           0  0
2      2212  (p+)     -12     0         4           0  0
3       21  (g)      -21     1         5           6  101 102
4       21  (g)      -21     2         5           6  103 104
5       21  g        23     3         4           0  0  101 102
6       21  g        23     3         4           0  0  103 104

Charge sum: 0.000      Momentum sum:

----- End PYTHIA Event Listing -----

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Różniczkowy przekrój czynny

$$\frac{d\sigma^{gg \rightarrow gg}}{dp_T^2} = \frac{1}{16\pi} |A(\Delta\eta, p_T^2)|^2$$

[1]

Amplituda

$$A(\Delta\eta, p_T^2) = \frac{16N_c\pi\alpha_S^2(p_T^2)}{C_F p_T^2} \sum_{p=-\infty}^{\infty} \int \frac{d\gamma}{2i\pi} \frac{[p^2 - (\gamma - 1/2)^2] \exp\{\bar{\alpha}(p_T^2)\chi_{eff}[2p, \gamma, \bar{\alpha}(p_T^2)]\Delta\eta\}}{[(\gamma - 1/2)^2 - (p - 1/2)^2][(\gamma - 1/2)^2 - (p + 1/2)^2]}$$

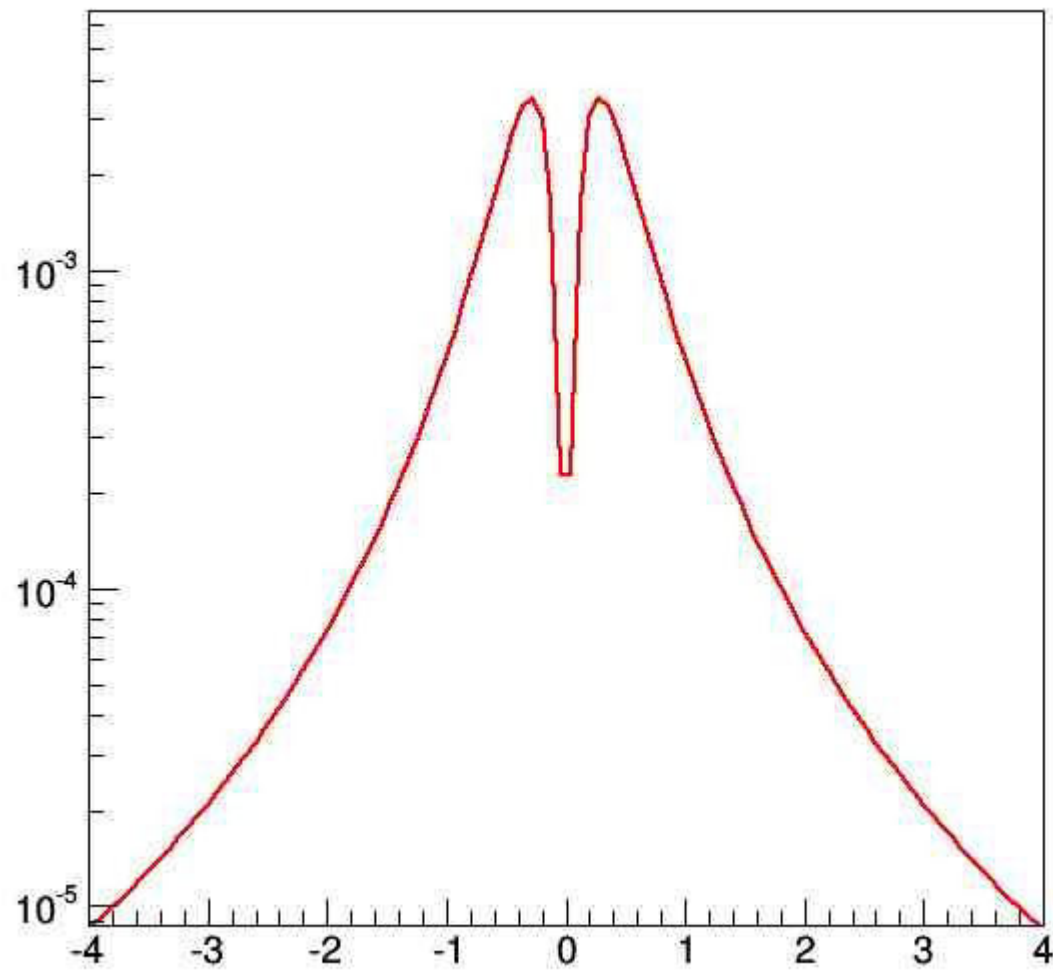
Przedział od $1/2 - i\infty$ do $1/2 + i\infty$

[1]

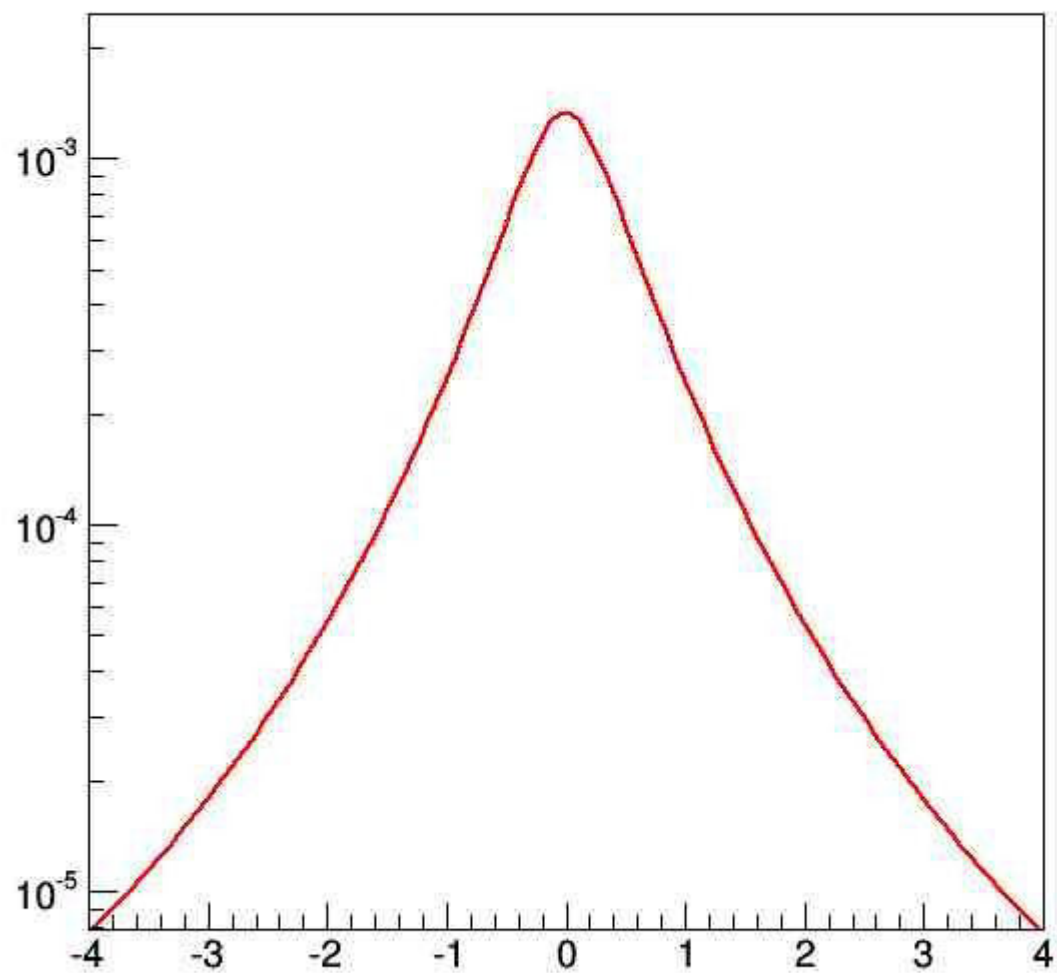
Pseudorapidity

$$\eta = -\ln\left(\tan\frac{\Theta}{2}\right)$$

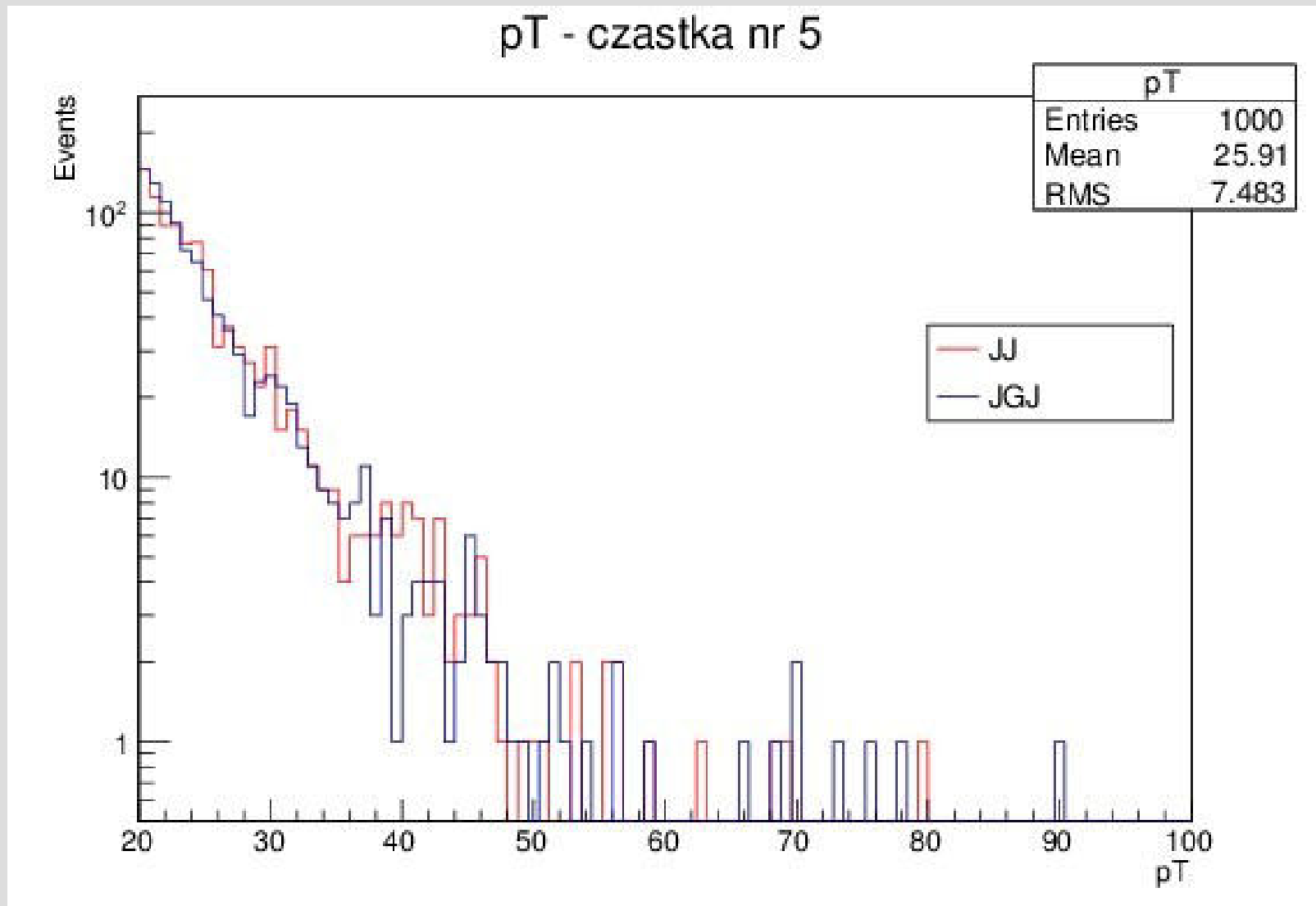
Funkcja podcałkowa dla $p=0$



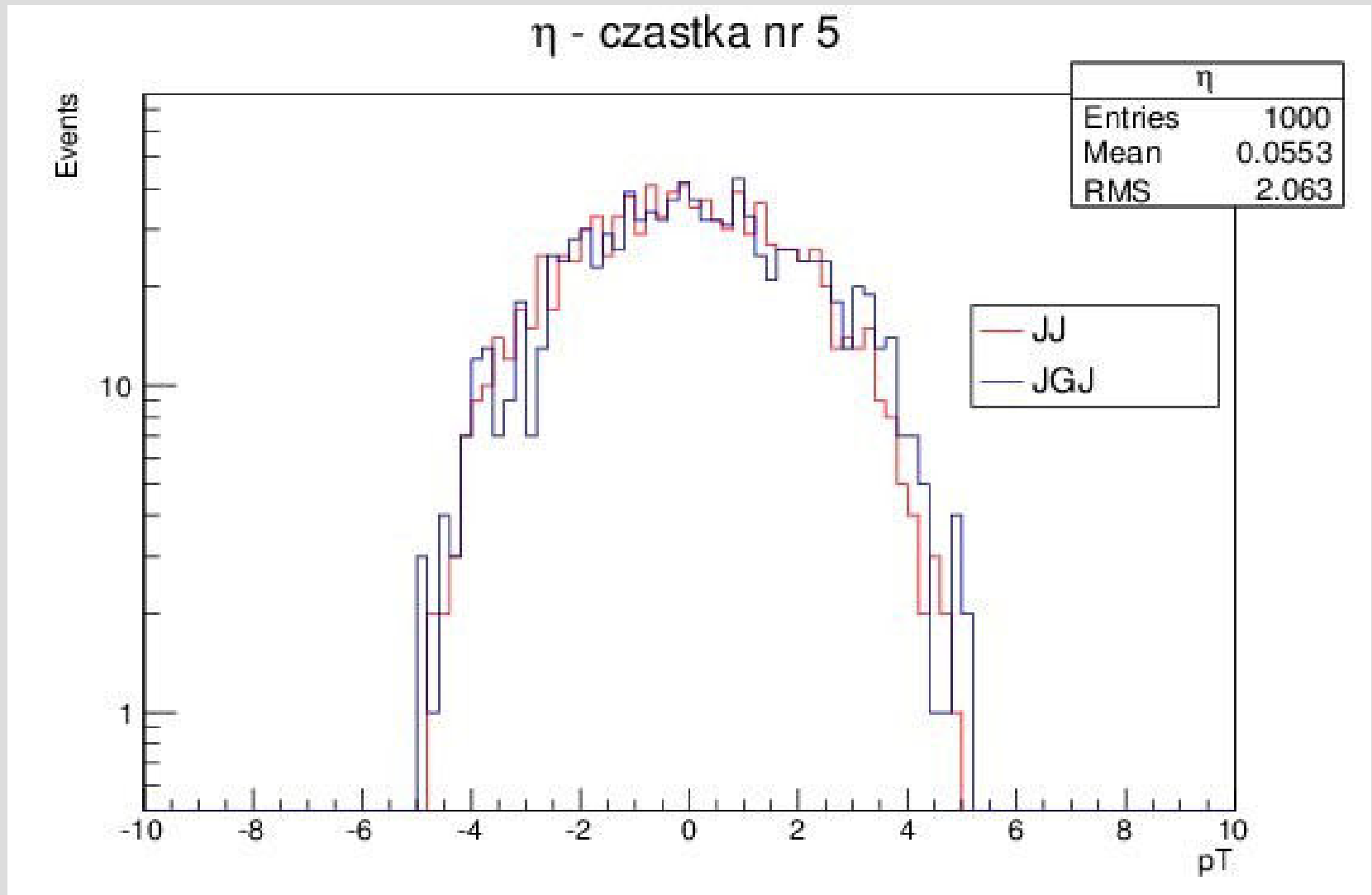
Funkcja podcałkowa dla $p=1$



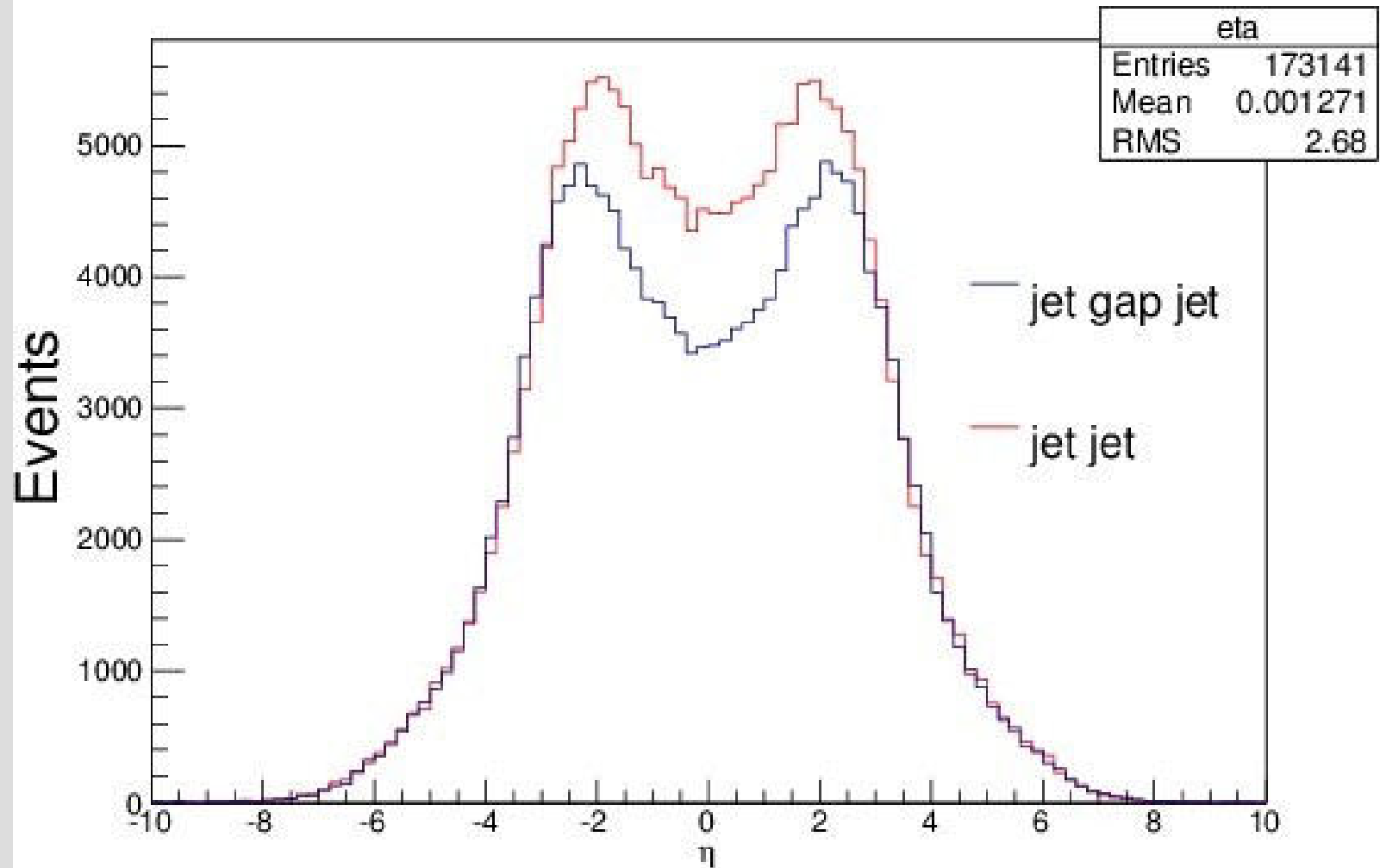
PT dla gluonu



Pseudorapidity dla gluonu



Pseudorapidity dla cząstek w stanie końcowym



Podsumowanie

- ♦ Został zaimplementowany proces Jet-gap-jet do generatora Pythia o amplitudzie przedstawionej w publikacjach [1,2].
- ♦ Sprawdzono czy brak przepływu kolorów wpływa na zmienną kinematyczną pseudorapidity w procesie Jet-Gap-Jet oraz Jet Jet dla cząstek w stanie końcowym.
- ♦ Zaobserwowano małą różnicę pomiędzy rozkładami zmiennej p_T i pseudorapidity dla twardego procesu, mogło być to spowodowane zbyt małą statystką wygenerowanych przypadków.

Bibliografia

- [1], „Gaps between jets at hadron colliders in the next-to-leading BFKL framework.”
F. Chevallier, O. Kepka, C. Marquet, C. Royon
(Phys.Rev.D79:094019,2009)
- [2], „Gaps between jets in hadronic collisions.”
O. Kepka, C. Marquet, C. Royon
(Phys.Rev.D83:034036,2011)

Dziękujemy za uwagę!