Searching for the Double Higgs Production

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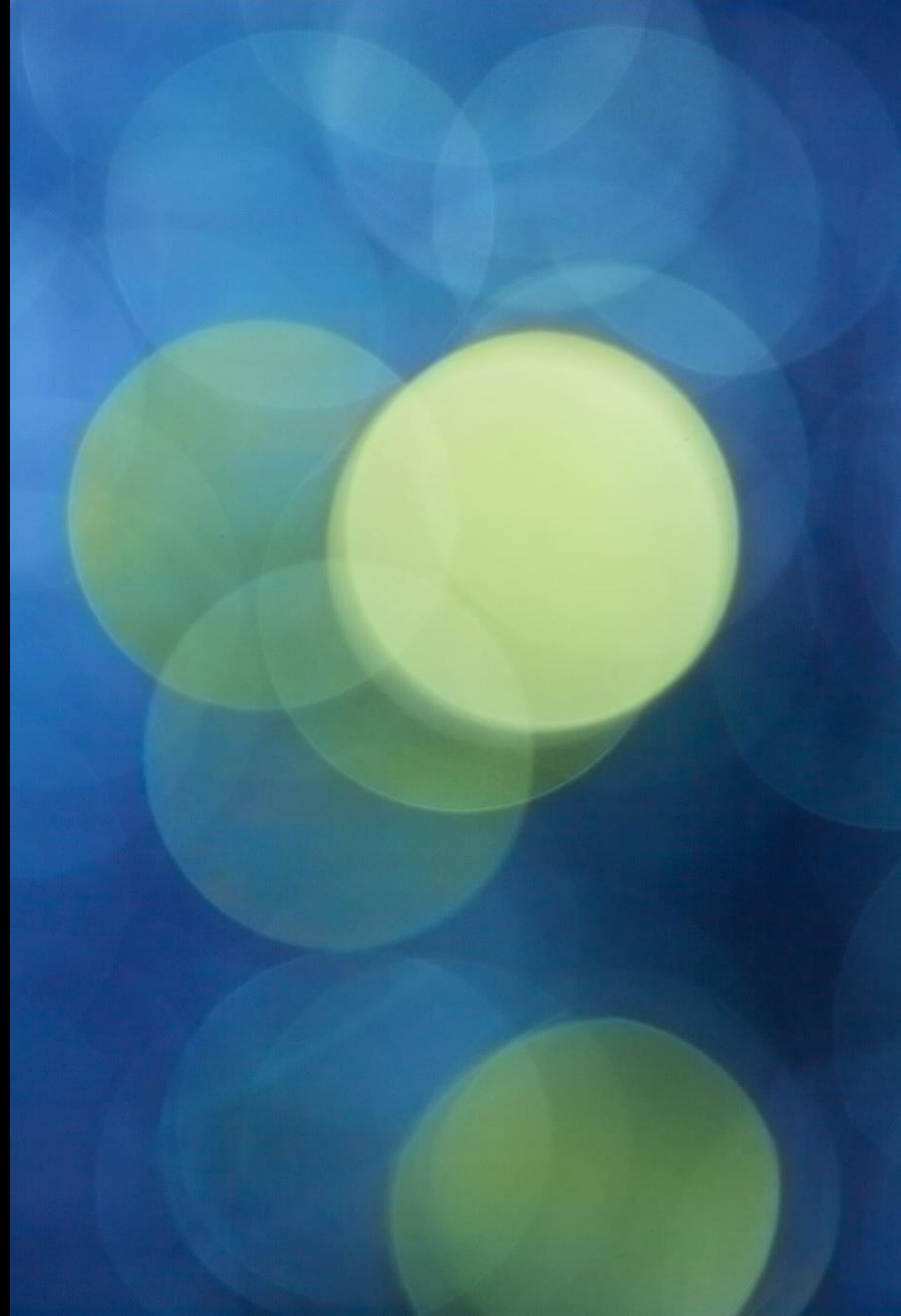
Overview

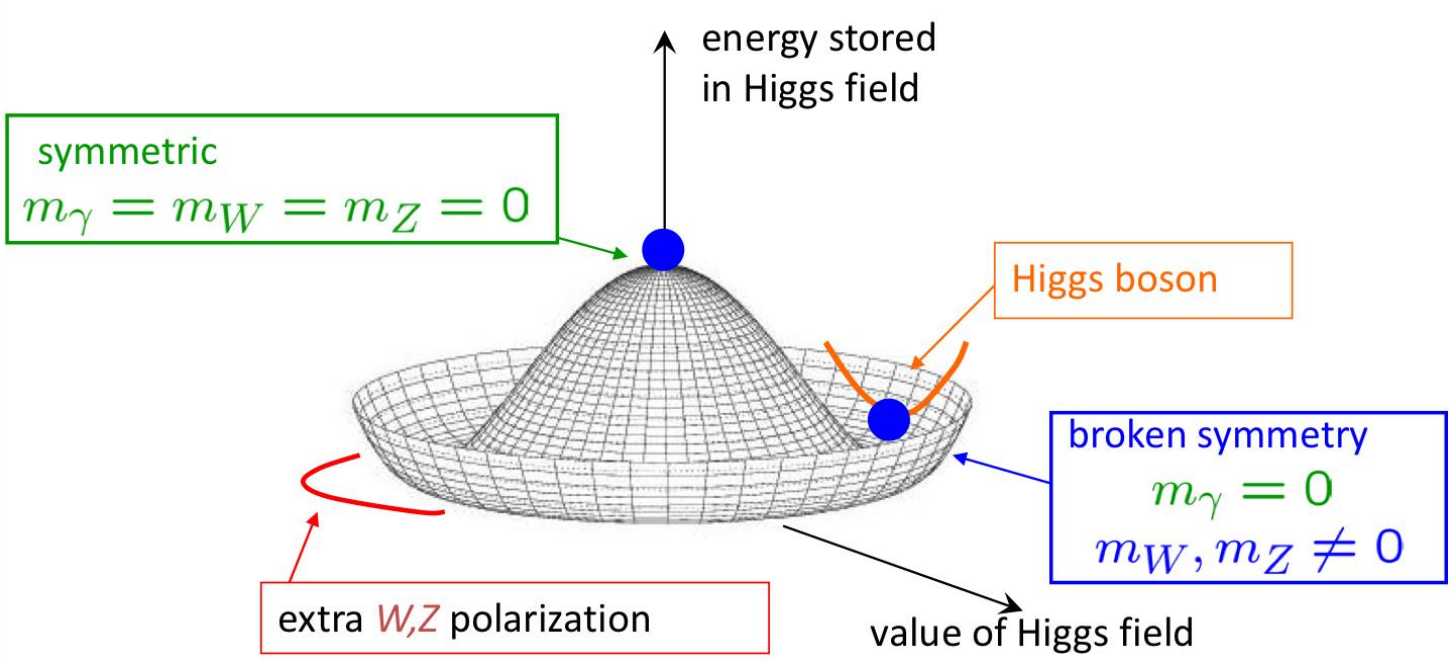
- Hunting for potential
- Double Higgs in the Standard model (SM)
- Double Higgs decays
- Chosen Double Higgs production
- Using simulations to find the DiHiggs



Hunting for Potential

Why is the finding the DiHiggs important?

- Higgs potential in SM
- What finding the DiHiggs can tell us



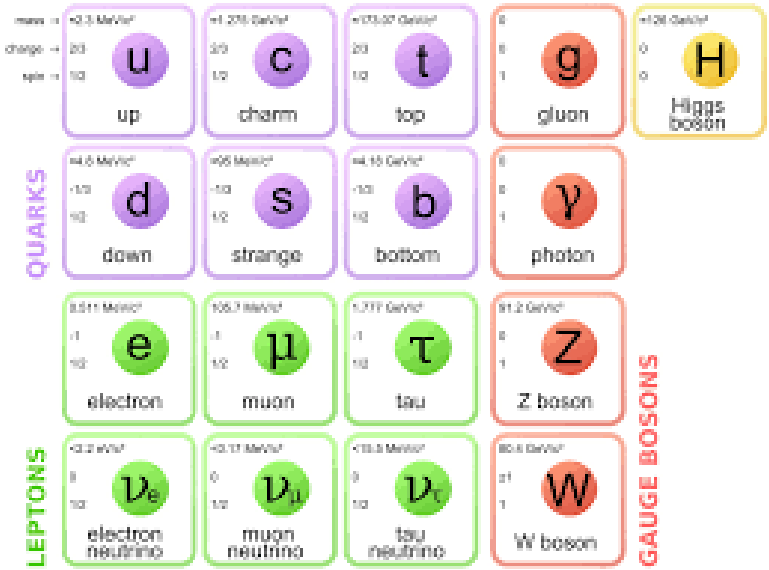
Double Higgs in the SM

- Higgs potential: $V(\varphi) = -\frac{1}{2}\mu^2\varphi^2 + \frac{1}{4}\lambda\varphi^4$
- Expand around the vacuum expectation value: $V(\phi) \rightarrow V(v + h)$
- Math happens here
- $V(h) = V_0 + \frac{1}{2}m_h^2 h^2 + \frac{m_h^2}{2v^2}vh^3 + \frac{1}{4}\frac{m_h^2}{2v^2}h^4 + \cdots$

Mass Term

Higgs trilinear self-coupling

Higgs quadratic self-coupling

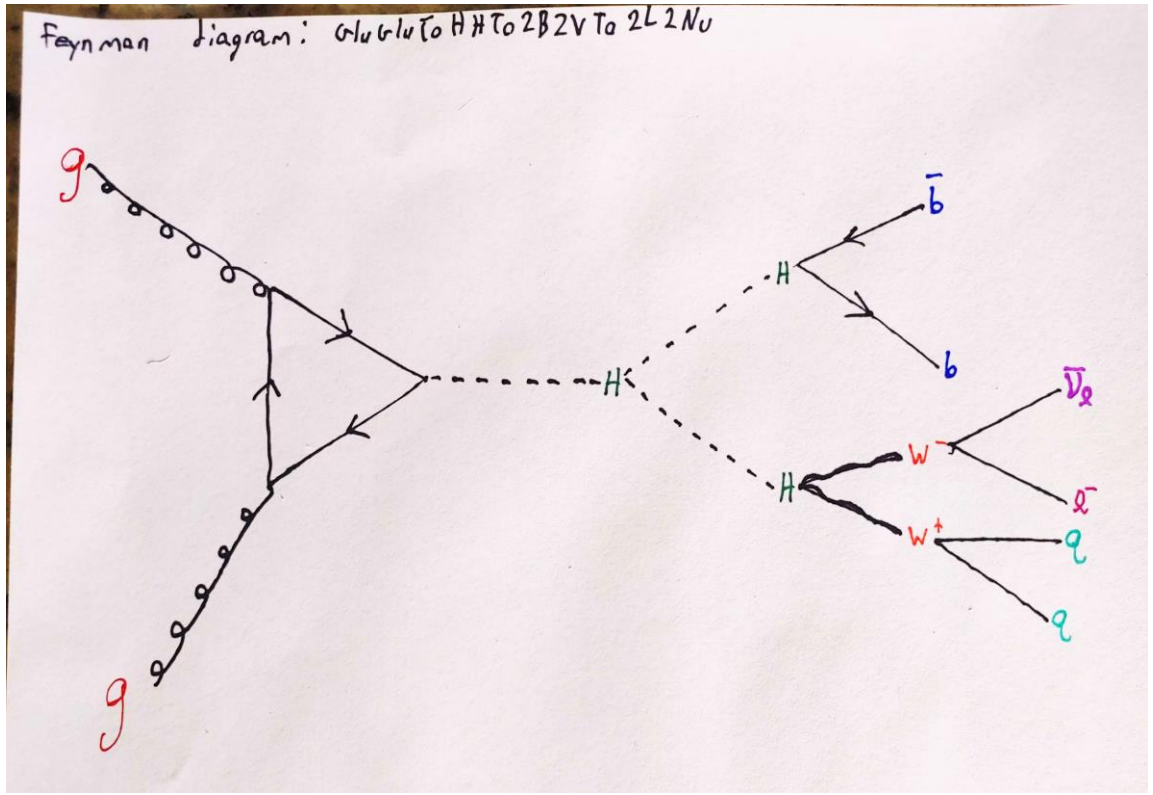


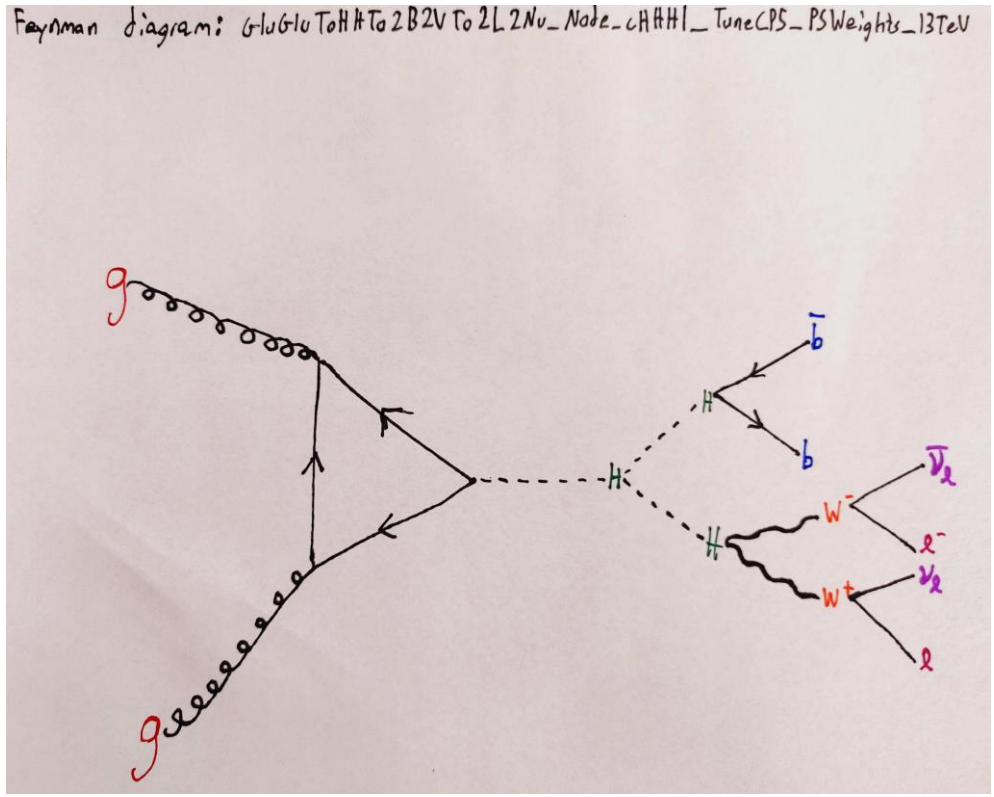
Double Higgs decays

	bb	WW	ττ	ZZ	γγ
bb	34%				
WW	25%	4.6%			
ττ	7.3%	2.7%	0.39%		
ZZ	3.1%	1.1%	0.33%	0.069%	
γγ	0.26%	0.10%	0.028%	0.012%	0.0005%

Chosen Double Higgs Production

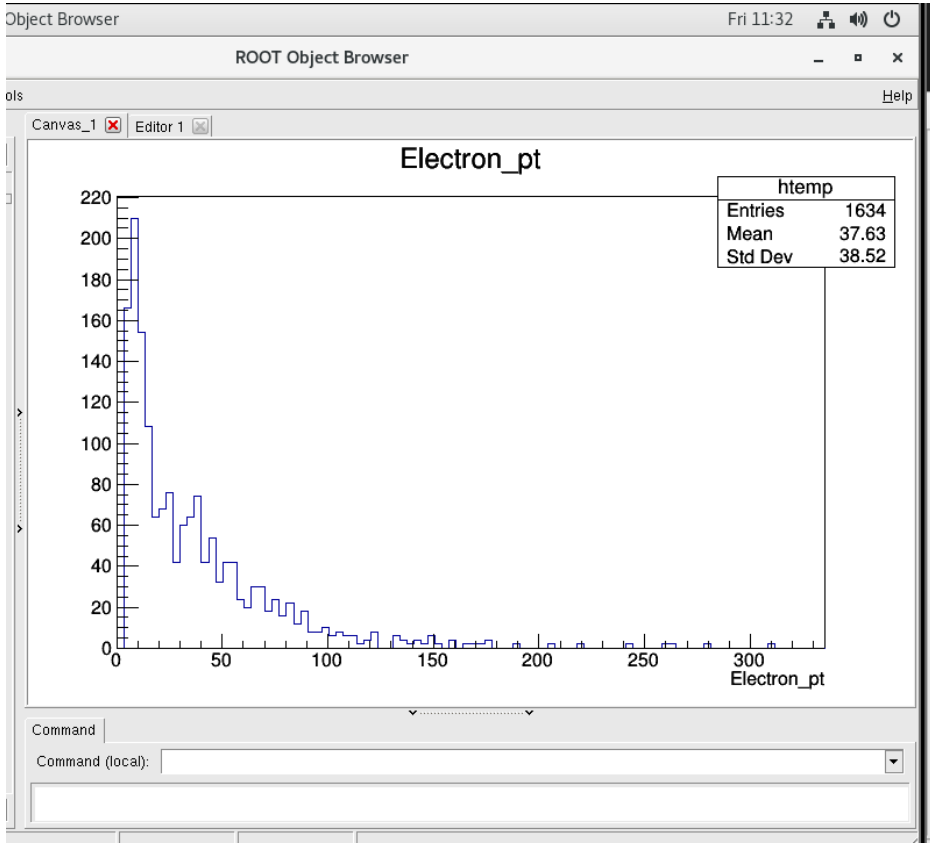
- The bbWW is the DiHiggs decay chosen to analyze
  - The DiHiggs has a very low chance of occurring
  - There is a lot more background (tt-bar) noise that occurs

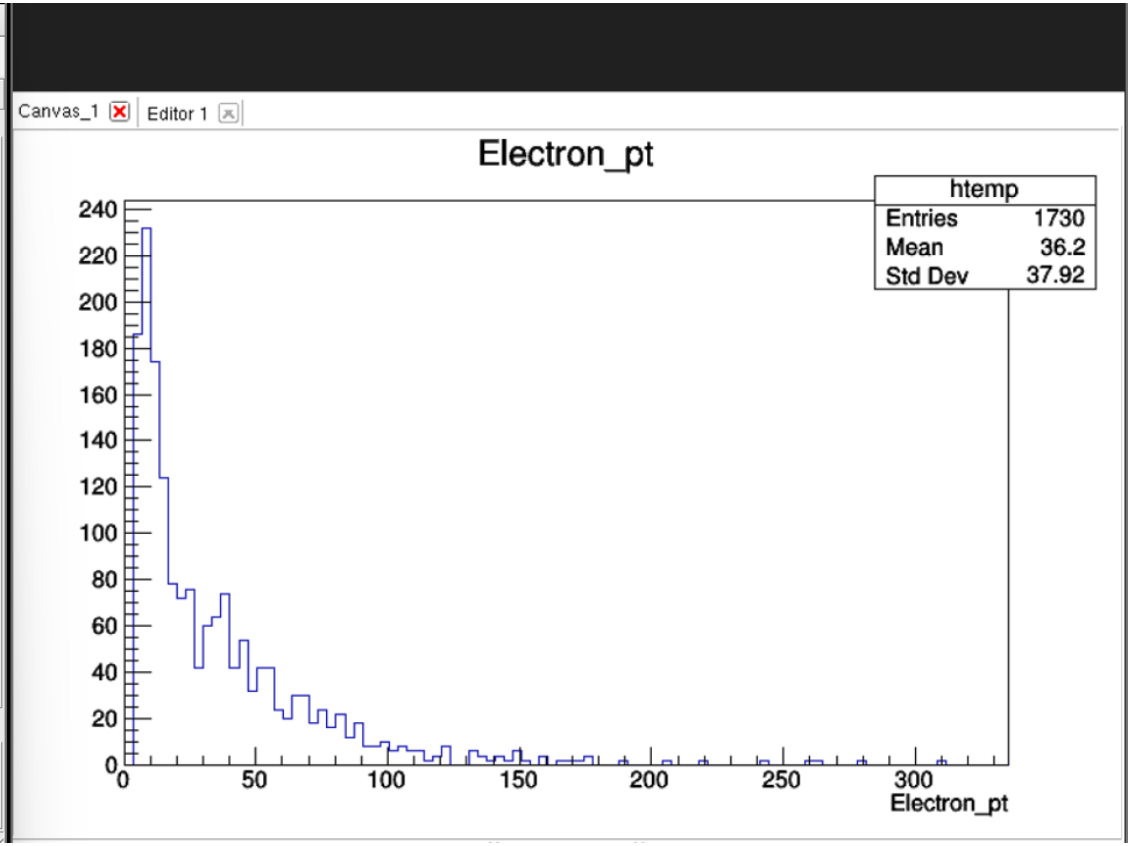




Using Simulations to find the DiHiggs

Preselection





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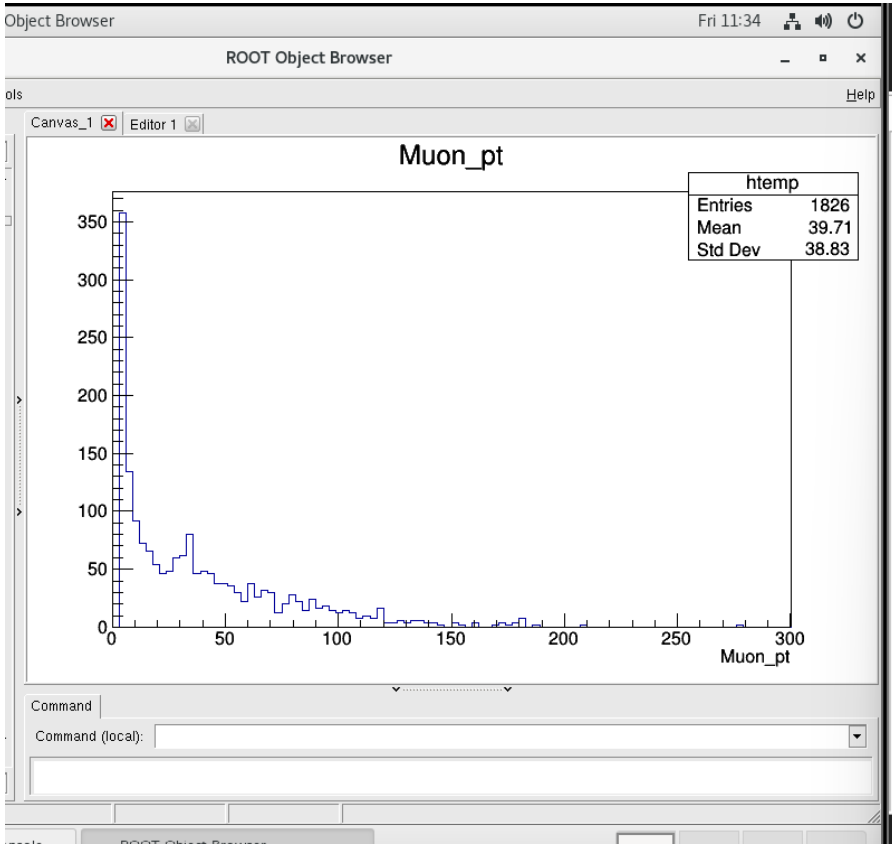

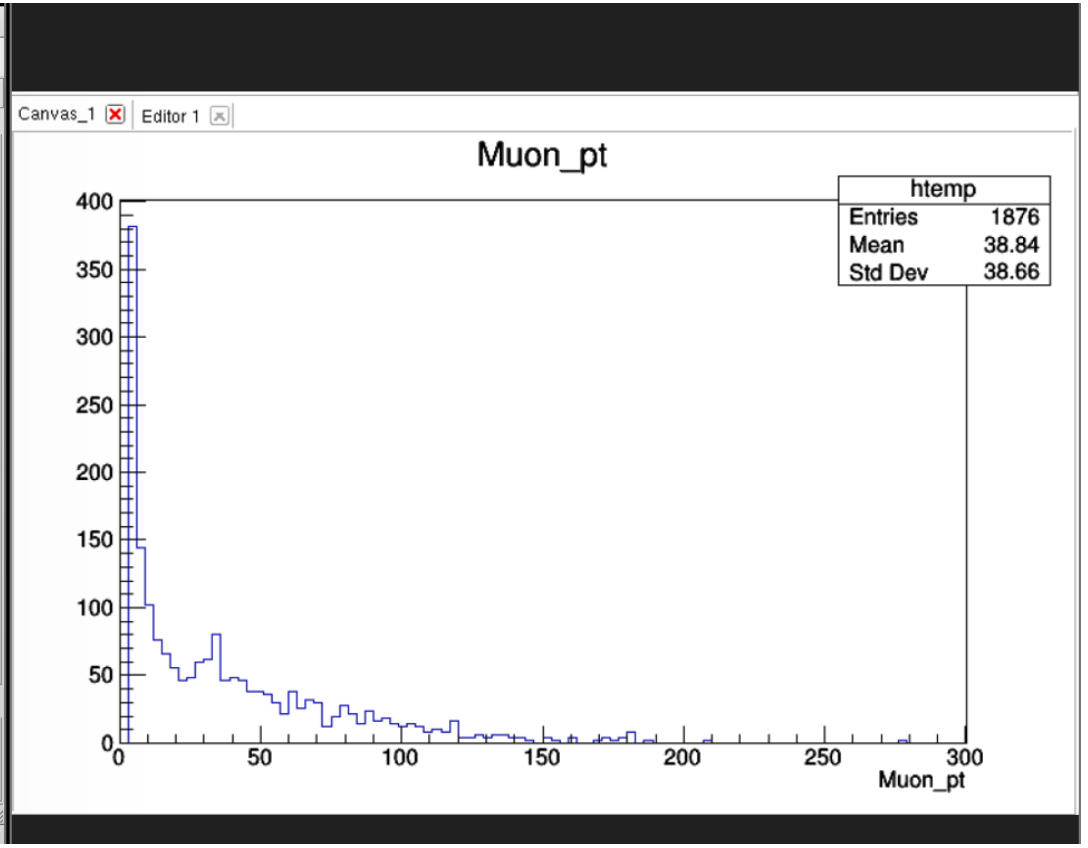

Preselection