

Physics Meeting

23 / 03 / 2010

LAPP

Ambroise Espargilière

Outline

- Physics simulations
 - Remarks on difference Pythia 6 vs. 8
 - Measuring MZp
- Beam Test 2009 analysis status
 - 2 GeV electron showers
 - 2 GeV hadron showers
 - Calorimeter preliminary characterization

Some brief remarks (work have been delayed because of some calcHEP issues together with Sasha Puckov in India)

PHYSICS SIMULATIONS

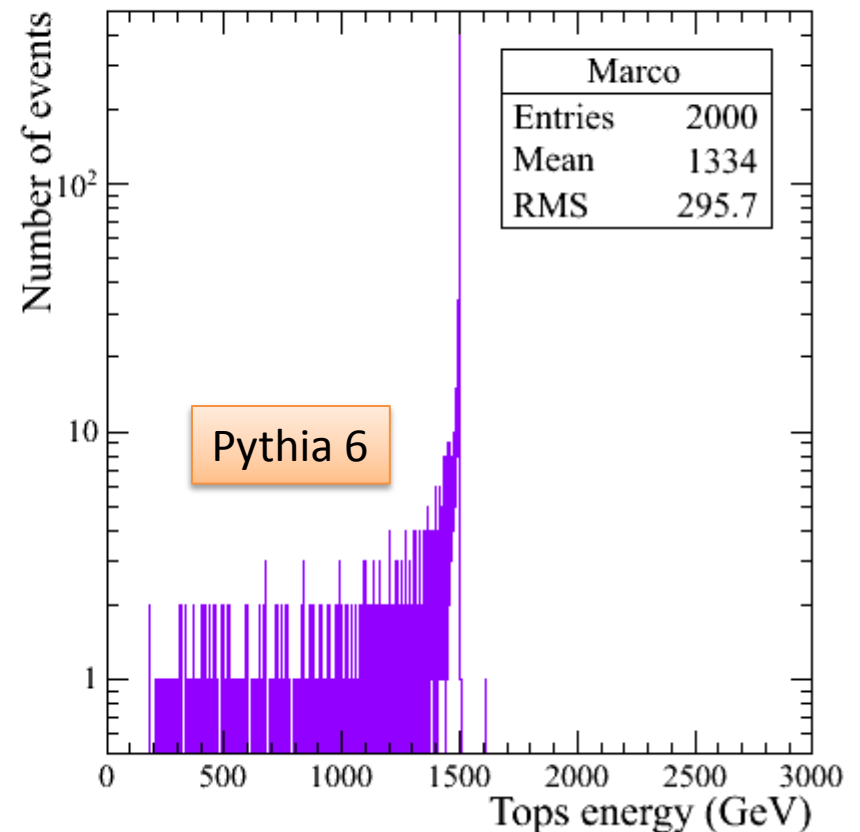
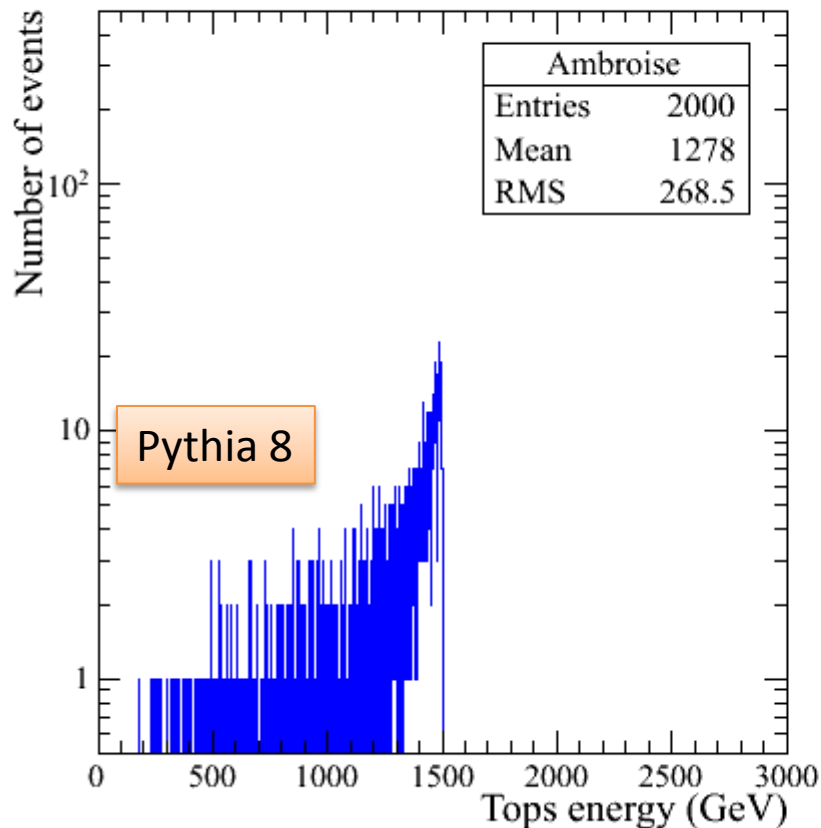
Stdhep output (pythia 6)

number	ID	status	3xCharge	m1	m2	d1	d2	px	py	pz	e	mass	x	y	z
1	11	3	-3	0	0	0	0	0.000	0.000	1500.000	1500.000	0.001	0.000	0.000	0.000
2	-11	3	3	0	0	0	0	0.000	0.000	-1500.000	1500.000	0.001	0.000	0.000	0.000
3	11	3	-3	1	0	0	0	0.000	0.000	1500.000	1500.000	-0.000	0.000	0.000	0.000
4	-11	3	3	2	0	0	0	0.000	0.000	-1500.000	1500.000	-0.000	0.000	0.000	0.000
5	11	3	-3	3	0	0	0	0.812	-0.700	1496.753	1496.753	0.000	0.000	0.000	0.000
6	-11	3	3	4	0	0	0	0.000	-0.000	-1499.911	1499.911	0.000	0.000	0.000	0.000
7	23	3	0	5	6	0	0	0.812	-0.700	-3.158	2996.665	2996.663	0.000	0.000	0.000
8	6	3	2	7	0	0	0	-920.153	980.364	-637.751	1498.707	177.771	0.000	0.000	0.000
9	-6	3	-2	7	0	0	0	920.965	-981.064	634.593	1497.957	174.655	0.000	0.000	0.000
10	24	3	3	8	0	0	0	-281.985	348.760	-183.415	490.907	78.739	0.000	0.000	0.000
11	5	3	-1	8	0	0	0	-444.699	481.422	-430.597	784.194	4.800	0.000	0.000	0.000
12	-24	3	-3	9	0	0	0	435.854	-466.864	383.210	748.581	74.789	0.000	0.000	0.000
13	-5	3	1	9	0	0	0	469.340	-494.249	249.343	725.781	4.800	0.000	0.000	0.000
14	-1	3	1	10	0	0	0	-245.236	251.040	-141.263	378.308	0.330	0.000	0.000	0.000
15	4	3	2	10	0	0	0	-36.721	97.671	-42.163	112.553	1.500	0.000	0.000	0.000
16	1	3	-1	12	0	0	0	86.781	-74.794	39.654	121.234	0.330	0.000	0.000	0.000
17	-2	3	-2	12	0	0	0	347.503	-390.362	341.660	624.398	0.330	0.000	0.000	0.000
18	23	2	0	7	0	24	39	0.812	-0.700	-3.158	2996.665	2996.663	0.000	0.000	0.000
19	22	1	0	3	0	0	0	-0.812	0.700	3.158	3.335	0.000	0.000	0.000	0.000
20	24	2	3	10	0	45	53	-281.957	348.711	-183.426	490.861	78.739	0.000	0.000	0.000
21	-24	2	-3	12	0	54	62	434.285	-465.156	381.314	745.632	74.789	0.000	0.000	0.000
22	22	1	0	1	0	0	0	-0.000	-0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	22	1	0	2	0	0	0	-0.000	-0.000	-0.000	0.000	0.000	0.000	0.000	0.000
24	-4	2	-2	9	0	63	63	0.180	-0.606	-2.142	2.690	1.500	0.000	0.000	0.000
25	21	2	0	8	0	63	63	-0.712	0.670	-0.278	1.016	0.000	0.000	0.000	0.000
26	21	2	0	8	0	63	63	-120.700	89.214	-4.033	150.146	0.000	0.000	0.000	0.000
27	21	2	0	8	0	63	63	-25.739	19.310	-0.081	32.178	0.000	0.000	0.000	0.000
28	21	2	0	8	0	63	63	-22.334	14.669	-0.565	26.727	0.000	0.000	0.000	0.000
29	21	2	0	8	0	63	63	-2.017	1.515	-1.002	2.714	0.000	0.000	0.000	0.000
30	21	2	0	8	0	63	63	-8.199	8.082	-7.247	13.604	0.000	0.000	0.000	0.000
31	21	2	0	8	0	63	63	-1.168	3.297	-1.834	3.949	0.000	0.000	0.000	0.000
32	21	2	0	11	0	63	63	-18.968	19.775	-17.570	32.551	0.000	0.000	0.000	0.000
33	5	2	-1	11	0	63	63	-425.759	461.696	-413.015	751.690	4.800	0.000	0.000	0.000
34	4	2	2	9	0	86	86	0.222	-1.098	-6.669	6.926	1.500	0.000	0.000	0.000
35	21	2	0	9	0	86	86	-0.272	-0.297	-0.263	0.481	0.000	0.000	0.000	0.000
36	21	2	0	9	0	86	86	-0.071	0.012	0.073	0.102	0.000	0.000	0.000	0.000
37	21	2	0	9	0	86	86	2.069	-2.522	1.029	3.420	0.000	0.000	0.000	0.000
38	21	2	0	9	0	86	86	0.112	0.247	-0.230	0.356	0.000	0.000	0.000	0.000
39	21	2	0	9	0	86	86	0.929	-2.263	1.542	2.892	0.000	0.000	0.000	0.000

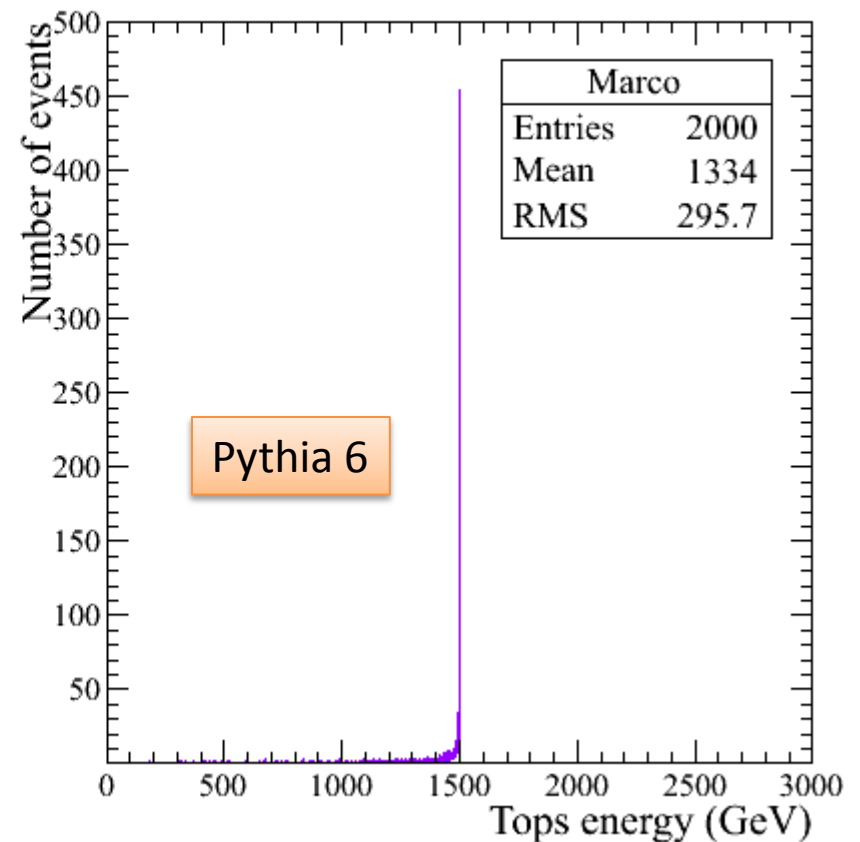
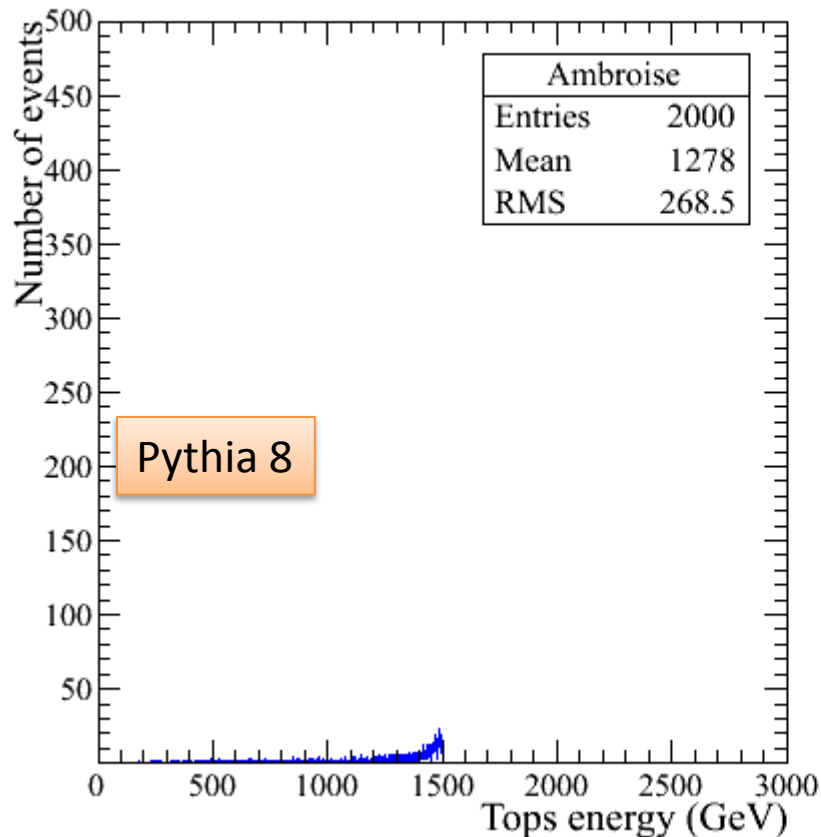
Pythia 8 output

no	id	name	status	mothers	daughters	colours	p_x	p_y	p_z	e	m
0	90	(system)	-11	0	0	0	0	0.000	0.000	0.000	3000.000
1	11	(e-)	-12	0	0	3	0	0.000	0.000	1500.000	1500.000
2	-11	(e+)	-12	0	0	4	0	0.000	0.000	-1500.000	1500.000
3	11	(e-)	-21	1	0	5	6	0.000	0.000	1500.000	1500.000
4	-11	(e+)	-21	2	0	5	6	0.000	0.000	-1500.000	1500.000
5	6	(t)	-22	3	4	9	9	500	0	804.334	579.696
6	-6	(tbar)	-22	3	4	7	8	0	500	-804.334	-579.696
7	-6	(tbar)	-51	6	0	12	12	0	503	-774.739	-618.013
8	21	(g)	-51	6	0	10	11	503	500	-15.498	48.477
9	6	(t)	-52	5	5	18	18	500	0	790.237	569.536
10	21	(g)	-51	8	0	15	15	504	500	18.835	19.751
11	21	(g)	-51	8	0	13	14	503	504	-68.903	0.047
12	-6	(tbar)	-52	7	7	33	33	0	503	-740.169	-589.334
13	21	(g)	-51	11	0	28	29	503	505	-55.874	0.977
14	21	(g)	-51	11	0	21	21	505	504	-12.628	-0.510
15	21	(g)	-52	10	10	16	17	504	500	18.434	19.330
16	21	(g)	-51	15	0	19	20	504	506	22.790	18.938
17	21	(g)	-51	15	0	22	23	506	500	-1.344	2.529
18	6	(t)	-52	9	9	25	26	500	0	787.226	567.399
19	21	(g)	-51	16	0	24	24	507	506	17.384	18.910
20	21	(g)	-51	16	0	40	41	504	507	4.753	0.001
21	21	(g)	-52	14	14	30	30	505	504	-11.976	-0.484
22	21	(g)	-51	17	0	27	27	508	500	0.075	0.155
23	21	(g)	-51	17	0	34	35	506	508	1.179	5.200
24	21	(g)	-52	19	19	36	36	507	506	14.787	16.085
25	6	(t)	-51	18	0	109	110	509	0	786.949	567.157
26	21	(g)	-51	18	0	286	286	500	509	0.277	0.243
27	21	(g)	-52	22	22	58	59	508	500	0.075	0.155
28	21	(g)	-51	13	0	31	32	503	510	-27.813	0.965
29	21	(g)	-51	13	0	48	48	510	505	-28.659	-0.012
30	21	(g)	-52	21	21	42	42	505	504	-11.378	-0.459
31	21	(g)	-51	28	0	54	54	511	510	-25.276	0.785
32	21	(g)	-51	28	0	52	53	503	511	-3.730	-0.943
33	-6	(tbar)	-52	12	12	96	96	0	503	-738.976	-588.211
34	21	(g)	-51	23	0	39	39	512	508	-0.220	2.006
35	21	(g)	-51	23	0	37	38	506	512	2.990	4.925
36	21	(g)	-52	24	24	43	44	507	506	13.195	14.353
37	21	(g)	-51	35	0	67	68	506	513	0.667	0.423
38	21	(g)	-51	35	0	93	93	513	512	2.186	5.757

Tops energy spectrum

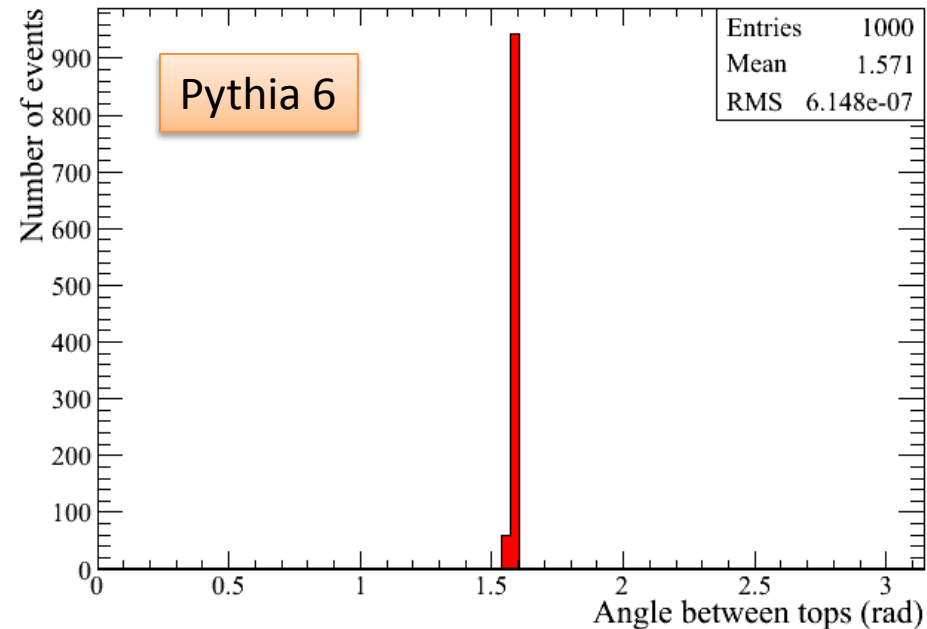
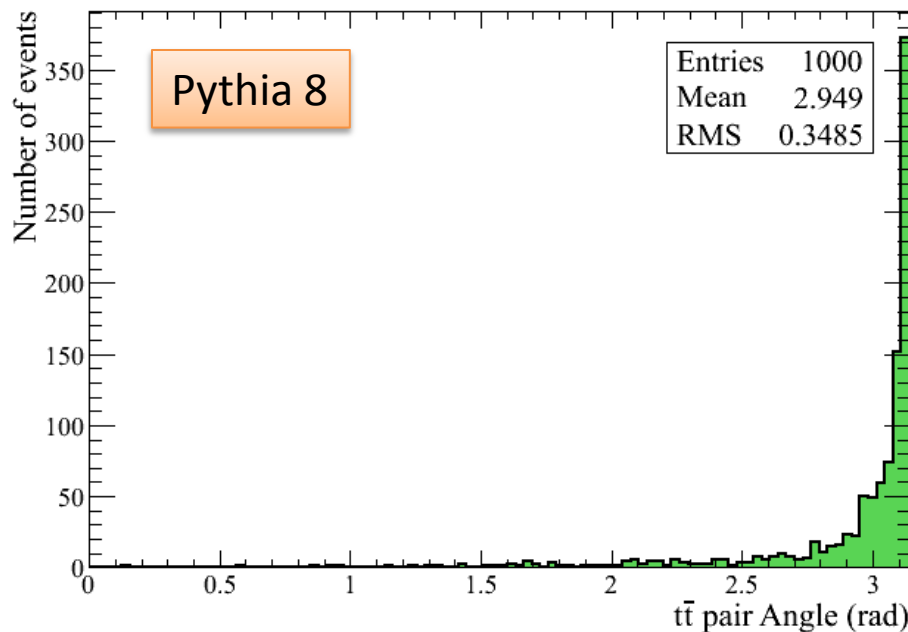


Tops energy spectrum



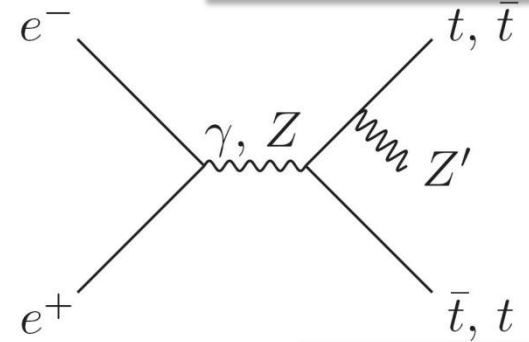
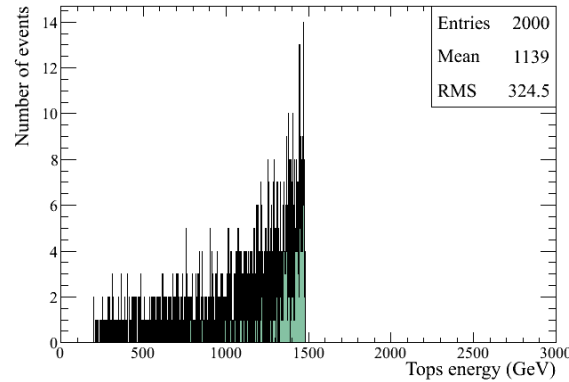
Angles

- $t\bar{t}$ pairs should be emitted at 180° not 90° !!
- Pythia 8 output seems more natural and gives the expected value



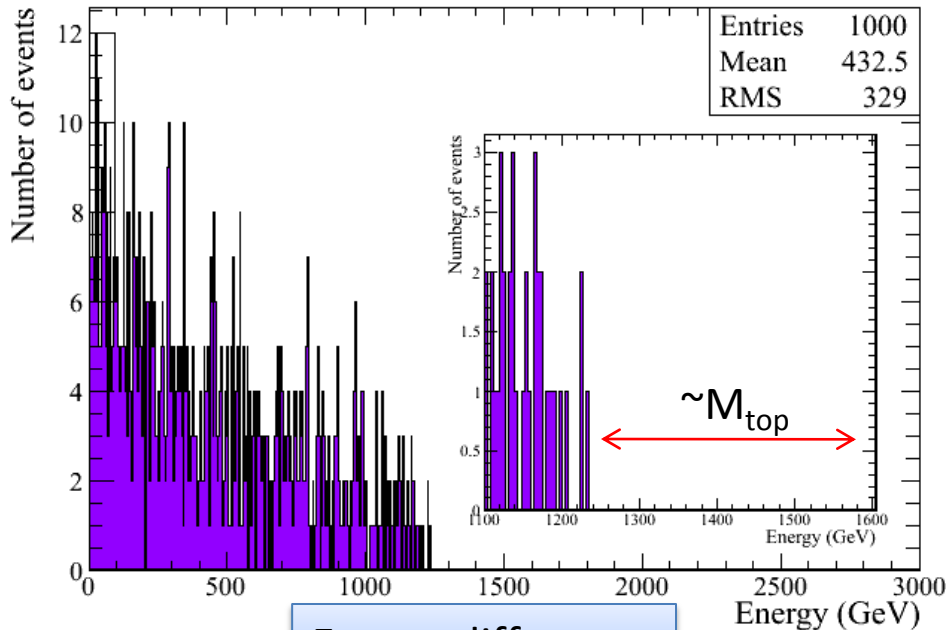
$$e^+e^- \rightarrow t\bar{t}Z'$$

Finding Z' mass:
 $\rightarrow$ Sum of jet Energies

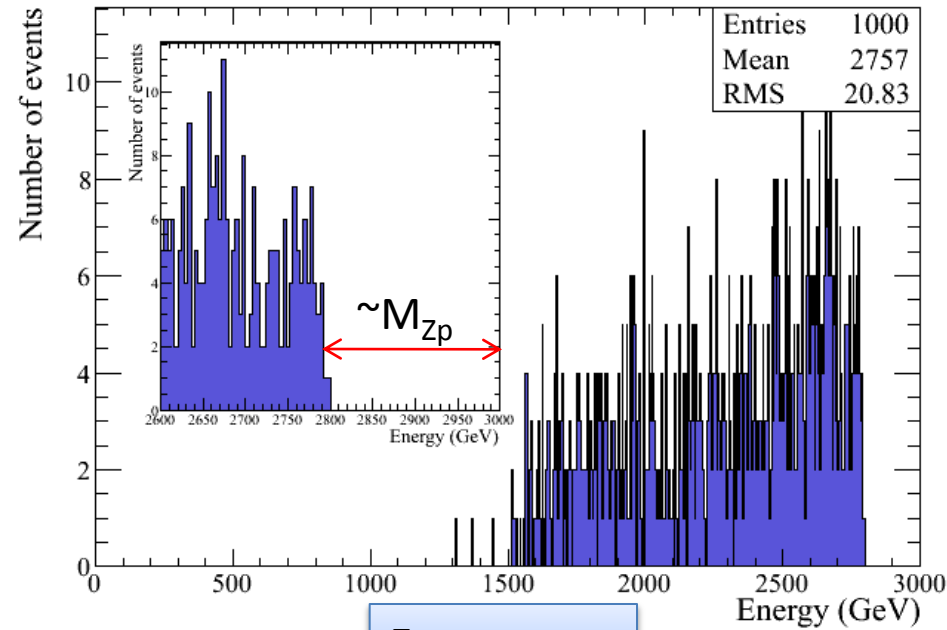


$\sim 1500 \text{ GeV} - E_{Zp}$

$\sim 1500 \text{ GeV}$



Energy difference



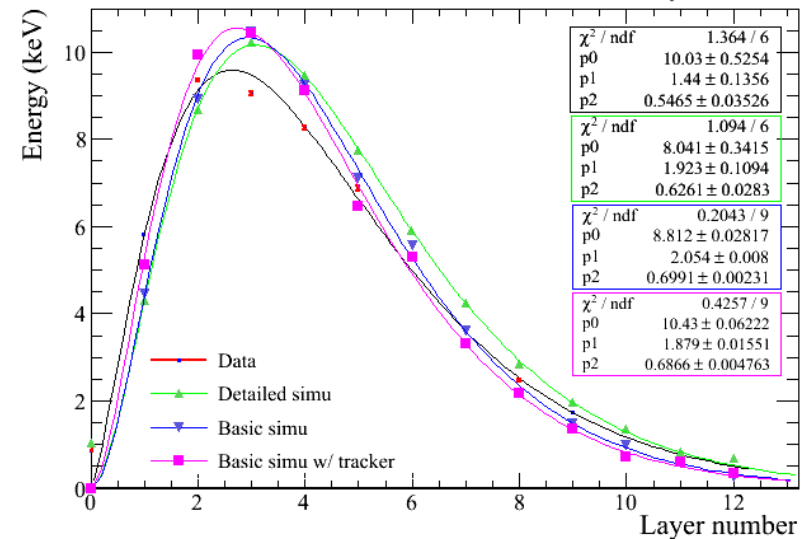
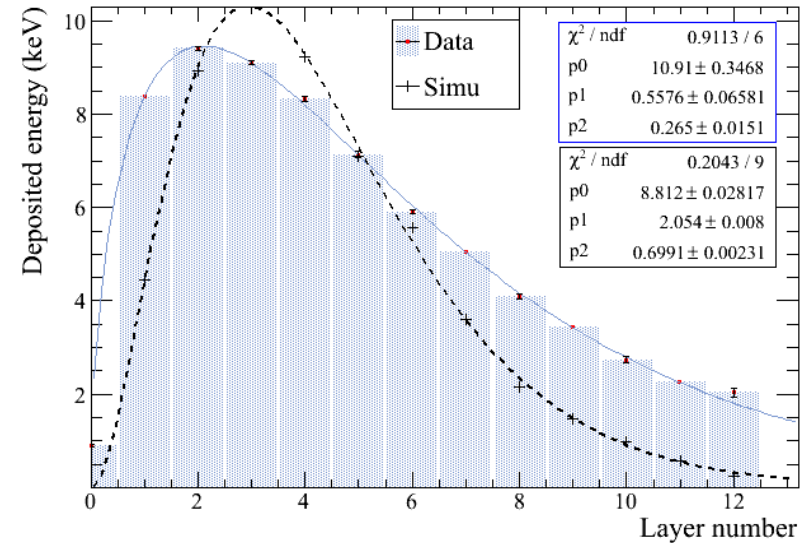
Energy sum

Meanwhile, some progress have been made on analysis of analog data from TB2009-May

BEAM TEST 2009 ANALYSIS STATUS

2GeV electron showers

- Improving data vs. simu agreement
 - Mistake in data analysis
 - Shower maximum sensitive to “tracker” thickness ($1/3 X_0$)
 - Missing energy at shower maximum:
 - Sparks $\rightarrow$ reject event
 - Shower max $\Rightarrow$ more sparks



e/mip ratio

- e/mip ratio :
 - ECAL proportionality
 - ECAL energy resolution
- Deduced from Beam Test data (extrapolated to 40 layers):
 - $\varepsilon_{\text{mes}}(e) = 54.3 \pm 0.3 \text{ keV}$
 - $98 \pm 5 \%$ containment
 - $\varepsilon_{\text{vis}}(e) = 55.4 \pm 2.9 \text{ keV}$
 - $e/mip = 0.87 \pm 0.05$

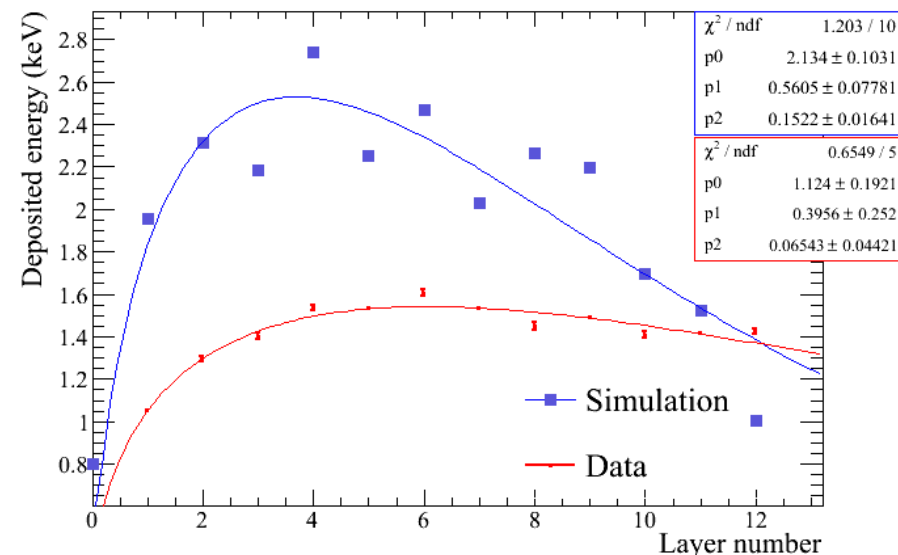
$$E = 3.61 \cdot 10^4 \varepsilon_{\text{vis}}$$

$$\sigma(E)/E = 18\%/E^{1/2}$$

2 GeV hadron showers

- No simu vs. data agreement !
- Still, data can lead to preliminary investigation
 - $\varepsilon_{\text{mes}}(\pi) = 16.5 \pm 0.2 \text{ keV}$
 - $43 \pm 12 \%$ containment
 - $\varepsilon_{\text{vis}}(\pi) = 38.3 \pm 10.8 \text{ keV}$
 - $\pi/\text{mip} = 0.60 \pm 0.17$

Mind the error bars



Calorimeter characterisation

- Knowing e/mip and π/mip ratios:
 - e/π and e/h can be computed
 - e/h is a constant of the HCAL
 - e/π relates to the constant term of HCAL energy resolution
- Preliminary results
 - $e/\pi = 1.45 \pm 0.49$ and $e/h = 1.55 \pm 0.52$
 - Constant term: $\Phi(e/\pi) = 8.3 \pm 9.5 \%$

Mind the error bars

Conclusion

- Physics simulation
 - Caveat pythia 6
 - Z' mass measurement
 - I need S. Puckov back
- TB2009 analysis
 - Hadron simulation to be improved
 - Analysis should be extended to other energies (4GeV May and September data)
 - Many informations can emerge from such analysis