HELMHOLTZ GEMEINSCHAFT

ATLAS Zeuthen Meeting
May 27, 2008

DESY

TOP2008
A Short Review

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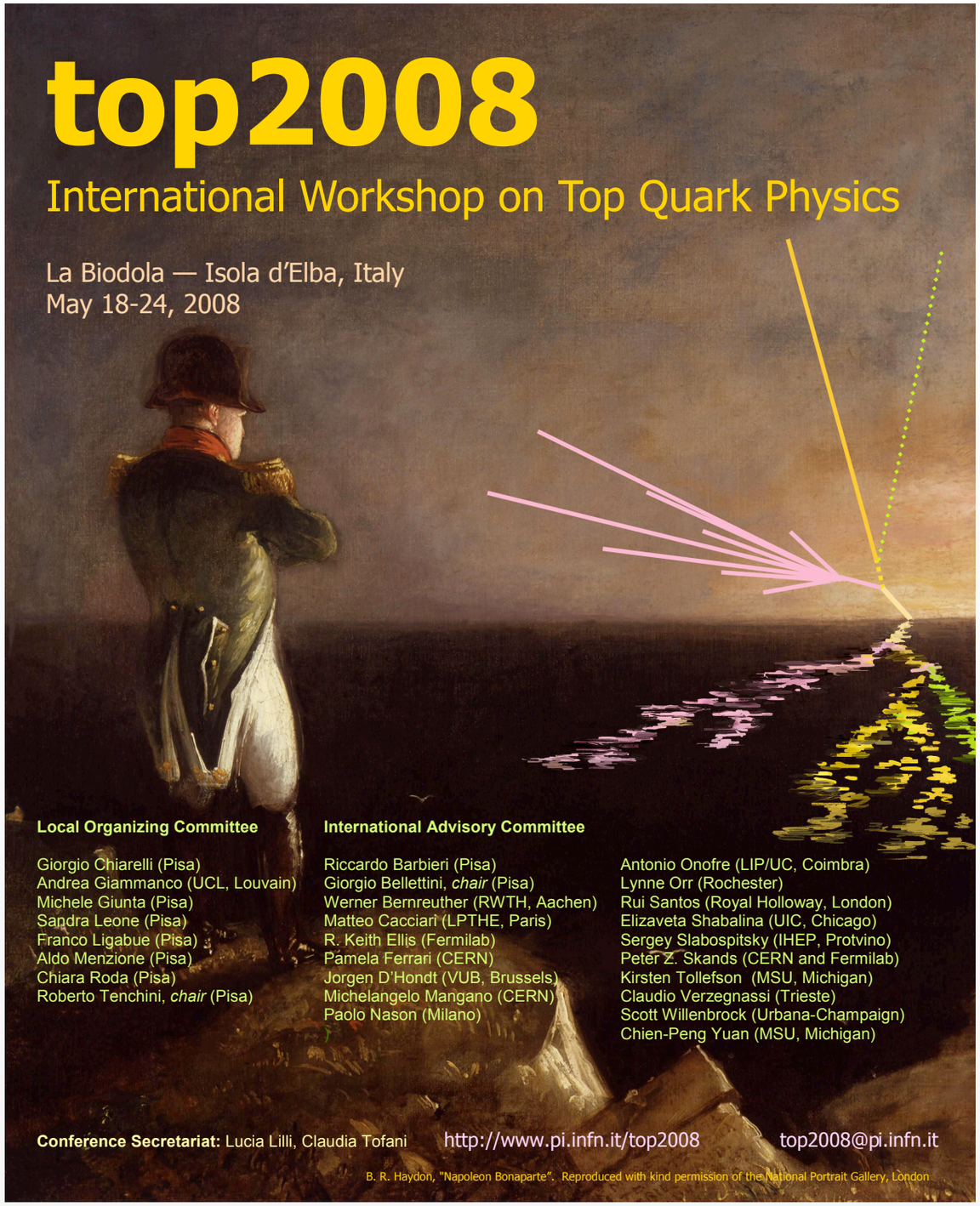
Deutsches Elektronen-Synchrotron

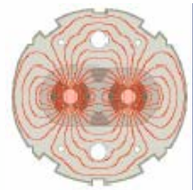
TOP2008



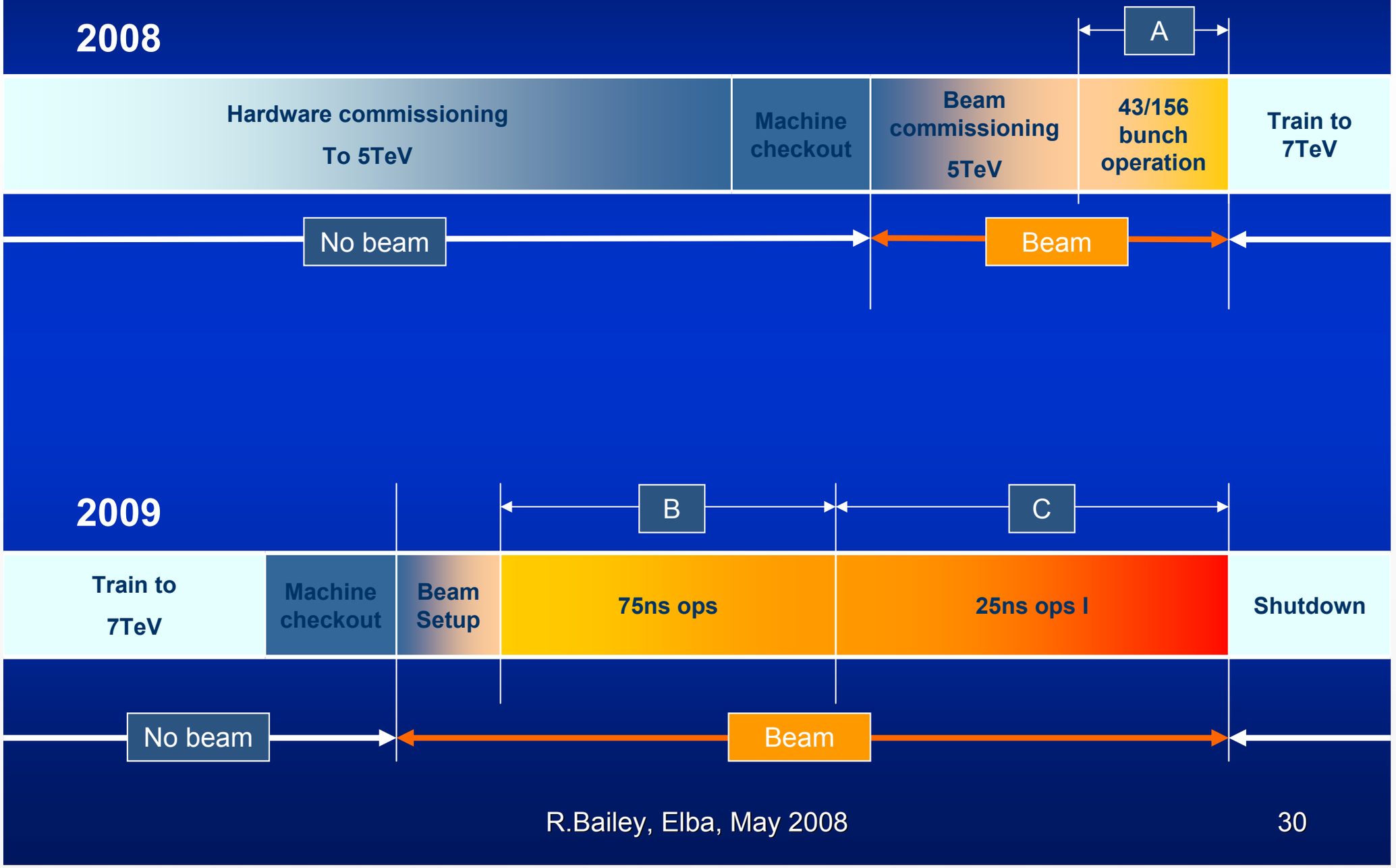
- 2nd International Workshop on Top Quark Physics (1st workshop: Coimbra 2006)
- Location: La Biadola, Isola d'Elba
- WWW: https://indico.pi.infn.it/conferenceDisplay.py?confId=227
- Workshop statistics:
  - 117 Participants
  - 49 Talks
  - 1825 Minutes
  - 1571 Slides
- Short summary:
  - The perfect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

Agenda Overview

- 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



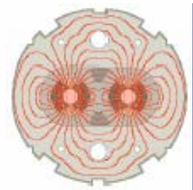
Strategy for 2008 and 2009



R.Bailey, Elba, May 2008 30

LHC Startup (R. Bailey)

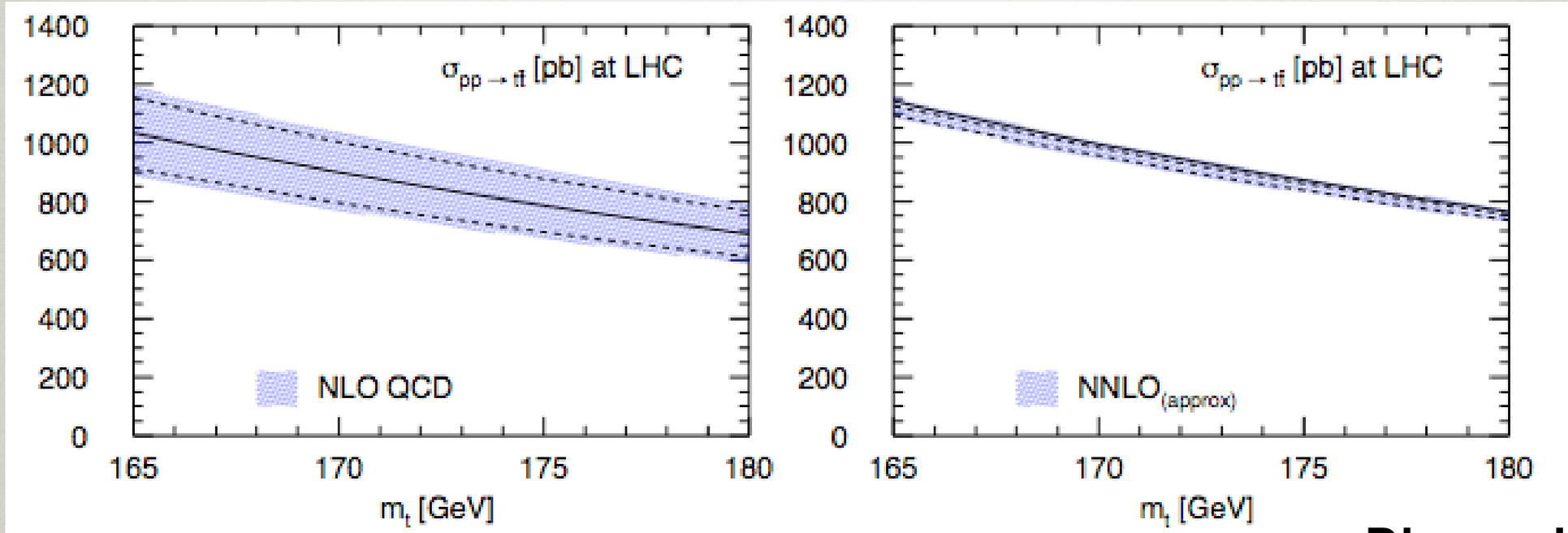
Strategy for 2008 and 2009



R.Bailey, Elba, May 2008 30

Top Pair Cross Section (M. Mangano)

Scale dependence



Moch and Uwer, arXiv/08041476

Discussion on correct way of evaluating scale uncertainties

Scale dependence criteria:

Moch and Uwer:

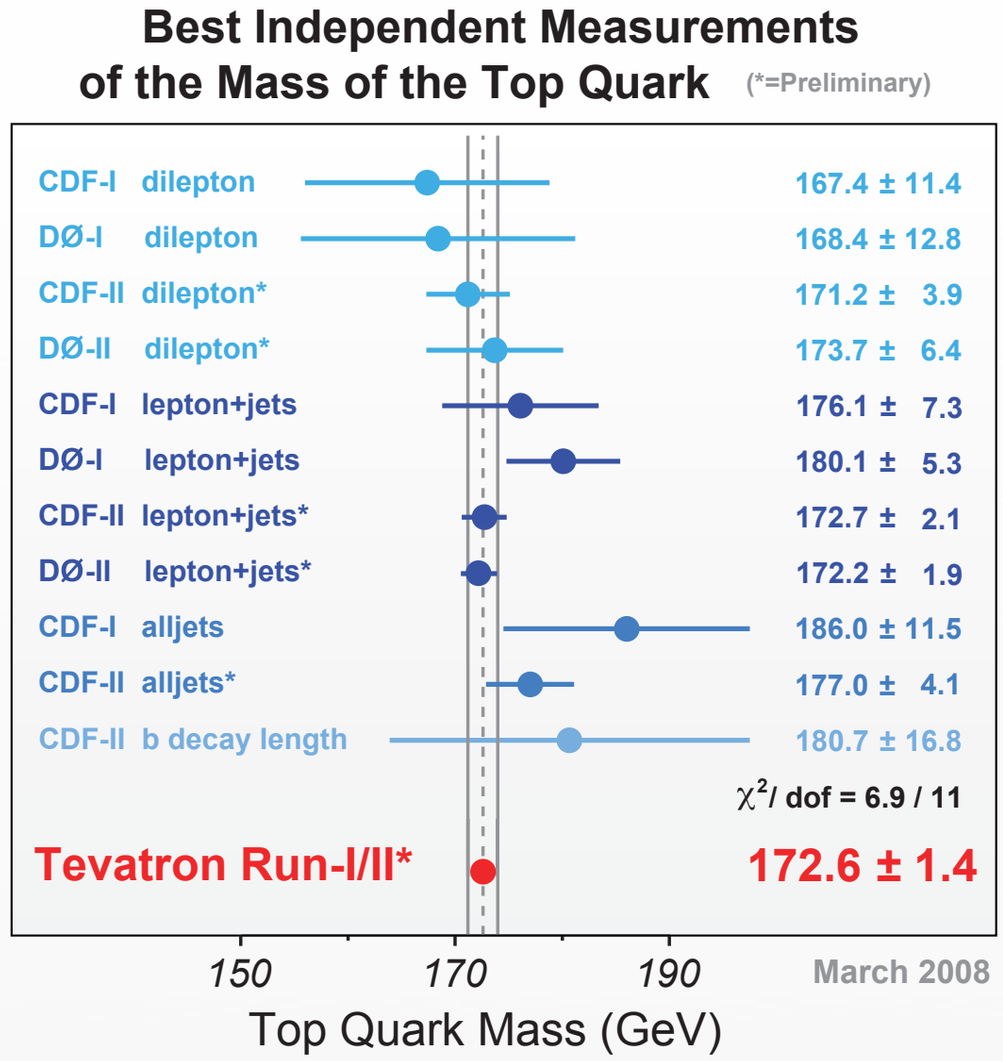
$\mu_R = \mu_F = \mu$ $\quad \mu_0/2 < \mu < 2\,\mu_0$ $\quad \mu_0 = m_{top}$

Cacciari et al.

$\mu_R \neq \mu_F$ $\quad 1/2 < \mu_F / \mu_R < 2$ $\quad \mu_0/2 < \mu_{R,F} < 2\,\mu_0$ $\quad \mu_0 = m_{top}$

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 $\Lambda_{QCD} \approx 200$ MeV
  - Problem 2: the MC generator may use additional assumptions
  - Theory (A. Huang) → RGE for top mass
  - Experiment (A. Juste) → ILC top threshold scan



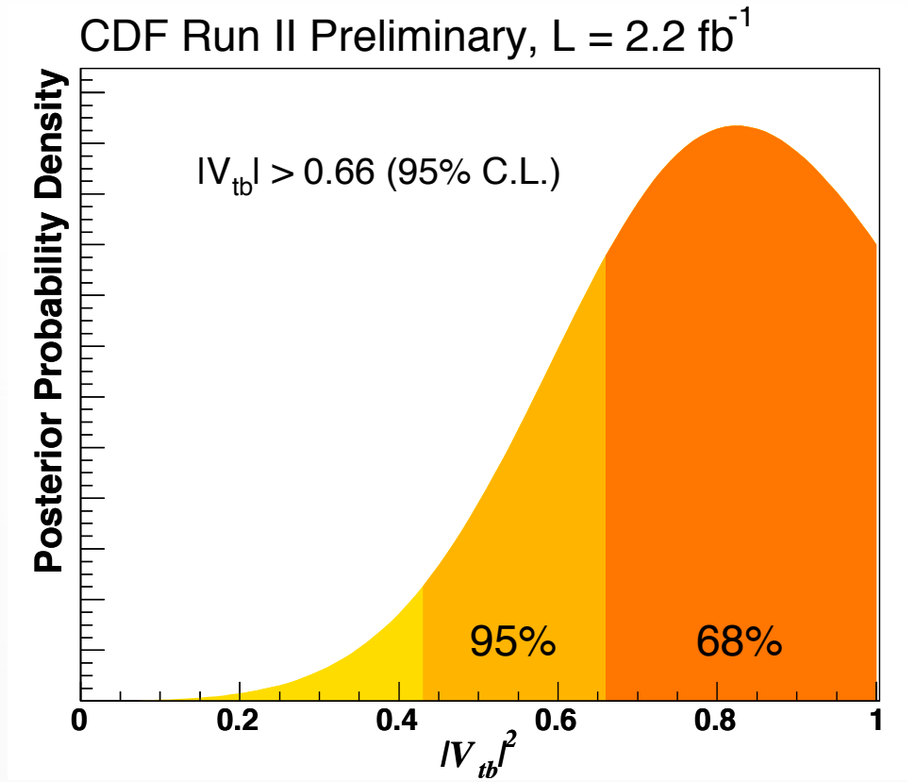
Fermion Propagator: Pole at |p| = ± m

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

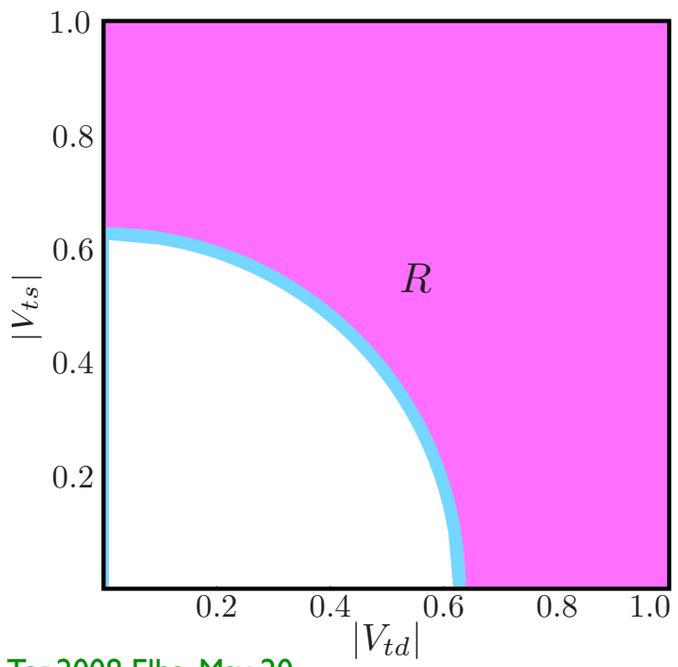
Time for a Coffee Break!

Are we Really Constraining V_{tb}?

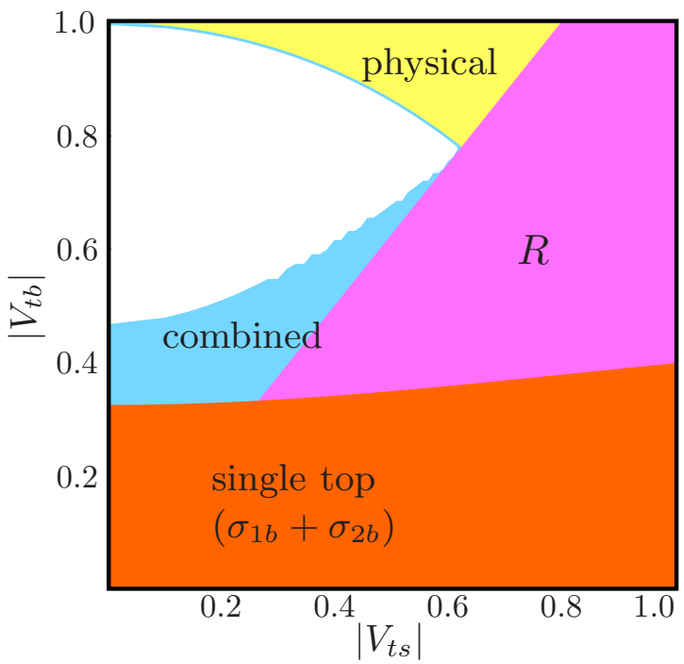
- Tevatron: single top evidence → cross section proportional to CKM matrix element $|V_{tb}|^2$
- Only valid if one assumes 3 generations or at least $|V_{tb}| >> |V_{td}|$, $|V_{ts}|$
- More sophisticated proposals: use also R (ratio of t → Wb over all decay channels), order by b-tags (R. Frederix)



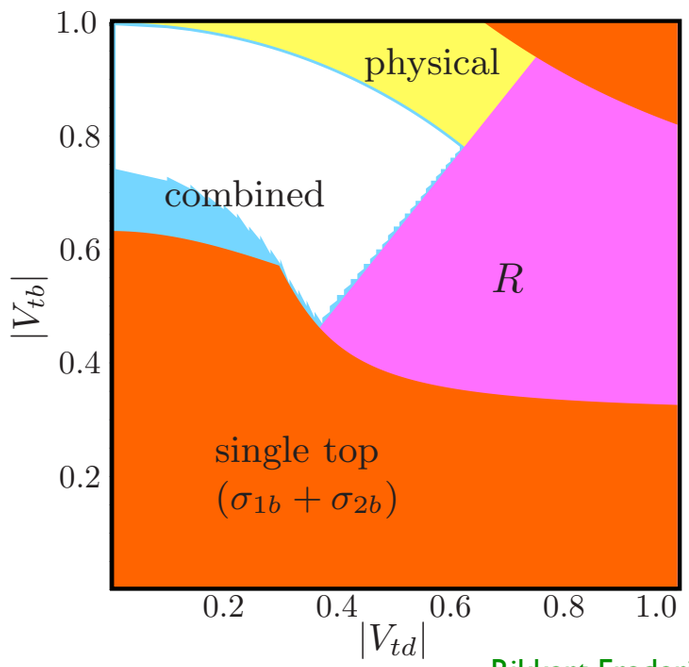
$|V_{td}|$ vs $|V_{ts}|$



$|V_{ts}|$ vs $|V_{tb}|$



$|V_{td}|$ vs $|V_{tb}|$

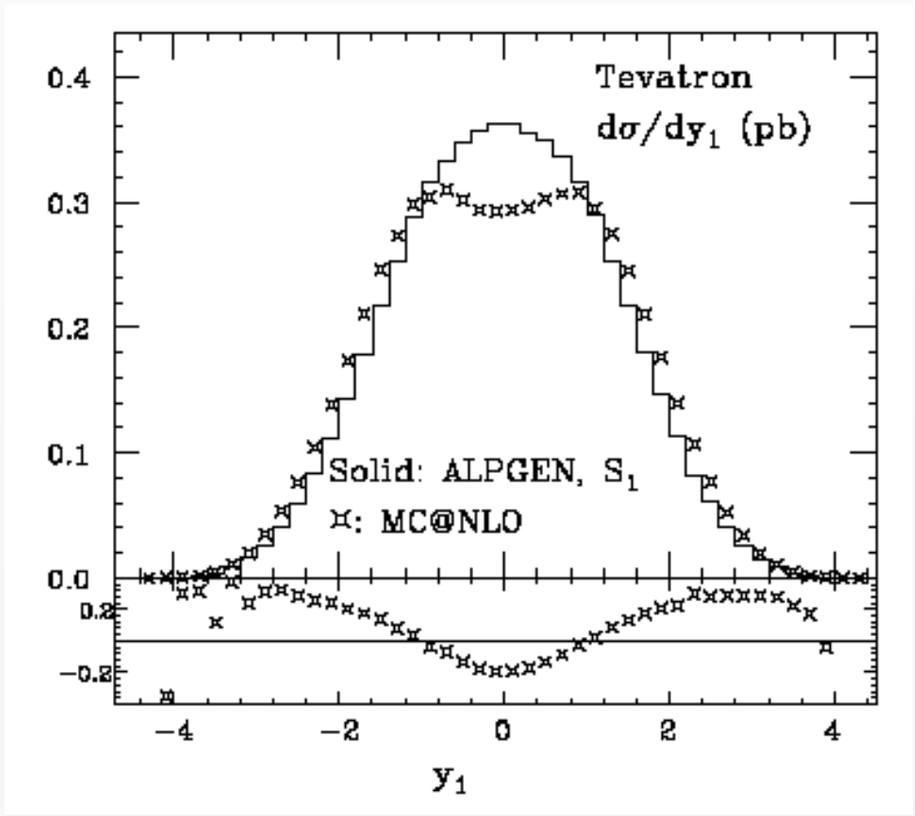


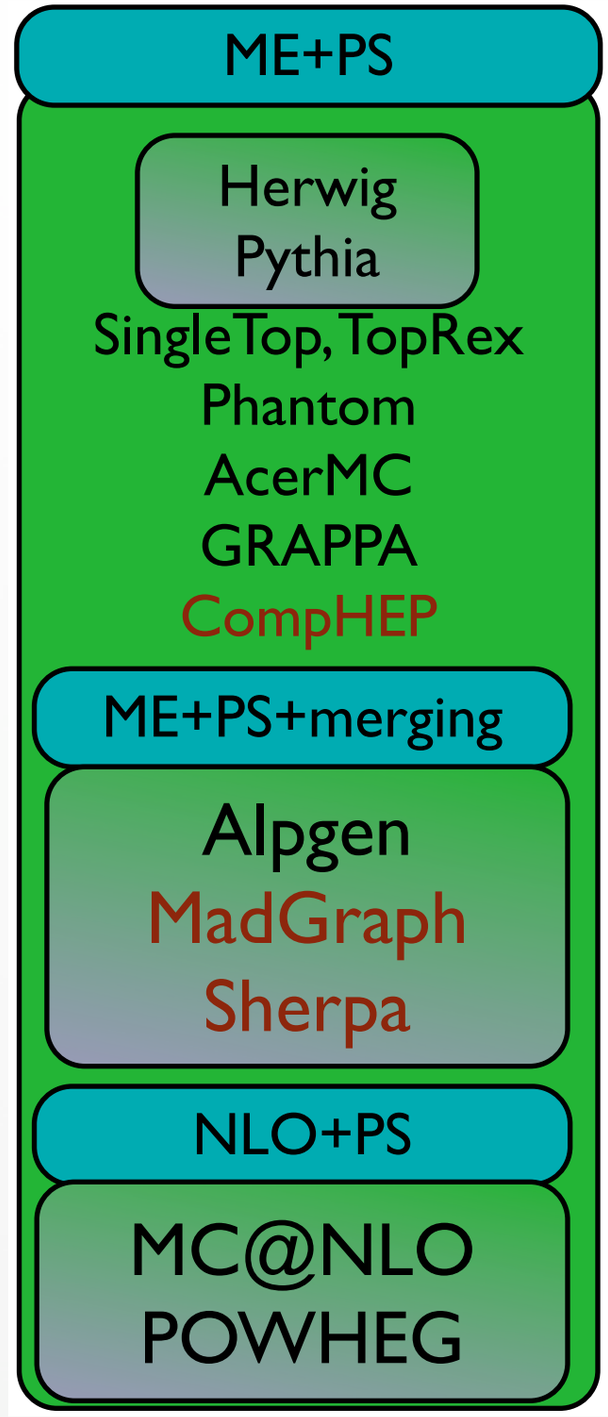
Top2008 Elba, May 20

Rikkert Frederix

Tools for Top: MC Generators

- 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]

Social Event: Beach and Roman Villa

Top Beyond the Standard Model

- Tevatron: lots of top properties measurements → is the top really the top?
  - Mosty 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

Conclusions

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