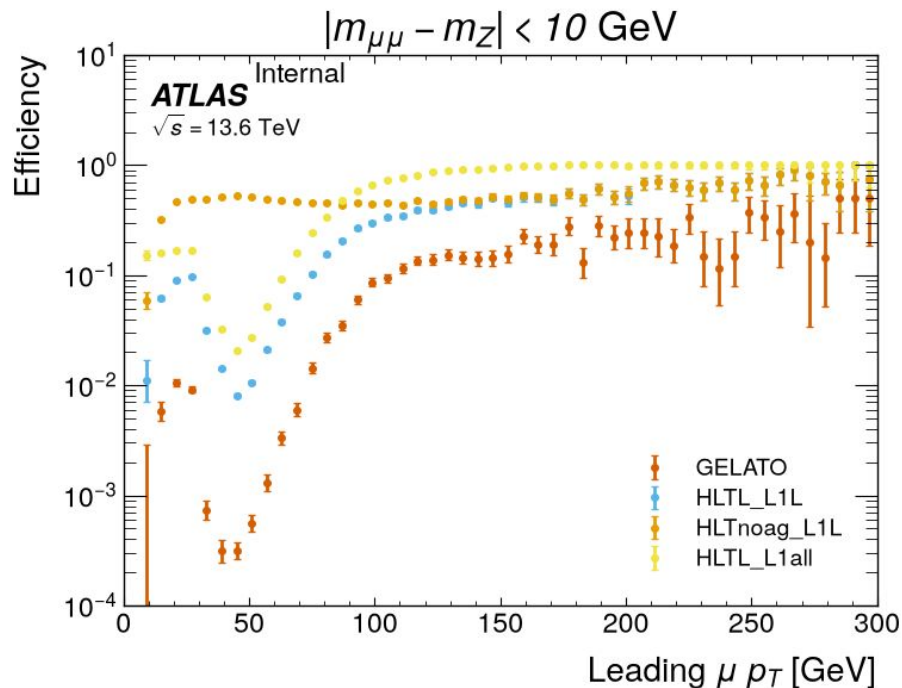


Recall from last time the MC efficiencies



These are calculated as

$$N_{\text{pass}} / N_{\text{all}}$$

This works because we have N_{all} in MC.

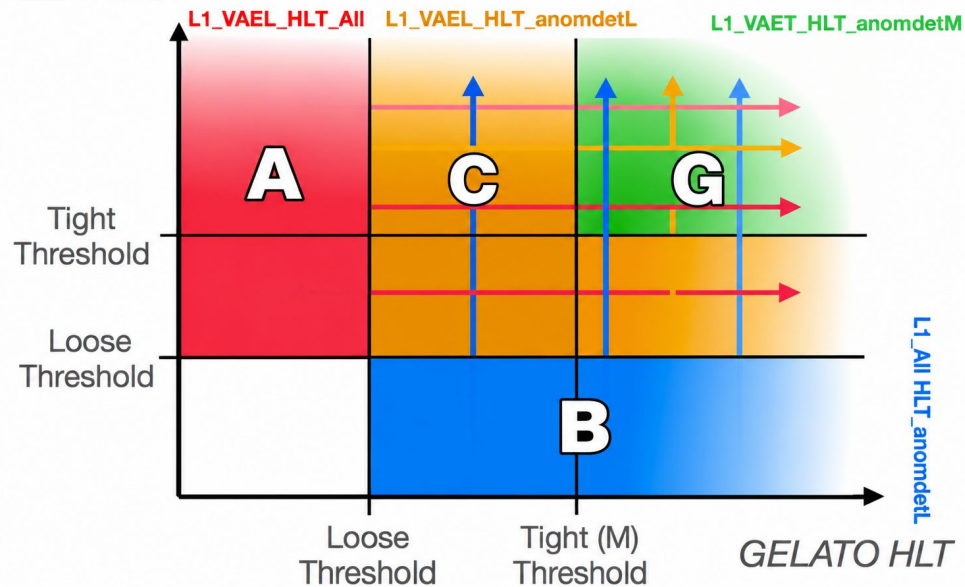
Unfortunately in data, we don't have N_{all} , so it's difficult to calculate the efficiency.

We want to calculate something like

G_{all}

But again, in data, we don't have all.

GELATO L1



$$\epsilon_G = P(G) = P(G | C) \cdot P(C)$$

If A, B are independent, then

$$P(C) = P(A)P(B)$$

but if A, B are independent, then

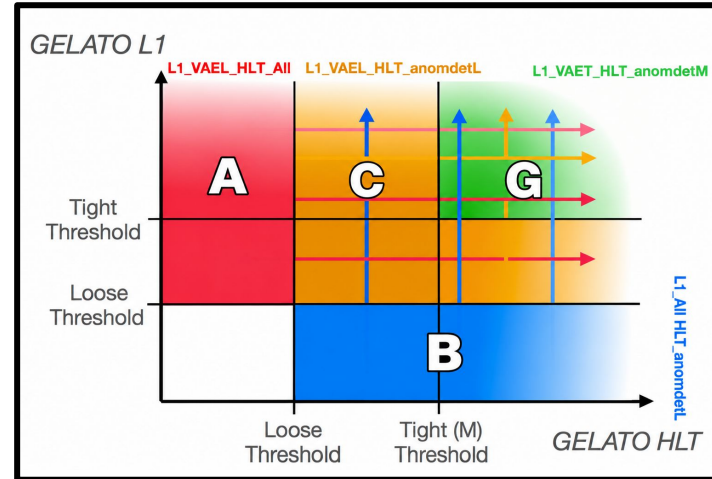
$$P(A) = P(A | B) = P(A \cap B | B) = P(C | B)$$

$$P(B) = P(B | A) = P(B \cap A | A) = P(C | A)$$

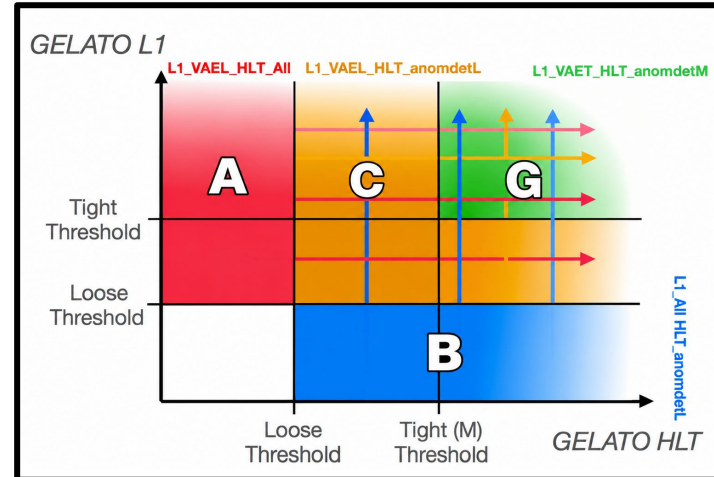
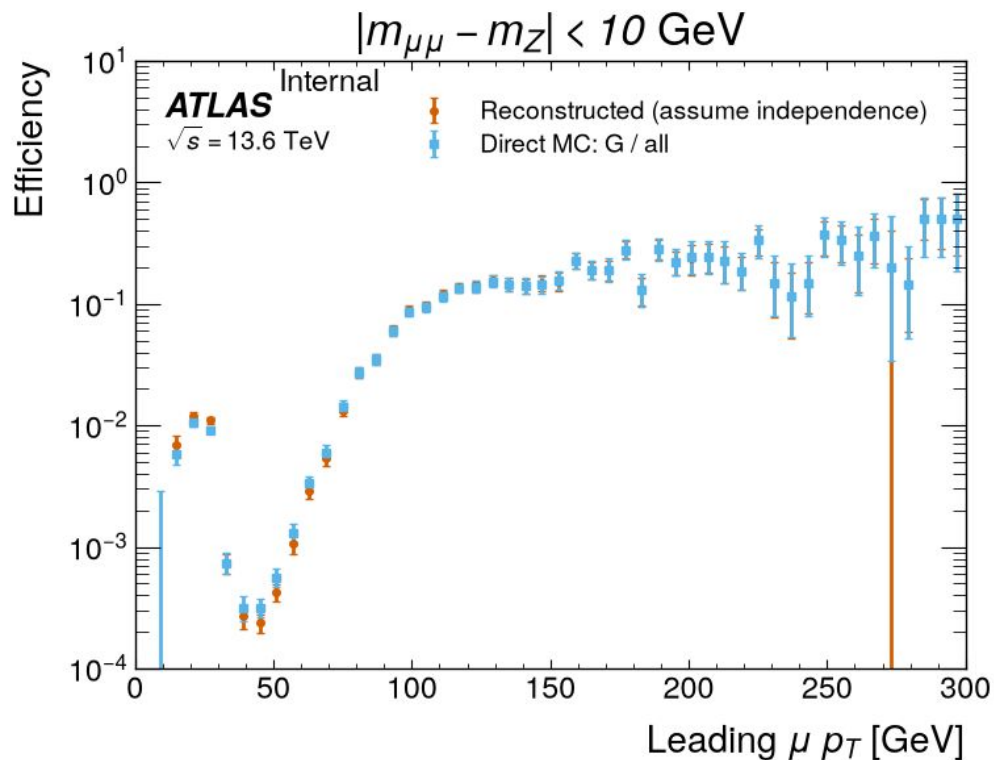
So

$$\epsilon_G = P(G | C) \cdot P(C | B) \cdot P(C | A)$$

$$\epsilon_G = \frac{\text{green}}{\text{yellow}} \cdot \frac{\text{yellow}}{\text{blue}} \cdot \frac{\text{yellow}}{\text{red}}$$



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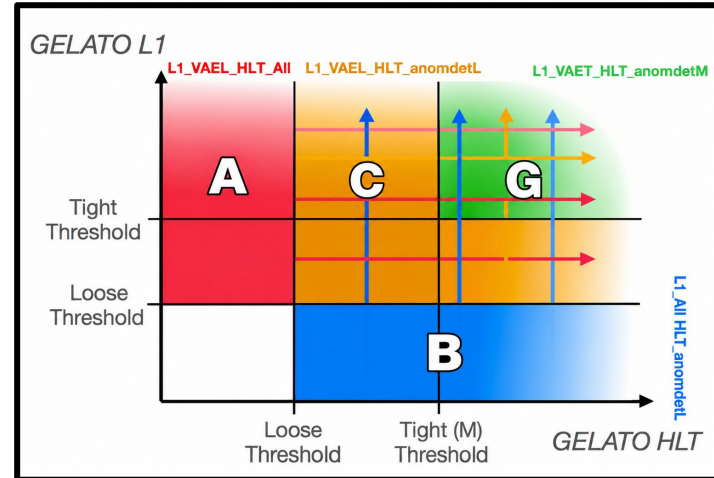
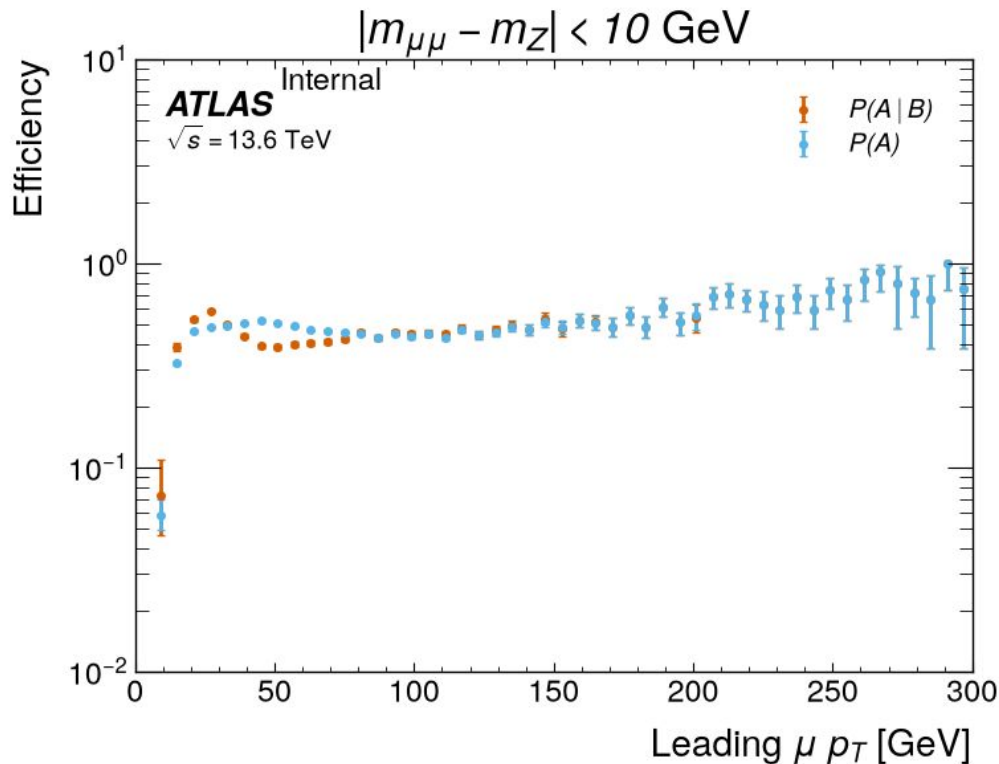


These are pretty close!

There are some differences in the low muon pt region caused by correlation between L1 and HLT.

Can we quantify these correlations?

$$\epsilon_G = \frac{\text{green}}{\text{yellow}} \cdot \frac{\text{yellow}}{\text{blue}} \cdot \frac{\text{yellow}}{\text{red}}$$



These are pretty close!

There are some differences in the low muon pt region caused by correlation between L1 and HLT.

Can we quantify these correlations?

Now let's do this again without assuming independence.

But now

So

$$\epsilon_G = P(G) = P(G \mid C) \cdot P(C)$$

$$P(C) = P(A \mid B) \cdot P(B)$$

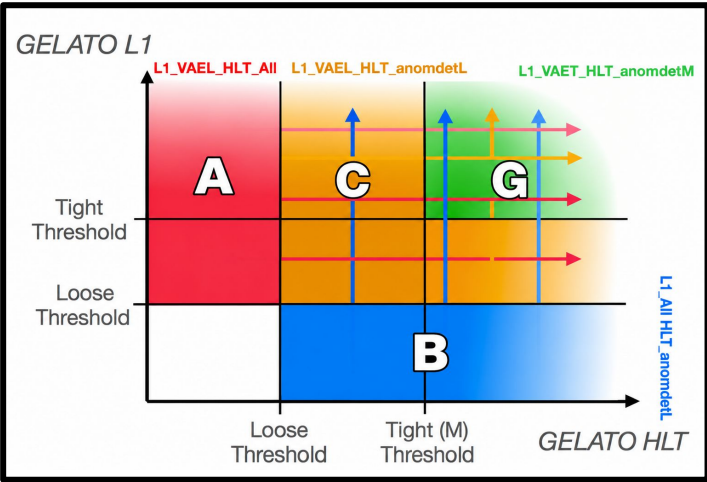
$$\epsilon_G = P(G \mid C) \cdot P(A \mid B) \cdot P(B)$$

$$= P(G \mid C) \cdot P(A \mid B) \cdot P(B \mid A) \cdot \left[\frac{P(B)}{P(B \mid A)} \right]$$

$$= P(G \mid C) \cdot P(A \mid B) \cdot P(B \mid A) \cdot \frac{1}{\kappa}$$

So

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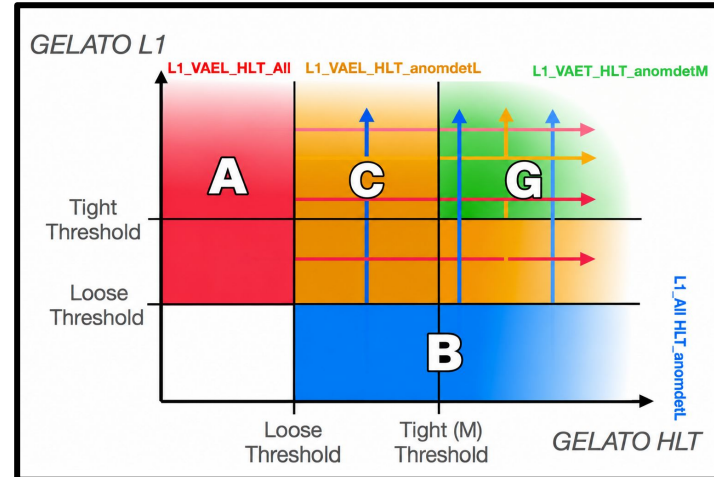
$$\kappa = \frac{P(B \mid A)}{P(B)} = \frac{P(A \mid B)}{P(A)}$$

$$\epsilon_G = \frac{\text{green}}{\text{yellow}} \cdot \frac{\text{yellow}}{\text{blue}} \cdot \frac{\text{yellow}}{\text{red}} \cdot \frac{1}{\kappa}$$

$$\kappa = \frac{P(B | A)}{P(B)}$$

Of course, we can't calculate κ in physMain.

But maybe, if it is a small correction, we can calculate it in ZB or EB?



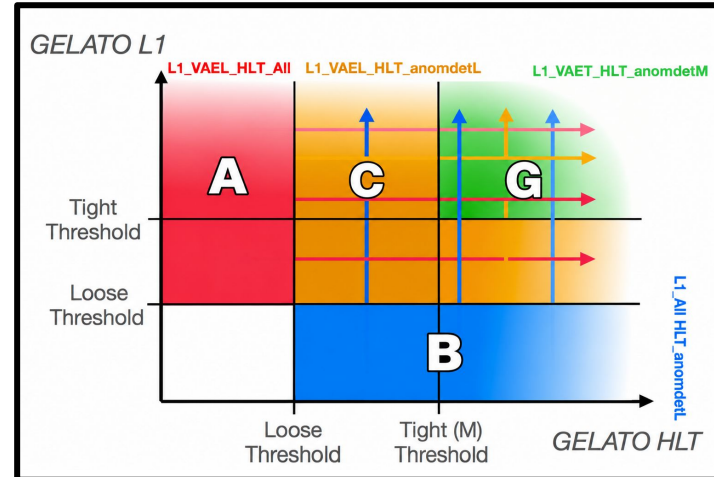
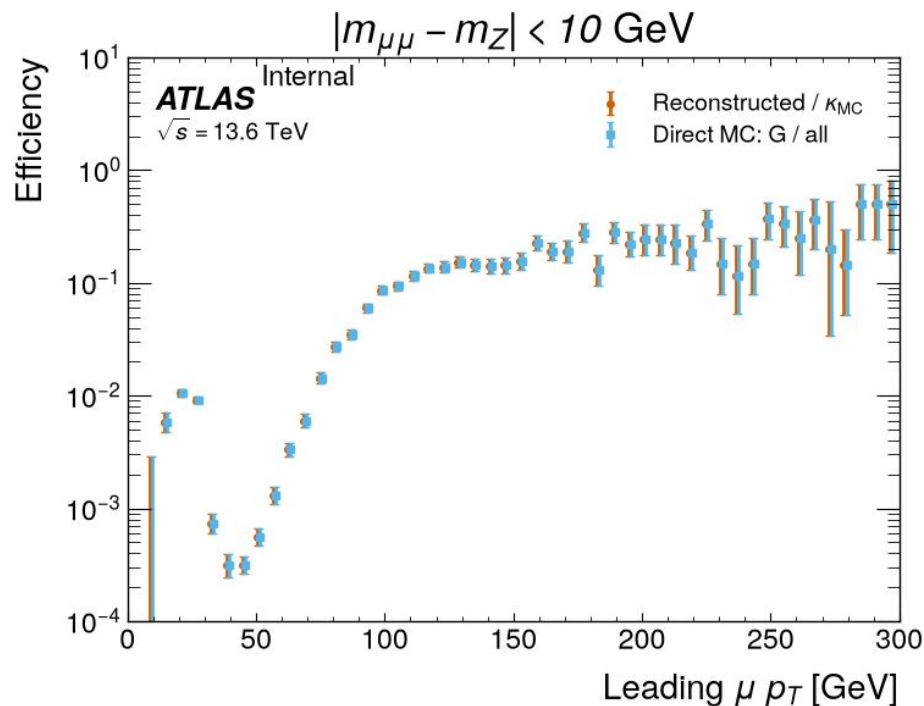
In MC, I can calculate κ directly:

$$P(B) = N_{\text{HLTL}}/N_{\text{all}}$$

...

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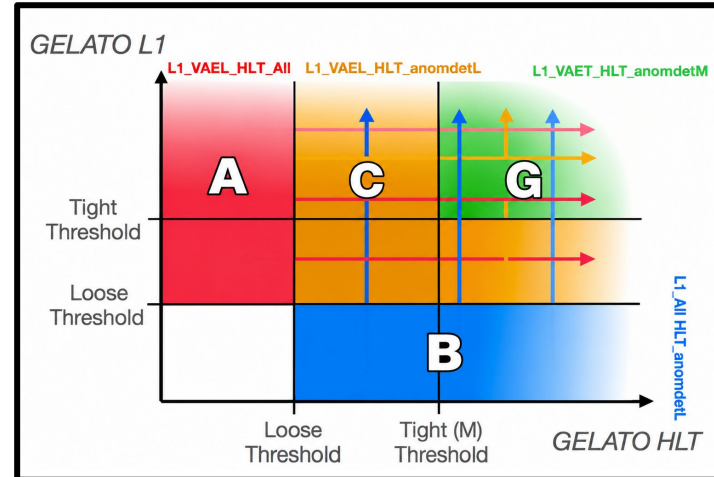
(of course, algebraically, the resulting efficiency simplifies to the old N_G / N_{all} , but it is still a good test of implementation)

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$$\kappa = \frac{P(B | A)}{P(B)} = \frac{P(A | B)}{P(A)}$$

and

$$P(A | B) = \frac{C}{B}$$

So we just need to measure $P(A)$.
The rate of $A \simeq 35$ kHz, so

$$P(A) \simeq \frac{35 \text{ kHz}}{40 \text{ MHz}} \simeq 8.75 \times 10^{-4}$$

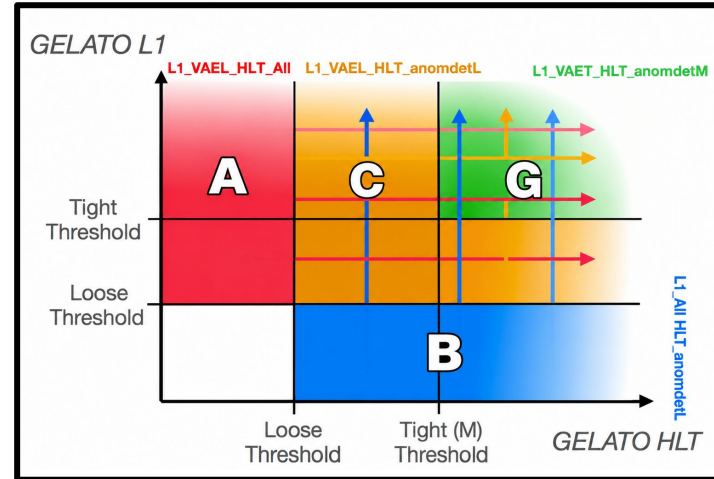
And the uncertainty is

$$\frac{1}{\sqrt{N_{\text{ZB}} \cdot P(A)}}$$

So if we want 1% uncertainty, then we need approximately

$$N_{\text{ZB}} \simeq 1.14 \times 10^7$$

events.



But maybe we want to calculate κ in bins of different variables.

e.g. maybe the correlation depends on jet pt, multiplicity, etc.

How does one usually do this?