Setting Limits for the 2016 Vertexing Analysis

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Introduction

- In this talk
  - Tail Fits on 10% data, ⅔ * 100% tritrig-wab-beam, and x3 tritrig samples
  - Mass resolution
  - ZCuts
  - A’ Acceptances*efficiency
  - Radiative fraction
  - Signal yield L1L1 and L1L2
  - Limits for L1L1 and L1L2 on 10% of the data
  - Another method for determining zcut (discussed yesterday)
  - Discussion of setting limits and combining datasets

Fitting Tails

- I use the same function from 2015 analysis

$$F\left(\frac{z - z_{mean}}{\sigma_z} < b\right) = Ae^{-\frac{(z - z_{mean})^2}{2\sigma_z^2}}$$

$$F\left(\frac{z - z_{mean}}{\sigma_z} >= b\right) = e^{-\frac{b^2}{2} - b\frac{z - z_{mean}}{\sigma_z}}$$

Gaussian Core + Exponential Tail

Cuts

- Same tight cuts as shown previously

Cut Description	Requirement
Layer 1 Requirement	e^+ and e^- have L1 hit
Layer 2 Requirement	e^+ and e^- have L2 hit
Track-cluster match	$\chi^2 < 10$
Cluster Time Difference	$\lvert t_{e^+Cluster} - t_{e^-Cluster}\rvert < 2$ ns
Track-Cluster Time Difference	$\lvert t_{e^+Track} - t_{e^+Cluster} - \text{offset}\rvert < 4$ ns
Track-Cluster Time Difference	$\lvert t_{e^-Track} - t_{e^-Cluster} - \text{offset}\rvert < 4$ ns
Beam electron cut	$p(e^-) < 1.75$ GeV
Track Quality	$\chi^2/dof < 6$
Vertex Quality	$\chi^2_{unc} < 10$

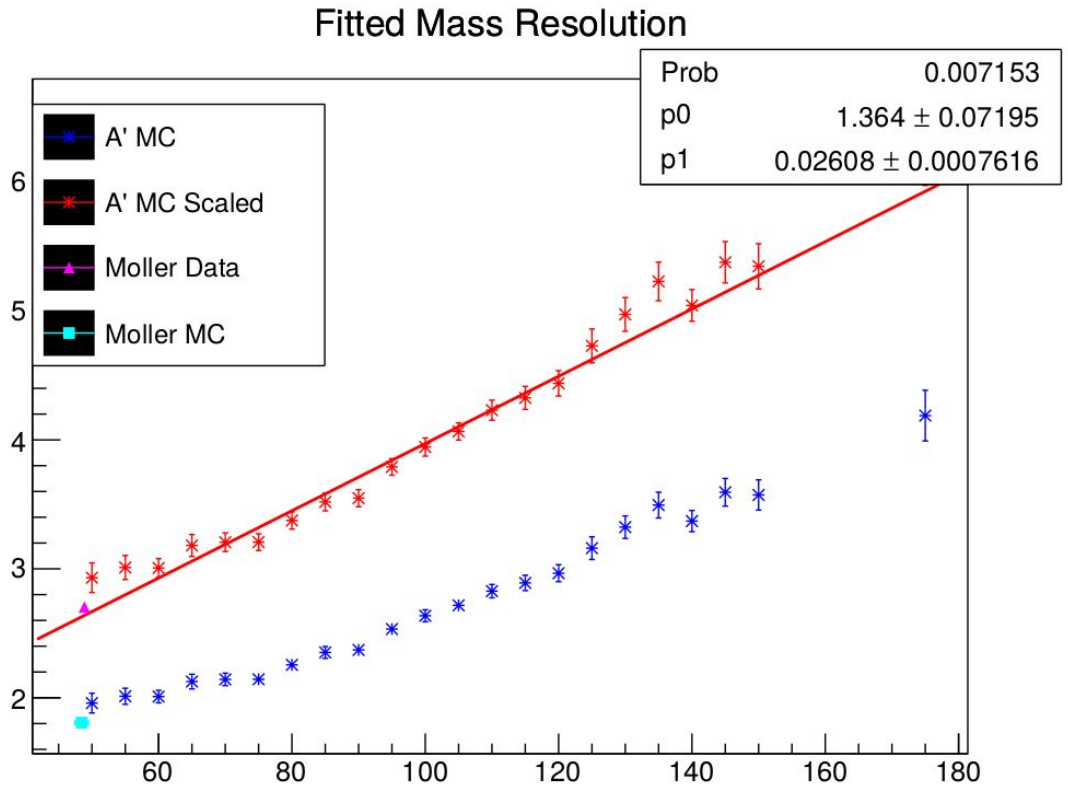
Table 4: Requirements applied to V_0 after reconstruction as an initial set to study. The time offset for data is 56 ns and the time offset for MC is 43 ns.

Cut Description	Requirement
Tight Vertex Quality	$\chi^2_{unc} < 4$
Radiative Cut	$V_{0p} > 0.8\ e_{beam}$ GeV
Maximum Vertex Momentum	$V_{0p} < 1.15\ e_{beam}$ GeV
V0 projection to target	Fitted 3σ cut
V0 x and y position	Fitted 3σ cut
Isolation Cut	$\delta + \frac{1}{2}(z0 + z_{targ}\ \frac{P_Y}{P}\ \text{sign}(P_Y)) > 0$

Table 5: Cuts currently being studied.

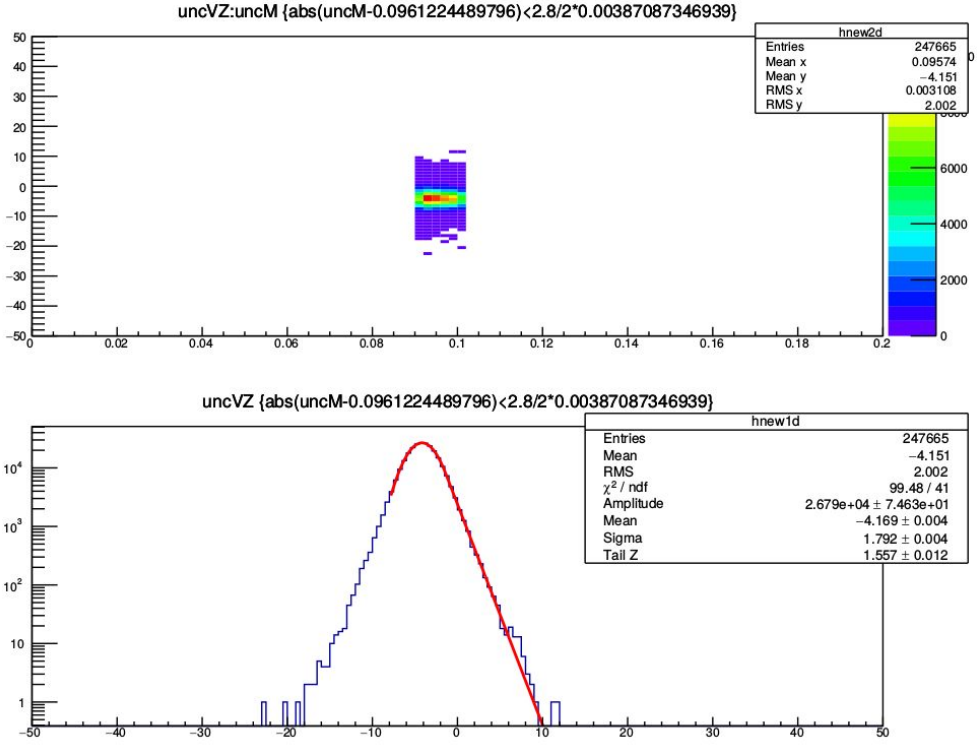
Mass Resolution

- Parametrized based on displace A' MC
- Use Rafo' latest data/MC moller mass
- (see detail mass resolution plots)
- Will be updated as we understand more
- I also have mass resolution for L1L2 and L2L2



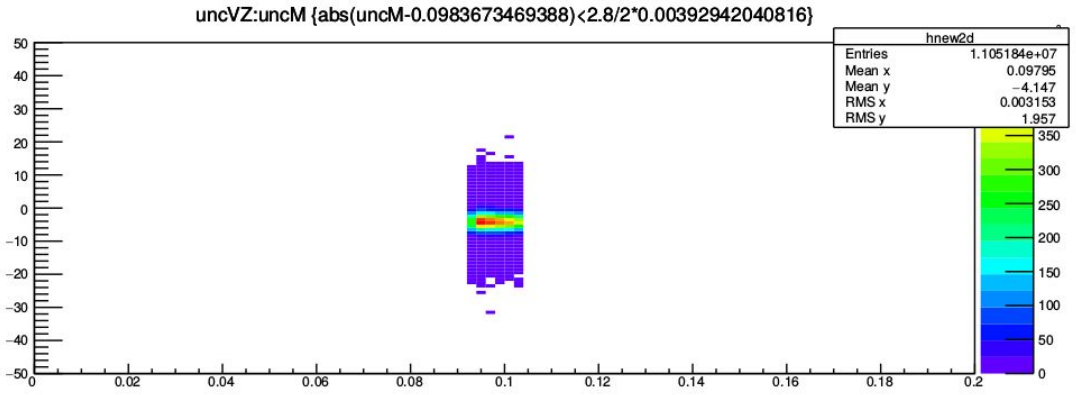
Tail Fits ~⅔ tritrig-wab-beam

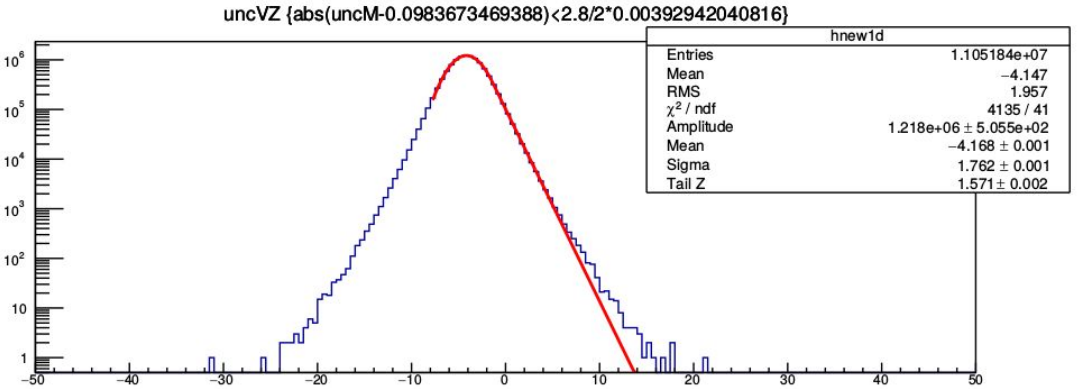
- (see detailed tail fit plots)



Tail Fits x3 Tritrig

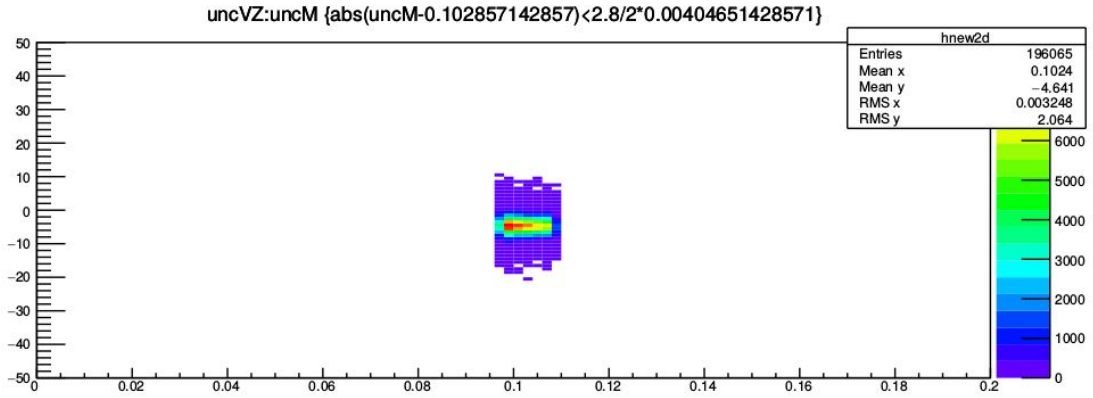
- (see detailed tail fit plots)

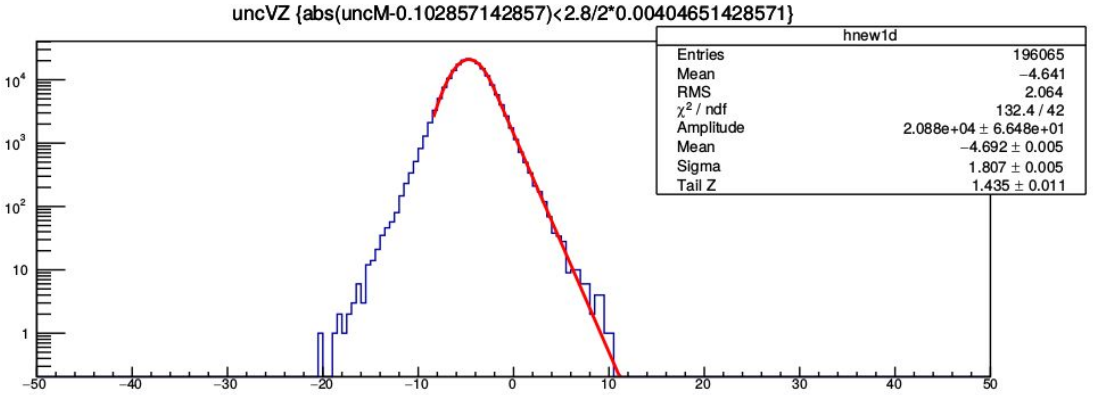




Tail Fits 10% Data

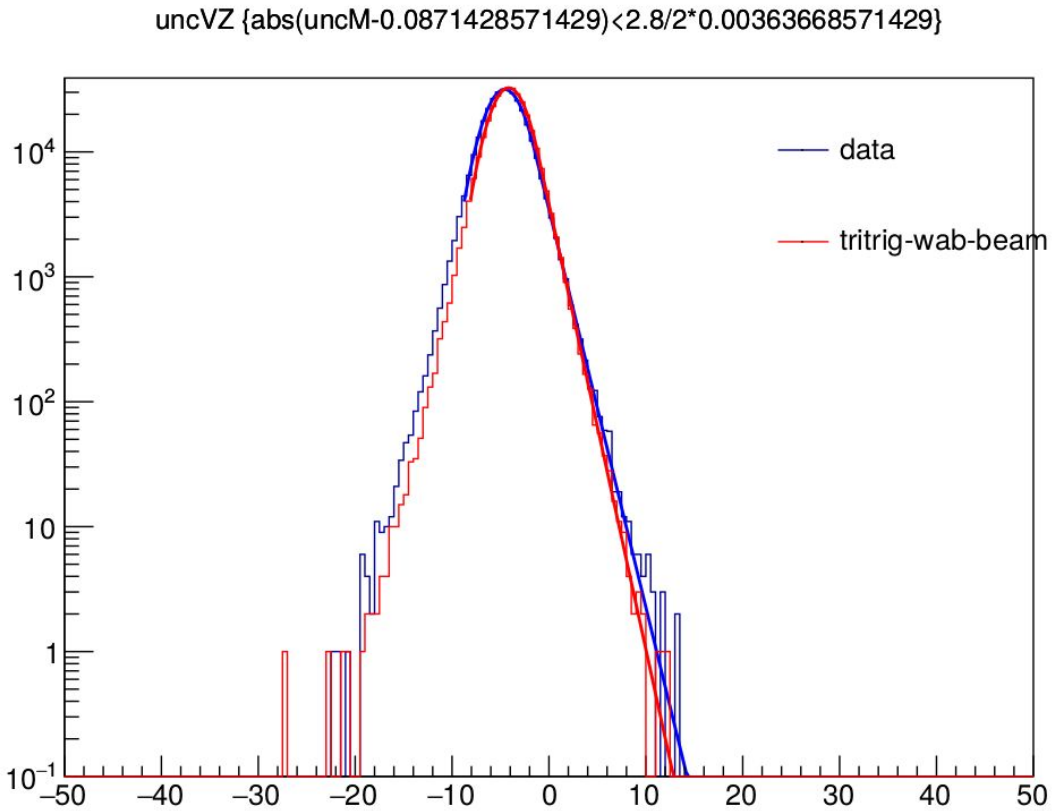
- (see detailed tail fit plots)





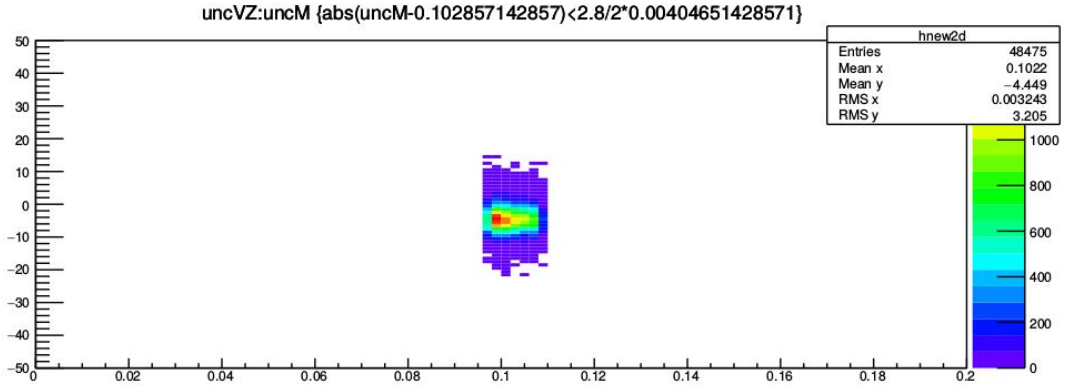
Data/MC Comparison

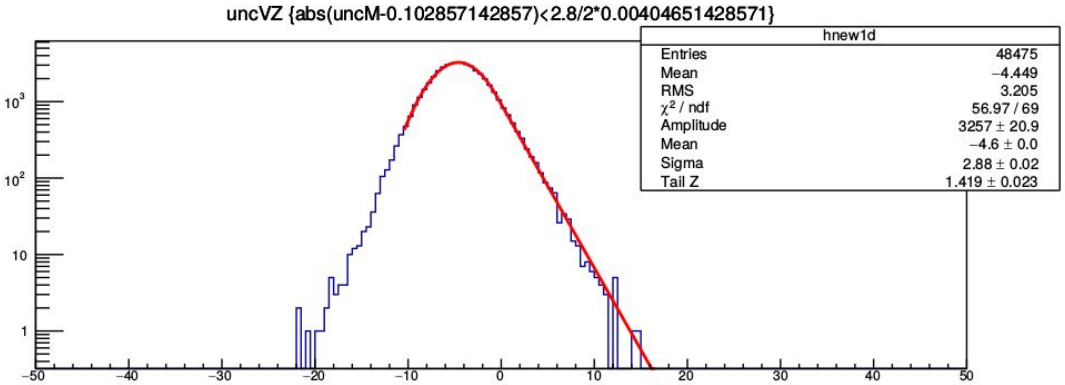
- Comparing about the same tritrig-wab-beam luminosity to 10% data
- (see detailed tail fit plots)



Data 10% L1L2

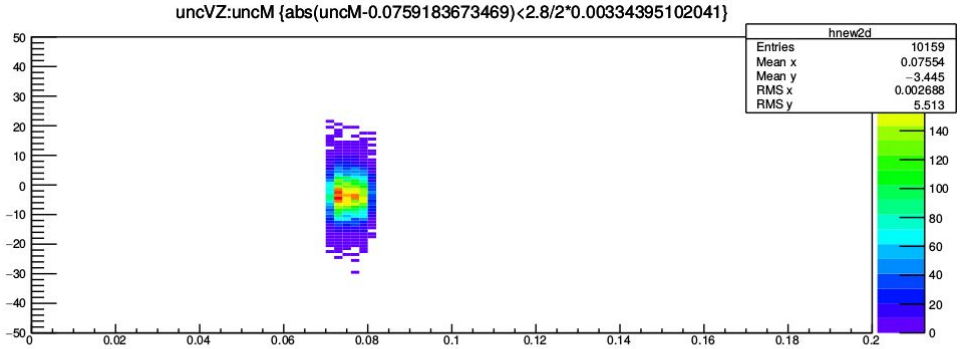
- Use the same fit function as L1L1 (needs to be explore)
- (see detailed tail fit plots)

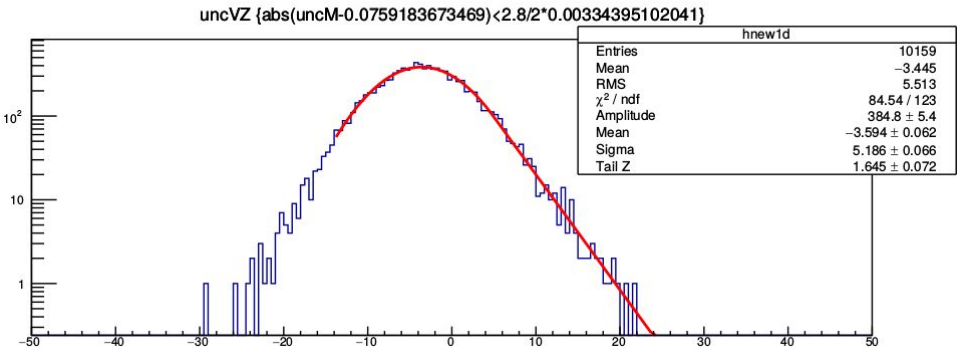




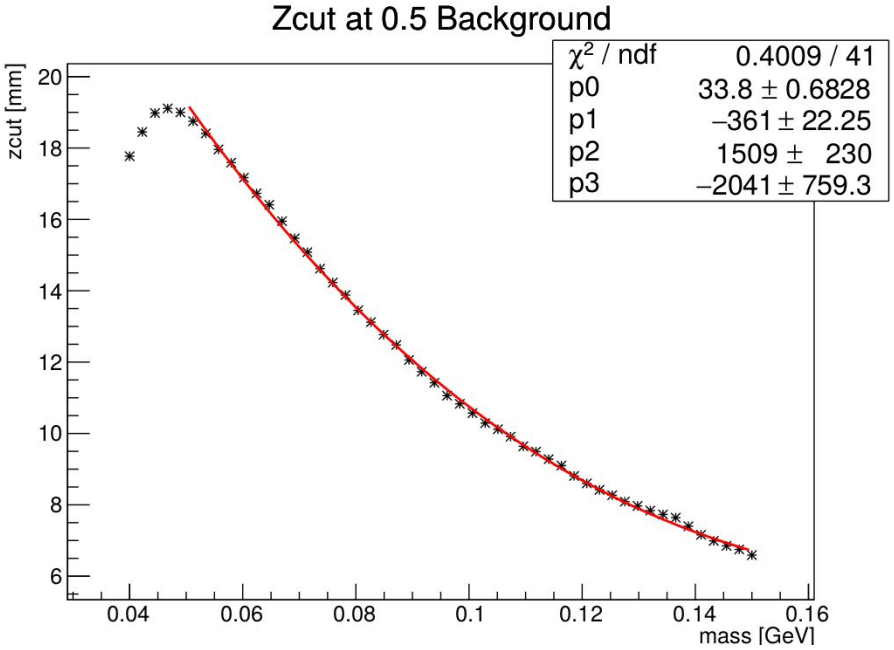
Data 10% L2L2

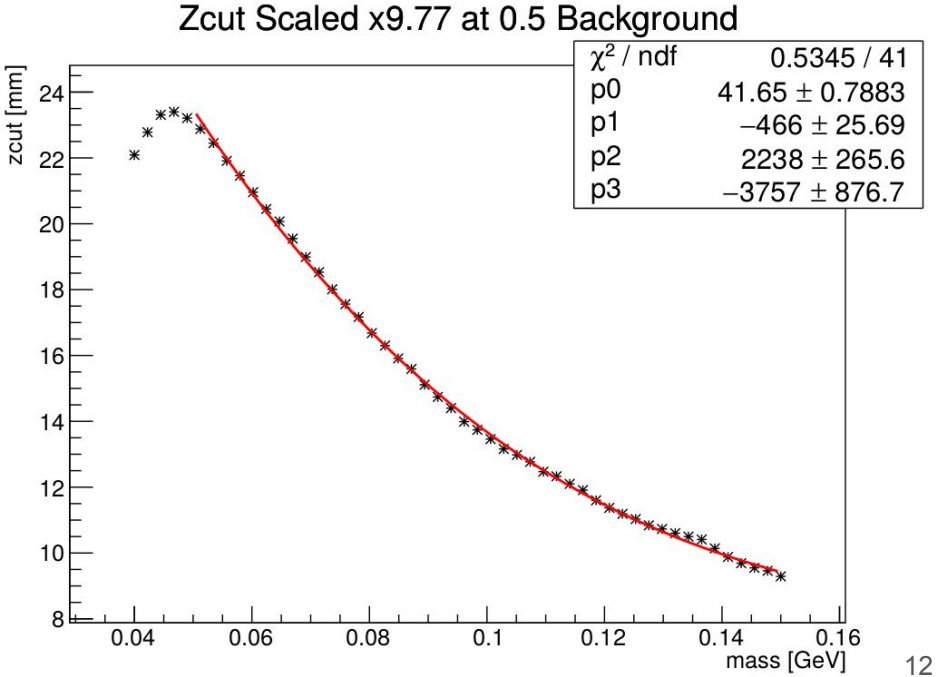
- Use the same fit function as L1L1 (needs to be explore)
- (see detailed tail fit plots)



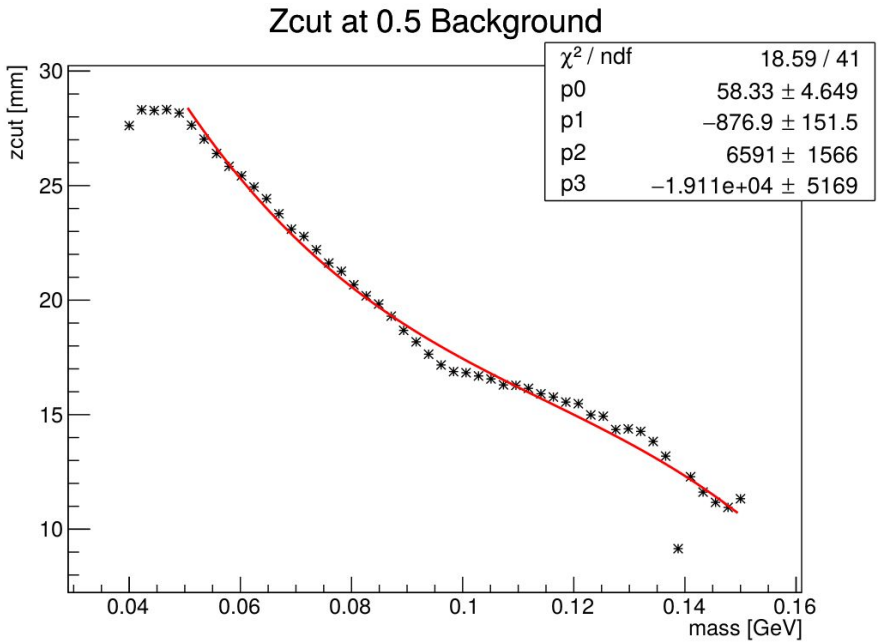


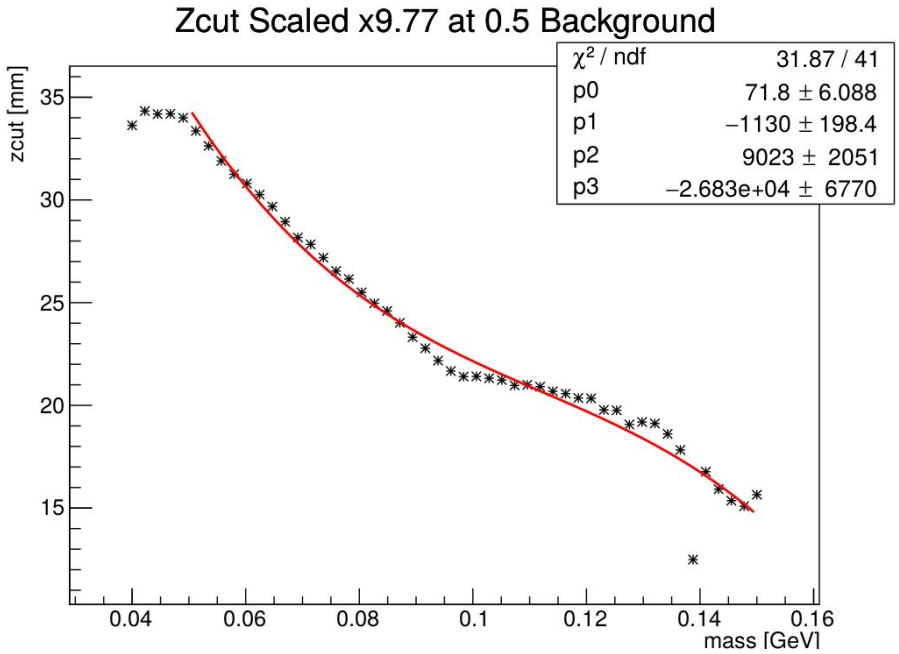
ZCuts L1L1


Zcut at 0.5 Background
χ² / ndf 0.4009 / 41
p0 33.8 ± 0.6828
p1 −361 ± 22.25
p2 1509 ± 230
p3 −2041 ± 759.3
zcut [mm]
mass [GeV]

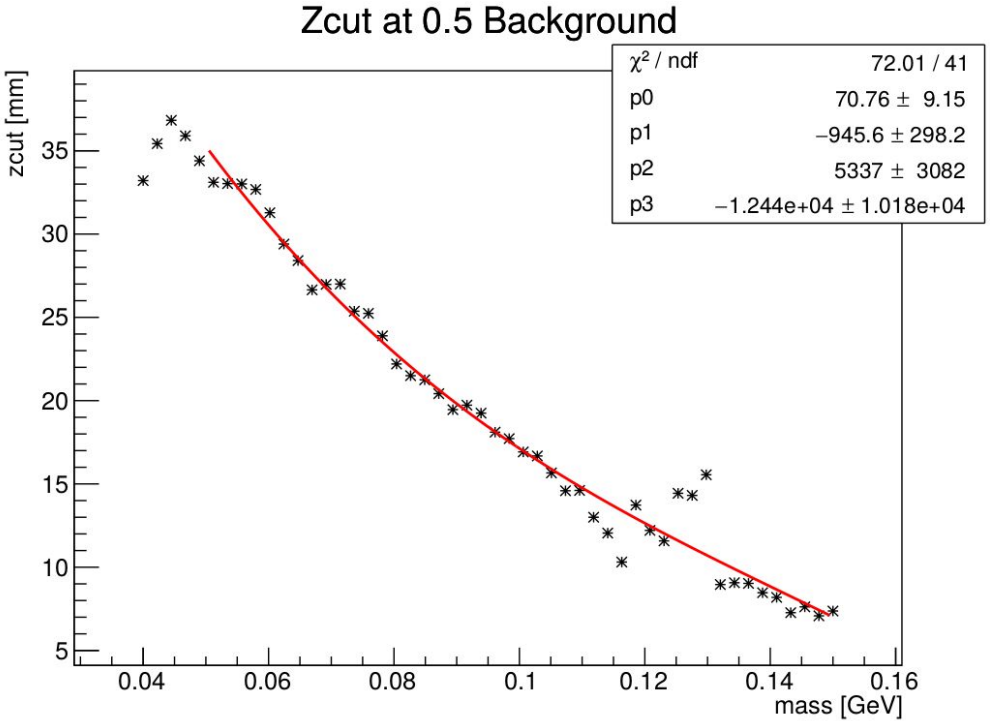

Zcut Scaled x9.77 at 0.5 Background
χ² / ndf 0.5345 / 41
p0 41.65 ± 0.7883
p1 −466 ± 25.69
p2 2238 ± 265.6
p3 −3757 ± 876.7
zcut [mm]
mass [GeV]

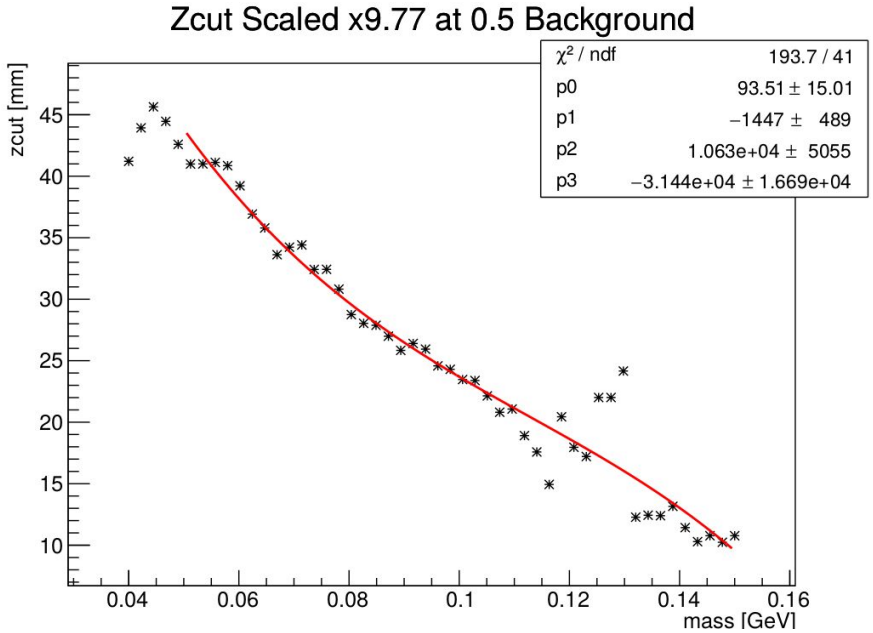
ZCuts L1L2


Zcut at 0.5 Background
χ² / ndf 18.59 / 41
p0 58.33 ± 4.649
p1 −876.9 ± 151.5
p2 6591 ± 1566
p3 −1.911e+04 ± 5169
zcut [mm]
mass [GeV]

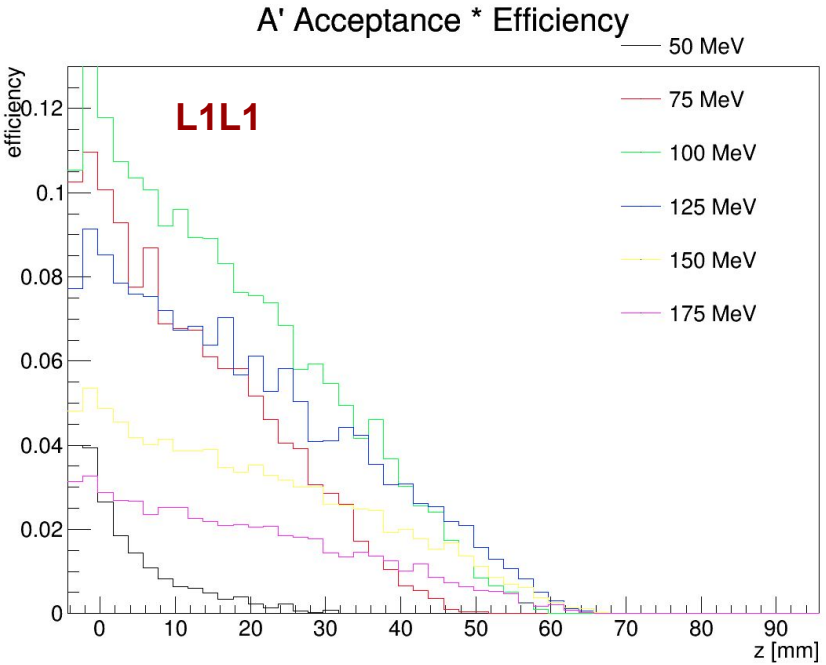

Zcut Scaled x9.77 at 0.5 Background
χ² / ndf 31.87 / 41
p0 71.8 ± 6.088
p1 −1130 ± 198.4
p2 9023 ± 2051
p3 −2.683e+04 ± 6770
zcut [mm]
mass [GeV]

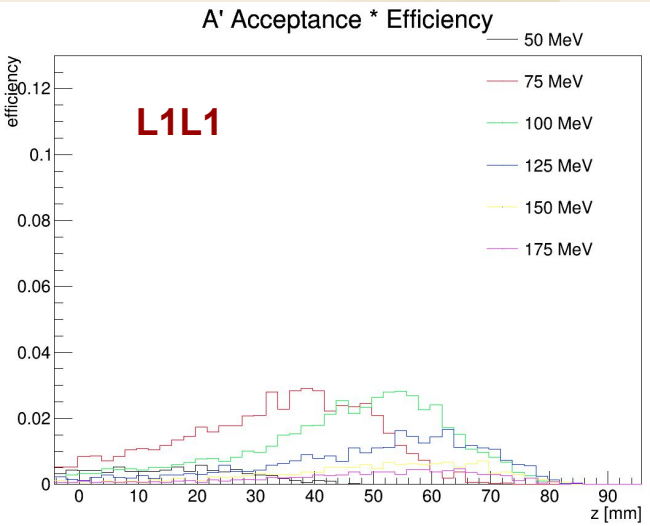
Zcuts L2L2

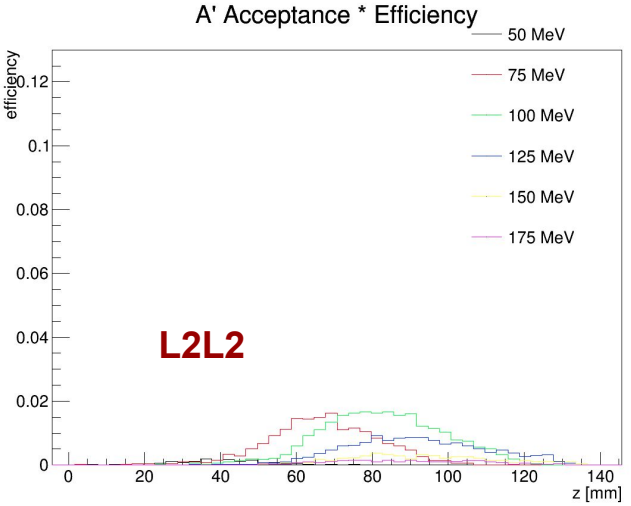

Zcut at 0.5 Background
χ² / ndf 72.01 / 41
p0 70.76 ± 9.15
p1 −945.6 ± 298.2
p2 5337 ± 3082
p3 −1.244e+04 ± 1.018e+04
zcut [mm]
mass [GeV]


Zcut Scaled x9.77 at 0.5 Background
χ² / ndf 193.7 / 41
p0 93.51 ± 15.01
p1 −1447 ± 489
p2 1.063e+04 ± 5055
p3 −3.144e+04 ± 1.669e+04
zcut [mm]
mass [GeV]

A’ Efficiency

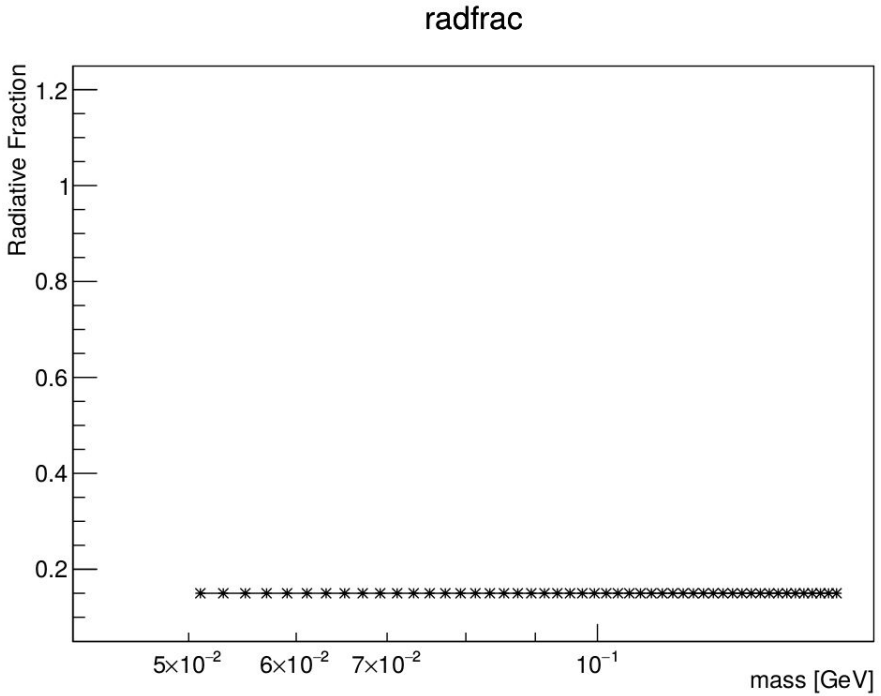






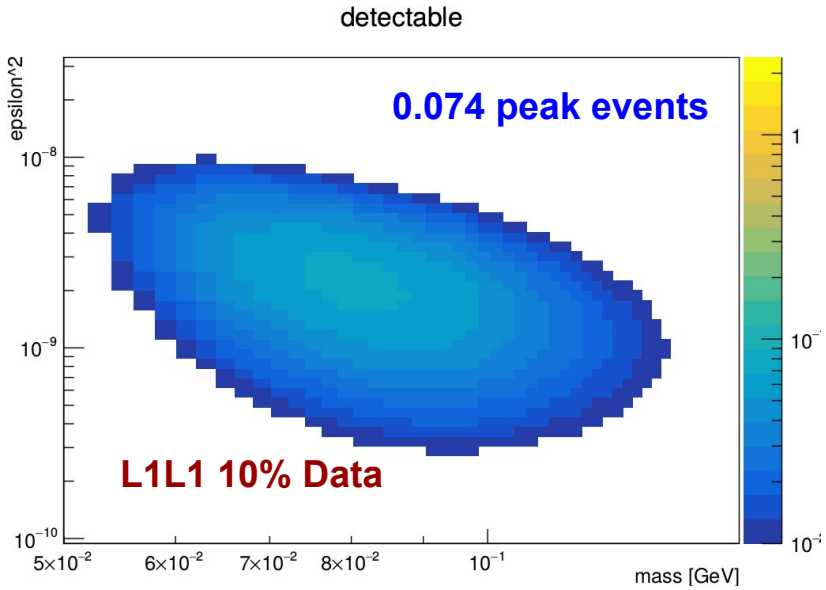
Radiative Fraction

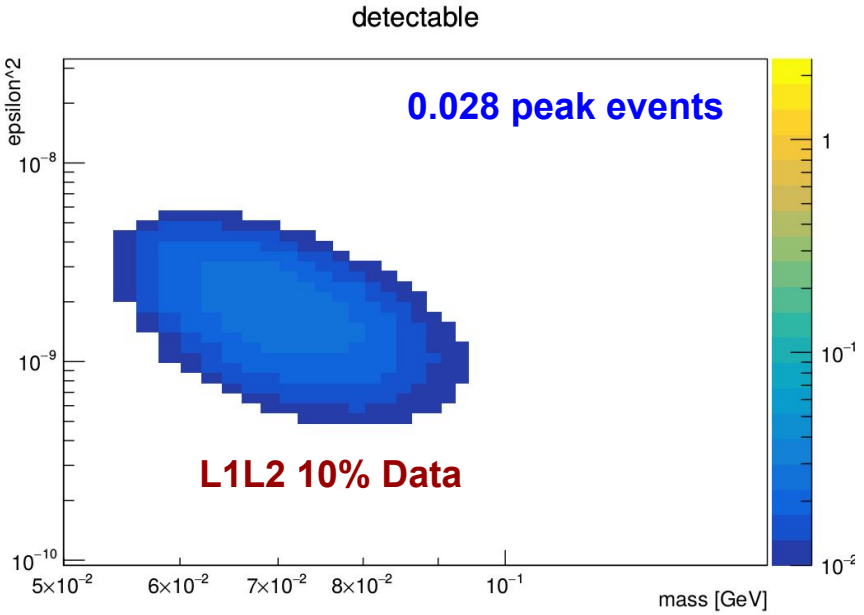
- Used constant 0.15 for now
- I need to update this with Tongtong's latest radfrac histogram
- I normalize the rate by grabbing the number of events in a small mass bin



Computing Signal Yield - 10% Data

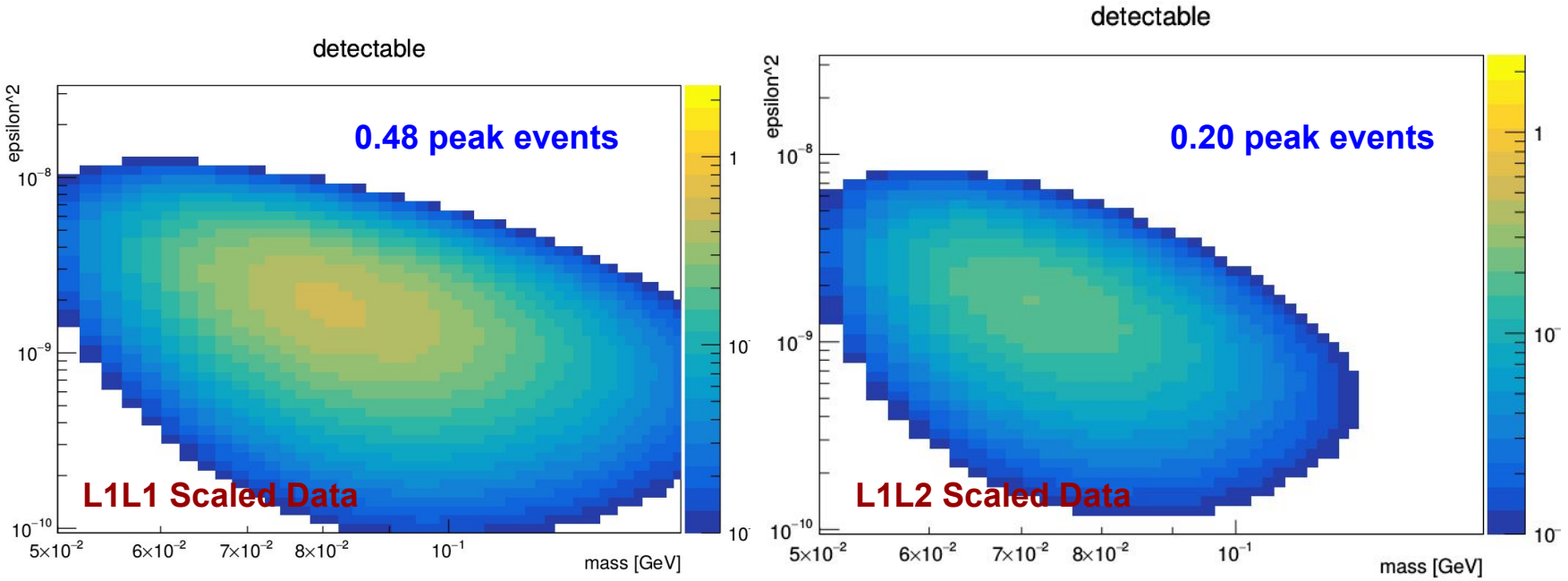
- Number of expected A' events integrated past zcut



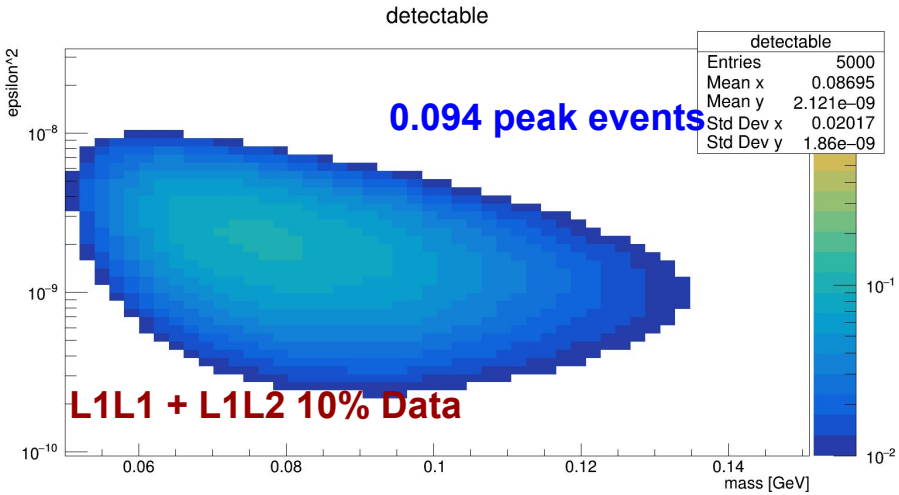


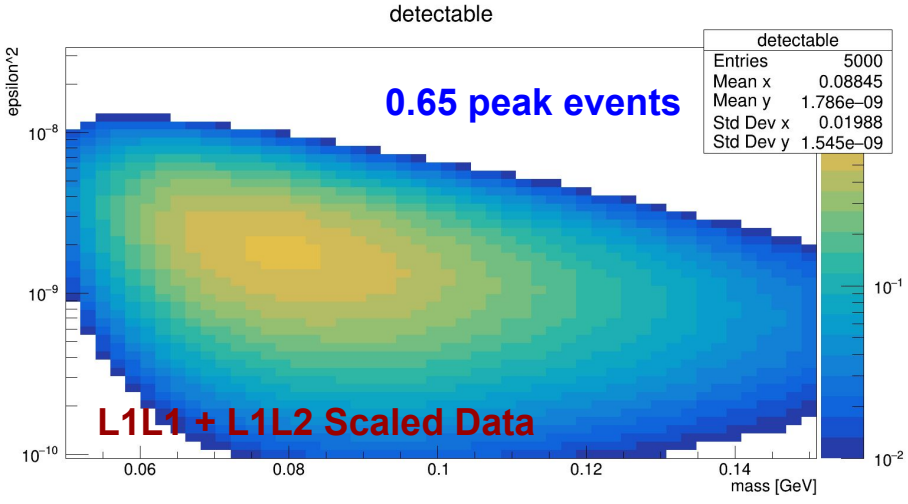
Computing Signal Yield - Scaled Data

- 0.08 peak events for L2L2 scaled data



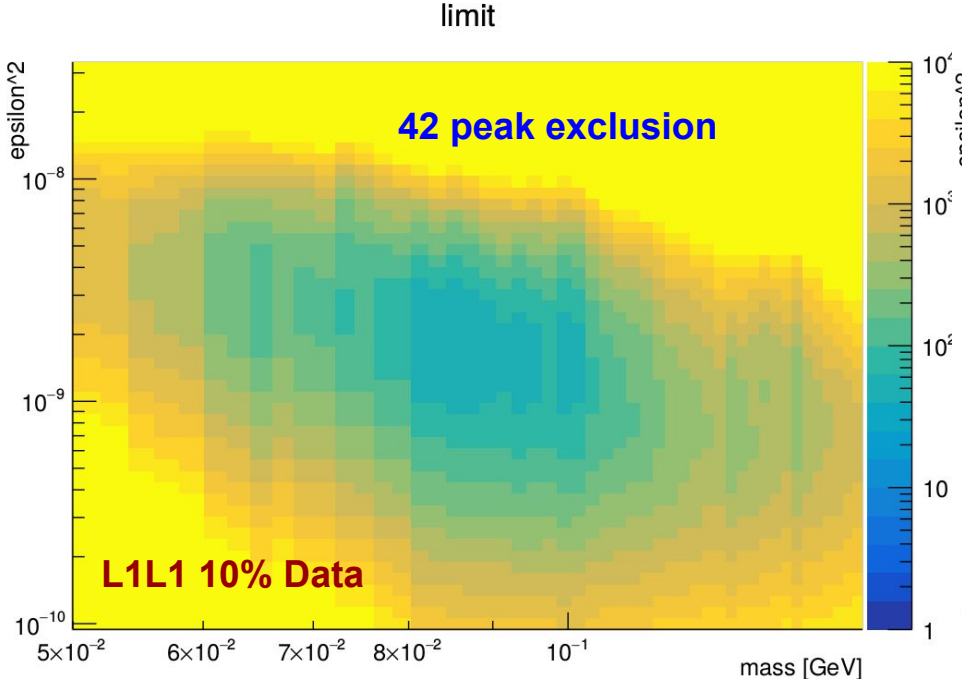
Computing Signal Yield - Totals

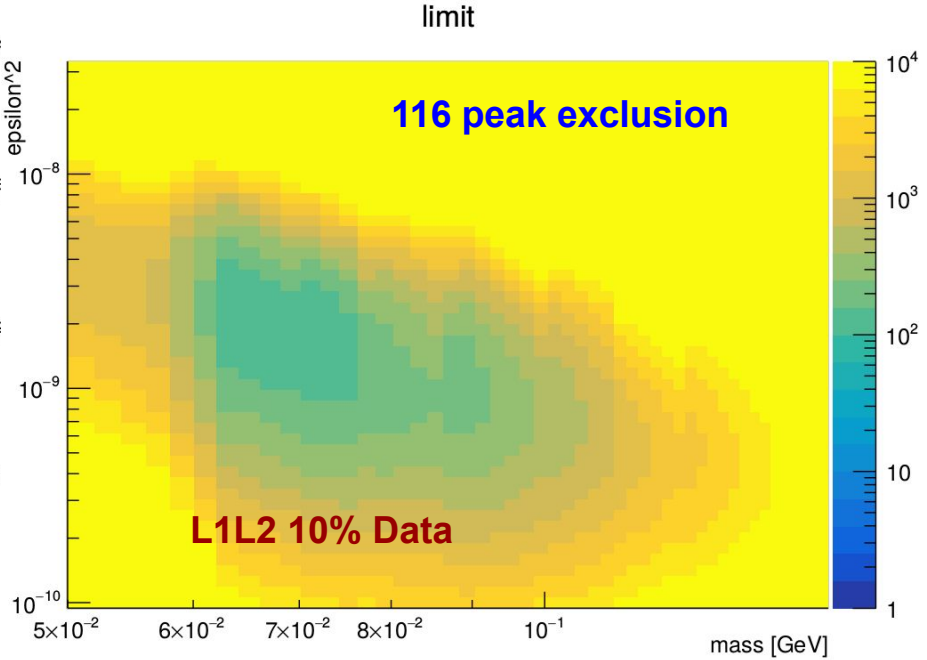




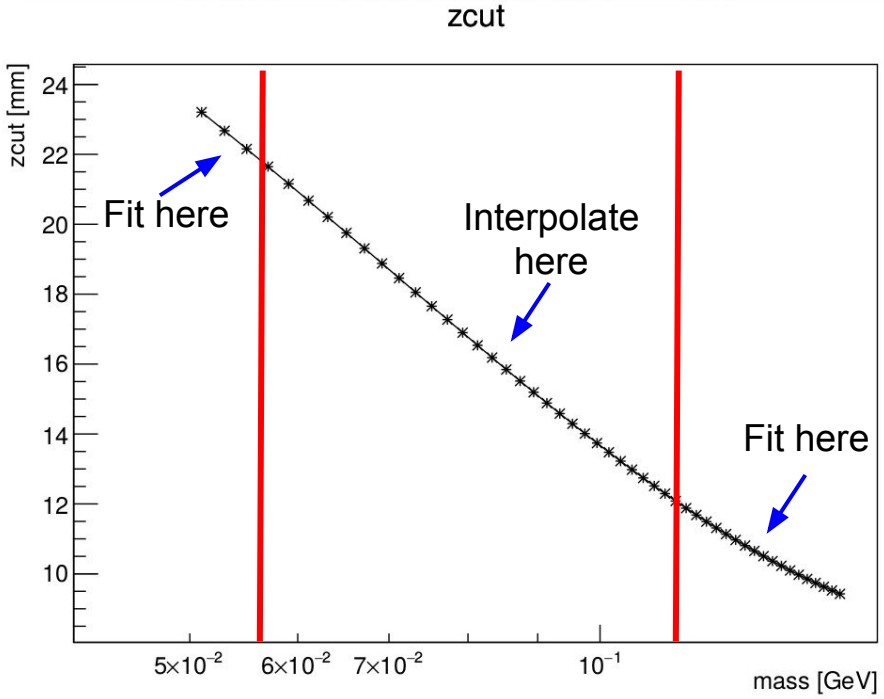
Setting Limits - 10% of Data

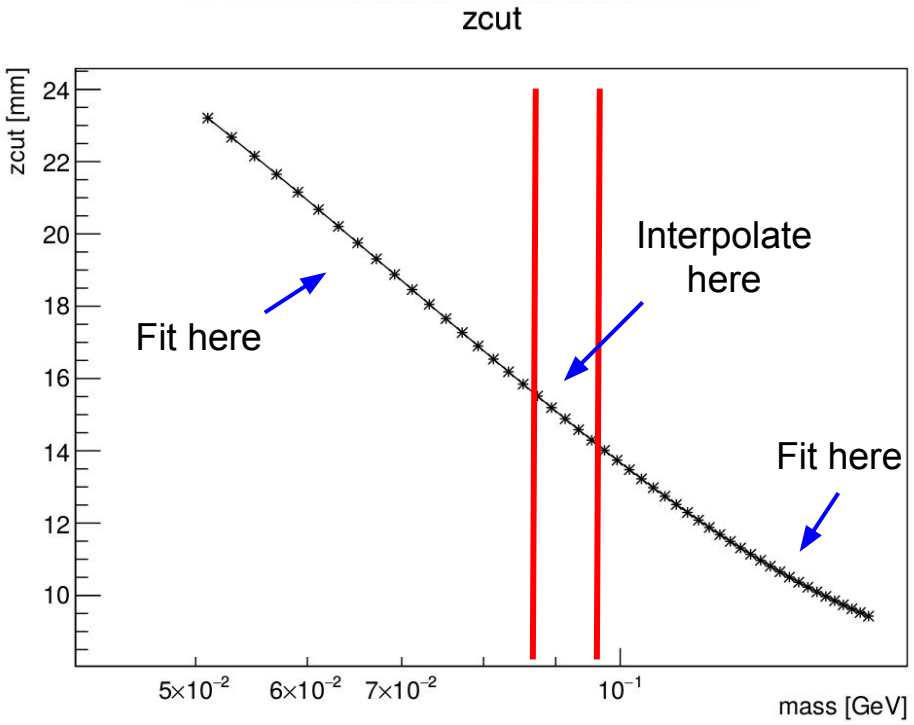
- Using the optimum interval method
- How do we combine results? Treat them like 2 independent experiments?





Determining Z Cut - A Better (Unbiased) Way





Conclusion