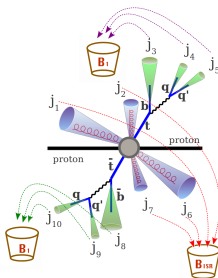


# Buckets of tops algorithm: C++ version update



source: <https://tinyurl.com/y7uvbjre>

Sourav Sen  
Duke

BSM 4-tops discussion  
September 7, 2018

# Buckets of tops Algorithm<sup>1</sup> [code repo]

## step 1 Complete top quark ('tw') bucket search

- ▶ distribute jets into two buckets, such that each has 1 b-jet and minimum  $\Delta^2 = 100 * \Delta_{B1}^2 + \Delta_{B2}^2$ ,  $\Delta_{B1(2)} = |m_{B1(2)} - m_{top}|$
- ▶ if bucket mass not within (155 GeV, 200 GeV) then 't0'
- ▶ if  $|\frac{m_{any\ jet\ pair}}{m_{B_i}} - \frac{m_W}{m_{top}}| < 0.15$  then 'tw' else proto-'t-'

## step 2 Incomplete top quark ('t-') bucket search

- ▶ exclude all jets in 'tw' buckets
- ▶ if event has one proto-'t-' bucket, find the b-jet quark-jet pair with minimum  $\Delta_B^{bj}$ , where:

$$\Delta_B^{bj} = \begin{cases} |m_B - 145| & \text{if } m_B < 155 \text{ GeV} \\ 0 & \text{else} \end{cases}$$

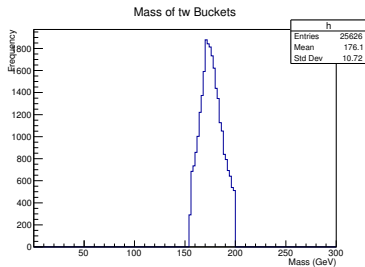
- ▶ if event has two proto-'t-' buckets, find two b-jet quark-jet pairs with minimum  $\Delta_{B1}^{bj} + \Delta_{B2}^{bj}$
- ▶ if bucket mass within (75 GeV, 155 GeV) then 't-' else 't0'
- ▶ any leftover jet is put in extra bucket 'tX'

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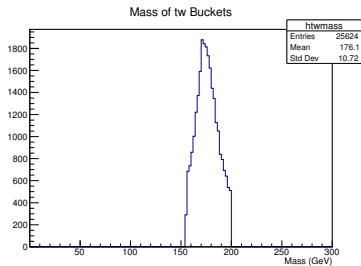
<sup>1</sup>ATL-COM-PHYS-2016-1496

## bbjjj comparison

version	tw	t-	t0	tX
python	25626	7132	167242	92123
C++	25624	7132	167244	92077

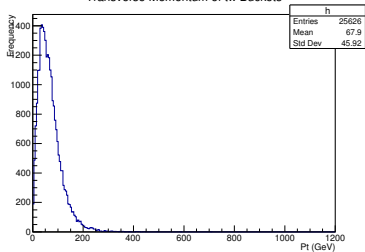


Chongbin(python)



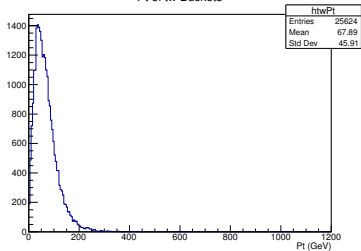
C++

Transverse Momentum of tw Buckets

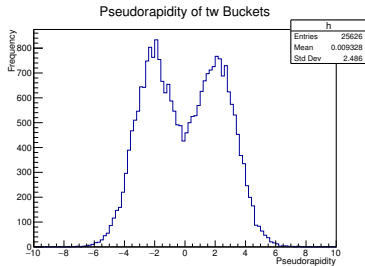


Chongbin(python)

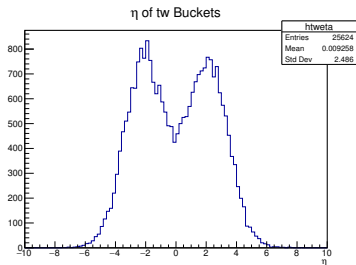
Pt of tw Buckets



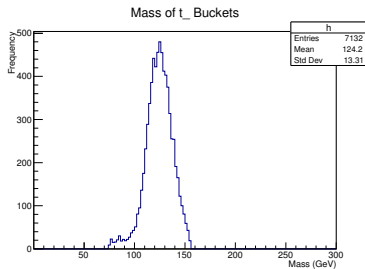
C++



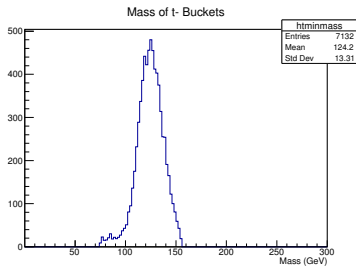
Chongbin(python)



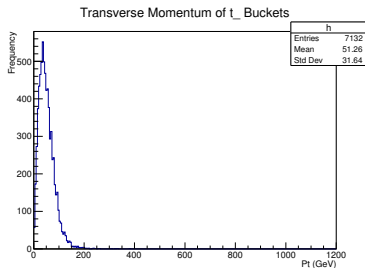
C++



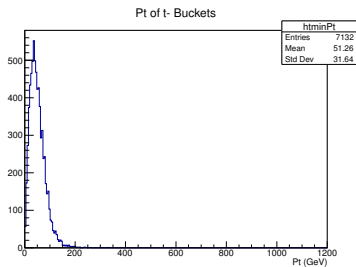
Chongbin(python)



C++

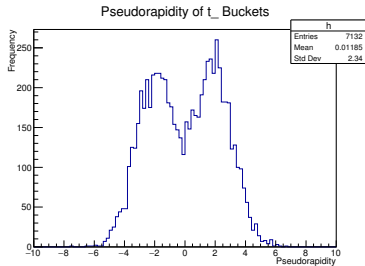


Chongbin(python)

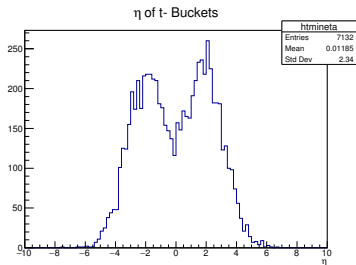


C++

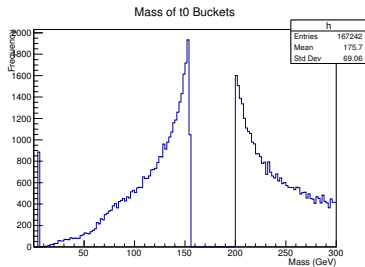




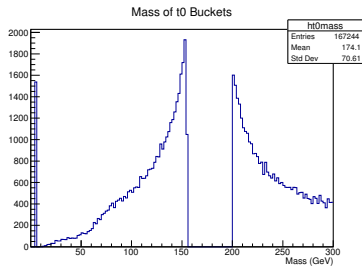
Chongbin(python)



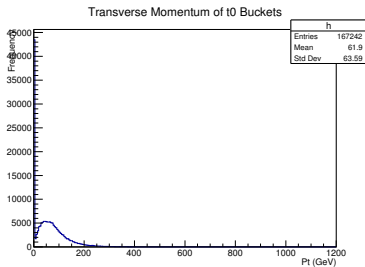
C++



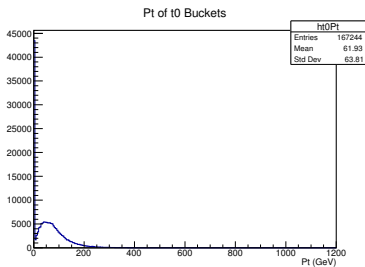
Chongbin(python)



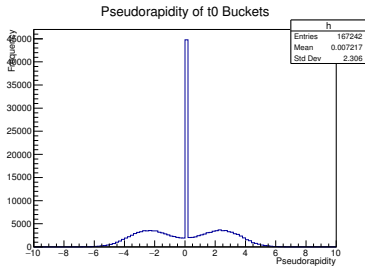
C++



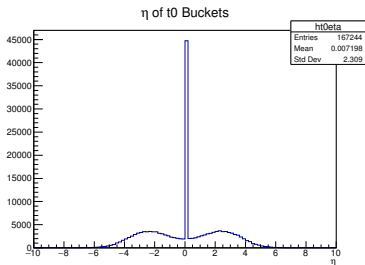
Chongbin(python)



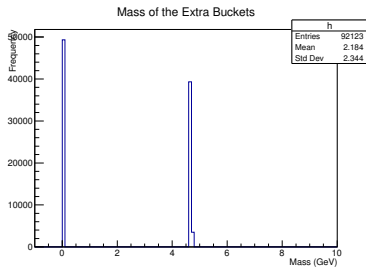
C++



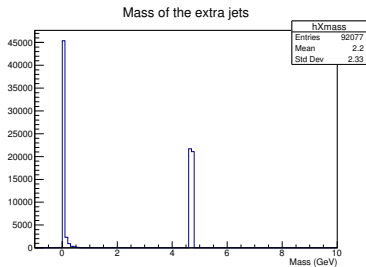
Chongbin(python)



C++

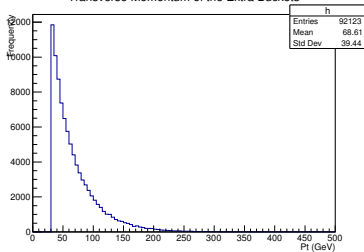


Chongbin(python)



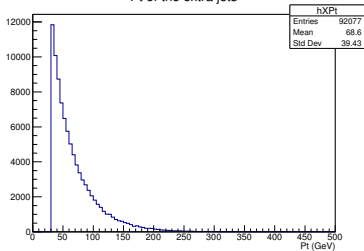
C++

Transverse Momentum of the Extra Buckets



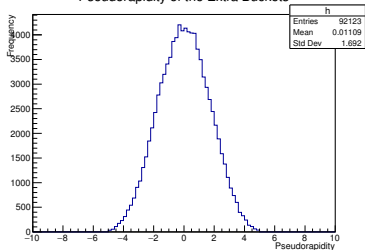
Chongbin(python)

Pt of the extra jets



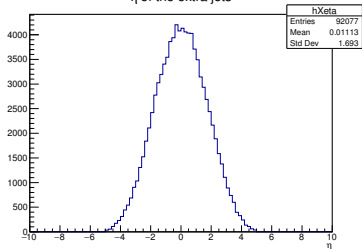
C++

Pseudorapidity of the Extra Buckets

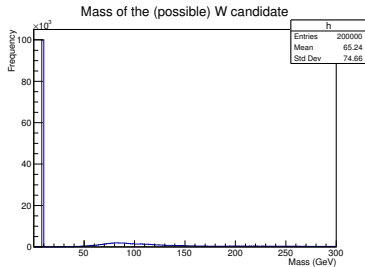


Chongbin(python)

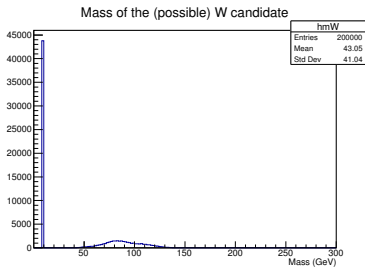
$\eta$  of the extra jets



C++



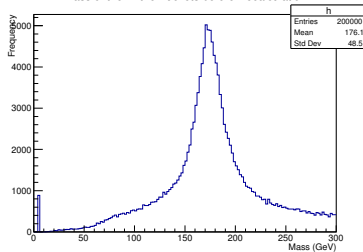
Chongbin(python)



C++

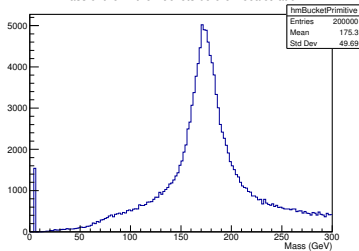


Mass of the Entire Buckets before Recalculation

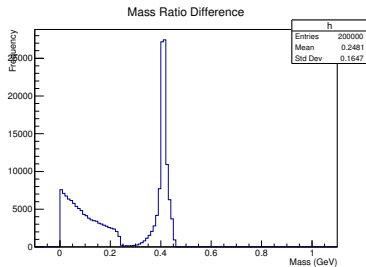


Chongbin(python)

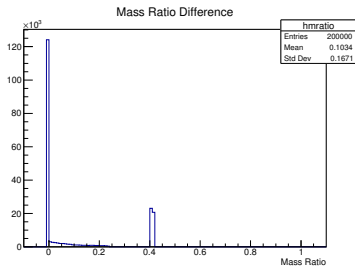
Mass of the Entire Buckets before Recalculation



C++



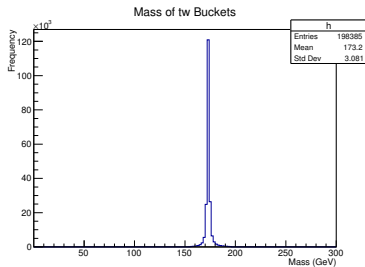
Chongbin(pyton)



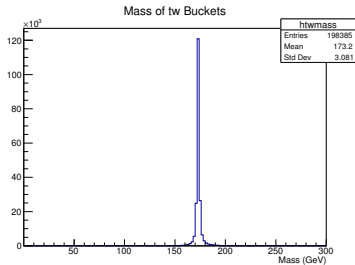
C++

## ttbar comparison

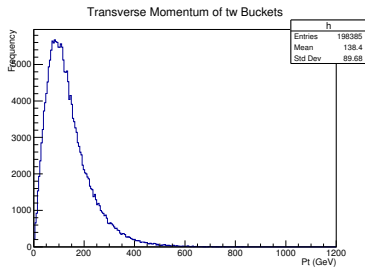
version	tw	t-	t0	tX
python	198385	1040	575	1262
C++	198385	1040	575	1262



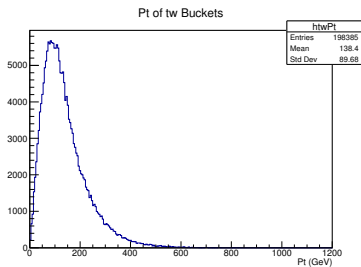
Chongbin(python)



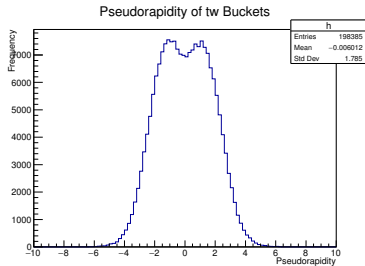
C++



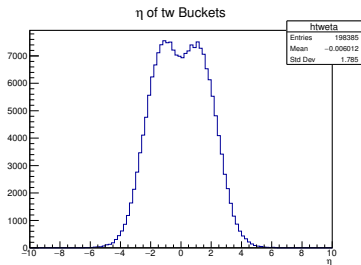
Chongbin(python)



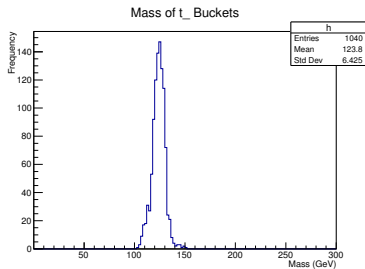
C++



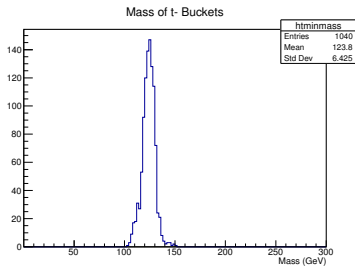
Chongbin(python)



C++

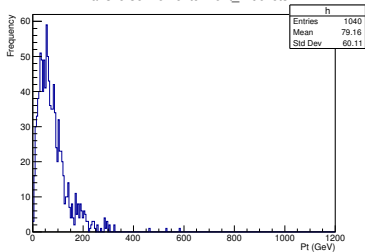


Chongbin(python)



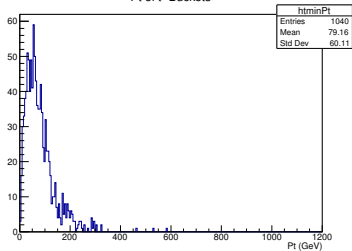
C++

Transverse Momentum of t\_ Buckets



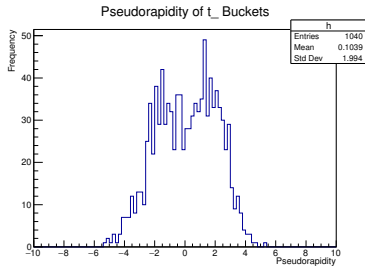
Chongbin(python)

Pt of t- Buckets

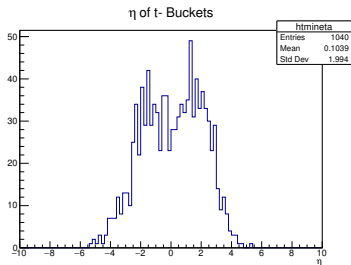


C++

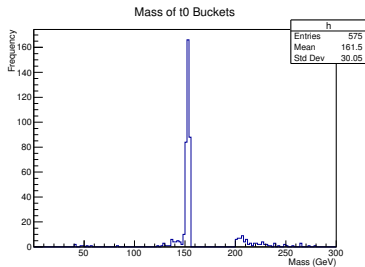




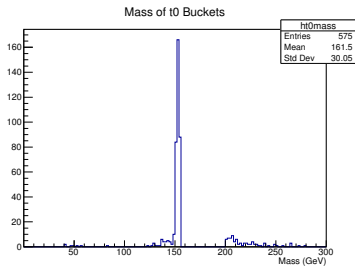
Chongbin(python)



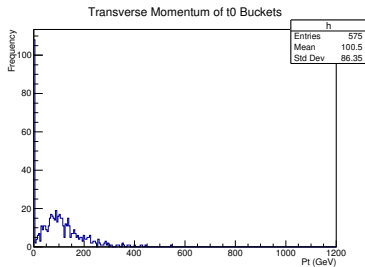
C++



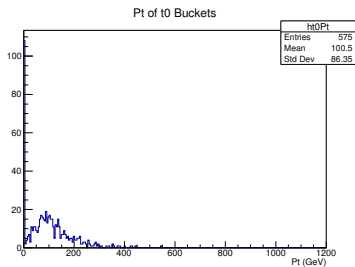
Chongbin(python)



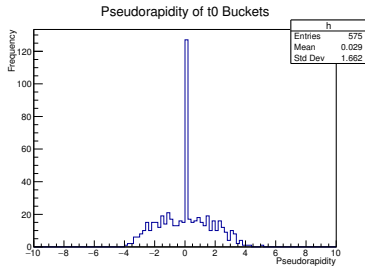
C++



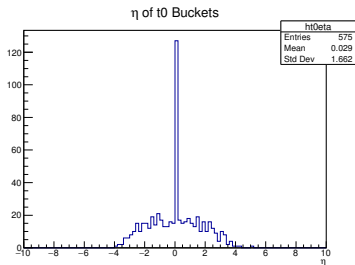
Chongbin(python)



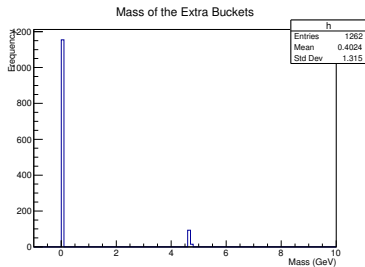
C++



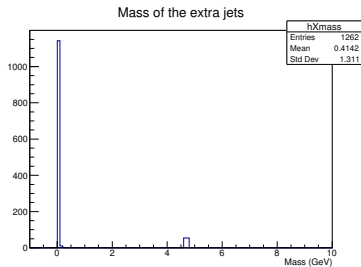
Chongbin(python)



C++

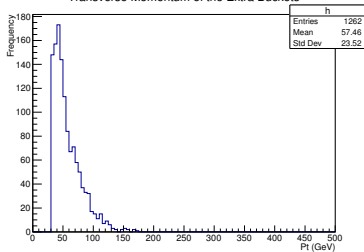


Chongbin(python)



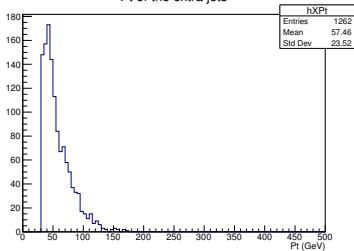
C++

Transverse Momentum of the Extra Buckets

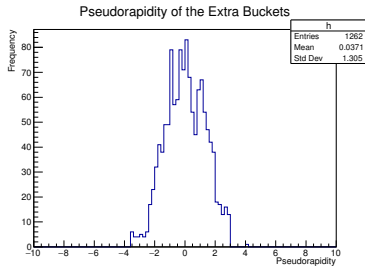


Chongbin(python)

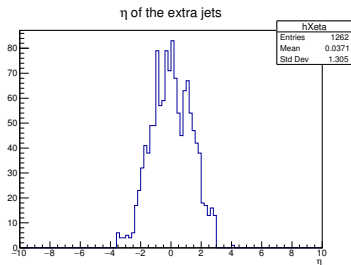
Pt of the extra jets



C++

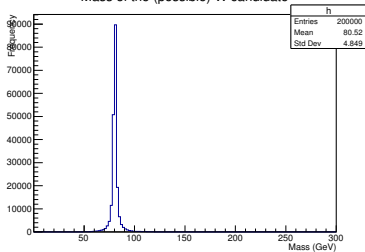


Chongbin(python)



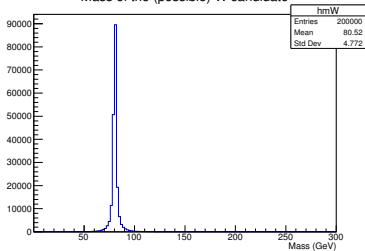
C++

Mass of the (possible) W candidate



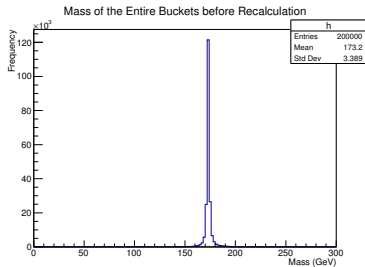
Chongbin(python)

Mass of the (possible) W candidate

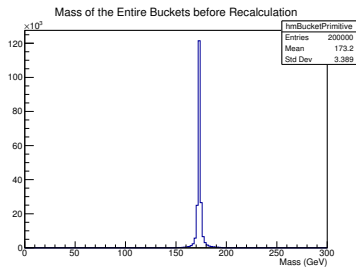


C++

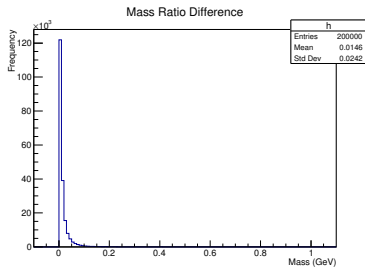




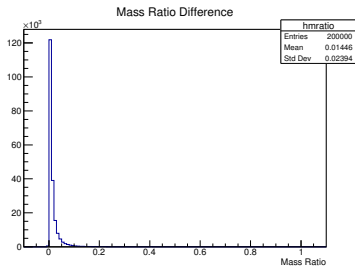
Chongbin(python)



C++



Chongbin(python)



C++

## Bug fixes in the python version

- ▶ jet pair with minimum mass-ratio is obtained and then checked if less than 0.15 (to assign 'tw' flag)
- ▶ nested for loops for b jet - q jet pair in single and double 't-' re-bucketing corrected
- ▶ proto-'t-' bucket was not being updated as empty when absent
- ▶ condition: `if ( $|mass^2| < 0.01$ ) then  $mass = 0$`  was changed to:  
`if ( $mass^2 < 0$ ) then  $mass = 0$`

# Summary

- ▶ Some discrepancies in the case of  $bb + 3\text{-jets}$
- ▶ WIP: find bugs in either versions to converge at the correct algorithm