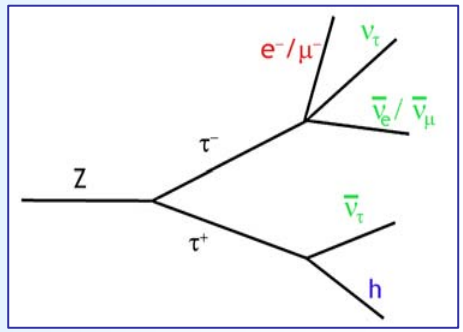
$Z \rightarrow \tau\tau$ short update and status

D. Cavalli, C. Pizio

$Z \rightarrow \tau\tau$ in first data

$Z \rightarrow \tau\tau \rightarrow$ lepton-hadron in first data (1-100pb-1):



- detector understanding (instrumental effects on EtMiss!)
- validation of SW for Tau and EtMiss reconstruction
- select a high purity sample
- determine the absolute energy scale of Tau and EtMiss
  $\rightarrow$ Tau and EtMiss CSC Note (D. Cavalli/C. Pizio)

- determination of τ-jet efficiency from data

- $\sigma(Z \rightarrow \tau\tau)$ measurement $\rightarrow$ overall consistency/universality

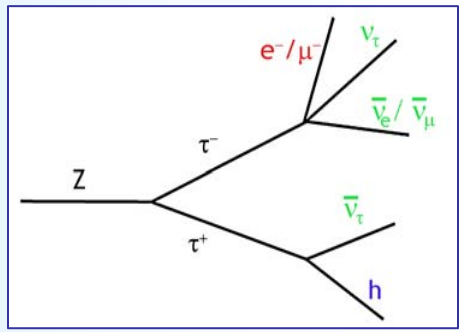
$Z \rightarrow \tau\tau \rightarrow$ lepton-hadron analysis

SM channel with leptons, τ, ETMiss

$\sigma(Z \rightarrow \tau\tau) = 1656pb$

in 100pb-1 expect: ~ 70000 $Z \rightarrow \tau\tau \rightarrow$lepton-hadron

(~ 7000 with pte or ptmu> 15GeV)



- Select $Z \rightarrow \tau\tau \rightarrow$lepton-hadron - strict cuts applied to have low background level
- Signal events have opposite sign lepton and τ -jet (OS events)
- Background events (**QCD,Wμν,Weν,tt,Zee,Zμμ,WW**) have the same probability to be OS or SS. Estimate backgd from SS events and subtract
- Use the reconstructed invariant mass to tune the EtMiss scale in situ
- Use from the reconstructed visible mass to tune the Tau-jet scale

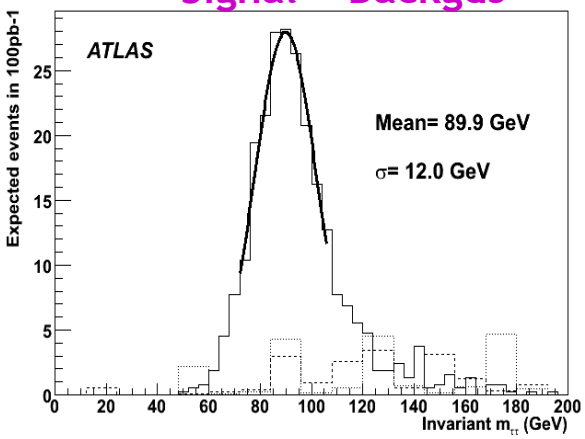
Use Full sim events (12.0.6) for Signal and backgrounds (also Atlfast QCD!)

Trigger aware Analysis: Single lepton Trigger events (EF6mu, EFe10i)

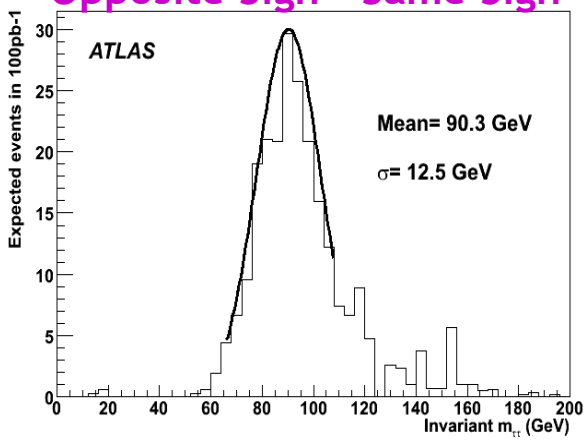
Analisys performed as in real life: not using MC information

Invariant Mass Results (E_TMissCSC note)

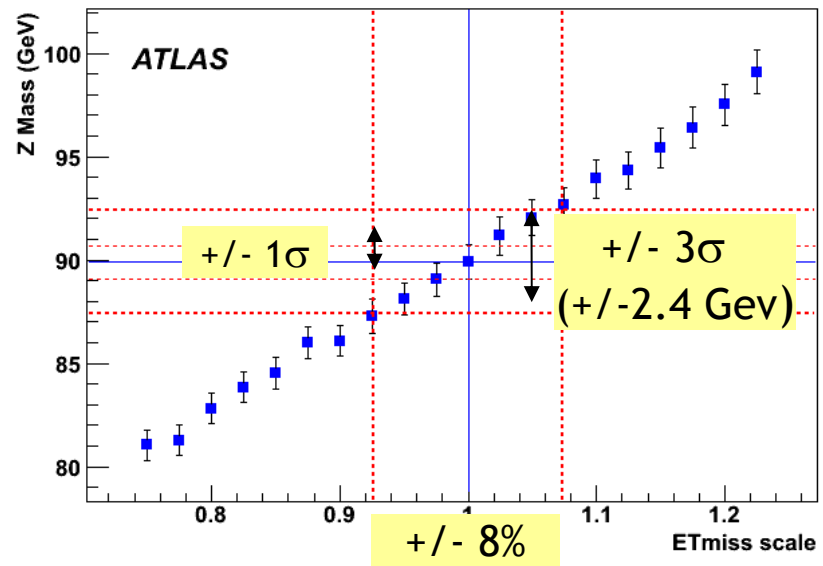
Signal + Backgds



Opposite Sign - Same Sign



Z Mass vs ETmiss scale



ETMiss scale precision:

3% with only stat errors

8% taking into account systematics, fit stability, …

In 100 pb $^{-1}$

in the mass bin (66-116 GeV)

209 signal evts

16 backgds evts OS (B≈8% S)

26 backgds evts SS

S/√B=50

Zττ: OS 209+/-7, SS 10+/-2

Jets: OS 7+/-6, SS 13+/-9

Wμν: OS 5+/-1, SS 2+/-1

Weν: OS 2+/-1, SS 1+/-1

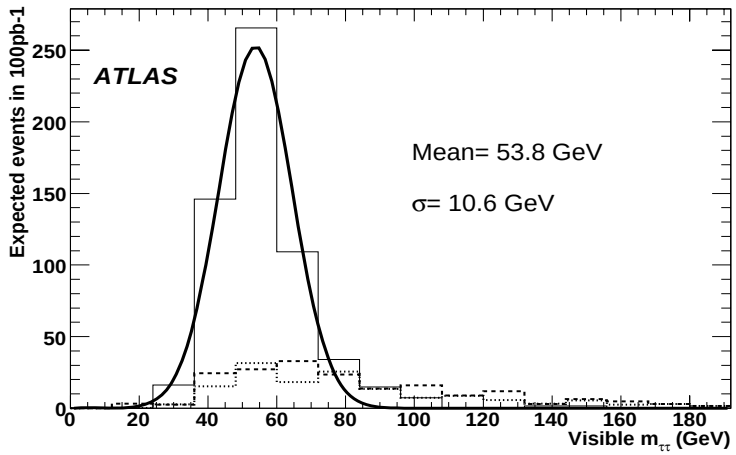
tt: OS 1+/-1, SS 0

Zee: OS 1+/1, SS 1+/1

Zμμ: OS 0, SS 0

Taurec Visible mass results (Tau CSC note)

Visible mass Signal + Backgds



In 100 pb $^{-1}$ in the mass bin (37-75 GeV)

520 signal evts

85 backgds evts OS

(B ≈ 16%S)

80 backgds evts SS

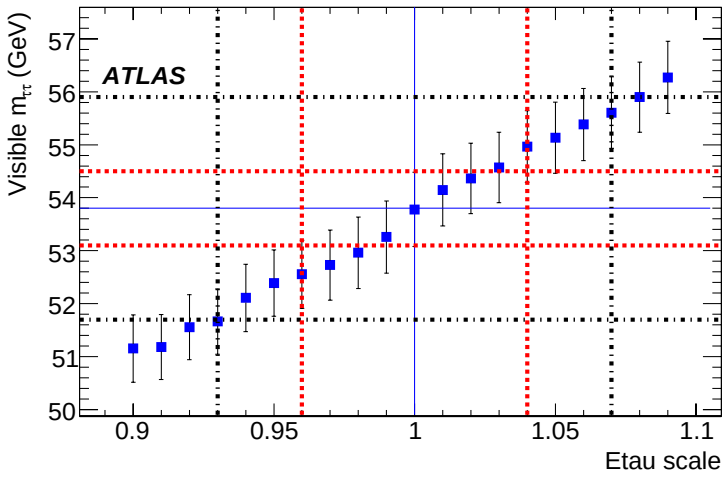
S/√B=23

Full line: OS Signal

Dashed line: OS backgrounds

Dotted SS Sigan+background

Tau energy scale



QCD backgds estimation from Fullsim+Atlfast

τ scale precision:

3% with only stat errors

SS vs OS events in background samples

- QCD: same probability for OS and SS
- W+jets: OS/SS=1.5, constant ratio also w/o applying the $m_T^{lep\text{-}MET}$ cut)
- Procedure to estimate in situ how to correct the SS distribution for backgd subtraction

1) From $m_T^{lep\text{-}MET}$ distribution at the end of cuts:

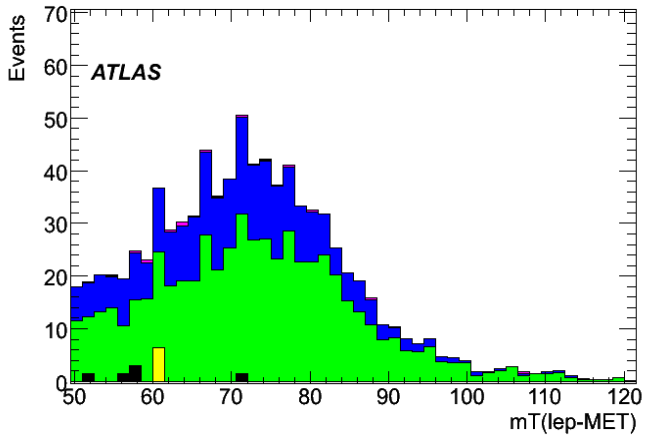
   - Evaluate the number of SS events: for $50<m_T^{lep\text{-}MET}$ (GeV)<100 only W events are collected (rest 2.5% of W evts)→ 270 evts in 100 pb^{-1}

   - Calculate the fraction of evts with $m_T^{lep\text{-}MET}$ <30 GeV→10% (27 evts)

2) The number of SS events at the end of the cuts is 88 so we can correct it :

   newSS= 88 – 27 + (27*1.5) =

   88 – 27 + 40 = 101



W+jets evts

At the end of cuts

OS 45

SS 25

From $m_T^{lep\text{-}MET}$ estimate

New SS 40.5

UPDATE!

Analysis done using release 12 CBNTs.

We are finalising a note (COM, PUB?) that will be ready by the end of this week

Draft version 01

ATL-PHYS-INT-2008-xxx

September 2, 2008

$Z \to \tau^+\tau^-$ in first ATLAS data

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Abstract

This note describes an analysis designed to select in the first 100 pb^{-1} of ATLAS data a pure sample of $Z \to \tau^+\tau^-$ events, to be used as a control sample for the channels containing τ leptons and $\not{E}_T$ and for the calibration of the τ-jet scale and of the $\not{E}_T$ scale in-situ.

The first part of the note describes the selection criteria used to separate the signal from the backgrounds.

The second and the third part show respectively how the τ-jet scale and the $\not{E}_T$ scale can be determined in-situ from a pure $Z \to \tau^+\tau^-$ sample.

Ztautau analysis in ATLAS

This channel is interesting for many working groups:

- Tau group: validate τ-algos, measure efficiencies…
- E_TMiss group: channel with real MET, MET scale determination
- SM group: cross section, comparison with Z→ll

Who is doing what

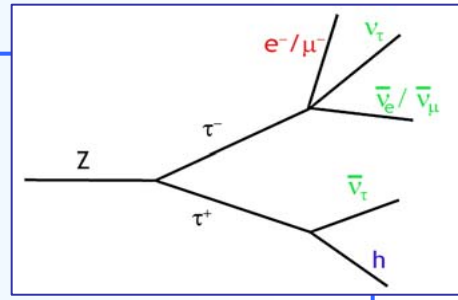
- Tau e E_TMiss CSC note → Milano (rel.12)
- J.Griffith (Washington) → Z→ττ→μ–had (rel.13, FDR???)
- Krakow (they have just started to work on it but….3 days ago ATL-COM-PHYS-2008-122)→ Z→ττ→e-had (rel.13) to get τ eff, ratio 1p/3p, cross section
- Freiburg → τ using Taurec algo…

How can we continue?

- Scale determination (MET and τ): nobody is doing that, in particular focusing in MET scale
- Redo visible mass analysis using events in which the invariant mass is well reconstructed: achieving better S/B ratio and precision in τ scale
- Obtain cross section measurement using lepton efficiencies from $Z \rightarrow ll(e,\mu)$ analyses
- Have a look at release 14 data? (Merged τ algos, b-tagging, e veto, μ veto)
- Commissioning toward real data, FDR, DPD etc

Backup

$Z \rightarrow \tau\tau$: Analysis method



Analysis as in real data→ no Montecarlo info

1. Select lepton evts:

- reco & id & isol ele : pt>15Gev η<2.5
- reco & id & isol μ: pt>15GeV η<2.5

2. Basic cut flow:

- E_TMiss>20 GeV
- Trasvers Leptone –E_TMiss Mass (m_T) < 50 Gev
- ΣE_T < 400GeV
- No b-jets

No dependence on τ-Id algo

3. Invariant/Visible mass reconstruction:

combining each e/μ candidate with each τ-jet candidate

4. Second cut flow:

- $\Delta\varphi$ (lept – τ-jet)
- Invariant Mass $\tau\tau$ >0
- τ-identification

At the end of the cuts only 1 combination per event is saved

5. Separate OS evts from SS evnts

Signal:only OS evts,

Backgds: OS and SS with same probability→background contribution can be estimated in-situ using SS events.

6. Subtract SS from OS evts

7. E_TMiss scale determination

from invariant mass

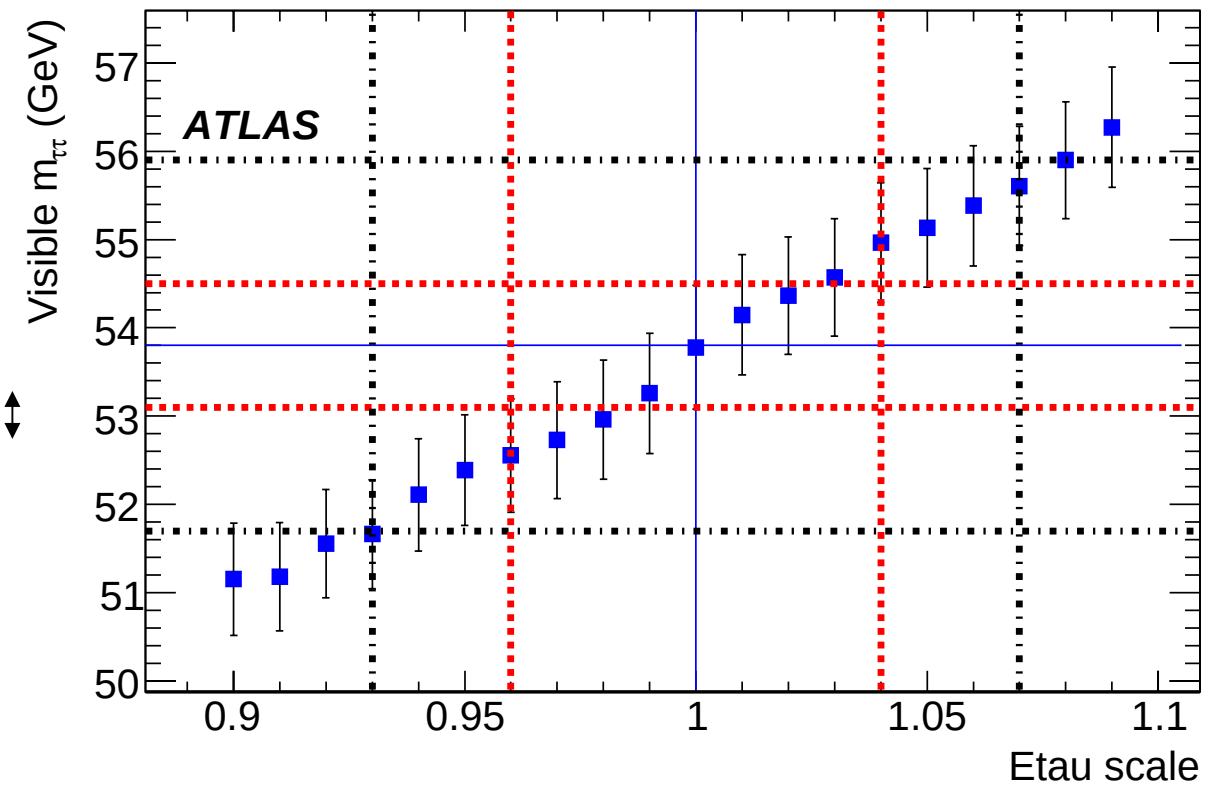
τ scale determination from visible mass

Due to the limited statistics, t-Id factorized for backgds:
if applied in sequence all backgrounds go to zero after all cuts

Large statistics of Atlfast QCD events also used for visible mass analysis

τ-jet scale determination from Visible mττ

+/-2.4 GeV Z mass peak → +/- 7% Tau-jet scale



L = 100pb-1

Precision mass peak value σ=0.7 GeV

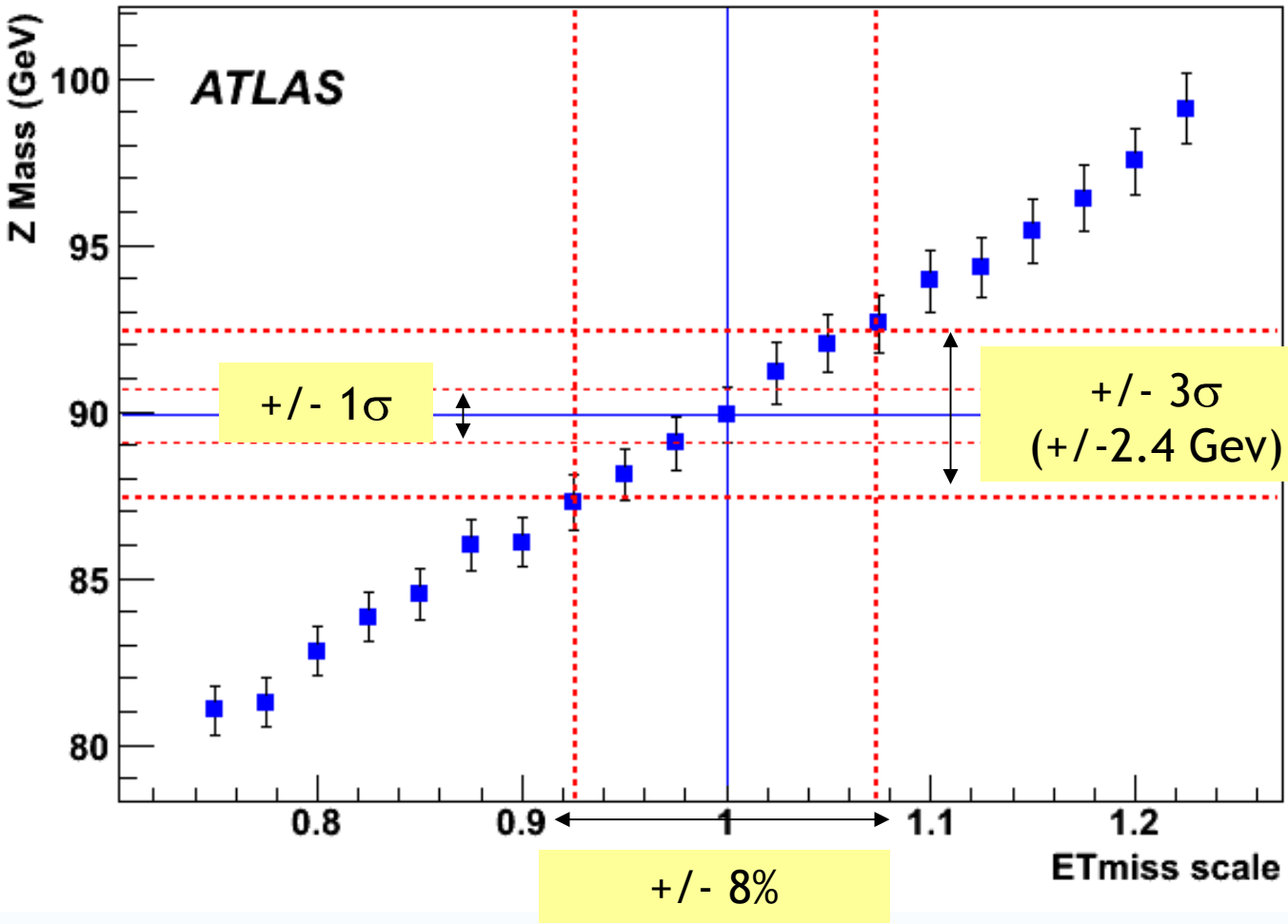
+/- 1σ

+/- 3σ (+/-2.4 Gev)

+/- 7%

EtMiss scale determination from Invariant $m_{\tau\tau}$

+/-2.4 GeV Z mass peak → +/- 8% EtMiss scale



L = 100pb-1

Precision mass peak value σ=0.8 GeV

$Z \rightarrow \tau\tau$ in first data

Next work plan (2):

- $Z \rightarrow \tau\tau$ cross section measurement

$$\sigma_{W(Z)} \times BR(W(Z) \rightarrow leptons) = \frac{N^{obs}_{W(Z)} - N^{bkg}_{W(Z)}}{\epsilon_{W(Z)} A_{W(Z)} \int \mathcal{L}\, dt}$$

- single lepton trigger efficiency from $Z \rightarrow ll$
- lepton Reco/Id/Isolation eff from $Z \rightarrow ll$
- Nobs= OS evts, Nbkg=SS evts
- Acc from OS analysis on Signal

from invariant mass analysis

from visible mass analysis

Present Analysis:

Inv mass: σ=1565+/- 107

Vis mass: σ=1696+/- 94

Only MC stat errors…

determine τ reconstruction/Identification efficiency in-situ