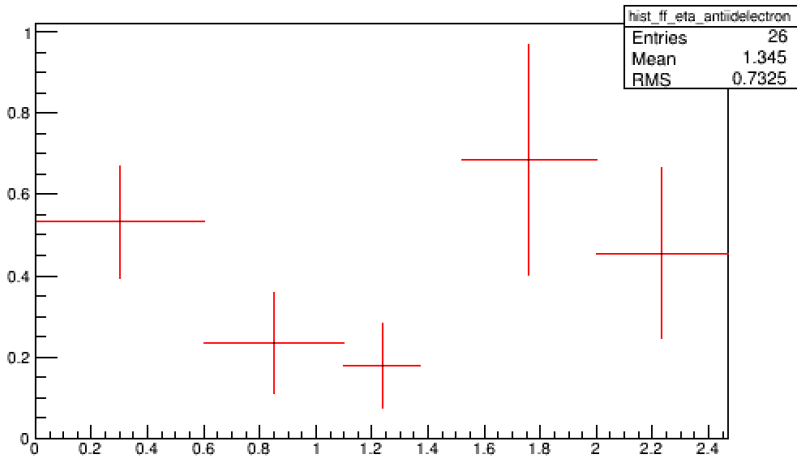
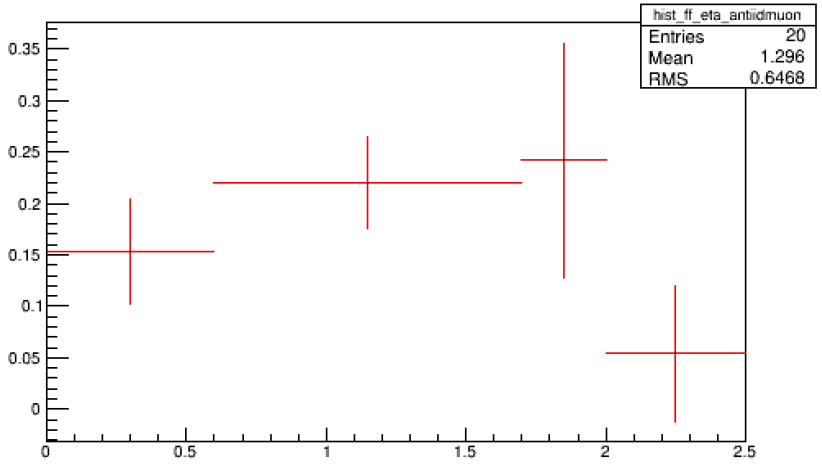
# Weekly Report

# Fake factor check




Electron




Muon

# Matrix Method introduction

- Standard Matrix Method
- Define two effciencies
  - Real lepton $r = \frac{N_{tight}^{real}}{N_{loose}^{real}}$, fake lepton f $= \frac{N_{tight}^{fake}}{N_{loose}^{fake}}$,
- One lepton case

$$N^T = \varepsilon_r \, N^r + \varepsilon_f \, N^f$$

$$N^{\not T} = \varepsilon_{\not r} \, N^r + \varepsilon_{\not f} \, N^f$$

  - Where r/ =1-r, f/ =1-f
- relate the unkown number of real and fake leptons (Nr, Nf) to observables.

# Matrix Method

- Two lepton case

$$\begin{pmatrix} N_{TT} \\ N_{TL'} \\ N_{L'T} \\ N_{L'L'} \end{pmatrix} = \begin{pmatrix} r_1 r_2 & r_1 f_2 & f_1 r_2 & f_1 f_2 \\ r_1(1-r_2) & r_1(1-f_2) & f_1(1-r_2) & f_1(1-f_2) \\ (1-r_1)r_2 & (1-r_1)f_2 & (1-f_1)r_2 & (1-f_1)f_2 \\ (1-r_1)(1-r_2) & (1-r_1)(1-f_2) & (1-f_1)(1-r_2) & (1-f_1)(1-f_2) \end{pmatrix} \begin{pmatrix} N_{RR} \\ N_{RF} \\ N_{FR} \\ N_{FF} \end{pmatrix}$$

- Numbers of different kinds of pairs($N_{TT}$, $N'_{TL}$ … …) are known
- r, f can be measured in event-enriched regions

# Solve the matrix

- Assume efficiency is identical for e from e+e- pair
  - r1=r2, f1=f2

$$\begin{pmatrix} N_{RR} \\ N_{RF} \\ N_{FR} \\ N_{FF} \end{pmatrix} = \frac{1}{(r-f)^2} \begin{pmatrix} (1-f)^2 & (f-1)f & f(f-1) & f^2 \\ (f-1)(1-r) & (1-f)r & f(1-r) & -rf \\ (r-1)(1-f) & (1-r)f & r(1-f) & -rf \\ (1-r)^2 & (r-1)r & r(r-1) & r^2 \end{pmatrix} \begin{pmatrix} N_{TT} \\ N_{TL'} \\ N_{L'T} \\ N_{L'L'} \end{pmatrix}$$

$$\begin{aligned} N_{TT}^{\text{fakes}} = \quad & \alpha[2rf(f-1)(1-r) + f^2(1-r)^2]N_{TT} \\ & +\alpha(1-f)fr^2(N_{TL'} + N_{L'T}) \\ & -\alpha r^2 f^2 N_{L'L'} \end{aligned}$$

- Then number of fakes can be derived
- $N_{TT}^{fakes} = N^{rf} + N^{fr} + N^{ff}$ at least one fakes in SR.(two Tight )

# FakeBkgTool

- Still working on the code
- Now this package has been installed properly out of athena environment.
- Function
  - Provide  a standard matrix method and fake factor method implement
  - Input: efficiencies for fake and real leptons
  - Lack of instruction to follow up

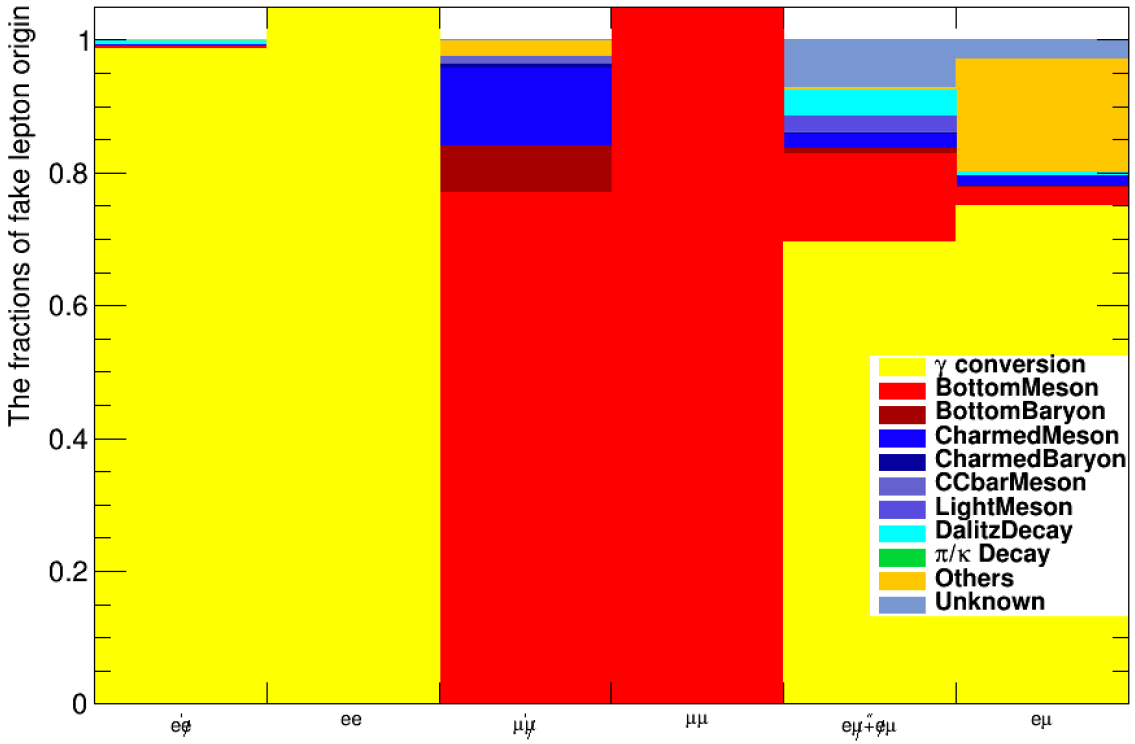
# Events critiria

| electron | | | |
|---|---|---|---|
| | Loose | Tight | Anti-Tight |
| \|D0sig\| | 5 | 5 | 5 |
| \|Z0sintheta\| | 0.5mm | 0.5mm | 0.5mm |
| Electron ID | LooseLH | Tight LH | Fail one of tight requirements |
| Isolation | | FixedCutLoose WP | |
| Non-prompt rejection | | PromptLeptonVeto<-0.7 | |
| Qmis rejection | | QMisIDBDT>0.7 | |

| muon | | | |
|---|---|---|---|
| | Loose | Tight | Anti-tight |
| \|D0sig\| | 3 | 3 | 3 |
| \|Z0sintheta\| | 0.5mm | 0.5mm | 0.5mm |
| Electron ID | Medium | Tight | Fail one of tight requirements |
| Isolation | | FixedPFlowLoose WP | |
| Non-prompt rejection | | PromptLeptonVeto<-0.5 | |

Loose = tight +anti-tight

# Fake composition




Tight+anti-tight leptons CR

Tight-Tight leptons pre SR

- Most of the fake electrons arise from
- While muon are from HF
- Need to be checked

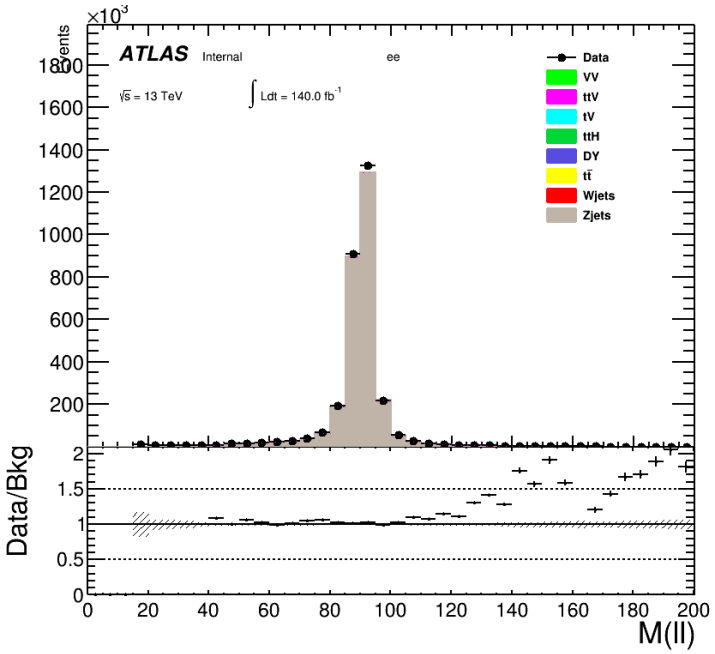
To do list

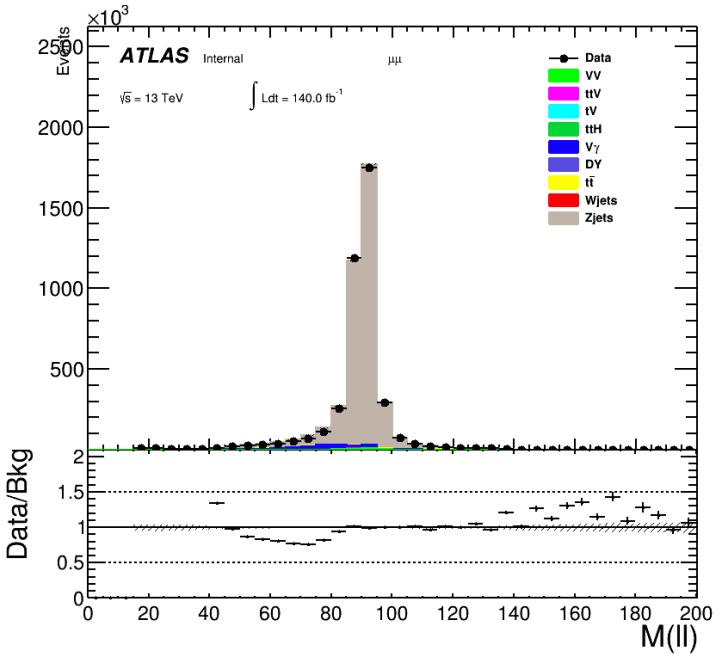
- In new releases photon conversion using the conversion radius and mtrack_track can be separated to
  - Material CO
  - Internal CO

| Using $m(trk-trk)$ at PV and conv. vertex radius and mass: |
| --- |
| External CR ($r > 20$mm and 0<m(trk-trk)$atPV$ <100MeV |
| Internal CR (not External and 0<m(trk-trk)$atPV$ <100MeV |

- Defined CR regions
- efficiencies measurement
- Applied to data

# Real lepton efficiency measurement




- To select prue Z->ee/mumu events
- Consider Tag&probe method
  - One Tight lepton(Tag) one go though loose
  - Something overestimated in mumu channel