



# L2 EM Update

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# Outline

- Review/Overview
- Improving the Likelihood Variable
  - Zeroing negative EM and HAD TT energies
  - Correlated variables
  - Fixed a bug
- Putting It Together
- Still Working On...

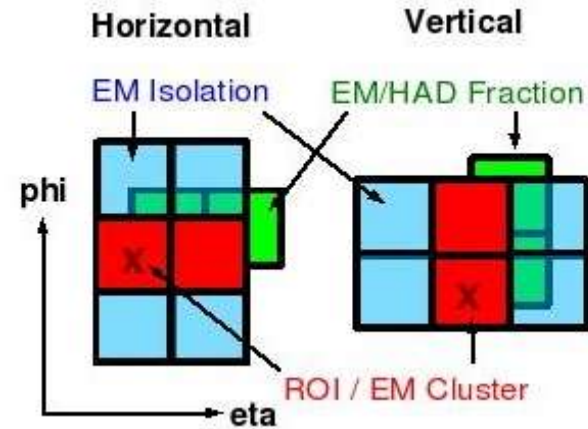


# Overview/Review

- Run2b L1 and L2 EM variables

$$\text{L1 EM/HAD Fraction} = \frac{\text{EM}}{\text{HAD}}$$

$$\text{L1 EM Isolation} = \frac{\text{EM}}{\text{EM}}$$



$$\text{L2 EM Fraction} = \frac{\text{EM}}{\text{HAD} + \text{EM}} = \frac{(\text{L1 EM/HAD Fraction})}{(\text{L1 EM/HAD Fraction}) + 1}$$

$$\text{L2 EM Isolation} = \frac{\text{EM}}{\text{EM} + \text{EM}} = \frac{(\text{L1 EM Isolation})}{(\text{L1 EM Isolation}) + 1}$$

– Related by simple algebra ...



# Overview/Review

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- L1 and L2 variables related by simple algebra
  - This allows for direct comparison between L1 and L2
  - However, no additional rejection at Level 2 from these (except for precision of cut)
- ⇒ Construct a likelihood variable to get rejection at Level 2

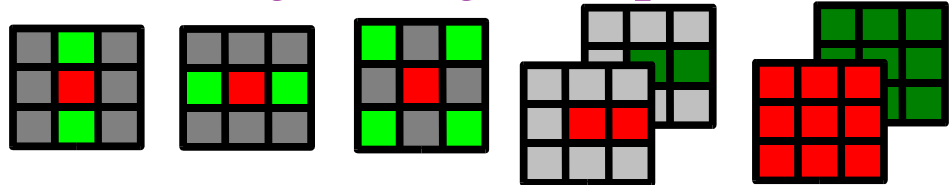


# Overview/Review

- Likelihood

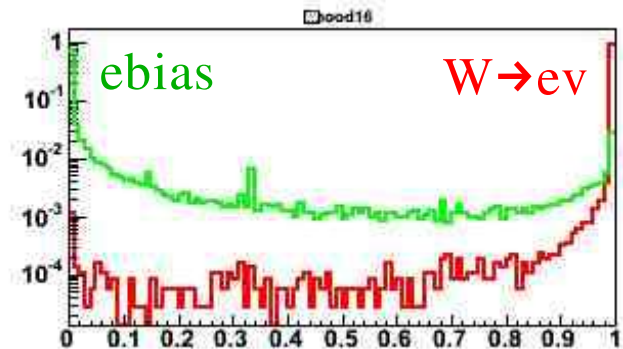
- Find iso and emf variables with good signal separation

- E.g. Likelihood “6”:



- Multiply the likelihood ratios  $[0, \infty)$  for the separate variables to get the total likelihood ratio,  $LR \in [0, \infty)$

- Likelihood =  $LR/(LR+1) \in [0, 1]$



Likelihood



# Overview/Review

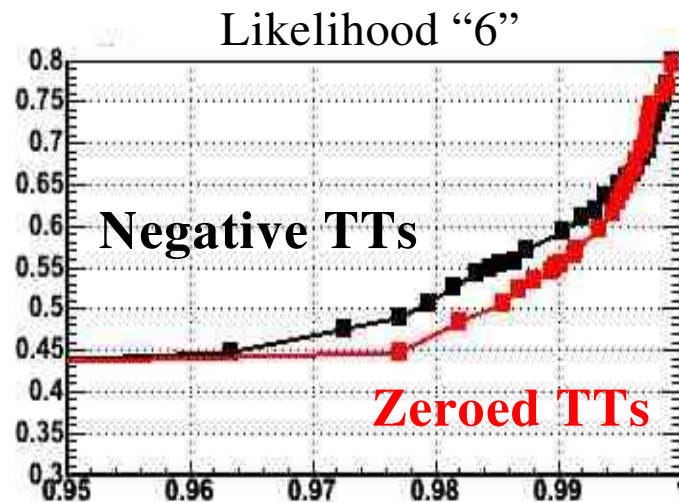
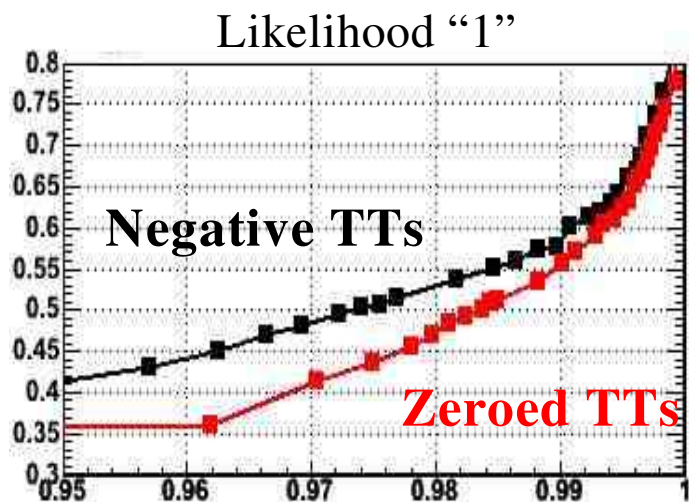
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- About the following turn-on plots
  - After Level 1 requirements:
    - $EM Et \geq 16, Emf \geq 2^3, Iso \geq 2^2$   
 $\Rightarrow$  609 enhanced bias events (out of 311598)  
 $\Rightarrow$  37465  $W \rightarrow ev$  events (out of 37629)
  - Cut on OR-ing likelihoods of all L2 object in event (new)
  - x-axis =  $W \rightarrow ev$  efficiency
    - #  $W \rightarrow ev$  events that passed some likelihood cut / 37465
  - y-axis = enhanced bias efficiency
    - # ebias events that passed same likelihood cut / 609



# Improving the Likelihood

- Zeroing negative EM and HAD TT energies
  - Set all negative TT energies to zero
    - `tt_em = (tt_em < 0) ? 0 : tt_em; //for each tower`
    - `tt_had = (tt_had < 0) ? 0 : tt_had;`
  - Then calculate the variables use in the likelihood





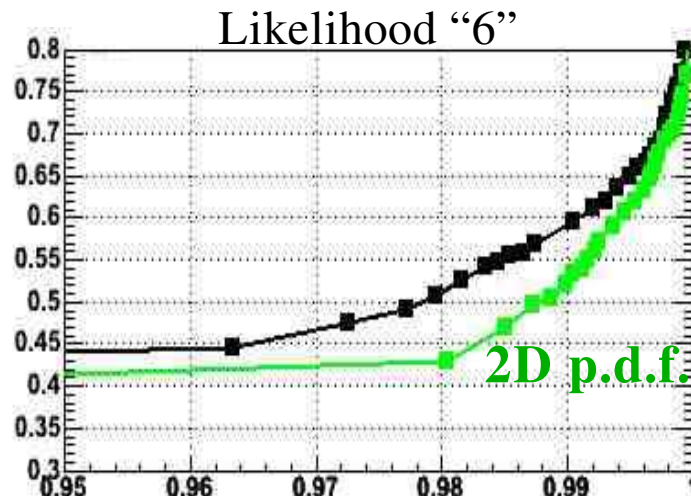
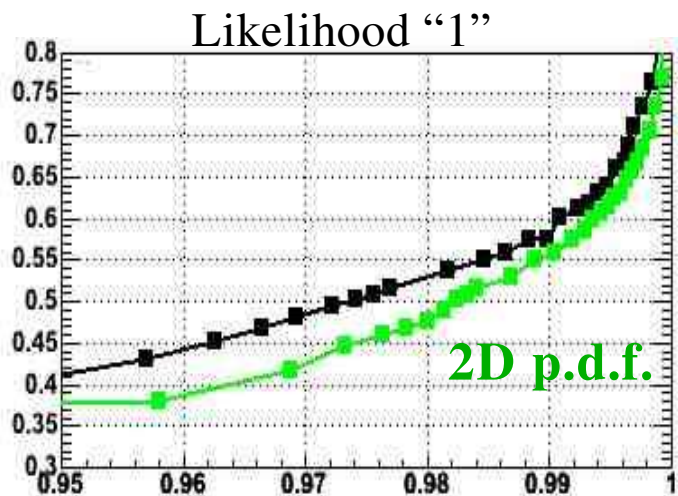
# Improving the Likelihood

- Correlated variables

- Likelihood "1" and "6" use the variables



- These are correlated => should use the 2D p.d.f.



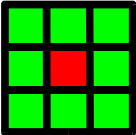
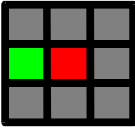


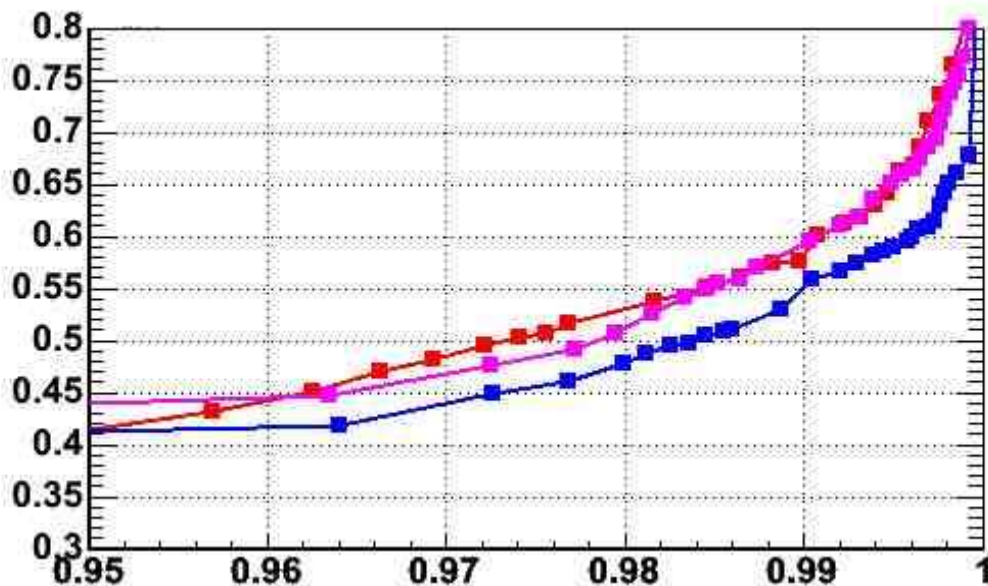


# Improving the Likelihood

- Fixed a Bug

- Variables used for likelihood ‘2’

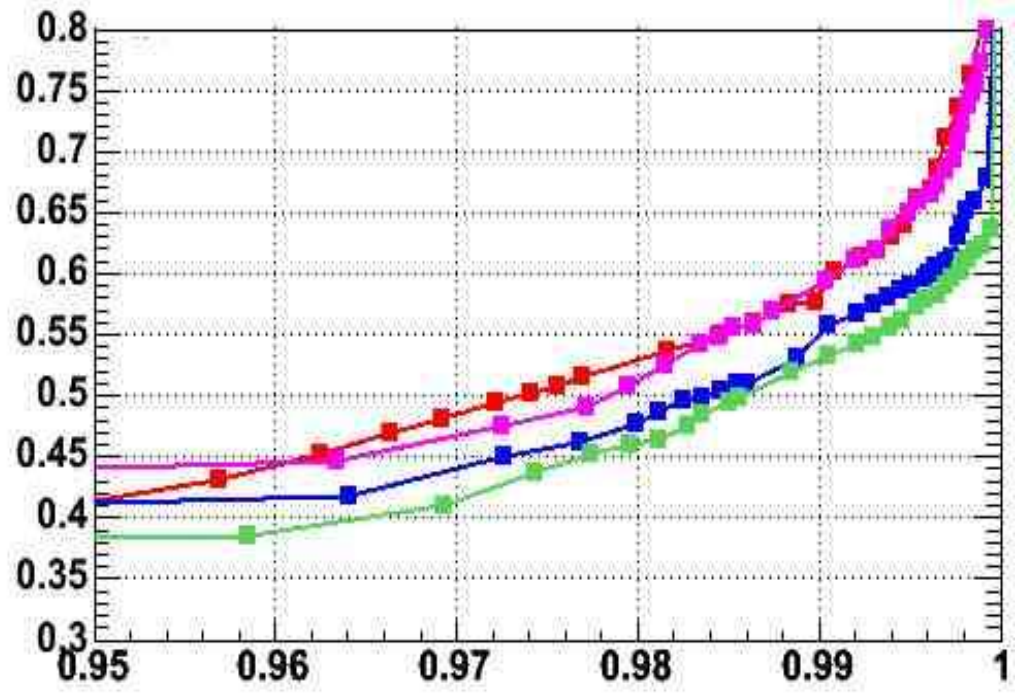
- EmfSN, Emf3X3, and SeedIso  vs. NvS 
    - 1D Emf3X3 p.d.f. was being used for 2D SeedIso vs. NvS p.d.f.



Likelihood ‘1’  
Likelihood ‘6’  
Likelihood ‘2’



# Putting It Together



Likelihood:

1

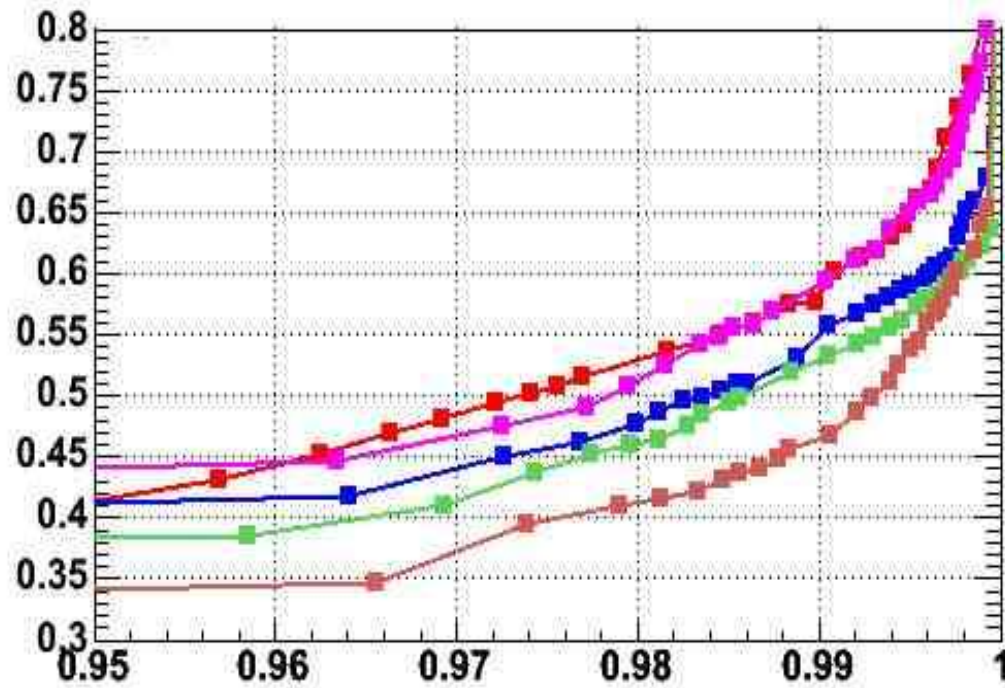
6

2

2 + correlated Emfs



# Putting It Together



Likelihood:

**1**

**6**

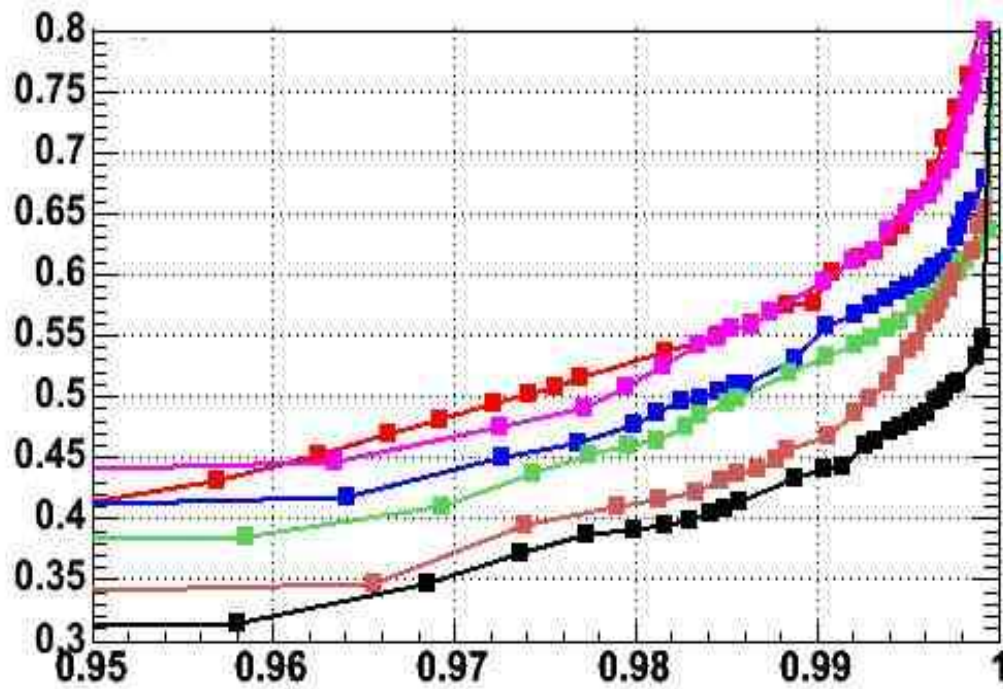
**2**

**2 + correlated Emfs**

**2 + zeroed TTs**



# Putting It Together



Likelihood:

**1**

**6**

**2**

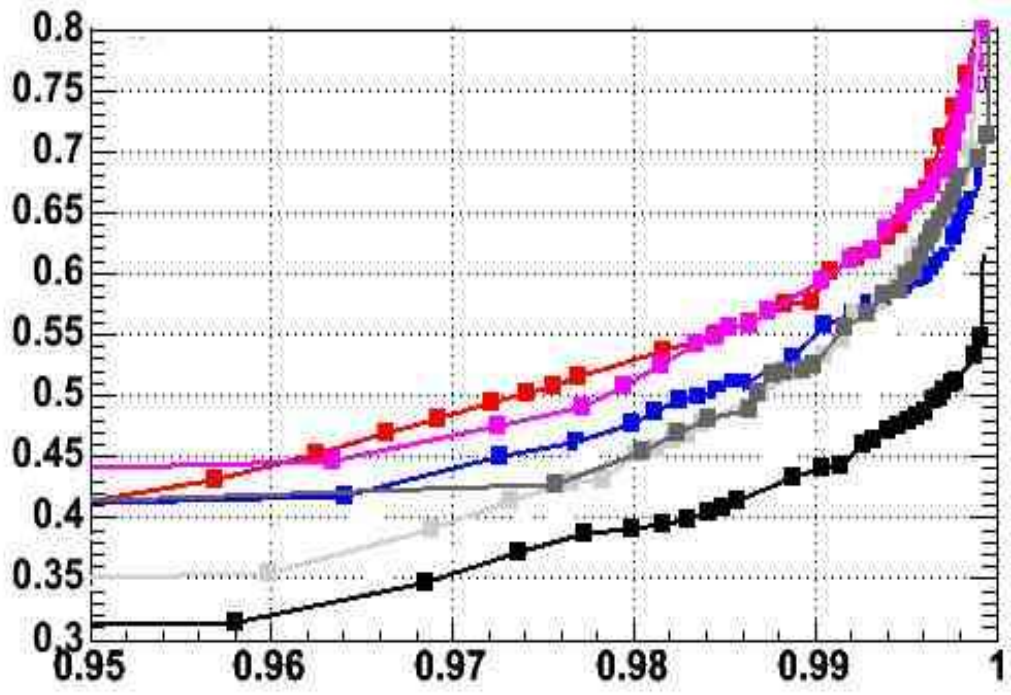
**2 + correlated Emfs**

**2 + zeroed TTs**

**2 + correlated Emfs + zeroed TTs**



# Putting It Together



Likelihood:

- 1
- 6
- 2

- 2 + correlated Emfs + zeroed TTs
- 6 + correlated Emfs + zeroed TTs
- 1 + correlated Emfs + zeroed TTs



# Still Working On...

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