

# TurboSim

A fast, self-tuning, detector simulation



Bruce  
Knuteson



David  
Friend



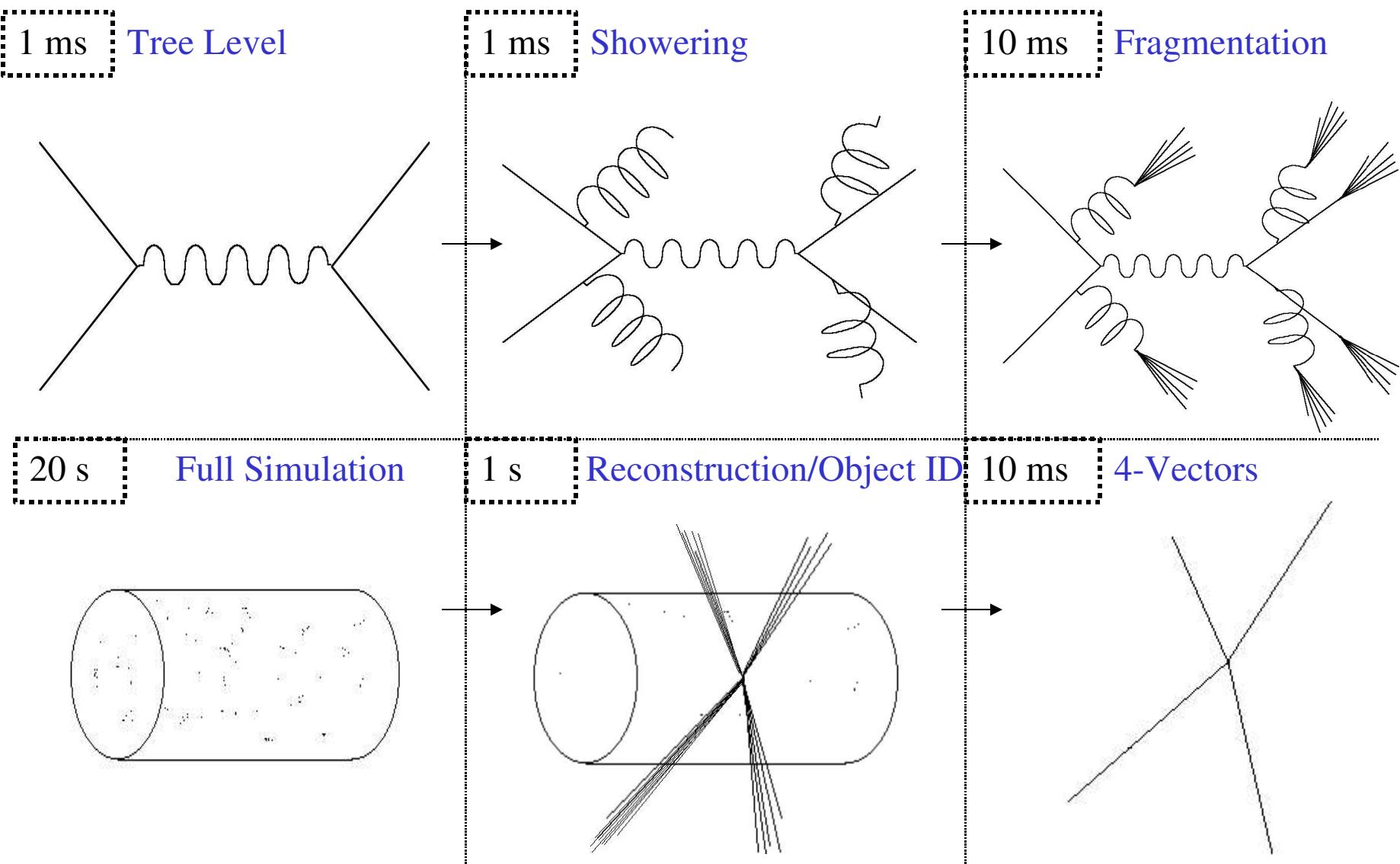
Khaldoun  
Makhoul

# Motivation

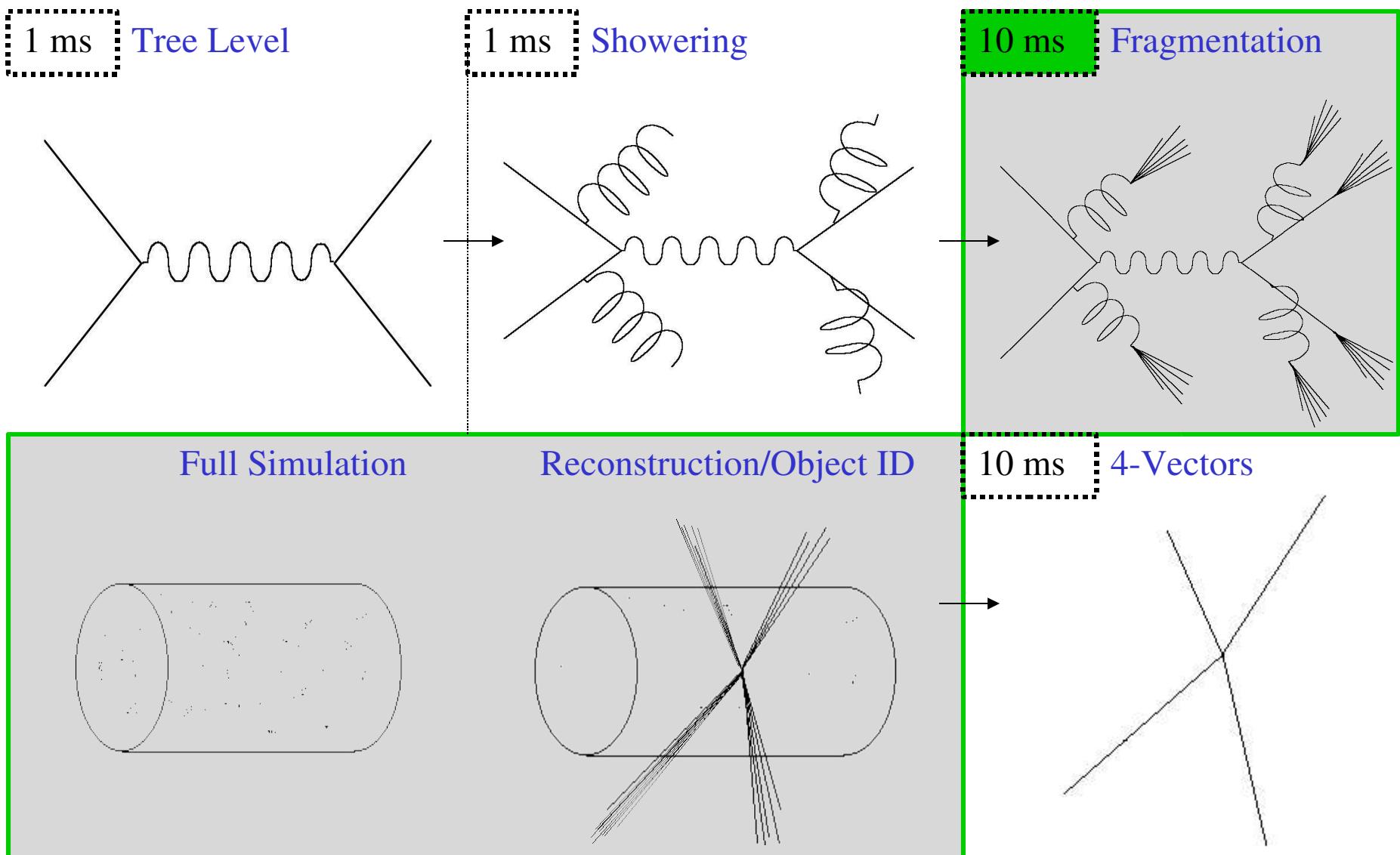
- Lookup table --> avoid repeating calculations
- $\sim 10^3$  times faster than CDF full simulation
- Efficient use of computing resources --> the Grid



# The Simulation Chain: Where do we fit in?



# With TurboSim



# Construction of the Lookup Table

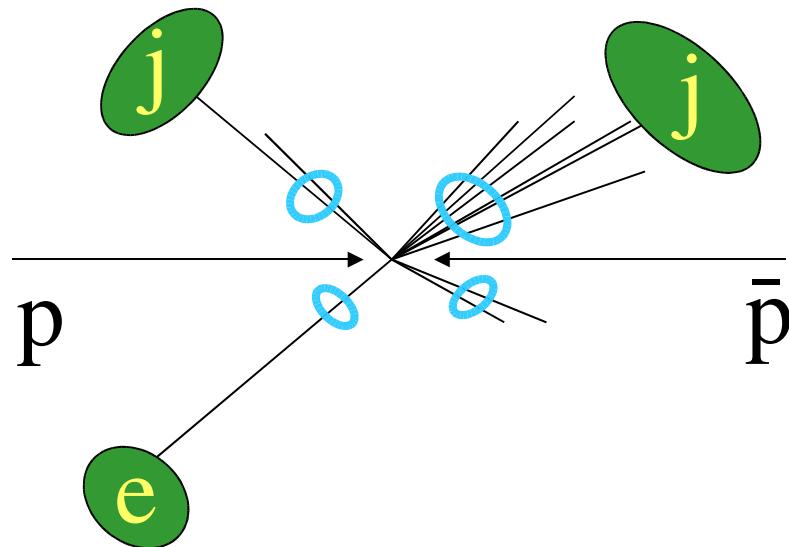
```
turboSim -create partonEvents.txt recoEvents.txt > table.txt
```

input

## output

Use events from full simulation to:

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



# TurboSim@CDF Lookup Table

(last 1,000,000 lines suppressed)

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

# Application

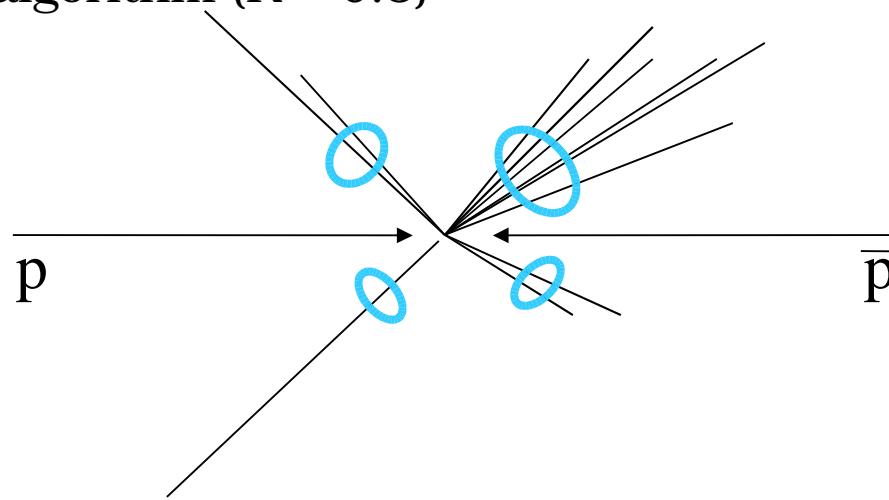
```
turboSim -simulate partonEvents.txt table.txt > recoEvents.txt
```

input

output

## Take sample of events to simulate

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



# Test Results

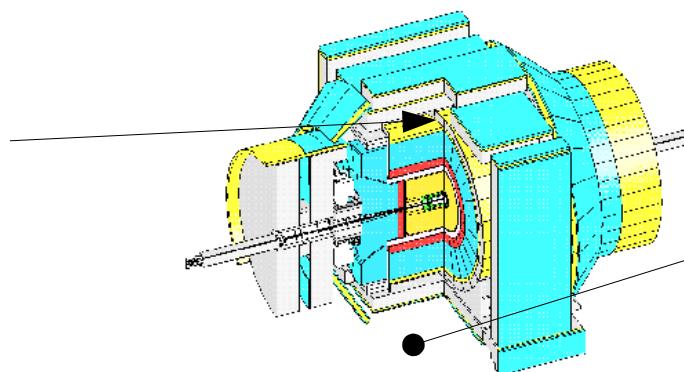
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Running the same set of events at parton level through both TurboSim and Full Sim.

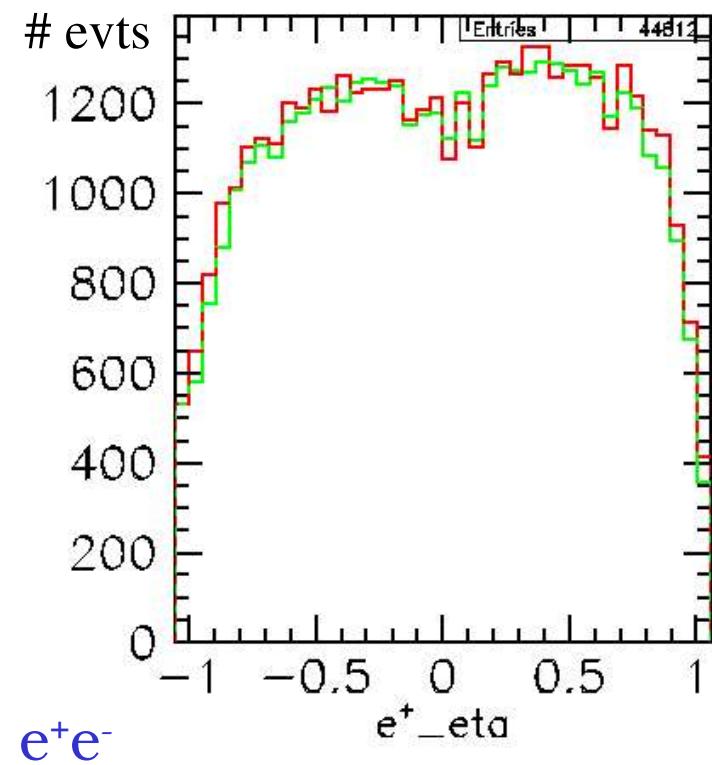
- Examine:
1. Populations
  2. Distributions

# Comparison Plots: CDF

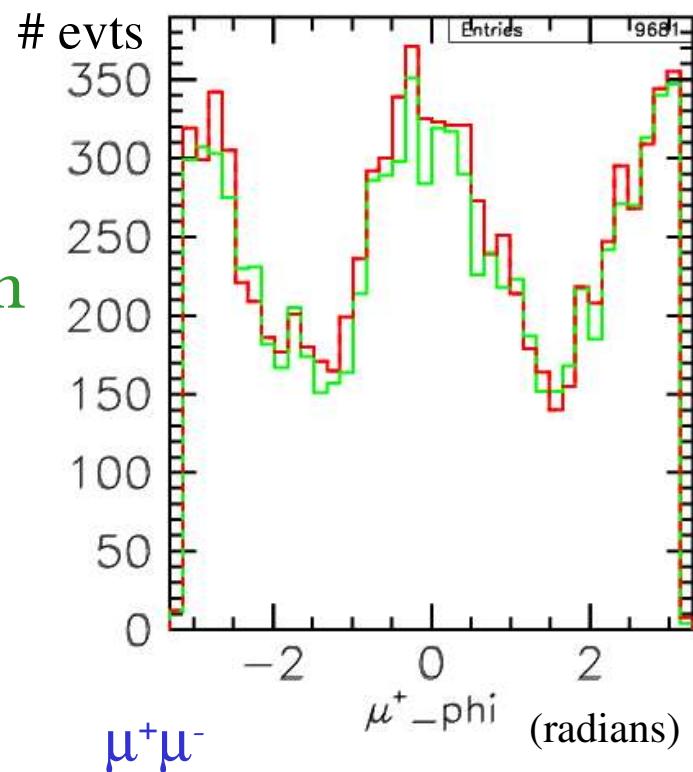
Crack in EM  
Calorimeter  
at eta =0



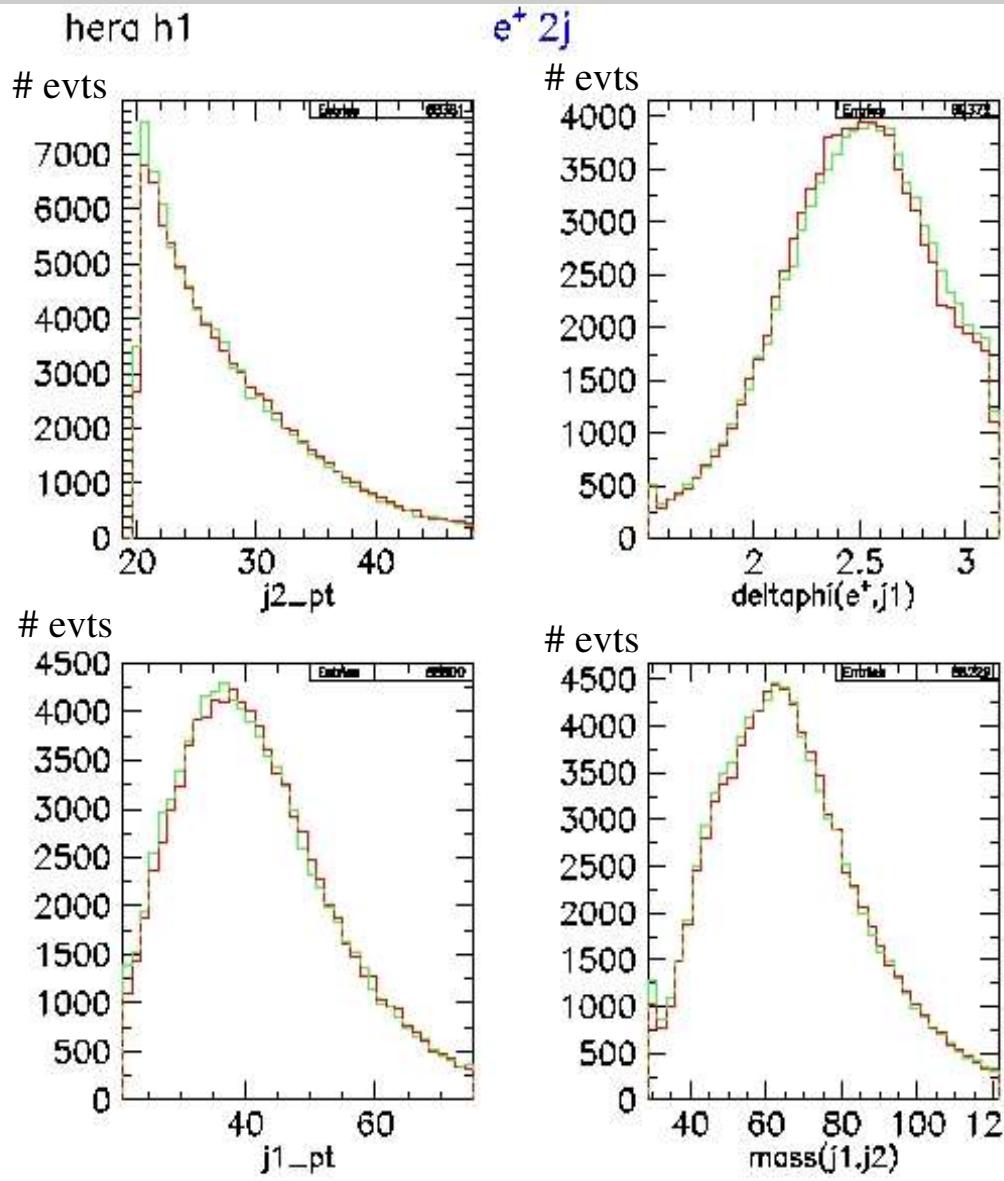
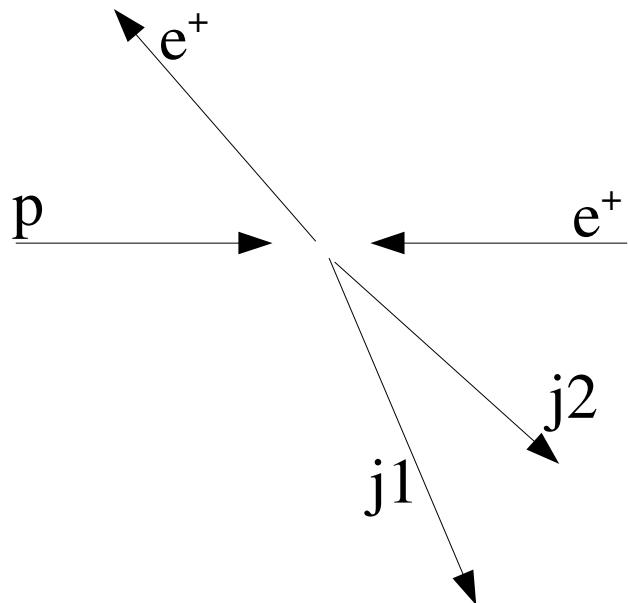
Muon coverage  
varies with phi



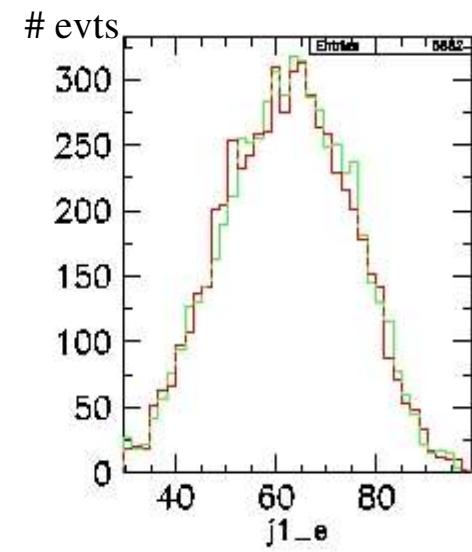
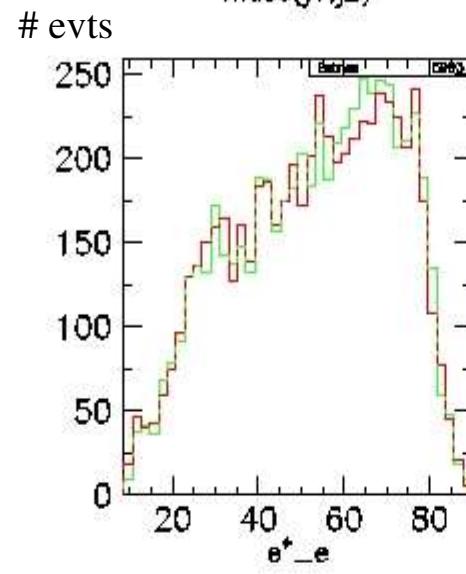
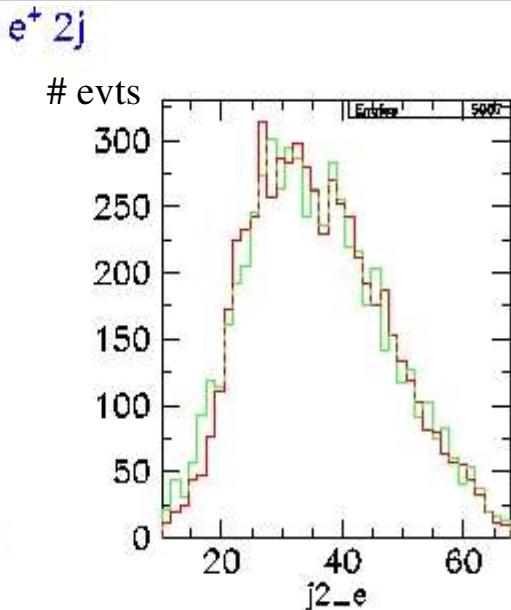
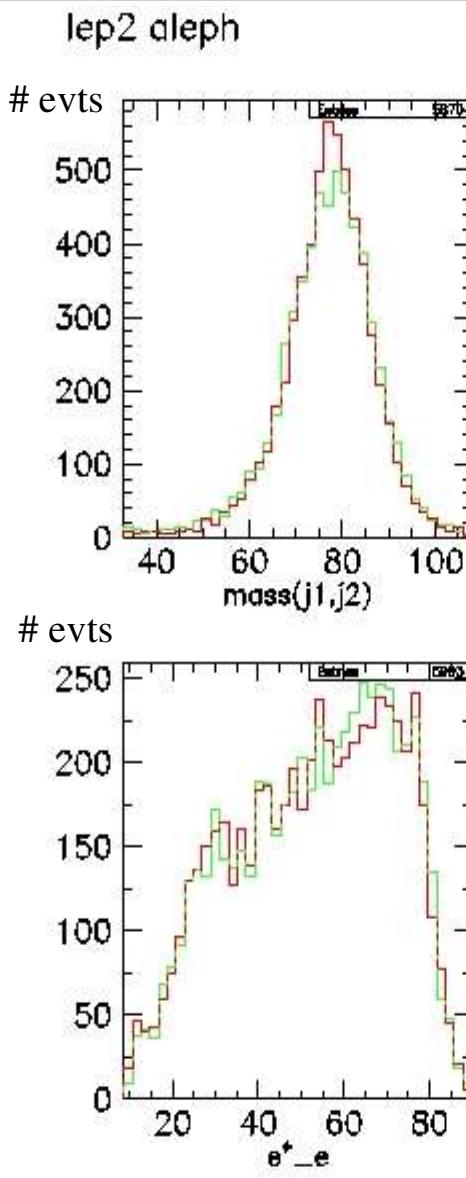
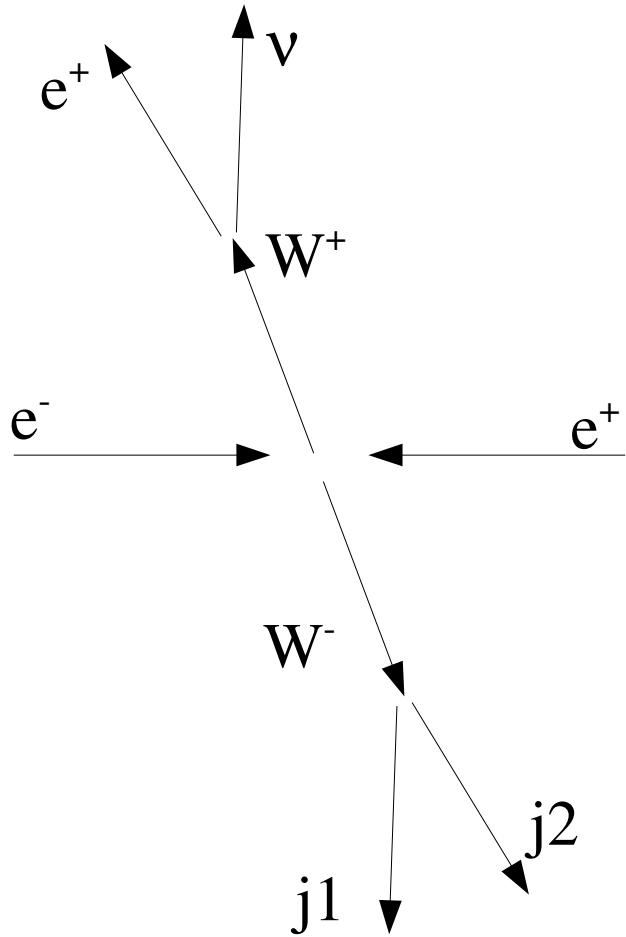
TurboSim  
CdfSim



# Comparison Plots: H1



# Comparison Plots: Aleph



# Summary

- TurboSim – self-tuning detector simulation
- Uses knowledge of full simulation
- Application to any frontier energy experiment
- Commissioned at H1, Aleph, L3
- Ready for use in current analyses