TurboSim

Motivation

Construction

Application

Test Results

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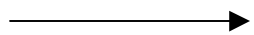
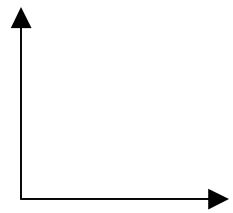
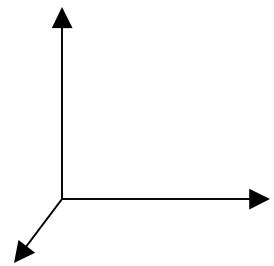
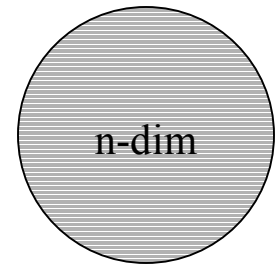
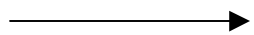
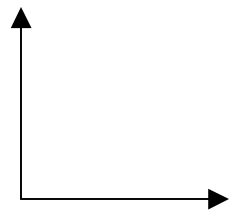
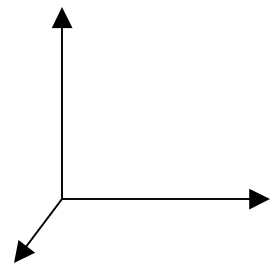
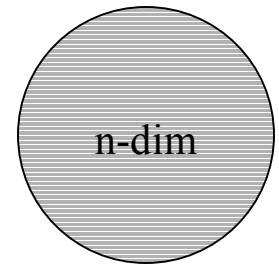
Statistics

Dimensionality of Variable Space				
# Bkg Evts	10	10^2	10^3	10^n

Typical Analysis:

1	Computer	Full Simulation:	2 000 000 seconds ~**20 days**
1	Final State		
5	Variables	TurboSim:	1 000 seconds ~**20 minutes**
100 000	Events		

Statistics

Dimensionality of Variable Space				
# Bkg Evts	10	10^2	10^3	10^n

Typical Analysis:

1 000 Computers 100 Final States ~~5~~ 6 Variables 100 000 000 Events	Full Simulation:	2 000 000 seconds ~**20 days**
	TurboSim:	1 000 seconds ~**20 minutes**

Fast Simulations

Three ways to do a fast simulation:

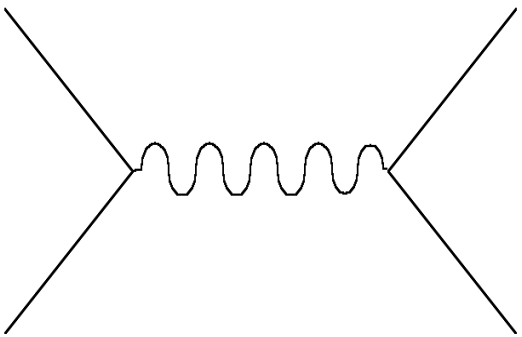
Optimize/Simplify the full simulation		
Build a parametric Monte Carlo from scratch		
Use the full simulation to create a fast simulation		

More = Faster

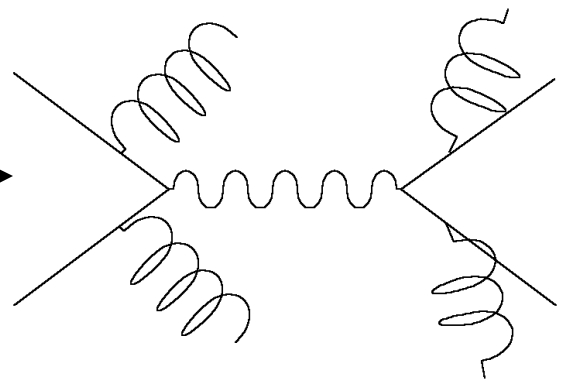
The Simulation Chain

Time Cost Per Event

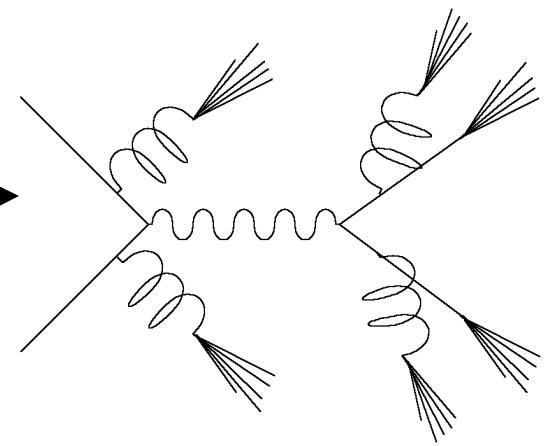
1 ms Tree Level



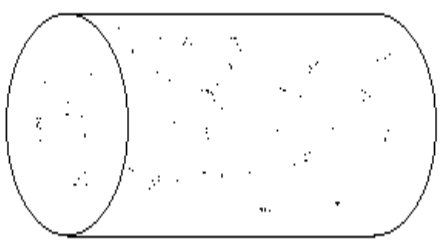
1 ms Showering



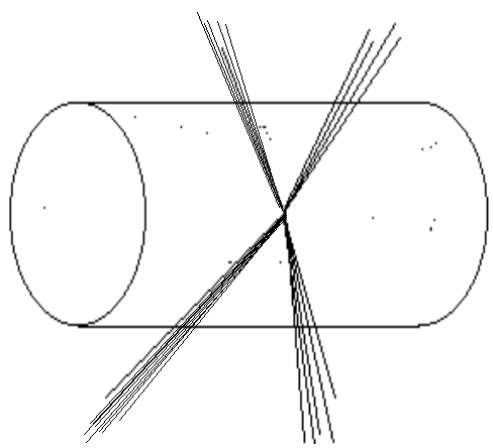
10 ms Fragmentation



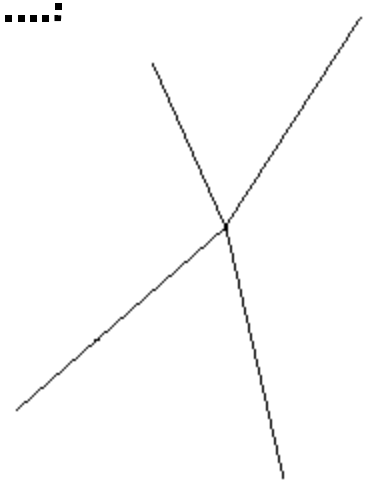
20 s Full Simulation



1 s Reconstruction/Object ID

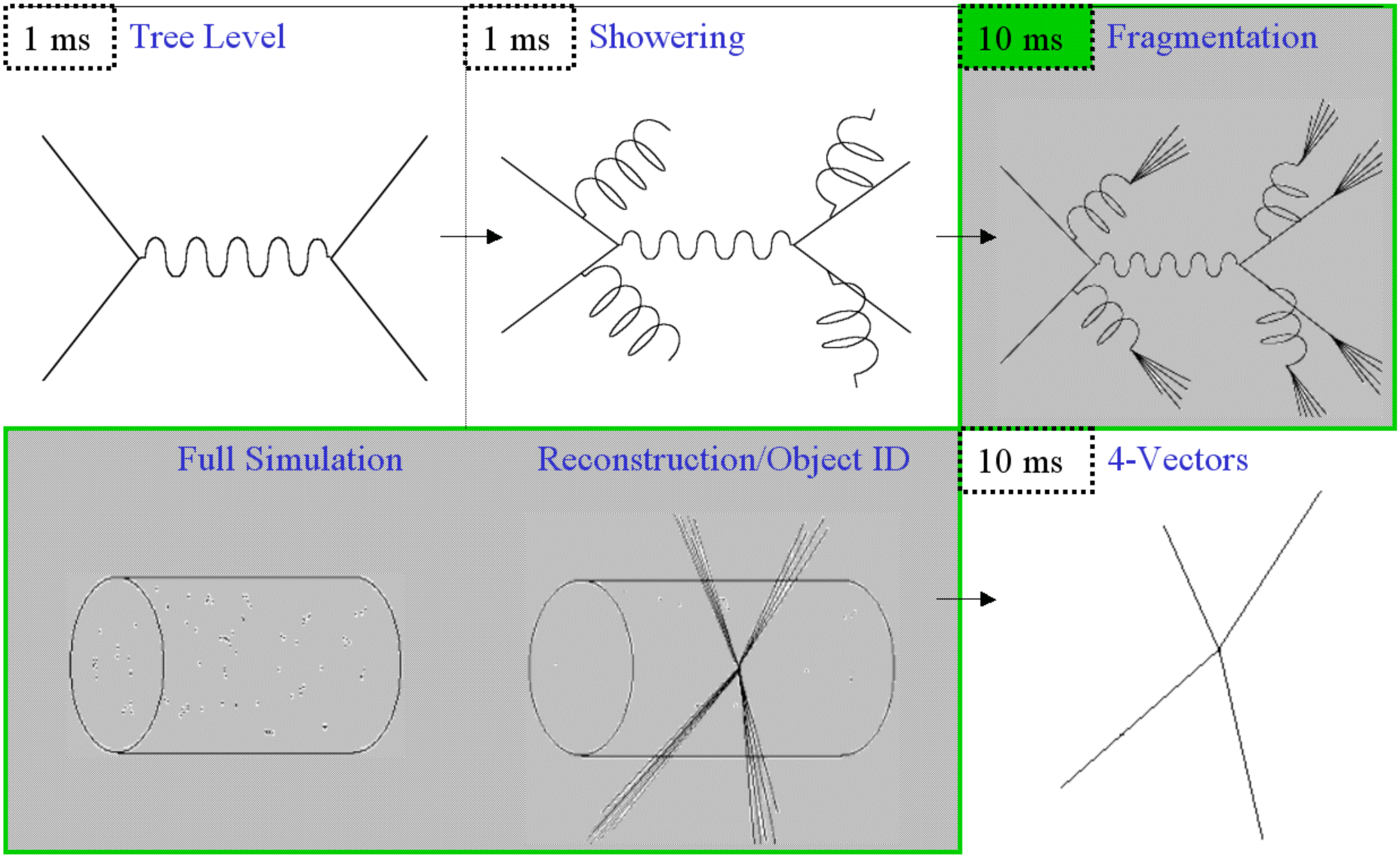


10 ms 4-Vectors



With TurboSim

Time Cost Per Event



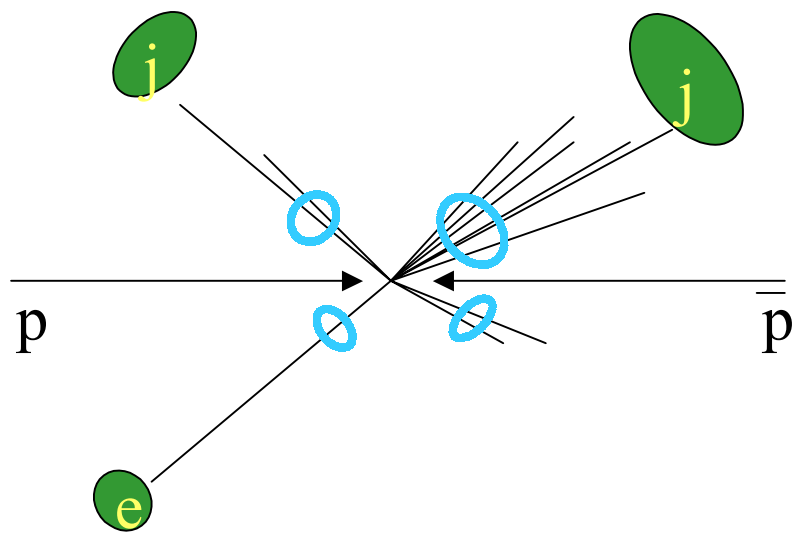
Construction

```
> turboSim -create table.txt partonEvents.txt recoEvents.txt
```

output input input

Use events from full simulation to:

- Cluster parton level objects (Cone R<0.5)
- Identify reconstructed objects with parton clusters



Text Files

```
> turboSim -create table.txt partonEvents.txt recoEvents.txt
```

output

Parton Level

Event1:	p_T	η	ϕ	p_T η ϕ	…
Event2:	p_T	η	ϕ	p_T η ϕ	…
Event3:	p_T	η	ϕ	p_T η ϕ	…
Event4:	p_T	η	ϕ	p_T η ϕ	…
Event5:	p_T	η	ϕ	p_T η ϕ	…
Event6:	p_T	η	ϕ	p_T η ϕ	…
Event7:	p_T	η	ϕ	p_T η ϕ	…

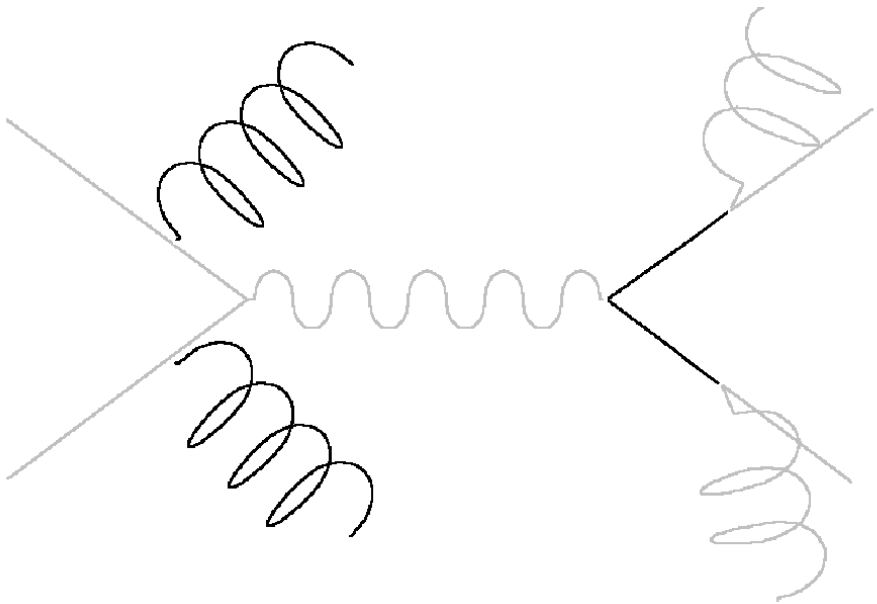
Reconstructed

Event1:	p_T	η	ϕ	p_T η ϕ	…
Event2:	p_T	η	ϕ	p_T η ϕ	…
Event3:	p_T	η	ϕ	p_T η ϕ	…
Event4:	p_T	η	ϕ	p_T η ϕ	…
Event5:	p_T	η	ϕ	p_T η ϕ	…
Event6:	p_T	η	ϕ	p_T η ϕ	…
Event7:	p_T	η	ϕ	p_T η ϕ	…

Object Details

Parton Cluster

- Initial State Radiation
- Outgoing legs



Reconstructed Objects

- Using standard particle definitions for $e^{\pm}$ $\mu^{\pm}$ $\tau^{\pm}$ γ b j

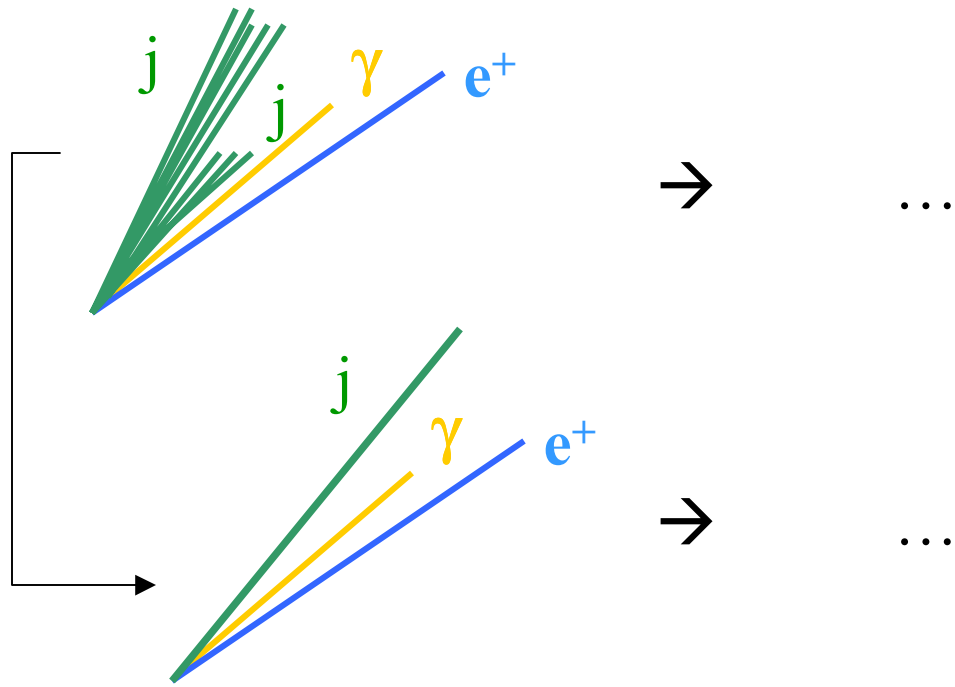
Lookup Table

vtx(cm)		Parton Cluster pt	eta	phi		Reconstructed Object pt	eta	phi
16.19	j	21.484	1.878	13.71	->	j 16.157	1.959	14.35
16.19	j	10.155	-0.886	-47.46	->	j 7.374	-0.823	-48.92
19.51	e+	20.811	1.446	-84.02	->	ph 20.793	1.444	-83.51
-6.65	b	21.846	1.462	3.16	->	j 21.449	1.468	3.17
3.28	b	111.95	-0.347	17.63	->	b 104.065	-0.294	18.05
3.28	tau-	47.544	-0.513	-74.5	->	tau- 21.521	-0.543	-75.56
12.65	tau-	39.999	0.952	-145.03	->	e- 23.512	0.956	-145.25
13.68	mu-	83.159	-0.388	124.59	->	mu- 77.632	-0.389	124.6
15.94	mu+	33.422	-1.862	-124.42	->			
25.26	e+	17.097	1.092	38.51	→	e+ 19.351	1.089	41.04
	ph	15.614	1.065	66.63		ph 15.093	1.063	66.67
8.47	j	30.997	0.239	-151.05	->	j 23.824	0.259	-150.29
8.47	e+	15.394	-1.612	28.89	→			
	ph	11.003	-1.492	39.9		ph 15.632	-1.614	29.28
29.48	e+	28.919	1.346	-41.49	->	ph 28.253	1.346	-40.84
29.48	ph	13.63	0.594	5.03	->	ph 13.106	0.59	4.81
30.75	ph	27.083	-0.285	61.34	->	ph 27.709	-0.278	61.3
53.24	e+	18.932	-0.222	-18.13	->			
69.38	ph	21.292	0.69	46.59	→	ph 23.255	0.688	58.45
	e+	12.177	1.123	56.53		e+ 51.409	1.121	58.32

Last 1,000,000 lines suppressed

Table Notes

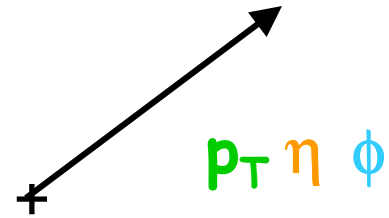
Merging particles

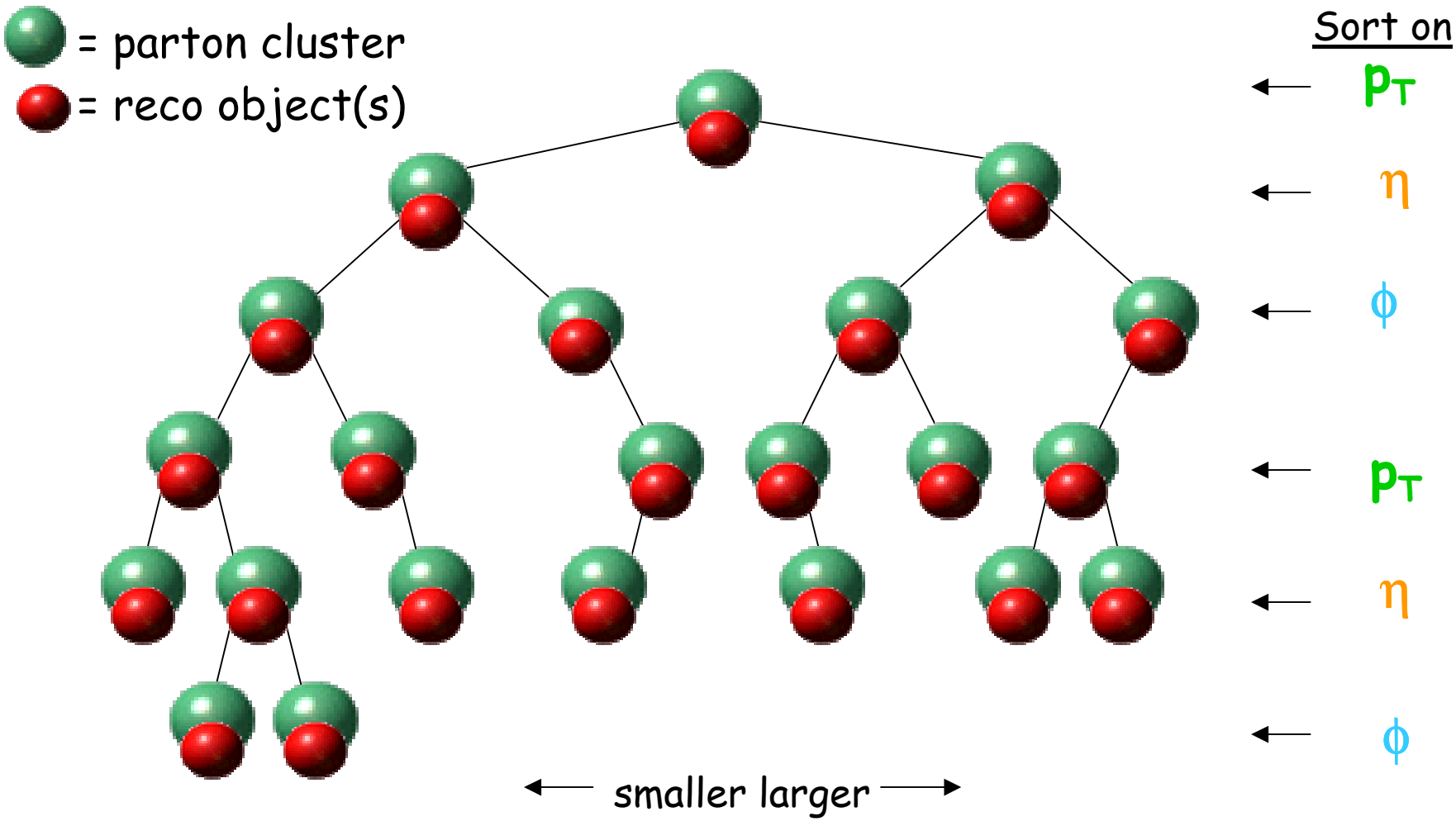


Missing Energy

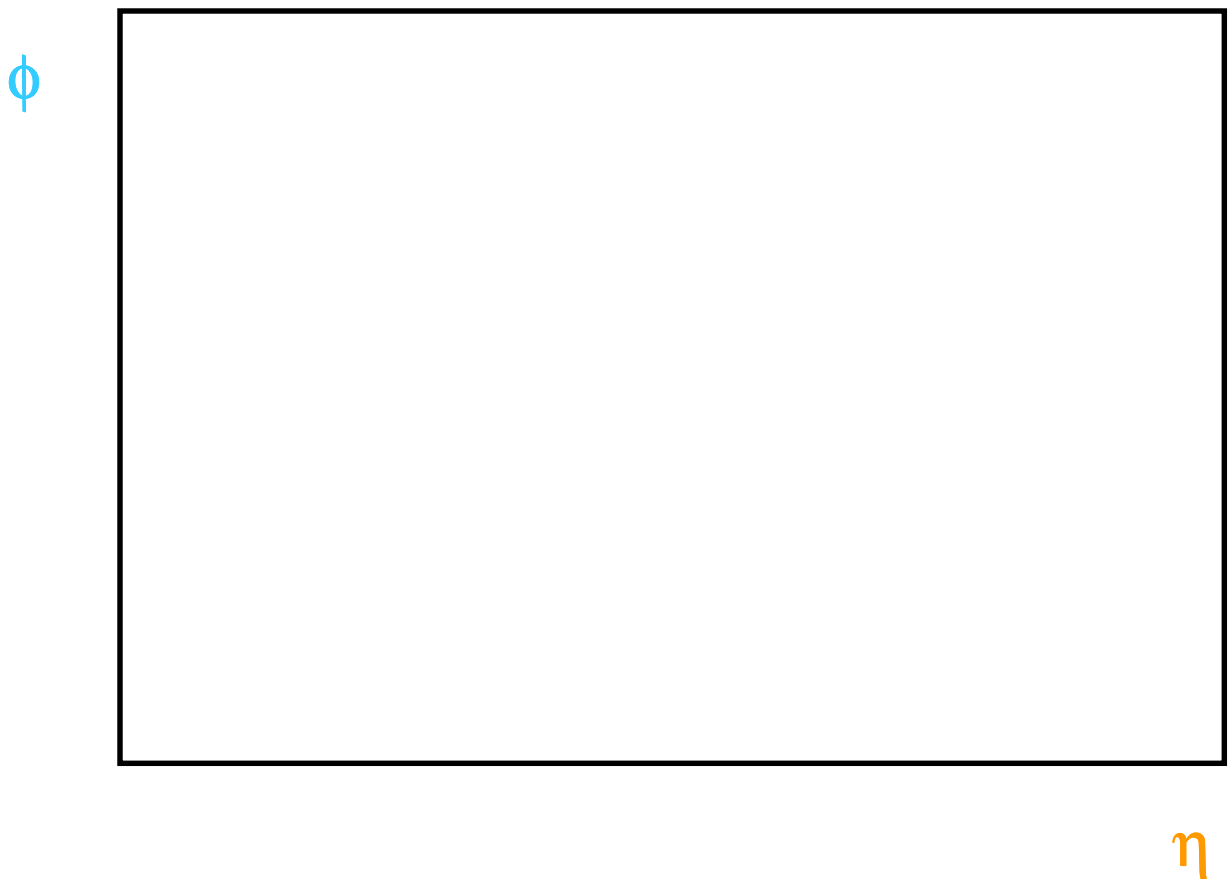
- Defined in terms of main objects

Binary Tree: Singlets

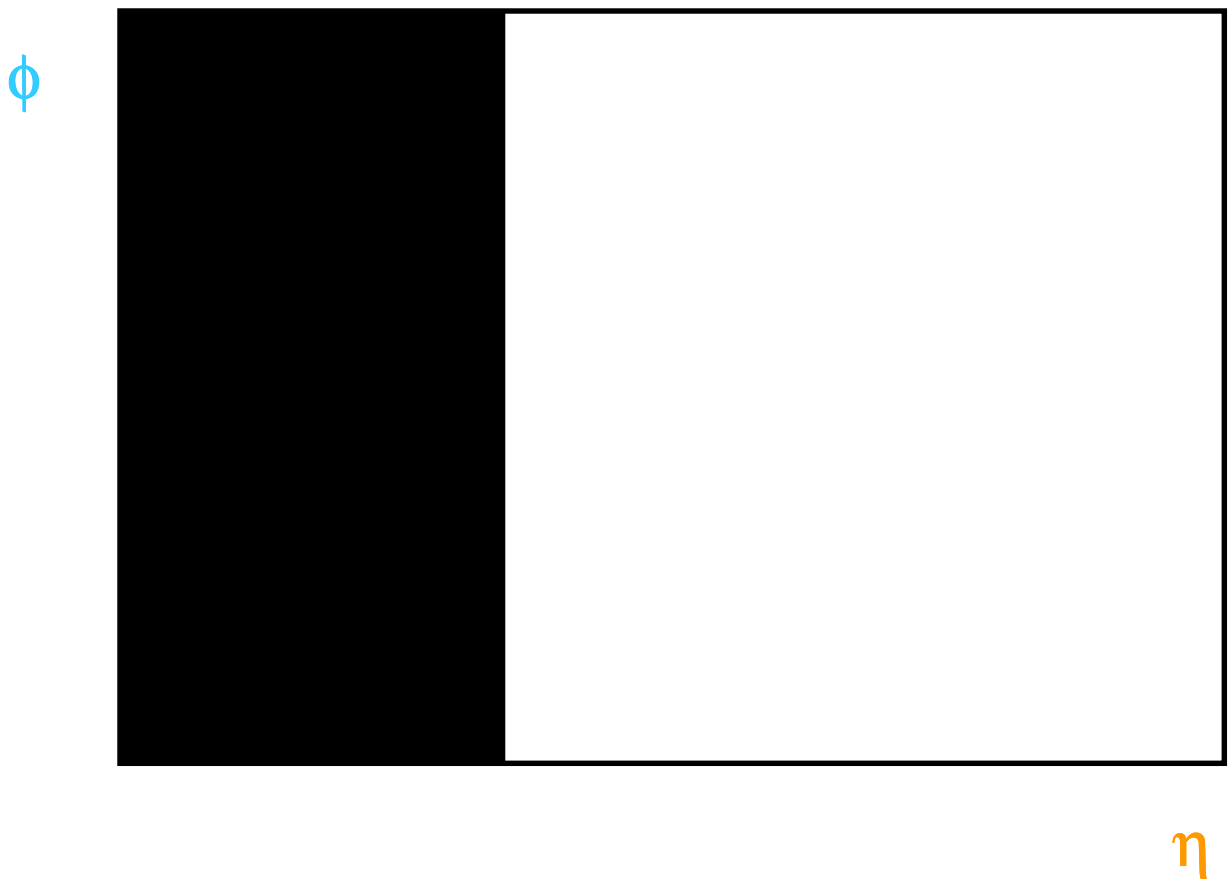




Binary Search Example



Binary Search Example



Binary Search Example

Binary Search Example

Binary Search Example

ϕ

η

Binary Search Example

ϕ

η

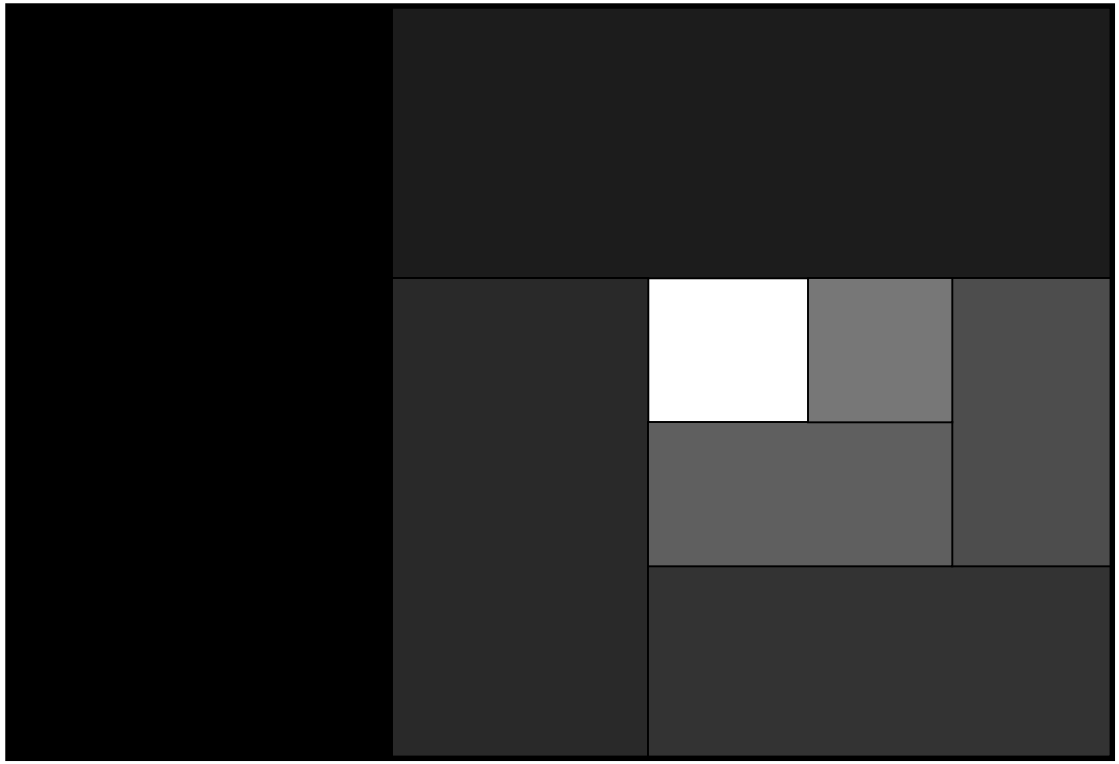
Binary Search Example

ϕ

η

Binary Search Example

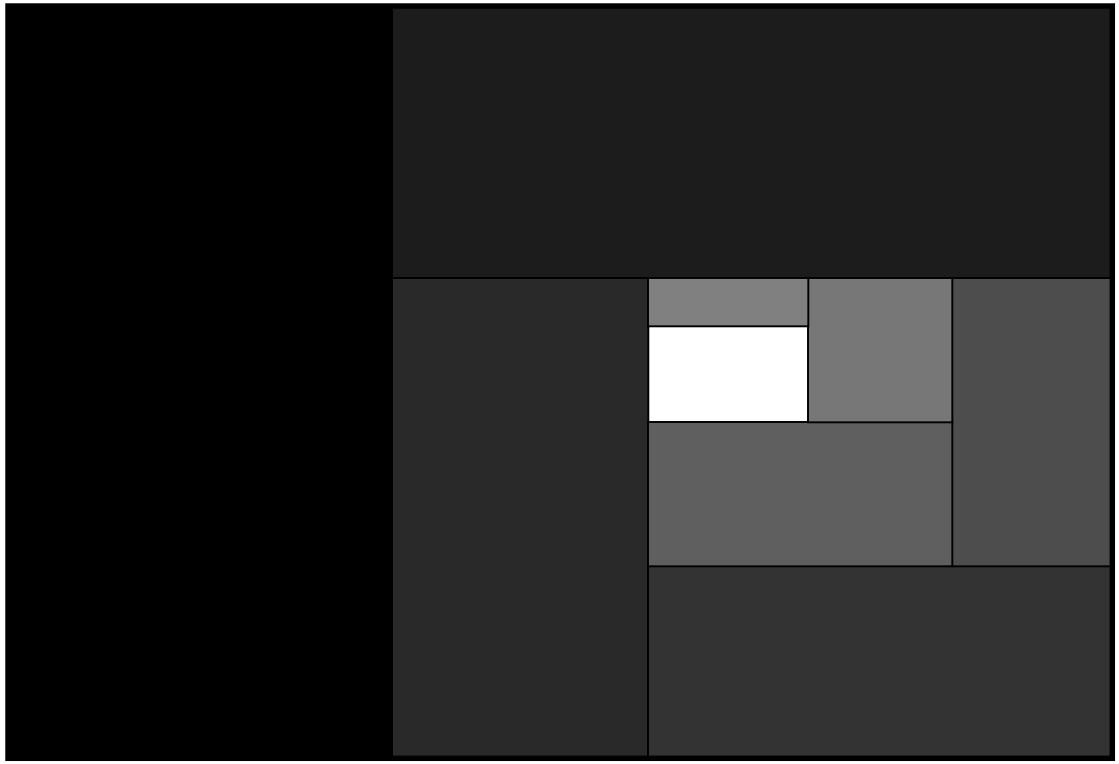
ϕ



η

Binary Search Example

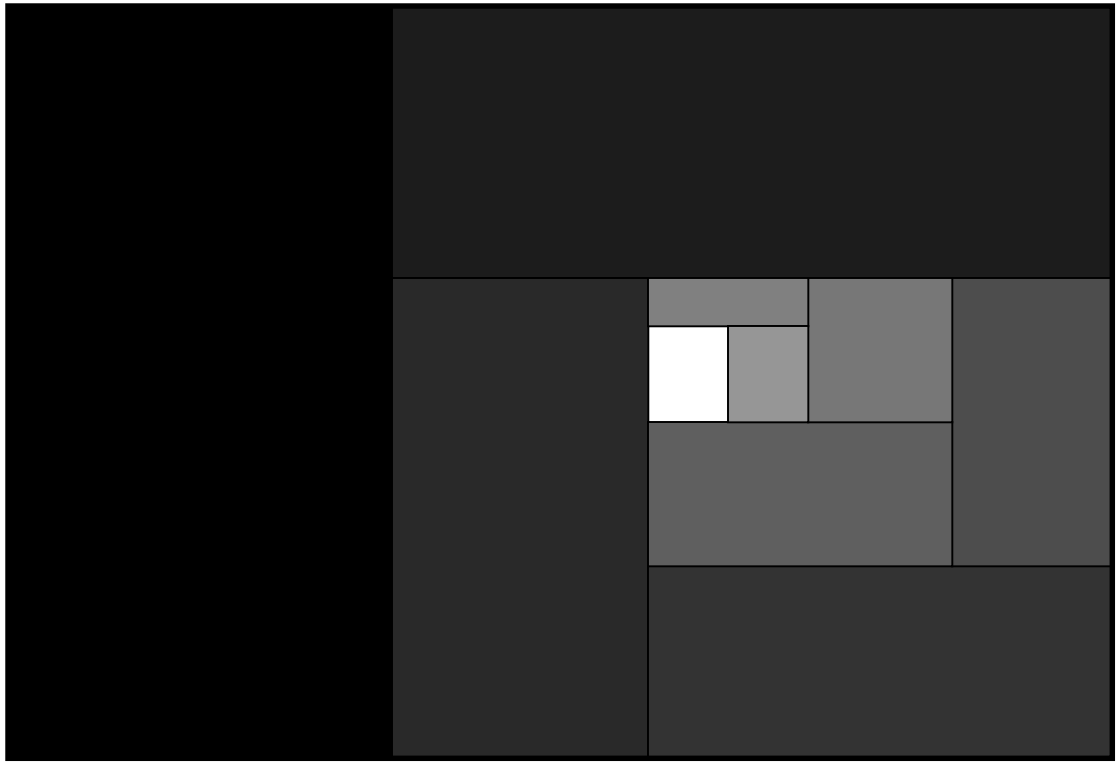
ϕ



η

Binary Search Example

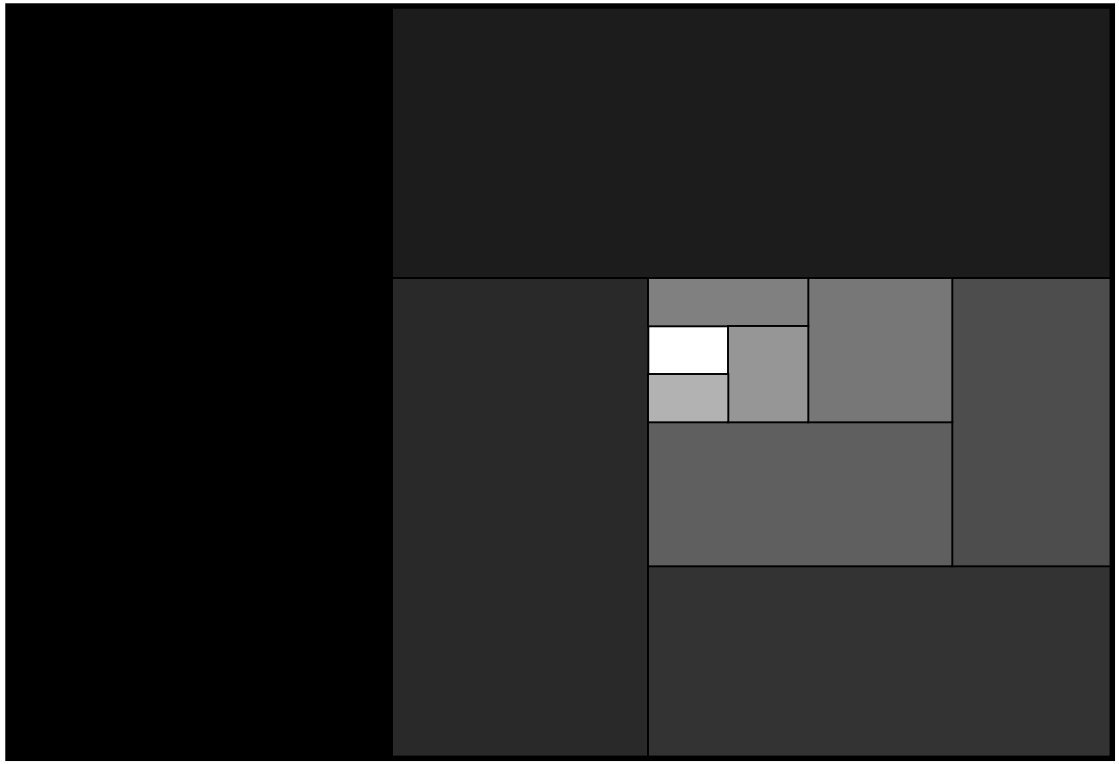
ϕ



η

Binary Search Example

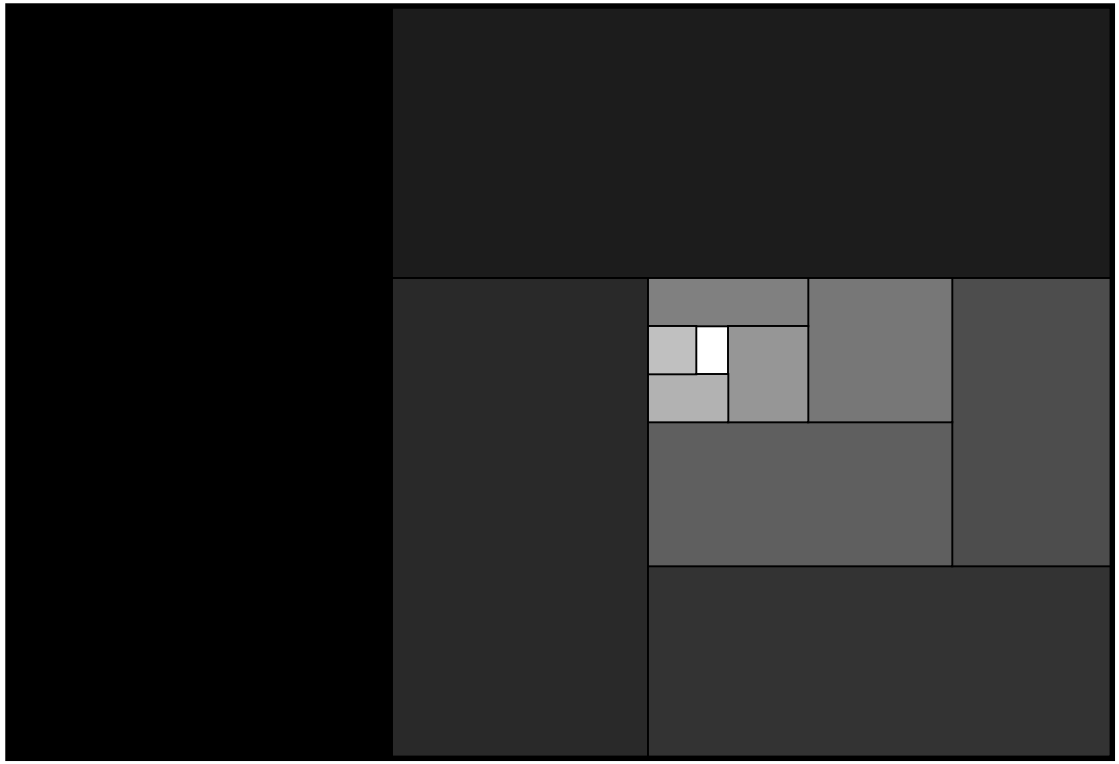
ϕ



η

Binary Search Example

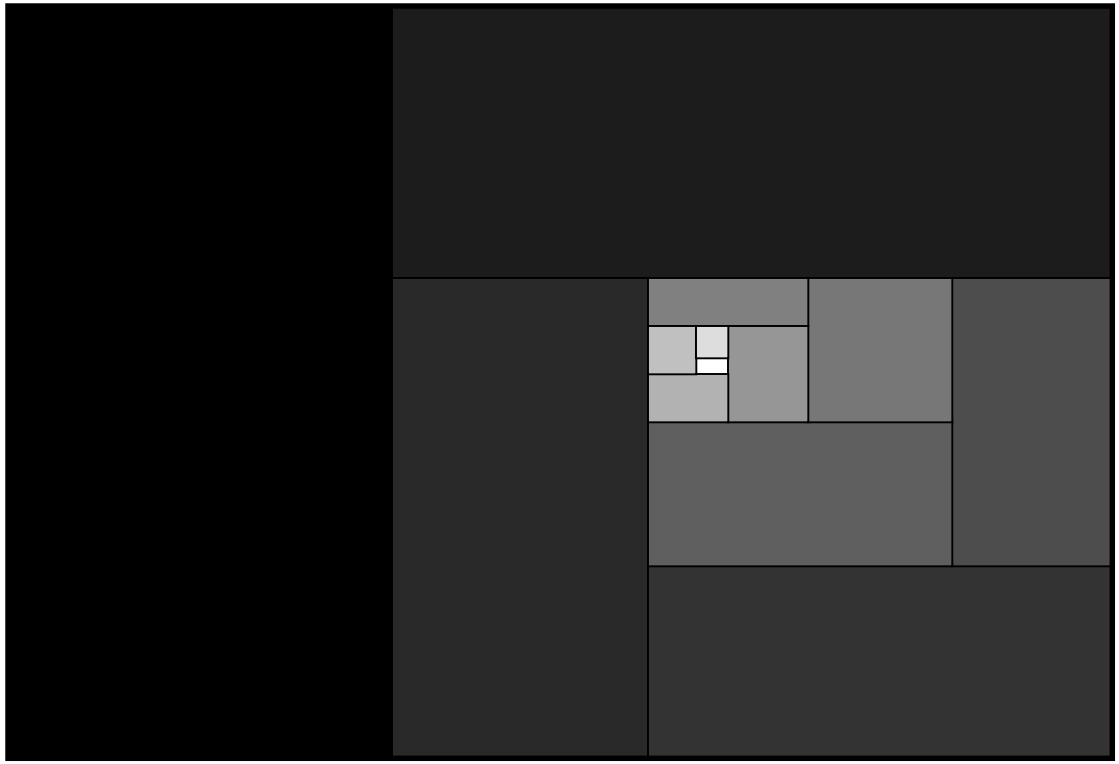
ϕ



η

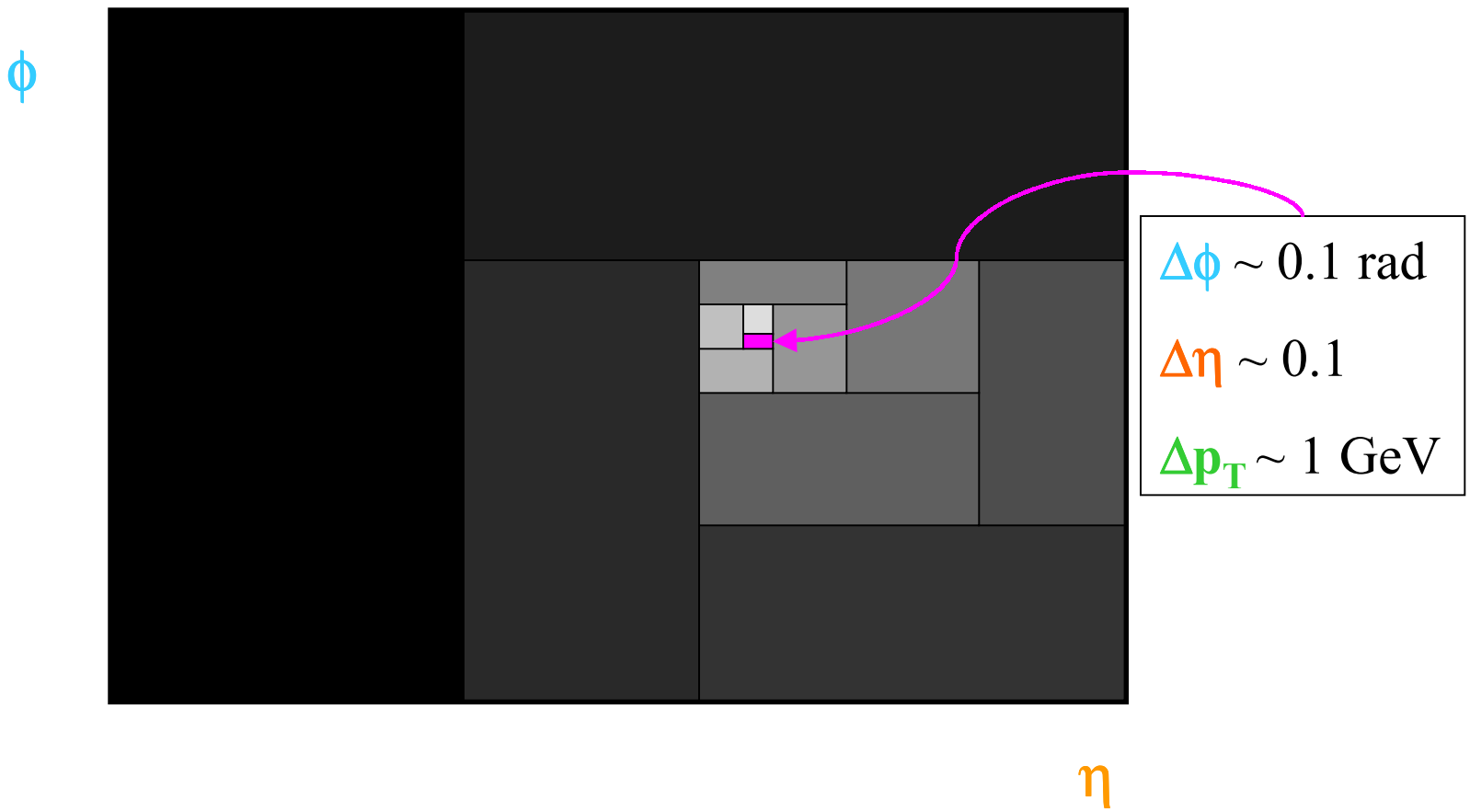
Binary Search Example

ϕ

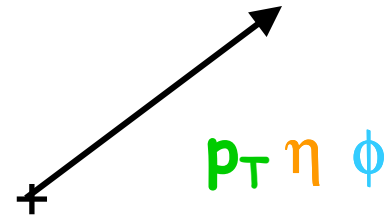


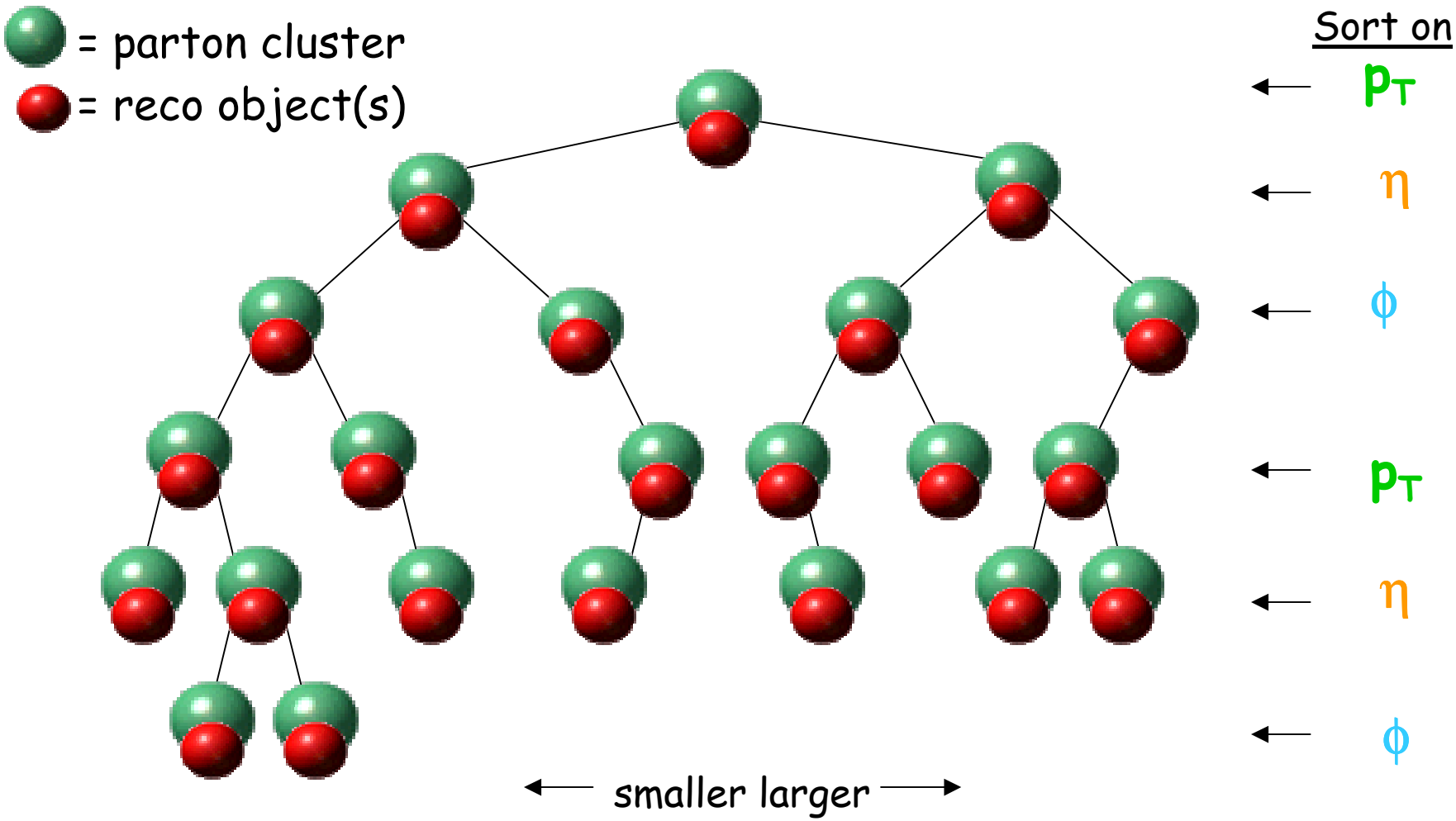
η

Binary Search Example

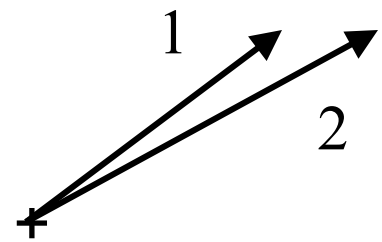


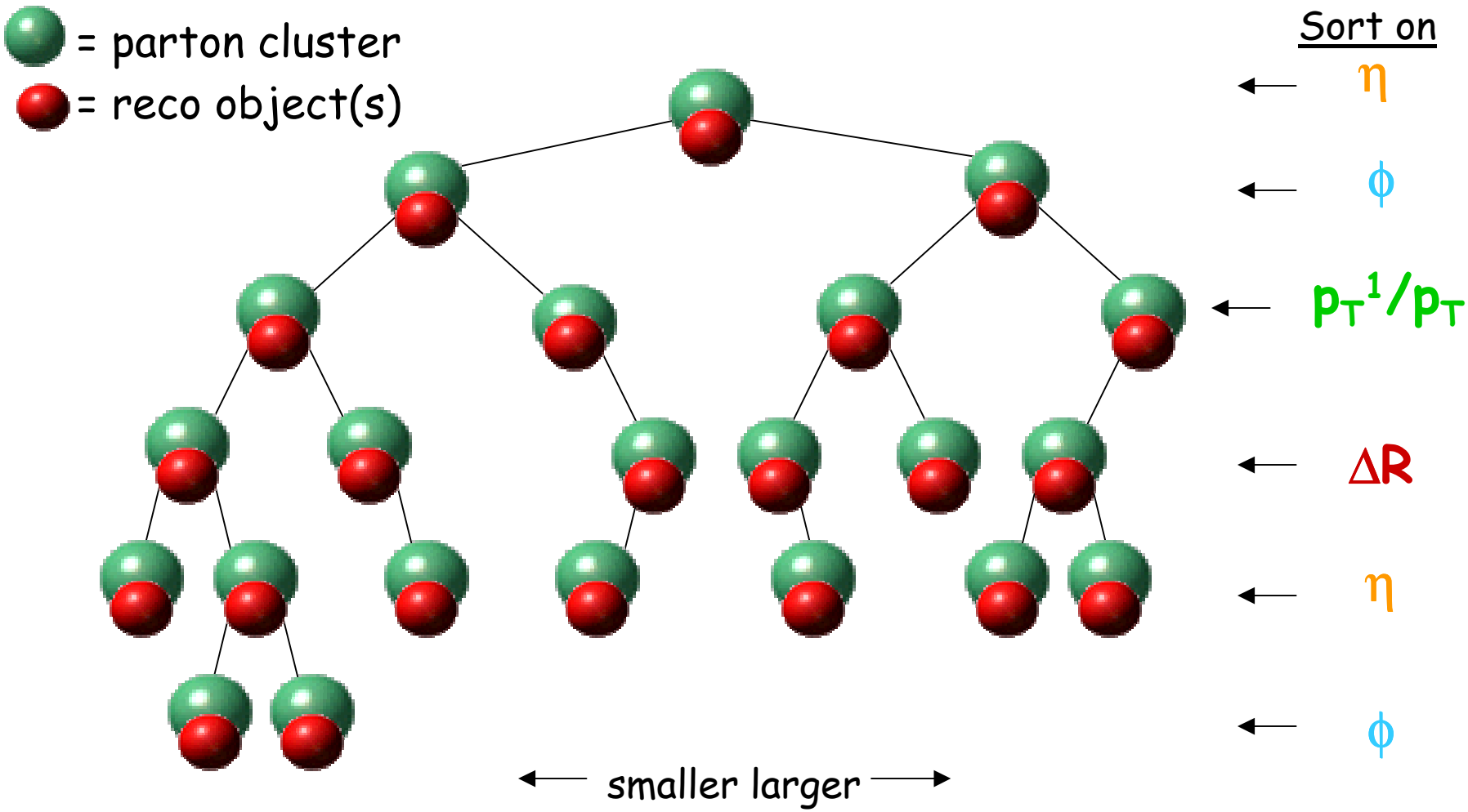
Binary Tree: Singlets



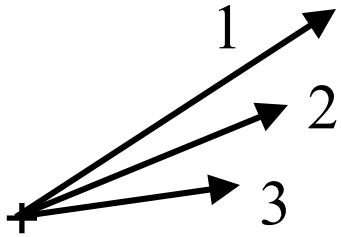


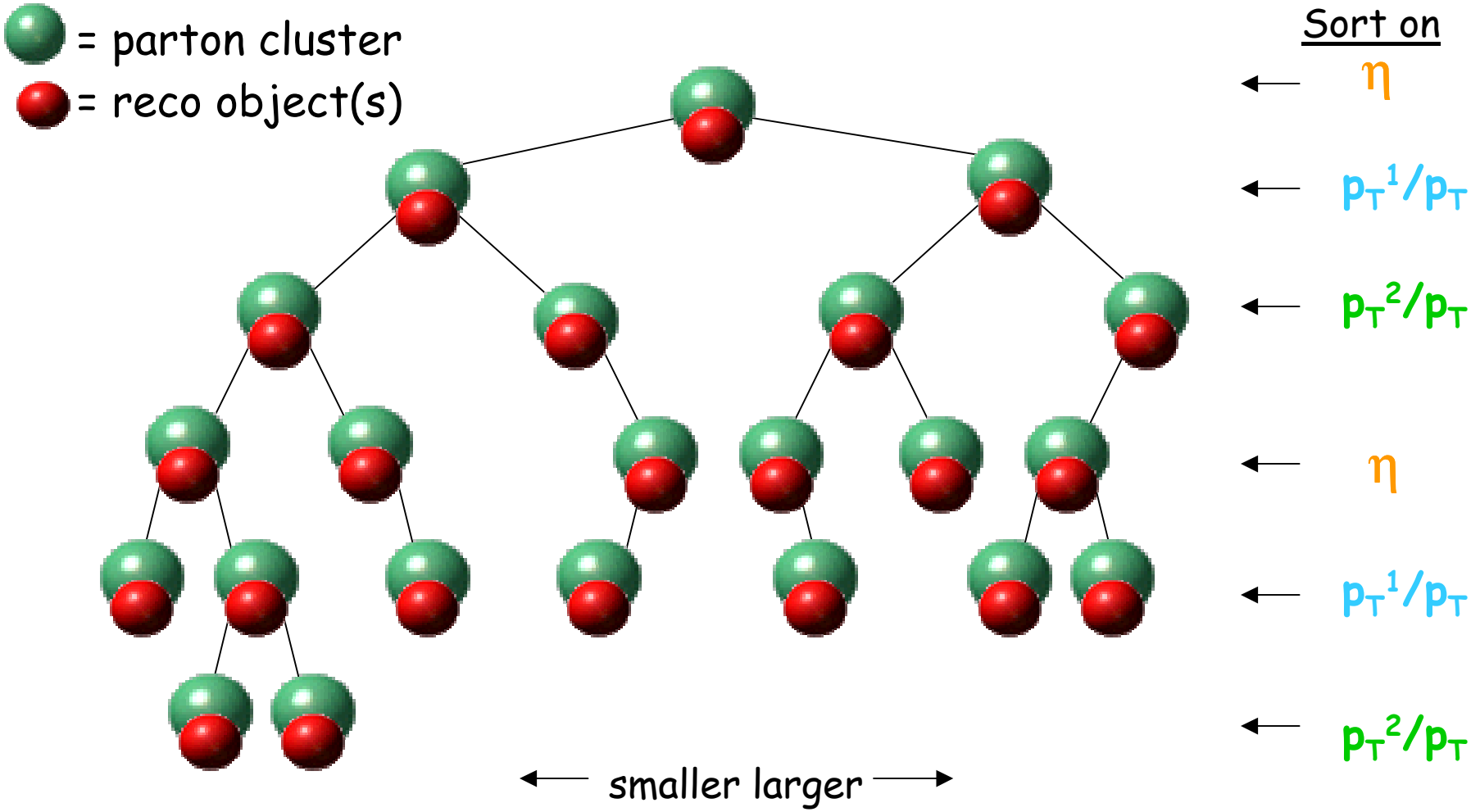
Binary Tree: Doublets





Binary Tree: Triplets





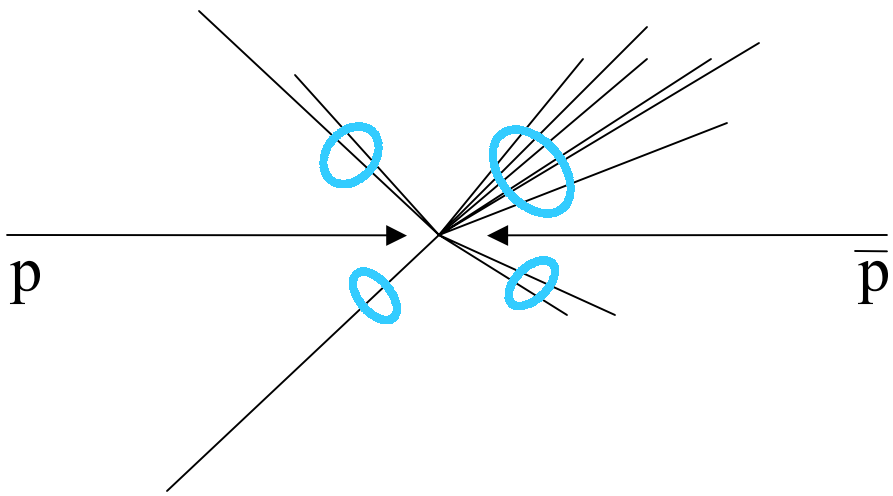
Application

```
> turboSim  table.txt  partonEvents.txt  recoEvents.txt
```

input input output

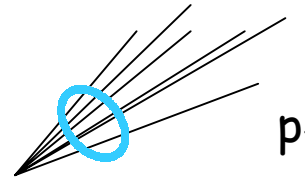
1. Take sample of stdhep events

- Cluster parton objects
  - Cone algorithm (R = 0.5)

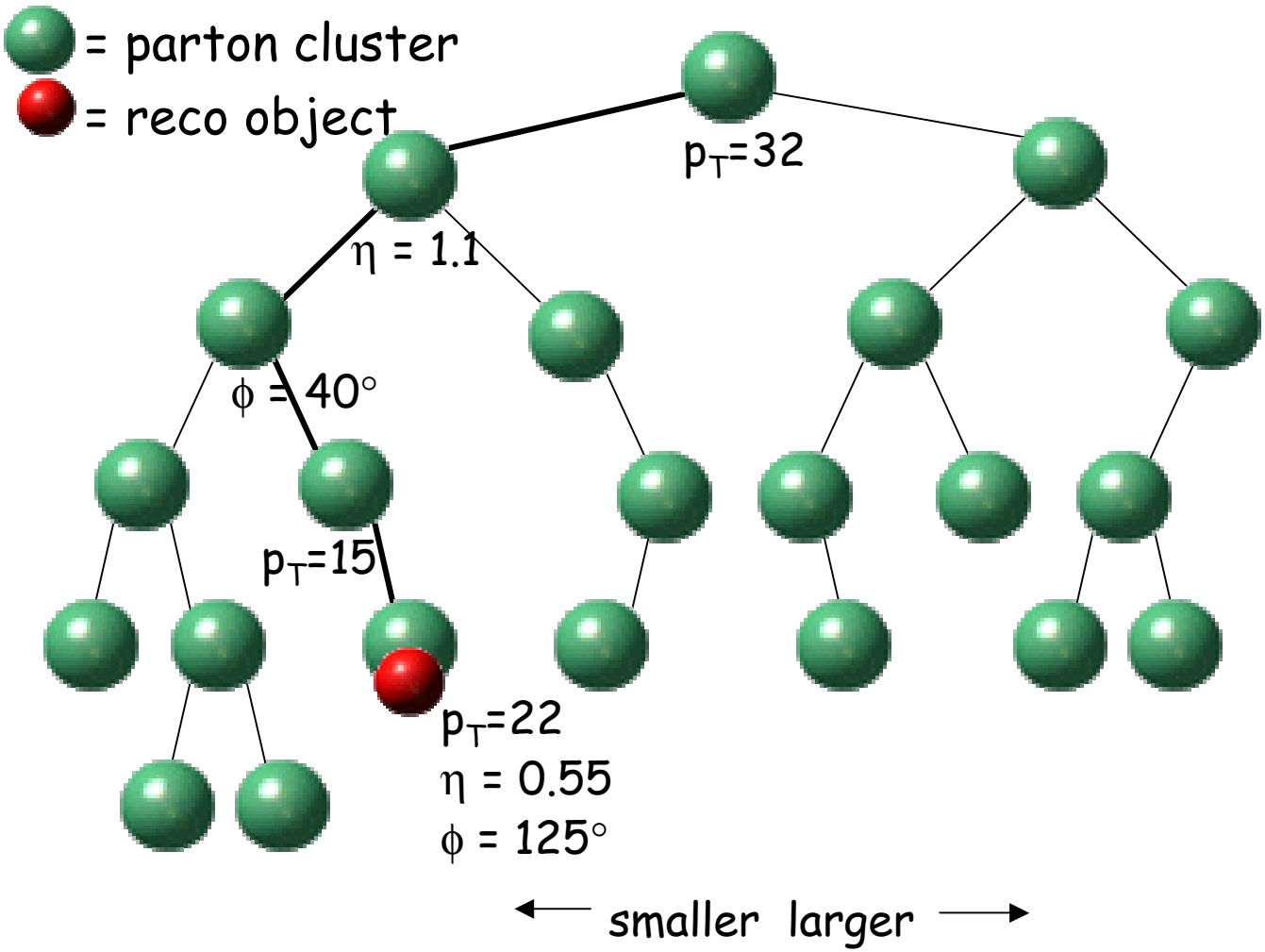


† Different

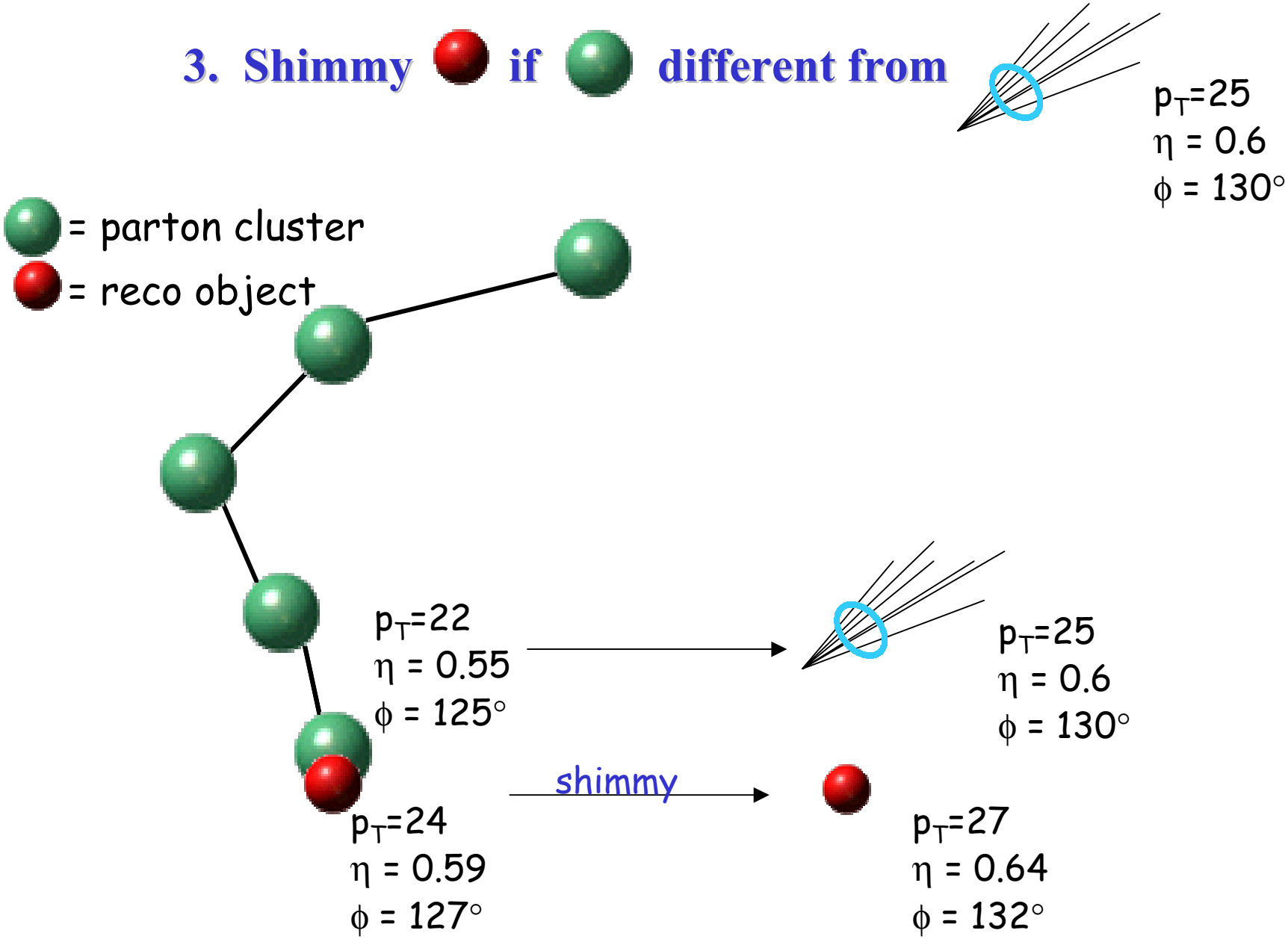
2. For each cluster, walk the tree



p_T=25
η = 0.6
ϕ = 130°



3. Shimmy if different from



(This step is irrelevant in the large lookup table limit)

Test Results

Mon Aug 4 14:02:32 CDT 2003

With 9522 distributions considered in 766 final states,

Dissimilarities follow:

	Final state		turboSim	cdfSim	
*	1j [399]	+9.9	3983[illegible]	367[illegible]3	+- 1[illegible] 8
*	1mu-1b [532]	+8.7	4[illegible]	176	+- 14.3
*	1mu+1mu-1b [429]	+7.2	245	92	+- 10.6
*	1mu+1b [412]	+7	364	175	+- 14.2
*	1ph1j [627]	+6.8	18506	17038	+- 131.5
*	1ph2j [642]	+4.2	5670	5089	+- 72.3
*	2b [837]	-4	684	904	+- 31.1
*	3ph [940]	-3.4	1233	1495	+- 39.7
*	1e+1b [3]	-3.2	3382	3792	+- 62.6
*	2j [878]	+2.9	20127	19205	+- 139.6
*	1e-1ph1b [296]	+2.9	380	261	+- 17.2
*	1e+1e- [6]	-2.9	16053	16888	+- 131
*	1j2b [403]	-2.4	820	1006	+- 32.7
*	1e+2b [199]	-2.1	457	593	+- 25.4
*	1tau-2b [805]	-1.9	67	126	+- 12.2
*	1e+2ph [223]	-1.6	1489	1708	+- 42.3
*	1e+1ph [118]	-1.5	17291	18001	+- 135.2
	2e+ [840]	+1.1	321	234	+- 16.3
	1ph1b [624]	-0.9	976	1140	+- 34.8
	2ph1b [892]	+0.8	242	169	+- 14
	1b [1]	+0.5	2440	2209	+- 48
	1e-2b [347]	-0.4	109	167	+- 13.9
	1e+1ph1b [121]	+0.3	375	288	+- 18
	2e+1j [851]	+0.1	129	80	+- 9.9
	1tau-1j [779]	0	1040	1192	+- 35.5
	1ph3j [654]	0	1379	1216	+- 35.9
	1e-1ph1j [300]	0	5454	5129	+- 72.6
	1mu+1mu- [426]	0	9260	9681	+- 99.4
	1mu- [531]	0	16776	17332	+- 132.7
	1mu-2j [599]	0	1696	1877	+- 44.3
	1e+1e-1tau+ [-]	0	29	9	+- 4
	1mu-1ph1b [549]	0	47	21	+- 5.6
	1mu-1ph1j [553]	0	463	376	+- 20.4
	1e+4j [251]	0	496	406	+- 21.1
	1e+5j [259]	0	92	55	+- 8.4
	1mu+ [411]	0	16786	17313	+- 132.6
	1mu+2j [503]	0	1524	1687	+- 42.1
	1e+1tau+1j [156]	0	77	44	+- 7.6
	4ph [964]	0	109	157	+- 13.5
	1tau+1tau-2b [723]	0	10	30	+- 6.5
	1tau+ [674]	0	734	846	+- 30.1
	1mu+1ph2j1b [-]	0	14	2	+- 2.4
	1mu+1j1b [418]	0	669	573	+- 24.9
	2ph1j [896]	0	4591	4352	+- 67
	1e-2ph [363]	0	987	1102	+- 34.2
	1mu+1mu-1ph1b [-]	0	7	0	+- 1
	2e-3j [-]	0	7	0	+- 1
	1mu-1j1b [538]	0	668	581	+- 25.1
	2e-1j [866]	0	80	51	+- 8.1
	1e+1j2b [80]	0	196	248	+- 16.7
	5j1b [972]	0	81	52	+- 8.2
	2e+3j [-]	0	14	3	+- 2.7
	1e+1ph1j [125]	0	5849	5598	+- 75.8
	2e+1e-1j [-]	0	31	14	+- 4.7
	2ph2j1b [5127]	0	55	32	+- 6.7
	1ph5j [970]	0	61	37	+- 7.1
	1e+1mu+1mu-2j [-]	0	6	0	+- 1
	1ph2b [638]	0	160	205	+- 15.3
	1e+1e-3j1b [65]	0	44	24	+- 5.9
	1e+1e-2ph [53]	0	263	319	+- 18.9
	1mu+1mu-4j [465]	0	12	28	+- 6.3
	1e+1j [73]	0	30105	30655	+- 176.1
	1e+1ph4j1b [-]	0	9	1	+- 2
	1ph4j [662]	0	311	257	+- 17
	1ph6j [-]	0	18	6	+- 3.4
	1e-2ph1b [-]	0	11	2	+- 2.4
	3ph1b [-]	0	11	2	+- 2.4
	1e+1e-1ph1b [-]	0	21	8	+- 3.8
	1e+3ph [243]	0	178	223	+- 15.9
	1e+6j [-]	0	19	7	+- 3.6
	1e- [263]	0	10026	9733	+- 99.7
	1e+1mu-1b [90]	0	90	63	+- 8.9
	6j [976]	0	128	96	+- 10.8
	9j [-]	0	5	0	+- 1
	1e+1e-1ph1j1b [-]	0	12	3	+- 2.7
	1e+1mu+2j [-]	0	12	3	+- 2.7
	1mu-1ph1j2b [-]	0	12	3	+- 2.7
	1e-1ph [293]	0	15649	16012	+- 127.5
	1e+1tau-3j1b [-]	0	8	1	+- 2
	1mu-3j2b [-]	0	8	1	+- 2
	3ph1j1b [-]	0	8	1	+- 2
	1mu+1tau-1j1b [491]	0	46	69	+- 9.3
	1e+1mu-1j2b [-]	0	21	9	+- 4
	1e+1tau-2j1b [191]	0	22	39	+- 7.2
	1e-1mu+2j1b [-]	0	25	12	+- 4.5
	3ph1j [944]	0	253	210	+- 15.5
	2ph2j [908]	0	791	871	+- 30.5
	1e+1e-2j [45]	0	1938	2058	+- 46.4
	2e+2j [859]	0	44	27	+- 6.2
	1ph1j2b [634]	0	102	132	+- 12.5
	1e+1tau-1j2b [-]	0	11	3	+- 2.7
	1e+1mu-2j [106]	0	454	513	+- 23.6
	1mu+1j2b [422]	0	69	94	+- 10.7
	1tau+1ph3j [704]	0	10	22	+- 5.7
	1mu+1ph1b [-]	0	20	9	+- 4
	1e+1tau-1j [171]	0	151	186	+- 14.6
	1tau+1tau-1j1b [719]	0	78	104	+- 11.2
	1e-1tau-1j1b [-]	0	9	2	+- 2.4
	8j [-]	0	9	2	+- 2.4
	1e+2e-2j [-]	0	7	1	+- 2

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2e+2j1b [-]	0	7	1	+-	2
7j1b [-]	0	7	1	+-	2
1mu-2b [595]	0	95	123	+-	12.1
1tau-3j [825]	0	453	510	+-	23.6
1e+1e-1mu-1j [-]	0	4	0	+-	1
1e-1mu-1ph2j [-]	0	4	0	+-	1
1e-1mu-3j [-]	0	4	0	+-	1
1e-4j2b [-]	0	4	0	+-	1
1ph8j [-]	0	4	[illegible]	+-	1
1e-2j2b [359]	0	22	[illegible]	+-	7.1
2j2b [885]	0	[illegible]	[illegible]	+-	[illegible]
1mu+1ph1j [472]	0	149	119	+-	11.9
1mu+1mu-2j [453]	0	633	698	+-	27.4
1e+1e-2ph1j [57]	0	19	33	+-	6.7
1tau+1tau- [708]	0	73	97	+-	10.8
1e+1mu-1ph [-]	0	15	6	+-	3.4
2ph [889]	0	15193	15498	+-	125.5
1e+1tau+ [153]	0	76	55	+-	8.4
1e+1mu-3j [114]	0	97	124	+-	12.1
1tau+1tau-1b [711]	0	16	29	+-	6.4
1e+1mu-1j [94]	0	697	633	+-	26.2
1ph2j1b [646]	0	578	520	+-	23.8
1e+3j [235]	0	2311	2430	+-	50.3
1e-1ph2j1b [316]	0	79	58	+-	8.6
1tau-5j [-]	0	23	12	+-	4.5
1e+1mu-1ph2j [-]	0	10	3	+-	2.7
1e+2ph1b [-]	0	10	3	+-	2.7
2e+1j1b [-]	0	16	7	+-	3.6
1e+ [2]	0	44784	45283	+-	213.8
1mu+1mu-3j [461]	0	118	146	+-	13.1
1ph4j1b [666]	0	33	20	+-	5.5
1e-3j2b [-]	0	8	2	+-	2.4
1mu+1mu-2j1b [457]	0	64	46	+-	7.8
1mu+2b [499]	0	125	153	+-	13.4
1mu+1mu-1j2b [-]	0	17	8	+-	3.8
1mu-1ph3j1b [-]	0	6	1	+-	2
1e+3j2b [-]	0	14	6	+-	3.4
1e+3j1b [239]	0	237	203	+-	15.2
1e+1e-2b [41]	0	143	172	+-	14.1
1e+2e-1j [-]	0	22	12	+-	4.5
1e+1e-1b [9]	0	549	498	+-	23.3
1tau+2ph [755]	0	12	22	+-	5.7
1e+1e-1mu- [-]	0	3	0	+-	1
1e+1tau-1ph1b [-]	0	3	0	+-	1
1e-1ph3j2b [-]	0	3	0	+-	1
1mu+1j3b [-]	0	3	0	+-	1
1mu+1mu-1j3b [-]	0	3	0	+-	1
1mu+1tau+1ph [-]	0	3	0	+-	1
1mu-2ph3j [-]	0	3	0	+-	1
2e-1ph2j [-]	0	3	0	+-	1
1e+1tau-3j [195]	0	20	32	+-	6.7
1tau-1ph1j1b [797]	0	30	44	+-	7.6
1e+1e-1ph [25]	0	1269	1346	+-	37.7
1e-1tau+1j2b [-]	0	2	8	+-	3.8

1e+3b [-]	0	5	12	+-	4.5
1tau+3j2b [-]	0	7	2	+-	2.4
1e+1tau+3j [-]	0	1	6	+-	3.4
1e-1mu+1mu- [-]	0	10	4	+-	3
2e+1e-2j [-]	0	10	4	+-	3
1mu+1ph2j [480]	0	44	59	+-	8.7
1e-2j [351]	0	3181	3072	+-	56.4
1e-1j [267]	0	7843	7672	+-	88.6
1e-1tau+1ph [-]	0	28	18	+-	5.2
1tau-1b [7[illegible]6]	0	123	146	+-	13.1
2e+2e- [-]	0	5	1	+-	2
1mu+1j [415]	0	5880	6025	+-	78.6
1e+1ph4j [149]	0	49	36	+-	7
1tau-1j1b [782]	0	493	536	+-	24.2
1tau-1ph1b [-]	0	10	18	+-	5.2
1tau+5j [771]	0	14	23	+-	5.8
2e-1ph1j [-]	0	19	11	+-	4.3
1e-1tau- [-]	0	24	15	+-	4.9
1j3b [407]	0	36	25	+-	6
1e-1ph2j [312]	0	1153	1217	+-	35.9
1mu-1tau+2b [-]	0	11	5	+-	3.2
1ph2j2b [650]	0	30	42	+-	7.5
1e+1mu-2b [102]	0	44	58	+-	8.6
1e+1e-5j [-]	0	15	8	+-	3.8
1e+1e-1ph1j [29]	0	290	259	+-	17.1
1e-1tau+3j1b [-]	0	2	7	+-	3.6
3j [928]	0	8429	8596	+-	93.7
1e+1mu-1ph1j [-]	0	8	3	+-	2.7
1tau-4j [833]	0	82	100	+-	11
1e-1tau-1j [-]	0	16	9	+-	4
1mu+1ph [469]	0	407	372	+-	20.3
1e-2ph2j [371]	0	41	30	+-	6.5
1e+1mu-3j1b [-]	0	9	16	+-	5
1mu+1tau-2b [-]	0	9	16	+-	5
6j1b [-]	0	17	10	+-	4.2
2ph4j [920]	0	35	25	+-	6
1e+2e- [203]	0	73	89	+-	10.4
1tau-1j2b [786]	0	73	89	+-	10.4
1tau+1j [678]	0	1172	1231	+-	36.1
1tau+1ph3j1b [-]	0	1	5	+-	3.2
1mu+1mu-1ph [441]	0	55	69	+-	9.3
1mu-1tau- [592]	0	14	22	+-	5.7
2e-2j [874]	0	29	20	+-	5.5
1mu+1tau-1j [487]	0	81	66	+-	9.1
1e-1mu+1b [-]	0	23	15	+-	4.9
2e+1e- [843]	0	94	78	+-	9.8
1e+1e-1mu-2j [-]	0	2	0	+-	1
1e+1e-6j [-]	0	2	0	+-	1
1e+1mu-1ph2j2b [-]	0	2	0	+-	1
1e+1mu-4j1b [-]	0	2	0	+-	1
1e+1tau+4j [-]	0	2	0	+-	1
1e+2e-1b [-]	0	2	0	+-	1
1e+2ph3j1b [-]	0	2	0	+-	1
1e+2ph4j [-]	0	2	0	+-	1
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

6j2b [-]	0	2	0	+-	1
1e+1tau-1j1b [175]	0	90	107	+-	11.3
1e-3j [375]	0	920	970	+-	32.1
1e-1ph1j2b [-]	0	19	12	+-	4.5
1e+2j1b [215]	0	1006	956	+-	31.9
1mu-1ph2j [565]	0	206	230	+-	16.2
1e+1tau+1j1b [-]	0	10	5	+-	3.2
1tau+3j [759]	0	435	469	+-	22.7
1e-1ph1j1b [304]	0	319	291	+-	18.
1tau+1tau-2j1b [731]	0	17	25	+	5
1e+1mu+ [84]	0	13	2[illegible]	+	5.[illegible]
1e+1ph5j [-]	0	2	6	+-	3.4
1tau+1ph2j [700]	0	49	61	+-	8.8
1e-1tau-1ph [-]	0	21	14	+-	4.7
1e-1mu+1ph2j [-]	0	4	1	+-	2
1e-1tau+1ph2j [-]	0	4	1	+-	2
1mu+1ph4j [-]	0	4	1	+-	2
1e+1tau+1b [-]	0	5	10	+-	4.2
1e-1tau+4j [-]	0	7	3	+-	2.7
1mu+1tau-1j2b [-]	0	7	3	+-	2.7
1e-3ph [383]	0	175	196	+-	15
1mu+1mu-1tau- [-]	0	9	15	+-	4.9
1e-1mu-2j [-]	0	11	6	+-	3.4
1mu+2j2b [511]	0	15	22	+-	5.7
1mu-4j1b [-]	0	17	11	+-	4.3
1e+1e-1ph3j [-]	0	12	7	+-	3.6
1e+1tau-2b [183]	0	16	23	+-	5.8
1e-1mu+1j2b [-]	0	3	7	+-	3.6
1e-1ph3j [320]	0	220	242	+-	16.6
1e+1e-1j [13]	0	7029	6913	+-	84.1
1tau-1ph3j [-]	0	18	12	+-	4.5
1ph [623]	0	32958	33209	+-	183.2
1e-6j [-]	0	8	4	+-	3
1e-5j [395]	0	42	33	+-	6.7
1mu-3j [607]	0	548	516	+-	23.7
1mu-1tau+1j [580]	0	63	75	+-	9.7
1e+1tau- [164]	0	237	216	+-	15.7
1mu+5j [527]	0	18	25	+-	6
2e-2ph [-]	0	13	8	+-	3.8
1e+1mu-4j [-]	0	13	19	+-	5.4
1e+1e-1tau-1j [-]	0	4	8	+-	3.8
1mu-1tau+1b [-]	0	8	13	+-	4.6
1e-1tau-1b [-]	0	5	2	+-	2.4
1tau-5j1b [-]	0	5	2	+-	2.4
2e+1ph2j [-]	0	5	2	+-	2.4
1e-1mu+1j [281]	0	101	115	+-	11.7
1e+1mu+1mu- [-]	0	9	5	+-	3.2
1e+1tau-4j [-]	0	9	5	+-	3.2
1mu+1mu-3j1b [-]	0	9	5	+-	3.2
1mu+1tau+1j [-]	0	9	5	+-	3.2
1ph1j1b [630]	0	1127	1171	+-	35.2
1mu-1ph3j [573]	0	49	59	+-	8.7
1e+1e-1tau- [37]	0	15	21	+-	5.6
1tau+1j2b [685]	0	63	74	+-	9.6
[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]

1e-1ph5j [-]	0	8	5	+-	3.2
1mu-5j [619]	0	18	23	+-	5.8
1tau+1j1b [681]	0	512	535	+-	24.1
1tau+1ph [689]	0	157	170	+-	14
1tau+1tau-3j1b [-]	0	1	3	+-	2.7
1tau+3b [-]	0	1	3	+-	2.7
1tau+5j1b [-]	0	1	3	+-	2.7
1tau-1j3b [-]	0	1	3	+-	2.7
1e+1e-2ph2j [-]	0	5	8	+-	3.8
1e-1tau-1ph1j[illegible] [-]	0	5	8	+-	3.8
1e-1tau-2j [-]	0	16	12	+-	4.5
1mu-2j2b [-]	0	16	12	+-	4.5
1e+1e-1j2b [21]	0	47	54	+-	8.3
1mu+1ph3j [-]	0	13	17	+-	5.1
1ph3b [-]	0	4	2	+-	2.4
2e+1mu-1j [-]	0	4	2	+-	2.4
2e-1b [-]	0	4	2	+-	2.4
2tau-1j [-]	0	4	2	+-	2.4
3e+ [-]	0	4	2	+-	2.4
2e+2ph [-]	0	18	14	+-	4.7
3ph2j [948]	0	29	24	+-	5.9
1e-1mu+2j [289]	0	69	77	+-	9.8
1e+1tau-1ph [179]	0	24	29	+-	6.4
1e-2j1b [355]	0	460	441	+-	22
1e+1ph3j [145]	0	248	234	+-	16.3
1e-1ph3j1b [-]	0	19	15	+-	4.9
1tau+1ph1j1b [696]	0	31	26	+-	6.1
1e+1mu-1tau+1j [-]	0	2	4	+-	3
1e-3ph2j [-]	0	2	4	+-	3
1mu+5j1b [-]	0	2	4	+-	3
2e+1e-1b [-]	0	2	4	+-	3
4j2b [960]	0	16	20	+-	5.5
1tau+2j [743]	0	1089	1062	+-	33.6
1mu+1mu-2b [449]	0	51	45	+-	7.7
1e+2ph1j [227]	0	240	253	+-	16.9
3ph3j [-]	0	5	3	+-	2.7
1mu+1mu-2j2b [-]	0	3	5	+-	3.2
1tau+1tau-4j [-]	0	3	5	+-	3.2
2e-1j1b [-]	0	3	5	+-	3.2
1mu+3j1b [519]	0	70	77	+-	9.8
1tau+3j1b [763]	0	80	73	+-	9.5
4j1b [956]	0	339	325	+-	19
1mu+3j [515]	0	486	503	+-	23.4
1e+1tau-2j [187]	0	142	133	+-	12.5
1mu+1tau-2j1b [-]	0	11	14	+-	4.7
1e+2ph1j1b [-]	0	6	4	+-	3
1tau+2b [739]	0	105	113	+-	11.6
1mu-1j [535]	0	6194	6137	+-	79.3
5j [968]	0	541	524	+-	23.9
1tau+1tau-2j [727]	0	111	119	+-	11.9
2e-1ph [870]	0	66	60	+-	8.7
1e-1tau+2j1b [-]	0	12	15	+-	4.9
1tau-3j2b [-]	0	4	6	+-	3.4
2e-2j1b [-]	0	4	6	+-	3.4
1tau+2j1b [747]	0	317	330	+-	19.2

2ph3j1b [-]	0	2	3	+-	2.7
2ph3j [916]	0	163	157	+-	13.5
1mu+1tau-2j [495]	0	72	76	+-	9.7
1mu+2j1b [507]	0	319	311	+-	18.6
1mu+1tau+ [-]	0	19	17	+-	5.1
7j [-]	0	19	17	+-	5.1
1e+1mu-1ph1j1b [-]	0	4	3	+-	2.7
1e-1tau+2ph [-]	0	4	3	+-	2.7
1mu-1tau-1j [-]	0	4	3	+-	2.7
2ph5j [-]	0	4	3	+-	2.7
1e-2ph3j [-]	0	3	4	+-	3
1mu+1tau-4j [-]	0	3	4	+-	3
1e+1mu-1j1b [98]	0	276	283	+-	17.8
1tau+2j2b [751]	0	19	21	+-	5.6
3j1b [932]	0	1574	1558	+-	40.5
2ph1j1b [900]	0	157	152	+-	13.3
1e-2ph1j1b [-]	0	5	4	+-	3
1ph5j1b [-]	0	5	4	+-	3
1e+2j2b [219]	0	57	54	+-	8.3
1e+1tau+1ph [160]	0	24	22	+-	5.7
1e-1mu+1j1b [285]	0	54	57	+-	8.5
1e-1mu-1j1b [-]	0	4	5	+-	3.2
1tau+1ph1j2b [-]	0	4	5	+-	3.2
1tau+2ph1j [-]	0	4	5	+-	3.2
1e-1tau+1b [331]	0	24	26	+-	6.1
3j2b [936]	0	110	114	+-	11.7
1mu+3j2b [-]	0	6	5	+-	3.2
1mu-2ph1j [-]	0	6	5	+-	3.2
2j3b [-]	0	6	5	+-	3.2
1e-1tau+ [328]	0	140	136	+-	12.7
1tau-2j1b [813]	0	340	334	+-	19.3
1tau+1ph2j1b [-]	0	8	7	+-	3.6
1tau+1ph2b [-]	0	7	8	+-	3.8
1e+1mu- [87]	0	554	547	+-	24.4
1e+1e-1tau+1j [-]	0	8	9	+-	4
1mu-4j [615]	0	100	103	+-	11.1
1e+2ph2j [231]	0	44	42	+-	7.5
1e+1ph2j [137]	0	1239	1229	+-	36.1
1e-2ph1j [367]	0	194	190	+-	14.8
2ph1j2b [-]	0	10	9	+-	4
4ph1j [-]	0	9	10	+-	4.2
1tau+1ph1b [-]	0	10	11	+-	4.3
1mu+1mu-1j1b [437]	0	228	232	+-	16.2
1tau-4j1b [-]	0	12	13	+-	4.6
1e-1j1b [270]	0	804	797	+-	29.2
1mu+4j1b [-]	0	14	13	+-	4.6
1e-1tau+2b [-]	0	13	14	+-	4.7
1e-1mu-1j [-]	0	14	15	+-	4.9
1mu+1tau-3j [-]	0	15	16	+-	5
1e-1mu+ [278]	0	185	182	+-	14.5
1e-1mu+3j [-]	0	18	19	+-	5.4
1e-1tau+3j [-]	0	18	19	+-	5.4
1e+1e-2j1b [49]	0	199	196	+-	15
1e+3ph1j [247]	0	19	20	+-	5.5
1e+1e-3j [61]	0	397	401	+-	21

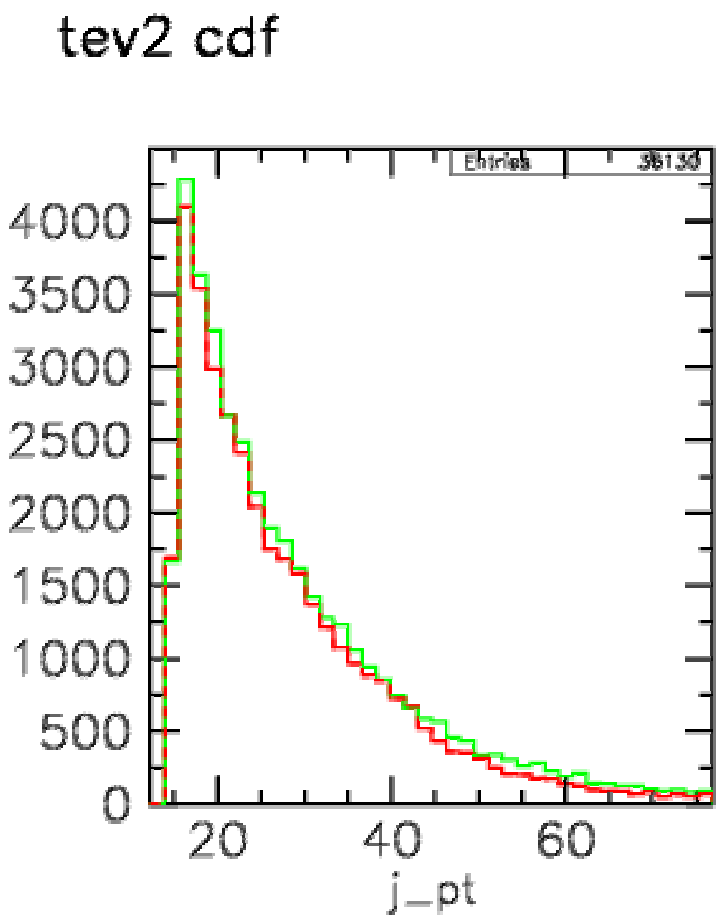
2e+1ph [855]	0	107	109	+-	11.4
1mu+4j [523]	0	109	111	+-	11.5
1mu+1mu-1j [433]	0	3068	3078	+-	56.5
1e+1tau-1b [167]	0	30	31	+-	6.6
1mu-1tau+1j1b [584]	0	34	35	+-	6.9
1e-1ph4j [324]	0	39	38	+-	7.2
1e+4j1b [255]	0	45	44	+-	7.6
1e-1ph2b [308]	0	52	53	+-	8.3
1mu-1tau+ [577]	0	62	61	+-	8.8
1e+1ph2j [[illegible]]	0	61	62	+-	8.9
1mu-3j1b [[illegible]]	0	64	63	+-	8.9
1mu-1j2b [542]	0	66	67	+-	9.2
1e-1tau+1j1b [339]	0	69	70	+-	9.4
1e+1ph2j1b [141]	0	76	75	+-	9.7
1e+1ph1j1b [129]	0	365	367	+-	20.2
1tau+1ph1j [692]	0	100	99	+-	10.9
1ph3j1b [658]	0	132	131	+-	12.4
1mu-1ph [546]	0	555	557	+-	24.6
1e+2j [211]	0	11120	11127	+-	106.5
1e+1e-1ph2b [-]	0	4	4	+-	3
1e+1e-1ph2j1b [-]	0	1	1	+-	2
1e+1e-1tau+1ph [-]	0	1	1	+-	2
1e+1e-3ph [-]	0	1	1	+-	2
1e+1e-4j1b [-]	0	2	2	+-	2.4
1e+1j3b [-]	0	5	5	+-	3.2
1e+1mu+3j [-]	0	2	2	+-	2.4
1e+1mu-1ph1b [-]	0	1	1	+-	2
1e+1mu-1ph3j [-]	0	2	2	+-	2.4
1e+1mu-2j1b [110]	0	72	72	+-	9.5
1e+1mu-2j2b [-]	0	4	4	+-	3
1e+1ph2j2b [-]	0	4	4	+-	3
1e+1ph3j2b [-]	0	1	1	+-	2
1e+1tau+1ph1j [-]	0	5	5	+-	3.2
1e+1tau+1ph2j [-]	0	2	2	+-	2.4
1e+1tau-1ph1j [-]	0	8	8	+-	3.8
1e+1tau-2j2b [-]	0	1	1	+-	2
1e+1tau-2ph [-]	0	2	2	+-	2.4
1e+2e-1ph [207]	0	21	21	+-	5.6
1e+2tau- [-]	0	1	1	+-	2
1e+2tau-3j [-]	0	1	1	+-	2
1e+7j [-]	0	1	1	+-	2
1e-1j3b [-]	0	1	1	+-	2
1e-1mu+1mu-1b [-]	0	1	1	+-	2
1e-1mu+1mu-1j [-]	0	2	2	+-	2.4
1e-1mu+1tau- [-]	0	1	1	+-	2
1e-1mu+4j [-]	0	5	5	+-	3.2
1e-1mu-1ph1j [-]	0	1	1	+-	2
1e-1mu-2b [-]	0	2	2	+-	2.4
1e-1ph4j1b [-]	0	3	3	+-	2.7
1e-1ph6j [-]	0	1	1	+-	2
1e-1tau+1j [335]	0	132	132	+-	12.5
1e-1tau+1ph1j1b [-]	0	2	2	+-	2.4
1e-1tau+5j [-]	0	1	1	+-	2
1e-1tau-1ph2j [-]	0	2	2	+-	2.4
[illegible]	0	1	1	[illegible]	[illegible]

Jets

Example of disagreement at greater than 10σ

TurboSim

CdfSim



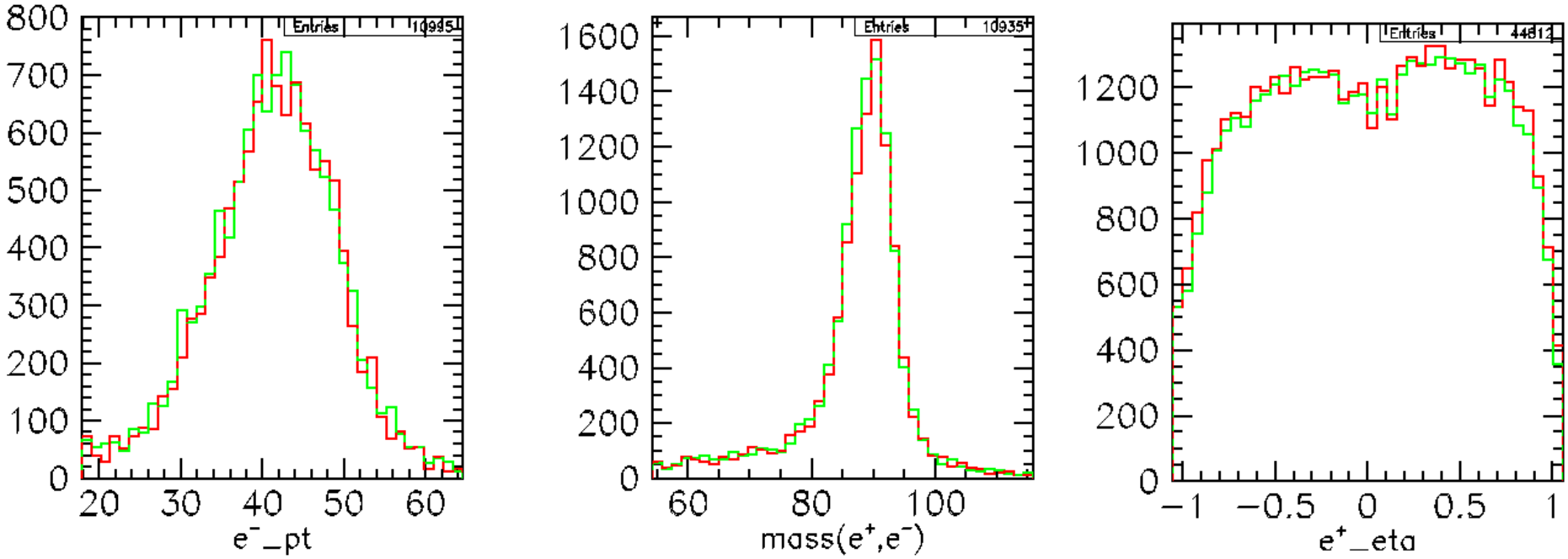
The worst distribution in the only final state with normalization disagreement larger than 10 σ

Electrons

TurboSim

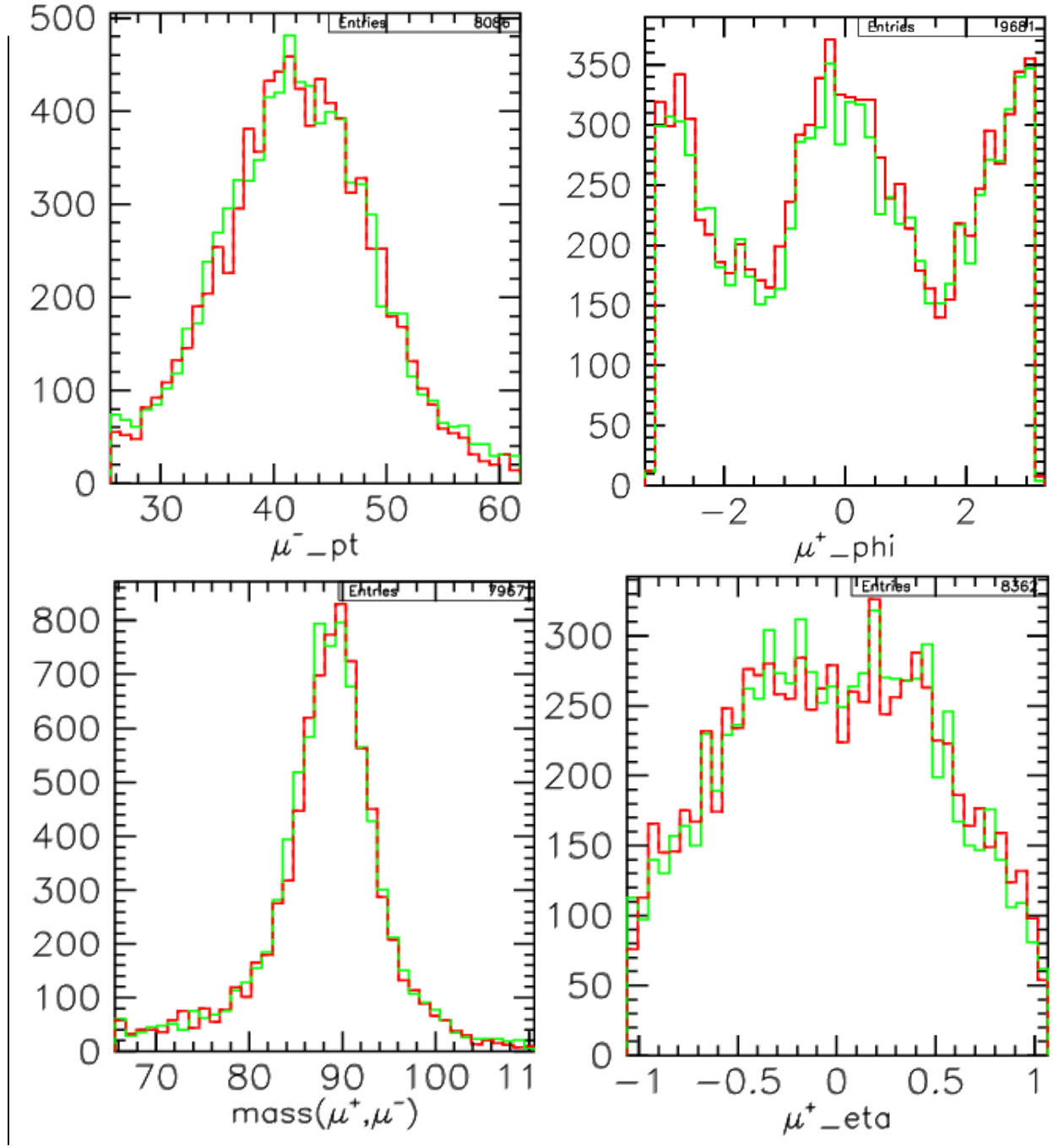
CdfSim

e^+e^-



$\mu^+ \mu^-$

Muons



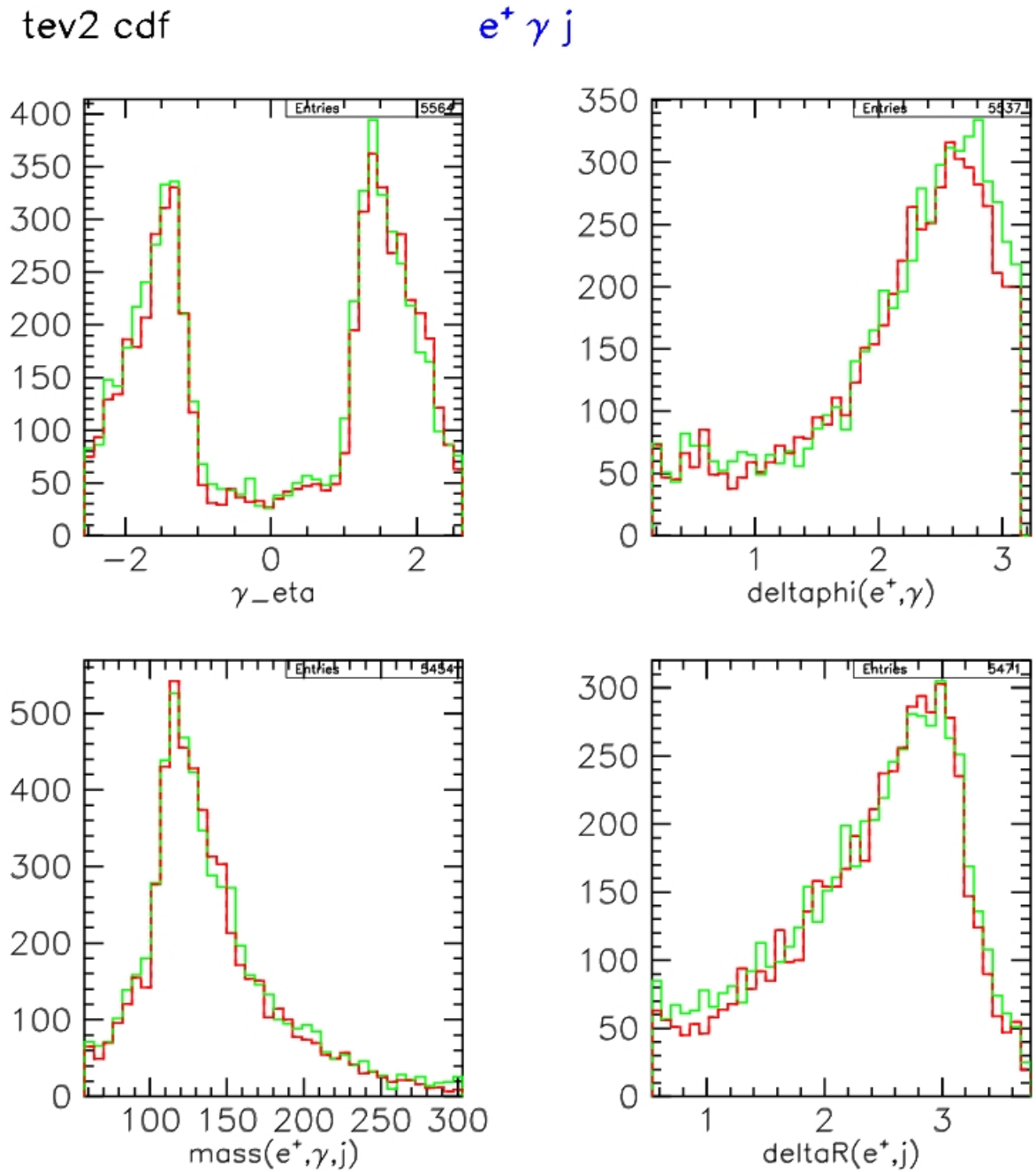
TurboSim

CdfSim

A More Complicated Final State

TurboSim

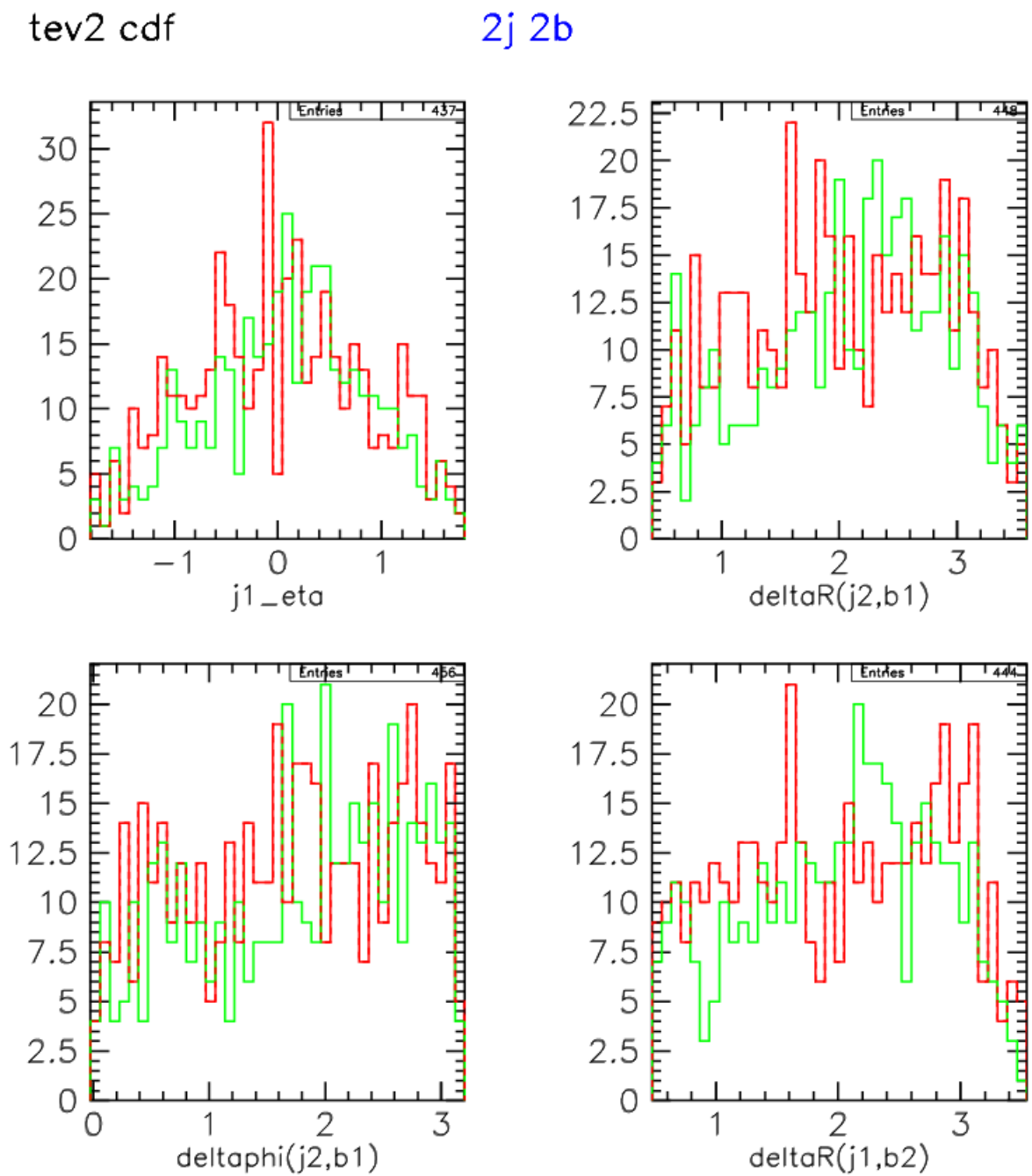
CdfSim



Objects Close Together

TurboSim

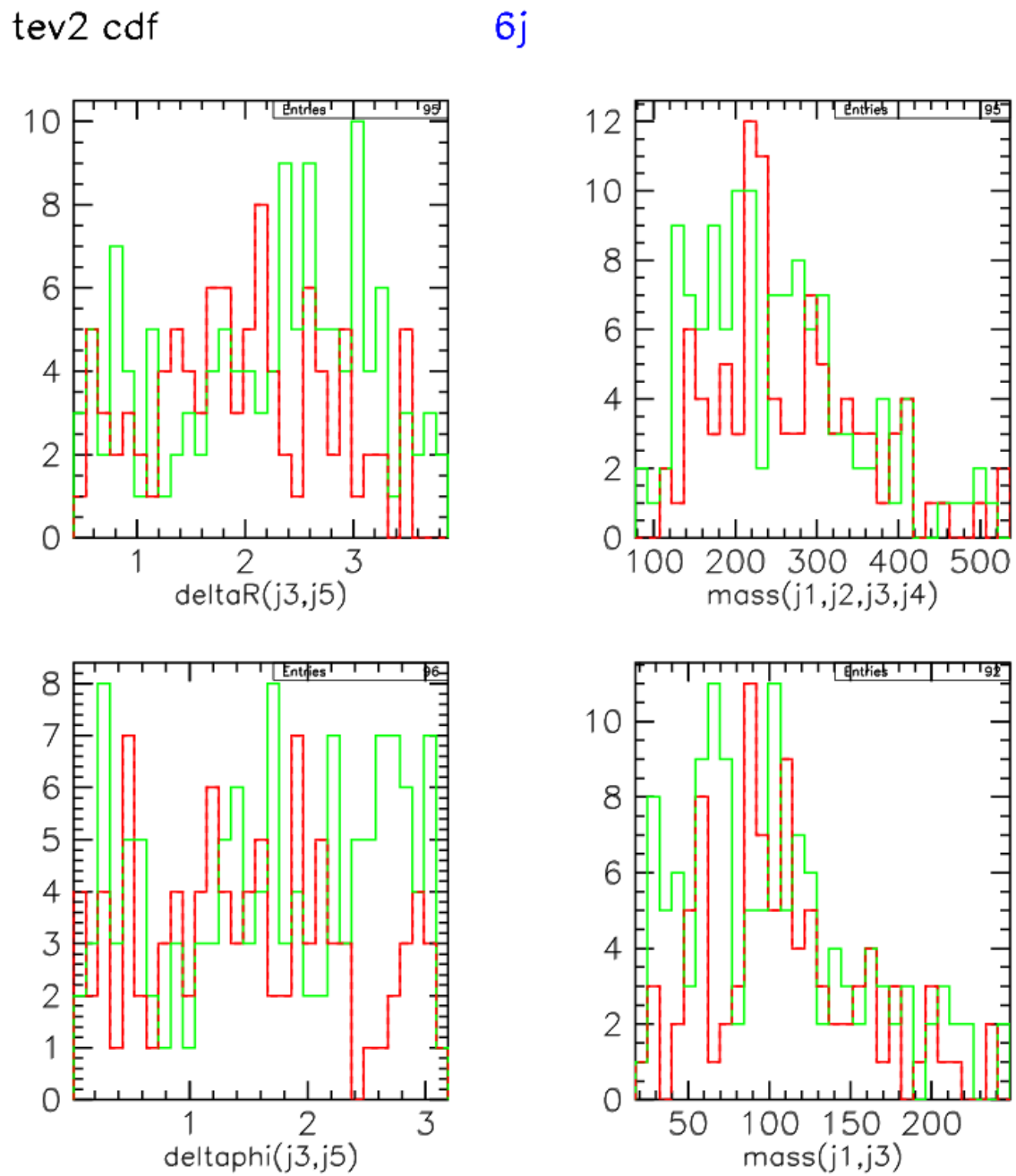
CdfSim



The 4 Most Discrepant Distributions in 6j

TurboSim

CdfSim



Summary

- TurboSim – self-tuning detector simulation
- Uses knowledge of full CDF simulation
- Application to any frontier-energy experiment
- Initial results look promising
- Real test is future analysis