

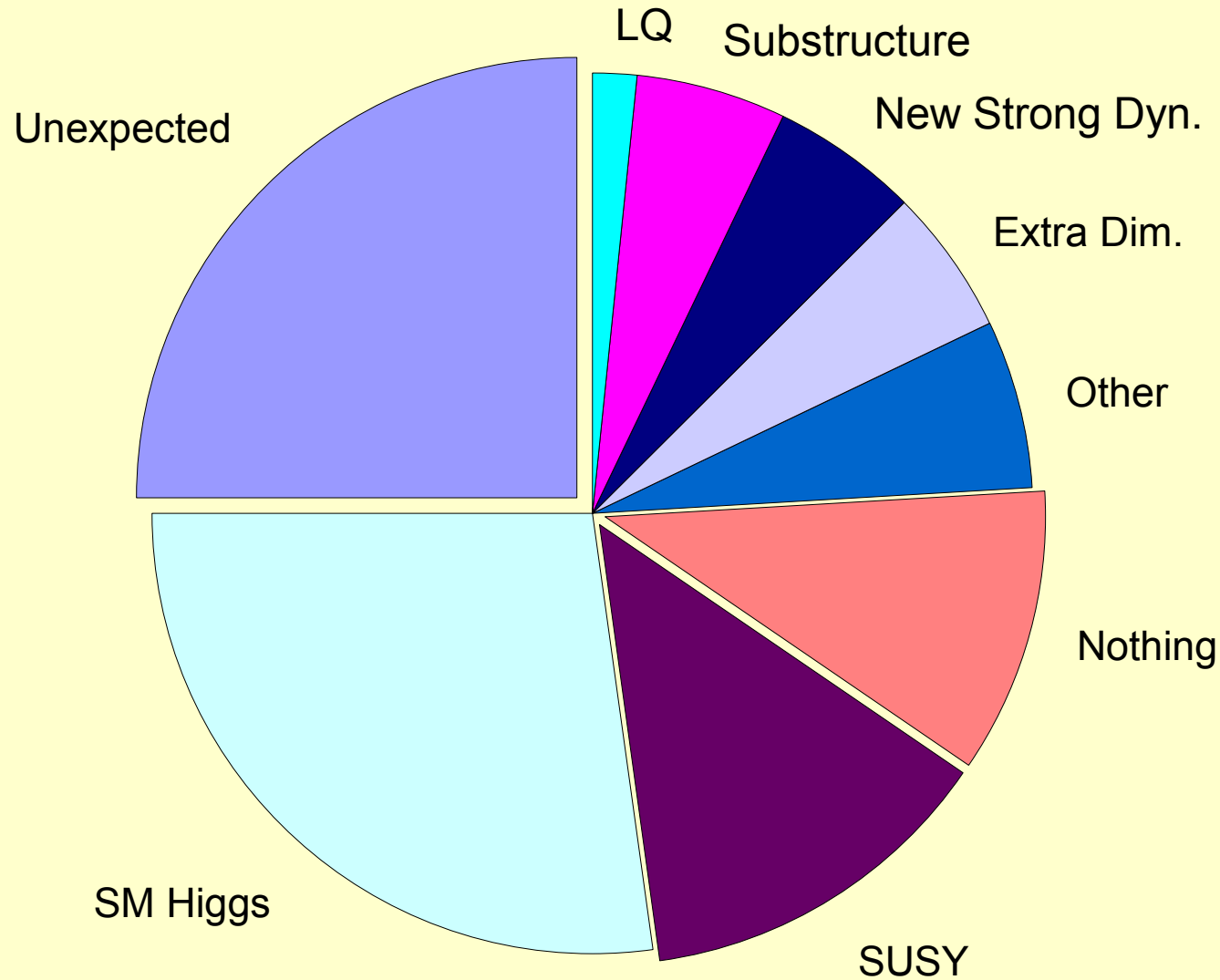
# Model-Independent Search for New Physics at CDF

DPF2006  
2006/11/01

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**MIT**

for the **CDF** Collaboration

# What will be discovered next?



~330 votes total

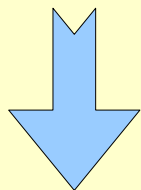
# Search Scheme

## Vista

How well can the SM describe the high- $p_T$  data?

It determines the **correction factors** needed to obtain the best **global** agreement.

**SM background** = MC x **correction factors**



## Sleuth

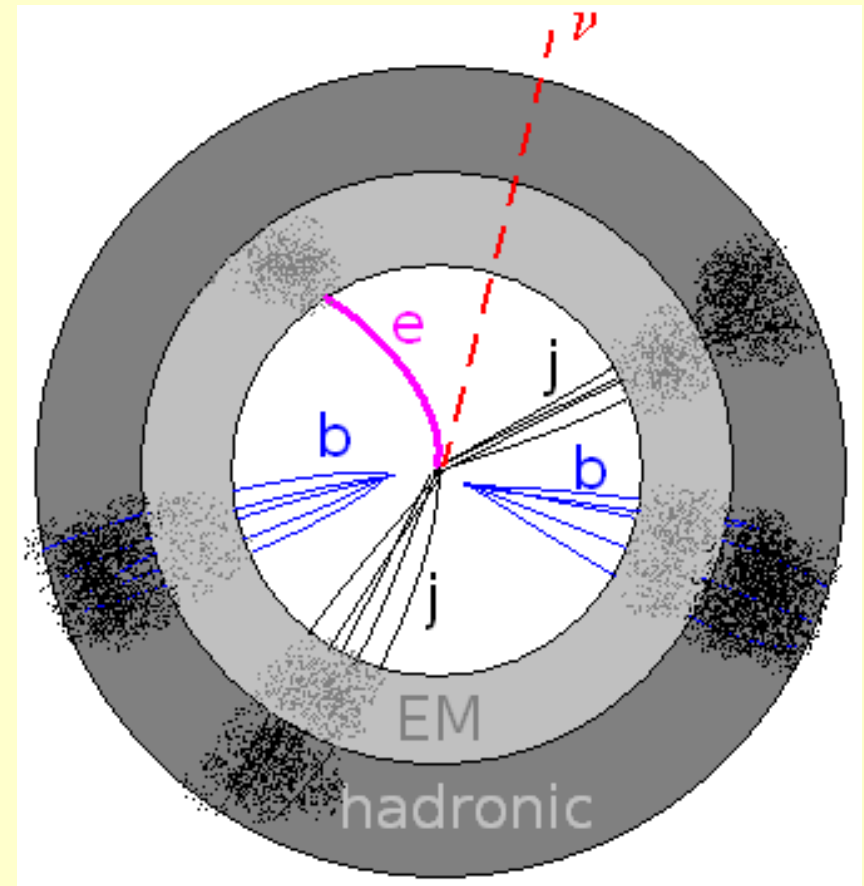
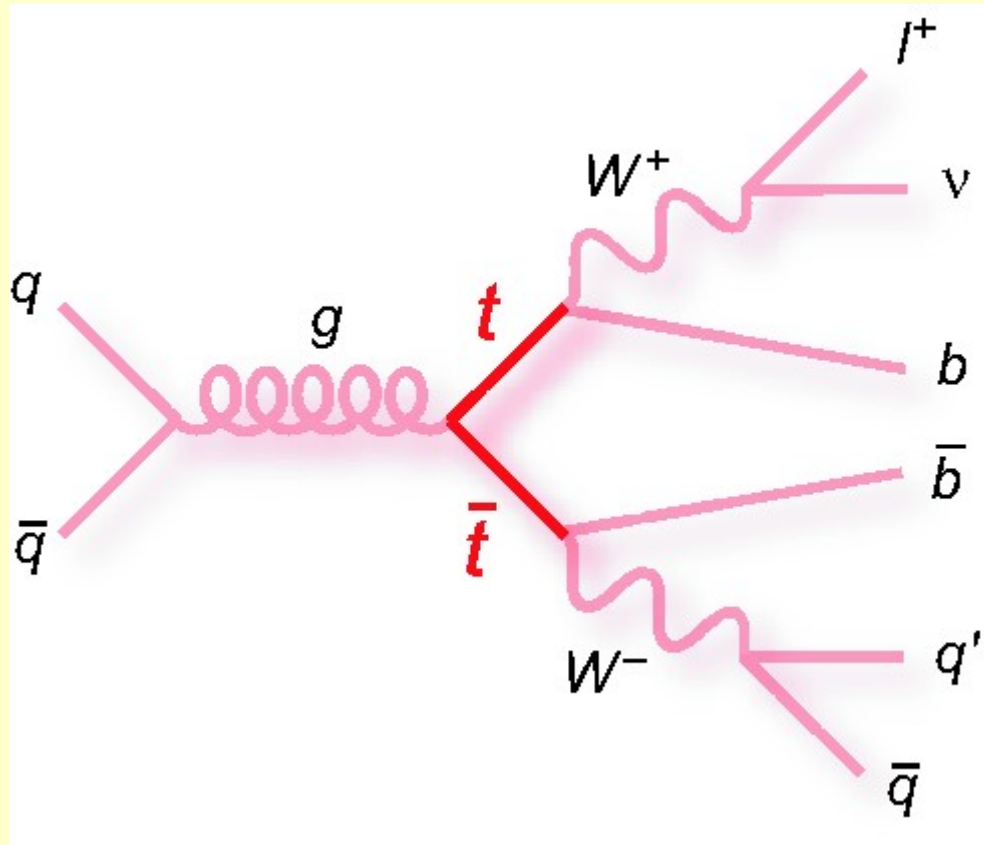
- It searches for any statistically interesting excess of data in the high- $\Sigma p_T$  tails.

# Vista output

~15,000 plots of kinematic distributions of ~340 exclusive final states.

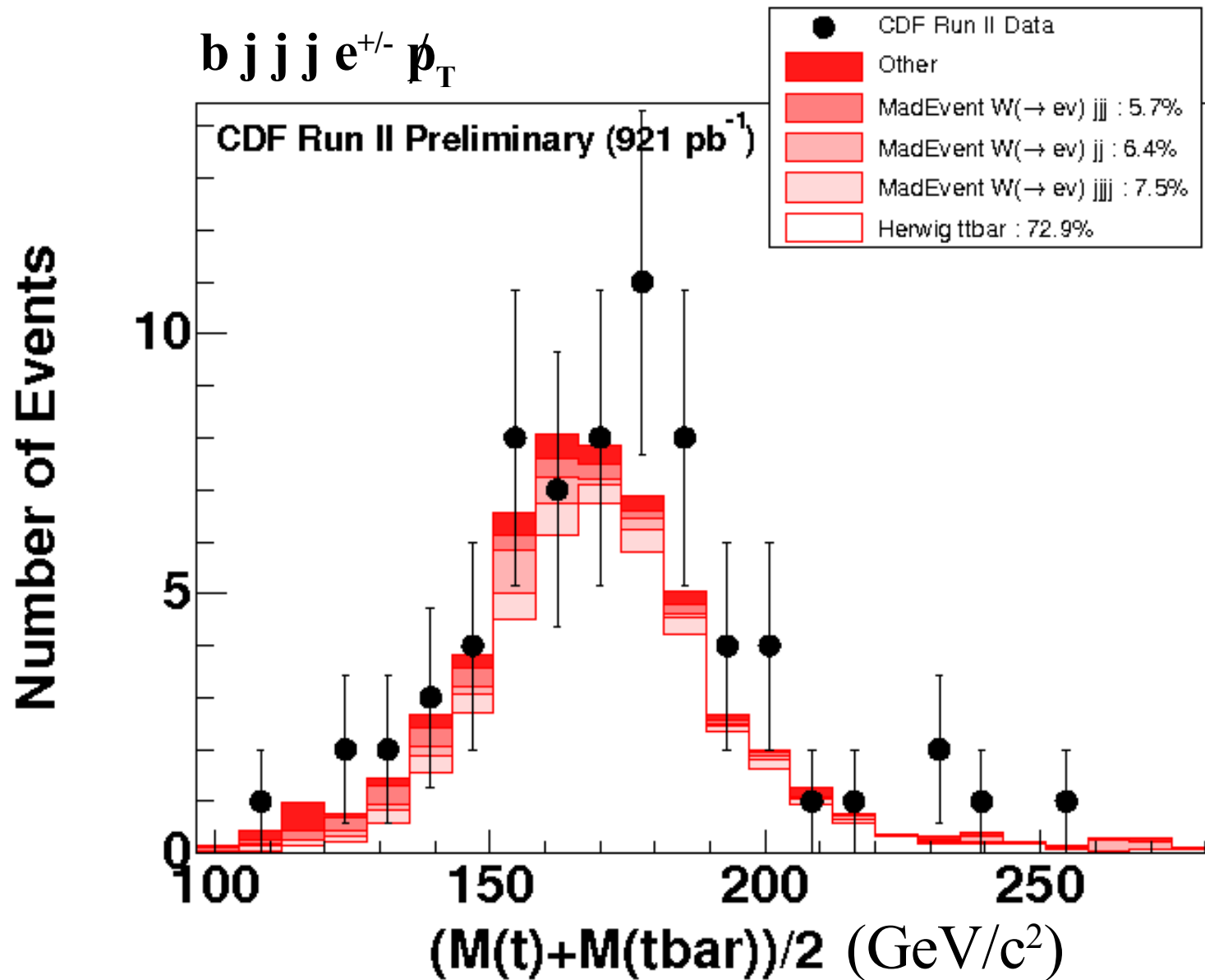
Sorted by statistical significance (populations & shapes)

# t-tbar production and decay



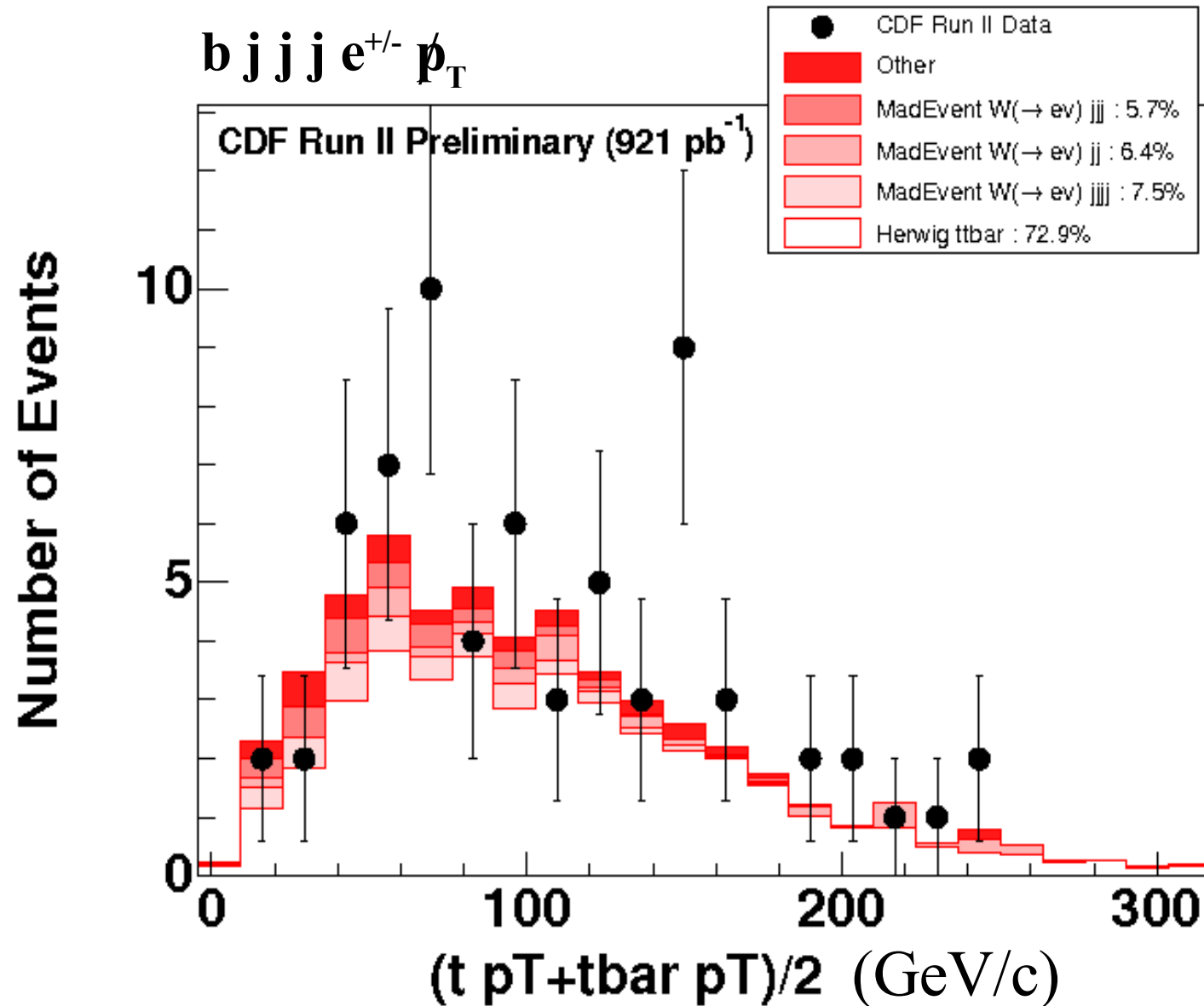
# 3 of the $\sim 15,000$ plots

#1



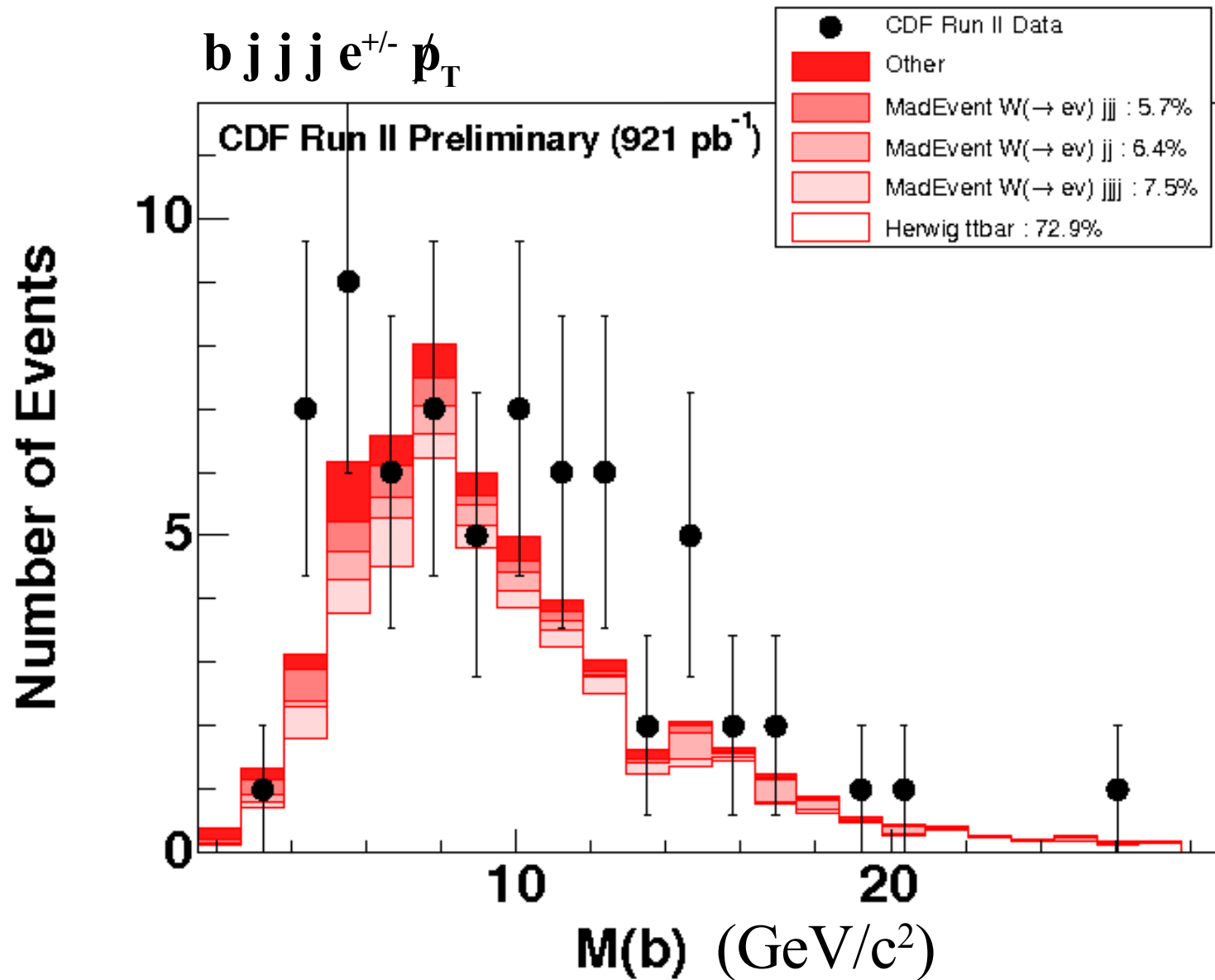
# 3 of the $\sim 15,000$ plots

#2



# 3 of the $\sim 15,000$ plots

#3





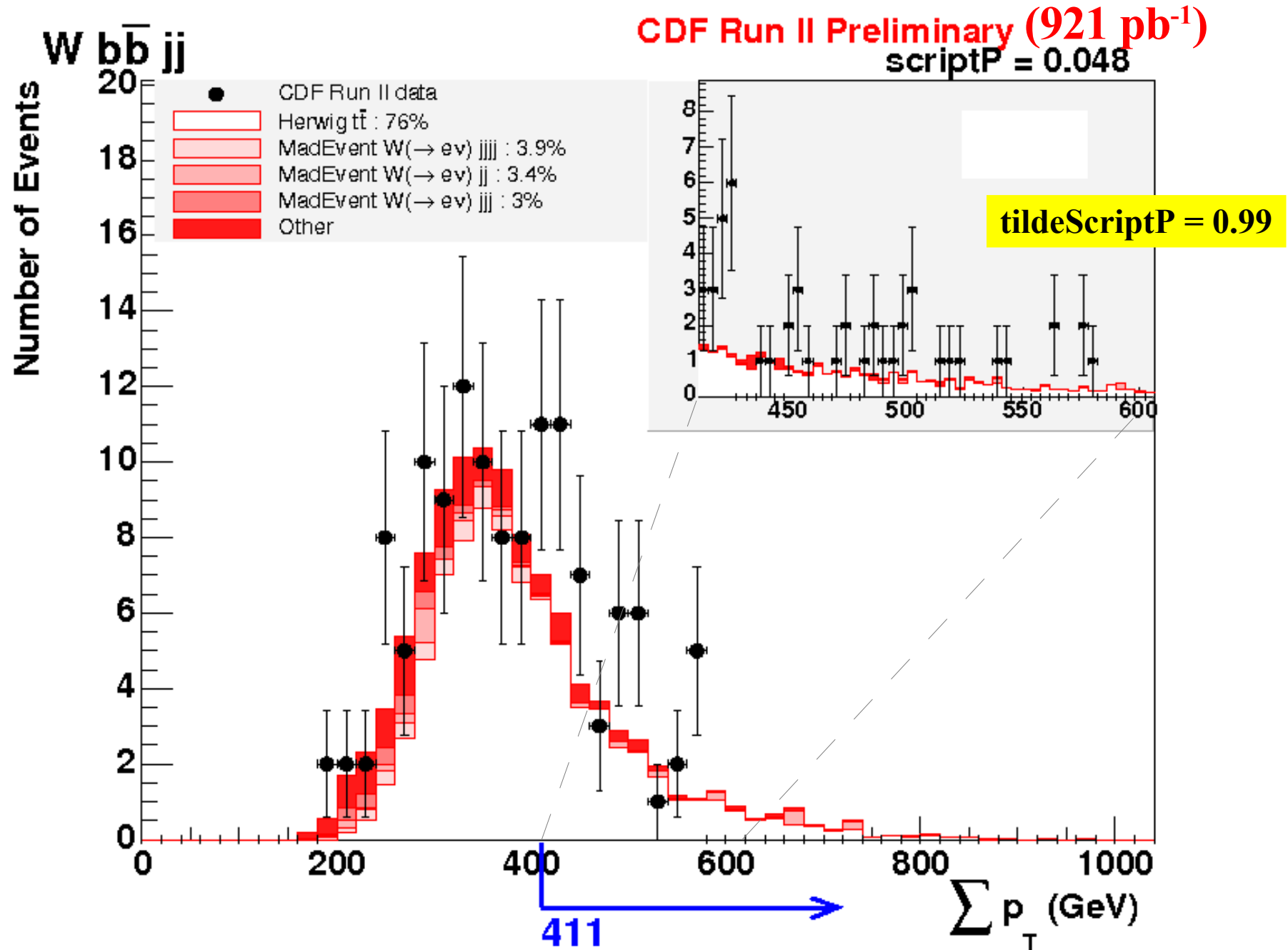
# t-tbar sensitivity test, part I

at  $920 \text{ pb}^{-1}$ , with real data

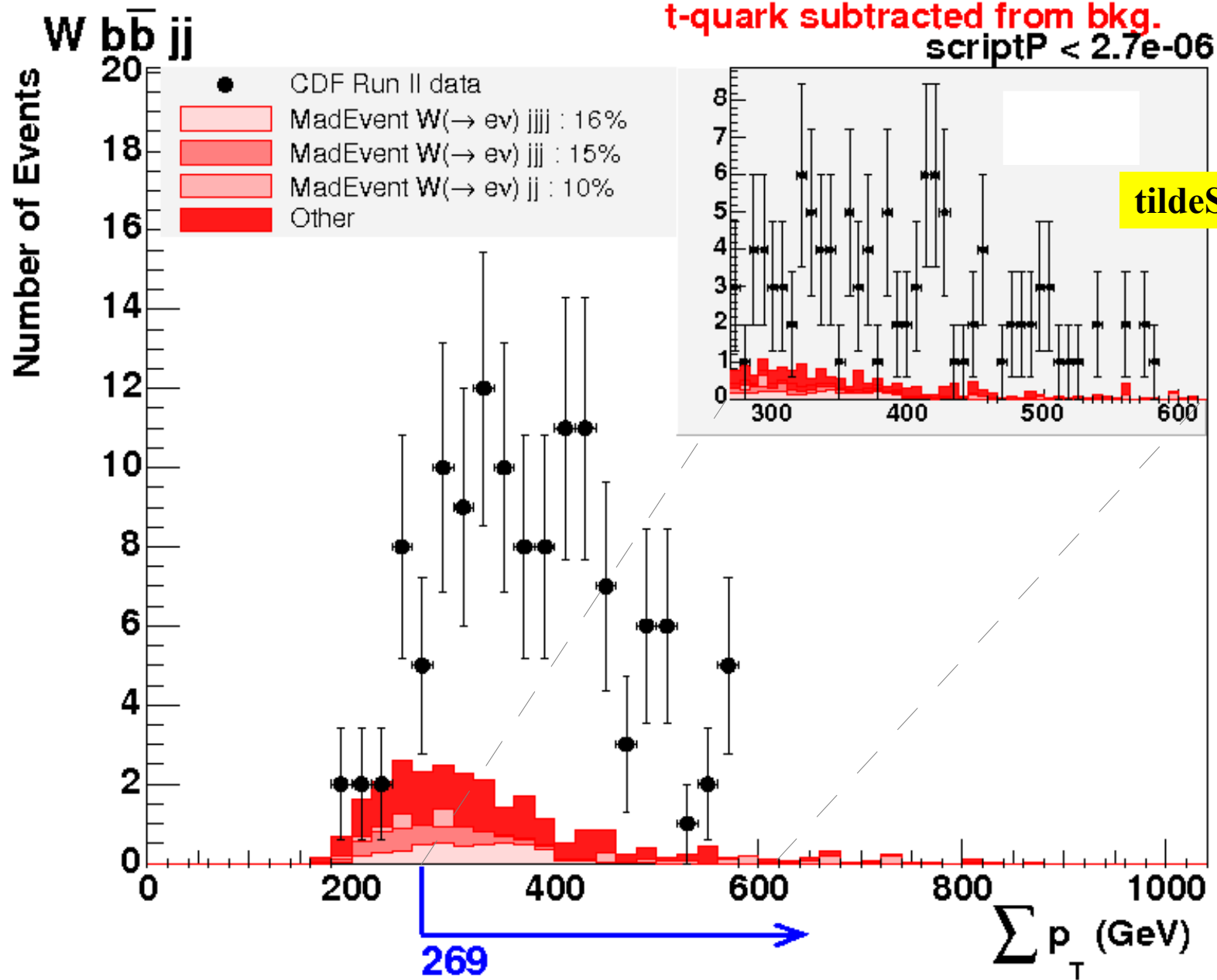
**Question:** Would Sleuth have found t-tbar if we didn't know it was there?

**Answer:** Yes.

# before removing t-tbar



# after removing t-tbar



# t-tbar sensitivity test, part II

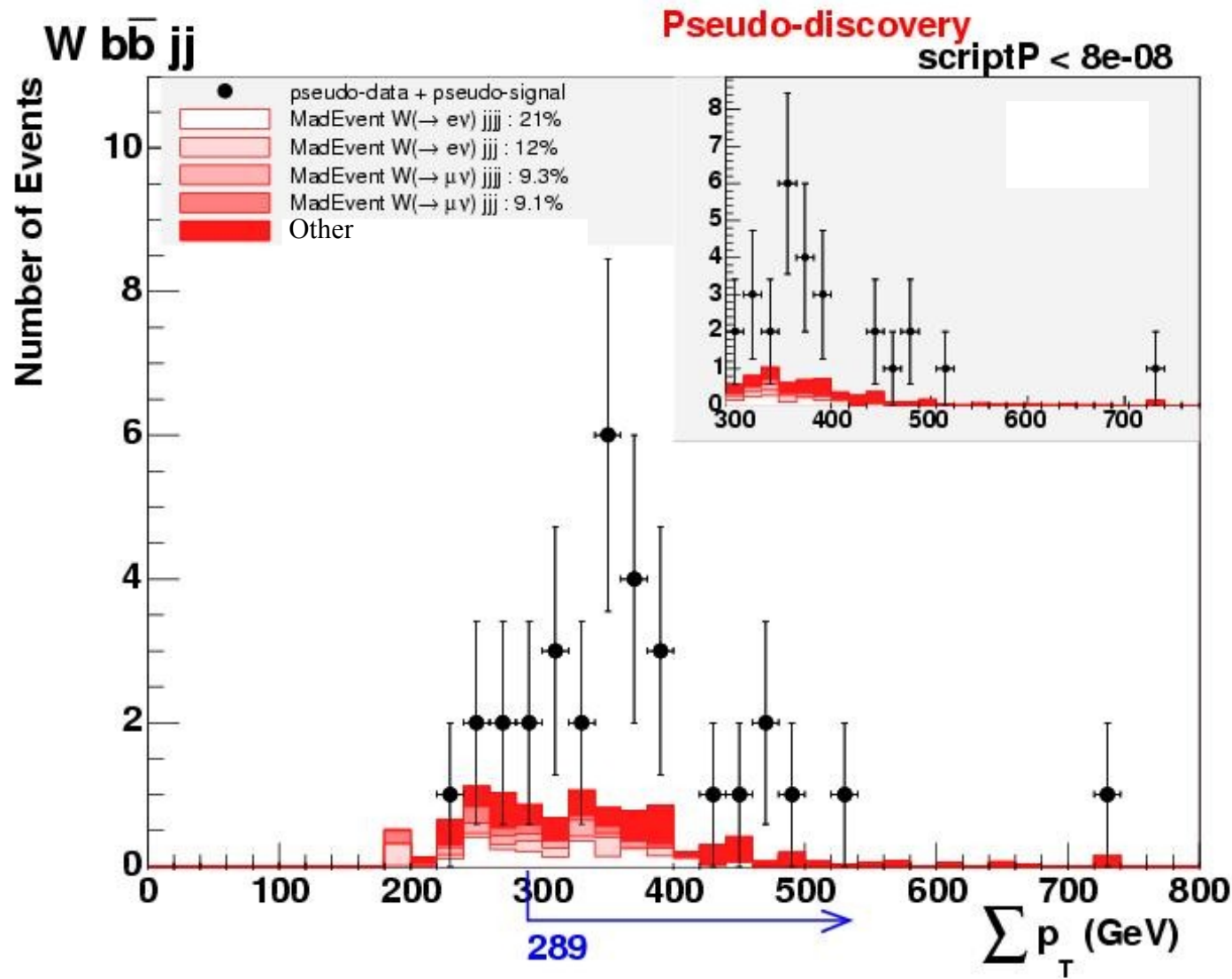
**Question:** How much t-tbar signal would need to be there to be pointed out by Sleuth, if we didn't know t-tbar existed?

**To answer:**

1. Subtract the t-tbar component from the SM background in all final states.
2. Produce pseudo-data that agrees with this top-less SM background in all final states.
3. On top of that pseudo-data, start injecting t-tbar pseudo-signal, until the statistical significance reaches discovery threshold.

# t-tbar sensitivity test, part II

at 630 pb<sup>-1</sup>, with pseudo-data



**Answer:**

Needed about 245

t-tbar events

→  $\sigma_{tt} > 0.4$  pb

**Sleuth looks everywhere**

$\sigma_{tt} \sim 7$  pb →

~ 40 pb<sup>-1</sup>  
would be needed

# Summary

- CDF has obtained a global view of its high- $p_T$  data.
- Vista & Sleuth
- Sensitivity comparable to that of dedicated  $t$ - $\bar{t}$  search.

Backup slides

# Sleuth output

The most interesting  $\Sigma p_T$  tail in each final state.

scriptP = the fraction of pseudo-experiments in which in this final state the most interesting region is more interesting than the most interesting region in this final state observed in the data.

tildeScriptP = the fraction of pseudo-experiments that would produce a region in any final state as interesting as the most interesting region observed in the most interesting final state in the data.

region=High- $\Sigma p_T$  tail.



# Sleuth

- Quantifies the statistical significance of the high- $\Sigma p_T$  tails.
- Minimal assumptions:
  - massive resonances  $\rightarrow$  high- $p_T$  decay products.
  - new physics  $\rightarrow$  excess of data.
- Partitioning assumptions:
  - global  $e \leftrightarrow \mu$  symmetry
  - global charge conjugation symmetry
  - $(2N+1)$  jets  $\sim (2N)$  jets
  - $(2N+1)$  b-jets + jet  $\sim (2N+2)$  b-jets

# What is a discovery?

Every observation is like a diving competition with 4 judges:

1. Is it statistically significant?
2. Is it likely due to poor implementation of the SM?
3. Is it likely due to a detector effect?
4. Does it have a plausible new physics interpretation?

# Vista

Exclusive  
final states:

