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**Higgs boson in the four-lepton analysis  
&  
FCal/sFCal Analysis**

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## Code Salah

```

if (event_type==2) //mmee
{
    if (Z1_lepplus_trk_iso <0.15 && Z1_lepminus_trk_iso <0.15 &&
Z2_lepplus_trk_iso <0.15 && Z2_lepminus_trk_iso<0.15)// track isolation
    {
        if (Z1_lepplus_calor_iso<0.30 && Z1_lepminus_calor_iso< 0.30 &&
Z2_lepplus_calor_iso<0.20 && Z2_lepminus_calor_iso < 0.20)//calorimeter
isolation
        { if ((Z1_lepplus_d0sig) < 3. && (Z1_lepminus_d0sig) < 3. &&
(Z2_lepplus_d0sig) < 5 && (Z2_lepminus_d0sig) <5)//Impact parameter
significance
//_____
if (event_type==0) //mmmm
{
    if (Z1_lepplus_trk_iso <0.15 && Z1_lepminus_trk_iso <0.15 &&
Z2_lepplus_trk_iso <0.15 && Z2_lepminus_trk_iso<0.15)// track isolation
    {
        if (Z1_lepplus_calor_iso<0.30 && Z1_lepminus_calor_iso< 0.30 &&
Z2_lepplus_calor_iso<0.30 && Z2_lepminus_calor_iso < 0.30)//calorimeter
isolation
        {
            if ((Z1_lepplus_d0sig) < 3 && (Z1_lepminus_d0sig) < 3 &&
(Z2_lepplus_d0sig) < 3 && (Z2_lepminus_d0sig) <3)//Impact parameter
significance

```

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## Code Joany

```

// APPLY DOSIG, IN LEADING LEPTON PAIR
if(mmmm || mmee)
{
    if(fabs(Z1_lepplus_d0sig) <3.0 && fabs(Z1_lepminus_d0sig) <3.0 )
    {
        isTight_Z1 = true;
    }
}

// APPLY DOSIG, IN SUBLEADING LEPTONS
if(mmmm || eemm)
{
    if(fabs(Z2_lepplus_d0sig) <3.0){
        isTight_Z3 = true;
    }
}
if(fabs(Z2_lepminus_d0sig) <3.0){
    isTight_Z4 = true;
}
}
}

```

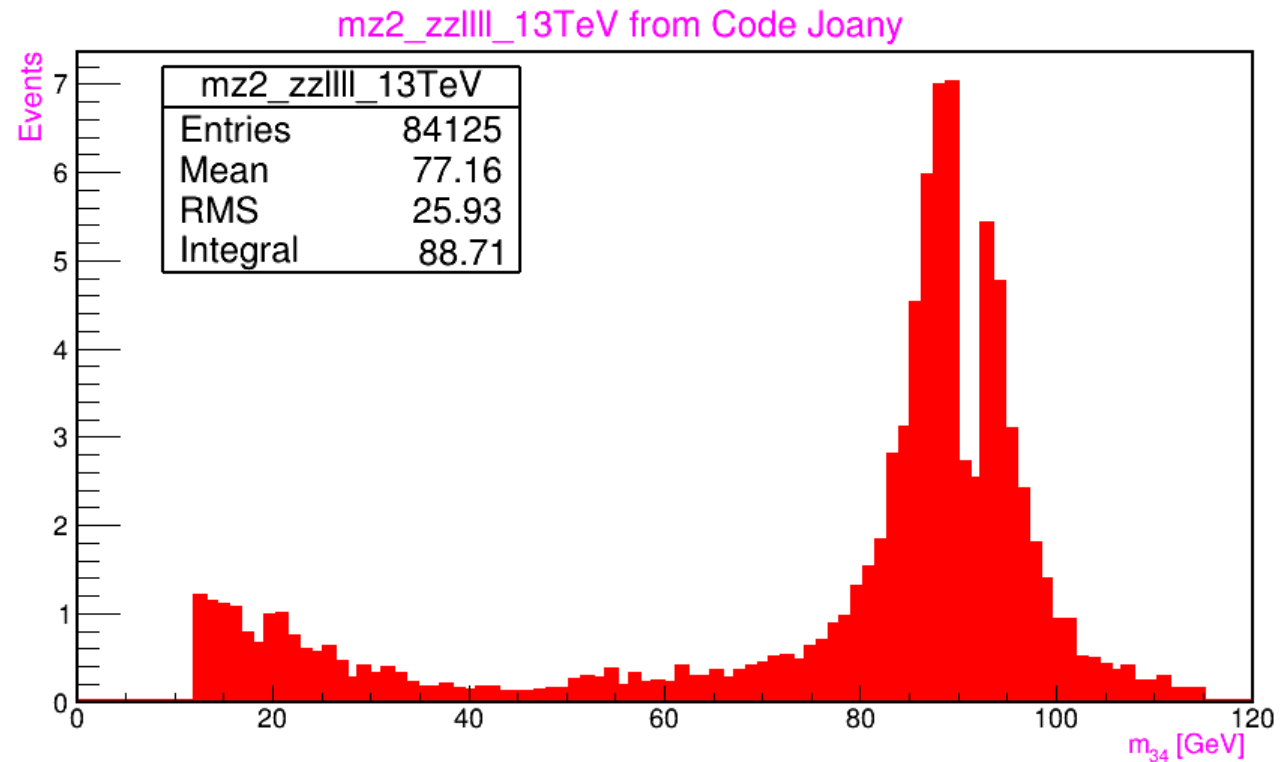
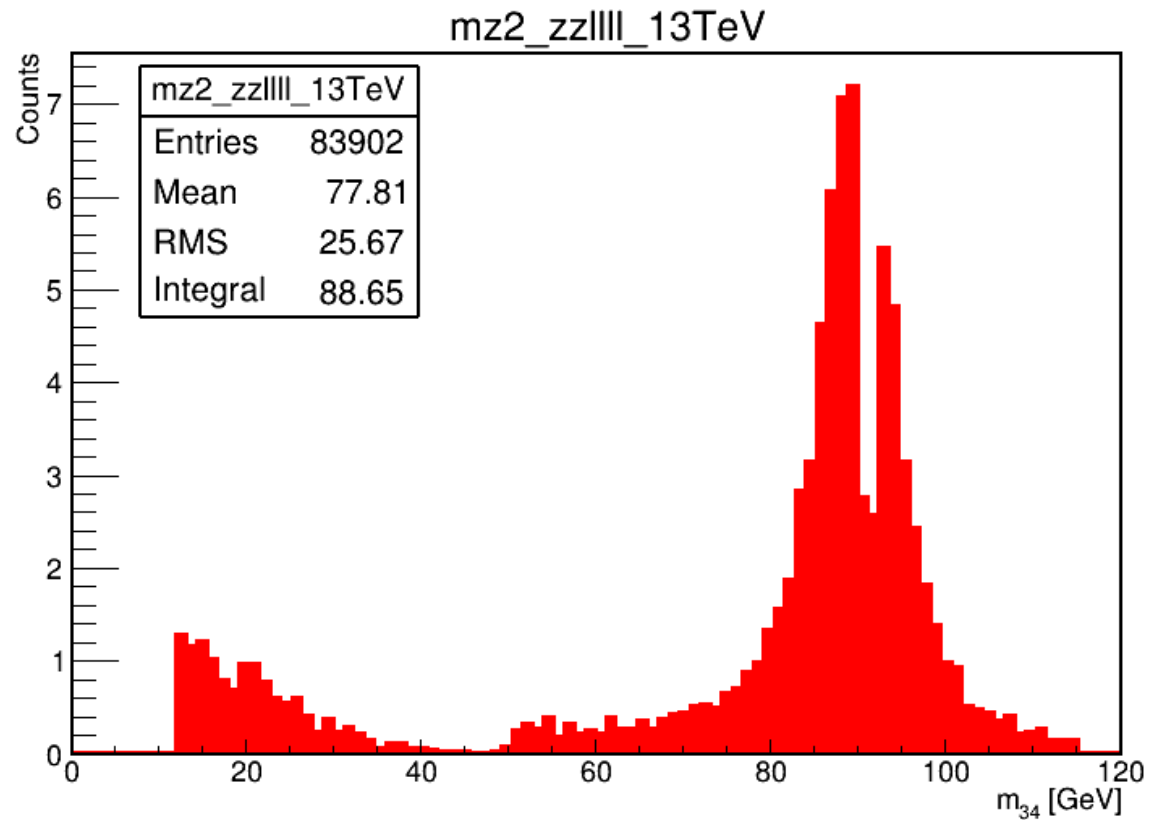
# Remarks

1. For Impact parameter significance Cuts ,We have two difference way to apply cuts:
  - Joany appleid DOSIG cuts for **LEADING and SUBLEADING LEPTONS PAIR** separately
  - I appleid DOSIG cuts for an individual channel wich all particles have to pass CutFlow.
  - Joany aplleid cut using **fabs()** : absolute value of DOSIG.
2. For track isolation and calorimeter isolation,I'm not sure but I don't find isolation cuts in this macro « Histos » :
  - Track isolation and calorimeter isolation for leading leptons pair are not defined, « Z1\_lepminus\_trk\_iso ..... »
  - Not applying For subleading Leptons pair.
3. For Impact parameter , track isolation and calorimeter isolation .I don't understand some values and its utility:

```
if(evt->Z2_lepplus_calor_iso > 0.65) Z2_lepplus_calor_iso = 0.5;  
if(evt->Z2_lepminus_calor_iso > 0.65) Z2_lepminus_calor_iso = 0.5;  
if(evt->Z2_lepplus_trk_iso > 0.5) Z2_lepplus_trk_iso = 0.45;  
if(evt->Z2_lepminus_trk_iso > 0.5) Z2_lepminus_trk_iso = 0.45;  
if(evt->Z2_lepplus_d0sig > 7) Z2_lepplus_d0sig = 6;  
if(evt->Z2_lepminus_d0sig > 7) Z2_lepminus_d0sig = 6;
```

- Some values are not defined in the note.

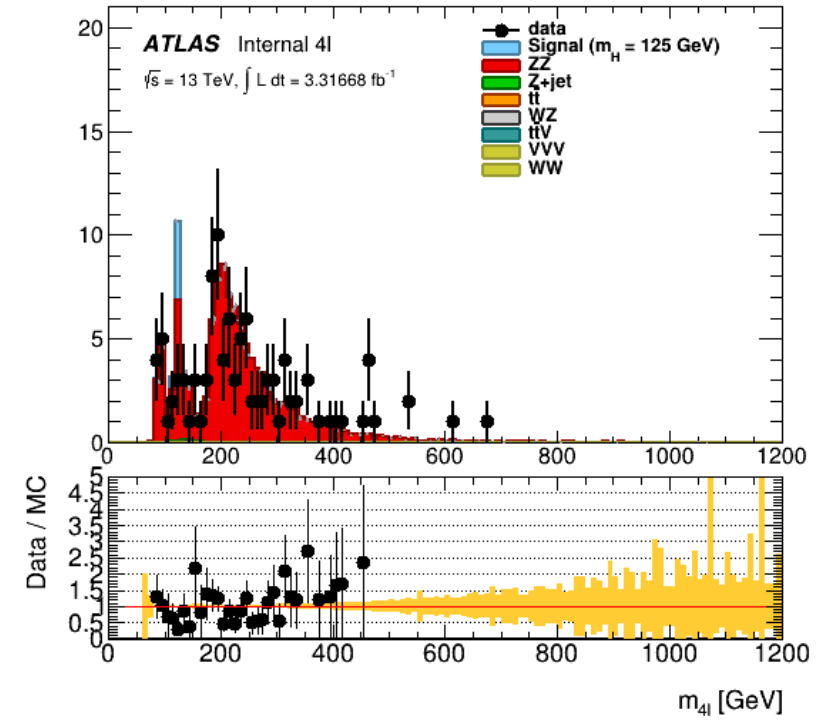
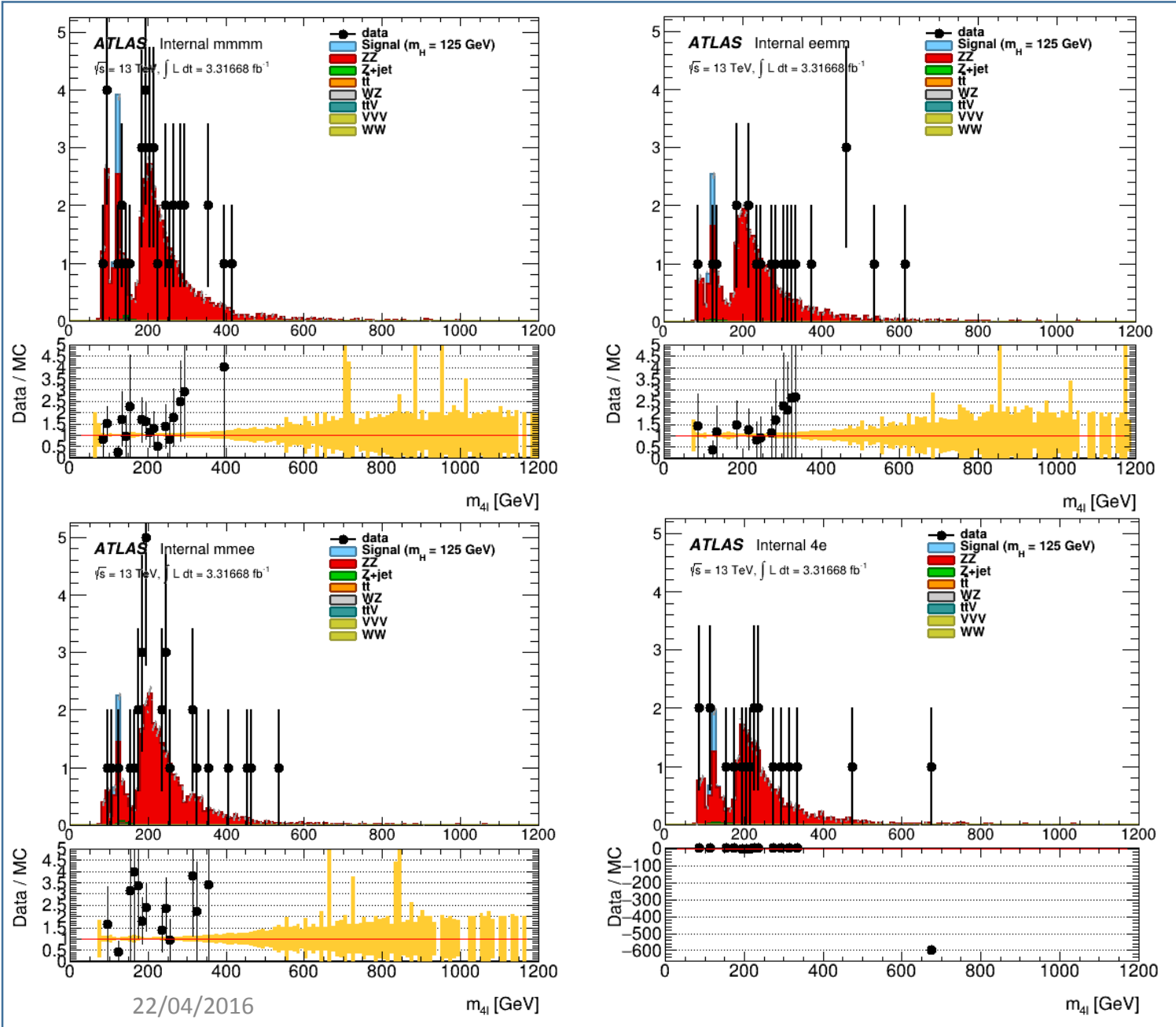
## $m_{34}$ mass distributions after CutFlow and Normalisation



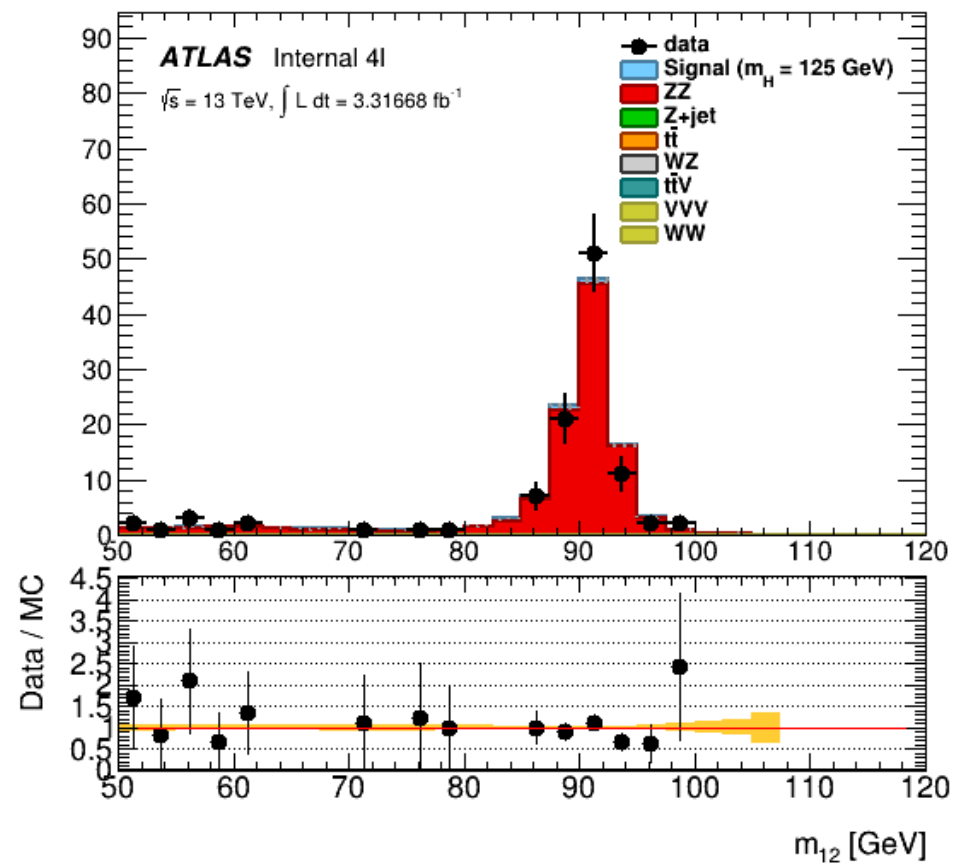
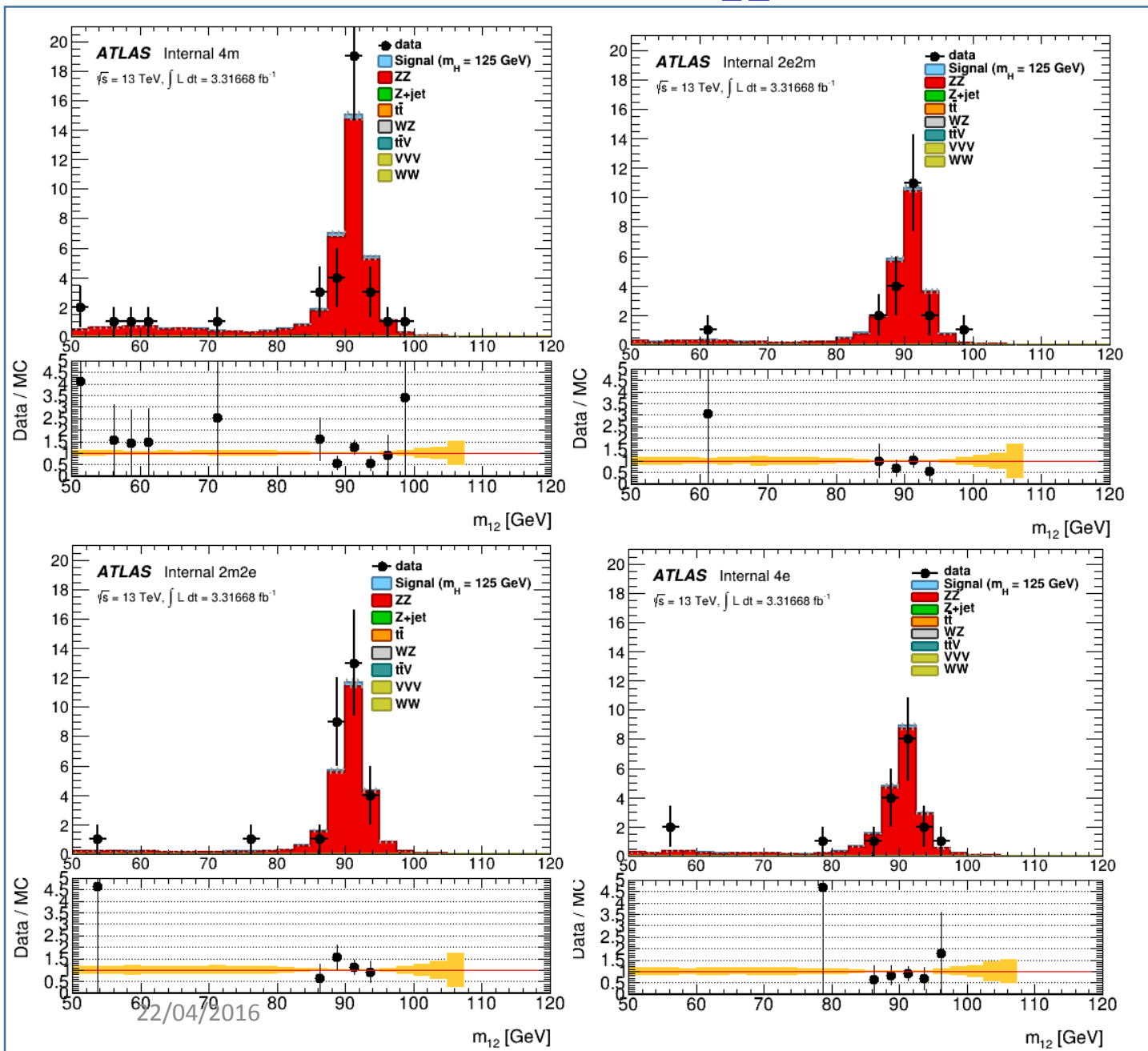
### Remarks :

- *223 entries of difference .*
- *Nearly the same statistics parameters ( Mean,RMS,Integral).*

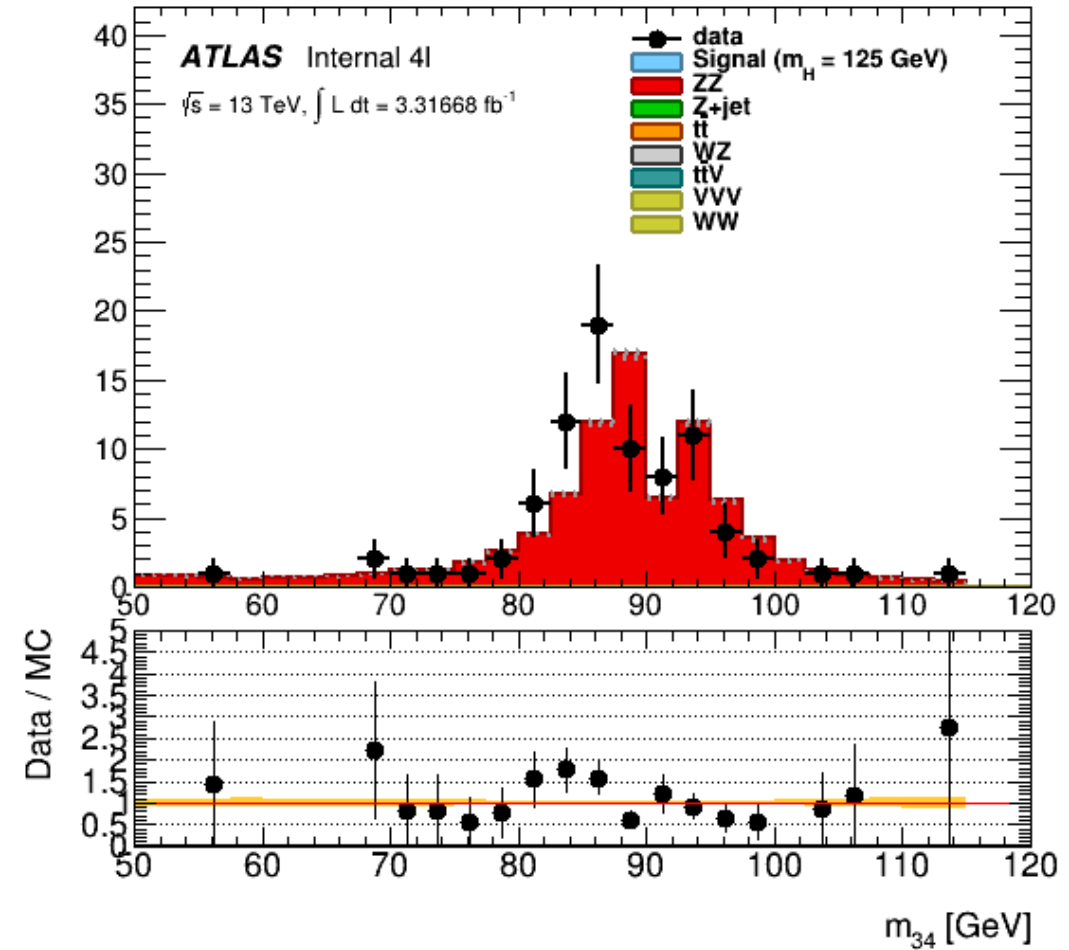
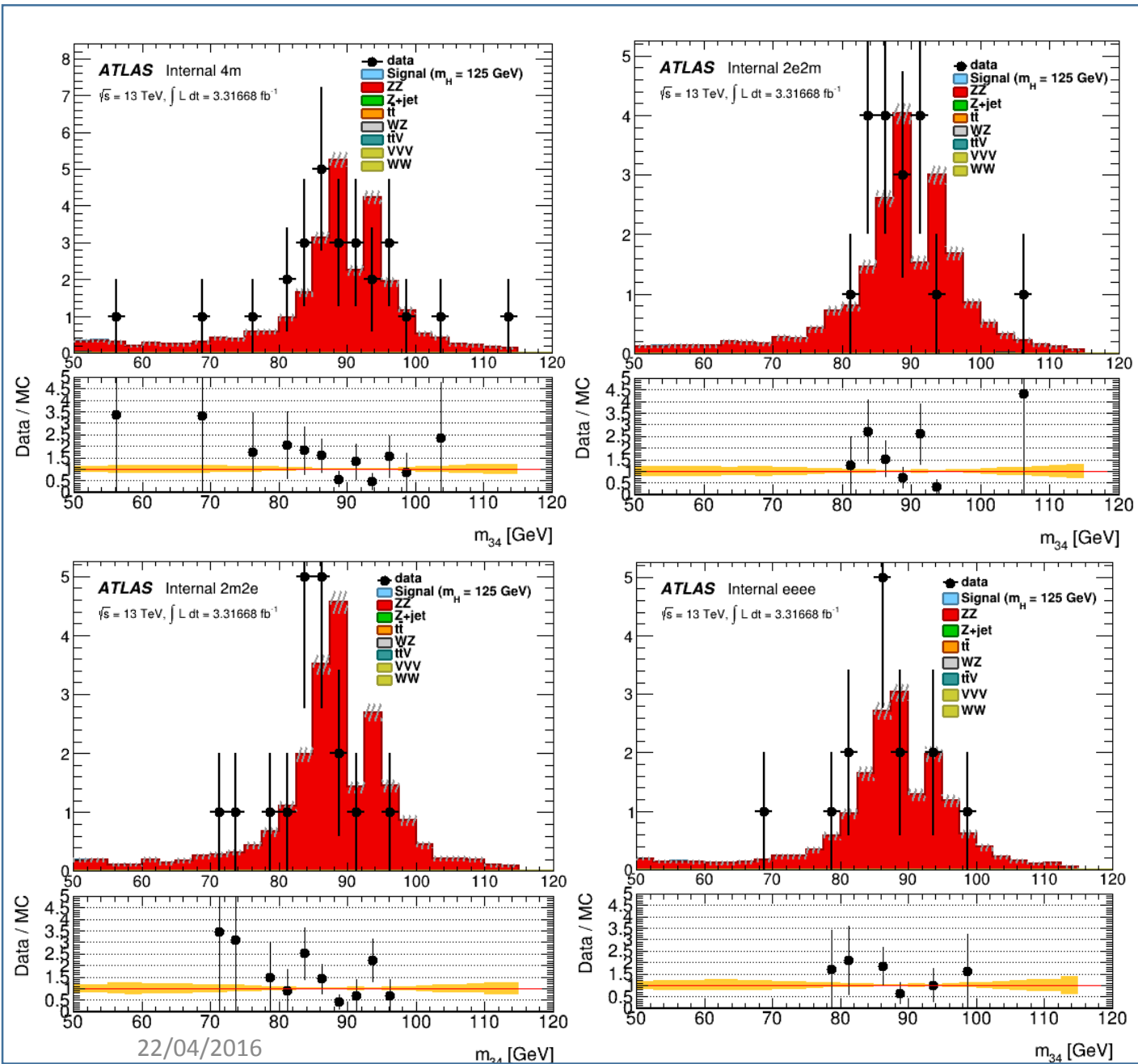
# $m_{4l}$ mass distributions



# $m_{12}$ mass distributions



# $m_{34}$ mass distributions



22/04/2016

# The total number of signal events

quark-quark->zz : mc15\_13TeV.361603.PowhegPy8EG\_CT10nloME\_AZNLOCTEQ6L1\_ZZlll\_mll4\_V2.0\_tree.root

## My Results

<i>4l</i>	<b>ZZ* 130 &gt; m4l &gt; 115</b>	<b>ZZ* 140 &gt; m4l &gt; 110</b>	<b>ZZ* 129 &gt; m4l &gt; 118</b>	<b>ZZ* m4l &gt; 200</b>
4μ	0.757742	1.51142	0.572843	18.8951
2e2μ	0.484753	0.999517	0.369894	14.511
2μ2e	0.504875	0.942753	0.379067	15.3504
4e	0.400595	0.726096	0.29214	11.8265
<b>Total</b>	<b>2.14796</b>	<b>4.17978</b>	<b>1.61394</b>	<b>60.583</b>

## Code Joany Results

<i>4l</i>	<b>ZZ* 130 &gt; m4l &gt; 115</b>	<b>ZZ* 140 &gt; m4l &gt; 110</b>	<b>ZZ* 129 &gt; m4l &gt; 118</b>	<b>ZZ* m4l &gt; 200</b>
4μ	0,71415	1,42551	0.530676	18.612
2e2μ	0,469593	0,967414	0.354735	14.1717
2μ2e	0,491489	0,908196	0.365748	15.0655
4e	0,36821	0,684274	0.275148	11.7899
<b>Total</b>	<b>2,04344</b>	<b>3,98539</b>	<b>1.52631</b>	<b>59.6391</b>



**My Results**

<i>4l</i>	<b>ZZ* 130 &gt; m4l &gt; 115</b>	<b>ZZ* 140 &gt; m4l &gt; 110</b>	<b>ZZ* 129 &gt; m4l &gt; 118</b>	<b>ZZ* m4l &gt; 200</b>
4μ	0.809477	0.85364	0.787453	1.5006
2e2μ	0.58923	0.527853	0.561215	1.18042
2μ2e	0.498298	0.626998	0.469897	1.28853
4e	0.423041	0.468696	0.388083	0.974873
<b>Total</b>	<b>2.32005</b>	<b>2.47719</b>	<b>2.20665</b>	<b>4.94443</b>

**Code Joany Results**

<i>4l</i>	<b>ZZ* 130 &gt; m4l &gt; 115</b>	<b>ZZ* 140 &gt; m4l &gt; 110</b>	<b>ZZ* 129 &gt; m4l &gt; 118</b>	<b>ZZ* m4l &gt; 200</b>
4μ	0,800421	0,838018	0,77858	1.48833
2e2μ	0,54637	0,582968	0,518996	1.16245
2μ2e	0,482013	0,509336	0,456332	1.27094
4e	0,419468	0,463841	0,386997	0.971037
<b>Total</b>	<b>2,24827</b>	<b>2,39416</b>	<b>2,14091</b>	<b>4.89275</b>

My Results

<i>4l</i>	ZZ* 130> m4l > 115	ZZ* 140 > m4l > 110	ZZ* 129> m4l > 118	ZZ* m4l > 200
4μ	1.567219	2,36506	1,360296	20.3957
2e2μ	1.073983	1,52737	0.931109	15.69142
2μ2e	1.003173	1,470606	0.848964	16.63893
4e	0.823636	1,194792	0.680223	12.801373
<b>Total</b>	<b>4.46801</b>	<b>6,65697</b>	<b>3.82059</b>	<b>65.52743</b>

Code Joany Results

<i>4l</i>	ZZ* 130> m4l > 115	ZZ* 140 > m4l > 110	ZZ* 129> m4l > 118	ZZ* m4l > 200
4μ	1,514571	2,263528	1,309256	20,10033
2e2μ	1,015963	1,550382	0,873731	15,33415
2μ2e	0,973502	1,417532	0,82208	16,33644
4e	0,787678	1,148115	0,662145	12,760937
<b>Total</b>	<b>4,29171</b>	<b>6,37955</b>	<b>3,66722</b>	<b>64,53185</b>

# The total number of signal events

## ATLAS Note 2015-1277

<i>4l</i>	<b>ZZ* 130 &gt; m4l &gt; 115</b>	<b>ZZ* 140 &gt; m4l &gt; 110</b>	<b>ZZ* 129 &gt; m4l &gt; 118</b>	<b>ZZ* m4l &gt; 200</b>
<i>4μ</i>	<b>0.85</b>	<b>1.66</b>	<b>0.64</b>	<b>20.36</b>
<i>2e2μ</i>	<b>0.58</b>	<b>1.13</b>	<b>0.44</b>	<b>15.53</b>
<i>2μ2e</i>	<b>0.44</b>	<b>0.90</b>	<b>0.34</b>	<b>16.52</b>
<i>4e</i>	<b>0.42</b>	<b>0.83</b>	<b>0.32</b>	<b>12.70</b>
<b>Total</b>	<b>2.29</b>	<b>4.52</b>	<b>1.74</b>	<b>65.12</b>

# CONCLUSION

- To compile and run code joany, I need to install RooFit package . I'm moving from Scientific linux to CentOS7.
- Using code joany to calculate the *number of signal events* gives nearly the same results .The difference may be due to CutFlow.
- The number of signal events in the region 110-140 for Gluon\_Gluon is uper then the number for Quark\_Quark processus. the results are not compatible with Note in this region

## Upgrade Plans for ATLAS Forward Calorimetry

- Applying S-shape corrections using Sample control for electrons improves the resolution at Nominal Granularity.
- sFCal geometry update ,the dimensions of the gaps in sFCal have been corrected. : new samples have been generated for energy and position resolution studies.

