# Status of ZH->llbb CONF note

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# Analysis Strategy - I

- CONF note intended for Winter conferences:

"Estimation of the Z+jets background to ZH→llbb Search with the ATLAS Detector at 7TeV"

  - Documentation: https://twiki.cern.ch/twiki/bin/view/AtlasProtected/ZHBackgroundNote2011

- Cut-based analysis with 2010 data
  - Based on existing SM Z+jets analysis: see ATL-COM-PHYS-2010-884
  - Main backgrounds to ZH are tt, Z+jets and QCD

- NOTE: the idea is to make as much progress as possible towards producing a note
  - If it doesn't converge in time we still gain the work done and the results achieved
  - The real aim is to gain confidence in our understanding of the background and so pave the way for later analyses

# Analysis Strategy - II

- There is 3 stages to this analysis:
  1. Inclusive: Z-boson identification (using Z+jets selection cuts for now)
  2. Pre-tag: Requiring at least 2 jets and apply kinematic cuts
  3. Final: Apply b-tagging using Loose Double Tag (DT) or Tight Single Tag (ST)

- Use same cut flow up to "pre-tag" stage
  - Avoid b-tagging calibration and b-jet energy scale issues
  - Follow same systematics as Z+jets analysis

- Release 16 to be used for final results:
  - Using rel.15 at the moment while reprocessed D3PDs unavailable

- Theory input and MC samples: all ok

# Analysis Strategy - III

- Baseline selection exists: below and next slide

## Electrons

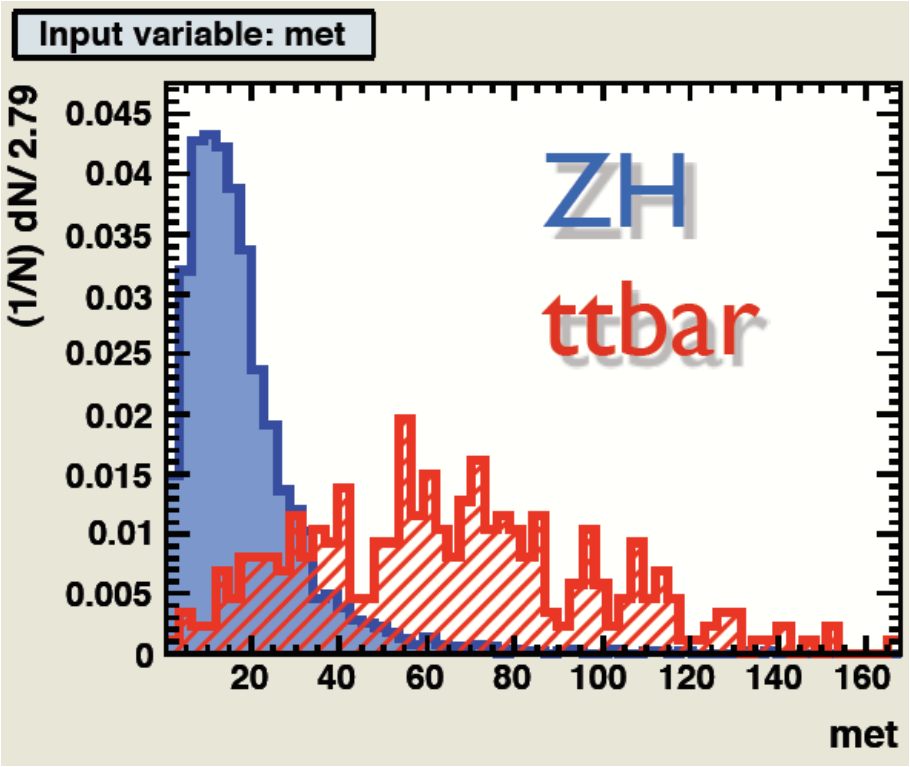
| | |
|---|---|
| **Collision event selection** | |
| Primary vertex | $N_{vtx} \geq 1$ with $N_{tracks} \geq 3$, $\lvert z_{vtx} \rvert < 150$mm |
| Trigger | L1_EM14 |
| **Good-electron selection** | |
| Phase space | $p_T > 20$ GeV |
| | $\lvert\eta\rvert < 2.47$, excluding $1.37 < \lvert\eta\rvert < 1.52$ |
| Electron ID | Medium |
| | Electron author 1 or 3 |
| Calorimeter problems | not in bad OTX region |
| **$Z \rightarrow ee$ event selection** | |
| | Exactly 2 good electrons |
| Charge | Opposite sign |
| Invariant Mass | $71 < M_{ee} < 111$ GeV |

## Muons

| | |
|---|---|
| **Collision event selection** | |
| Primary vertex | $N_{vtx} \geq 1$ with $N_{tracks} \geq 3$,, $\lvert z_{vtx} \rvert < 150$mm |
| Trigger | L1_MU10 |
| **Good-muon selection** | |
| Phase space | $p_T > 20$ GeV, $\lvert\eta\rvert < 2.4$ |
| Muon ID | Staco, combined |
| Muon cleaning | $p_T$ MS $> 10$ GeV, |
| | $\lvert p_T(\text{MS}) - p_T(\text{ID})\rvert < 0.5 \times p_T(\text{ID})$ |
| | $\lvert z_{muon} - z_{vxt}\rvert < 10$ mm |
| | $d_0 < 0.1$ mm (wrt. the primary vertex) |
| | $N_{PIXhits} > 1$, $N_{SCThits} > 5$, $N_{TRThits} > 0$, if $\lvert\eta\rvert < 2$ |
| Track isolation | $\Sigma p_T < 1.8$ in $\Delta R < 2.0$ around the muon track |
| **$Z \rightarrow ee$ event selection** | |
| | Exactly 2 good muons |
| Charge | Opposite sign |
| Invariant Mass | $71 < M_{ee} < 111$ GeV |

# Pre-tag Selection Cuts

| Jet selection | |
|---|---|
| Phase space | $p_t > 20$ GeV |
| | $\|\eta\| < 2.8$ |
| Quality | isGood |
| Algorithm | Anti-Kt4 |
| **Event variables** | |
| MET $< 40$ GeV | |
| **Higgs event selection** | |
| Jet Properties | Two highest $p_t$ jets |
| | $p_t > 30$ GeV |
| Invariant Mass | $85 < M_{jj} < 125$ GeV |



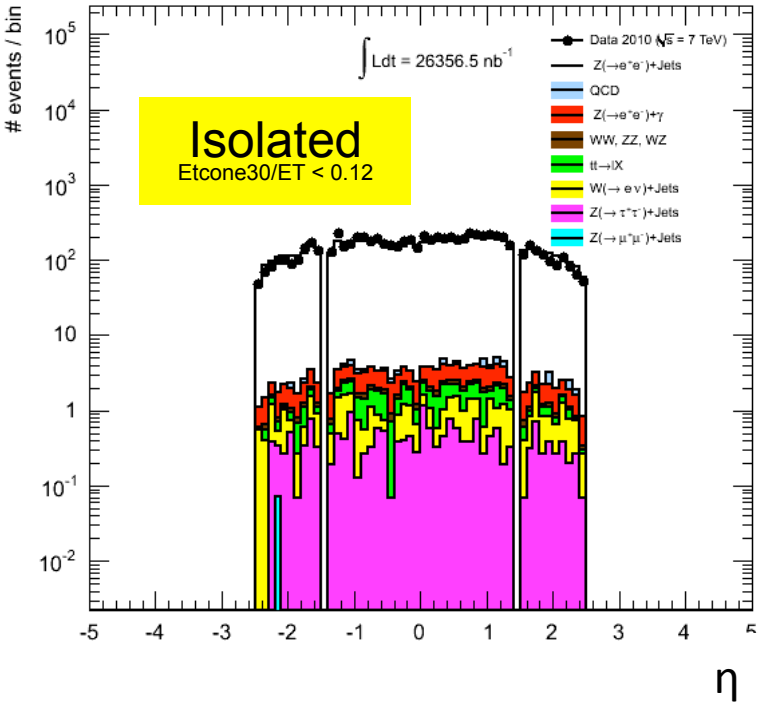
# Analysis Strategy - IV

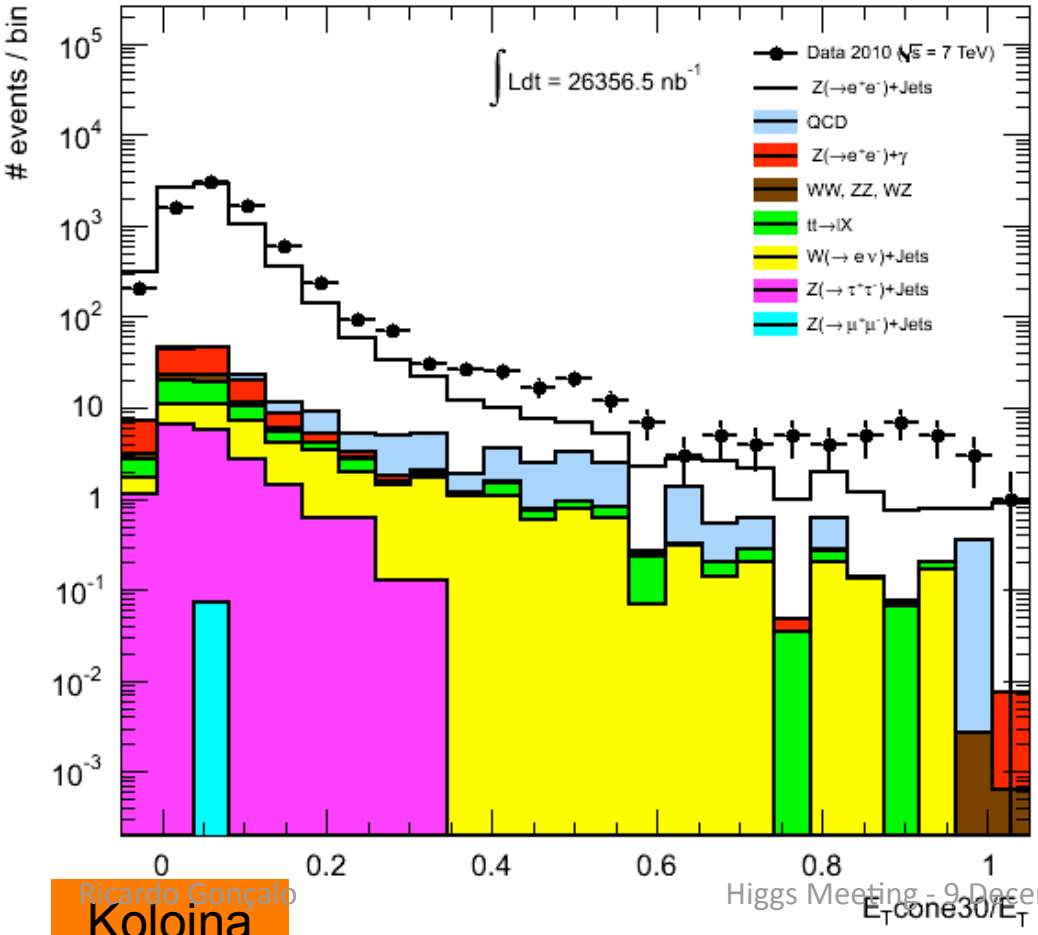
- Systematic uncertainties – not exhaustive list, work in progress:
  - Lepton and jets reconstruction efficiency
  - Jet energy scale and jet energy resolution
  - Pileup reweighting and associated systematic uncertainty
  - Trigger efficiency systematic uncertainty

- Background estimation strategy: this is the subject of the note
  - Investigating sideband techniques to estimate each major background
  - Looking for best methods to estimate each background
  - Tried reversing MET cut:
    - Found some Z+jets contamination in sideband region
  - Studying “lepton flavour sideband”:
    - Request eμ instead of ee or μμ

# Electron isolation

- Investigated reversal of electron isolation cut to define sideband
- Currently investigating disagreement between data and MC in isolation

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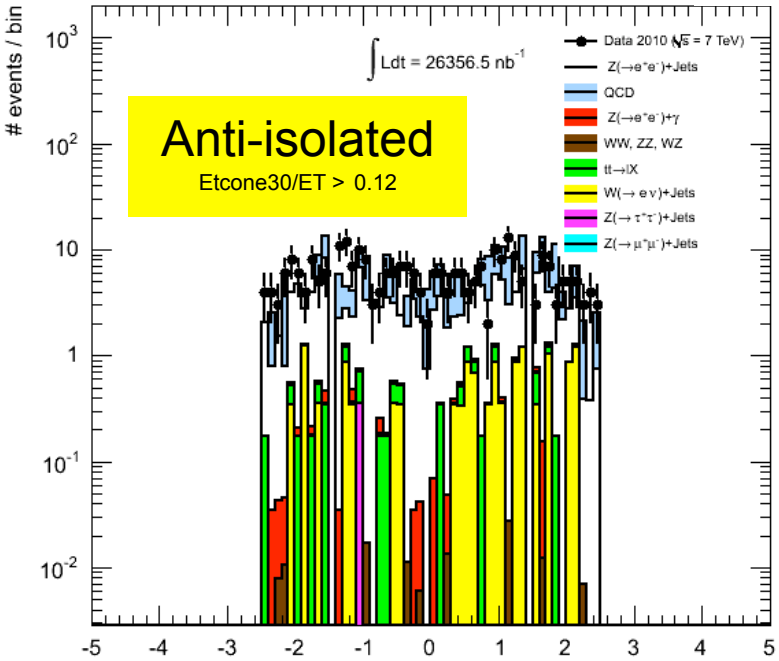


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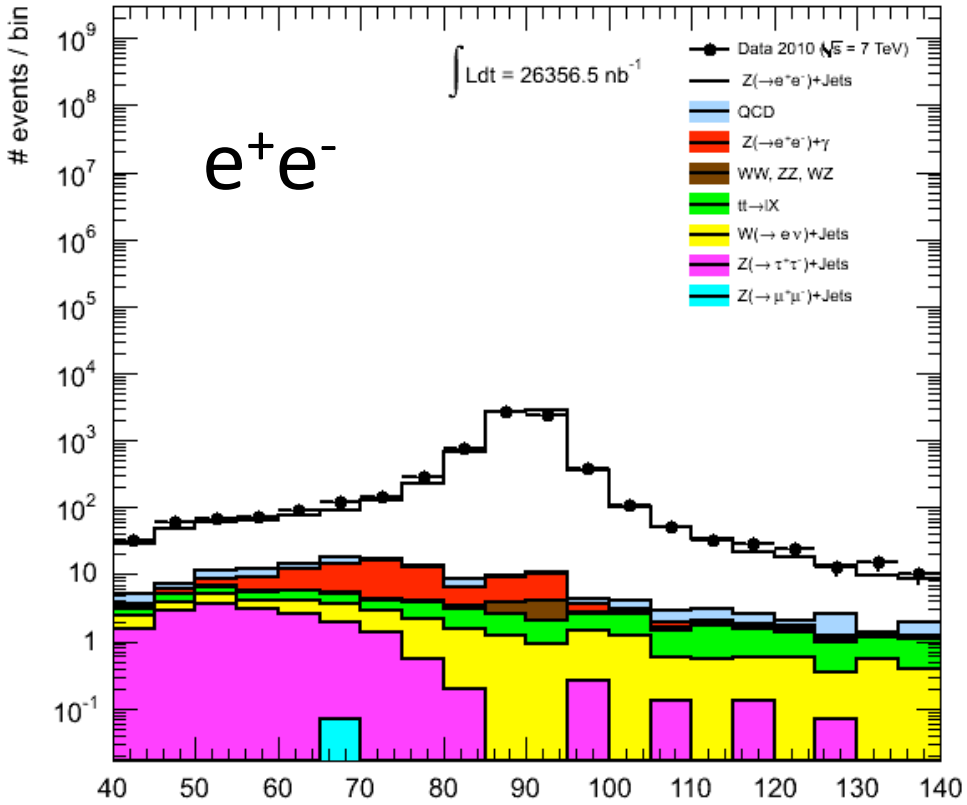
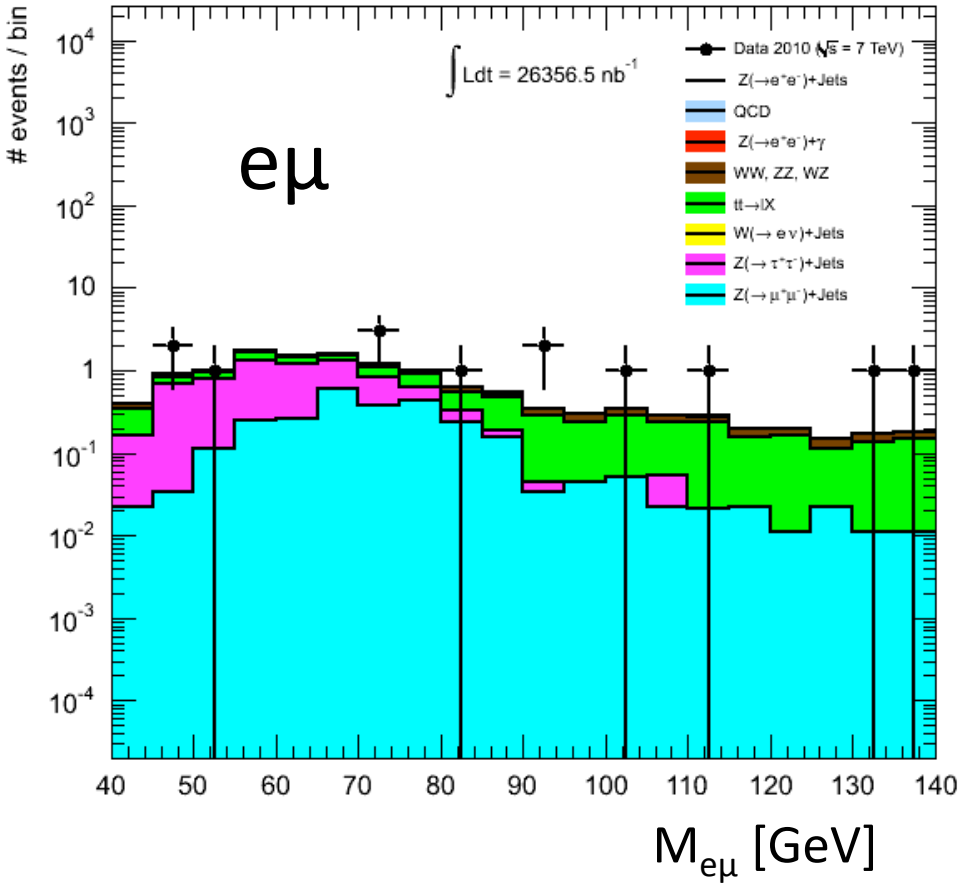
# “Flavour sideband”

- Also investigated the effect of requesting e+μ instead of ee and μμ
- Good description of data but few events left in sideband

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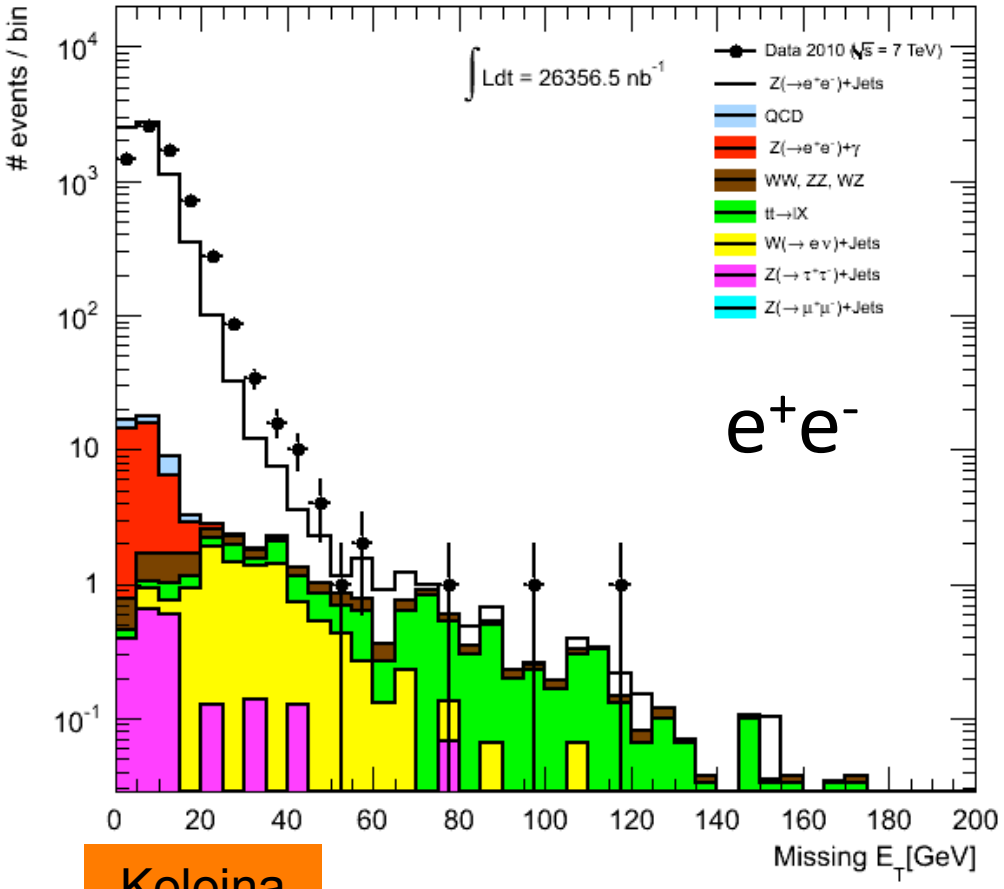
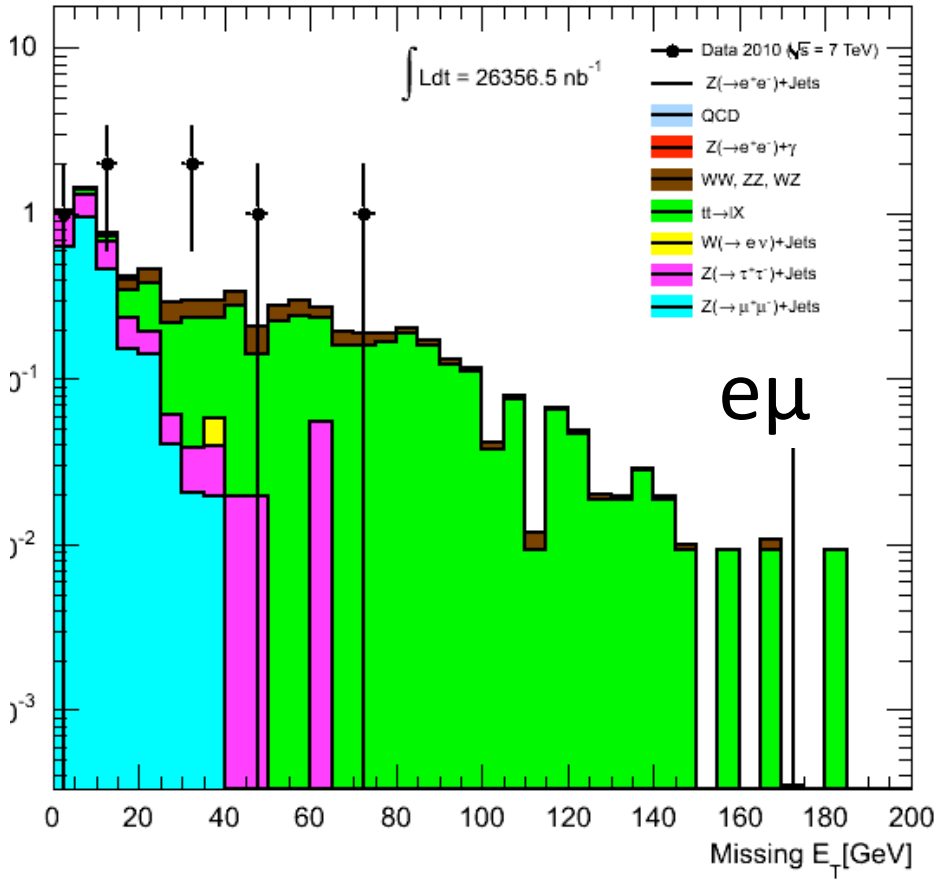
# Missing $E_T$

Investigated reversing MET to get a top-enriched sideband

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# Timeline & etc…

- Working back from circulating date of 22nd February:
  - Two weeks iteration with Ed.Board (optimistic?...) means complete polished draft by 8th February – aim for 1st February
  - First draft of note in SVN by mid-January at the latest: aiming for early draft before Christmas for internal use
  - When should we aim to present at the Higgs WG?
  - Supporting documentation in Wiki only, if allowed, to save time
- Main problem affecting us is lack of people!
  - Essentially ≈1 FTE at the moment… Trying to recruit…
  - Plan to cut all legitimate corners: e.g. considering to use only latest data periods if that saves time
- Manpower:
  - Malachi focused on Z->μμ channel; starting to write first note draft
  - Koloina focusing on Z->ee channel
  - Ricardo ramping up on Z->μμ channel

# Conclusions

- Quite late since there is a huge amount to do…
- …but we're not giving up so easily!