

# *Testing weights on $t\bar{t}$ events*

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- ▶ Introduction
- ▶ Creating ESDs and AODs
- ▶  $t\bar{t}$  analysis example job
- ▶ Results



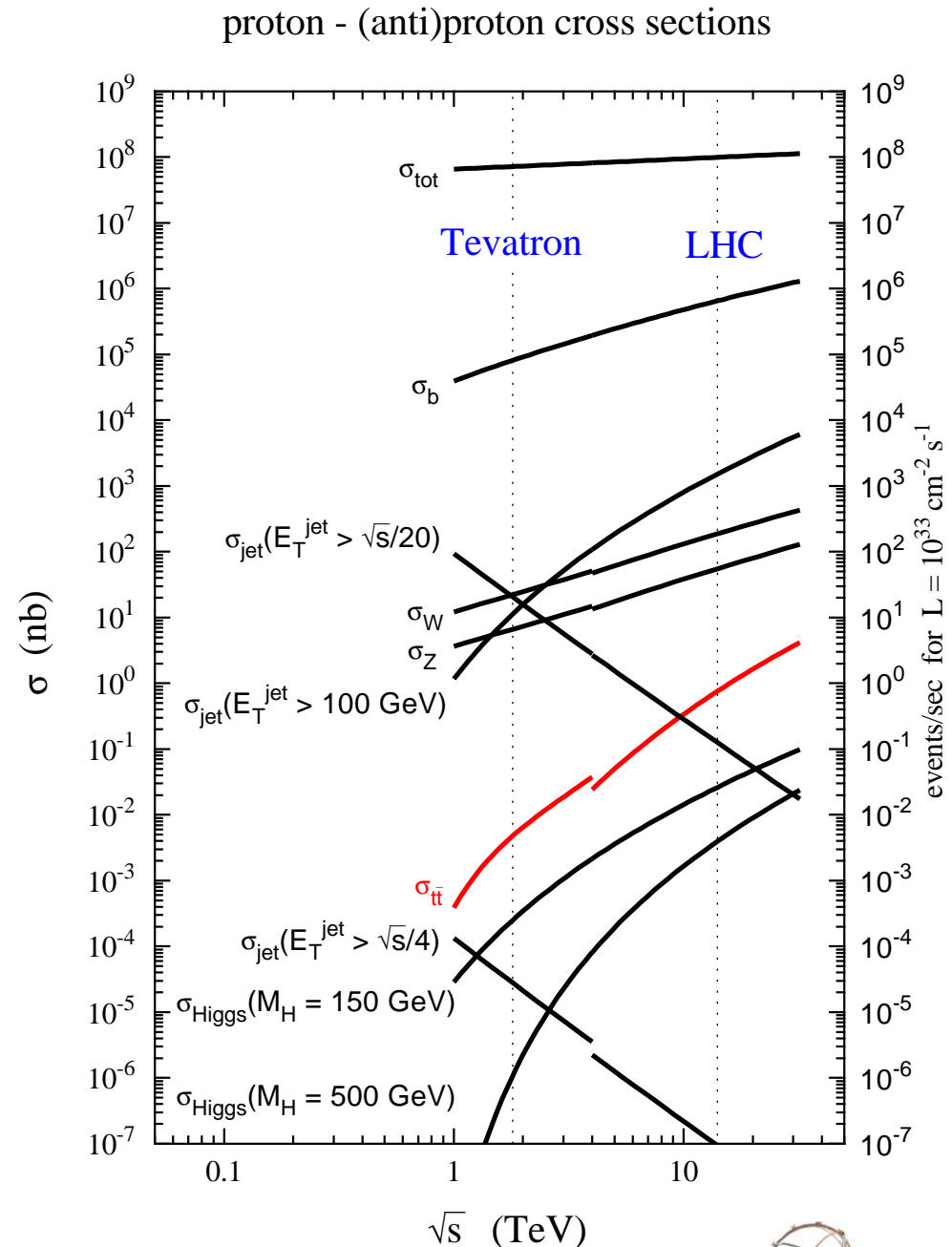
# Introduction

- ▶ The aim of this work is to study hadronic calibration by testing e.g. calibration weights on  $t\bar{t}$  events
- ▶  $t\bar{t}$  events provide
  - jets
  - b-jets (Energy scale)
  - light flavour jets (invariant mass)
  - top mass (combined b-jet + 2 light jets)
- ▶ This is a good physics sample to study/understand the effects of the calorimeter calibration



# $t\bar{t}$ production: Total Cross Section

- ▶ Total cross section for  $t\bar{t}$ -production is about a factor of **100** larger at LHC than at Tevatron
- ▶  $\sigma_{t\bar{t}}(14.0 \text{ TeV}) = 800 \text{ pb}$
- ▶ More than **8 million**  $t\bar{t}$  produced per year at low luminosity ( $10^{33} \text{ cm}^{-2} \text{ s}^{-1}$ )
- ▶ LHC will be a top factory



# Golden plated: $t\bar{t} \rightarrow WWb\bar{b} \rightarrow (l\nu)(jj)b\bar{b}$

- ▶ Golden channel: here one  $W$  decays leptonically ( $e, \mu$ ) and the other  $W$  decays hadronically
  - Clean trigger from the isolated lepton
- ▶ The reconstruction starts with the  $W$  mass:
  - Different ways to pair the right jets to form the  $W$
  - Jet energies calibrated using the  $m_W$
- ▶ Important to tag the b-jets:
  - Reduces the background
  - Clean top quark samples
- ▶ Typical event selection:
  - Isolated lepton with  $P_T > 20\text{GeV}$
  - $E_T^{\text{miss}} > 20\text{GeV}$
  - 4 jets with  $E_T > 40\text{GeV}$
  - $> 1$  b-jet



# $t\bar{t}$ analysis: 1st step create ESDs and AODs I

- ▶ The first step to study the effects of the hadronic calibration on  $t\bar{t}$  events is to create ESDs and AODs:
- ▶ Set of ESDs/AODs created
  - Without local hadron calibration information
  - With local hadron calibration information
  - With the JetRec H1 weights
- ▶ To create ESDs and AODs I have followed the information given by Sven in his MPI talk  
<http://cds.mppmu.mpg.de/cdsagenda/askArchive.php?base=agenda&categ=a0567&id=a0567s1t0/transparencies>
- ▶ Release used to run the code: 11.0.41
- ▶ Data used: `/castor/cern.ch/grid/atlas/datafiles/rome/digit/rome.004520.digit.ttbarWm/rome.004520.digit.ttbarWm._00001.pool.root.1`
- ▶ Only 50 events



# $t\bar{t}$ analysis: 1st step create ESDs and AODs II

## ► Our case:

- Our original idea was to produce one ESD from digit files (it takes long time). Since the ESD contains all calo cells, we thought to use the ESD to re-reconstruct any higher calo reco object
- Because some **tracking problems**, it is not possible to produce ESD from ESD
- Now the strategy to test/evaluate/compute calibration constants is:
  - Produce several ESDs with various calibration options from digit files
  - Produce AODs from ESDs and run AOD analyses on the produced AODs



# How to create ESDs with no calibration

- ▶ Set the lines in `KtTopoJet_jobOptions.py` as follow:

```
# "JetTowerNoiseTool/DoNoise",
# "JetPreClusterTool/PreClustering",
# "JetMonitorTool/PreClusterMonitor",
# "JetCellCalibratorTool/CellCalibrator",
KtTopoJets.KtFinder.RParameter = 0.1 # really means R^2 = 0.1
#KtTopoJets.KtFinder.RParameter = 1
#KtTopoJets.CellCalibrator.CellCalibratorName = "H1WeightToolAug04"
```

- ▶ Set in `myTopOptions.py`

```
doWriteAOD=False
doWriteTAG=False
doCBNT=False
PoolESDOutput="ESD.rome.004520.digit.ttbar.nocalib01.pool.root"
include ("RecExCommon/RecExCommon\_topOptions.py")
EventSelector.InputCollections = [ "rfio:/castor/cern.ch/grid/atlas/datafiles/r\
ome/digit/rome.004520.digit.ttbarWm/rome.004520.digit.ttbarWm._00001.pool.root.\
1" ]
```

- ▶ Change `RecExCommon_topOptions.py` to not include `H1WeightToolG4`

```
        thisAlg.ParticleJetBuilderTool.CellCalibratorName=" "
#        thisAlg.ParticleJetBuilderTool.CellCalibratorName="H1WeightToolG4"
```

- ▶ Run: `athena.py myTopOptions.py`
- ▶ This create ESD with no calibration



# How to create ESDs with local hadron calibration

- ▶ Set the lines in `KtTopoJet_jobOptions.py` as follow:

```
#         "JetTowerNoiseTool/DoNoise",  
#         "JetPreClusterTool/PreClustering",  
#         "JetMonitorTool/PreClusterMonitor",  
#         "JetCellCalibratorTool/CellCalibrator",  
KtTopoJets.KtFinder.RParameter = 0.1 # really means R^2 = 0.1  
#KtTopoJets.KtFinder.RParameter = 1  
#KtTopoJets.CellCalibrator.CellCalibratorName = "H1WeightToolAug04"
```

- ▶ Set in `myTopOptions.py`

```
doWriteAOD=False  
doWriteTAG=False  
doCBNT=False  
PoolESDOutput="ESD.rome.004520.digit.ttbar.calib01.pool.root"  
include ("RecExCommon/RecExCommon\_topOptions.py")  
include ("CaloClusterCorrection/CaloTopoLocalCalib\_jobOptions.py")  
EventSelector.InputCollections = [ "rfio:/castor/cern.ch/grid/atlas/datafiles/r\  
ome/digit/rome.004520.digit.ttbarWm/rome.004520.digit.ttbarWm._00001.pool.root\  
1" ]
```

- ▶ Change `RecExCommon_topOptions.py` to not include `H1WeightToolG4`

```
        thisAlg.ParticleJetBuilderTool.CellCalibratorName=" "  
#         thisAlg.ParticleJetBuilderTool.CellCalibratorName="H1WeightToolG4"
```

- ▶ Run: `athena.py myTopOptions.py`

- ▶ This create ESD with local hadron calibration





# How to create ESDs with JetRec H1 weights

- ▶ Set the lines in `KtTopoJet_jobOptions.py` as follow:

```
#         "JetTowerNoiseTool/DoNoise",
#         "JetPreClusterTool/PreClustering",
#         "JetMonitorTool/PreClusterMonitor",
#         "JetCellCalibratorTool/CellCalibrator",
KtTopoJets.KtFinder.RParameter = 0.1 # really means R^2 = 0.1
#KtTopoJets.KtFinder.RParameter = 1
KtTopoJets.CellCalibrator.CellCalibratorName = "H1WeightToolAug04"
```

- ▶ Set in `myTopOptions.py`

```
doWriteAOD=False
doWriteTAG=False
doCBNT=False
PoolESDOutput="ESD.rome.004520.digit.ttbar.nocalib01H1w.pool.root"
include ("RecExCommon/RecExCommon\_topOptions.py")
EventSelector.InputCollections = [ "rfio:/castor/cern.ch/grid/atlas/datafiles/r\
ome/digit/rome.004520.digit.ttbarWm/rome.004520.digit.ttbarWm._00001.pool.root.\
1" ]
```

- ▶ Change `RecExCommon_topOptions.py` to include `H1WeightToolG4`

```
    thisAlg.ParticleJetBuilderTool.CellCalibratorName="H1WeightToolG4"
```

- ▶ Run `athena.py myTopOptions.py`

- ▶ This create ESD with JetRec H1 weights



# How to create AODs with no calibration

## ► Set in myTopOptions.py

```
doWriteESD=False
doWriteAOD=True
readESD=True
doWriteTAG=False
doCBNT=False
PoolAODOutput="AOD.rome.004520.digit.ttbar.nocalib01.pool.root"
include ("RecExCommon/RecExCommon_flags.py")
include ("RecExCommon/RecExCommon\_topOptions.py")
EventSelector.InputCollections = [ "rfio:/castor/cern.ch/user/t/teresab/ESD.rome
.004520.digit.ttbar.nocalib01.pool.root"]
```

- The RecExCommon\_topOptions.py is like the ESD's
- Run: `athena.py myTopOptions.py`
- This create AODs with no calibration



# How to create AODs with local hadron calibration

## ► Set in myTopOptions.py

```
doCaloTopoCluster = True
doWriteESD=False
doWriteAOD=True
readESD=True
doWriteTAG=False
doCBNT=False
PoolAODOutput="AOD.rome.004520.digit.ttbar.calib01.pool.root"
include ("RecExCommon/RecExCommon_flags.py")
include ("RecExCommon/RecExCommon_topOptions.py")
EventSelector.InputCollections = [ "rfio:/castor/cern.ch/user/t/teresab/ESD.rom\
e.004520.digit.ttbar.calib01.pool.root"]
```

- The RecExCommon\_topOptions.py is like the ESD's with local hadron calibration
- Run: `athena.py myTopOptions.py`
- This create AODs with local hadron calibration



# How to create AODs with JetRec H1 weights

## ► Set in myTopOptions.py

```
doWriteAOD=False
doWriteTAG=False
doCBNT=False
PoolESDOutput=PoolAODOutput="AOD.rome.004520.digit.ttbar.nocalib01H1w.pool.root"
include ("RecExCommon/RecExCommon_flags.py")
include ("RecExCommon/RecExCommon_topOptions.py")
EventSelector.InputCollections = [ "rfio:/castor/cern.ch/user/t/teresab/ESD.rome
.004520.digit.ttbar.nocalibH1w.pool.root"]
```

- Set the RecExCommon\_topOptions.py like in the ESD case with the JetRec H1 weights
- Run: `athena.py myTopOptions.py`
- This create AOD with JetRec H1 weights



# $t\bar{t}$ analysis job example I

- ▶ To start running a  $t\bar{t}$  analysis, I have used the  $t\bar{t}$  job example in:  
[11.0.41/PhysicsAnalysis/AnalysisCommon/AnalysisExamples/AnalysisExamples-00-11-05](#)
- ▶ This  $t\bar{t}$  example demonstrates a  $g g \rightarrow l\nu b jj b$  reconstruction
- ▶ I have used the default `ttbarExample_jobOptions.py` given in  
[11.0.41/PhysicsAnalysis/AnalysisCommon/AnalysisExamples/AnalysisExamples-00-11-05/share](#)
- ▶ I have changed `KtTower` with `KtTopo` for the  $t\bar{t}$  analysis



# *tt̄ analysis job example II*

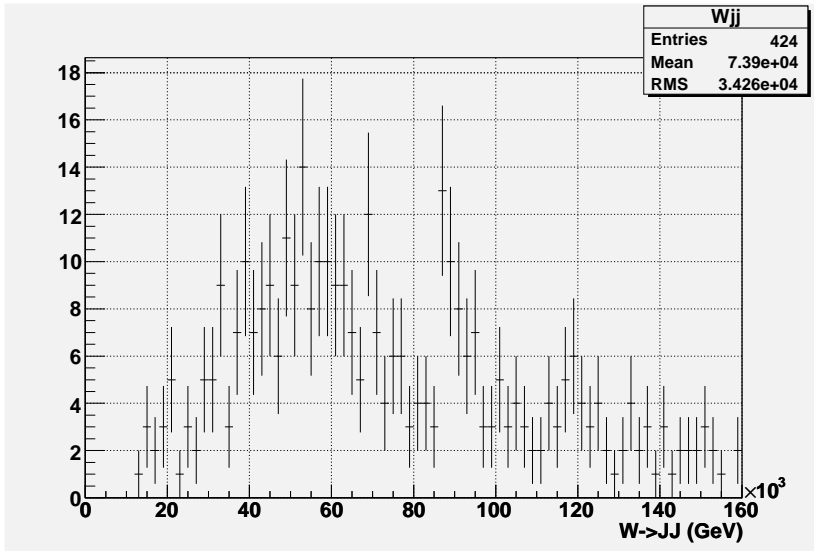
## ► Basic cuts used in the `tt̄` code (see `ttbarExample_jobOptions.py`):

```
# Author: Ketevi A. Assamagan
# BNL, July 16, 2004
# job options for ttbar -> jjb lnub analysis example
...
# User analysis steering algorithm
# Missing ET calibration options: "Raw" = uncalibrated, "H1" or "Region"
theApp.TopAlg          += [ "ttbar" ]
ttbar                  = Algorithm( "ttbar" )
ttbar.PreSelectedElectrons = "MyPreSelectedElectrons"
ttbar.PreSelectedMuons   = "MyPreSelectedMuons"
ttbar.PreSelectedBJets   = "MyPreSelectedBJets"
ttbar.PreSelectedJets    = "MyPreSelectedParticleJets"
ttbar.OutputLevel       = ERROR
ttbar.MissingEtObject    = "MET_Final"
ttbar.MissingEtCut       = 18.0*GeV
ttbar.EventWeight        = 1.0
ttbar.DeltaMjj           = 25.0*GeV
ttbar.HistDirectoryName = "ttbar"

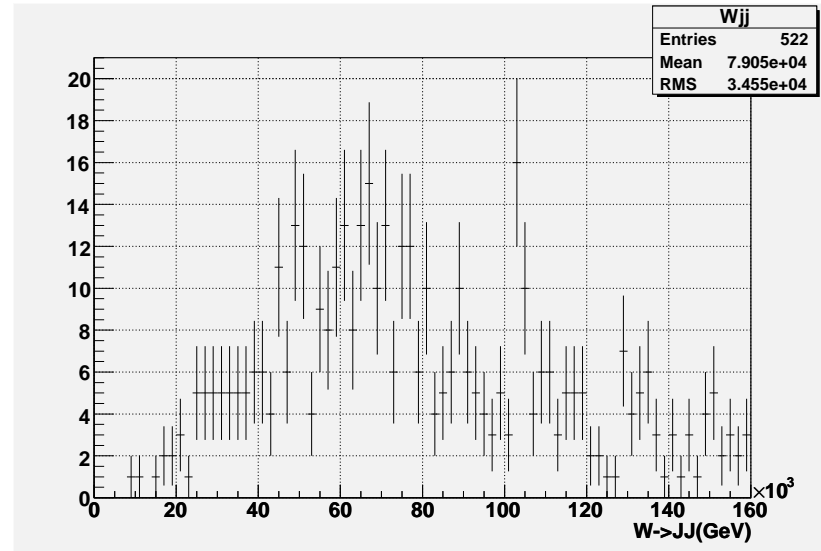
# The AOD input file
EventSelector.InputCollections = [
    "/afs/cern.ch/user/k/ketevi/w0/aod/ttbar/dc2.003026.A0_top.g4dig807.aod870._00001.pool1.root"
```



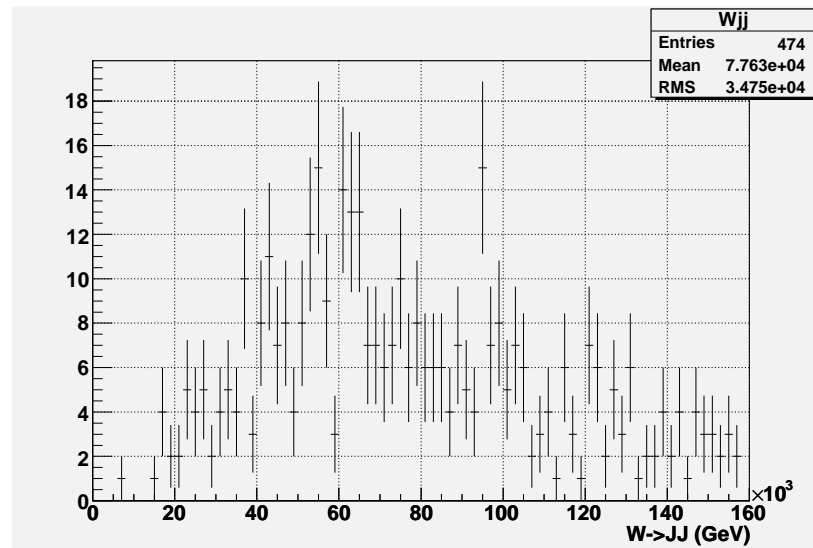
# A first look at the $W \rightarrow JJ$ distribution



$W \rightarrow JJ$  distribution for not calibrated data



$W \rightarrow JJ$  distribution for data with JetRec H1 weights



$W \rightarrow JJ$  distribution for data with local hadron calibration (no DM corr.)

