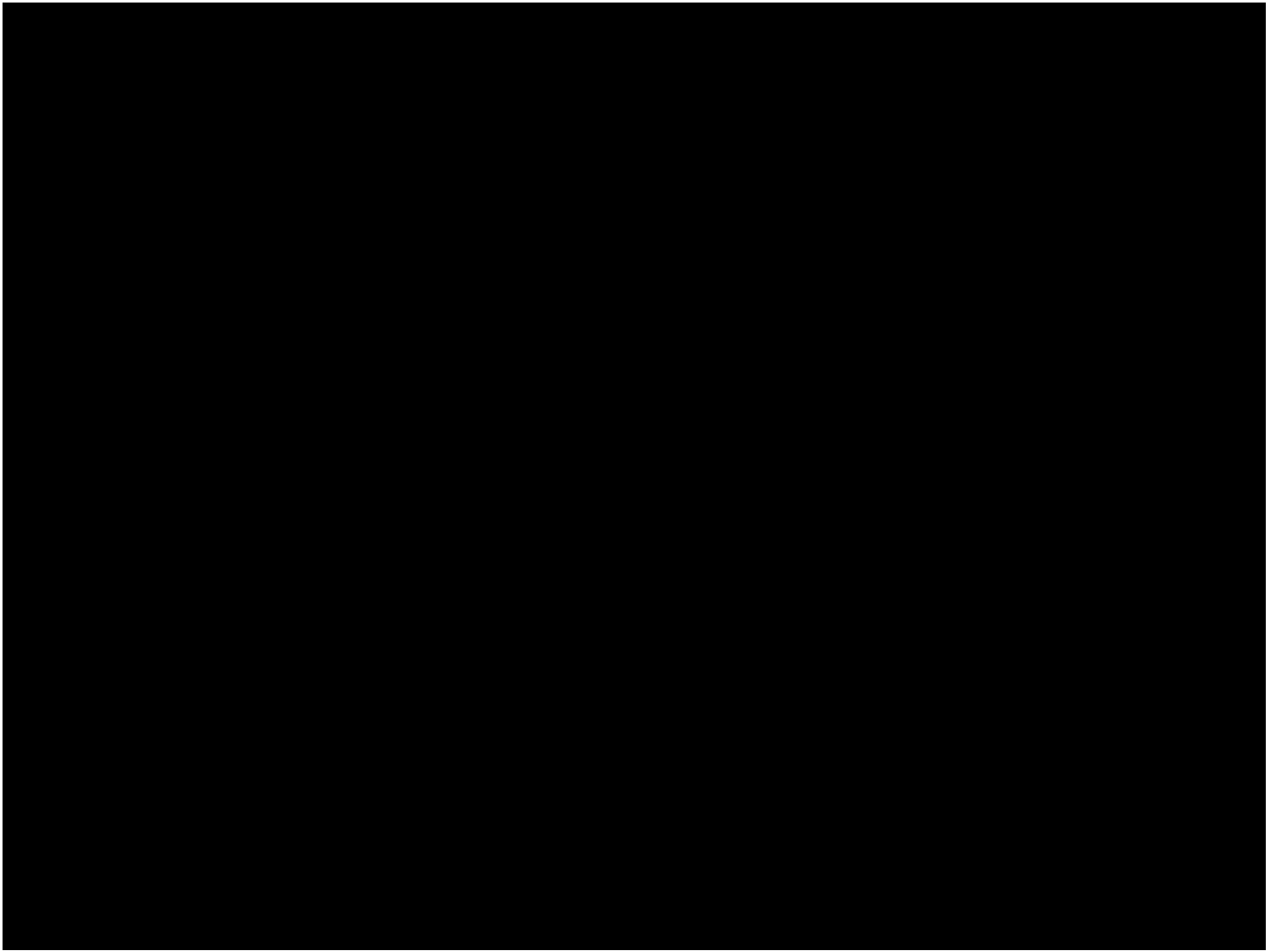
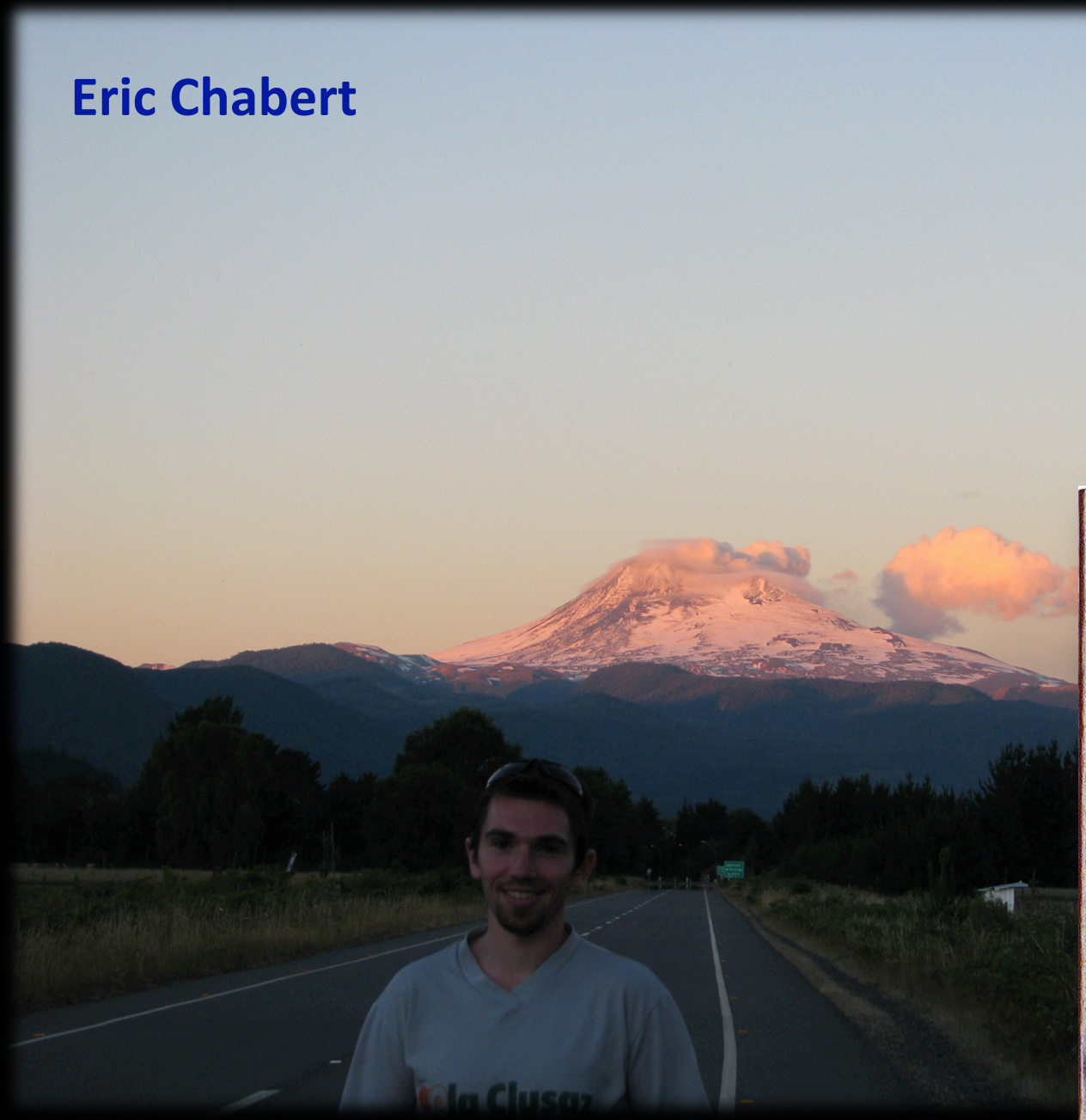
Event from last night when beams were circulating in the LHC



Eric Chabert



Jorgen D'Hondt

First Top Quark convenor in CMS (2007 & 2008)

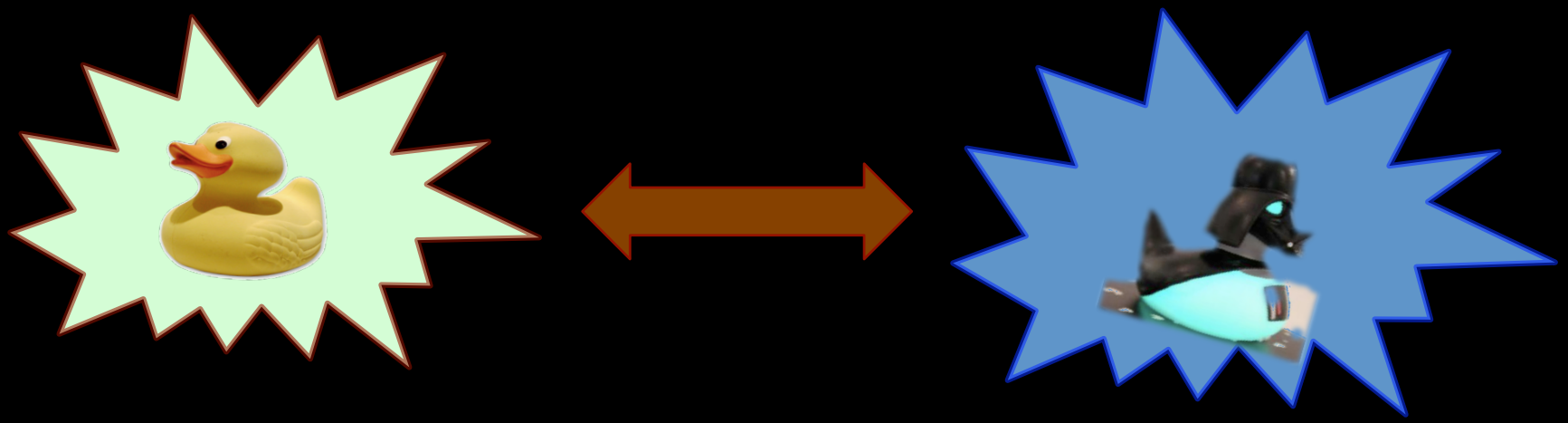
Testing Top Topologies

(The T^3 strategy)

Herman Van Rompuy
(new “EU president”)

Testing Top Topologies

(The T^3 strategy)



This talk is a" food-for-discussion" presentation. Many of the items can be developed for the Tevatron and the LHC settings. First tests of the principle can be performed at the Tevatron…

T^3

The obvious

The LHC is developed to search for new physics phenomena…

The key point

Understanding our machine, our detector, our simulation, our reconstruction, our background, …

The struggle

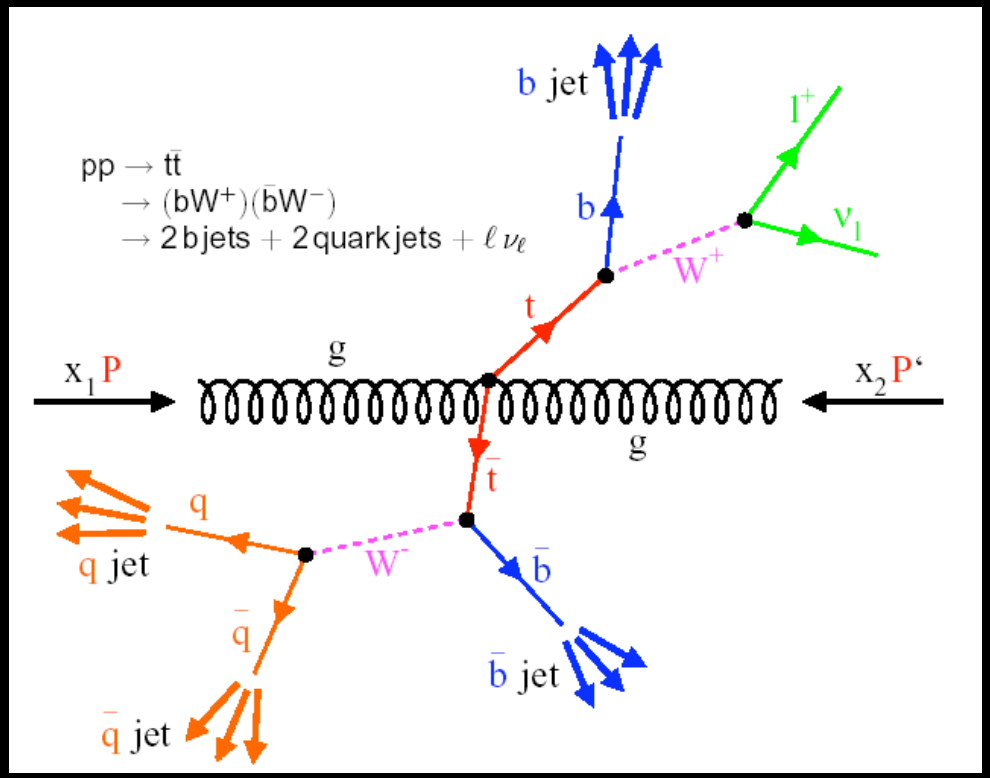
To be confident that we belief in the outcome of the goodness-of-fit tests to test the consistency of the Standard Model in the Top Quark sector…

How to characterize the top topology ?

- Minimize the set of "T^3 variables"
- The kinematics of the events can be projected into few variables
- Develop a criteria to define the "best" minimal set of variables

- *Add the "extra multiplicity" variables (eg. # extra jets, # b-tags, # extra lepton, …)*
- *Add differences between decay channels…*
- *Add differences between top and anti-top (eg. CPT symmetry)*

- *Apply a basic event selection…*

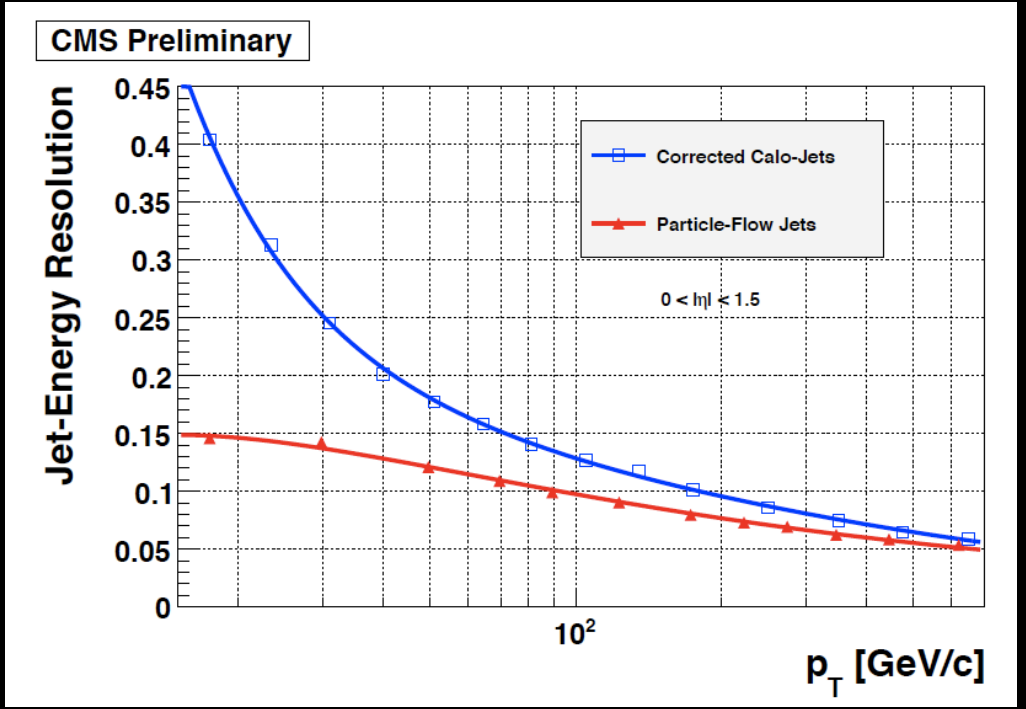


*Early Tevatron reference "Search for Anomalous Kinematics in ttbar Dilepton Events at CDF II" - **arXiv:hep-ex/0412042v2***

Optimal reconstruct of these T^3 variables

- Standard reconstruction techniques aren't always the most optimal strategy to look for new physics phenomena
- To first order we need the highest efficiency and the highest purity in the relevant range of our T^3 variables, together with the best resolution

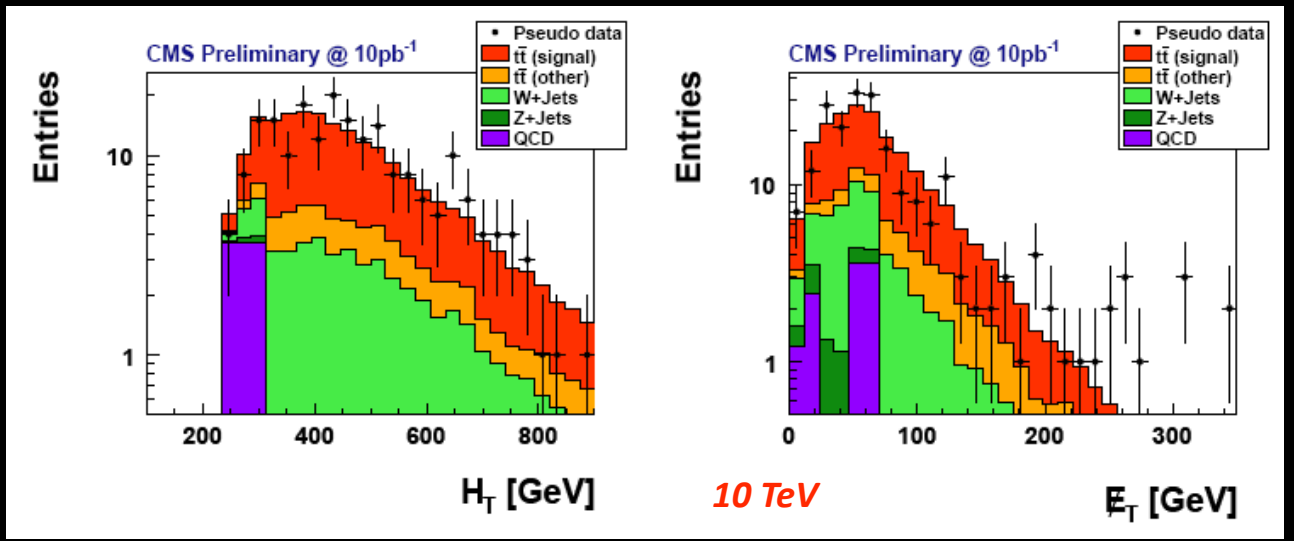
- *When testing the Top Topology, how to deal with different reconstruction methods for different variables?*
- *How to deal with different reconstruction methods for one variable?*



Phase 1: simple blind goodness-of-fit test

- First phase in a step-by-step T^3 strategy
- Take into account the correlations between the variables (rotation techniques)
- Perform a simple goodness-of-fit (test with pseudo-experiments)
- Take the QCD & Z & W background from control regions (eg. ABCD methods)
- In a next step, take the top expected shape/level from a control region

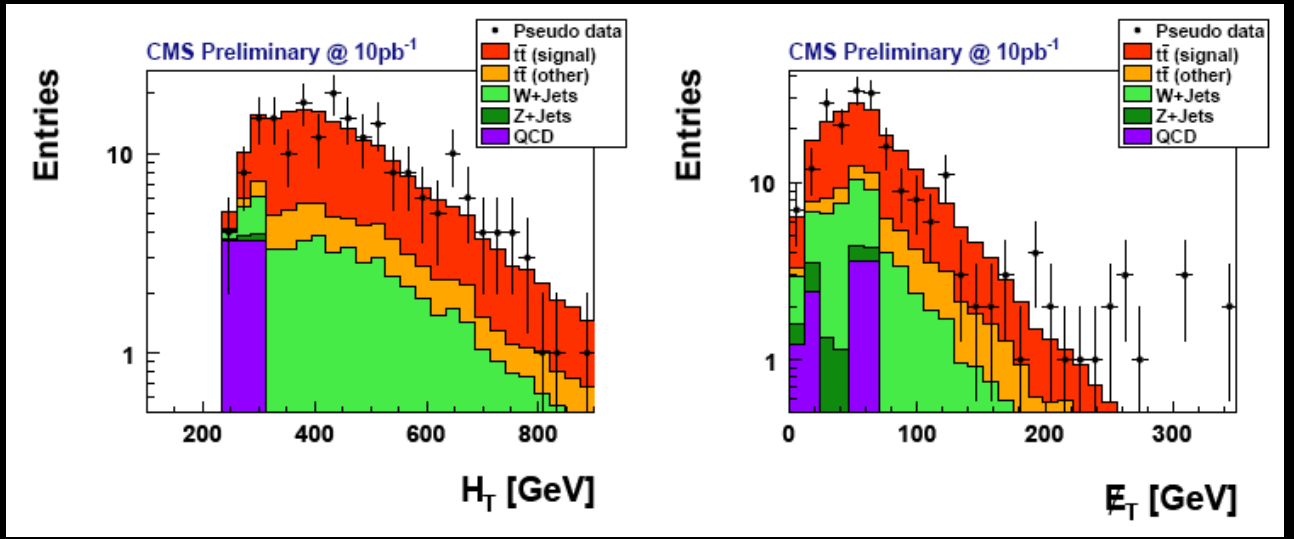
- Basis for detector understanding relevant in the top quark sector and for Monte-Carlo tuning



Phase 2: rank the events (still general)

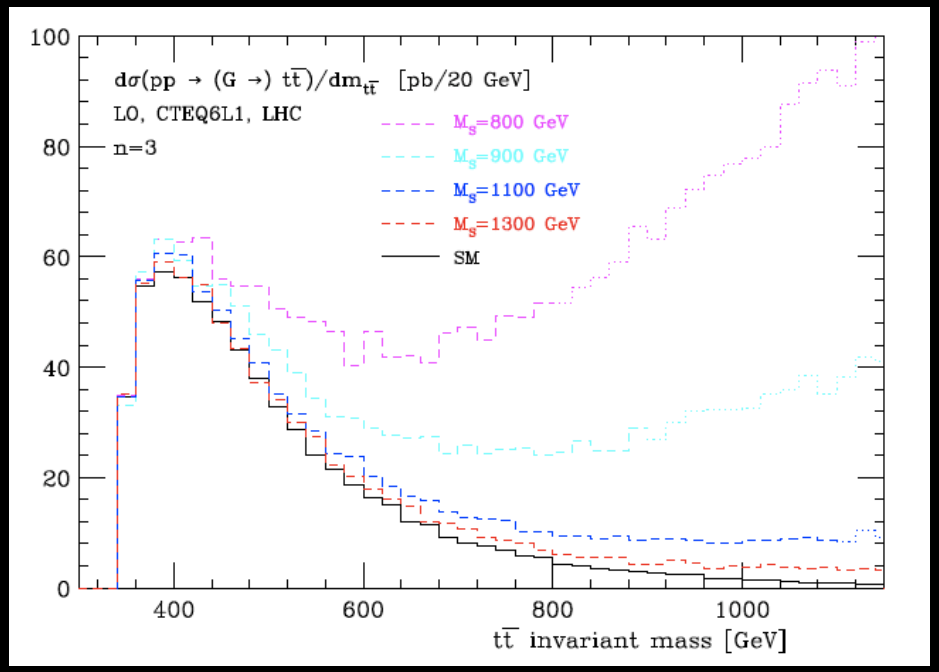
- With more detector/simulation understanding
- Rank the events according to general new physics phenomena sensitivity (eg. the kinematic probability to be a ttbar topology via Matrix Elements)
- Perform this transformation with the least possible bias to a BSM model
- Apply goodness-of-fit methods on the cumulative distribution

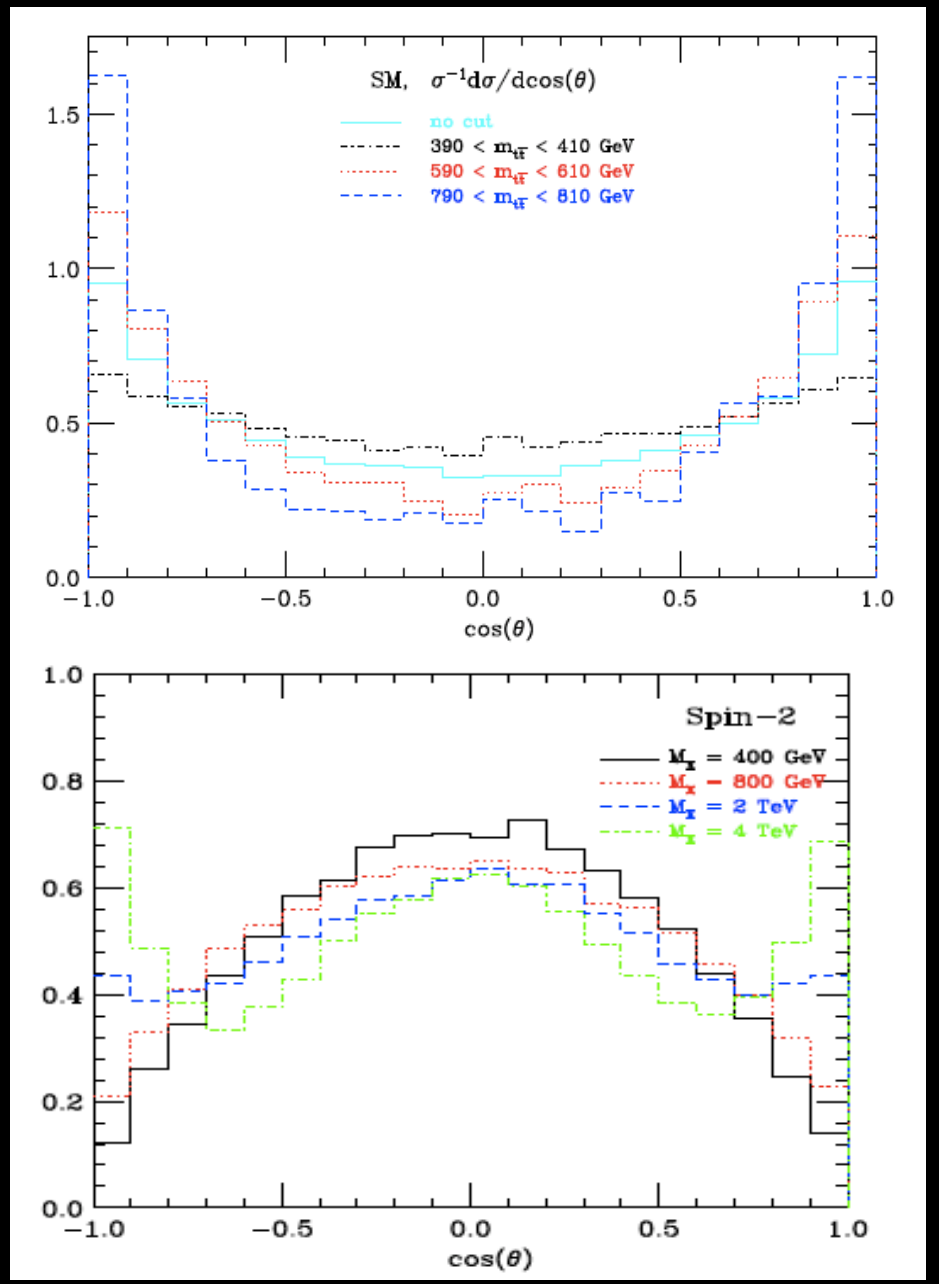
- Example: new physics to appear at high H_T and high MET, hence rank the events according to the transformation $P = H_T + MET$



Phase 3: model dependent goodness-of-fit

- Take a model and transform the T3 space accordingly
- Scan the parameter space for this model via dedicated goodness-of-fit or hypothesis tests
- *Eg. Mttbar and Collins-Soper angle*

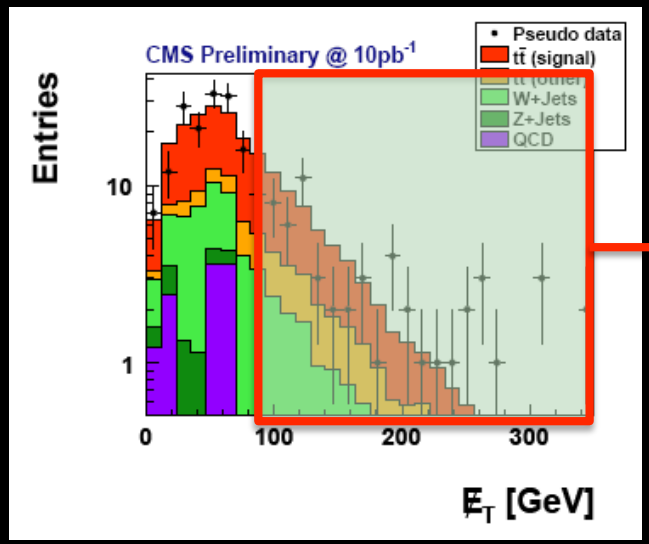




Frederix & Maltoni, **arXiv:0712.2355v3**

Phase 4: zoom in…

- Apply a specific event selection to enhance the new physics signal in these top topologies
- Repeat the goodness-of-fit (or hypothesis) testing
- Include the information from discoveries on other channels…

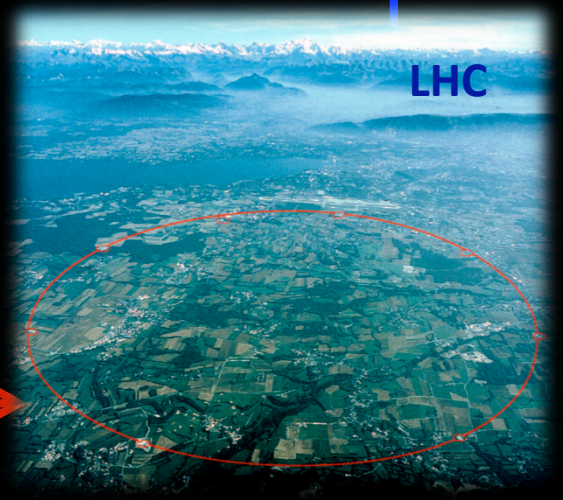


Check relevant distributions in this range

… this T3 strategy could be a path for a full research group (or several of them)

- Top Quark physics is the key topic for the Tevatron and will be the key physics topic for 2-10TeV LHC collisions
- An understanding on the full process, from production over properties to decays, has still to arise

- Goodness-of-fit techniques can be developed and tested at the Tevatron, in order to be applied with confidence at the LHC
- The "*T^3 strategy*" involves lots of work from both the Tevatron and the LHC side



TOP2010 Conference

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Brugge, Belgium

CP3 - IIHE

http://www.top2010.be/