Search for b-Quark Associated MSSM Higgs
Decaying to Tau Pairs with ATLAS

Jana Schaarschmidt, TU Dresden
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1. Introduction to the MSSM Higgs
2. Higgs Boson Reconstruction
3. Analysis with 30 fb$^{-1}$
4. Background Estimation from Data
5. Prospects for First Data
Introduction

• SM very successful theory, description of three of the four fundamental forces
• One component missing: Higgs boson as quantum excitation of the Higgs field
• Higgs field: Property of space, scalar and isotrop
• Fermions get mass by interacting with the Higgs field (SM predicts massless fermions)
• Still hypothetical, proof missing. Discovery would be great success
• Direct search (LEP) led to exclusion limit of $m_H > 114$ GeV. Theory predicts $m_H < 1$ TeV

SM has some problems:

• Dark Matter
• Fine Tuning
• Unification of couplings

SUSY solves those problems! However, more parameteres are introduced (105).

No SUSY particles have ever been found

⇒ SUSY must be broken symmetry with $m_{\text{Sparticles}} \gg m_{\text{Particles}}$.

Minimal SUSY Model: MSSM.
Higgs Sector in the MSSM

- 2 Higgs doublets $\Rightarrow$ 5 Higgs bosons: $h^0, H^0$ (CP = +1), $A^0$ (CP = -1), $H^\pm$

- Tree level described by only two parameters: $m_A$, $\tan\beta = v_u/v_d$, $v_u^2 + v_d^2 = v^2$

- $m_h < m_Z$ but large loop corrections increase this limit!

Couplings: $g_{\text{MSSM}} = \xi g_{\text{SM}}$

<table>
<thead>
<tr>
<th>$\xi$</th>
<th>$t$</th>
<th>$b/\tau$</th>
<th>$W/Z$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$h$</td>
<td>$\cos\alpha/\sin\beta$</td>
<td>$-\sin\alpha/\cos\beta$</td>
<td>$\sin(\alpha-\beta)$</td>
</tr>
<tr>
<td>$H$</td>
<td>$\sin\alpha/\sin\beta$</td>
<td>$\cos\alpha/\cos\beta$</td>
<td>$\cos(\alpha-\beta)$</td>
</tr>
<tr>
<td>$A$</td>
<td>$\cot\beta$</td>
<td>$\tan\beta$</td>
<td>-</td>
</tr>
</tbody>
</table>

Additional parameters:
- $X_t$: Stop mixing parameter
- $M_{\text{SUSY}}$: Energy scale of SUSY breaking
- $M^2$: Gaugino mass at EW scale
- $M_g$: Gluino mass at EW scale
- $\mu$: Strength of SUSY Higgs mixing

All parameters except $\tan\beta$, $m_A$ fixed in benchmark scenarios:

- $m_h^{\text{max}}$: $m_h < 133$ GeV, maximum allowed mass for $h$
- Nomixing: $m_h < 116$ GeV, no mixing in stop sector
- Gluophobic: $m_h < 119$ GeV, suppressed $gg$ fusion
- Small $\alpha$: $m_h < 123$ GeV, suppressed $tt$bar $h$, $h \rightarrow bb$

$\alpha = \text{mixing angle between } h \text{ and } H$

MSSM Higgs

Signal Production

**gluon fusion**

\[ \begin{array}{c}
\text{g} \\
\text{b} \\
\text{g} \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\text{g} \\
\text{b} \\
\text{b} \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
\phi \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
\phi \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
\phi \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
\phi \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
\phi \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
\phi \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
\phi \\
\end{array} \rightarrow \phi \\
\end{array} \\

**b-quark associated production**

\[ \begin{array}{c}
\text{g} \\
\text{b} \\
\text{g} \\
\text{b} \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\text{g} \\
\text{b} \\
\text{b} \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
\phi \\
\phi \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
\phi \\
\phi \\
\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
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\phi \\
\end{array} \rightarrow \phi \\
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\begin{array}{c}
\text{g} \\
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\end{array} \rightarrow \phi \\
\begin{array}{c}
\text{g} \\
\phi \\
\phi \\
\phi \\
\end{array} \rightarrow \phi \\
\end{array} \\

Dittmaier, Kramer, Spira

Enhanced coupling to
down-type fermions

\[ \Rightarrow \sigma_{bbH/A} \sim \tan^2 \beta \]

Harlander, Kilgore

Signal Properties

**S. Heinemeyer, Feynhiggs**

\[ \text{BR} (h/A/H \rightarrow \tau \tau) \]

\[ \approx 10\% \text{ for low } m_A \]

\[ \text{Irrelevant for } h/A/H \rightarrow \tau \tau \]
due to mass resolution

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Cross sections (14 TeV):

<table>
<thead>
<tr>
<th>m_A / GeV</th>
<th>( \sigma_{bbH} )</th>
<th>( \sigma_{bbA} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>95 pb</td>
<td>103 pb</td>
</tr>
<tr>
<td>200</td>
<td>39 pb</td>
<td>40 pb</td>
</tr>
<tr>
<td>300</td>
<td>9 pb</td>
<td>9 pb</td>
</tr>
</tbody>
</table>

\[ \Rightarrow \text{Add up cross sections} \]

**NLO**

\[ \tan b = 20 \]

Dittmaier, Kramer, Spira

Harlander, Kilgore

**Natural width**

\[ \Gamma (\phi) / \text{GeV} \]

\[ m_A = 130 \text{ GeV} \]

\[ m_A / \text{GeV} \]

\[ m_\phi / \text{GeV} \]

\[ m_h [\text{GeV}] \]

\[ m_H [\text{GeV}] \]

\[ \tan \beta = 20 \]

\[ m_\phi = 450 \text{ GeV} \]

\[ m_A / \text{GeV} \]

\[ m_h [\text{GeV}] \]

\[ m_H [\text{GeV}] \]

\[ \tan \beta = 20 \]

Harlander, Kilgore

**Mass degeneration**

\[ \Rightarrow \text{Add up cross sections} \]
SM and MSSM Higgs Production

Talk by R. Harlander, Zürich ‘09

Belyaev et al. ‘05

b-quark associated Higgs production
dominant production process in the MSSM

By applying a b-tag, gluon fusion signal negligible
The ATLAS Detector at LHC

- 46 m length, 24 m diameter
- 7000 t weight
- 3000 km cables

Luminosity:
$10^{33}$ cm$^{-2}$ s$^{-1}$ (10 fb$^{-1}$ per year @ 14 TeV)

Trigger:
$10^{9}$ Hz $\Rightarrow$ 75 kHz $\Rightarrow$ 100 MB / s storage
Taus - Overview

Tau Decay Modes:

- 35% leptonic ($\tau \rightarrow e \nu \nu / \tau \rightarrow \mu \nu \nu$)
- 65% hadronic ($\tau \rightarrow \pi \nu / \tau \rightarrow \pi \pi \nu / ...$)
- Probability that tau-pair decays fully leptonic only 12% (leplep)
- In 45% of the cases one leptonic and one hadronic decay (lephad)
- In the remaining 42% both taus decay hadronically (hadhad)

Hadronic tau in the Atlas detector:

- Collimated calorimeter cluster
- Low charged tracks multiplicity
- Displaced secondary vertex

$\Rightarrow$ Combined reconstruction in calorimeter and tracker

Sources for fake taus:

- QCD jets
- Electrons
- Muons
Higgs Mass Reconstruction

Collinear Approximation

Conditions:

- Higgs mass large compared to $t$ mass
- Higgs boson has non-zero $p_T$
- $p_{T,\text{miss}}$ in the detector due to neutrinos only

\[
\tau = p_{T,\ell} / p_{T,\tau} \\
0 < x < 1
\]

Approximation unstable at $\Delta \Phi \approx \pi$. 

Truncate events to those with physical solution.
Higgs Mass Resolution

$m_{\tau\tau}$ shape in $A/H \rightarrow \tau\tau \rightarrow \text{leplep}$

- Very "challenging" resolution
- No chance to separate the Higgs bosons

![Mass resolution graph](image)

Mass resolution:

<table>
<thead>
<tr>
<th>$m_A$ / GeV</th>
<th>$\sigma$ / GeV</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>21</td>
</tr>
<tr>
<td>200</td>
<td>33</td>
</tr>
<tr>
<td>300</td>
<td>52</td>
</tr>
<tr>
<td>800</td>
<td>~ 100</td>
</tr>
</tbody>
</table>

Another issue: Mass shift w.r.t. true mass

- Mass resolution deteriorates for low $p_{T,Higgs}$ (leptons back-to-back)
- High-energy tail in $m_{\tau\tau}$

![Mass shift graph](image)

Ongoing studies in the Helmholtz $m_{\tau\tau}$ working group
Signal Topology and Background Processes

Signal Topology

- two high $p_T$ leptons (leplep) or 1 high $p_T$ lepton and 1 high $p_T$ tau jet (lephad)
- (true) $p_{T,\text{miss}}$
- (true) b-jet(s)

Relevant Background Processes (xsecs for 14 TeV)

- QCD (up to 23 500 nb)
- $W+\text{jets}$ (20 045 pb), bbar $W$ (111 pb)
- $Z(\rightarrow \tau\tau/ee/\mu\mu)+\text{jets}$ (2 036 pb), bbar $Z$ (52.3 pb)
- ttbar (833 pb)

Reduce them strongly with b-tag
We search for Higgs masses from 110 GeV up to 450 GeV.

⇒ Selection needs to be Higgs mass dependent to exploit the full potential of ATLAS

- Trigger: Single or di-lepton triggers (e.g. mu20, 2e15, ...)
- Select events with a physical solution to the collinear approximation
- Suppress most of backgrounds by b-tag (Of course there is a mistagging rate!)
- Discriminate against W and Z by requiring $pT_{miss}$ and high $pT$ objects
- Select event with back-to-back topology. Cut on $m_{ll}$.
- Reduce $t\bar{t}b$ by cutting on events with low jet multiplicity.
- $S/\sqrt{B}$ analysis to cut at best value.
At low $m_A$: $Z \to \tau\tau \to \ell\ell\ell\ell$ dominates

Higher $m_A$: $t\bar{t}$ dominates

$W+\text{Jets}$ and QCD under control

MC statistic smaller than expected real data statistic with 30$fb^{-1}$. 
Systematic Uncertainties - LepLep

Electron efficiency ± 0.2 %
Electron E scale ± 0.2 %
Electron resolution $\sigma(E_T) = 0.0073 E_T$

Muon efficiency ± 1 %
Muon $p_T$ scale ± 1 %
Muon resolution $\sigma(1/p_T) = 0.001/p_T \oplus 0.00017$

Jet energy scale ± 3 % (10 %, $|\eta|>3.2$)
Jet energy resolution $\sigma(E) = 0.45 \sqrt{E} (0.63 \sqrt{E}, |\eta|>3.2)$

b-tagging efficiency ± 5 %
b-tagging fake rate ± 10 %

Tau Efficiency ± 5 %
Tau $p_T$ scale ± 5 %
Tau Resolution $\sigma(\sqrt{p_T}) = 0.45 \sqrt{p_T}$

Assumed uncertainties for 10 fb$^{-1}$
(1 year running with $10^{33}$ cm$^{-2}$s$^{-1}$, 14 TeV)

Impact on Analysis in LepLep:
- ttbar 5%-7%
- W+Jets 5%
- bbh/A/H 5%-9%
- Z+jets 3%

Only LepHAD

Large uncertainties on signal cross section (5 % - 15 %)
Large uncertainties on Z, ttbar and W cross sections ($\approx 10 \%$)
⇒ This demands for data-driven background estimation procedures
Discovery Limits - LepLep Channel

Up-to-date LepLep results on fully simulated MC with NLO cross sections. $m_h^{\text{max}}$ scenario.

- Large parts of $m_A$ - $\tan\beta$ plane covered with lep-lep channel alone!
- Expect improved results when combined with lep-had (had-had) channel


Search for b-Quark Associated MSSM Higgs Decaying to Tau Pairs
Work in Progress - Analysis in LepHad Channel

- Due to larger branching fraction expand search up to 800 GeV
- Expect large contributions from W+jets and QCD due to tau and lepton fakes

Tight tau and lepton ID
(use full detector info and require isolation to other objects)
at least one b-tag (vs. Z and W), less than 3 jets (vs. ttbar)
Small $m_T$ (vs. W+jets and ttbar)
Large $p_{T,miss}$ (vs. QCD)
$p_T$ of the tau (vs. QCD, W and ttbar)
$\Delta \Phi$ between lepton and tau (vs. W and ttbar)

Note in preparation
There are many methods to estimate the shape of $Z \rightarrow \tau\tau$ from data:

- Muon momentum rescaling using 3D reference histograms in $Z \rightarrow \tau\tau \rightarrow \mu\mu$ (Bonn/Dresden)
- Electron cluster reweighting in $Z \rightarrow \tau\tau \rightarrow ee$ (Dresden)
- Embedding of (all kind of) $\tau$ decays into $Z \rightarrow \mu\mu$ events (Bonn/Freiburg)

$\Rightarrow$ Obtained $m_{\tau\tau}$ shapes could be used by input to a mass fit

For a counting experiment we need to know the total number of $Z \rightarrow \tau\tau$ events in a possible signal region:

Weight MC $Z \rightarrow \tau\tau$ event number with ratio of $Z \rightarrow \mu\mu/ee$ event number ratio (MC to data) to become independent of MC lepton acceptance predictions.

\[
\#(Z \rightarrow \tau\tau \rightarrow \mu\mu)_{\text{Signal,DATA}} = \sum_{i,j} \#(Z \rightarrow \tau\tau \rightarrow \mu\mu)_{\text{Signal,MC},i,j} \cdot \frac{\#(Z \rightarrow \mu\mu)_{\text{Sideband,DATA},i,j}}{\#(Z \rightarrow \mu\mu)_{\text{Sideband,MC},i,j}}
\]

All these methods use $Z \rightarrow ee$ and/or $Z \rightarrow \mu\mu$ data events from a sideband region (sideband \( \equiv \) signal free)
**Z → ee / Z → μμ Selection as a Control Sample**

**Cuts:**
- Trigger (mu20 or 2e15, e25)
- $m_{lelep} (75 \ldots 100) \text{ GeV}$
- # Jets < 3 (vs. ttbar)
- $\geq 1$ b-tag (vs. W+jets, ggH, ..)

**Example, ee channel:**

$m_A = 130 \text{ GeV}, \tan b = 45, 1 \text{ fb}^{-1}$

18 K $Z \rightarrow ee$ events, 490 ttbar events

$\Rightarrow$ Sideband purity 97 %

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**Event Yield in Z → ee/μμ Sidebands**

- **14 TeV**
  - xsec = 2 036 pb
  - ee channel 14 TeV
  - μμ channel 14 TeV

- **10 TeV**
  - xsec = 1 357 pb
  - ee channel 10 TeV
  - μμ channel 10 TeV

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**ttbar Estimation from Data**

- We cut on the number of jets to reduce ttbar background $\Rightarrow \#jets < 3$, with jet $p_T > 20$ GeV
- Statistical significance is better if 2-jet bin kept in analysis
- The other backgrounds are aggressively reduced by kinematical cuts ($p_T$, $m$, $\Delta\Phi$, ..)

Two Methods are being studied:

We use ttbar Control region to get information on the njet distribution from data

1. Measure ratio of 1 to 2 jet bins in signal and control region to calculate number of tt events
2. Use full njet distribution from control region and normalise to tail of njet distribution in signal region to estimate $N_{ttbar}$
Cuts:
- $p_T^{\text{miss}} > 100$ GeV
- $m_T > 50$ GeV
- $p_T^{\ell,\text{lep}} > 40$ GeV
- $p_T^{\tau,\text{lep}} > 50$ GeV
- $\tau^{\text{LLH}} > -10$

Control region event yield:

- $W+jets$ irreducible. Small bias of the $n_{\text{jets}}$ distribution.

<table>
<thead>
<tr>
<th>Event</th>
<th>Yield</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t\bar{t}$</td>
<td>22,716</td>
<td>95.4 %</td>
</tr>
<tr>
<td>$W\rightarrow l\nu$</td>
<td>910</td>
<td>3.8 %</td>
</tr>
<tr>
<td>$W\rightarrow \tau\nu$</td>
<td>51</td>
<td>0.2 %</td>
</tr>
<tr>
<td>$Z\rightarrow \tau\tau/\ell\ell$</td>
<td>42</td>
<td>0.2 %</td>
</tr>
<tr>
<td>$b\bar{b}$ J1 - J6</td>
<td>25</td>
<td>0.1 %</td>
</tr>
<tr>
<td>$b\bar{b}$ H/A</td>
<td>68</td>
<td>0.3 %</td>
</tr>
</tbody>
</table>
ttbar Estimation from Data - Results in LepHad

Result in mass window (200-400 GeV):

- ttbar in data, signal region: $87 \pm 9$
- MC prediction: $85 \pm 9$

Exp. Stat. Uncertainty: 10.6 %

#jets=1 || #jets=2
Tight tau & tight lepton
At least one b-tag
$m_T < 25$ GeV
$p_T^{miss} > 25$ GeV
$p_{T\tau} > 50$ GeV
$3.0 > \Delta\Phi > 2.4$

Distributions normalized to bins with 3 and 4 jets

$m_A = 300$ GeV, $\tan\beta = 15$, 14 TeV

Signal region

Needed for Normalization

Legend:
- ttbar
- bbA/H300
- Ztautau
- Zee
- Zmumu
- Wenu
- Wmunu
- Wtaunu
- bb J1-J6
Prospects for First Data

• Expected Events in $200 \text{ pb}^{-1}$ with 10 TeV after cuts: \textit{L. Nisati, talk at Bonn ’09}
  
  • Hundred of thousands of $W (\rightarrow l \nu) + $jets
  
  • Tens of thousands of $Z (\rightarrow \ell^{+}\ell^{-}) + $jets
  
  • Several hundreds of $ttbar \rightarrow WWbb \rightarrow \ell\nu\nu\nu bb$

$\Rightarrow$ Possibilities given for important background studies.

• $H/A \rightarrow \tau\tau$ Analysis cannot be applied „as it is“ to first data but has to be adjusted!
  $\Rightarrow$ Loose object selection, no complicated highly tuned cuts

• General First Data steps:
  
  • Understand lepton trigger and lepton ID
  
  • Understand hadronic tau reconstruction and tau fake rate
  
  • Learn about jet reconstruction and b-tagging
  
  • Reconstruct $Z \rightarrow \tau\tau$ and ttbar events and try to apply background estimation procedures
  
  • A low Higgs mass signal at high $\tan\beta$ could already be seen if systematics are controlled
Conclusions

The MSSM channel $bb \ h/A/H \rightarrow \tau\tau$ covers almost the full allowed mass range.

Open issues and next steps:

- Finish 14 TeV study in the lephad channel before first collisions (note in prep)
- Understand $m_{\tau\tau}$ shifts, esp. by comparing to other channels and experiments
- Move the analysis to first data @ 10 TeV:
  - Adjust selection
  - Update the background estimation procedures

A possible early discovery in this model and channel is constraint by:

- The performance of the Atlas detector with first data
- The unknown theory parameter $\tan\beta$
Backup

13.8 billion years ago, a few seconds before the creation of our universe.

All set. Let's fire up this Large Hadron Particle Collider and see what happens!

http://www.geeksaresexy.net
SM Higgs Production Cross Sections

\( \sigma(pp \rightarrow H + X) \) [pb]
\( \sqrt{s} = 14 \text{ TeV} \)
NLO / NNLO

- \( gg \rightarrow H \) (NNLO)
- \( q\bar{q}' \rightarrow HW \)
- \( q\bar{q} \rightarrow Hqq \)
- \( q\bar{q} \rightarrow HZ \)
- \( gg/q\bar{q} \rightarrow t\bar{t}H \) (NLO)

MRST

\( M_H \) [GeV]

Search for b-Quark Associated MSSM Higgs Decaying to Tau Pairs
Estimation of irreducible $Z \rightarrow \tau \tau$ background from data

- Selection of $Z \rightarrow \mu \mu$ events from data (sideband) with 98% purity

- Alter $\mu$ energies and momenta according to $Z \rightarrow \tau \tau$ reference histograms (MC, signal region)
  
  (Martin Schmitz „Old Bonn Method“)

- Apply cuts to manipulated $Z \rightarrow \mu \mu$ events to obtain correct $Z \rightarrow \tau \tau$ shape

Shapes of other leptonic channels similar to $\mu \mu$ shape
Z → ττ → ll Estimation from Data

- 2D binning in $p_T$ to avoid difficulties of $p_T$ dependent acceptances, turn on curves etc
- Lepton $p_T$ spectra very different between sideband and signal region
- Calculation only in non-zero bins in overlap region of $p_T$ spectra

\[
\sum_{i,j} \left( Z \rightarrow \tau \tau \rightarrow \mu \mu \right)_{\text{Signal,DATA}} = \sum_{i,j} \left( Z \rightarrow \tau \tau \rightarrow \mu \mu \right)_{\text{Signal,MC}} \cdot \frac{\left( Z \rightarrow \mu \mu \right)_{\text{Sideband,DATA}}}{\left( Z \rightarrow \mu \mu \right)_{\text{Sideband,MC}}}
\]

What we want (see next slide)
ttbar Estimation - First Method

Assumptions:

- One keeps the one-jet ($N_1$) and two-jet bin ($N_2$).
- One understands the $Z \rightarrow \tau \tau$ background in both bins (important for lower masses) (eg. use data-driven method to estimate expected number of $Z \rightarrow \tau \tau$ background).
- One suppresses or understands other backgrounds ($W$+jets, QCD).

$\Rightarrow$ Only left with ttbar and signal in the Higgs signal region.
Use information from the two jet bins to estimate number of ttbar events.

All events in 1 (2) jet bin: Introduce jet ratios:

\[
N_1 = N_1^{\text{Higgs}} + N_1^{\text{ttbar}} \quad \quad V_{\text{higgs}} = \frac{N_2^{\text{Higgs}}}{N_1^{\text{Higgs}}} \quad \quad \rightarrow \text{Take from (well tuned) MC}
\]

\[
N_2 = N_2^{\text{Higgs}} + N_2^{\text{ttbar}} \quad \quad V_{\text{ttbar}} = \frac{N_2^{\text{ttbar}}}{N_1^{\text{ttbar}}} \quad \quad \rightarrow \text{Measure in control sample}
\]

\[
N_{\text{ttbar}} = \left(1 + V_{\text{ttbar}} \right) \cdot \frac{N_1^{\text{Higgs}} \cdot V_{\text{Higgs}} - N_2}{V_{\text{Higgs}} - V_{\text{ttbar}}} \quad \rightarrow \text{will not work if } V_{\text{Signal}} = V_{\text{Background}}
\]

N_1 and N_2 measured in signal region.

Do this calculation binned in $m_{\tau \tau}$ (if statistics allows) to obtain ttbar $m_{\tau \tau}$ shape!

By using this data-driven approach we avoid the large uncertainty on the ttbar $\times$sec.
LepLep Channel Results

Comparison $V_{ttbar}$ signal and control region:

$\sqrt{s}=14$ TeV, 30 fb$^{-1}$

Statistical Uncertainties only. $N_1$ and $N_2$ anti-correlated.

Errors bars reflect expected uncertainty, not real MC uncertainty, which is larger.

Does not look so great

Does not look so bad, except for a few bins.

Estimated $ttbar$ events:

$ttbar$ and $Z \rightarrow \tau\tau$ Estimation from Data in MSSM $H \rightarrow \tau\tau$