

TOP2008

A Short Review

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top2008

International Workshop on Top Quark Physics

La Biodola — Isola d'Elba, Italy
May 18-24, 2008

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Conference Secretariat: Lucia Lilli, Claudia Tofani

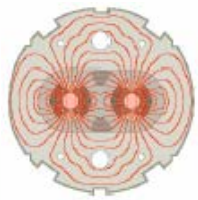
<http://www.pi.infn.it/top2008>

top2008@pi.infn.it

B. R. Haydon, "Napoleon Bonaparte". Reproduced with kind permission of the National Portrait Gallery, London

- 2nd International Workshop on Top Quark Physics (1st workshop: Coimbra 2006)
- Location: La Biadola, Isola d'Elba
- WWW: <https://indico.pi.infn.it/conferenceDisplay.py?confId=227>
- Workshop statistics:
 - 117 Participants
 - 49 Talks
 - 1825 Minutes
 - 1571 Slides
- Short summary:
 - The perfect location!
 - The perfect workshop!

- Status of Tevatron and LHC
- Top pair production cross section
- Top mass
- Single top production
- Tools for top: Monte Carlo generators, b-tagging, etc.
- Measurements of top quark properties
- Beyond standard model physics with top quarks



Strategy for 2008 and 2009

2008

Hardware commissioning
To 5TeV

Machine
checkout

Beam
commissioning
5TeV

43/156
bunch
operation

Train to
7TeV

No beam

Beam

A

2009

Train to
7TeV

Machine
checkout

Beam
Setup

75ns ops

25ns ops I

Shutdown

No beam

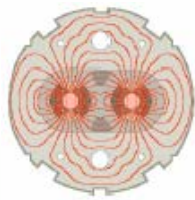
Beam

B

C

R.Bailey, Elba, May 2008

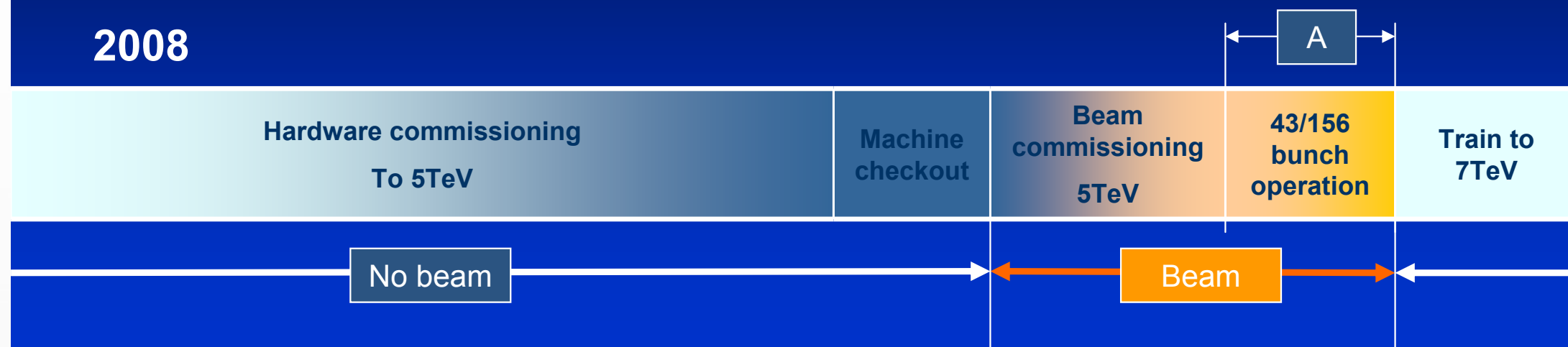
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Strategy for 2008 and 2009

Expect $\sim 10 \text{ pb}^{-1}$

2008



Expect $\sim 1 \text{ fb}^{-1}$

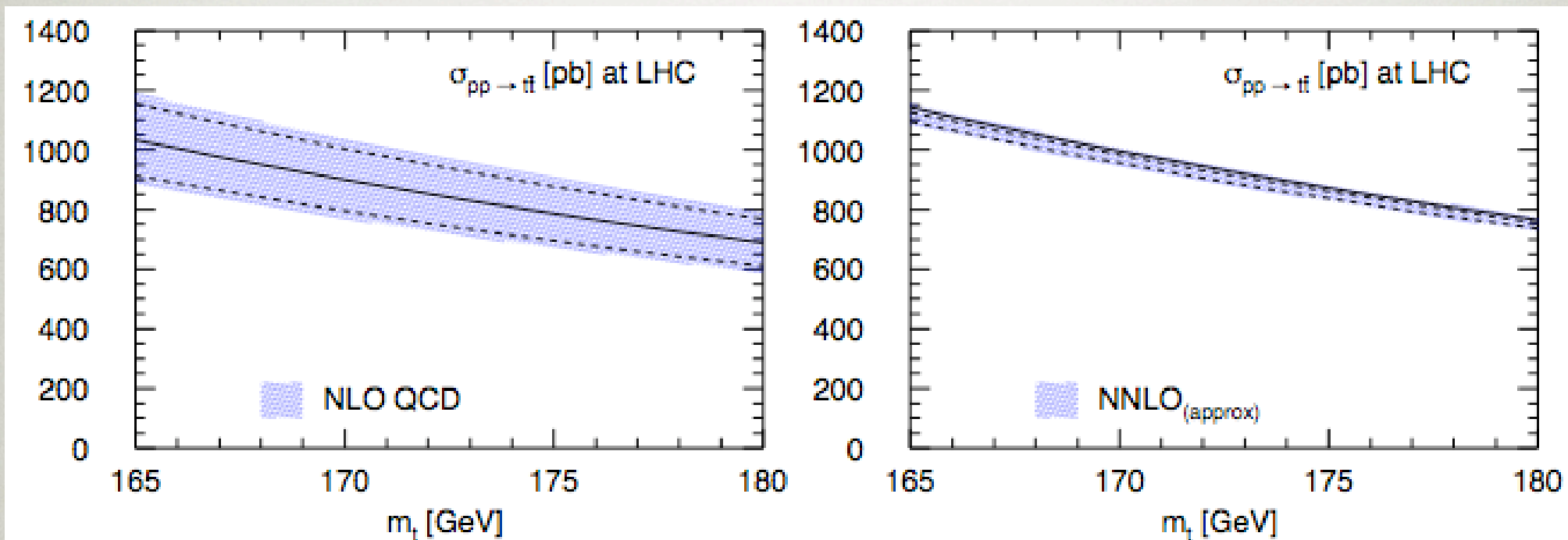
2009



R.Bailey, Elba, May 2008

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SCALE DEPENDENCE



Moch and Uwer, arXiv/08041476

Scale dependence criteria:

Moch and Uwer:

$$\mu_R = \mu_F = \mu$$

$$\mu_0/2 < \mu < 2 \mu_0$$

$$\mu_0 = m_{\text{top}}$$

Cacciari et al.

$$\mu_R \neq \mu_F$$

$$1/2 < \mu_F / \mu_R < 2$$

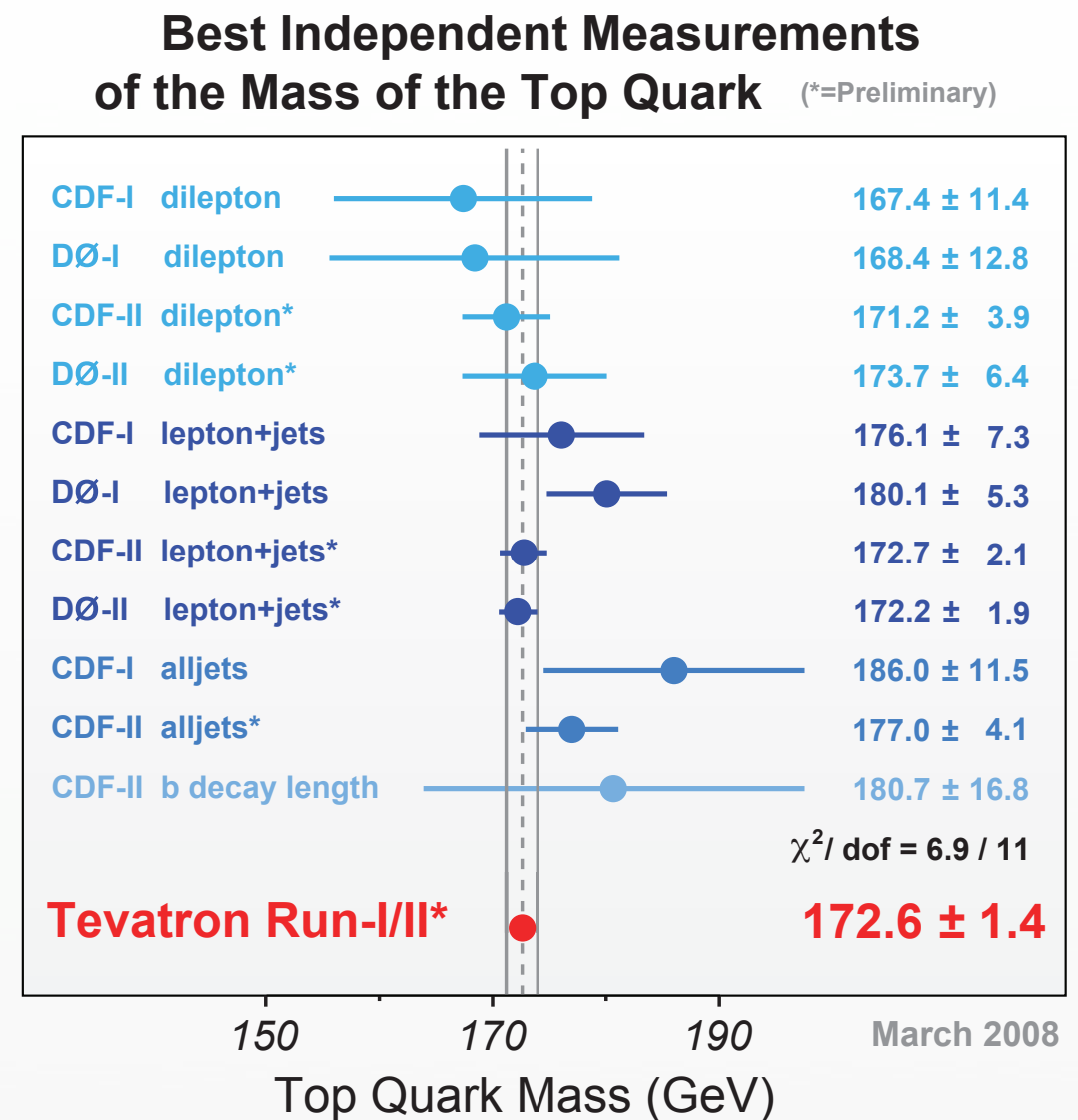
$$\mu_0/2 < \mu_{R,F} < 2 \mu_0$$

$$\mu_0 = m_{\text{top}}$$

**Discussion on
correct way
of evaluating
scale uncertainties**

What is the Top Mass?

- Uncertainty of Tevatron top mass combination: 1.4 GeV = 0.8%
- Two (related) questions:
 - Which top mass are we measuring?
 - All systematic uncertainties accounted for?
- Usual answer: measure “pole mass” (i.e. mass a quark would have without confinement) as used in MC generator → controversy
 - Problem 1: definition only good up to mass differences of order $\Lambda_{\text{QCD}} \approx 200 \text{ MeV}$
 - Problem 2: the MC generator may use additional assumptions
 - Theory (A. Huang) → RGE for top mass
 - Experiment (A. Juste) → ILC top threshold scan

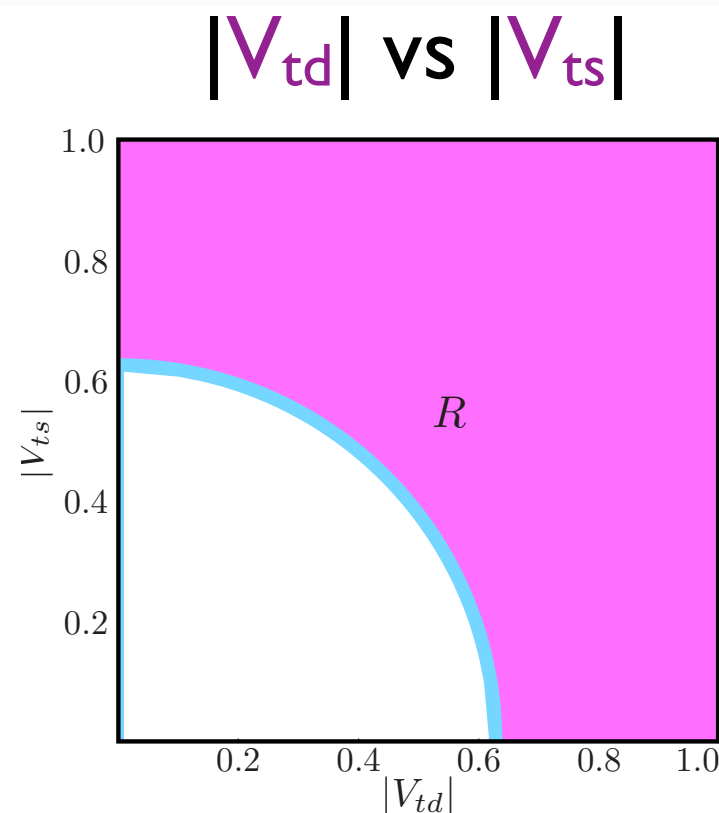
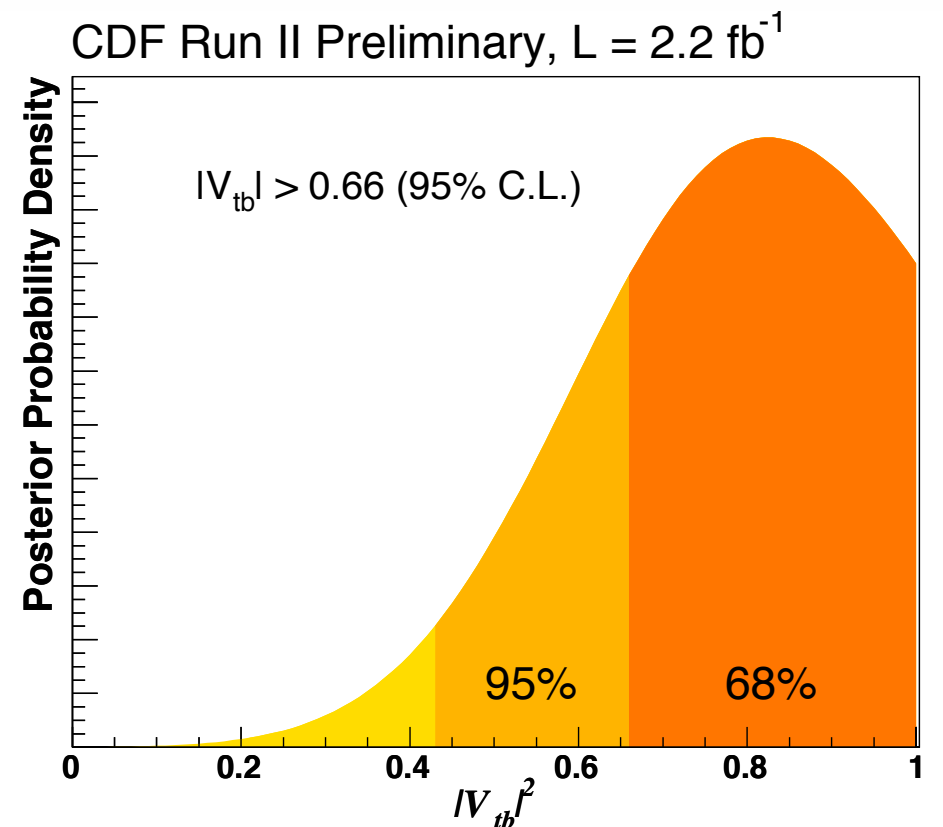


Fermion Propagator: Pole at $|p| = \pm m$

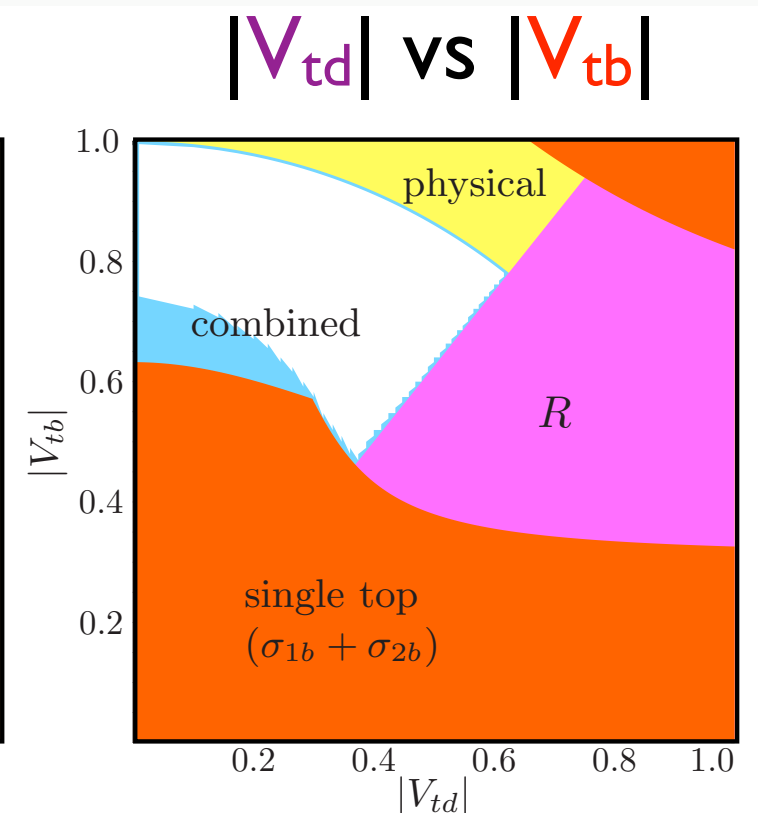
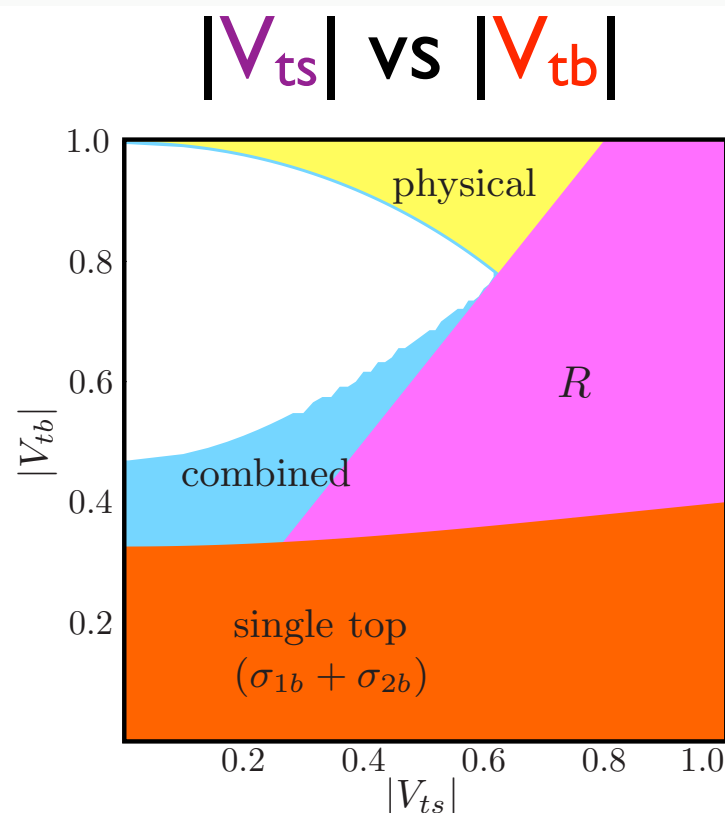
$$S_F(p) = \frac{\not{p} + m}{p^2 - m^2}$$



- Tevatron: single top evidence $\rightarrow$ cross section proportional to CKM matrix element $|V_{tb}|^2$
- Only valid if one assumes 3 generations or at least $|V_{tb}| \gg |V_{td}|, |V_{ts}|$
- More sophisticated proposals: use also R (ratio of $t \rightarrow Wb$ over all decay channels), order by b-tags (R. Frederix)

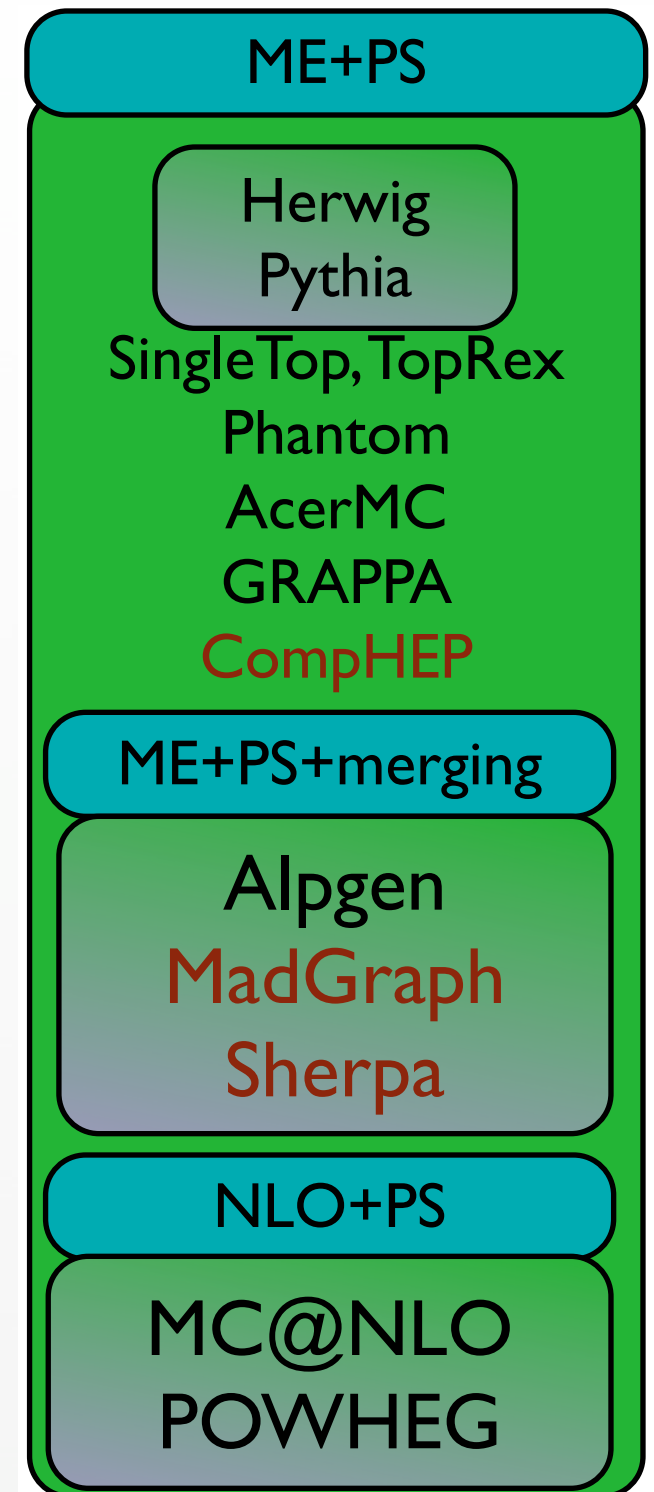
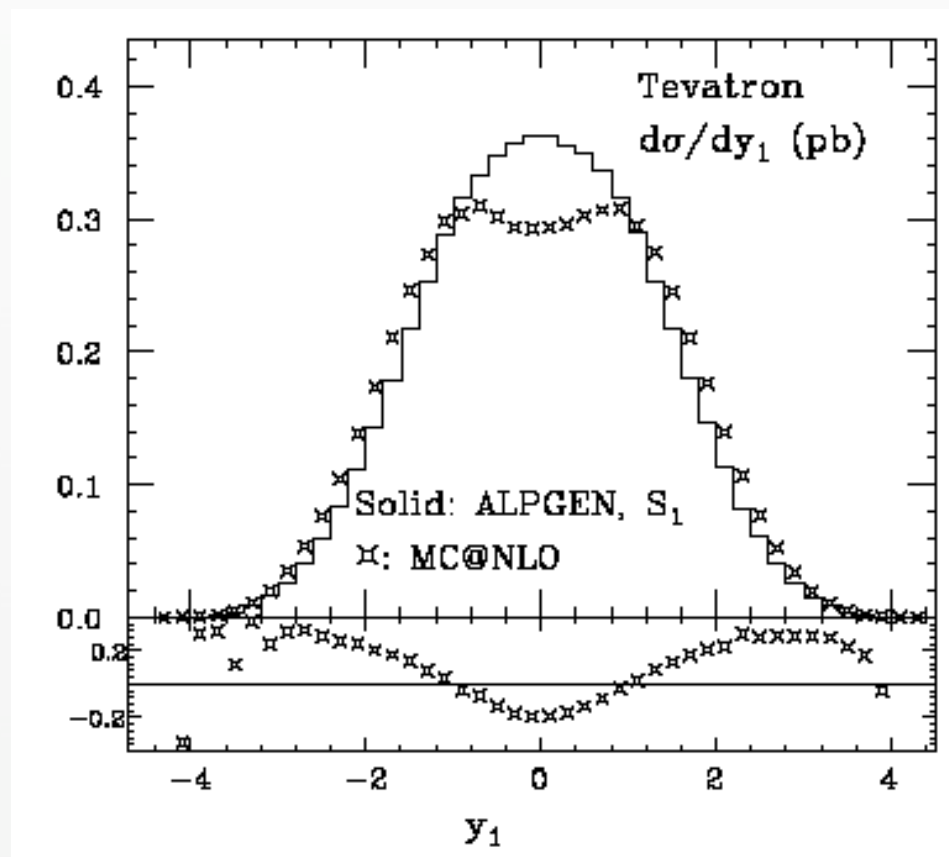


Top2008 Elba, May 20



Rikkert Frederix

- MC generators for top signal and background
 - Tevatron: limited set of fairly well validated tools
→ not always the latest greatest (person power limited)
 - LHC: about every generator on earth (but no data yet to validate them...)
 - MC generator uncertainties are important chunk of systematics (e.g. 0.3% in the 0.8% top mass uncertainty)
 - Several examples where NLO effects become important
 - Still discrepancies between generators, e.g. for first jet rapidity



[F. Maltoni]



- Tevatron: lots of top properties measurements → is the top really the top?
 - Mostly statistics limited
 - So far: agreement with standard model
- LHC: lots of studies, lots of sensitivity → search e.g. for $t\bar{t}$ mass bumps

- Many interesting models lead to resonances that decay into top pairs. They address a wide variety of deep questions faced by particle physics.
- Top resonances challenge us to think about top in new regimes:
 - Highly Boosted tops can be collimated and hard to reconstruct as tops.
 - Multi-top processes have challenging combinatorics.
- Top may be our portal to physics beyond the SM!



T. Tait

TOP2008 – A Great Workshop (some say: “The Perfect Workshop”)

