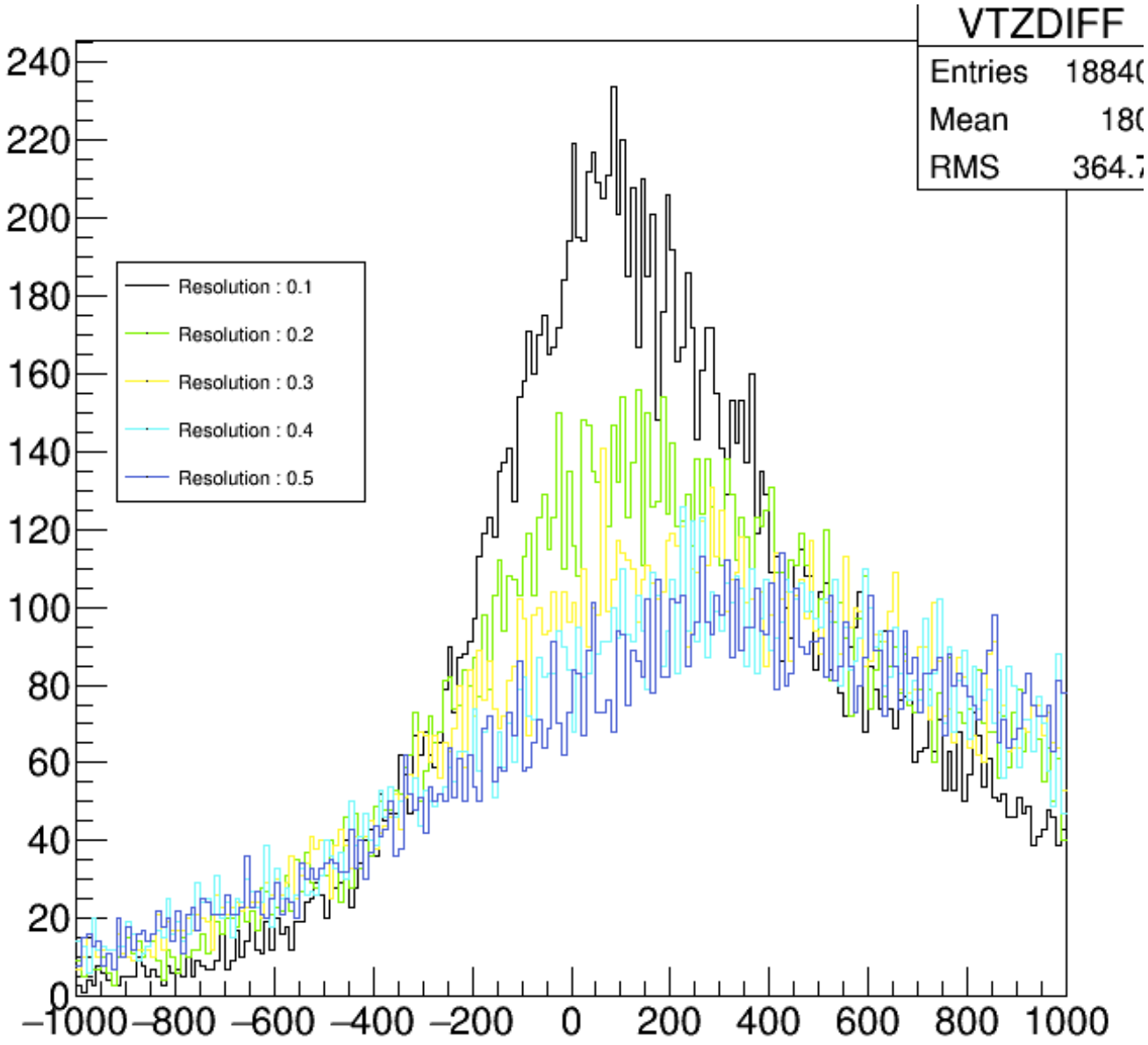
Report_161122

Add resolution on MC True



CsI Time Resolution

- 0.599 +/- 0.015 ns at MIP(~20MeV)
  - https://hep.uchicago.edu/cpv/Emily%20Casey%202012%20Senior%20ThesisV6.pdf
- In MC,

$$\sigma_{CsI} = \sqrt{\left(\frac{2C_0}{E_{CsI}}\right)^2 + \left(\frac{C_1}{\sqrt{E_{CsI}}}\right)^2} \quad [ns]$$

$C_1 = 5.00$

$C_2 = 3.63$

20MeV -> 0.95[ns]
100MeV ->0.38[ns]
1GeV -> 0.12[ns]

```
float MTConvertCSI::GetSmearedTime( float e, float t ) const
{
  return t + gRandom->Gaus( 0, sqrt( pow((float)MTBP::CSITimeResolutionCoeff[0]*2/e, 2) + pow((float)MTBP::CSITimeResolutionCoeff[1]/sqrt(e), 2)/* + pow(0.07791,2)*/ ) );
}

const double CSITimeDelayCoeff[3] = { 0.067843, -13.25397E-4, 15.91791E-7}; // pol2 coeff. over 400MeV.
const double CSITimeResolutionCoeff[3] = { 5.00, 3.63318, 0.13}; // Iwai-san's result
//const double CSITimeResolutionCoeff[3] = { 10.13, 3.412, 0.07791}; // sigma_t [ns] = 10.13/E[MeV] (+) 3.412/sqrt(E) (+) 0.07791
```

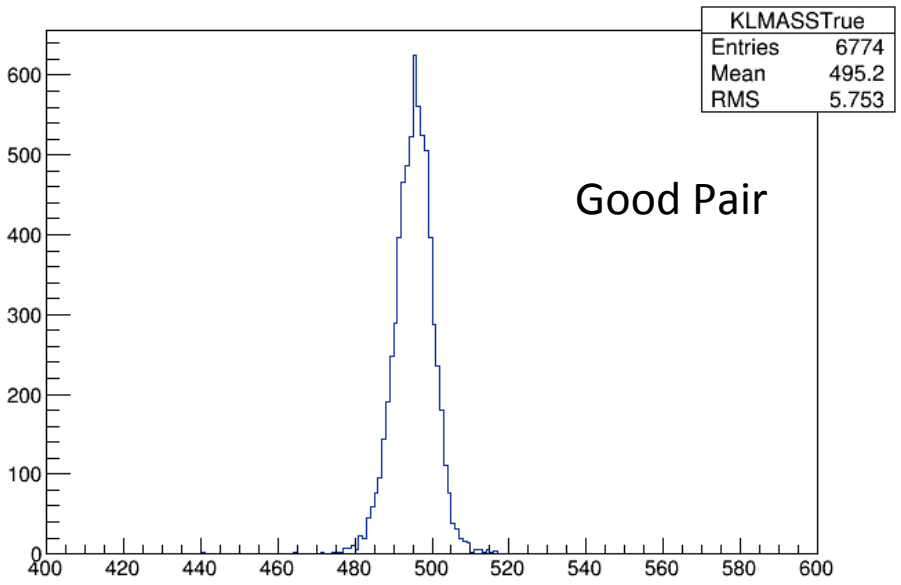
Cut list of 5g+1g

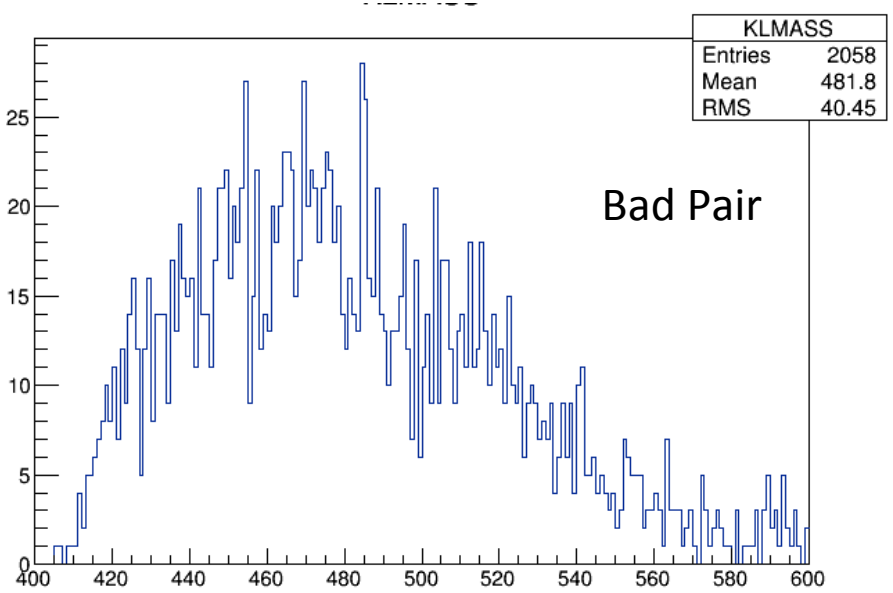
Cut Variables	Selected region
Klong Vertex	2500<VTZ<5000 [mm]
Gamma Energys on CSI	100<e<2000 [MeV]
Distances btw gammas	D>175 [mm]
Fiducial distance	150<r<900[mm]
Chi2_1st	Chi2<4
Chi2_2nd	Chi2>10
Klong Pt	Pt<40[MeV/c]
Shape Chi2	Chi2<10
Pi0mass cut	Abs(mass-134.97)<5
MassCombinationCut	Later

New cut

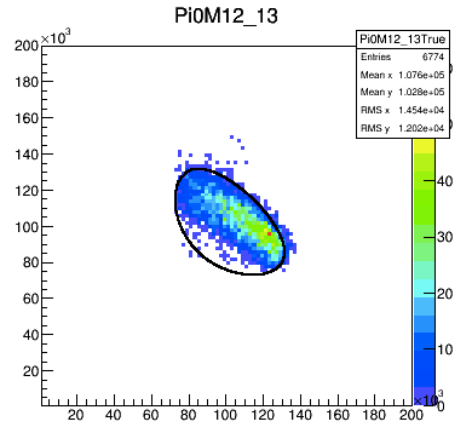
5g+1g status

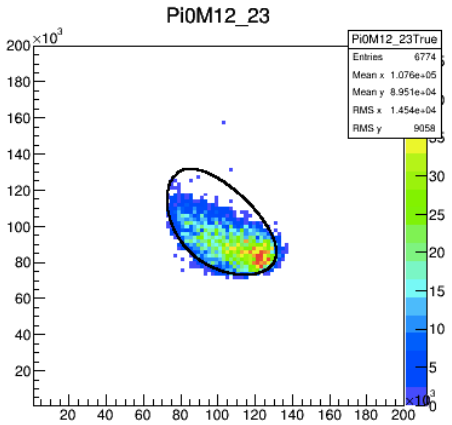
- After applying Kinematical cut,
  - Probability of bad-pair is ~0.22
  - 99% of bad-pair is induced by 5th gamma

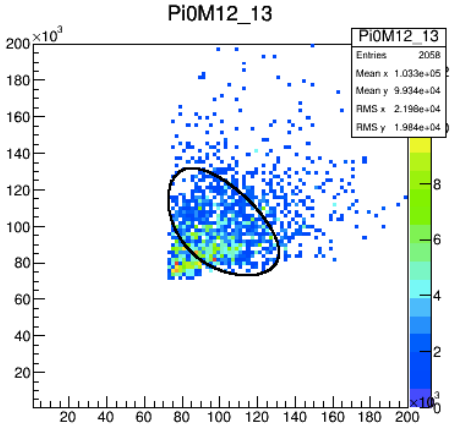


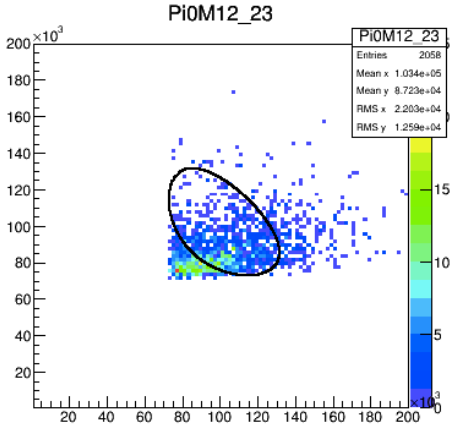


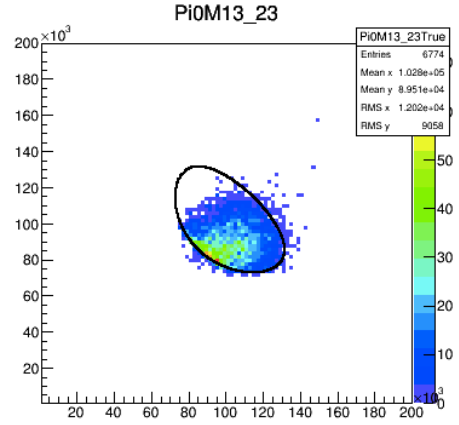
Dalitz plots



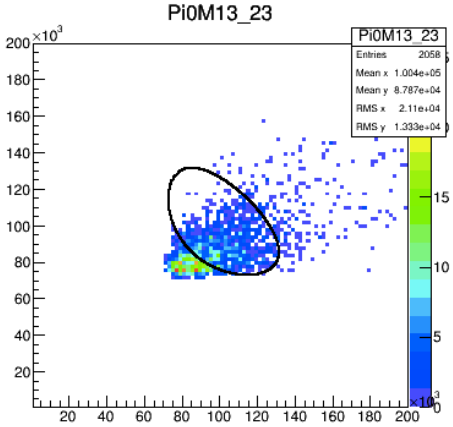






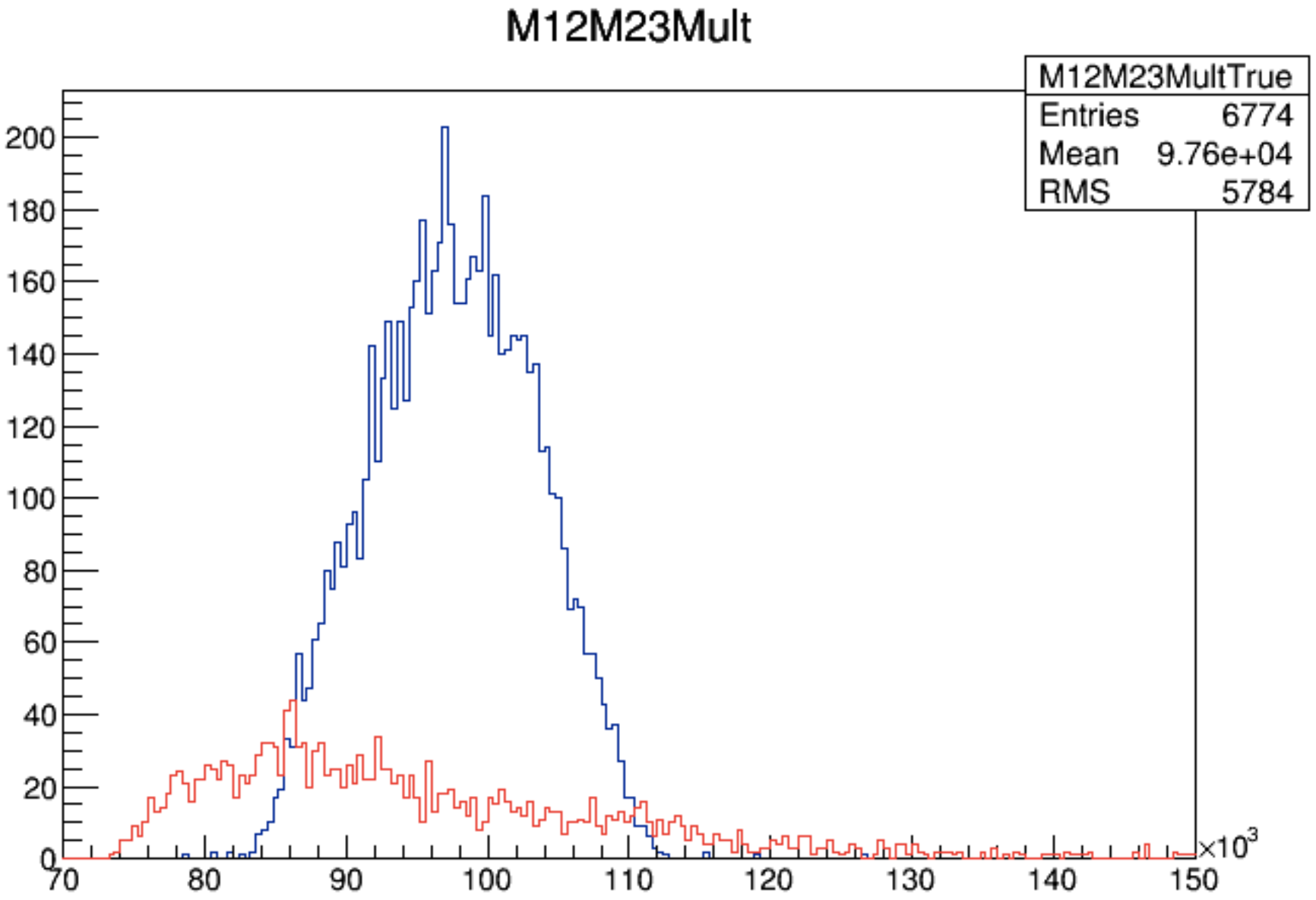


Good pair

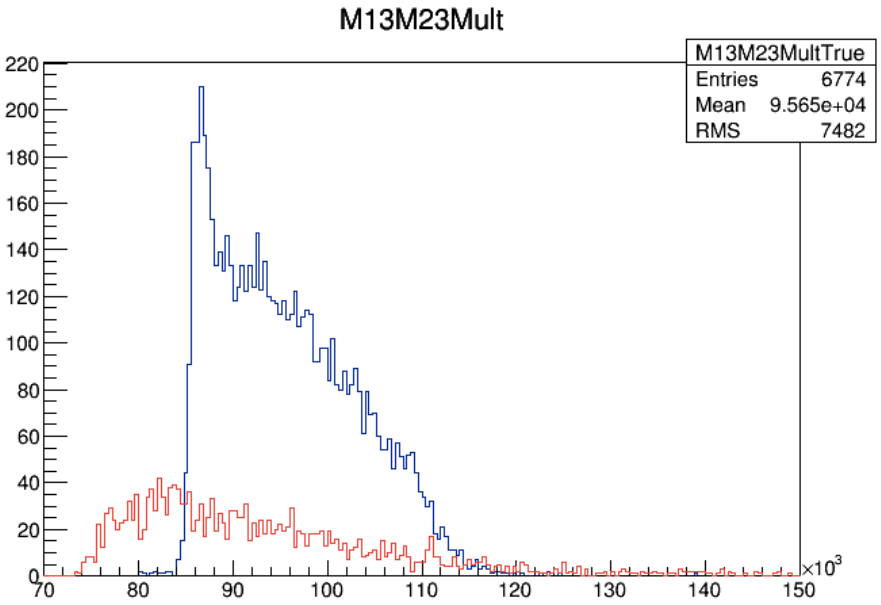


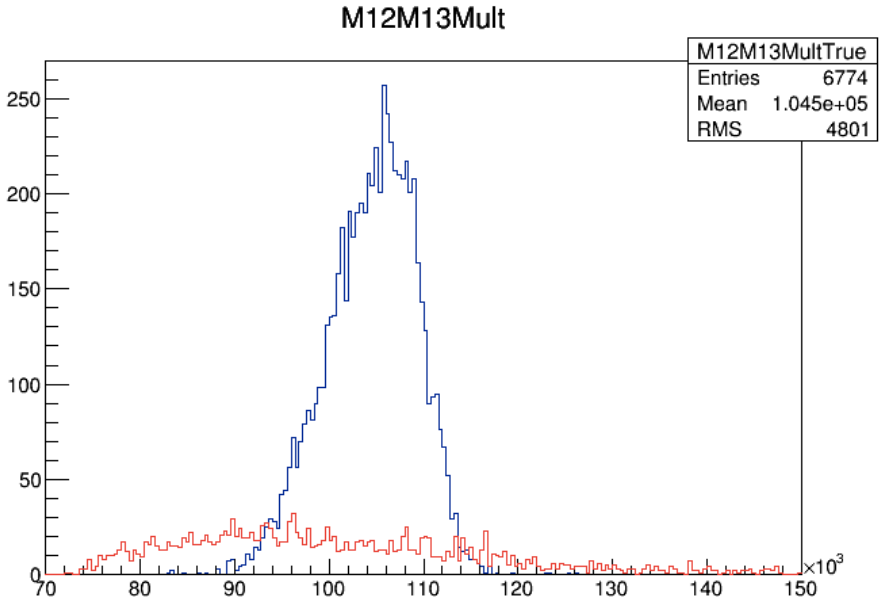
Bad pair

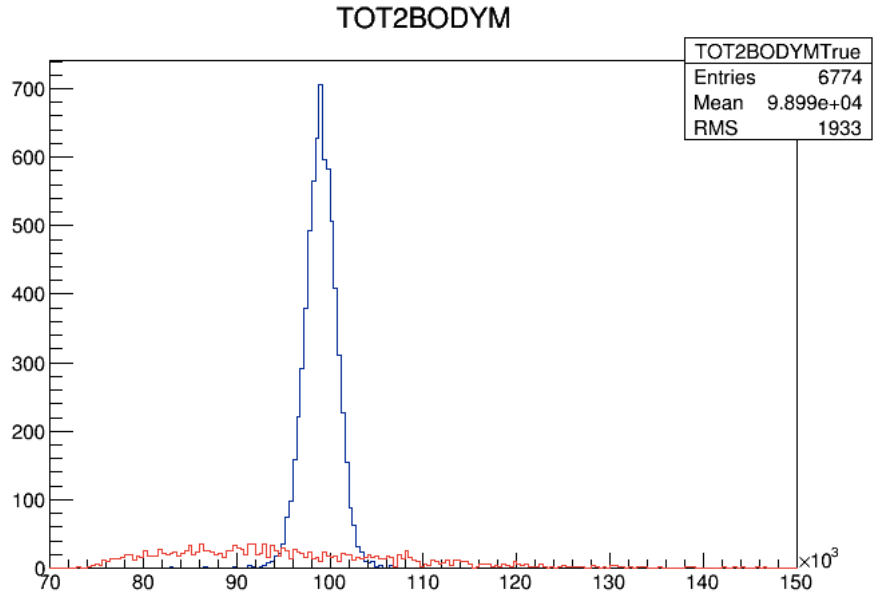
M12 by M23


M12M23Mult
M12M23MultTrue
Entries 6774
Mean 9.76e+04
RMS 5784
200
180
160
140
120
100
80
60
40
20
0
70
80
90
100
110
120
130
140
150
×10^3

Other combinations







Selected region

$$84 < \sqrt{M_{12}^2 M_3^2} < 112$$

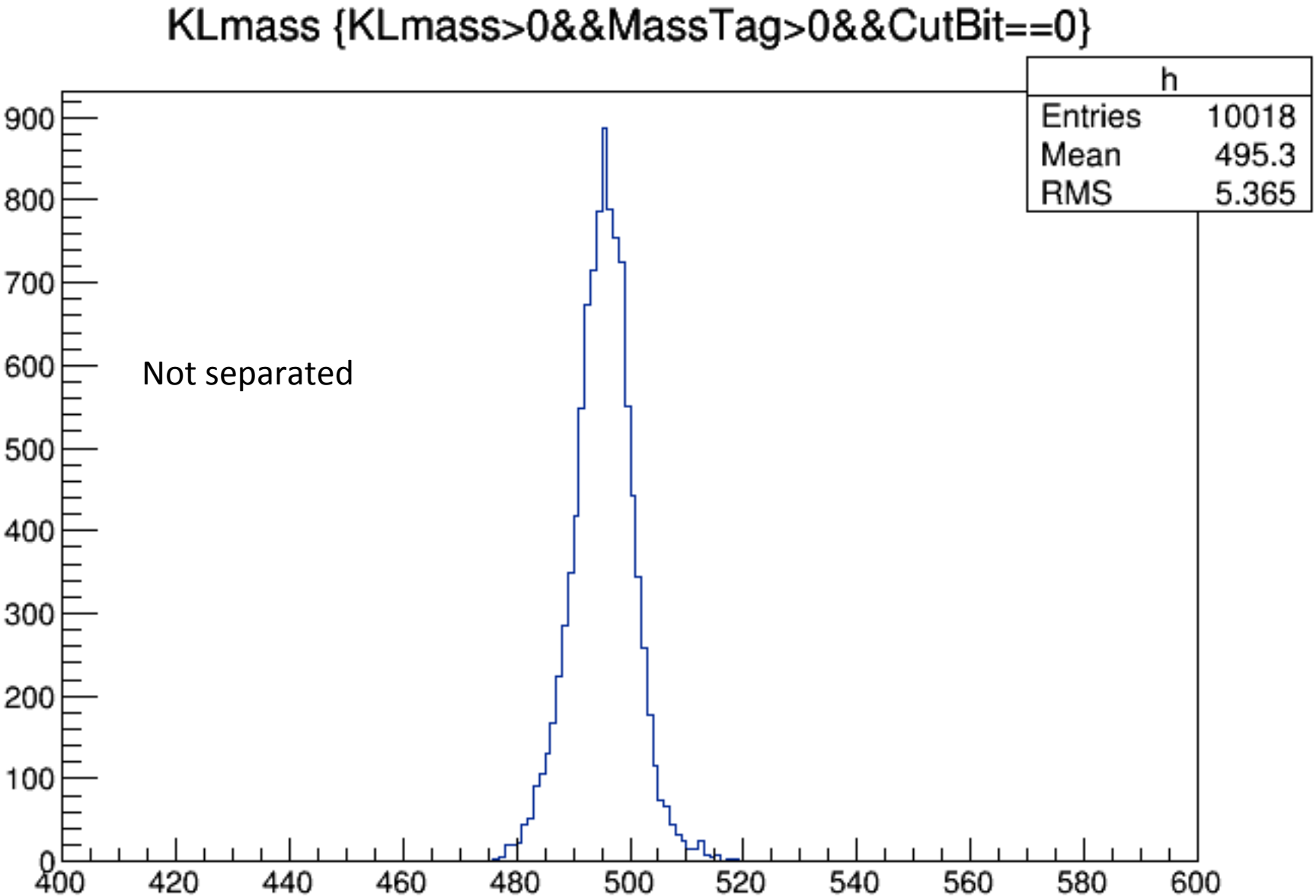
$$90 < \sqrt{M_{12}^2 M_{13}^2} < 116$$

X1000

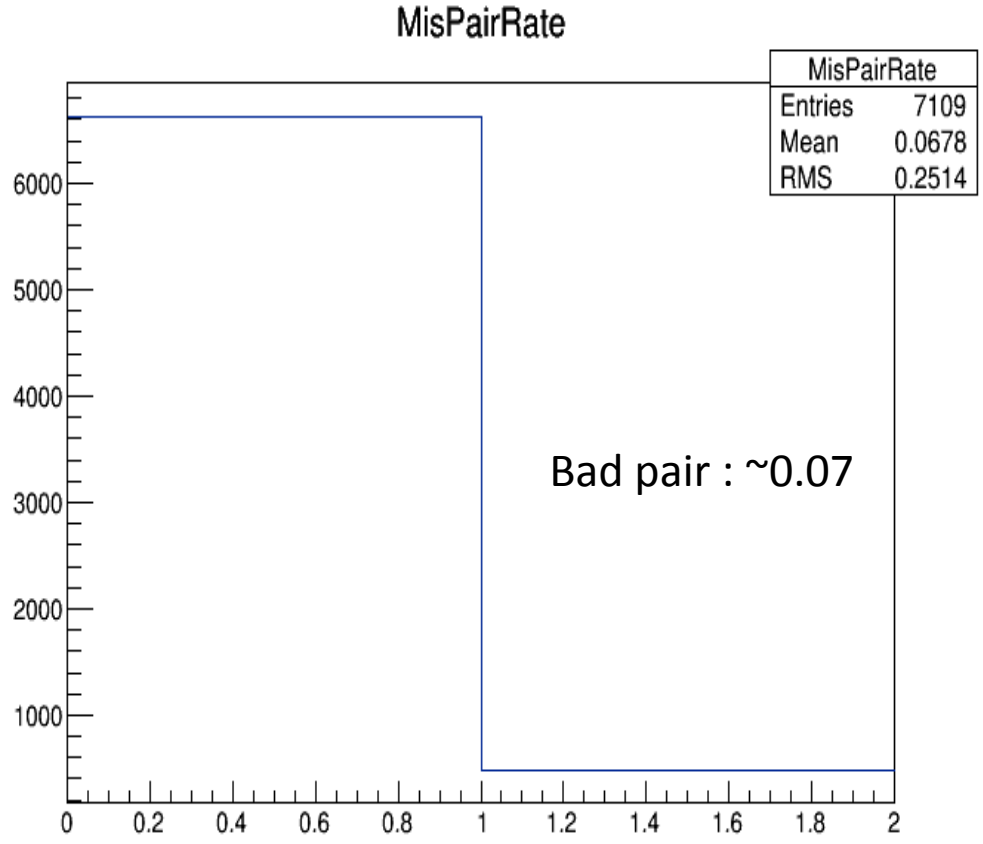
$$84 < \sqrt{M_{13}^2 M_{23}^2} < 114$$

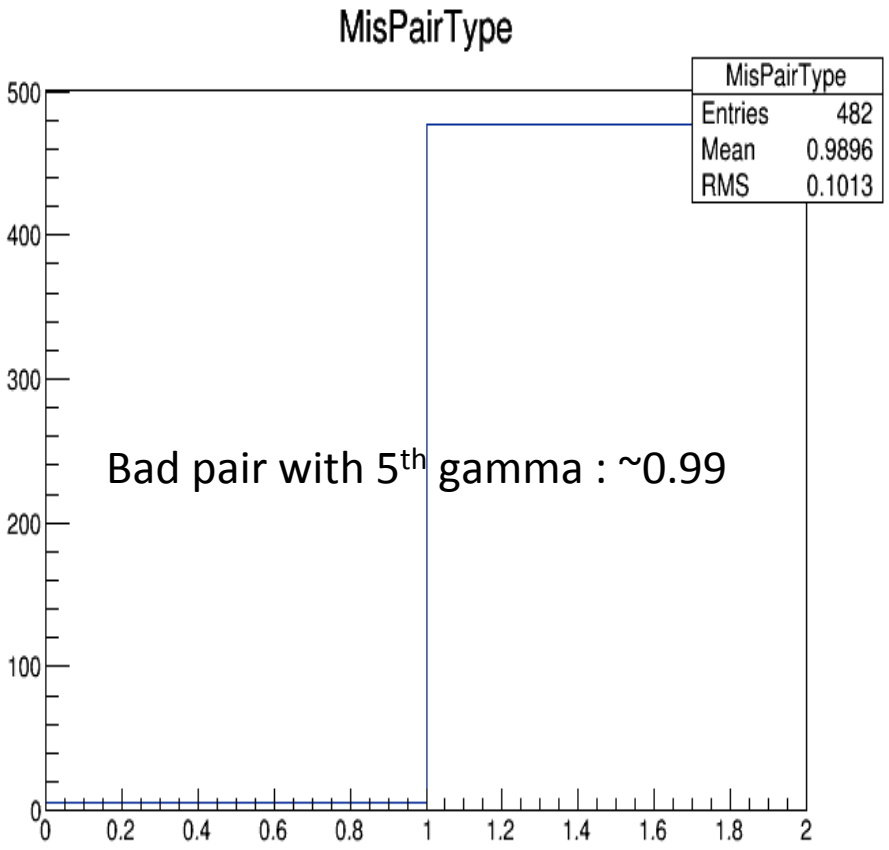
$$94 < \sqrt[3]{M_{12}^2 M_{13}^2 M_{23}^2} < 106$$

After Adding Mass Combination cut

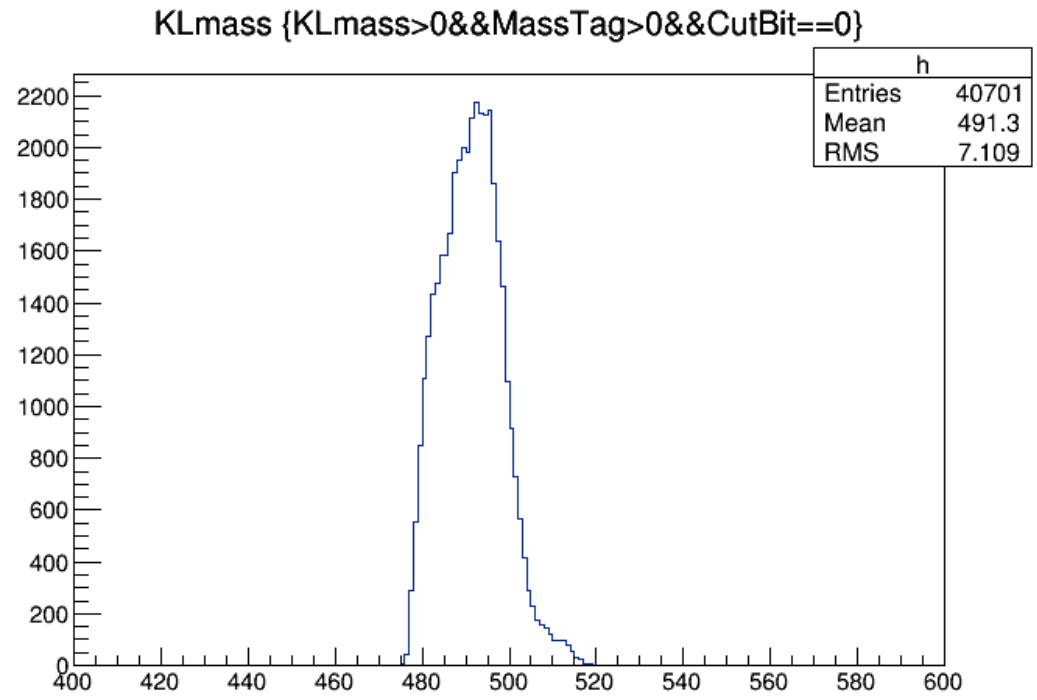


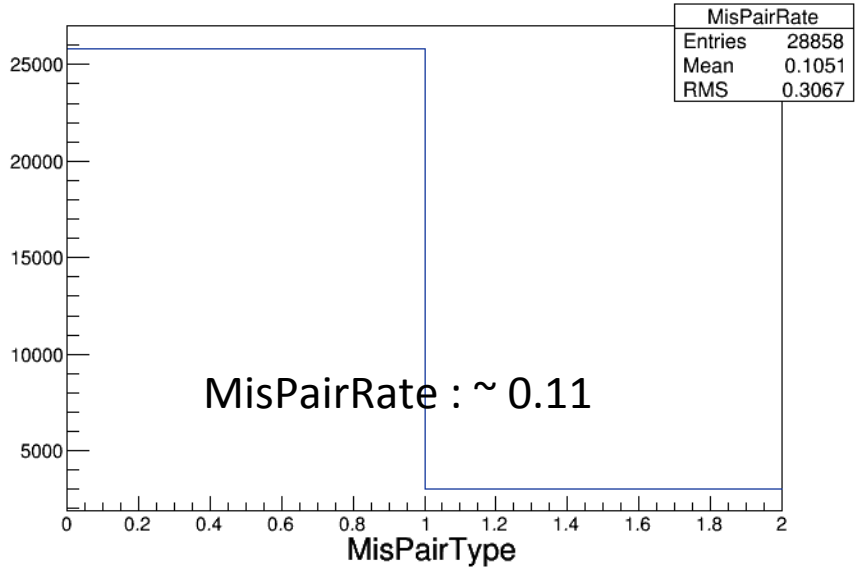
MisPairRate, type

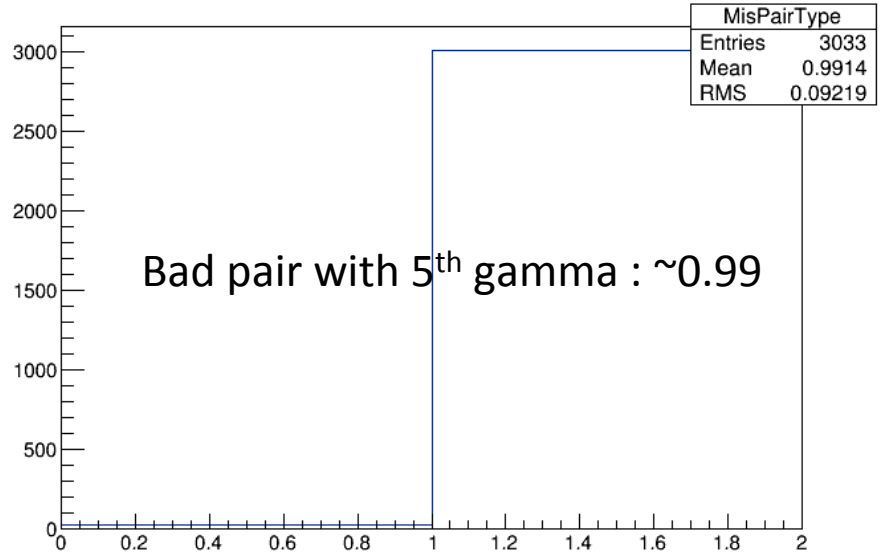




After Deleting KlongPt cut,

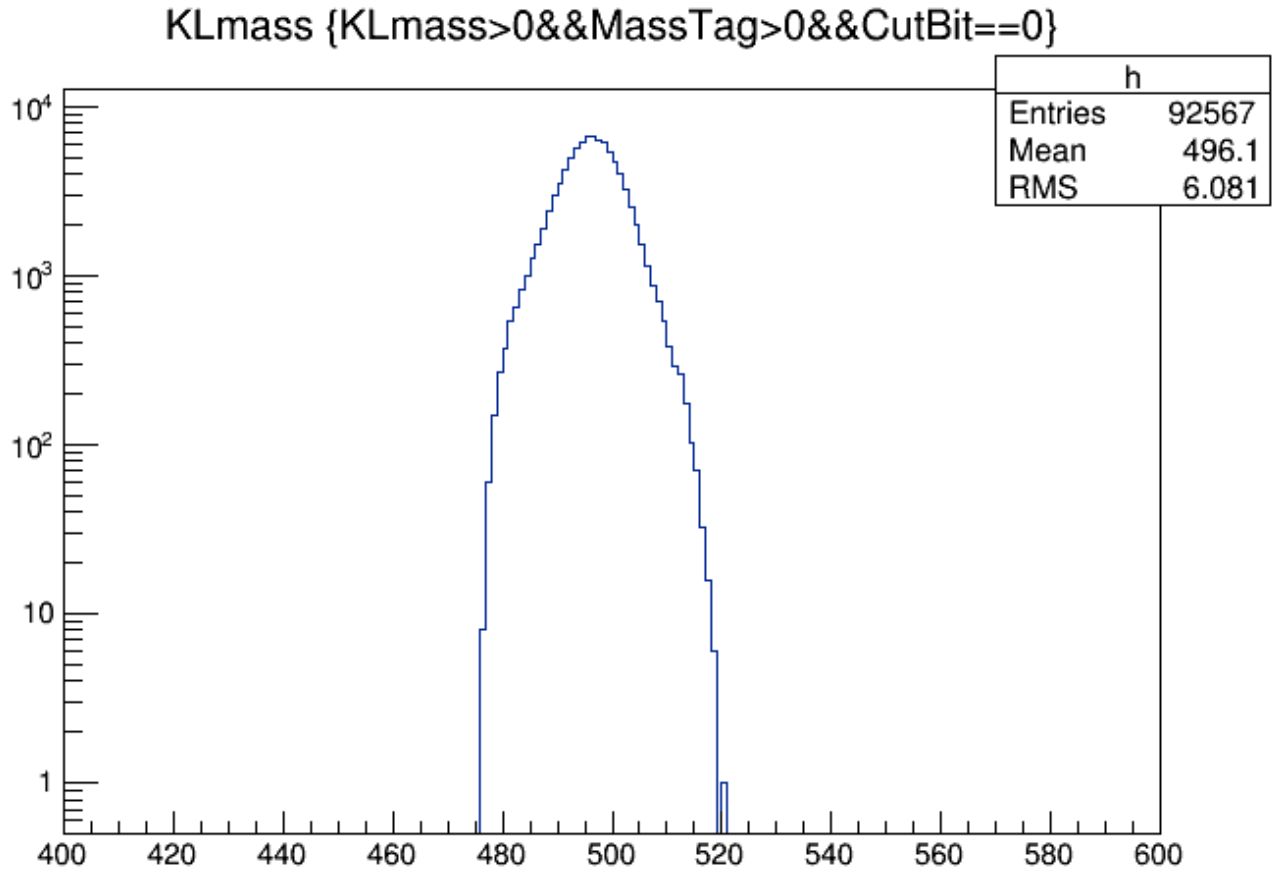




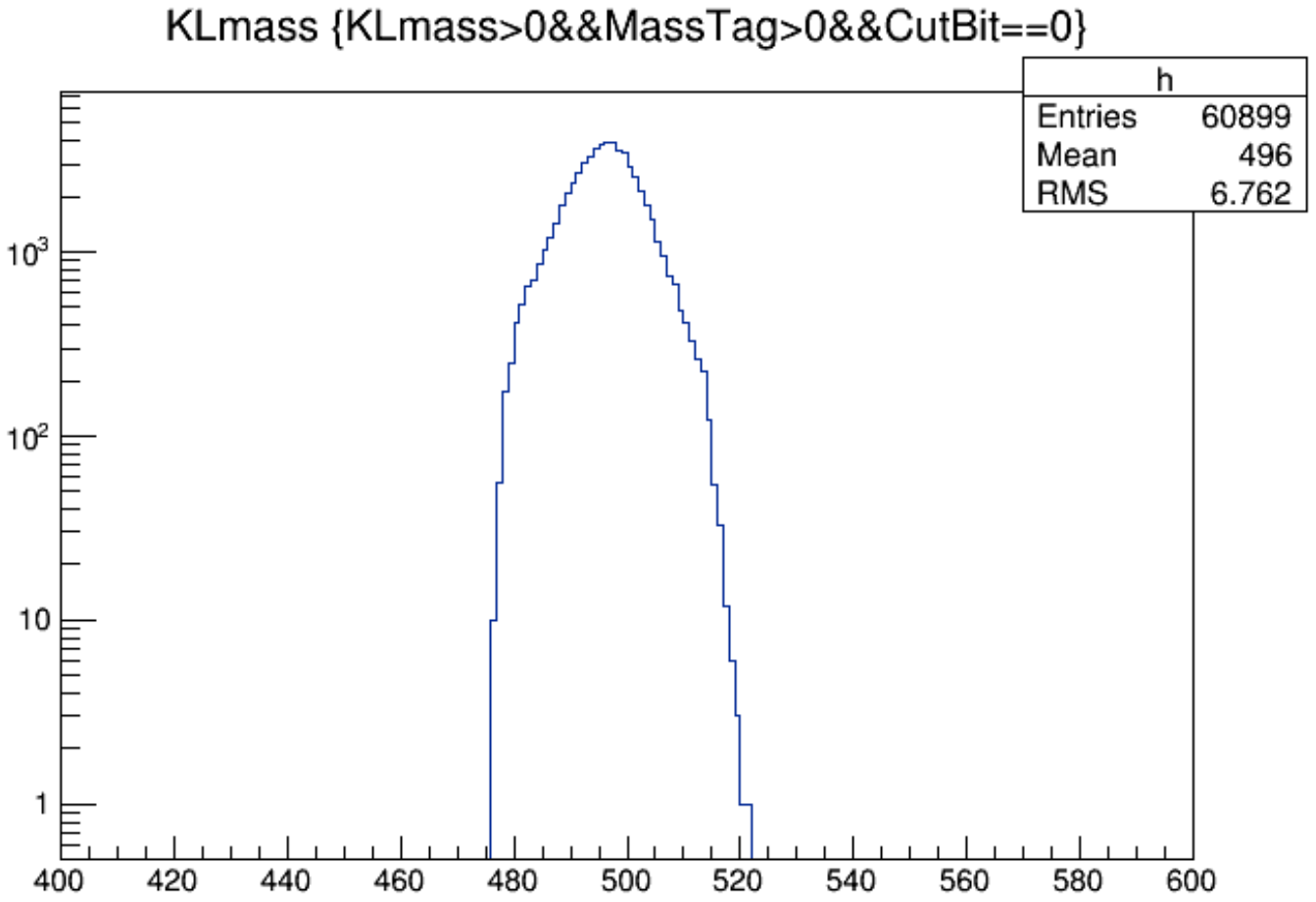


Klong Pt cut can reject
Events which have mis-reconstructed vertex. (?)

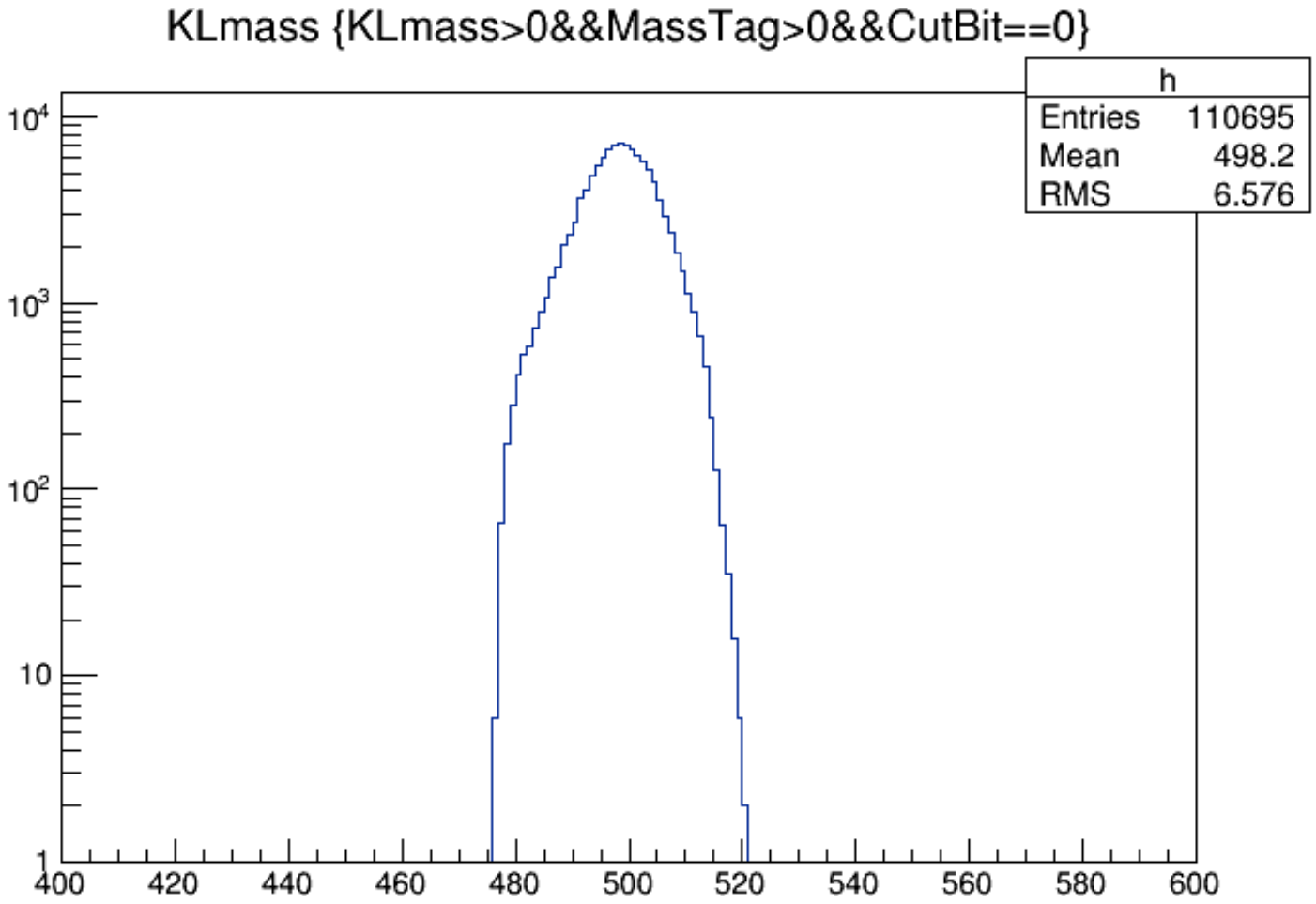
Data with new kinematical cut Run62



Data with new kinematical cut Run69 MB



Data with new kinematical cut Run69 IB



summary

- Timing resolution affects determination of vertex
- 22%->7% reduction of bad pair.
  - More study?
    - Other parameter?
  - Graphical cut