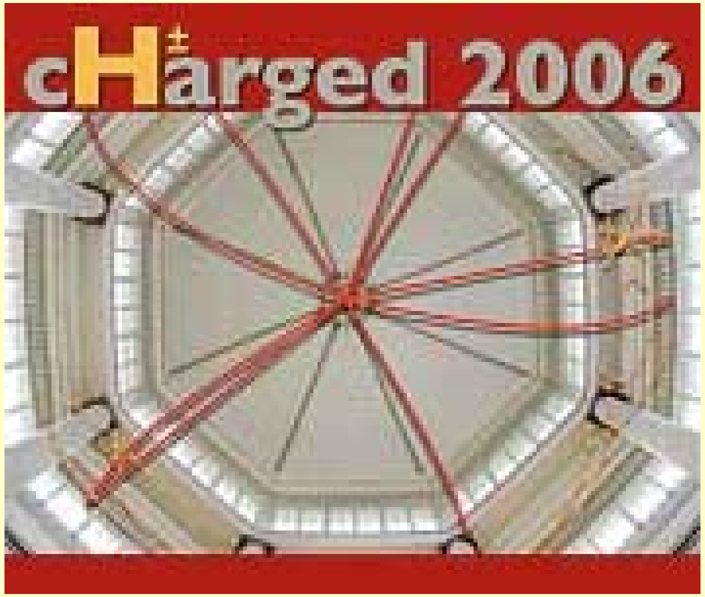
Results from analyses of physics and simulated data using different tools

-Brief Summary -



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Experimental issues in Charged Higgs Boson Searches

1. Identification of hadronic tau decays

- significant branching ratios over large areas of parameter space

2. b-tagging, E_T^{miss} signatures

- b-tagging is important, since multi-b final states appear
- b-tag important for significant background rejections

3. Triggering on hadronic taus

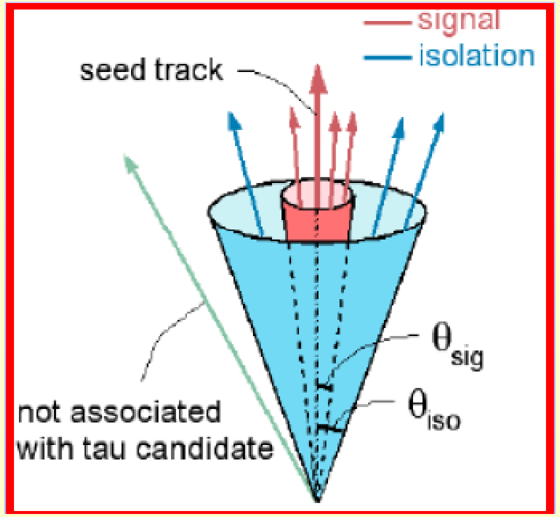
- in case of no accompanying leptons, dedicated hadronic tau triggers are needed

Identification of hadronic tau decays

Consensus about the general strategy: CDF, D0 $\rightarrow$ ATLAS, CMS

Standard approach:
Start from the calorimeter cluster information
- exploit shower shape variables
  (reconstruct π^0 in the calorimeter, depends on
  longitudinal and lateral calorimeter granularity)
- associate tracks to the calorimeter cluster
- apply calorimeter and track isolation
- additional handles: τ mass (track + π^0 mass)
  τ lifetime (impact parameter)

final step: multivariate analysis (likelihood, NN)
cuts may depend on P_T of the τ



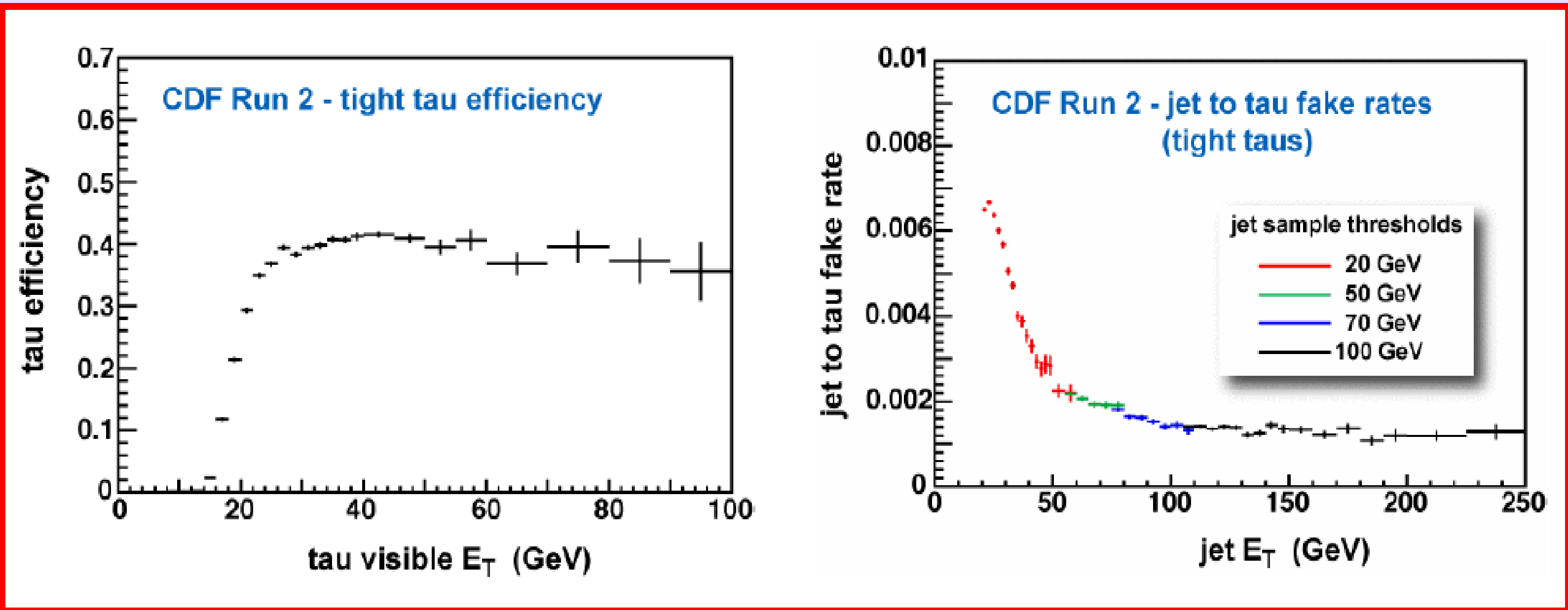
Further discrimination (separate various τ decay modes)
DØ collaboration

Limitation: efficiency drop for low p_T taus,
$\rightarrow$ alternative approaches: track based initialization for low p_T taus

M. Owen

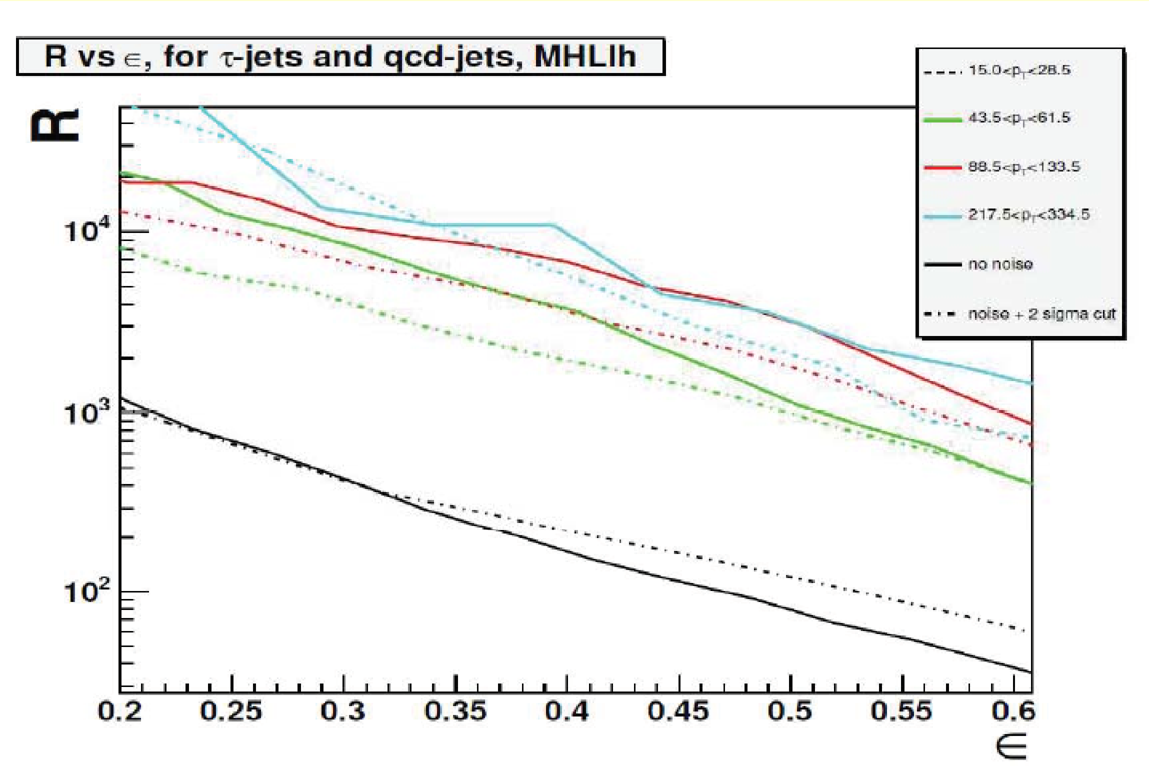
Tau Efficiency & Fake Rate at CDF

- Tau efficiency after tight selection :
- Jet fake rate, using jet triggers :



Similar results from the DØ experiment

Simulation results from ATLAS and CMS



M.Heldmann

In addition: Methods on how to determine efficiencies from data are being studied

C. Shepherd

Future steps (work to do for the LHC analyses)

- consolidate τ ID algorithms
  (profit from the rich experience from the TeVatron, TeV4LHC very useful,…)

- work towards a complementary track-based τ ID approach to improve the performance at low PT

- discriminate between various decay channels

- refine and consolidate multivariate analyses

- study further ways to measure the τ tag efficiency from data

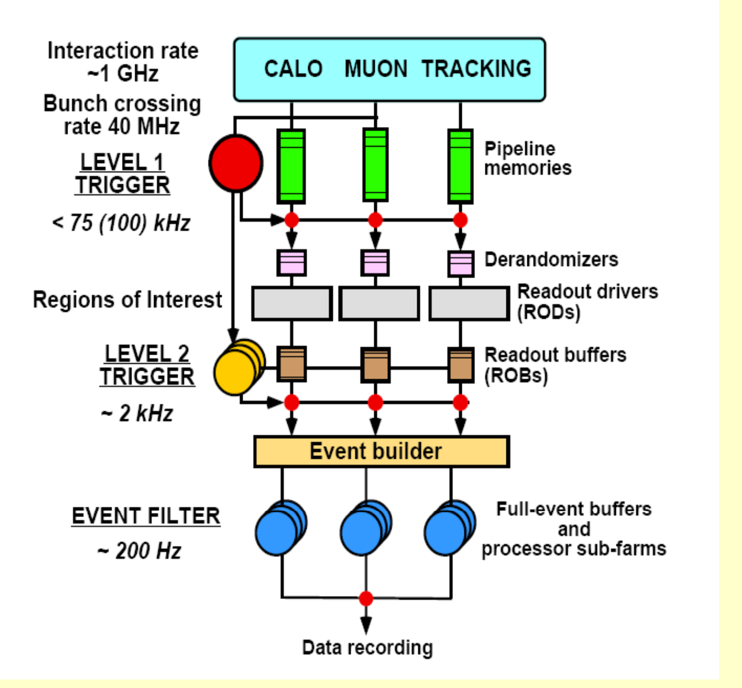
The trigger problem

S. Amerio
P. Casado

All experiments have multi layer trigger system

• dedicated tau triggers at the Tevatron
  profit from tracking info at L1
  (not possible at the LHC)

- e/μ + track
- tau + ETMISS
- di-tau trigger



LHC tau triggers:

• Single tau triggers have high thresholds
• Hadronic tau decay channels have to rely on ***tau + ETmiss***
and ***tau + jet*** ***and jet + ETmiss triggers***

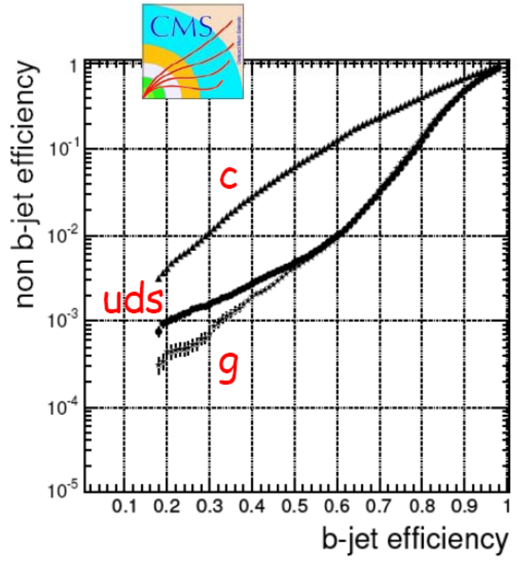
• Trigger efficiency seems to be adequate, given rather high PT thresholds in
  in offline analyses (50-70% trigger eff. even for low H+ masses)

b-tagging and b-signatures in H+ events

S. Lowette

- Several b-tagging algorithms in place for ATLAS and CMS
  (good performance expected, with degradation in forward and low-p_T region)

- b-tagging is an important tool in Charged Higgs analyses
  (in particular in the H+ → tb decay modes)



sec.vtx. algo on $t\bar{t}$
with $|\eta| < 1.4$

- b-tagging is essential in any Charged Higgs analyses using tb final states

  - difficult S/B conditions
  - improvements in b-tagging for soft and forward jets would certainly help
    however, some backgrounds irreducible (b-contents, gluon splitting,…)

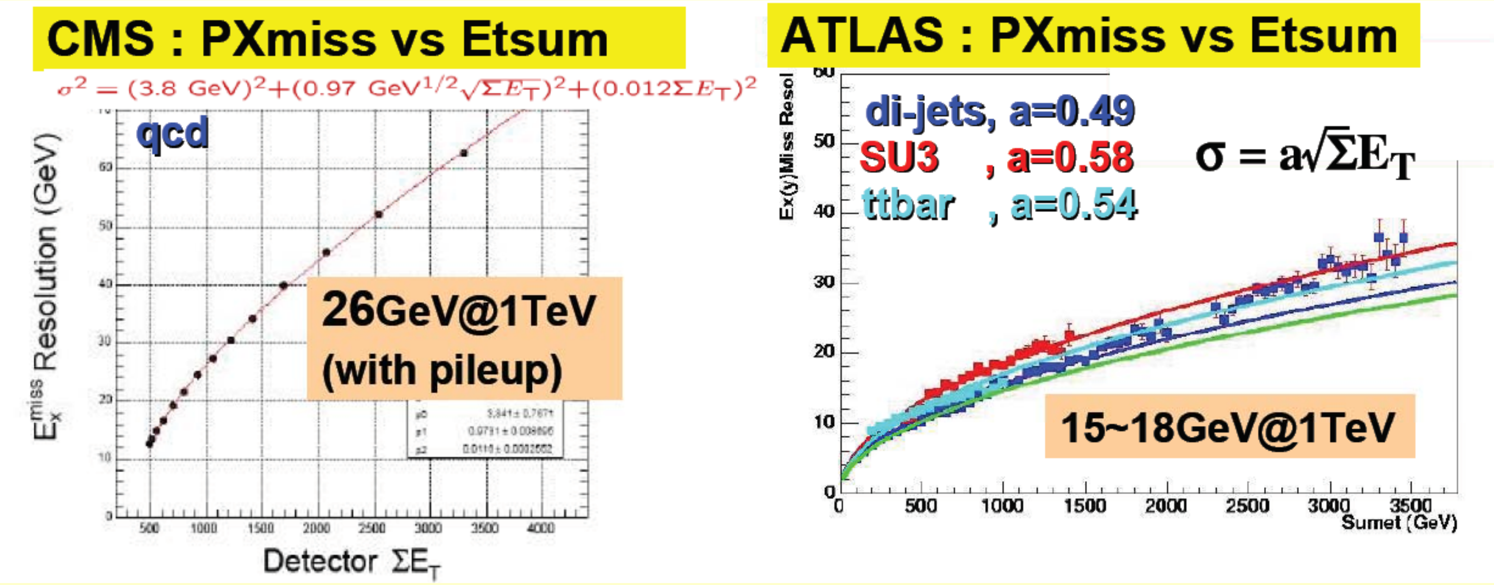
  - situation appears to be difficult (tb does not seem to be the "gold plated" charged Higgs boson discovery channel)

ETmiss reconstruction

N. Kanaya

- ETmiss is an important signature
  (also for Charged Higgs boson searches)

- resolution is primarily determined by calorimeter resolution and response



- Important issues for future work: calorimeter calibration, response uniformity, ….
  noise suppression
  + develop mehtods to determine resolution with data
    (validation, started already)

Conclusions

Search for the Charged Higgs boson at Hadron Colliders is extremely important

The **experimental techniques** are already well advanced

- ID of hadronic taus: some improvements still desirable
- Hadronic tau triggering seems feasible in combination with ETMISS /jets
- Additional complementary signatures: b-tagging, E_T^{miss}
- Top reconstruction is necessary, but difficult (Ketevi)

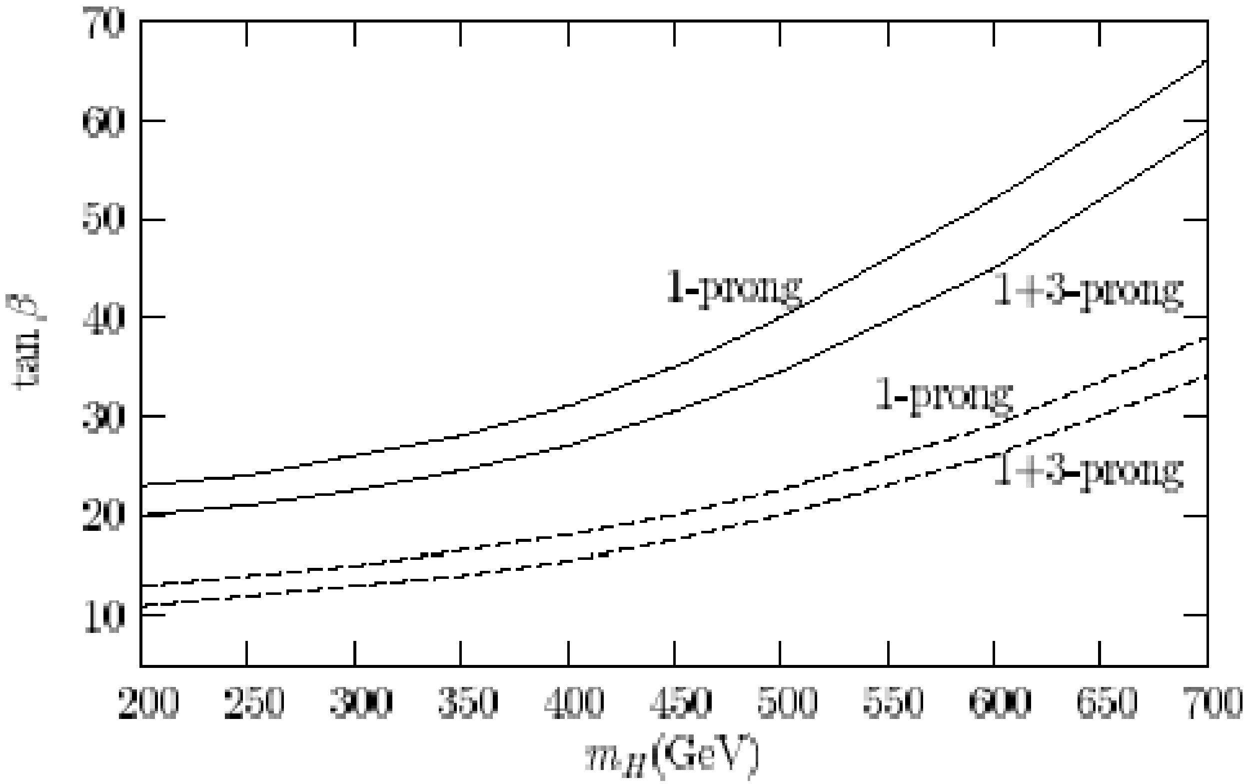
New analysis methods have been studied:

-Tau polarisation should be exploited in 1- and 3-prong-decays (improved signal significance)
- IDM method looks promising, however, real confirmation from Tevatron data still needed (+ consideration of all relevant backgrounds)
- And finally: updated LHC discovery contours

as usual: increased background is suppressed by smarter ideas / more sophisticated cuts

Discovery potential with 3-prong selection

R. Kinnunen



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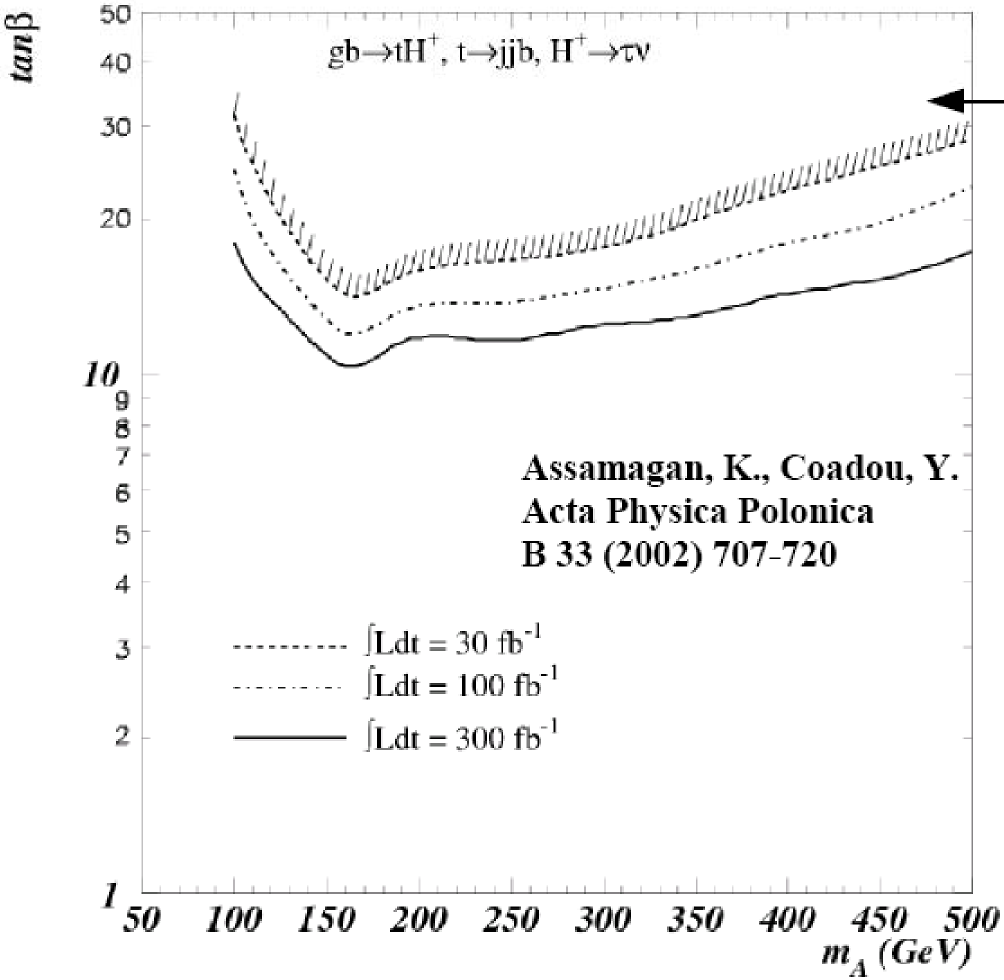
M. Flechl



- Discovery Contour by Assamagan/Coadou (Atlfast, 2002)

Preliminary

- **new Fullsim contour** to be approved by ATLAS:
- - large samples of all relevant backgrounds [estimated bkg: increase by O(10)]
  + three new selection cuts
  + new b-/tau-tagging strategies
  + three selection cut value sets
- **region $m_{H\pm}$ < 165 GeV covered similar** to the contour to the right for **165 < $m_{H\pm}$ < 200 GeV**, **steeper** for **higher masses**

Conclusions (cont.)

Uppsala is a nice place to be, looking forward to forthcoming workshops

Possible Roadmap:

→ 2008: work on tooling (tau, btags, methods to get efficiencies from first data)

→ 2010: first results from data ….

→ 2012: I hope that we know whether a Charged Higgs exists or not

regardless of the outcome: we could continue to get lectures on how to drink the Uppsala Schnaps

A big Thanks to the Organizers (Tord, Johan, ….) for the perfect organization