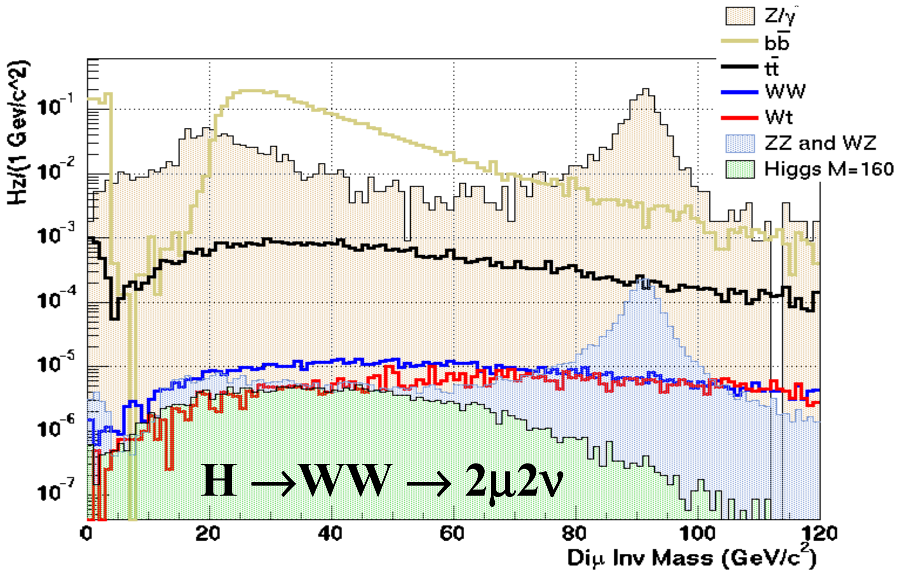
H->WW->2l: general properties

- High σ*BR higgs channel, but no peak!
- Clean but rather common final state, need high rejection (up to 10^{-5}) for higher rates processes (e.g. *tt* or DY)
- Big uncertainties from the theoretical and experimental side, need for S/B>1
- To understand the backgrounds the data must be utilized to the maximum extent.



	Signal (M=160)	*WW*	*tt*
σ*BR (fb)	1000	7400	52000
Events* after all selections	170	110	30

*Events for 10 fb^{-1} and 2l final state. Wtb, gg->WW, DY not included

Background Normalization: the idea

- Idea based on the relation:

MC

$$N_{bkg} = \underbrace{\left(\frac{\sigma_{bkg}}{\sigma_{ref}}\right)}_{\textit{Low theoretical uncertainty}} \cdot N_{ref}$$

Extrapolated

Measured

- Identify a region in the phase space where a given background is enhanced
- The reference region must be under control from the theoretical point of view to the maximum extent.
- Low/negligible contamination from other processes in ref. region
- Not too far away from signal region (similar topology/kinematics)

Experimental Viewpoint

- In real life we deal with:

$$N_{bkg} = \left(\frac{\sigma_{bkg} \cdot \varepsilon_{bkg}}{\sigma_{ref} \cdot \varepsilon_{ref}} \right) \cdot N_{ref}$$

- Crucial to understand the efficiency and its error of each reconstructed object involved

- Critical to estimate the possible contamination of the reference region(s) by high rate processes faking the actual final state

- Keep it simple: not too many reference regions and not too sophisticate selections

Example with *tt* background

tt reference region:

- same selections on leptons and MEt
- no jet-veto
- jet Pt > 50 GeV
- one b-tagged jet (no veto on extra jets)

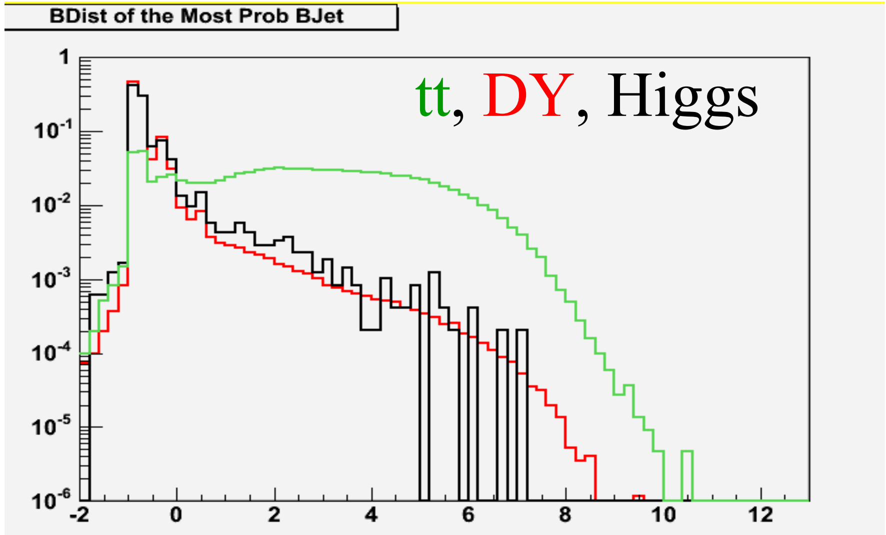
Results for LO *signal, DY* and *tt*. *Wt* not included

	Events* for 10 fb^{-1}
Higgs	0
DY	15
tt	280

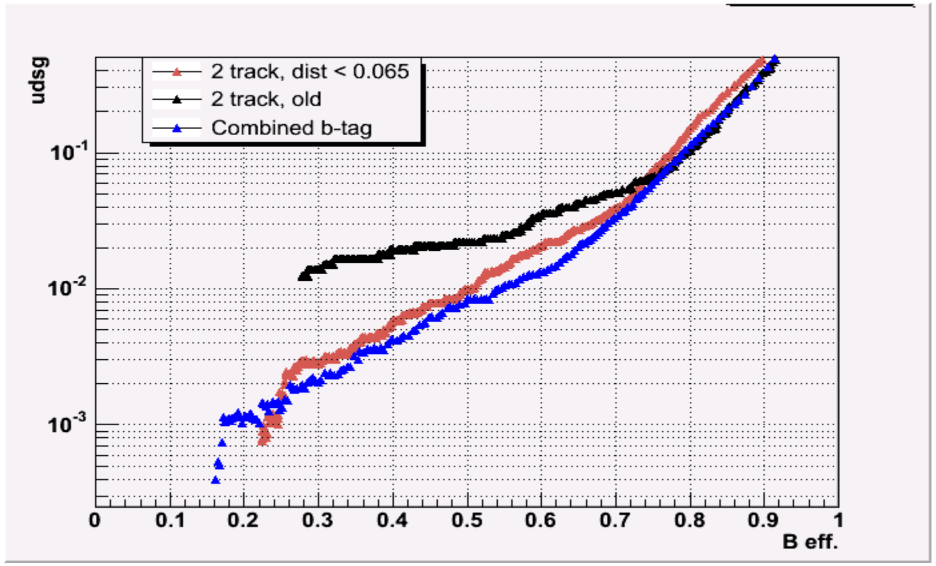
* 2 μ final state

Experimental Concerns: b-tagging

- Needs a precise and solid knowledge of the tracker and vertex detector
- Usually sophisticated algorithms relying on good performances of tracking and vertices (primary and secondary)
- The algorithms provide a probability for the jet to come from a *b*. Trade-off between pureness and efficiency
- Need to identify data samples with *b*'s without exploiting b-tagging to get the algorithmic efficiency and its error

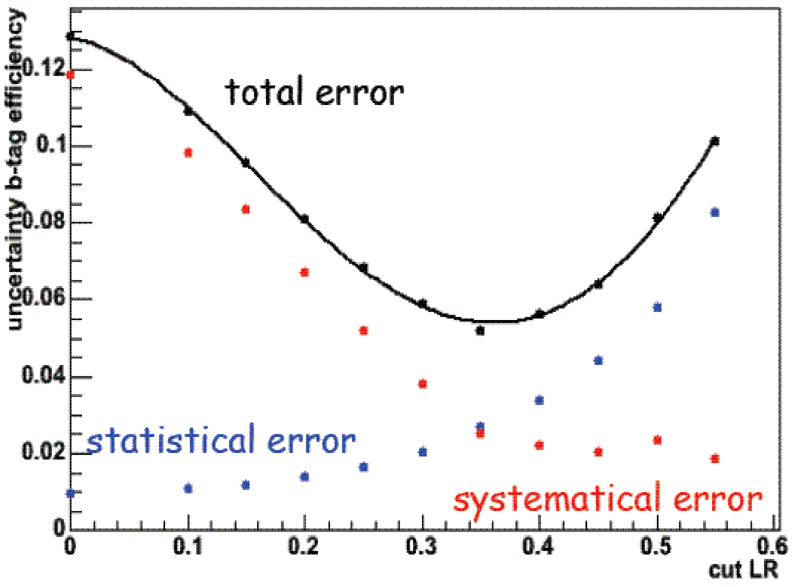


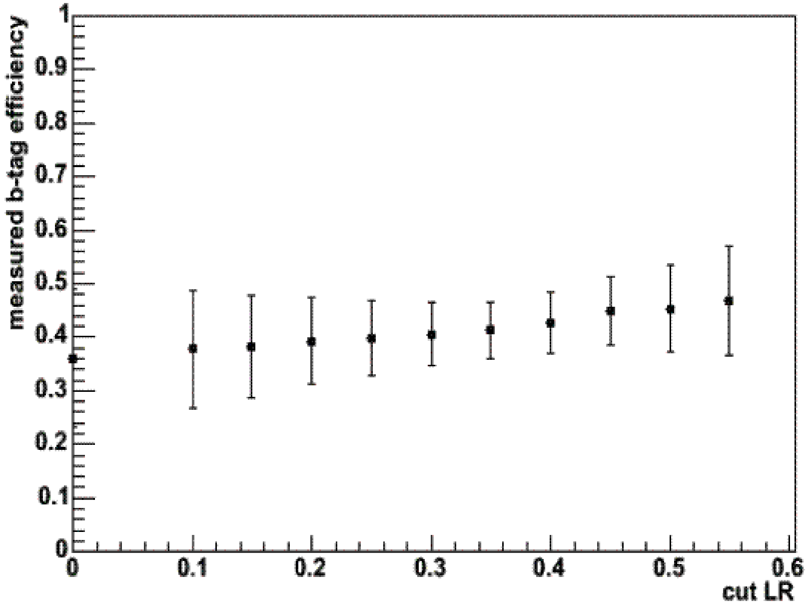
B-Tag discriminating variable



Experimental Concerns: b-tagging

- At the LHC high *tt* luminosity. Possible to select pure *tt* events just with kinematical constraints (*t*-mass)
- Checking the b-tagging efficiency w.r.t the *tt* control sample leads to uncertainties ~10%



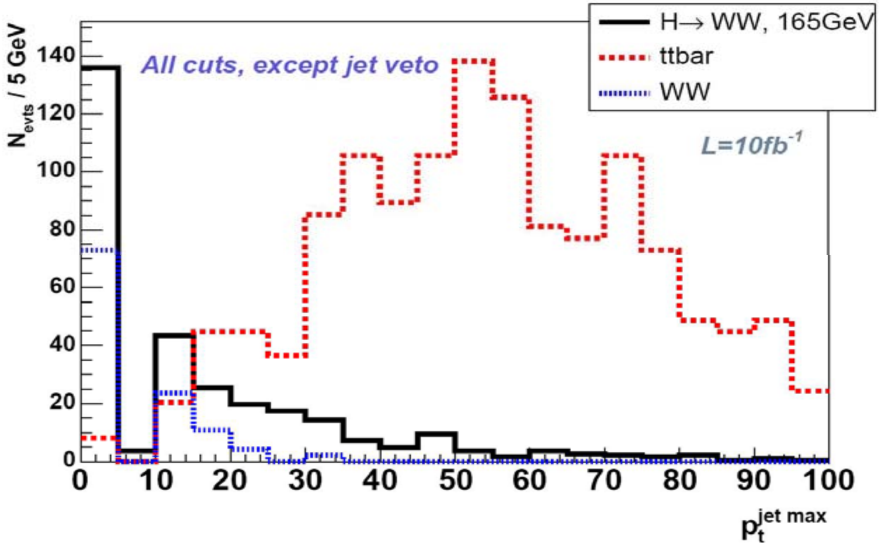


- Need a control sample also to estimate the mis-tagging efficiency (QCD)

tt normalization: alternative approach

tt Reference Region: same selections as before but NO request for a b-tagged jet

- To be applied only for different flavor leptons final state (avoid DY)
- Topology: $\mu^{\pm} + e^{-/+}$ +MEt+1j. Contamination from WW+j(s) (negligeble?)
- Systematics coming from uncertainty on jets energy scale (~10%) and from jets misidentification. (10^{-4} for *e*'s and 10^{-5} for μ's). Possible contamination by W+2j

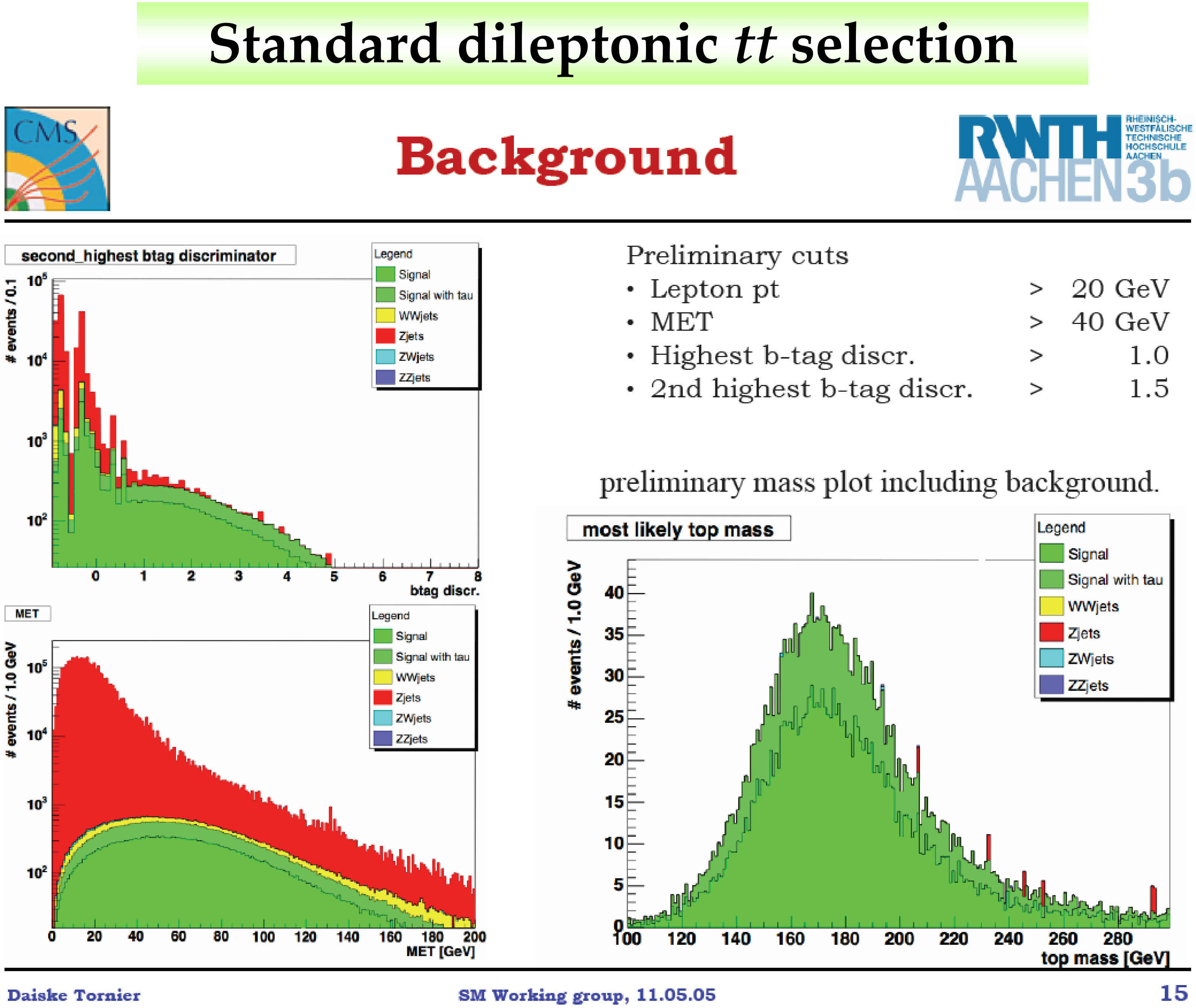


	Events* for 10 fb^{-1}
Higgs	70
tt	1050

Discussion

- Which ref. region for tt (number of b-tags, extra jet veto)?
- DY+bb not considered, could it be relevant?
- How to enhance Wt? Select a different ref. region?
- How should this ref. region for Wt be defined? Still dileptonic final state or a different one?

BACKUPS



Standard dileptonic *tt* selection

Background

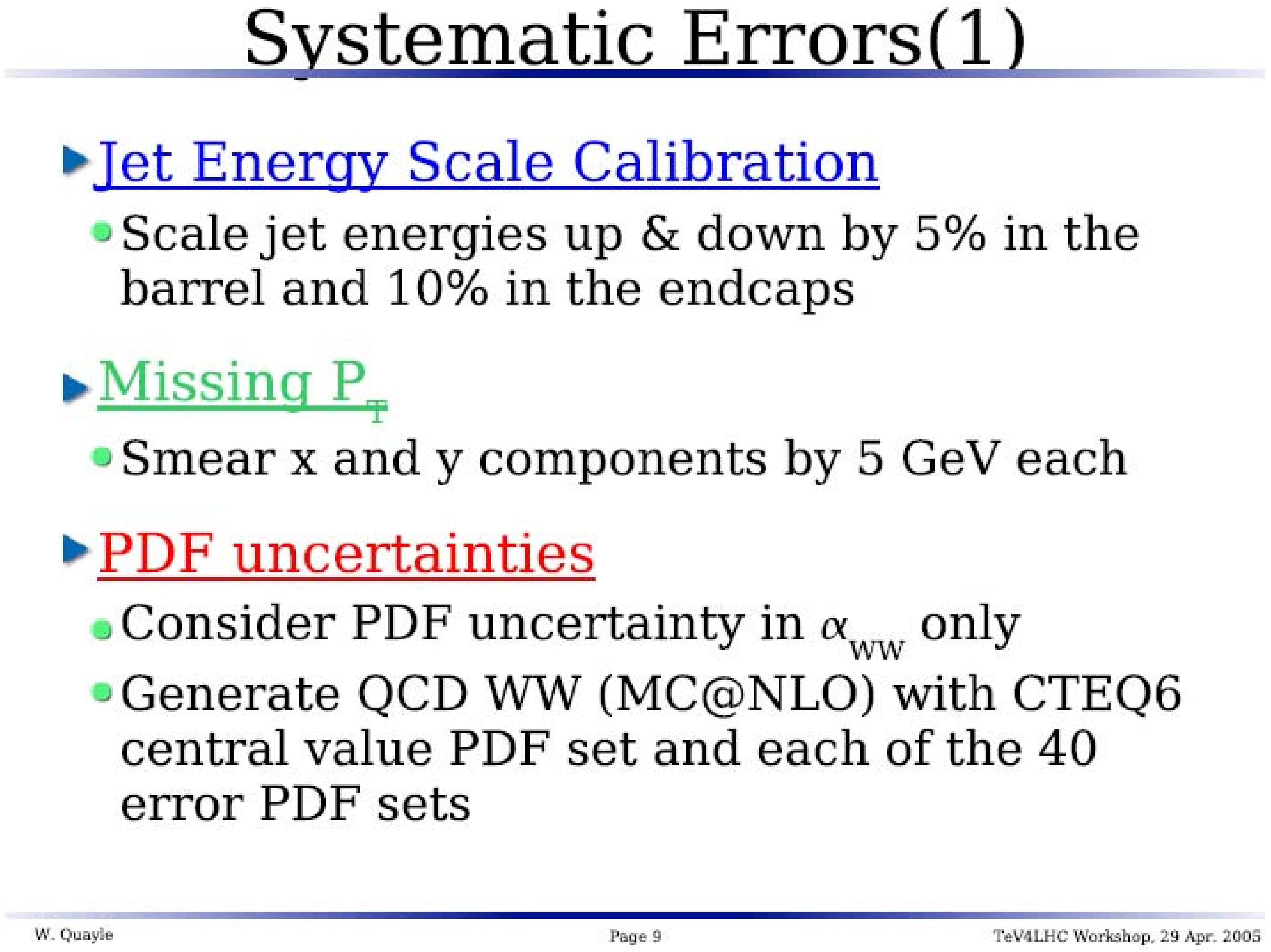
Preliminary cuts

- Lepton pt > 20 GeV
- MET > 40 GeV
- Highest b-tag discr. > 1.0
- 2nd highest b-tag discr. > 1.5

preliminary mass plot including background.

Daiske Tornier **SM Working group, 11.05.05** **15**

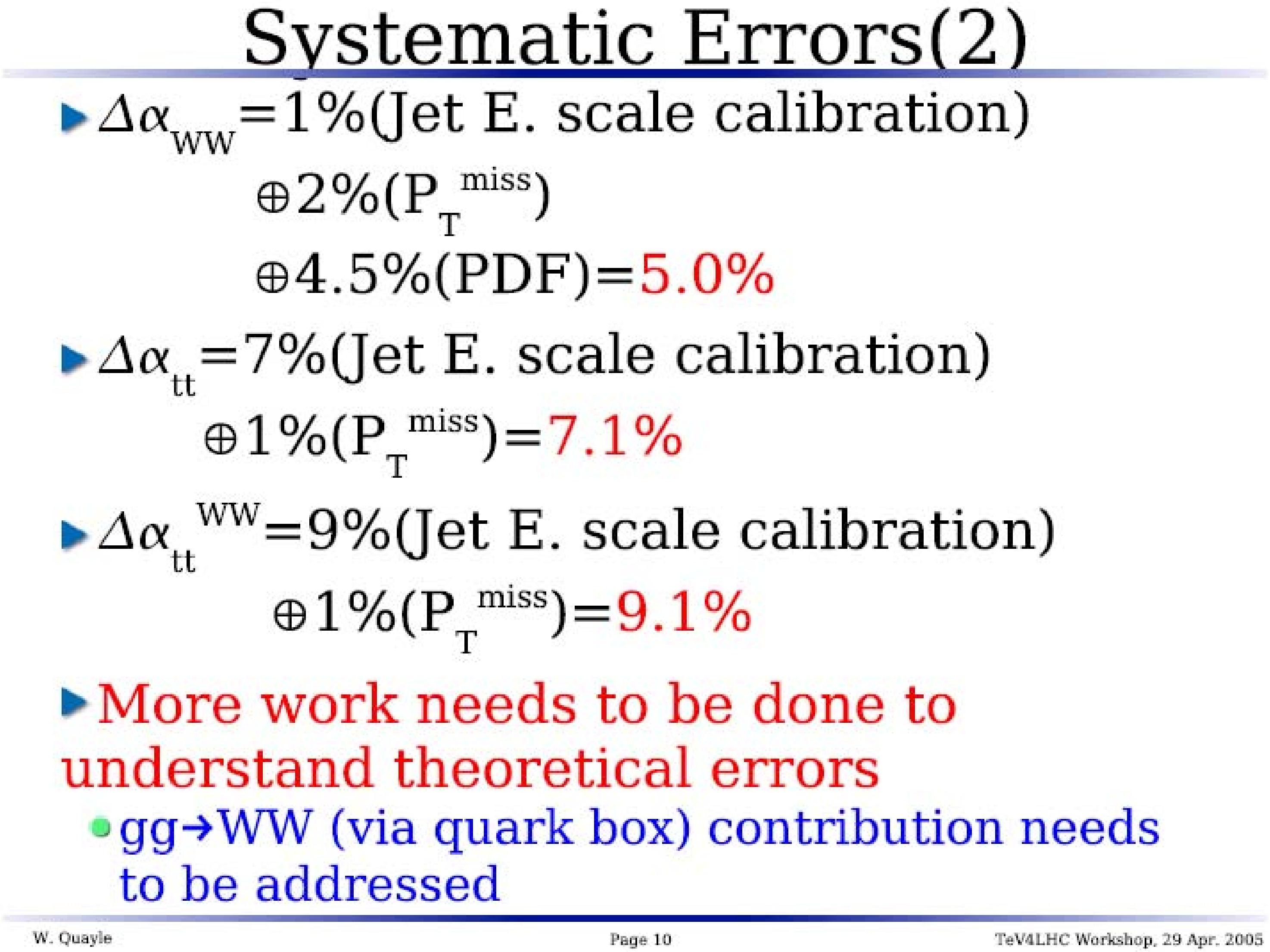
ATLAS systematics estimation



Systematic Errors(1)

- **Jet Energy Scale Calibration**
  - Scale jet energies up & down by 5% in the barrel and 10% in the endcaps
- **Missing P_T**
  - Smear x and y components by 5 GeV each
- **PDF uncertainties**
  - Consider PDF uncertainty in α_{WW} only
  - Generate QCD WW (MC@NLO) with CTEQ6 central value PDF set and each of the 40 error PDF sets

ATLAS systematics estimation



Systematic Errors(2)

- $\Delta\alpha_{WW}=1\%(\text{Jet E. scale calibration})$
  $\oplus 2\%(P_T^{miss})$
  $\oplus 4.5\%(\text{PDF})=5.0\%$
- $\Delta\alpha_{tt}=7\%(\text{Jet E. scale calibration})$
  $\oplus 1\%(P_T^{miss})=7.1\%$
- $\Delta\alpha_{tt}^{WW}=9\%(\text{Jet E. scale calibration})$
  $\oplus 1\%(P_T^{miss})=9.1\%$
- More work needs to be done to understand theoretical errors
  - gg→WW (via quark box) contribution needs to be addressed

W. Quayle

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TeV4LHC Workshop, 29 Apr. 2005