

Retrieving Generated Information in GlueX

2013/09/09

Kei Moriya

Indiana University

Background Studies

- Several physics analyses ongoing, at the stage where we want to know which backgrounds are prominent
 - $3\pi n$ (Tom)
 - $\eta'\pi^+n$ (Kevin)
 - excited hyperons (Kei)
- Use bggen (based on pythia), E_γ range is somewhat undecided (8.4-9.0 GeV?)
- Use each processor to reconstruct background events as signal

Problem

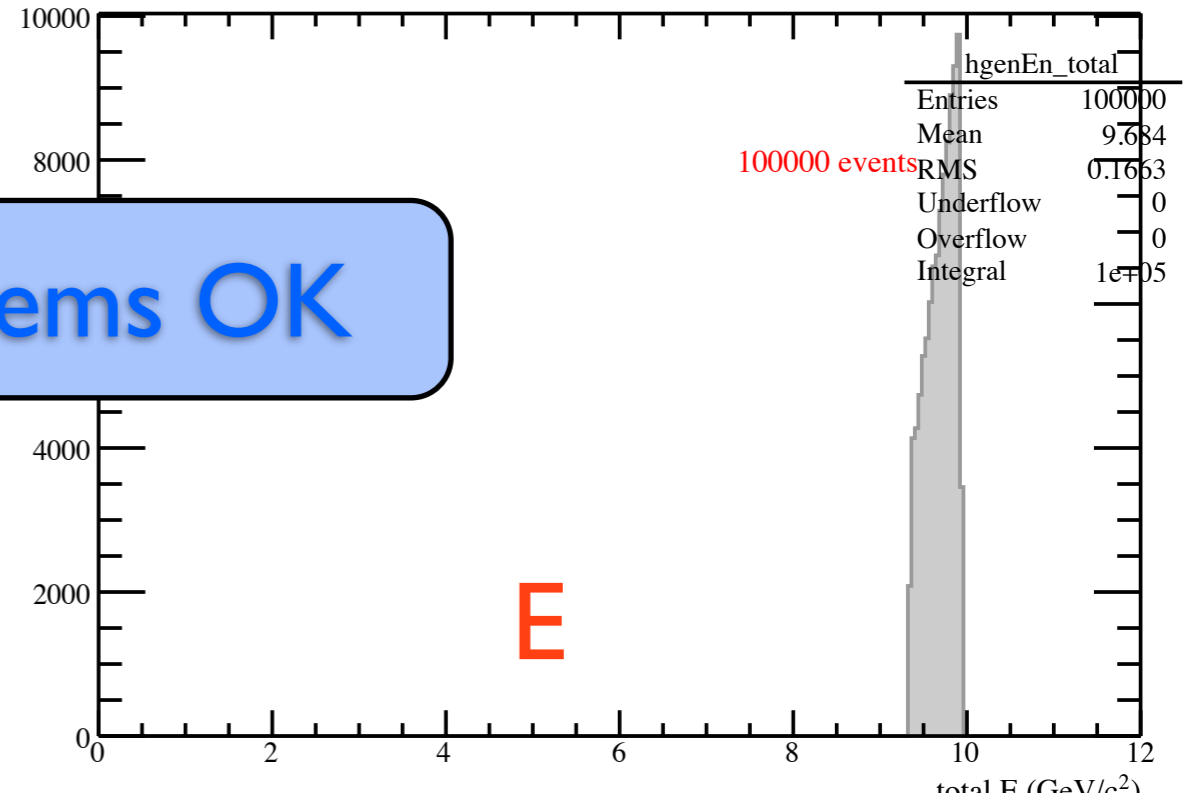
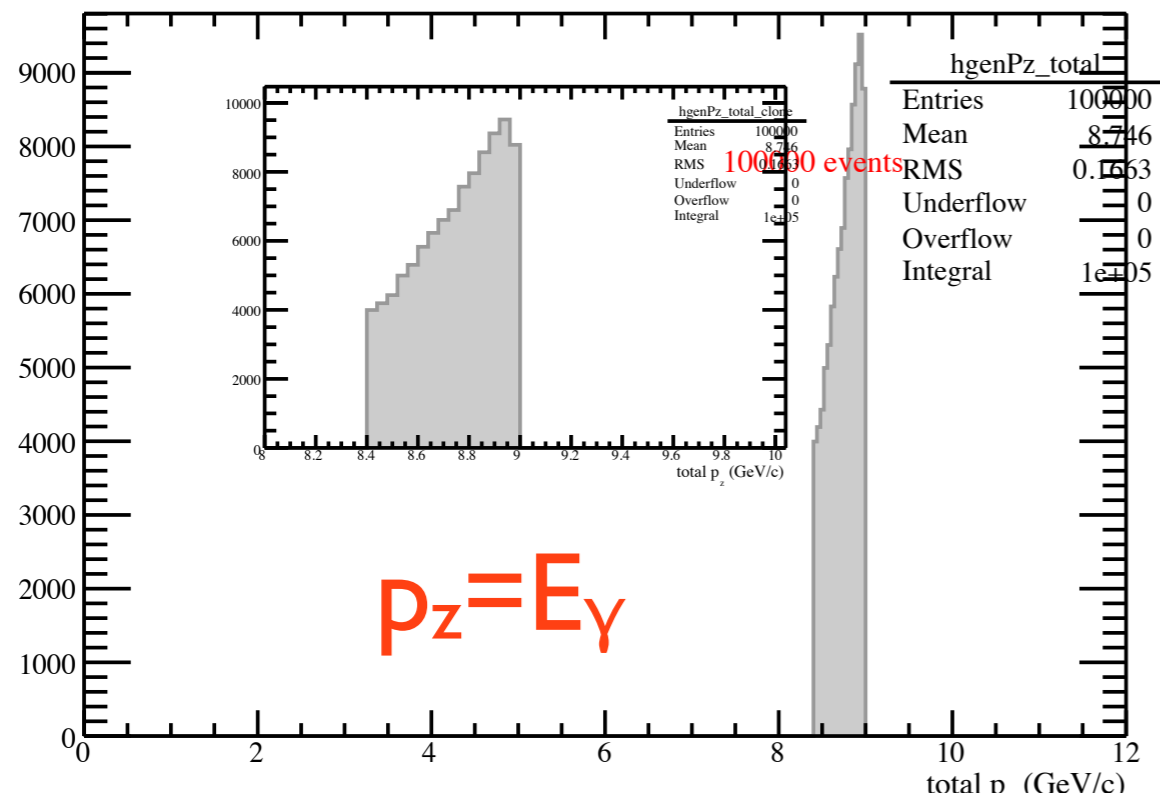
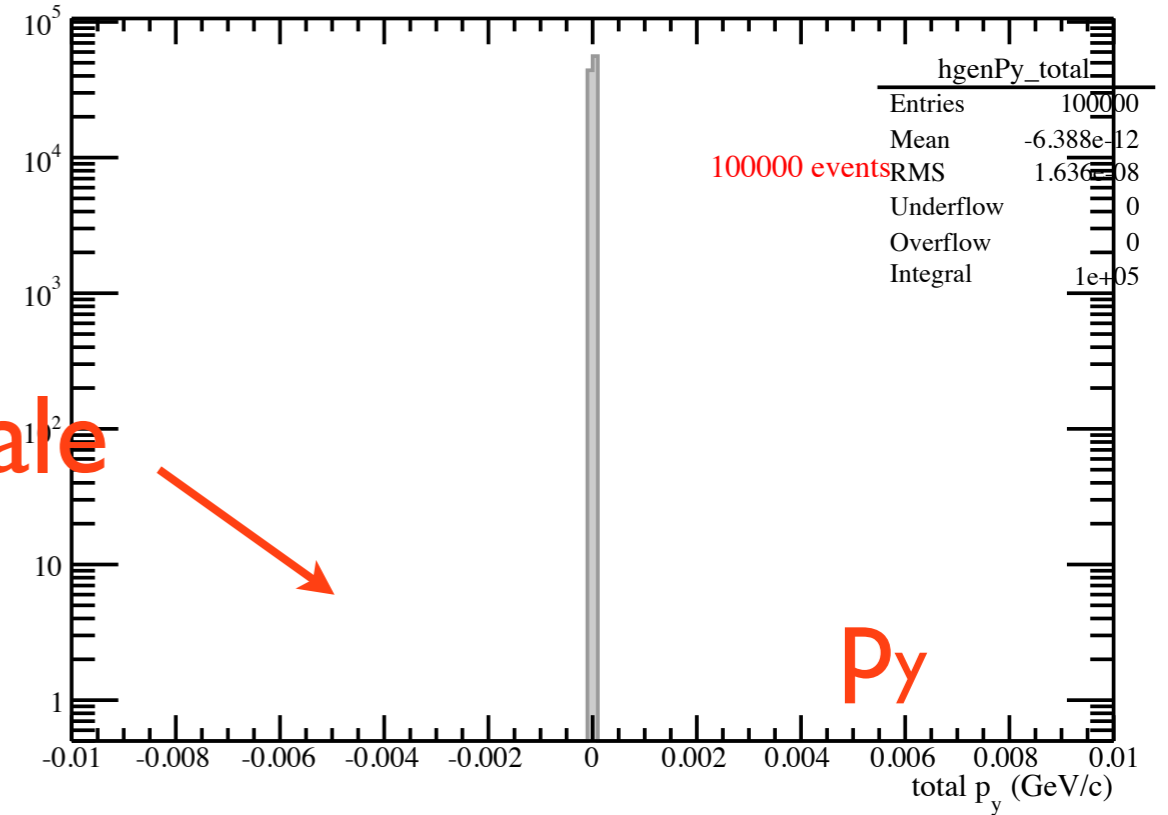
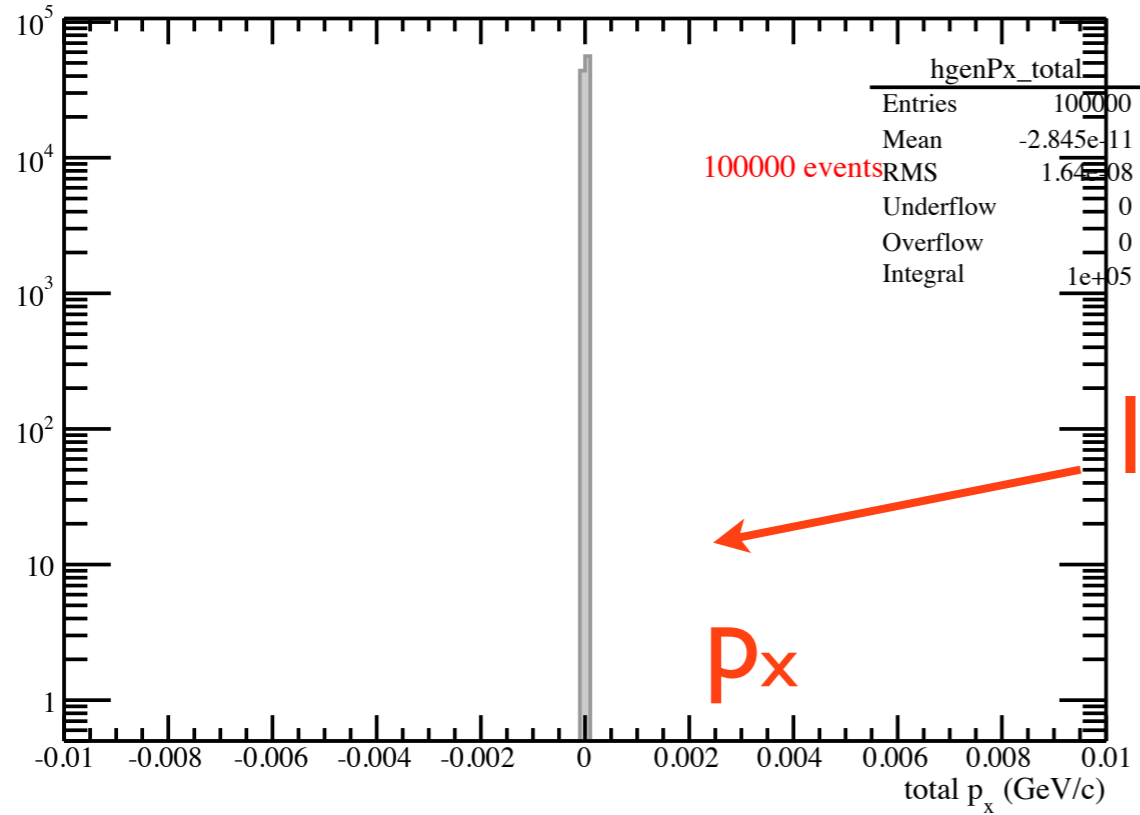
- In the current GlueX code, it is difficult to get the generated information of which hadronic reaction took place
- There are several ways of retrieving the information, but all have their drawbacks, bugs
- I will explain some of these methods in detail
- My goal is to be able to set up a system to consistently get the generated information

Method I:

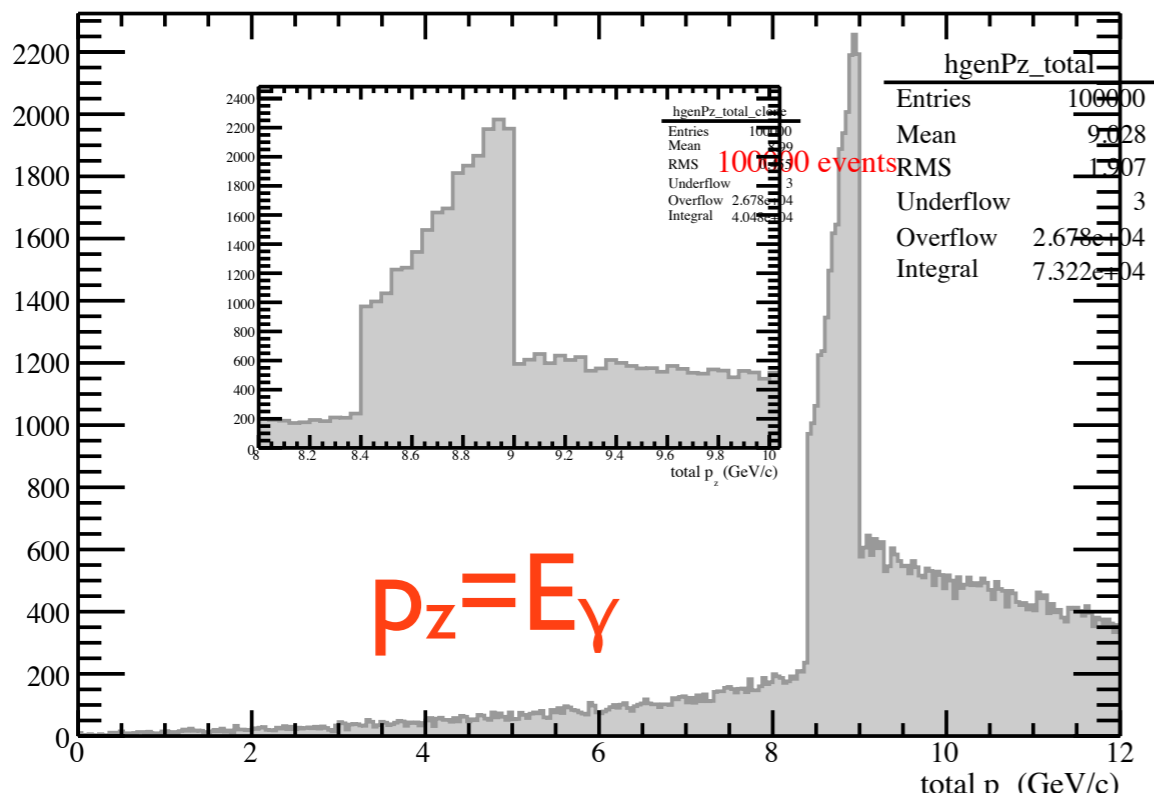
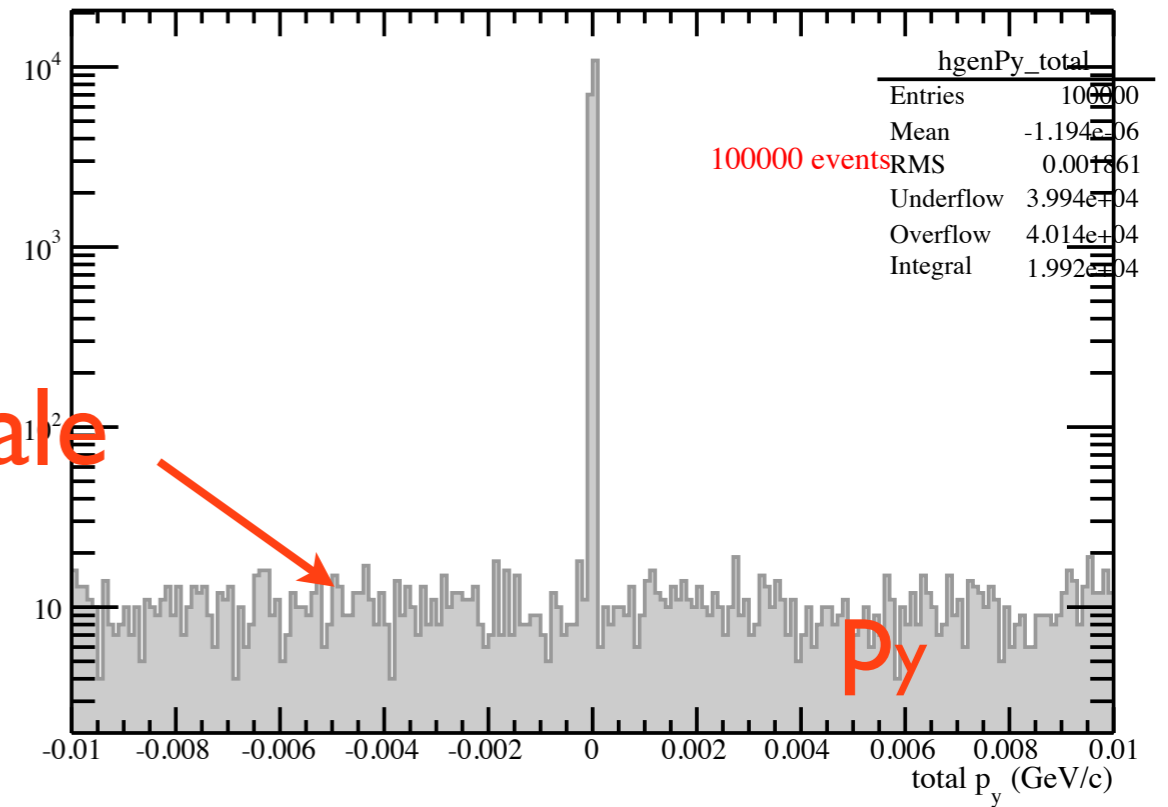
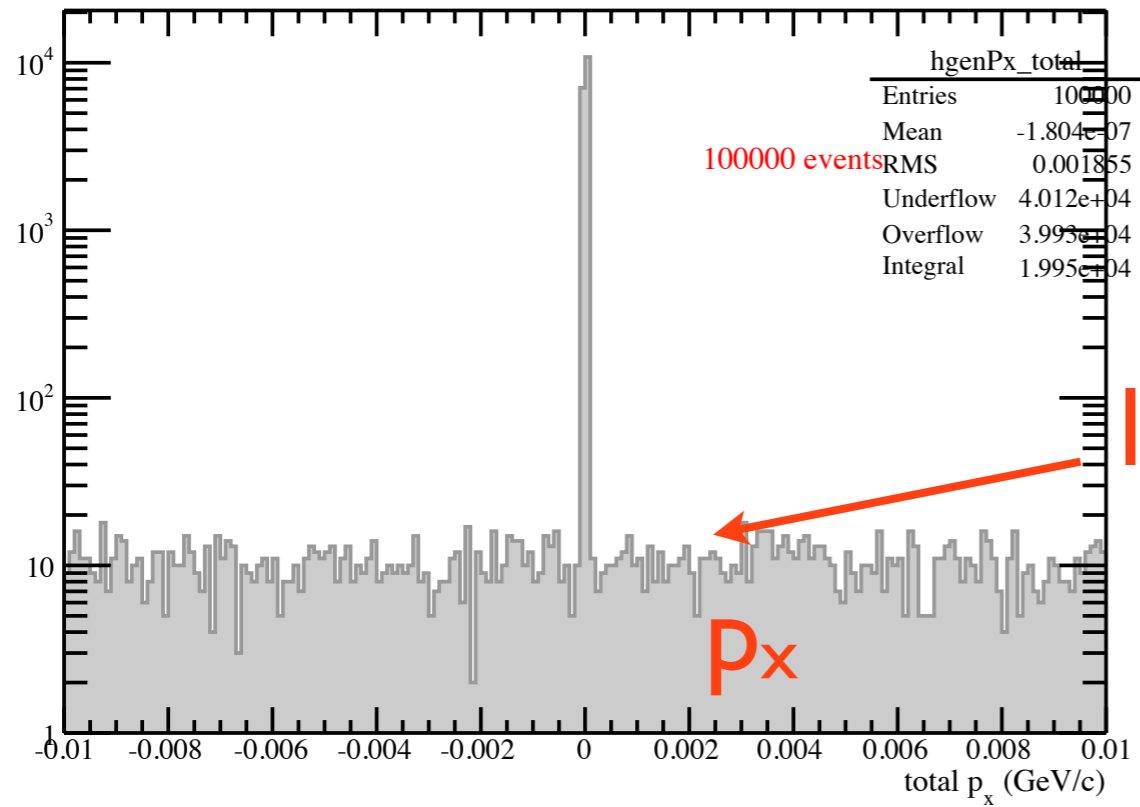
Using Paul's ANALYSIS Trees

- The branches
 - `TClonesArray *Thrown__P4_Thrown`
 - `Int_t Thrown__ParentID[N]`
in Paul's trees contain thrown information
- Can select particles with `Thrown__ParentID[n]==-1`,
add 4-mom to get total

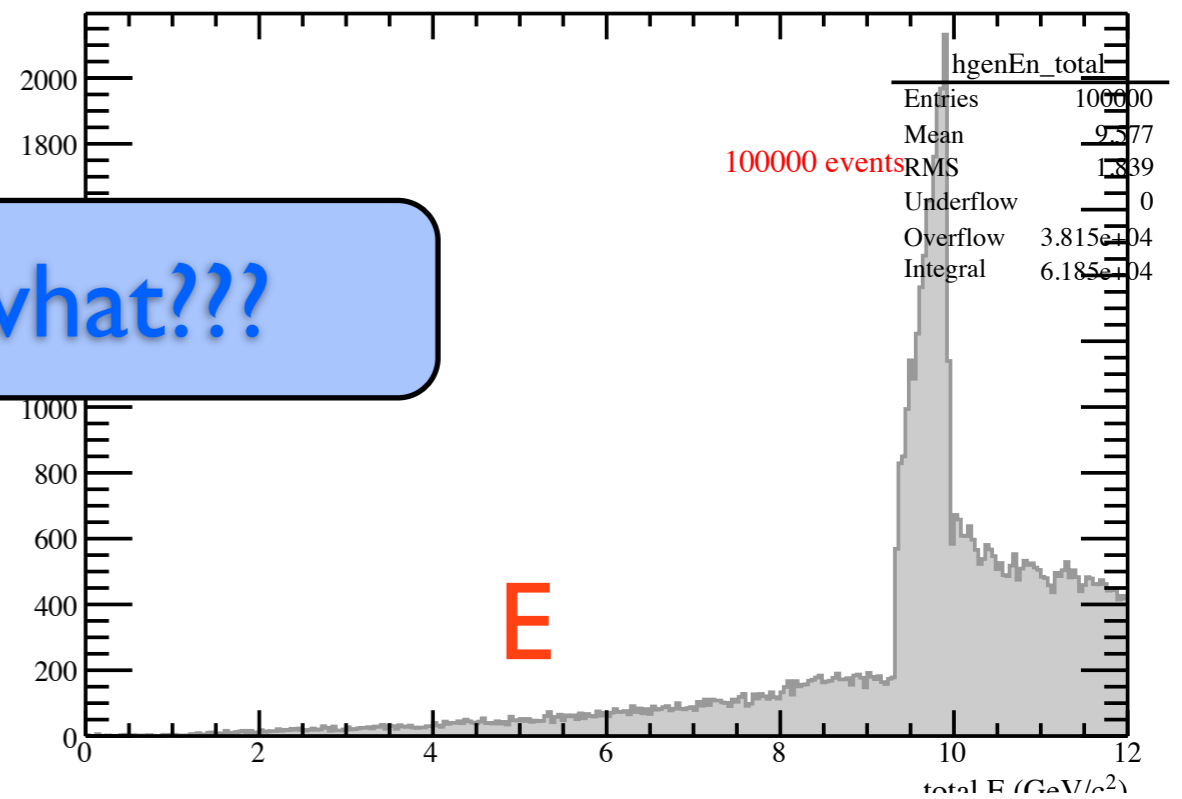
Run on hddm file from bggen



Run on REST hddm file



what???



What happened?

process flow (output)

1. bggen (hddm) ← first output
2. hdgeant (hddm)
3. mcsmeas (hddm)
4. REST ← second output
5. hd_root processor (ROOT)
6. analysis based on TSelector (ROOT)

- Use hd_dump to get DMCThrown information at each stage
- Select events that had $p_z > 15$ GeV/c

hd_dump results

bggen output for event 1707

PID:	Name:	q:	x(cm):	y(cm):	z(cm):	E(GeV):	t(ns):	p(GeV/c):	theta(deg):	phi(deg):	pdgtype:	myid:	parentid:	mech:	
0	Unknown	+0	0.0	0.0	0.0	7.7499	0.000	7.743	1.710	28.773	-2	1	0	12	
0	Unknown	+0	0.0	0.0	0.0	1.0225	0.000	0.968	6.755	-48.766	u	2	0	11	
0	Unknown	+0	0.0	0.0	0.0	0.4480	0.000	0.303	49.693	-151.227	2	3	0	12	
0	Unknown	+0	0.0	0.0	0.0	0.5909	0.000	0.116	101.657	131.234	ud	2101	4	0	11
0	Unknown	+0	0.0	0.0	0.0	1.0388	0.000	0.328	58.249	-174.733	91	5	3	11	
14	<u>Proton</u>	+1	0.0	0.0	0.0	0.9888	0.000	0.312	58.249	-174.733	2212	6	5	1	
0	Unknown	+0	0.0	0.0	0.0	7.7499	0.000	7.743	1.710	28.773	-2	7	1	12	
0	Unknown	+0	0.0	0.0	0.0	0.0501	0.000	0.016	58.249	-174.733	g	21	8	5	12
0	Unknown	+0	0.0	0.0	0.0	1.0225	0.000	0.968	6.755	-48.766	2	9	2	11	
0	Unknown	+0	0.0	0.0	0.0	8.8225	0.000	8.713	1.745	5.267	91	10	7	11	
7	<u>Pi0</u>	+0	0.0	0.0	0.0	5.7574	0.000	5.756	5.360	67.273	111	11	10	1	
17	<u>Eta</u>	+0	0.0	0.0	0.0	3.0651	0.000	3.016	9.061	-83.174	221	12	10	1	

- Reaction was $\gamma + p \rightarrow p \pi^0 \eta$, $\eta \rightarrow 3 \pi^0$
- pythia will generate reactions through single quarks, diquarks etc, so it is not too meaningful to follow the entire decay chain

hd_dump results

mcsmeas output for event 1707

PID:	Name:	q:	x(cm):	y(cm):	z(cm):	E(GeV):	t(ns):	p(GeV/c):	theta(deg):	phi(deg):	pdgtype:	myid:	parentid:	mech:
0	Unknown	+0	0.2	0.0	61.9	7.7499	0.000	7.743	1.710	28.773	-2	1	0	12
0	Unknown	+0	0.2	0.0	61.9	1.0225	0.000	0.968	6.755	-48.766	2	2	0	11
0	Unknown	+0	0.2	0.0	61.9	0.4480	0.000	0.303	49.693	-151.227	2	3	0	12
0	Unknown	+0	0.2	0.0	61.9	0.5909	0.000	0.116	101.657	131.234	2101	4	0	11
0	Unknown	+0	0.2	0.0	61.9	1.0388	0.000	0.328	58.249	-174.733	91	5	3	11
14	Proton	+1	0.2	0.0	61.9	0.9888	0.000	0.312	58.249	-174.733	2212	6	5	1
0	Unknown	+0	0.2	0.0	61.9	7.7499	0.000	7.743	1.710	28.773	-2	7	1	12
0	Unknown	+0	0.2	0.0	61.9	0.0501	0.000	0.016	58.249	-174.733	21	8	5	12
0	Unknown	+0	0.2	0.0	61.9	1.0225	0.000	0.968	6.755	-48.766	2	9	2	11
0	Unknown	+0	0.2	0.0	61.9	8.8225	0.000	8.713	1.745	5.267	91	10	7	11
7	Pi0	+0	0.2	0.0	61.9	5.7574	0.000	5.756	5.360	67.273	111	11	10	1
17	Eta	+0	0.2	0.0	61.9	3.0651	0.000	3.016	9.061	-83.174	221	12	10	1
7	Pi0	+0	0.2	0.0	61.9	0.9744	-0.000	0.965	9.232	-40.937	0	4	3	1497449284
7	Pi0	+0	0.2	0.0	61.9	0.7381	-0.000	0.726	15.902	-127.094	0	5	3	1497449284
7	Pi0	+0	0.2	0.0	61.9	1.3525	-0.000	1.346	9.396	-74.314	0	6	3	1497449284
1	Photon	+0	0.2	0.0	61.9	0.6978	-0.000	0.698	6.885	-110.243	0	7	6	1497449284
1	Photon	+0	0.2	0.0	61.9	0.6548	-0.000	0.655	14.117	-56.414	0	8	6	1497449284
1	Photon	+0	0.2	0.0	61.9	0.5344	-0.000	0.534	11.014	-108.607	0	13	5	1497449284
1	Photon	+0	0.2	0.0	61.9	0.2037	-0.000	0.204	31.691	-144.706	0	14	5	1497449284
1	Photon	+0	0.2	0.0	61.9	0.3085	-0.000	0.308	6.858	-133.493	0	150	4	1497449284
1	Photon	+0	0.2	0.0	61.9	0.6660	-0.000	0.666	13.966	-27.704	0	151	4	1497449284
1	Photon	+0	0.2	0.0	61.9	1.9132	-0.000	1.913	7.182	72.405	0	156	2	1497449284
1	Photon	+0	0.2	0.0	61.9	3.8443	-0.000	3.844	4.479	63.186	0	157	2	1497449284

?

wrong?

- hd_dump output has a lot more now
- Decay products of $\eta \rightarrow 3\pi^0$, $\pi^0 \rightarrow 3\gamma$ also included

hd_dump results

REST output for event 1707

PID:	Name:	q:	x(cm):	y(cm):	z(cm):	E(GeV):	t(ns):	p(GeV/c):	theta(deg):	phi(deg):	pdgtype:	myid:	parentid:	mech:
0	Unknown	+0	0.2	0.0	61.9	7.7499	0.000	7.743	1.710	28.773	-2	1	0	0
0	Unknown	+0	0.2	0.0	61.9	1.0225	0.000	0.968	6.755	-48.766	2	2	0	0
0	Unknown	+0	0.2	0.0	61.9	0.4480	0.000	0.303	49.693	-151.227	2	3	0	0
0	Unknown	+0	0.2	0.0	61.9	0.5909	0.000	0.116	101.657	131.234	2101	4	0	0
0	Unknown	+0	0.2	0.0	61.9	1.0388	0.000	0.328	58.249	-174.733	91	5	3	0
14	Proton	+1	0.2	0.0	61.9	0.9888	0.000	0.312	58.249	-174.733	2212	6	5	0
0	Unknown	+0	0.2	0.0	61.9	7.7499	0.000	7.743	1.710	28.773	-2	7	1	0
0	Unknown	+0	0.2	0.0	61.9	0.0501	0.000	0.016	58.249	-174.733	21	8	5	0
0	Unknown	+0	0.2	0.0	61.9	1.0225	0.000	0.968	6.755	-48.766	2	9	2	0
0	Unknown	+0	0.2	0.0	61.9	8.8225	0.000	8.713	1.745	5.267	91	10	7	0
7	Pi0	+0	0.2	0.0	61.9	5.7574	0.000	5.756	5.360	67.273	111	11	10	0
17	Eta	+0	0.2	0.0	61.9	3.0651	0.000	3.016	9.061	-83.174	221	12	10	0
7	Pi0	+0	0.2	0.0	61.9	0.9744	-0.000	0.965	9.232	-40.937	111	4	3	0
7	Pi0	+0	0.2	0.0	61.9	0.7381	-0.000	0.726	15.902	-127.094	111	5	3	0
7	Pi0	+0	0.2	0.0	61.9	1.3525	-0.000	1.346	9.396	-74.314	111	6	3	0
1	Photon	+0	0.2	0.0	61.9	0.6978	-0.000	0.698	6.885	-110.243	22	7	6	0
1	Photon	+0	0.2	0.0	61.9	0.6548	-0.000	0.655	14.117	-56.414	22	8	6	0
1	Photon	+0	0.2	0.0	61.9	0.5344	-0.000	0.534	11.014	-108.607	22	13	5	0
1	Photon	+0	0.2	0.0	61.9	0.2037	-0.000	0.204	31.691	-144.706	22	14	5	0
1	Photon	+0	0.2	0.0	61.9	0.3085	-0.000	0.308	6.858	-133.493	22	150	4	0
1	Photon	+0	0.2	0.0	61.9	0.6660	-0.000	0.666	13.966	-27.704	22	151	4	0
1	Photon	+0	0.2	0.0	61.9	1.9132	-0.000	1.913	7.182	72.405	22	156	2	0
1	Photon	+0	0.2	0.0	61.9	3.8443	-0.000	3.844	4.479	63.186	22	157	2	0

newly set

all reset

- Some variables are reset, others are changed in REST format. Other events available by request.

Method 2: Using all information in Paul's Trees

- The branches
 - `ULONG64_t NumPIDThrown_FinalState`
 - `ULONG64_t PIDThrown_Decaying`
 - `UINT_t NumThrown`
in Paul's trees also contain thrown information
- `NumPIDThrown_FinalState` contains **number** of final particles ($\gamma, e, \mu, \nu, p, n, \pi, K$) in each digit
- `PIDThrown_Decaying` contains the **presence** of decaying particles ($\eta, \Lambda, \Sigma, \Xi, \Omega$, etc)

Problems with this format

- **NumPIDThrown_FinalState** contains number of photons that were generated, regardless of whether they were part of the reaction or just a photon down the beamline
- **PIDThrown_Decaying** only tells you that a decaying particle existed, not how many
- η' are never found in **PIDThrown_Decaying** in 100k bggen events (fixed?)
- Sometimes sum of particles from FinalState and Decaying do not match NumThrown

hd_dump of mismatch event

PID:	Name:	q:	x(cm):	y(cm):	z(cm):	E(GeV):	t(ns):	p(GeV/c):	theta(deg):	phi(deg):	pdgtype:	myid:	parentid:	mech:
0	Unknown	+0	0.0	0.0	0.0	6.8650	0.000	6.847	3.097	-15.593	3	1	0	12
0	Unknown	+0	0.0	0.0	0.0	0.6236	0.000	0.231	61.608	176.351	2101	2	0	11
0	Unknown	+0	0.0	0.0	0.0	1.6043	0.000	1.524	14.044	164.407	-3	3	0	12
0	Unknown	+0	0.0	0.0	0.0	0.4125	0.000	0.248	55.042	-3.649	2	4	0	11
0	Unknown	+0	0.0	0.0	0.0	2.0168	0.000	1.630	6.214	150.641	91	5	3	11
0	Unknown	+0	0.0	0.0	0.0	1.6986	0.000	1.624	15.425	174.894	311	6	5	11
8	Pi+	+1	0.0	0.0	0.0	0.3182	0.000	0.286	78.894	9.863	211	7	5	1
0	Unknown	+0	0.0	0.0	0.0	7.4886	0.000	6.949	1.455	-29.359	92	8	1	11
0	Unknown	+0	0.0	0.0	0.0	6.0885	0.000	6.068	6.153	-6.122	-311	9	8	11
13	Neutron	+0	0.0	0.0	0.0	1.4000	0.000	1.038	28.372	-178.008	2112	10	8	1
16	KShort	+0	0.0	0.0	0.0	1.6986	0.000	1.624	15.425	174.894	310	11	6	1
16	KShort	+0	0.0	0.0	0.0	6.0885	0.000	6.068	6.153	-6.122	310	12	9	1

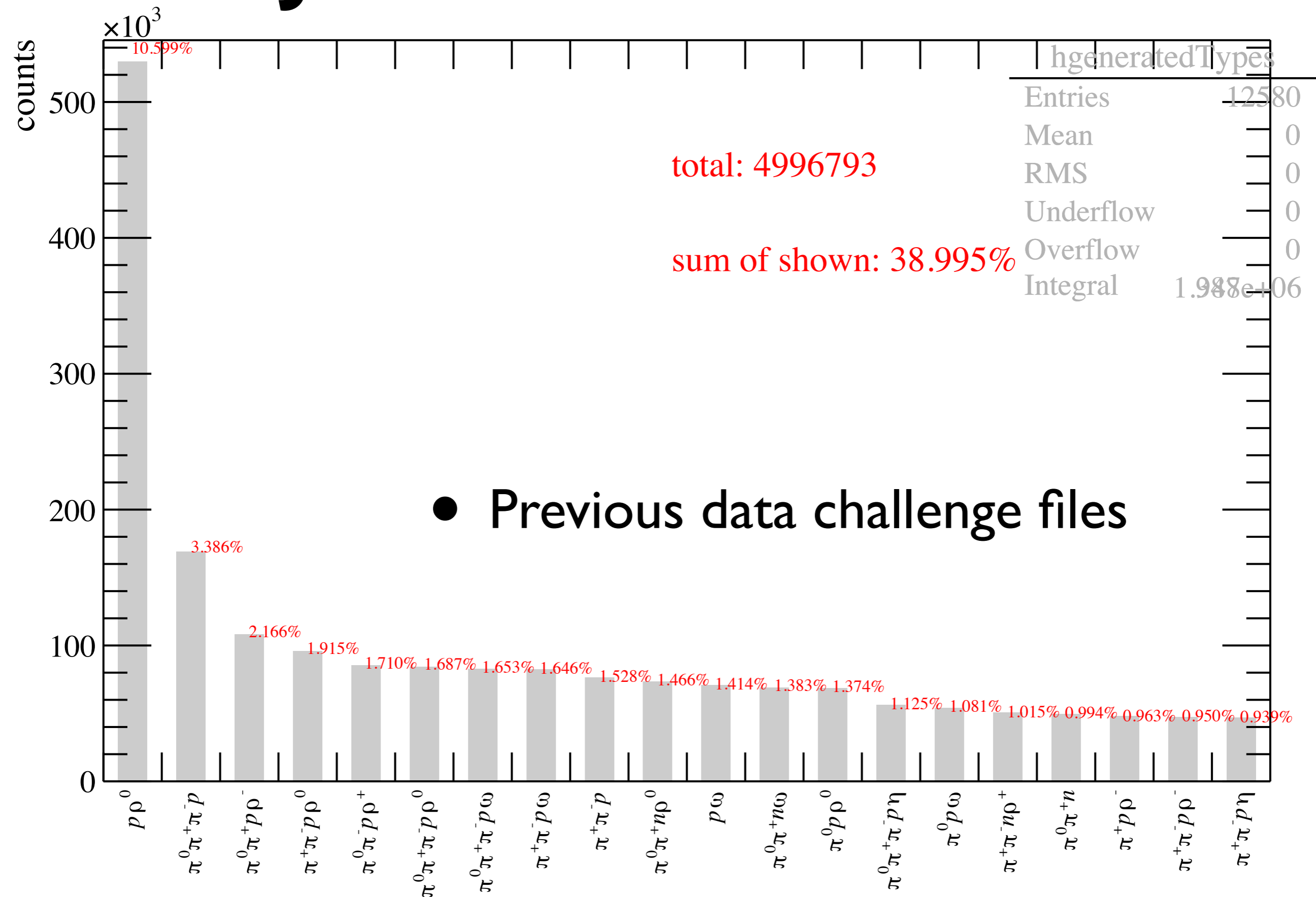
bggen output for event 2326

Since we only know that there was a K_s and not how many, we can't figure out the original topology

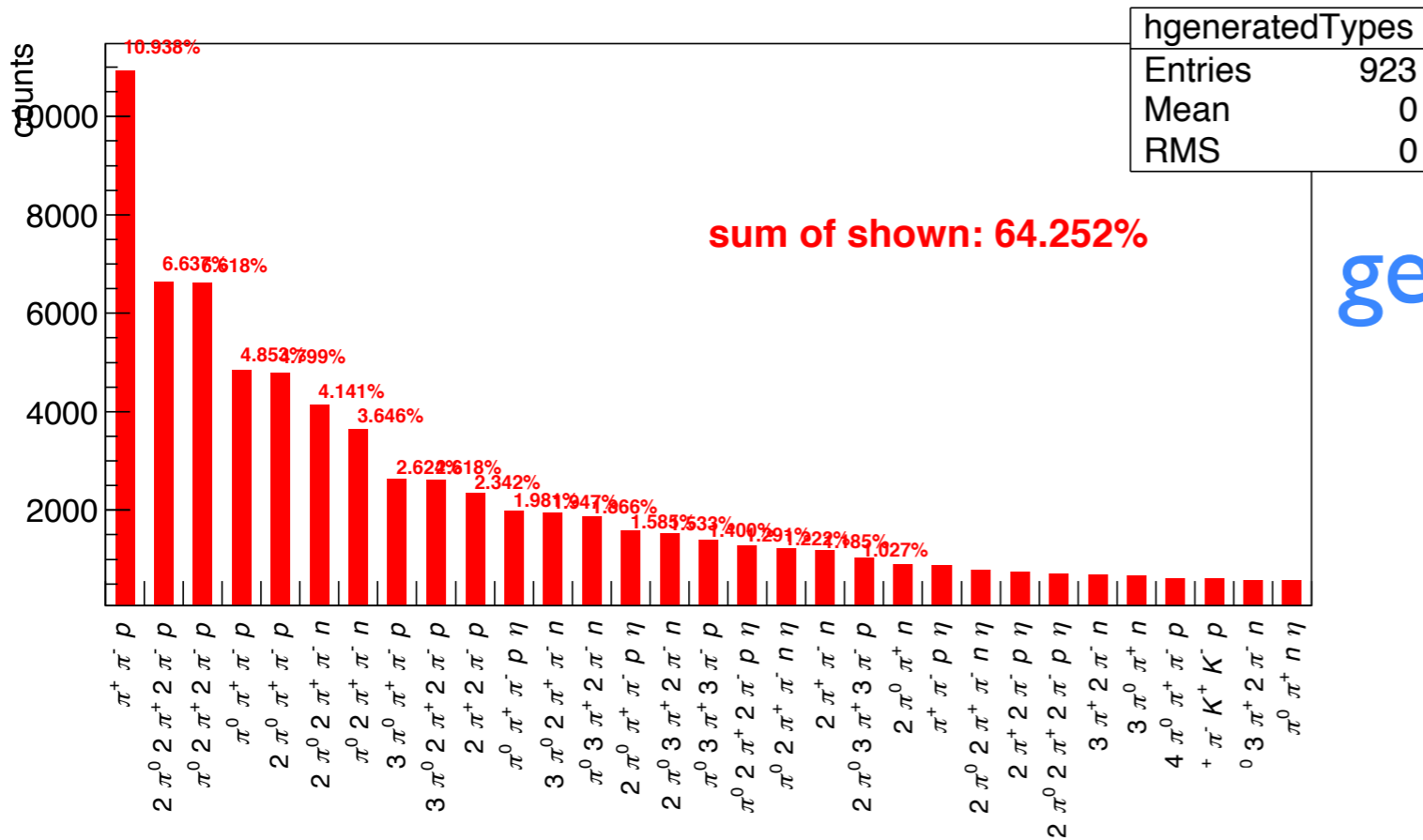
Method 3: Use DMCThrown Info

- Look at all particles that were generated with DMCThrown
- Count how many of each particle type were found
- This is what I used before at June Collaboration meeting

June 2013 Results

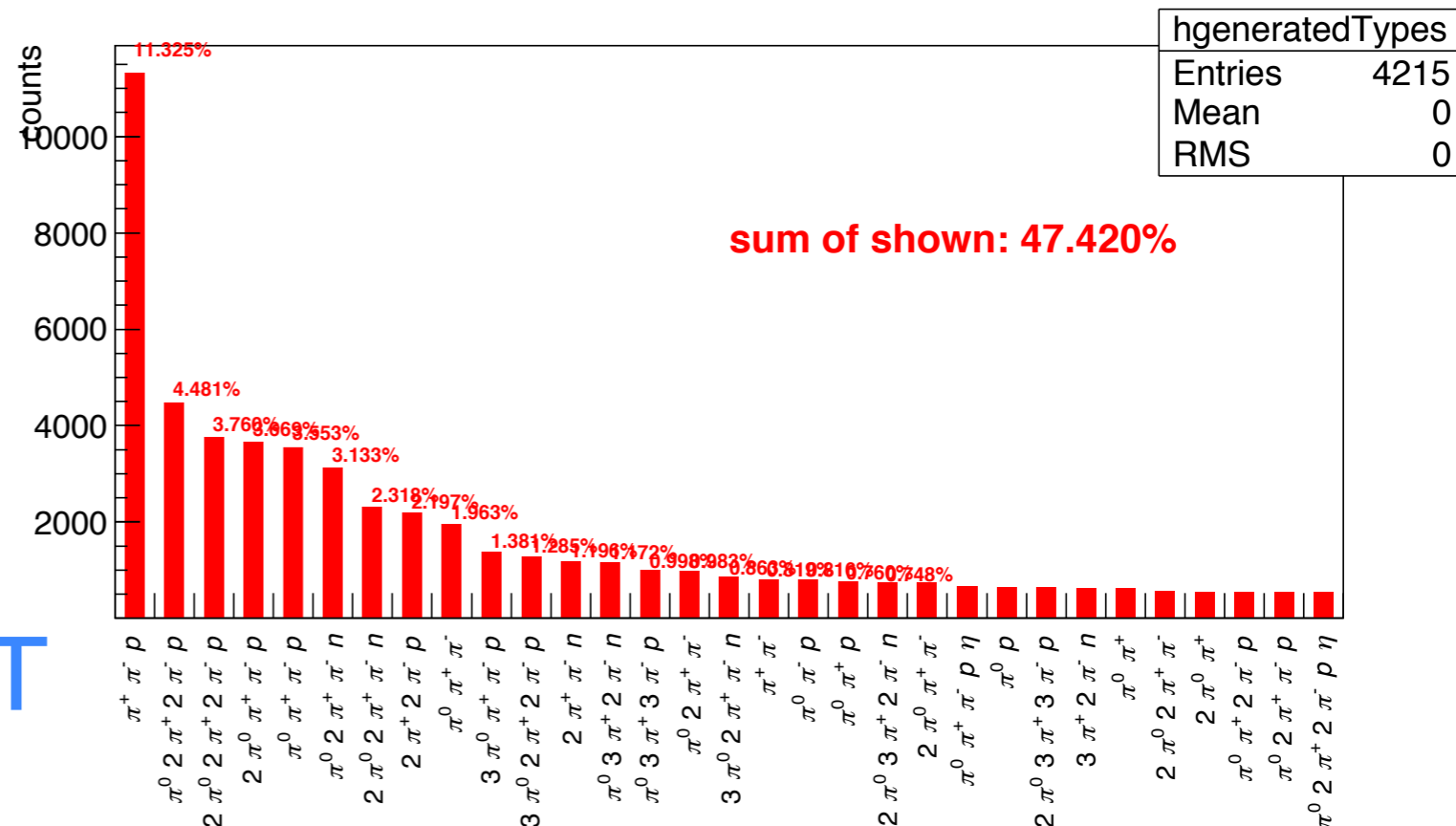


Current DMCThrown



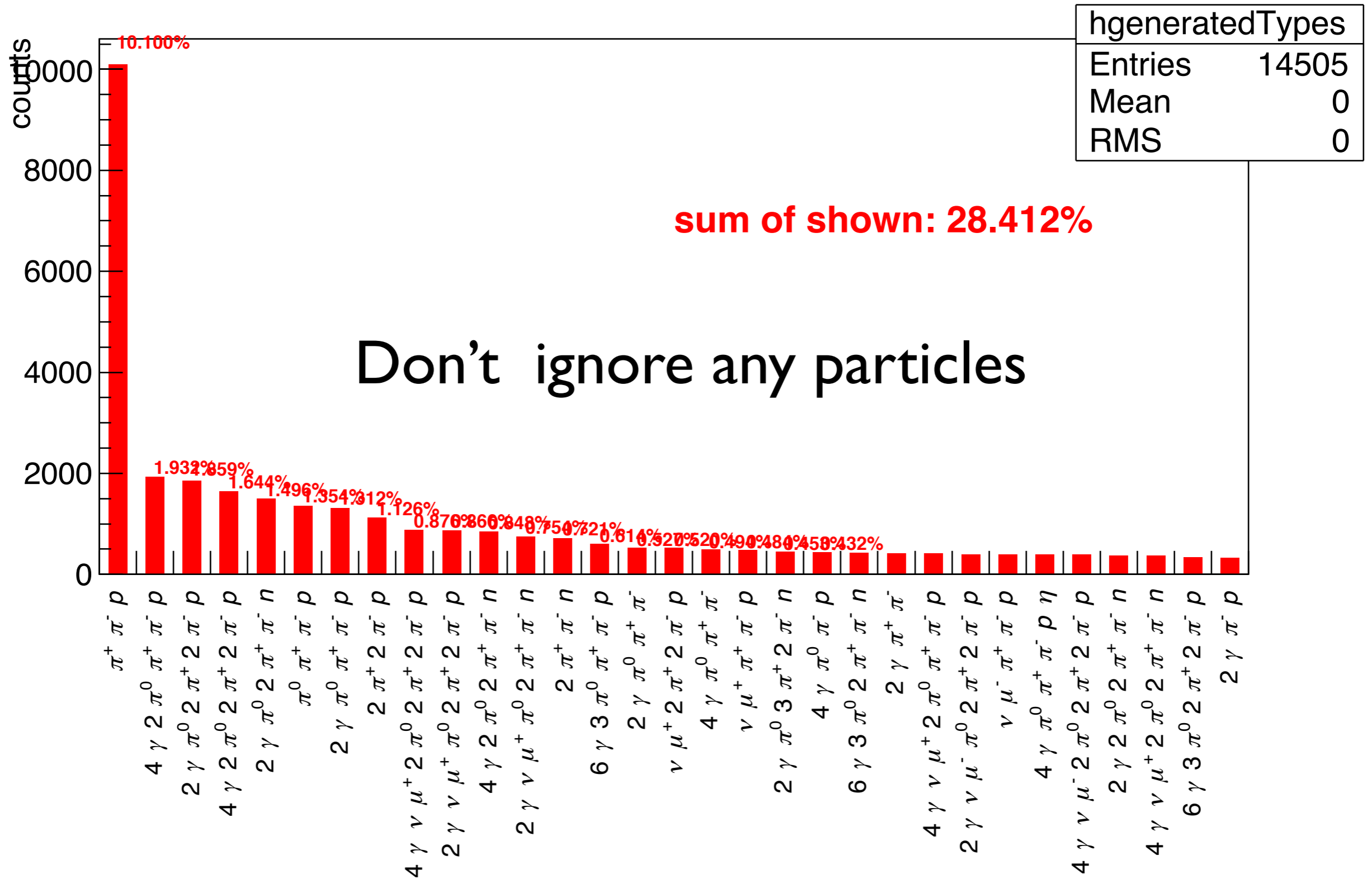
generated from bggen

Now lost ability to reconstruct ρ , ω etc.

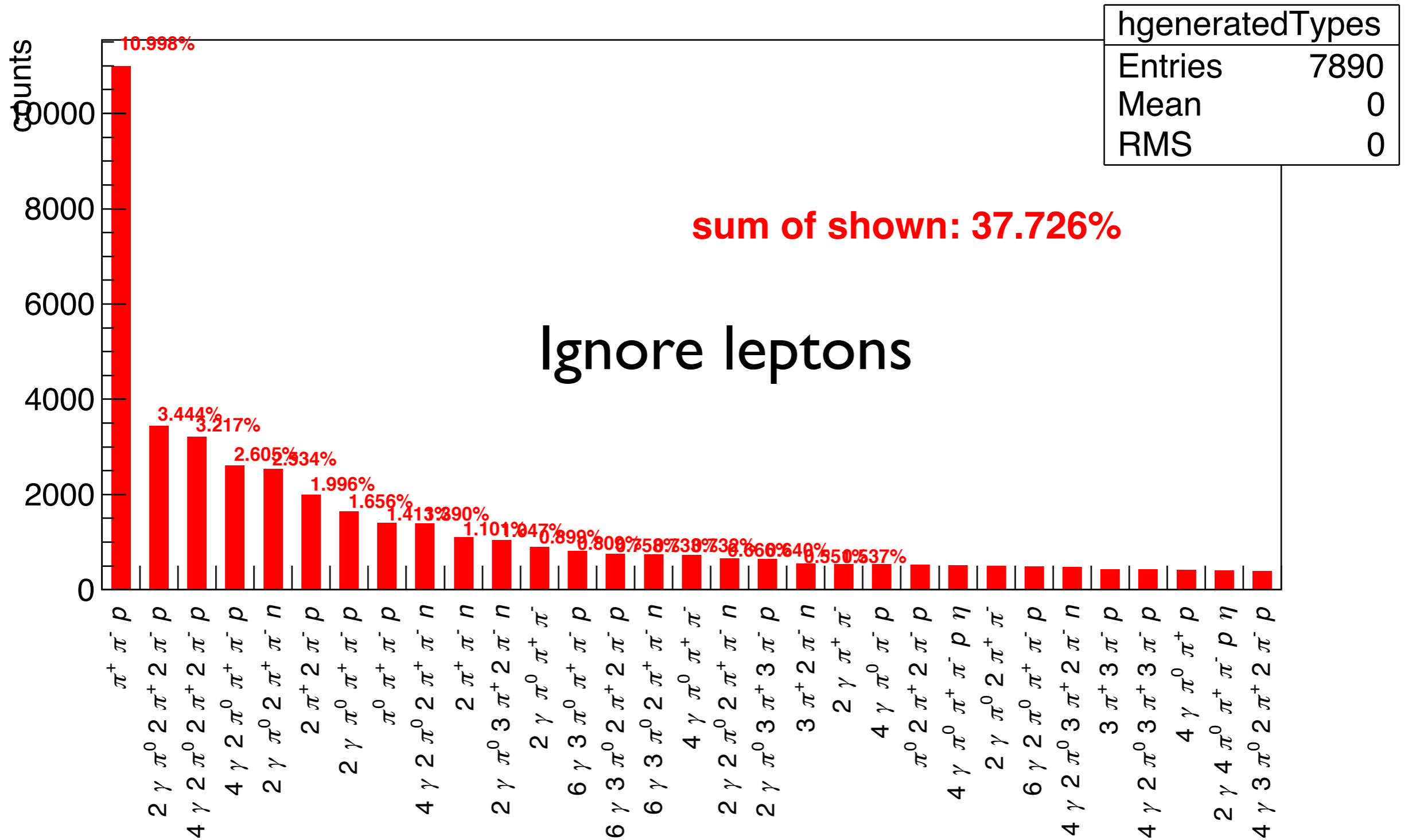


generated from REST

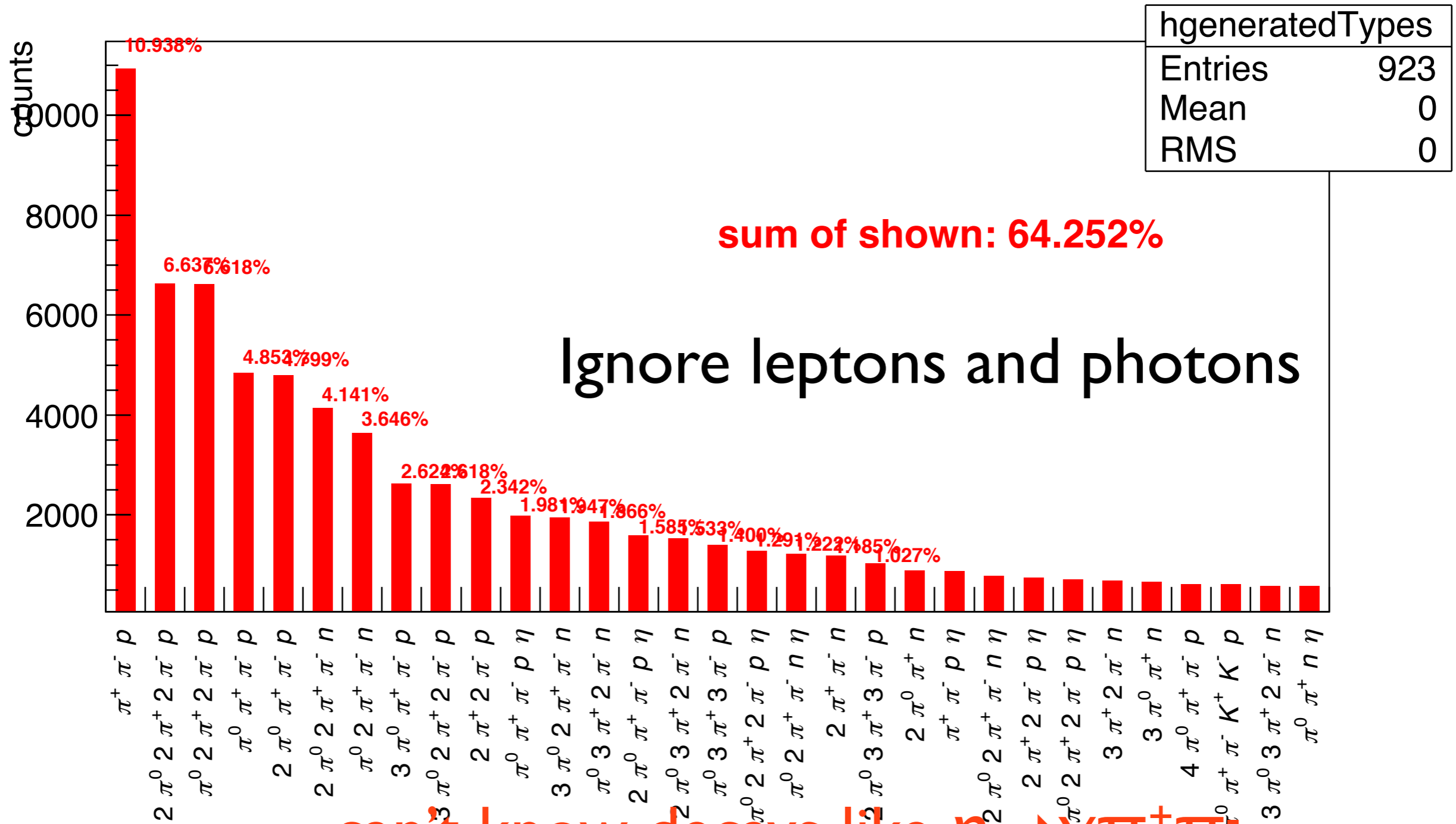
DMCThrown info



DMCThrown info



DMCThrown info



can't know decays like $\eta \rightarrow \gamma \pi^+ \pi^-$
 find events for Ξ , but not for Ξ ?

Summary

- Need fixes for pythia, hdgeant, REST output?
- This problem is also hampered by the GEANT4 upgrade
- Would be nice if fixes are in before next data challenge
- Current info saved in Paul's trees are incomplete, I would recommend saving (**very** biased)
 - all pseudoscalar and vector mesons
 - all octet and decuplet baryons
 - decay modes of specific particles (η , K_S , ω , η' , Λ , Ξ , etc)
- Way to run hd_dump in batch mode?