Progress Report
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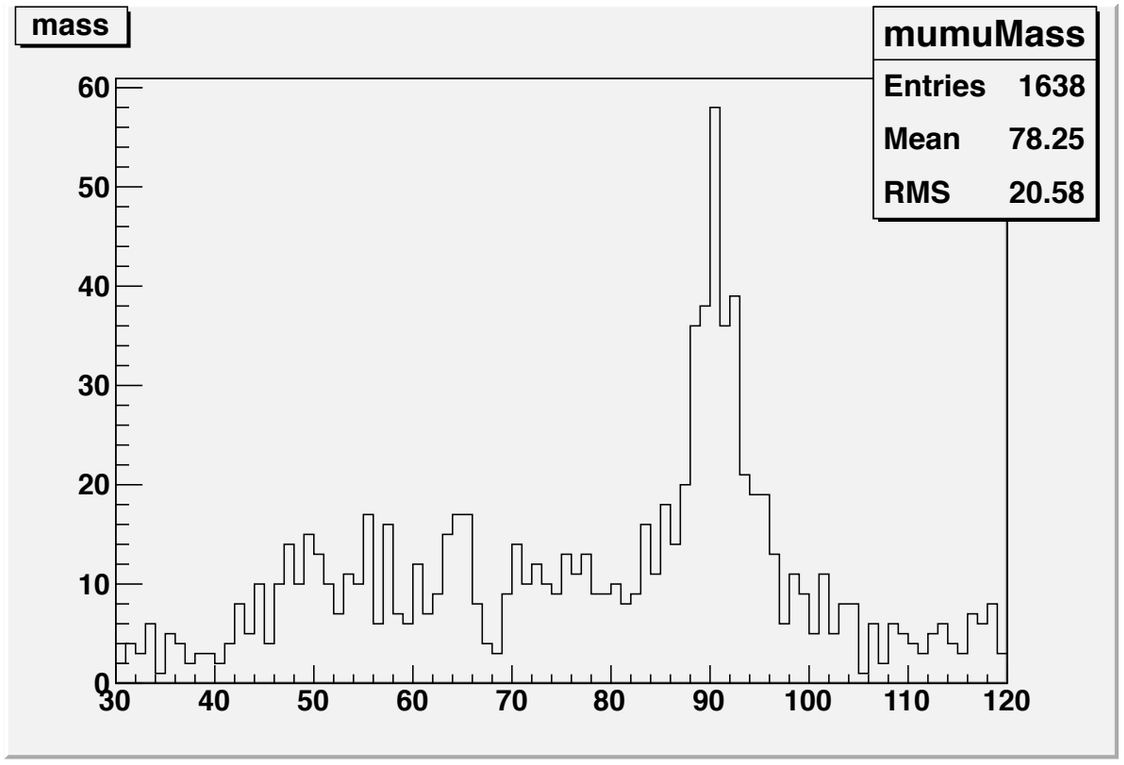
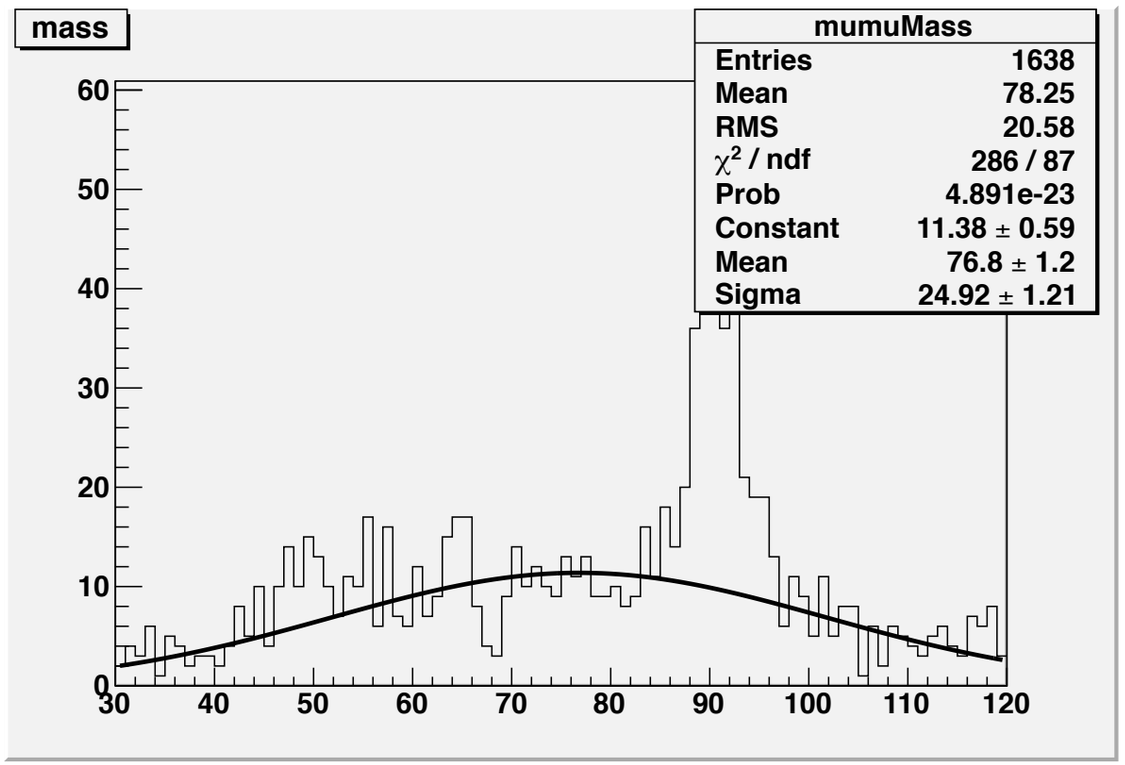
Oct. 12 , 2011
Fitting Root vs RooFit

FCN=285.977 FROM MIGRAD STATUS=CONVERGED 94 CALLS 95 TOTAL
EDM=8.35886e-12 STRATEGY= 1 ERROR MATRIX UNCERTAINTY 3.6 per cent

NO.	NAME	EXT PARAMETER VALUE	ERROR	STEP SIZE	FIRST DERIVATIVE
1	Constant	1.13830e+01	5.87137e-01	-1.84139e-05	1.87271e-06
2	Mean	7.67999e+01	1.16483e+00	9.70062e-05	5.89124e-07
3	Sigma	2.49170e+01	1.21418e+00	-2.41334e-08	3.36706e-04



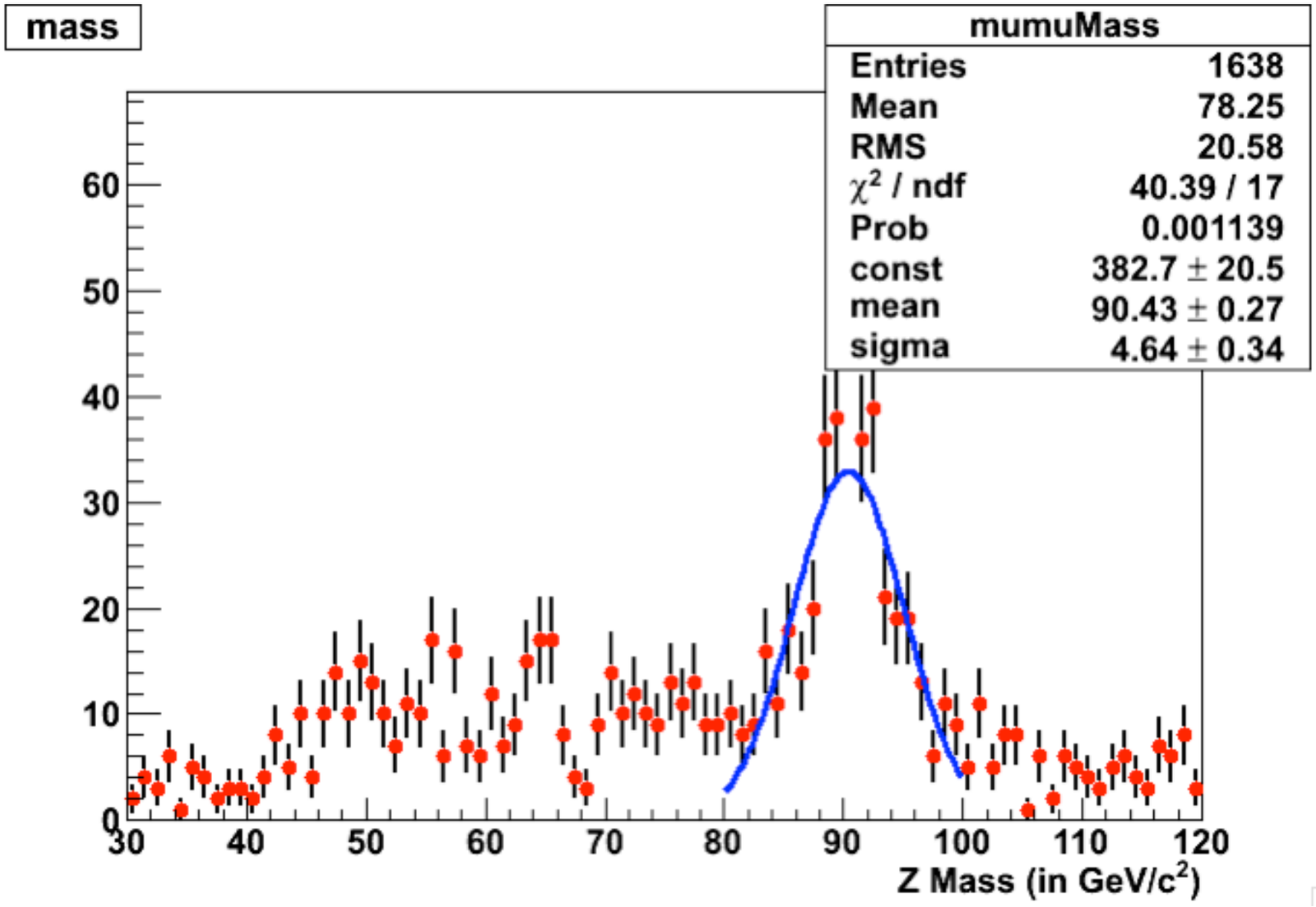


$$G(x;\mu,\sigma) = \frac{1}{\sqrt{2\pi}\sigma}\exp\left[-\frac{(x-\mu)^2}{2\sigma^2}\right]$$

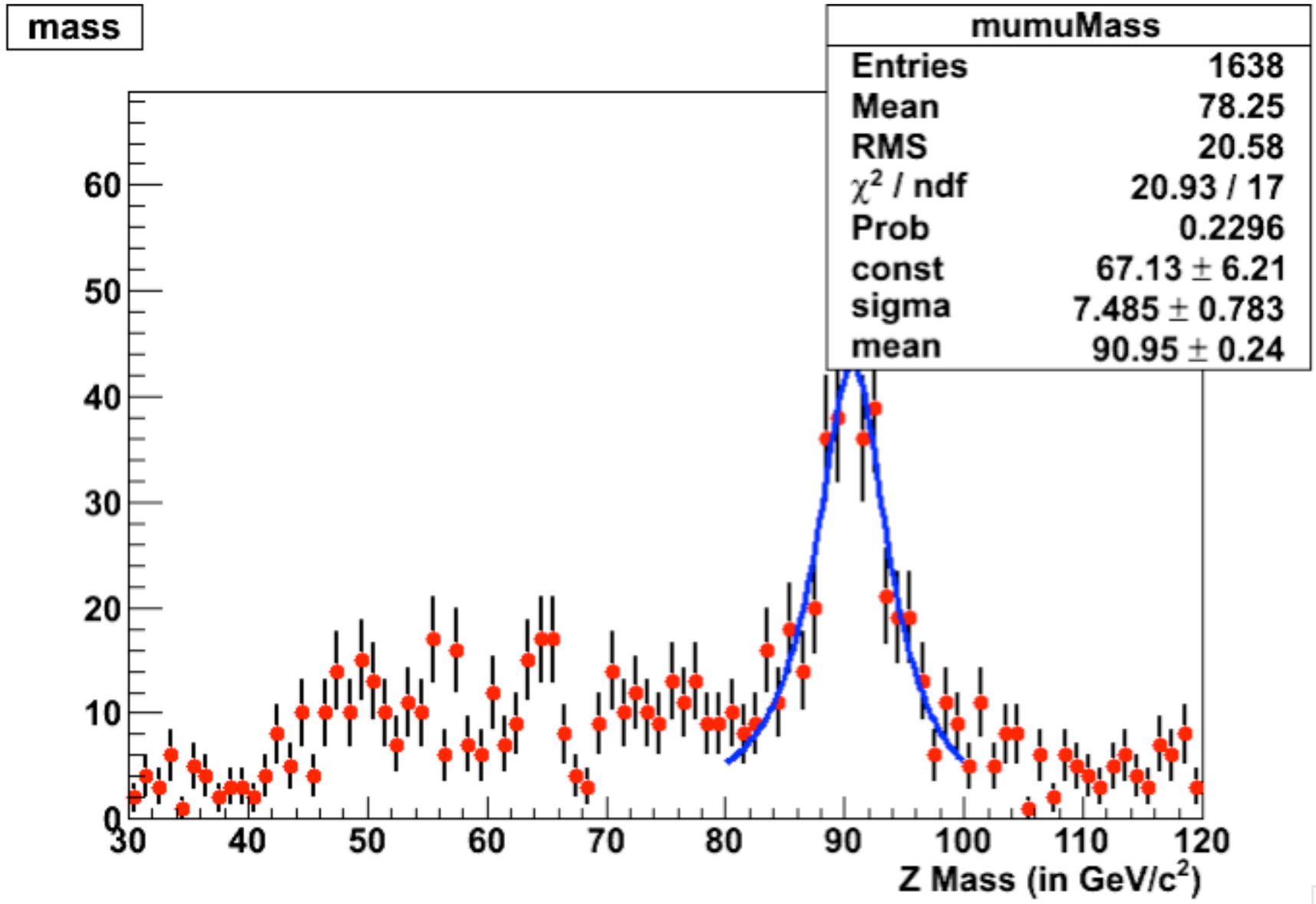
$$B(m;M,\Gamma) = N\cdot\frac{2}{\pi}\cdot\frac{\Gamma^2M^2}{(m^2-M^2)^2+m^4(\Gamma^2/M^2)}$$

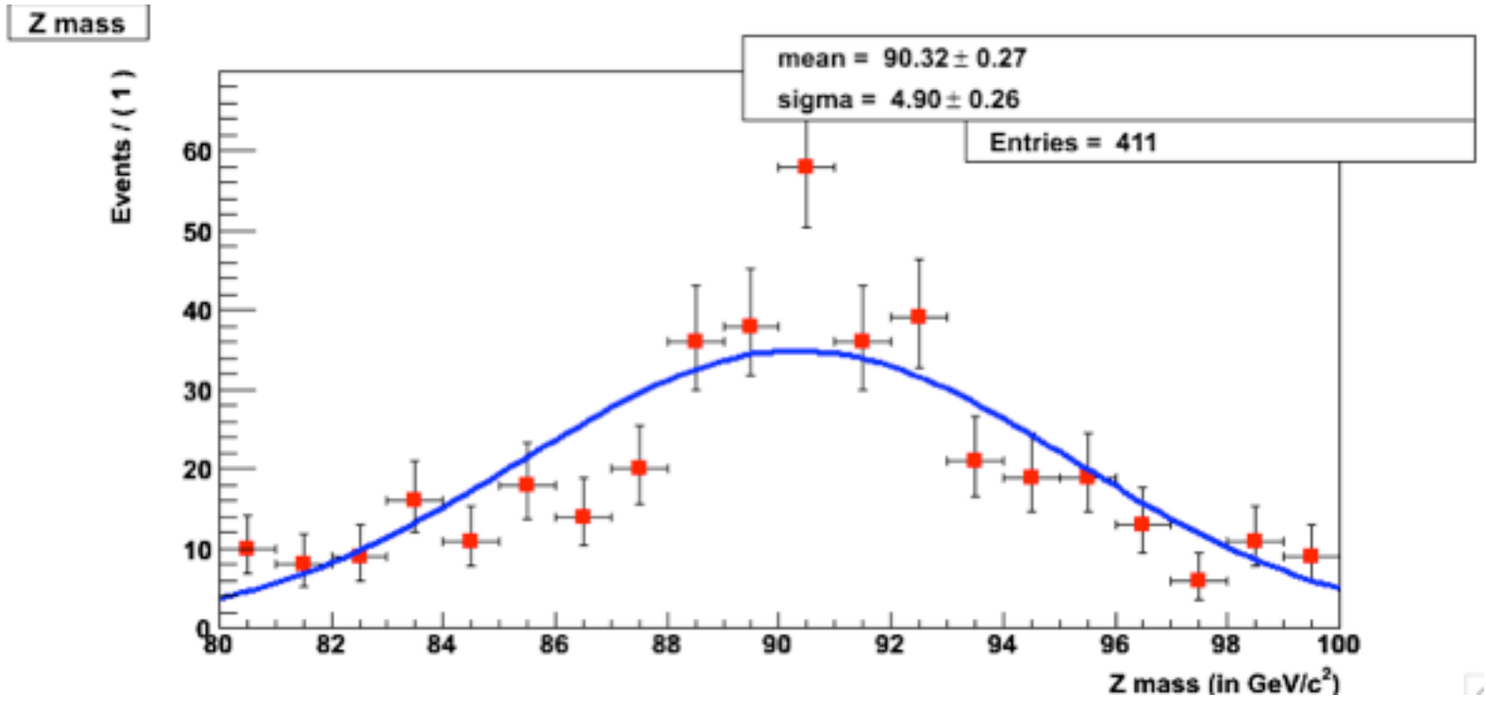
$$P(m) = \int B(m';M,\Gamma)\cdot G(m-m';\mu,\sigma)dm'$$

USING ROOT MACRO



USING ROOT B-W

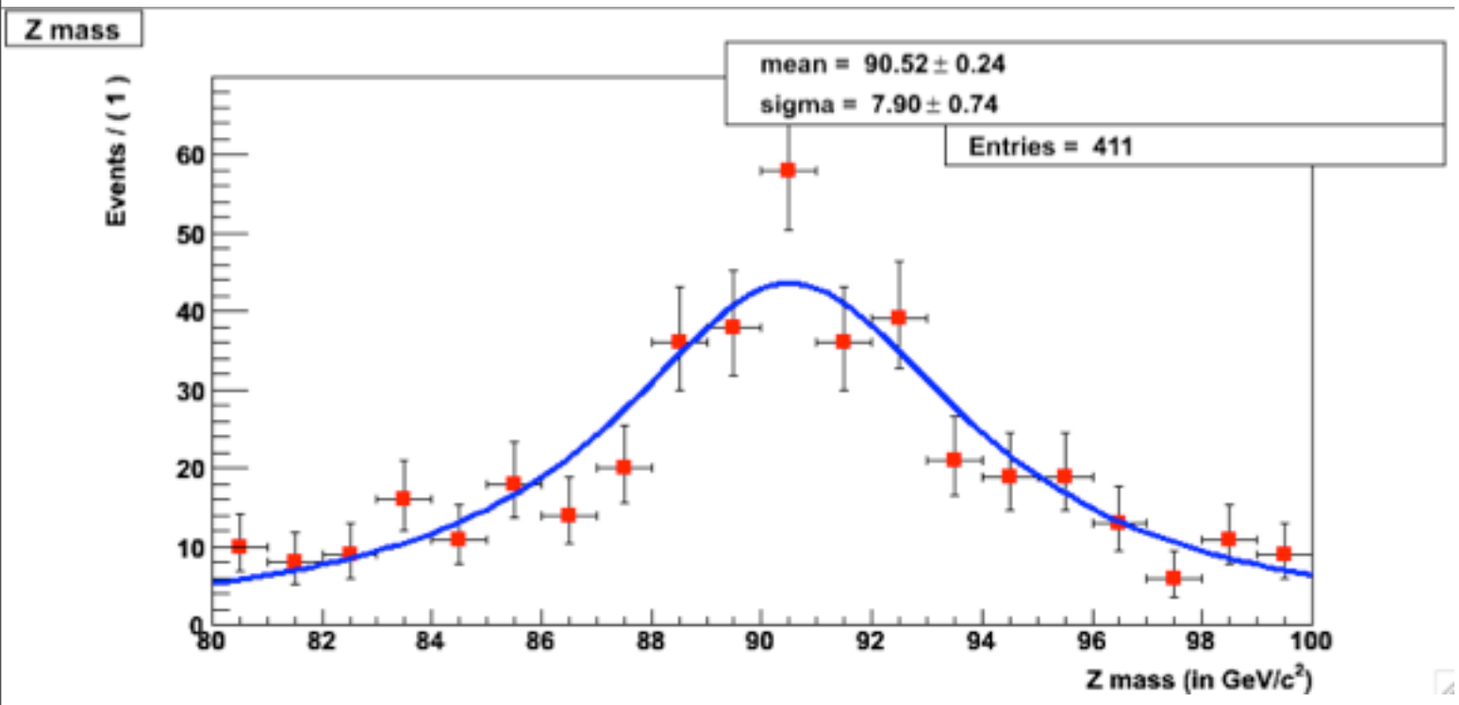




Gaussian Fit with RooFit

```
RooGaussian gauss("gauss","gauss",x,mean,sigma);
```

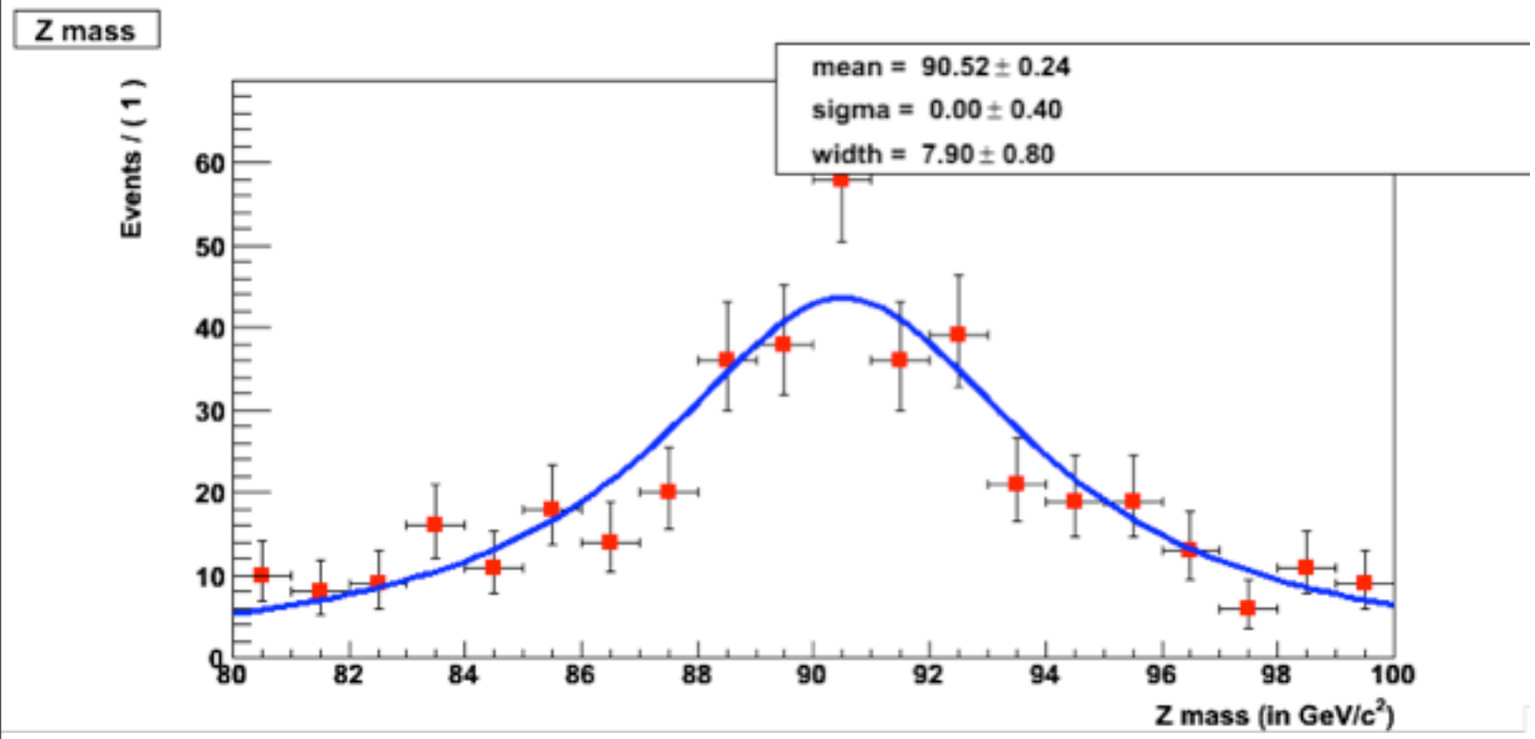
```
**********
**   13 **MIGRAD        1000           1
**********
FIRST CALL TO USER FUNCTION AT NEW START POINT, WITH IFLAG=4.
START MIGRAD MINIMIZATION.  STRATEGY  1.  CONVERGENCE WHEN EDM .LT. 1.00e-03
FCN=1308.04 FROM MIGRAD    STATUS=INITIATE        8 CALLS           9 TOTAL
                     EDM= unknown      STRATEGY= 1      NO ERROR MATRIX
 EXT PARAMETER                CURRENT GUESS       STEP         FIRST
 NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
  1  mean        9.50000e+01   5.00000e+00   2.01358e-01   1.36937e+03
  2  sigma       5.00000e+00   2.50000e+00   1.07837e-01  -1.89421e+03
                               ERR DEF= 0.5
MIGRAD MINIMIZATION HAS CONVERGED.
MIGRAD WILL VERIFY CONVERGENCE AND ERROR MATRIX.
COVARIANCE MATRIX CALCULATED SUCCESSFULLY
FCN=1175.2 FROM MIGRAD    STATUS=CONVERGED      58 CALLS          59 TOTAL
                     EDM=2.66329e-05    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                                   STEP         FIRST
 NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
  1  mean        9.03212e+01   2.72739e-01   2.61613e-04  -4.52202e-01
  2  sigma       4.89906e+00   2.60430e-01   2.57360e-04  -8.49778e-02
                               ERR DEF= 0.5
EXTERNAL ERROR MATRIX.    NDIM=  25    NPAR=  2    ERR DEF=0.5
 7.439e-02  4.114e-03
 4.114e-03  6.783e-02
PARAMETER  CORRELATION COEFFICIENTS
       NO.  GLOBAL      1      2
        1  0.05792   1.000  0.058
        2  0.05792   0.058  1.000
**********
**   18 **HESSE        1000
**********
COVARIANCE MATRIX CALCULATED SUCCESSFULLY
FCN=1175.2 FROM HESSE     STATUS=OK             10 CALLS          69 TOTAL
                     EDM=2.66134e-05    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                                INTERNAL      INTERNAL
 NO.   NAME      VALUE            ERROR       STEP SIZE       VALUE
  1  mean        9.03212e+01   2.72717e-01   5.23226e-05  -1.88261e-01
  2  sigma       4.89906e+00   2.60410e-01   5.14719e-05  -1.16389e+00
                               ERR DEF= 0.5
EXTERNAL ERROR MATRIX.    NDIM=  25    NPAR=  2    ERR DEF=0.5
 7.438e-02  4.017e-03
 4.017e-03  6.782e-02
PARAMETER  CORRELATION COEFFICIENTS
       NO.  GLOBAL      1      2
        1  0.05656   1.000  0.057
        2  0.05656   0.057  1.000
```



BreitWeigner with RooFit

```
RooGaussian gauss("gauss","gauss",x,mean,sigma);
```

```
*********
**   13 **MIGRAD        1000           1
*********
FIRST CALL TO USER FUNCTION AT NEW START POINT, WITH IFLAG=4.
START MIGRAD MINIMIZATION.  STRATEGY  1.  CONVERGENCE WHEN EDM .LT. 1.00e-03
FCN=1391.56 FROM MIGRAD    STATUS=INITIATE       8 CALLS           9 TOTAL
                     EDM= unknown      STRATEGY= 1      NO ERROR MATRIX
 EXT PARAMETER                CURRENT GUESS       STEP         FIRST
 NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
  1  mean         9.50000e+01   5.00000e+00   2.01358e-01   1.79486e+03
  2  sigma        5.00000e+00   2.50000e+00   1.07837e-01  -1.13294e+03
                               ERR DEF= 0.5
MINUIT WARNING IN MIGRAD
============== Negative diagonal element 2 in Error Matrix
MINUIT WARNING IN MIGRAD
============== 1.00475 added to diagonal of error matrix
MIGRAD MINIMIZATION HAS CONVERGED.
MIGRAD WILL VERIFY CONVERGENCE AND ERROR MATRIX.
COVARIANCE MATRIX CALCULATED SUCCESSFULLY
FCN=1164.95 FROM MIGRAD    STATUS=CONVERGED     161 CALLS         162 TOTAL
                     EDM=1.0028e-06    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                                   STEP         FIRST
 NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
  1  mean         9.05183e+01   2.44026e-01   2.34087e-04  -8.92570e-02
  2  sigma        7.90436e+00   7.37400e-01   5.85017e-04   1.87492e-02
                               ERR DEF= 0.5
EXTERNAL ERROR MATRIX.    NDIM=  25    NPAR=  2    ERR DEF=0.5
 5.955e-02 -5.989e-04
-5.989e-04  5.439e-01
PARAMETER  CORRELATION COEFFICIENTS
       NO.  GLOBAL      1      2
        1  0.00333   1.000 -0.003
        2  0.00333  -0.003  1.000
*********
**   18 **HESSE        1000
*********
COVARIANCE MATRIX CALCULATED SUCCESSFULLY
FCN=1164.95 FROM HESSE     STATUS=OK             10 CALLS         172 TOTAL
                     EDM=1.00092e-06    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                                INTERNAL      INTERNAL
 NO.   NAME      VALUE            ERROR       STEP SIZE       VALUE
  1  mean         9.05183e+01   2.44025e-01   4.68173e-05  -2.96135e+00
  2  sigma        7.90436e+00   7.37398e-01   1.17003e-04   4.19328e+00
                               ERR DEF= 0.5
EXTERNAL ERROR MATRIX.    NDIM=  25    NPAR=  2    ERR DEF=0.5
 5.955e-02 -3.794e-04
-3.794e-04  5.439e-01
PARAMETER  CORRELATION COEFFICIENTS
       NO.  GLOBAL      1      2
        1  0.00211   1.000 -0.002
        2  0.00211  -0.002  1.000
```



Convolution of BW with Gaussian

RooVoigtian gauss("gauss","gauss",x,mean,width,sigma);

```
**********
**   13 **MIGRAD        1500           1
**********
FIRST CALL TO USER FUNCTION AT NEW START POINT, WITH IFLAG=4.
START MIGRAD MINIMIZATION.  STRATEGY  1.  CONVERGENCE WHEN EDM .LT. 1.00e-03
FCN=1239.17 FROM MIGRAD    STATUS=INITIATE       12 CALLS          13 TOTAL
                     EDM= unknown      STRATEGY= 1      NO ERROR MATRIX
 EXT PARAMETER                CURRENT GUESS       STEP         FIRST
 NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
  1  mean         9.50000e+01   5.00000e+00   2.01358e-01   5.75079e+02
  2  sigma        5.00000e+00   2.50000e+00   1.07837e-01  -4.11463e+02
  3  width        5.00000e+00   2.50000e+00   1.07837e-01  -1.41553e+02
                               ERR DEF= 0.5
MIGRAD MINIMIZATION HAS CONVERGED.
MIGRAD WILL VERIFY CONVERGENCE AND ERROR MATRIX.
COVARIANCE MATRIX CALCULATED SUCCESSFULLY
FCN=1164.95 FROM MIGRAD    STATUS=CONVERGED     216 CALLS         217 TOTAL
                     EDM=2.89024e-05    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                                   STEP         FIRST
 NO.   NAME      VALUE            ERROR          SIZE      DERIVATIVE
  1  mean         9.05173e+01   2.44021e-01   2.33864e-04  -3.46957e-01
  2  sigma        4.36424e-03   1.45820e+01   1.87227e-02   5.67886e-03
  3  width        7.90413e+00   7.37410e-01   5.83917e-04  -3.15045e-02
                               ERR DEF= 0.5
EXTERNAL ERROR MATRIX.    NDIM=  25    NPAR=  3    ERR DEF=0.5
 5.955e-02 -6.157e-05 -1.468e-04
-6.157e-05  2.656e-01 -4.651e-03
-1.468e-04 -4.651e-03  5.439e-01
PARAMETER  CORRELATION COEFFICIENTS
       NO. GLOBAL      1      2      3
        1  0.00096   1.000 -0.000 -0.001
        2  0.01225  -0.000  1.000 -0.012
        3  0.01226  -0.001 -0.012  1.000
**********
**   18 **HESSE        1500
**********
COVARIANCE MATRIX CALCULATED SUCCESSFULLY
FCN=1164.95 FROM HESSE     STATUS=OK             26 CALLS         243 TOTAL
                     EDM=1.3642e-05    STRATEGY= 1      ERROR MATRIX ACCURATE
 EXT PARAMETER                                INTERNAL      INTERNAL
 NO.   NAME      VALUE            ERROR       STEP SIZE       VALUE
  1  mean         9.05173e+01   2.44159e-01   4.67728e-05  -1.80285e-01
  2  sigma        4.36424e-03   3.98878e-01   2.24037e-01  -1.55873e+00
  3  width        7.90413e+00   7.98410e-01   1.16783e-04  -1.05169e+00
                               ERR DEF= 0.5
EXTERNAL ERROR MATRIX.    NDIM=  25    NPAR=  3    ERR DEF=0.5
 5.962e-02 -6.862e-04  2.151e-03
-6.862e-04  6.971e-03 -2.557e-02
 2.151e-03 -2.557e-02  6.376e-01
PARAMETER  CORRELATION COEFFICIENTS
       NO. GLOBAL      1      2      3
        1  0.03372   1.000 -0.034  0.011
        2  0.38469  -0.034  1.000 -0.384
        3  0.38357   0.011 -0.384  1.000
```

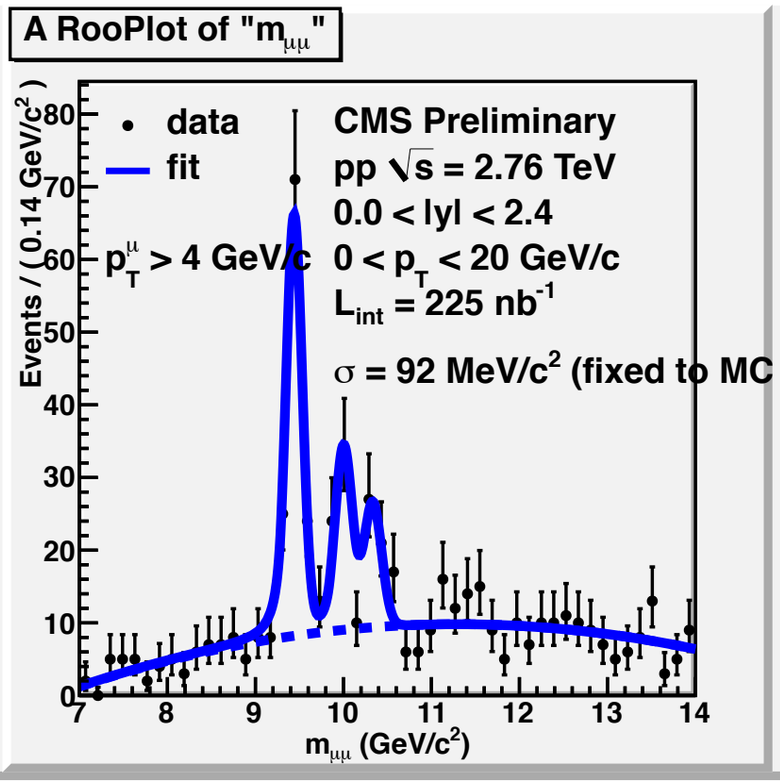
TO DO LIST

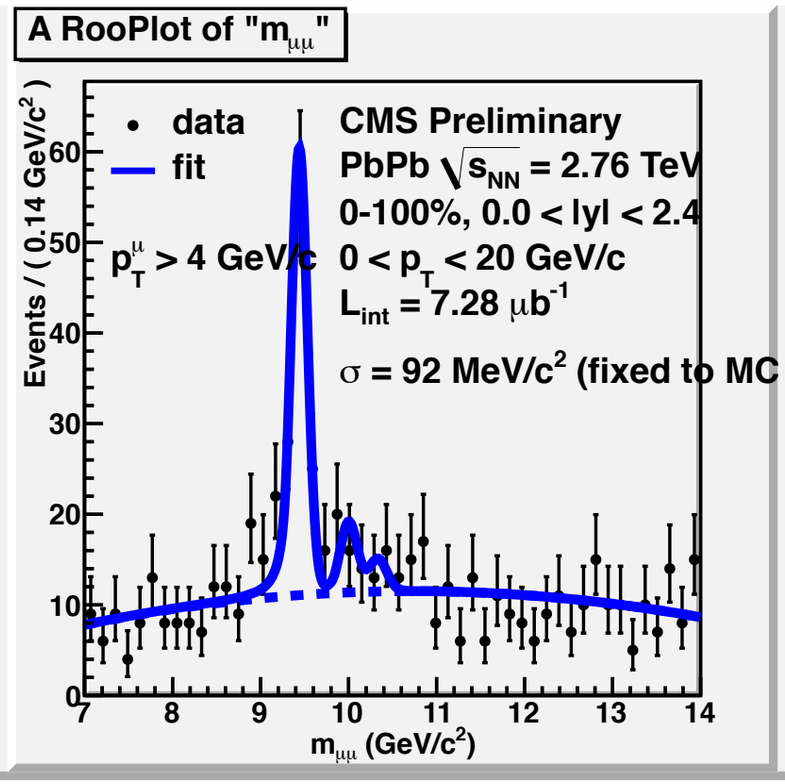
Everybody should think about the steps necessary for the analysis they want to do

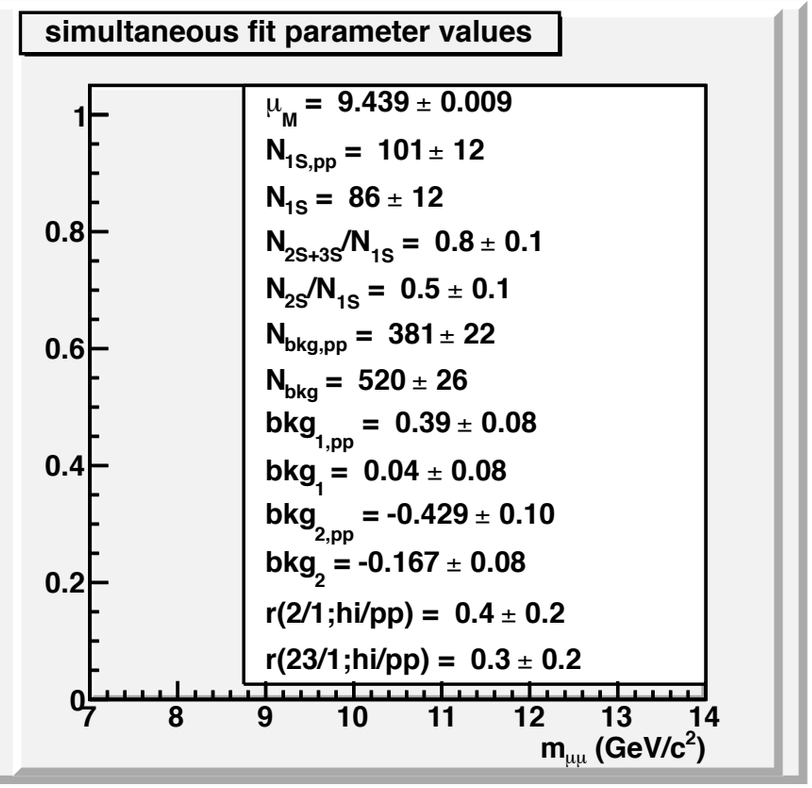
- Present a plan at the next meeting (1 slide). Next Wednesday.
  - also emphasize were you have already experience and where you would like to contribute in particular
- It's perfectly okay if several people present plans on the same topic
  - we'll work as a team, but in order for people to take more responsibilities everybody needs to be aware of what needs to be done to get from a RECO file to the final result

- Need to investigate how much MC statistics we need
  - how many more bins can we make with 10x the statistics in data?
  - what's the MC statistics in these bins?
- e.g. let's check MC statistics in the current J/psi centrality bins but split in 6.5-10 GeV and 10-30 GeV
- or, Y(1S) binned like J/psi this year
- Test your code in CMSSW 440
  - make sure it's in CVS and well documented (inside the code, but also on a twiki)

CMSSW_4_4_0


A RooPlot of "m_μμ"
data
fit
CMS Preliminary
pp √s = 2.76 TeV
0.0 < |y| < 2.4
p_T^μ > 4 GeV/c
0 < p_T < 20 GeV/c
L_int = 225 nb^-1
σ = 92 MeV/c^2 (fixed to MC
Events / (0.14 GeV/c^2)
m_μμ (GeV/c^2)


A RooPlot of "m_μμ"
data
fit
CMS Preliminary
PbPb √s_NN = 2.76 TeV
0-100%, 0.0 < |y| < 2.4
p_T^μ > 4 GeV/c
0 < p_T < 20 GeV/c
L_int = 7.28 μb^-1
σ = 92 MeV/c^2 (fixed to MC
Events / (0.14 GeV/c^2)
m_μμ (GeV/c^2)


simultaneous fit parameter values
μ_M = 9.439 ± 0.009
N_1S,pp = 101 ± 12
N_1S = 86 ± 12
N_2S+3S/N_1S = 0.8 ± 0.1
N_2S/N_1S = 0.5 ± 0.1
N_bkg,pp = 381 ± 22
N_bkg = 520 ± 26
bkg_1,pp = 0.39 ± 0.08
bkg_1 = 0.04 ± 0.08
bkg_2,pp = -0.429 ± 0.10
bkg_2 = -0.167 ± 0.08
r(2/1;hi/pp) = 0.4 ± 0.2
r(23/1;hi/pp) = 0.3 ± 0.2
m_μμ (GeV/c^2)