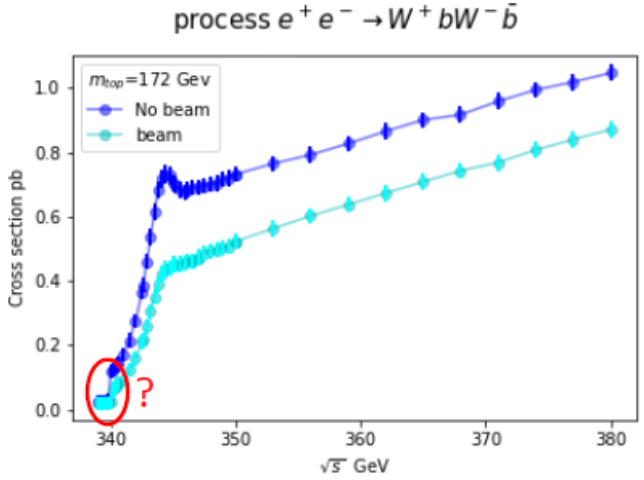
Event generation with whizard update

Problem encountered last time

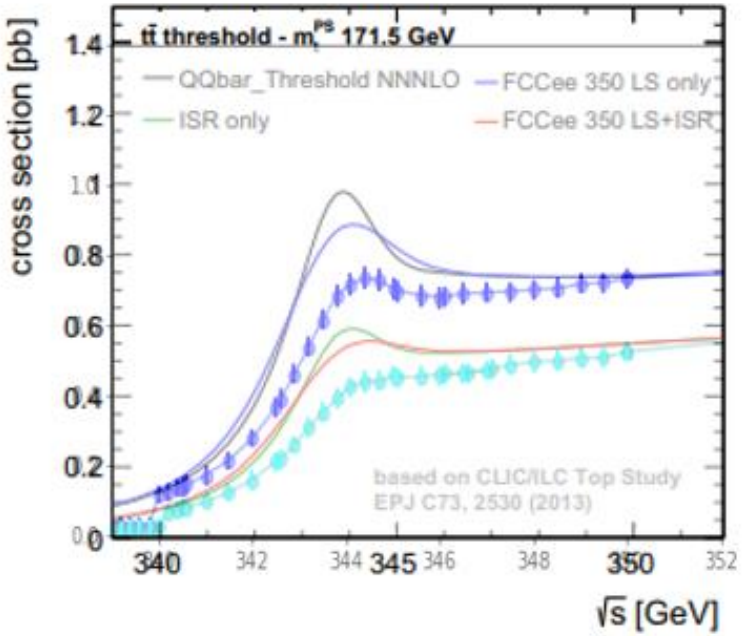
- Discontinuity origin at 340 GeV

  ➡ calculation grid from Whizard Log File

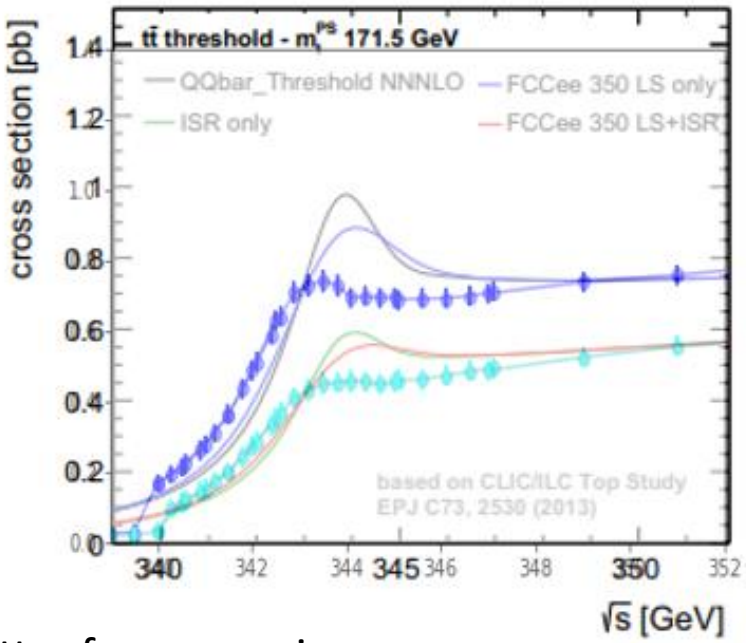


- Comparison with a study:

M_{top}=172 GeV



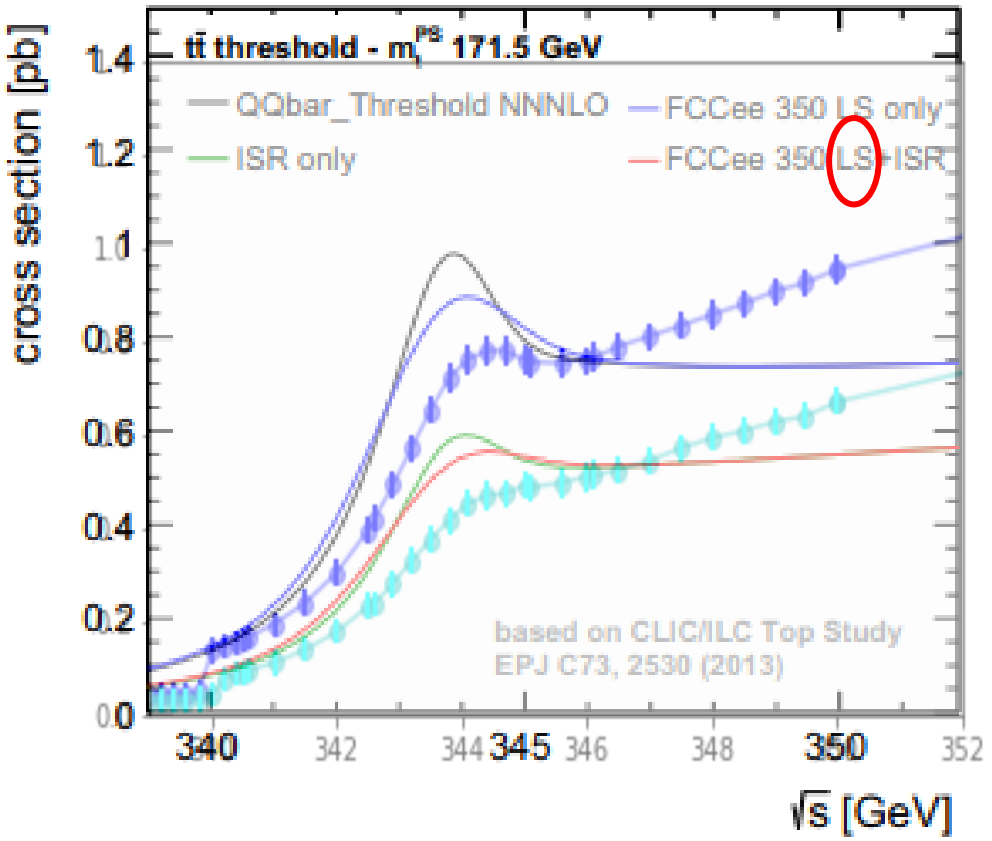
M_{top}=171,5 GeV



➡ M_{top}=172 GeV better for comparison

Comparison with a study

SM + SM_tt_threshold



LS = BES ?

➡ Blue lines little higher but not the same comportement from 346 GeV

Generate distribution study

3 steps :

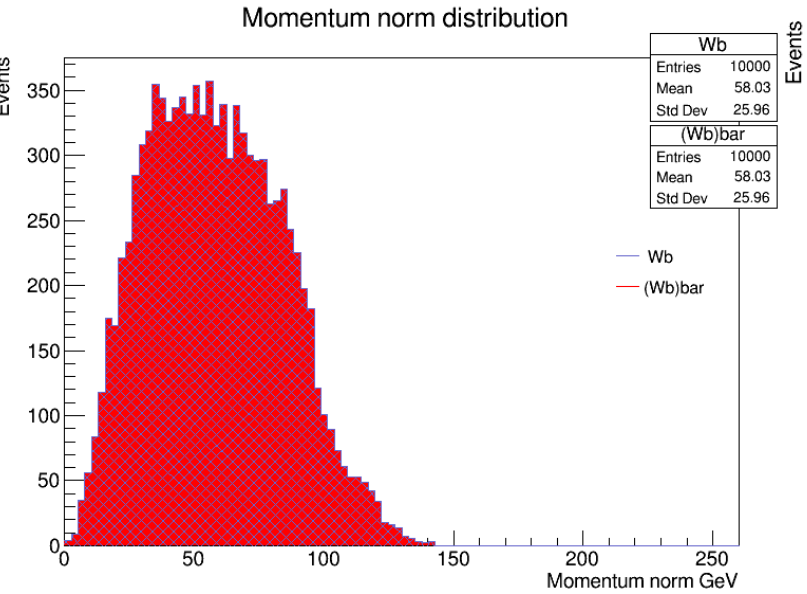
- Look at event kinematic for a $\sqrt{s}$

- Distribution evolution with center of mass energy

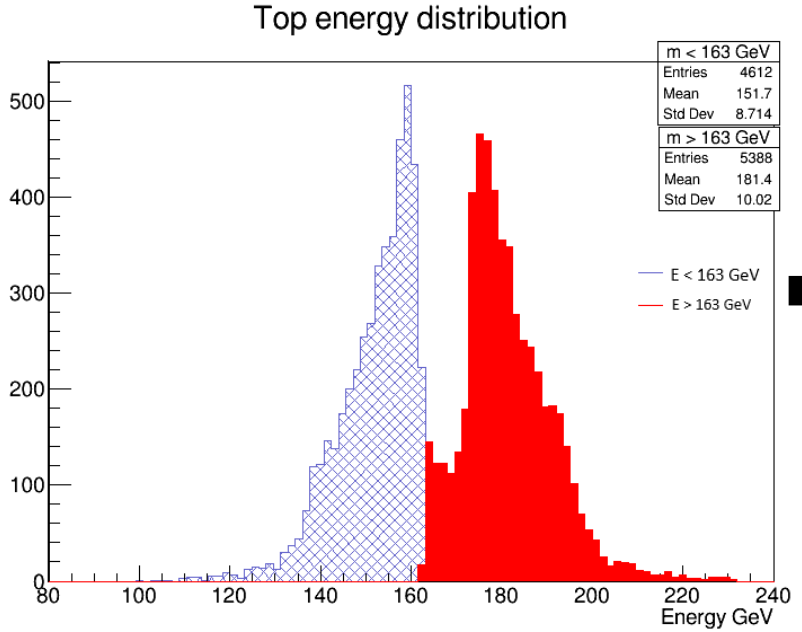
- Comparaison with MadGraph LHE file distribution

SM_tt_threshold

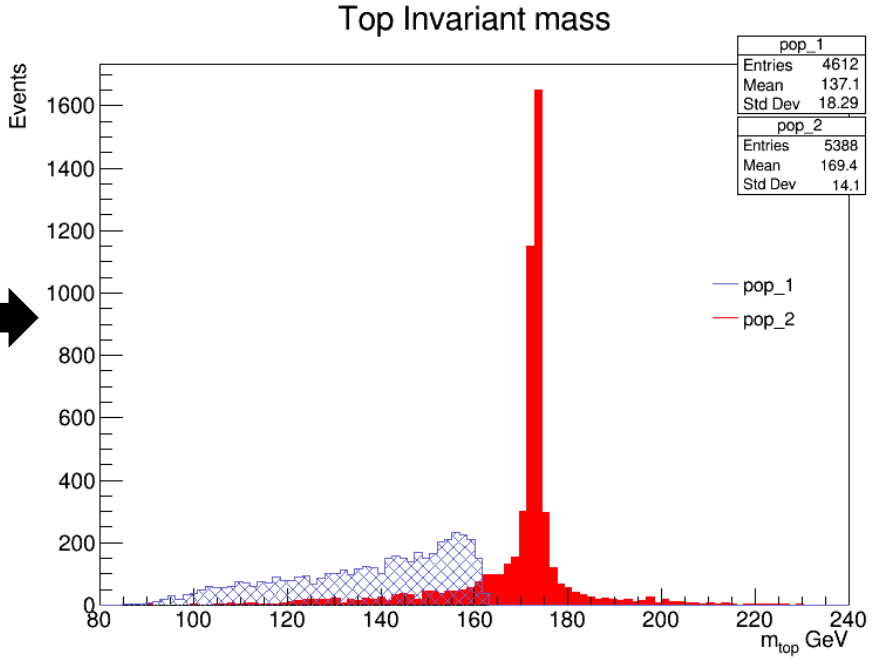
Top quark kinematic



$\sqrt{s} = 335\ GeV$ **Before threshold**



$\sqrt{s} = 335\ GeV$ **Before threshold**



$\sqrt{s} = 335\ GeV$ **Before threshold**

➡ Same shape

➡ Separate the virtual/real top quark contributions

➡ 2 contributions

Real Top =172 GeV

335-172=163 GeV

Cut at 163 GeV

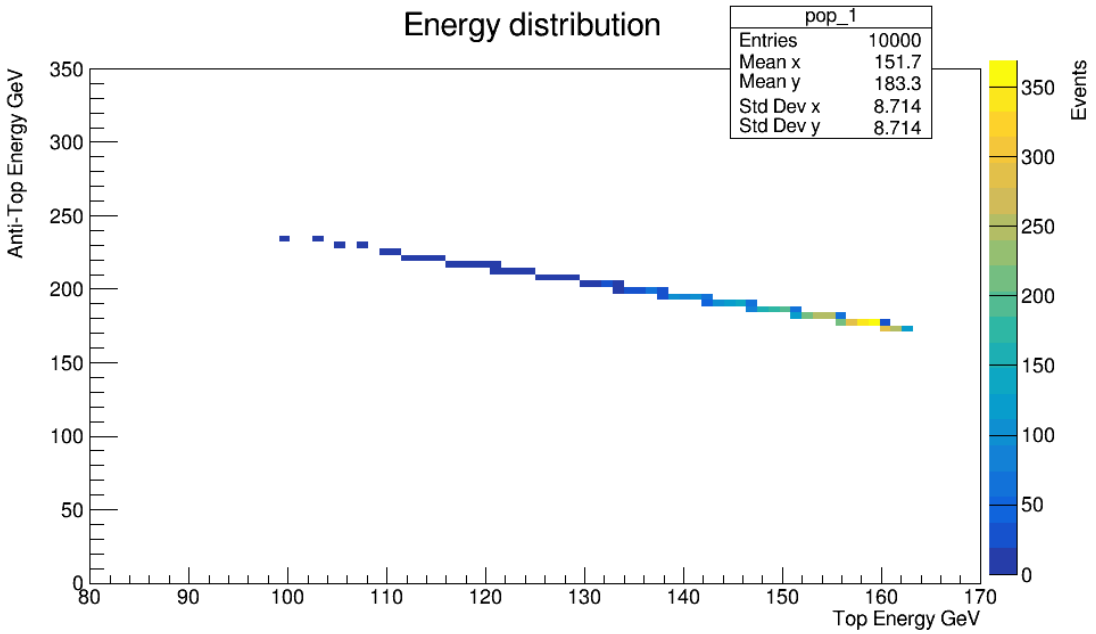
Continuum : virtual contribution

Peak : Real contribution

➡ Why there is a gap between the 2 peaks ?

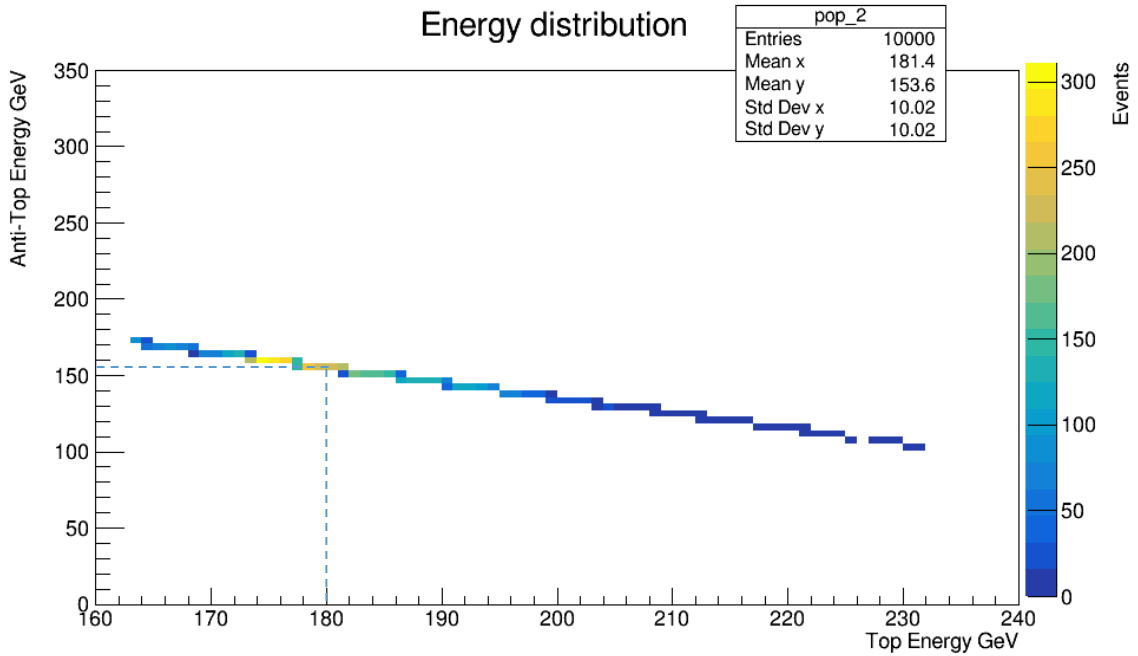
Top quark Energy distribution

Virtual Top contributions



$\sqrt{s} = 335\ GeV$ **Before threshold**

Real Top contributions



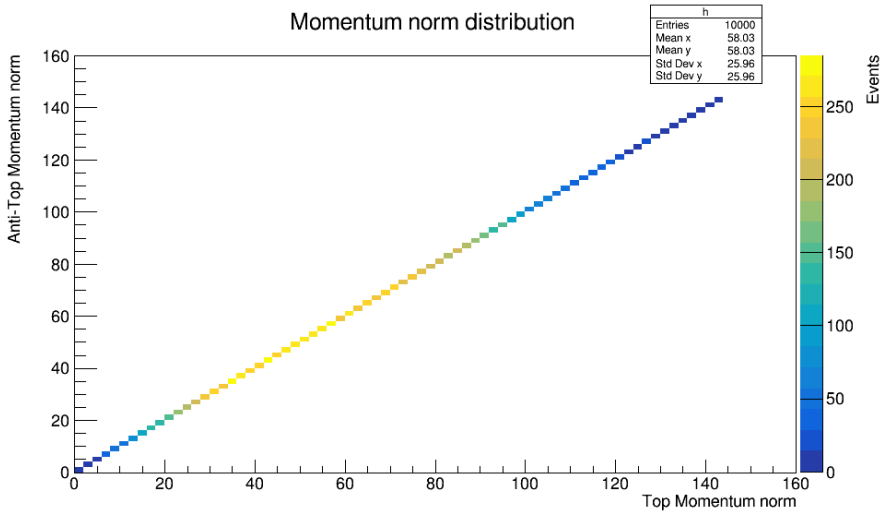
$\sqrt{s} = 335\ GeV$ **Before threshold**

$E_t + E_{\bar{t}} = 180 + 155 = 335$ GeV

➡ Distributions are anti-correlated

Why energy not distributed symmetrically ?

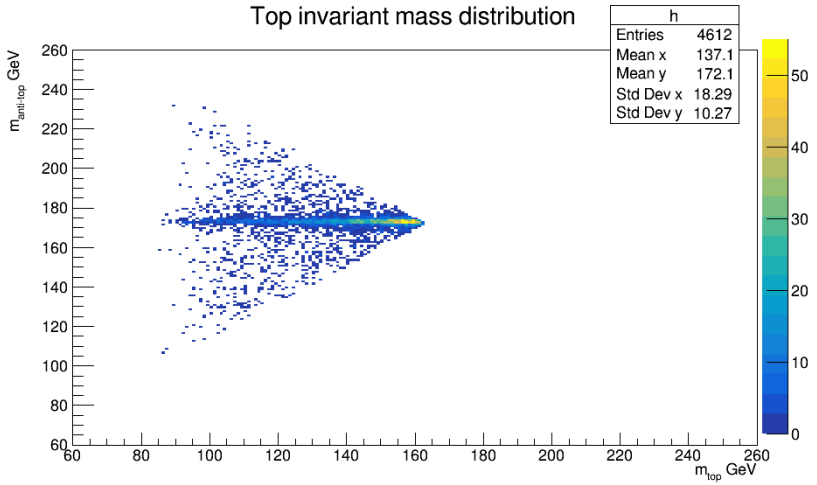
Top quark distribution



$\sqrt{s} = 335\ GeV$

Before threshold

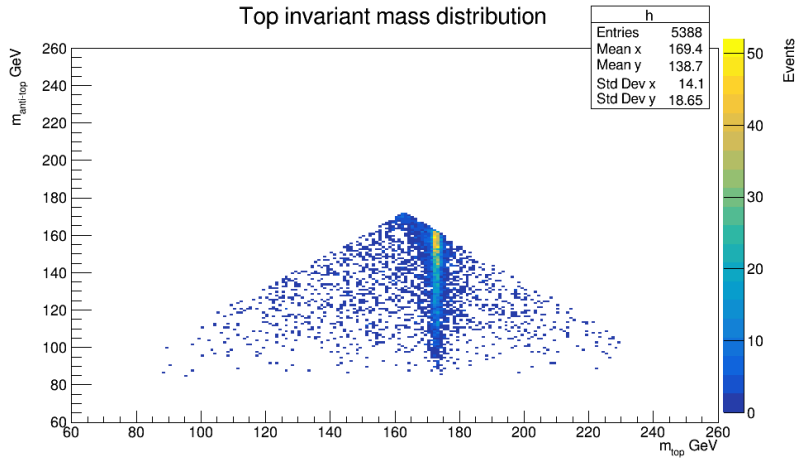
Virtual Top contributions



$\sqrt{s} = 335\ GeV$

Before threshold

Real Top contributions



$\sqrt{s} = 335\ GeV$

Before threshold

$$|\vec{p_t}| = |\vec{p_{\bar{t}}}|$$

$$\rightarrow \quad 2P^2 + m_t^2 + m_{\bar{t}}^2 + 2\sqrt{P^2 + m_t^2}\sqrt{P^2 + m_{\bar{t}}^2} = s$$

$$E = \sqrt{P^2 + m^2}$$

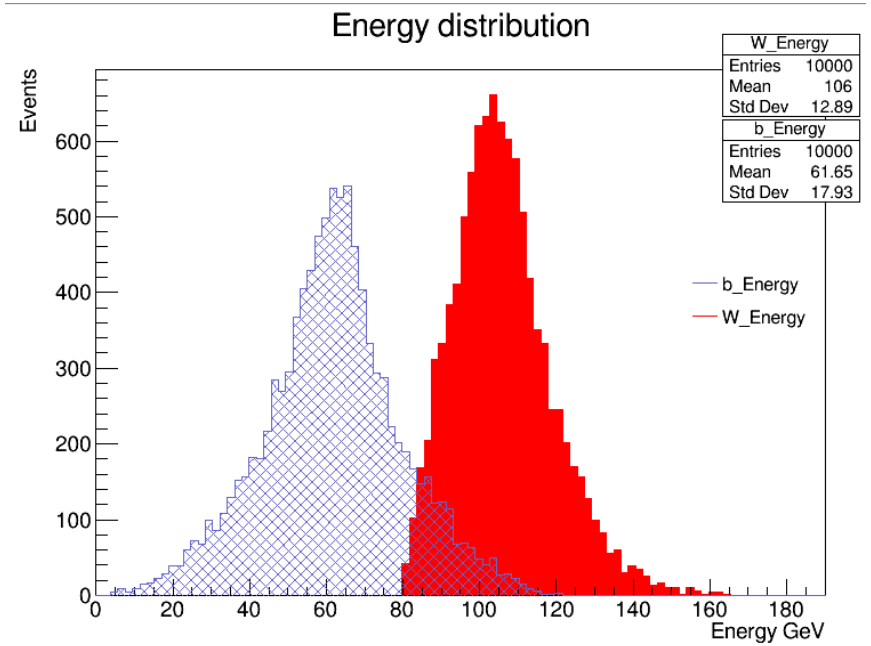
→ Top and Anti-Top asymmetry

Why energy not distributed symmetrically ?

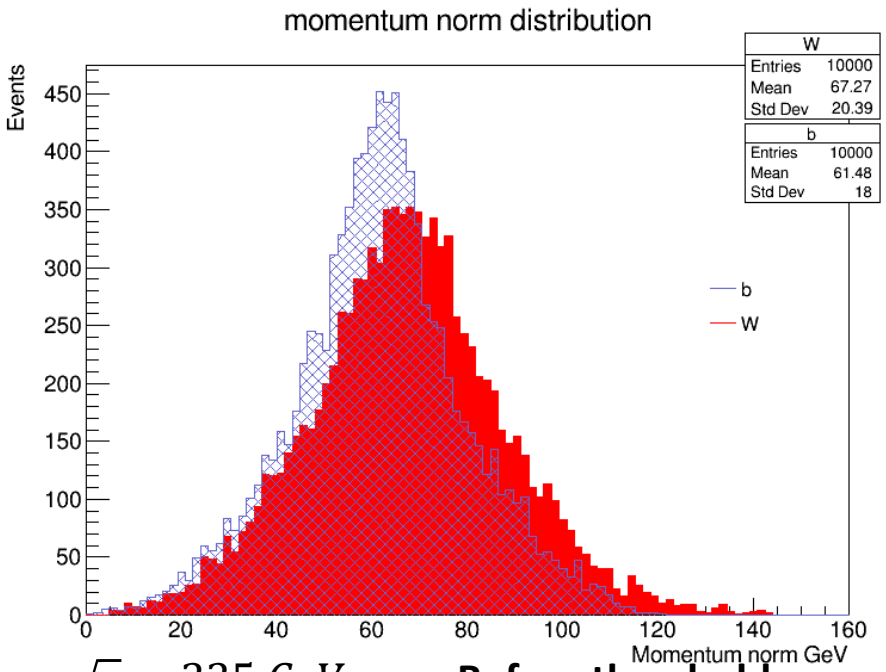
→ Seems to be related to invariant mass contribution

W and b distribution

SM_tt_threshold



$\sqrt{s} = 335\ GeV$ **Before threshold**



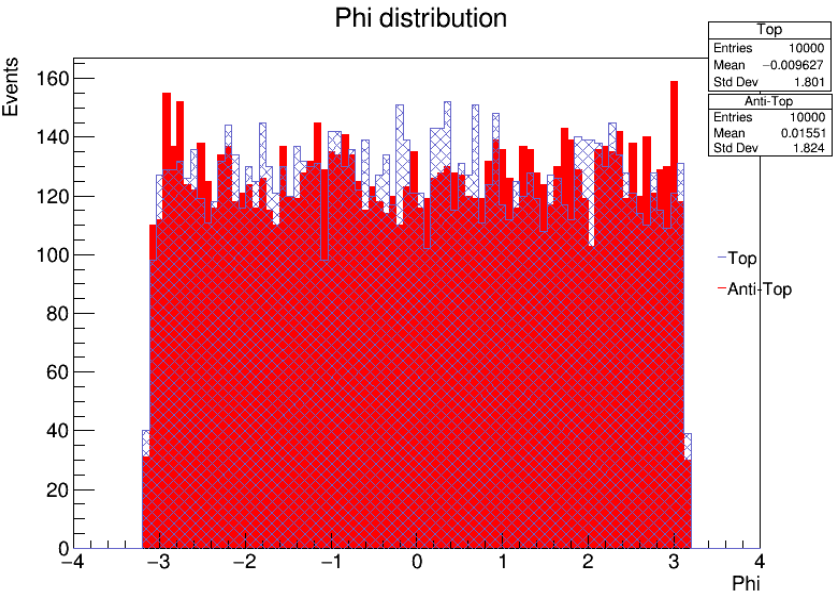
$\sqrt{s} = 335\ GeV$ **Before threshold**

$$E = \sqrt{P^2 + m^2}$$

→ Energy not distributed symmetrically between W and b **$M_W > M_b$**

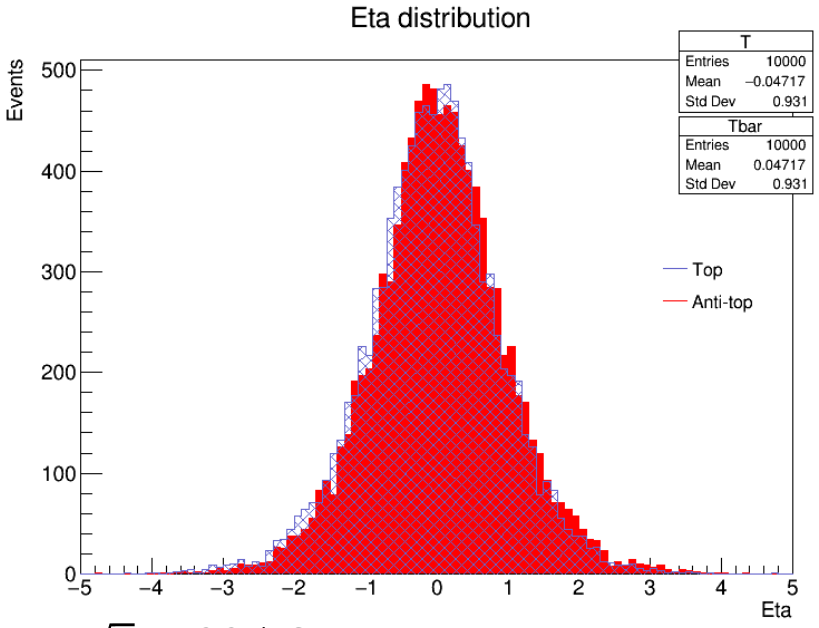
Top angular distribution

SM_tt_threshold



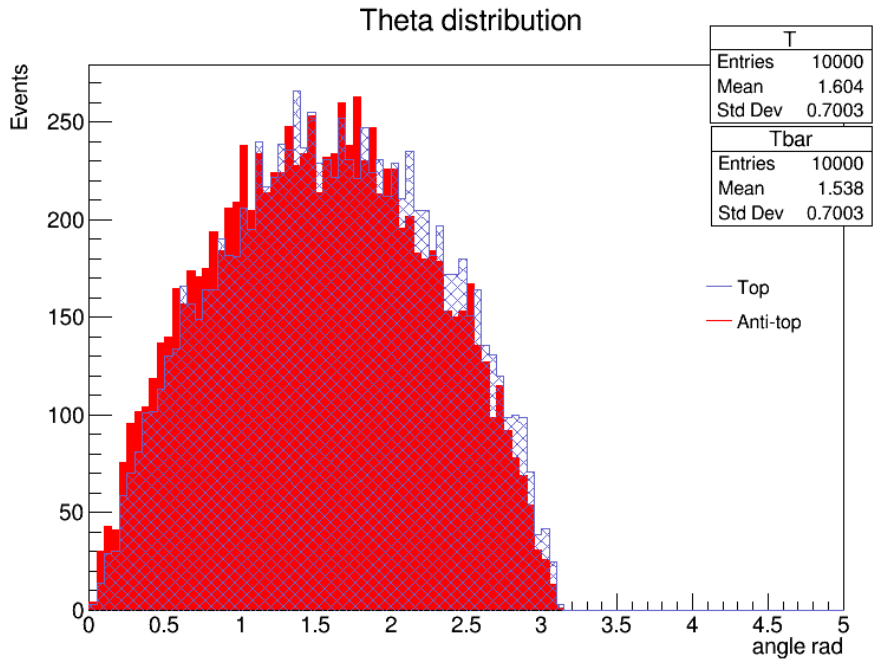
$\sqrt{s} = 335\ GeV$

Before threshold



$\sqrt{s} = 335\ GeV$

Before threshold



$\sqrt{s} = 335\ GeV$

Before threshold

➡ Equiprobable distribution

➡ Invariance under rotation around the beam

➡ Not exactly overlapped

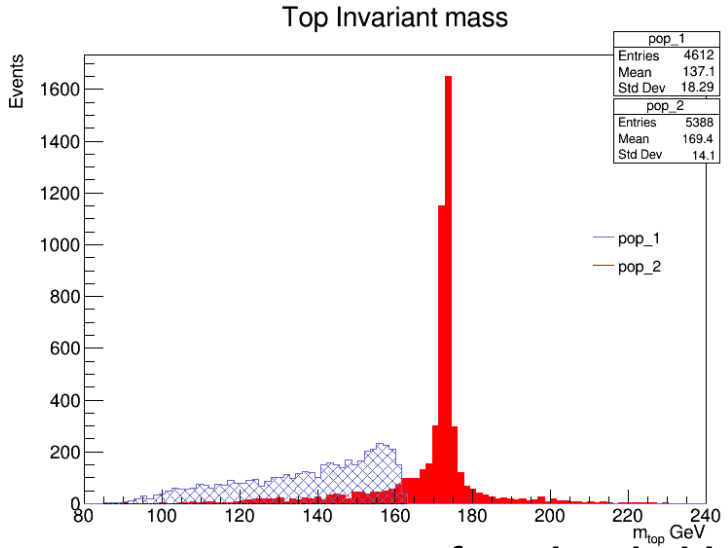
➡ $\Theta > \frac{\pi}{2}$

More Top than Anti-Top

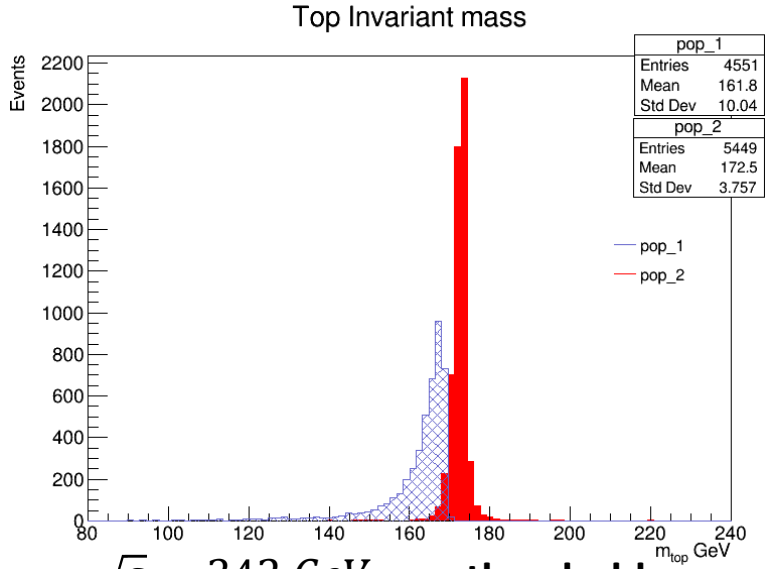
➡ AFB : parity violation by weak interaction due to Z°

Top quark invariant mass

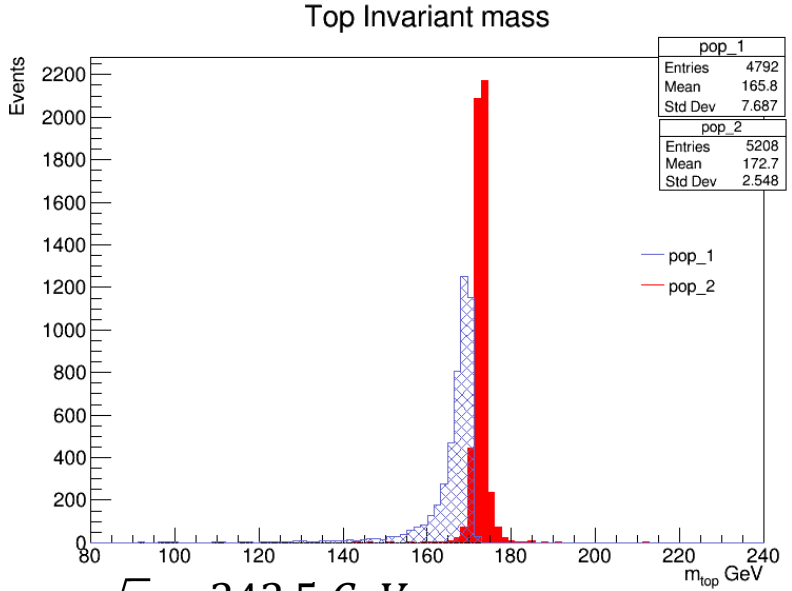
SM_tt_threshold



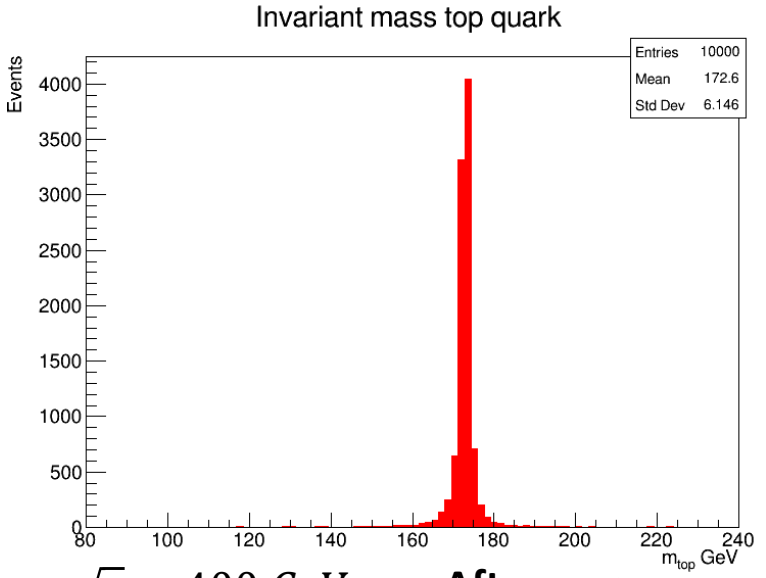
$\sqrt{s} = 335\ GeV$ **Before threshold**



$\sqrt{s} = 342\ GeV$ **threshold**



$\sqrt{s} = 343{,}5\ GeV$ **near resonance**

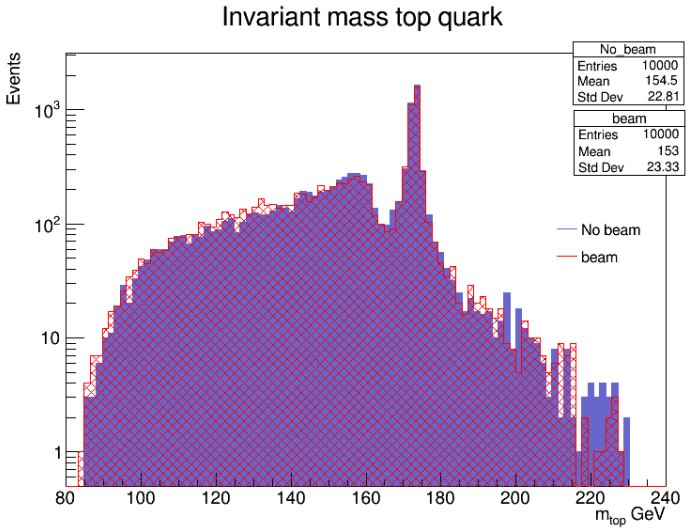


$\sqrt{s} = 400\ GeV$ **After resonance**

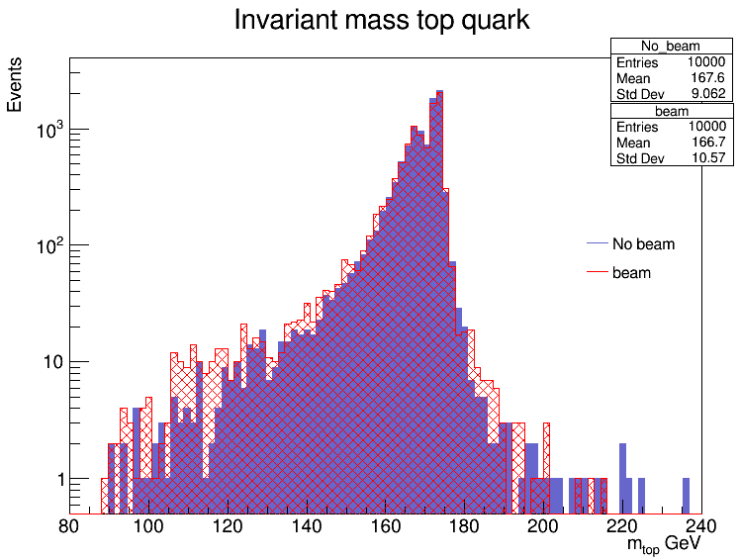
➡ Virtual Top contribution approach the peak with $\sqrt{s}$ increasing

Top Invariant mass – beam/no beam comparison

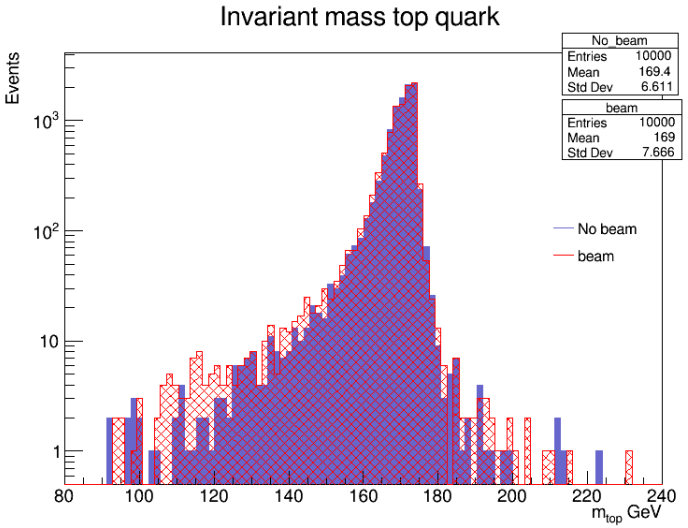
SM_tt_threshold



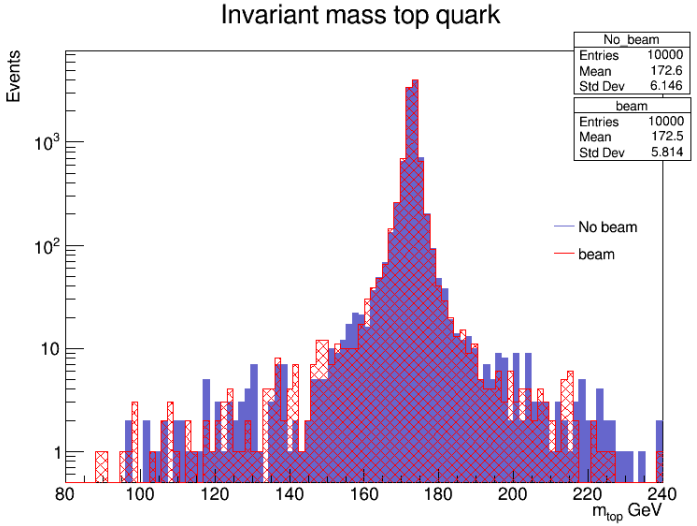
$\sqrt{s} = 335\ GeV$ **before threshold**



$\sqrt{s} = 342\ GeV$ **threshold**



$\sqrt{s} = 343{,}5\ GeV$ **near resonance**

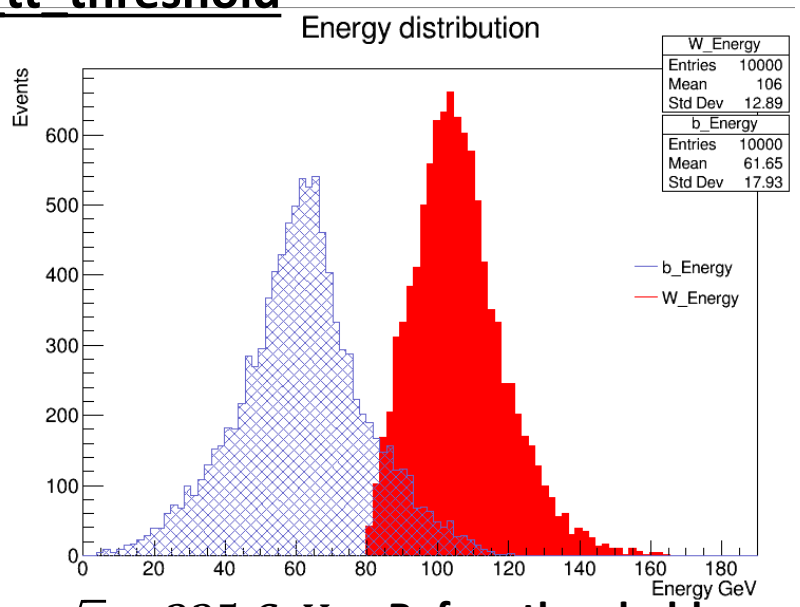


$\sqrt{s} = 400\ GeV$ **After resonance**

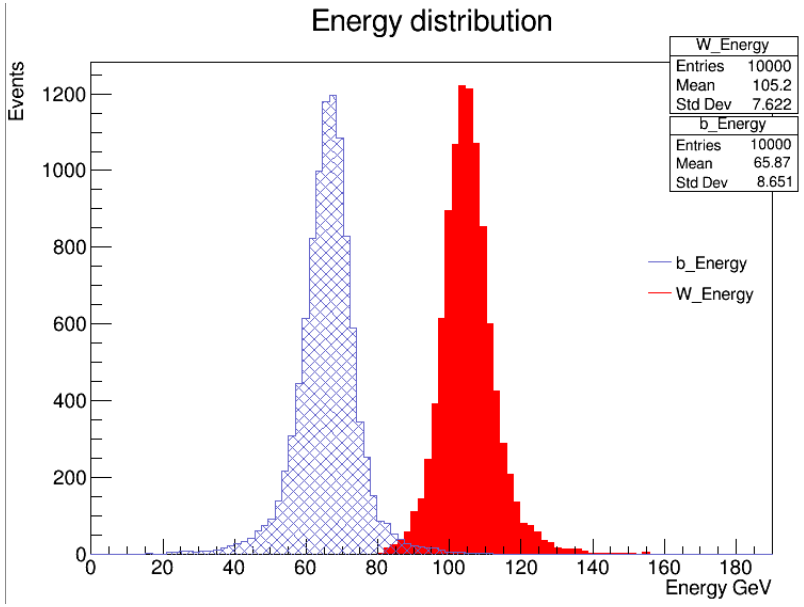
➡ Beam effect more important in the distribution tails

W and b Energy distribution

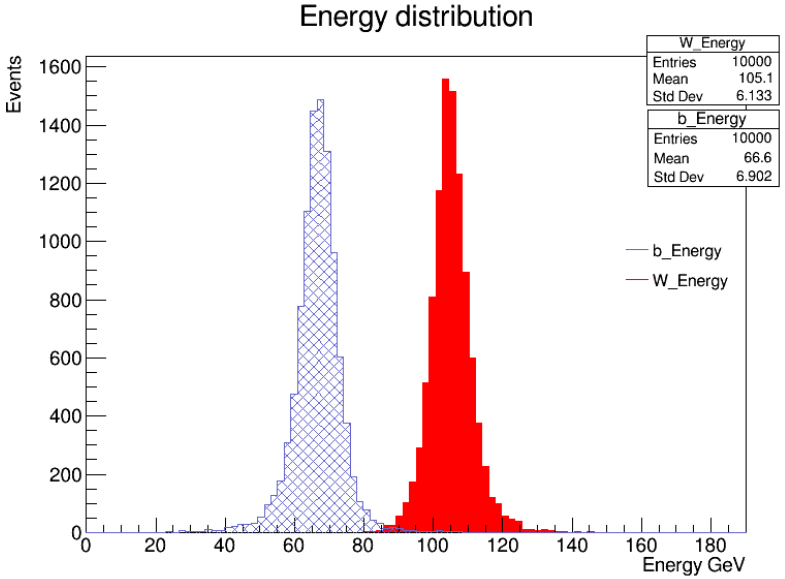
SM_tt_threshold



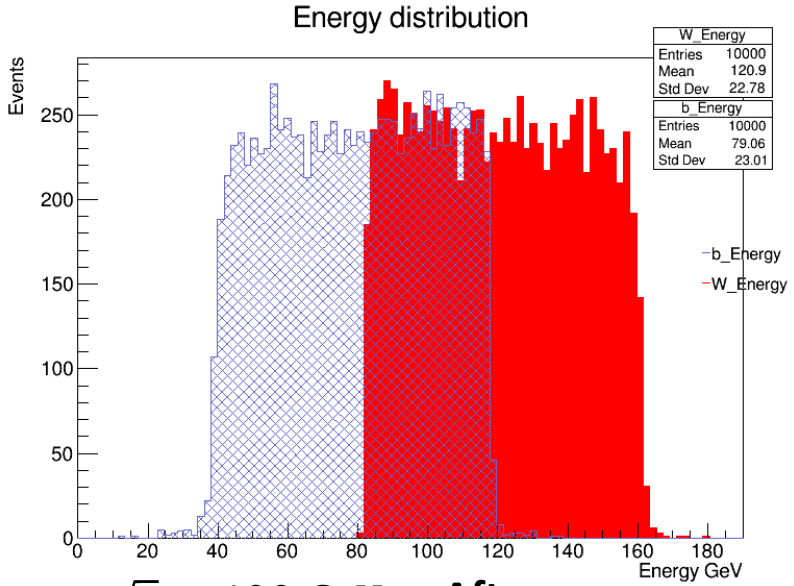
$\sqrt{s} = 335\ GeV$ **Before threshold**



$\sqrt{s} = 342\ GeV$ **threshold**



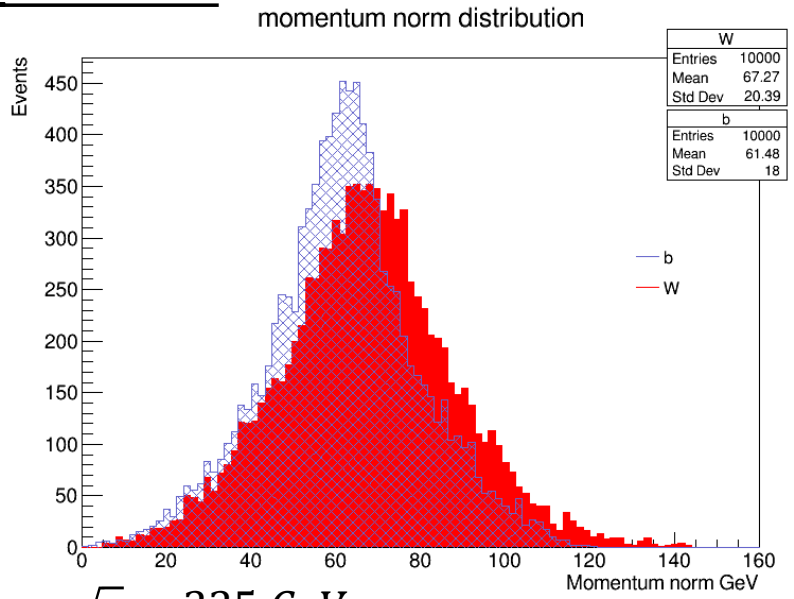
$\sqrt{s} = 343{,}5\ GeV$ **near resonance**



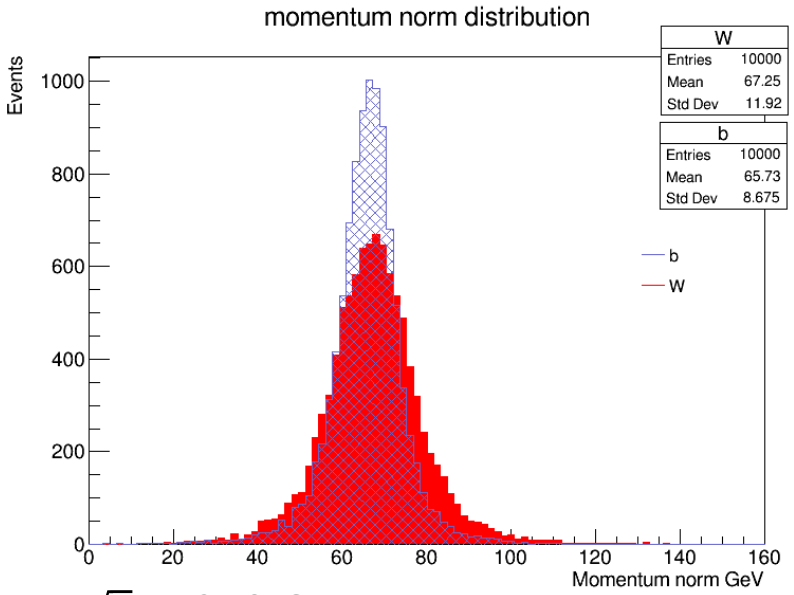
$\sqrt{s} = 400\ GeV$ **After resonance**

W and b momentum norm distribution

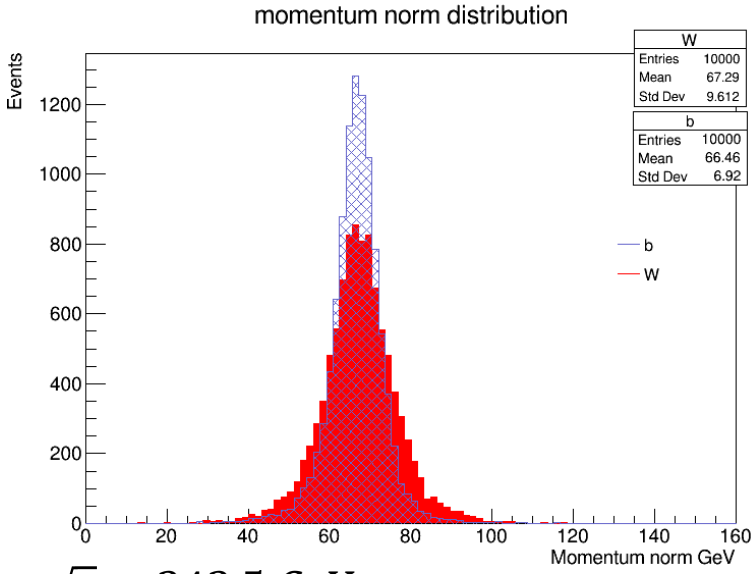
SM_tt_threshold



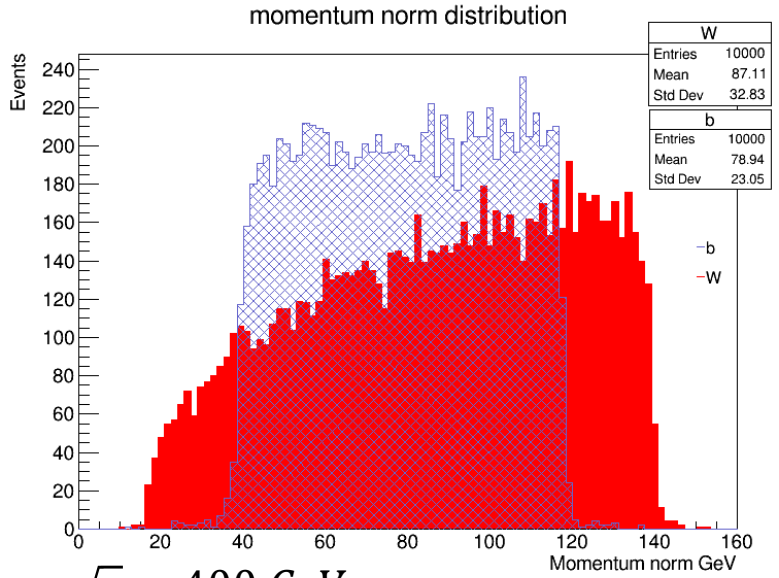
$\sqrt{s} = 335\ GeV$ **Before threshold**



$\sqrt{s} = 342\ GeV$ **threshold**



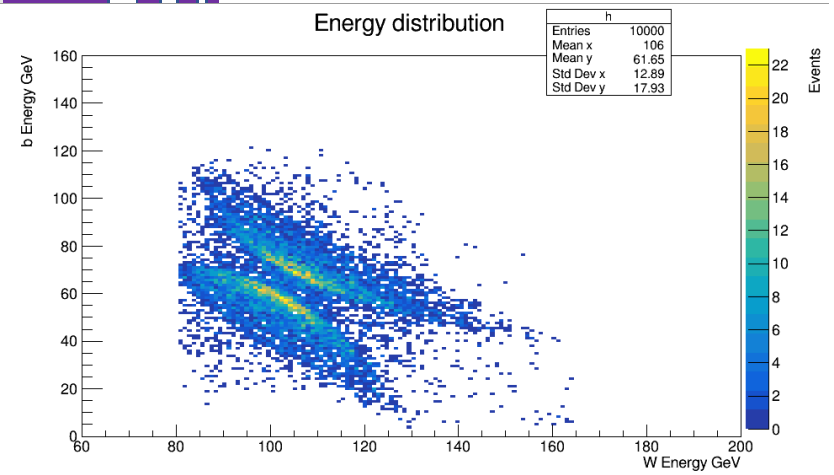
$\sqrt{s} = 343{,}5\ GeV$ **near resonance**



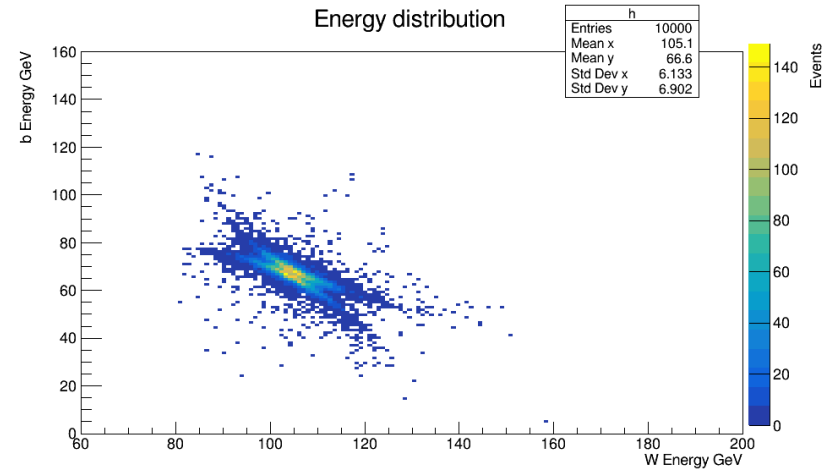
$\sqrt{s} = 400\ GeV$ **After resonance**

➡ Similar shape except at 400 GeV

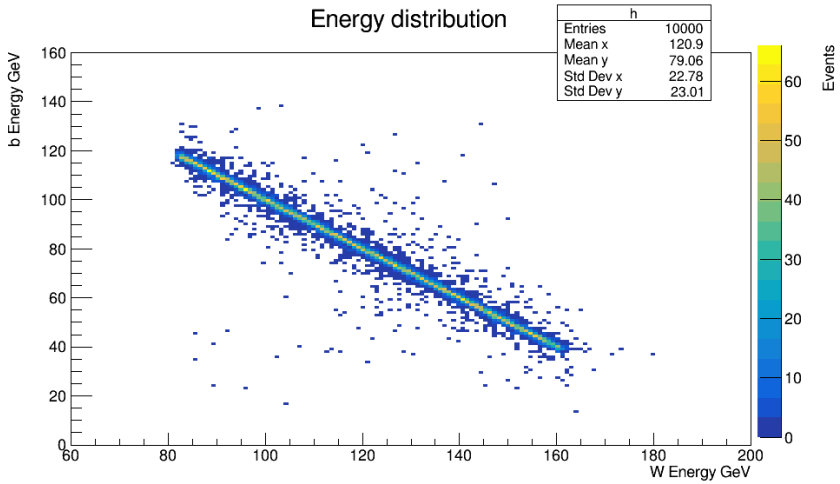
W and b Energy distribution



$\sqrt{s} = 335\ GeV$

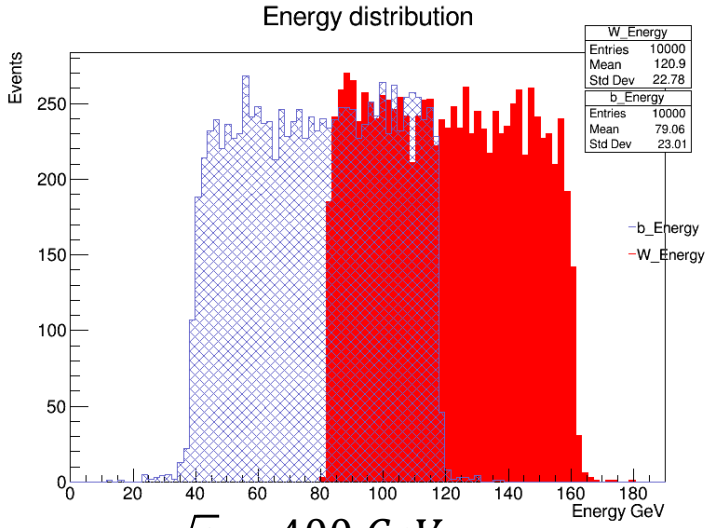


$\sqrt{s} = 343{,}5\ GeV$



$\sqrt{s} = 400\ GeV$

➡ W and b anti-correlation apparition with the center of mass energy rise



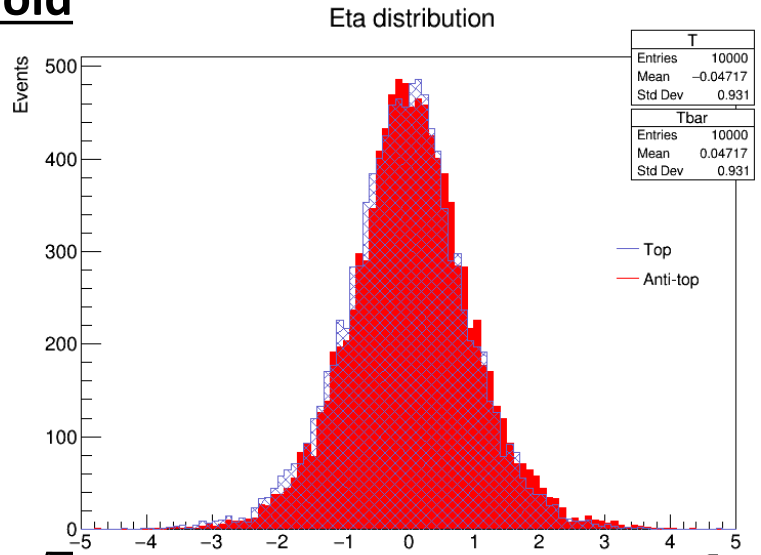
$\sqrt{s} = 400\ GeV$

➡ W and b energy anti-correlated

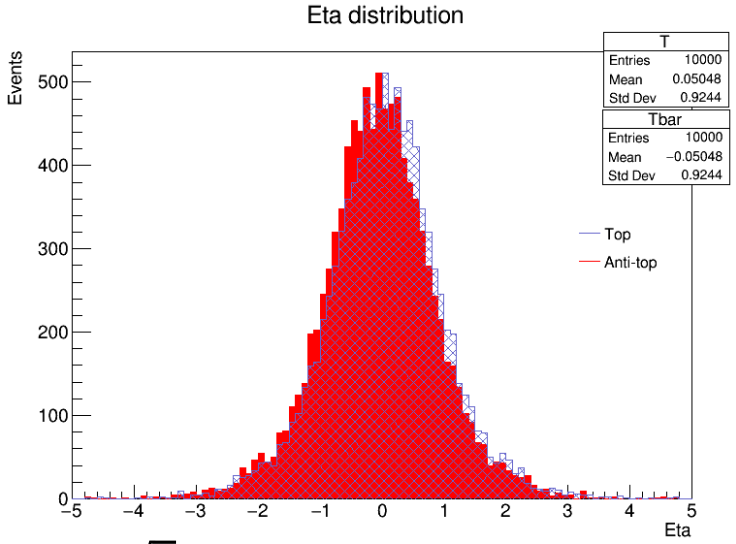
➡ Enough energy to have equiprobable disribution

Top angular distribution

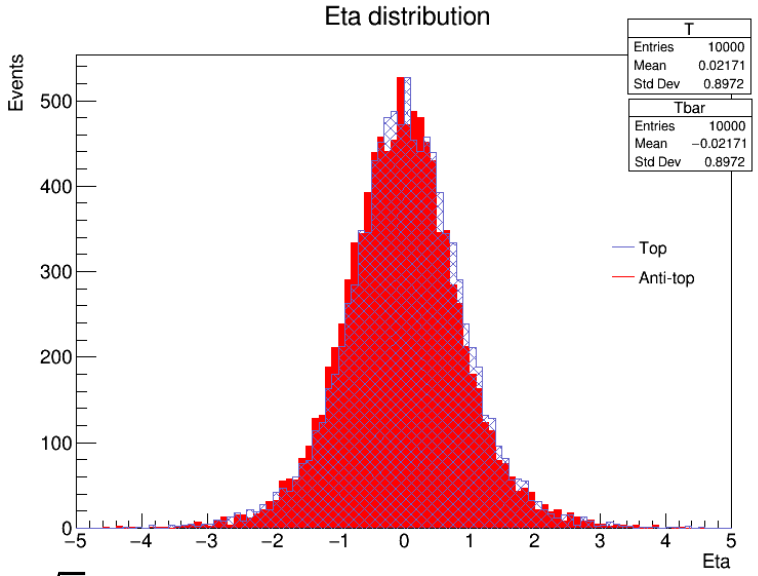
SM_tt_threshold



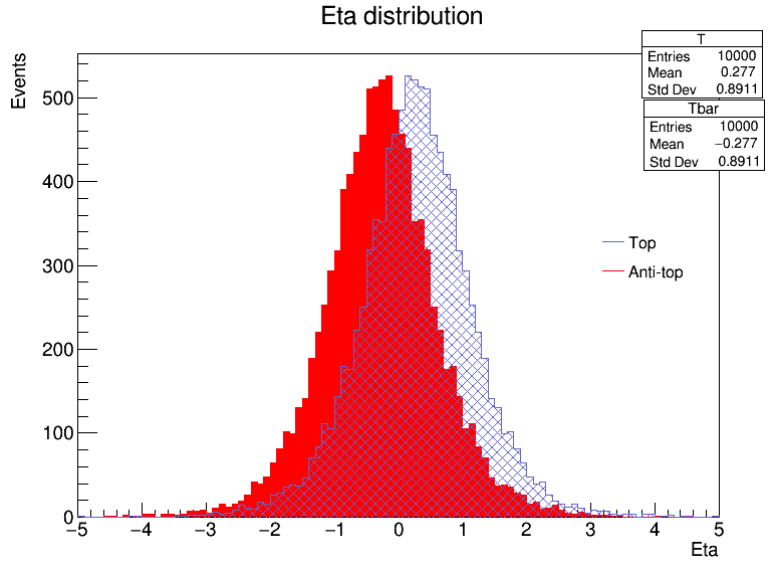
$\sqrt{s} = 335\ GeV$ **Before threshold**



$\sqrt{s} = 342\ GeV$ **threshold**



$\sqrt{s} = 343{,}5\ GeV$ **near resonance**

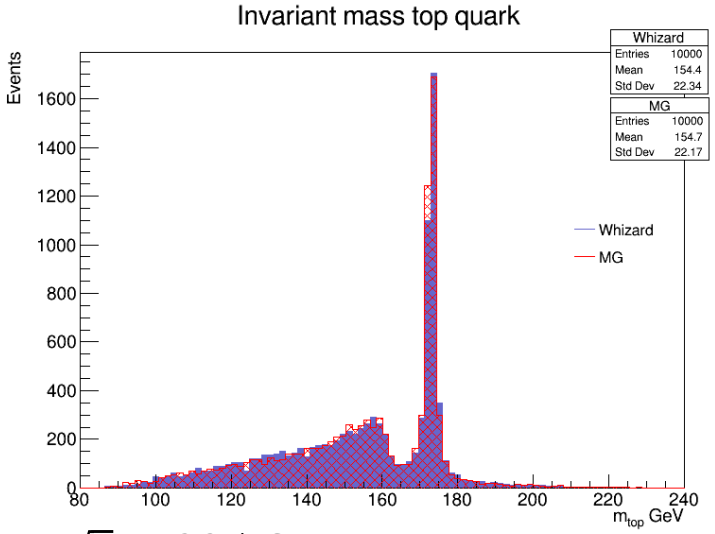


$\sqrt{s} = 400\ GeV$ **After resonance**

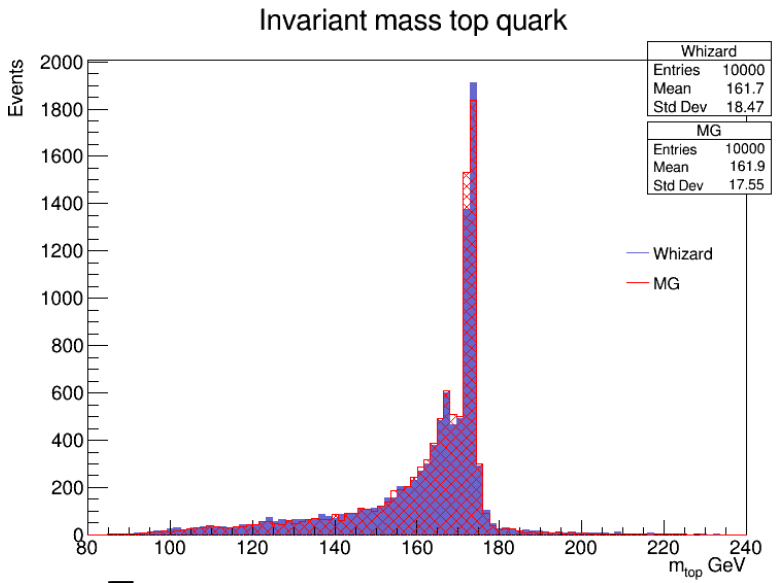
➡ <u>After resonance:</u> AFB more important due to Z° contribution

Top quark invariant mass

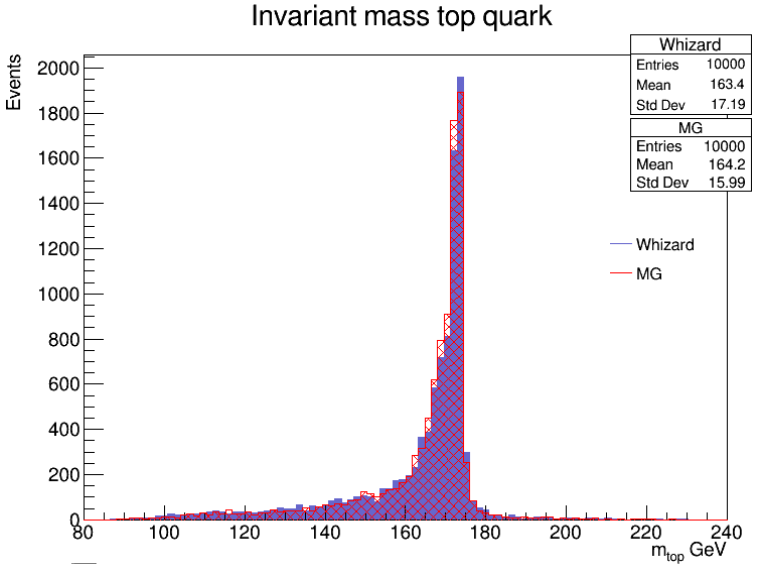
SM : No beam effect



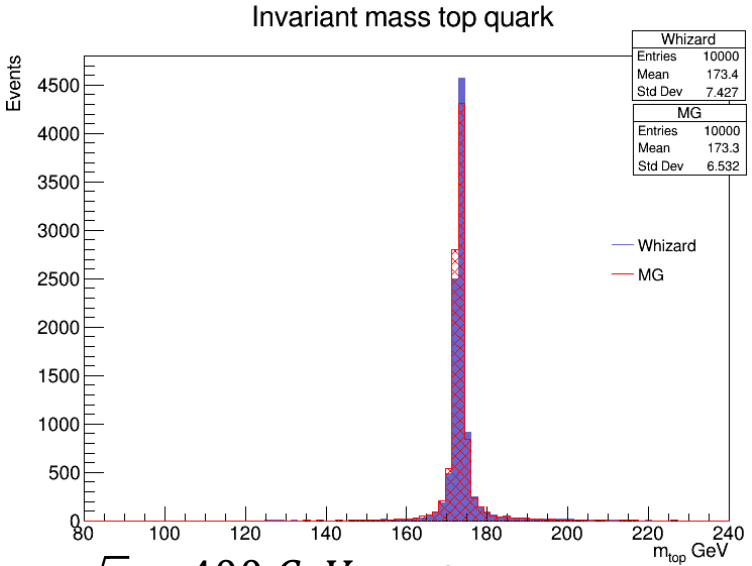
$\sqrt{s} = 335\ GeV$ **before threshold**



$\sqrt{s} = 342\ GeV$ **threshold**



$\sqrt{s} = 343{,}5\ GeV$ **near resonance**



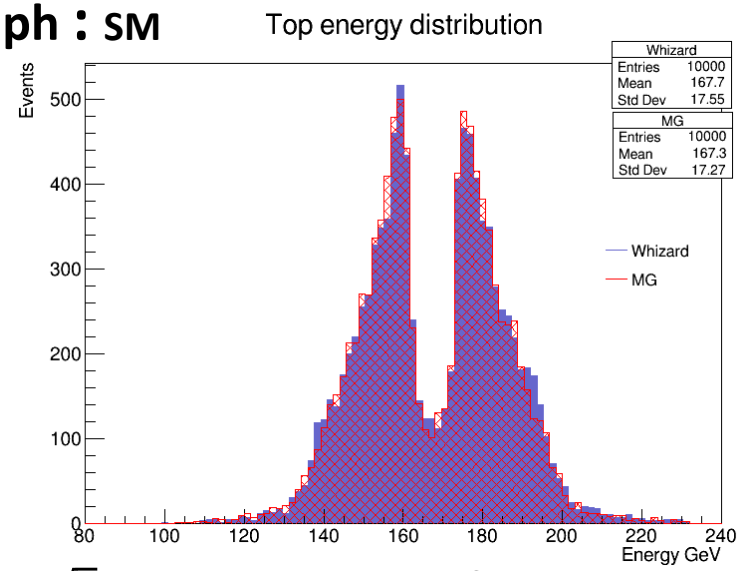
$\sqrt{s} = 400\ GeV$ **After resonance**

➡ Great agreement between Whizard and MadGraph distributions

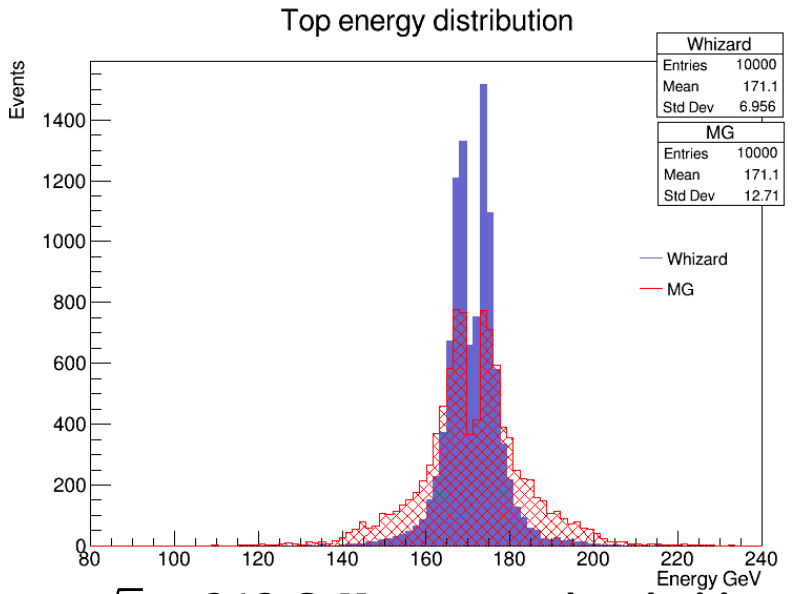
Top energy distribution-Comparison

Whizard : SM_tt_threshold

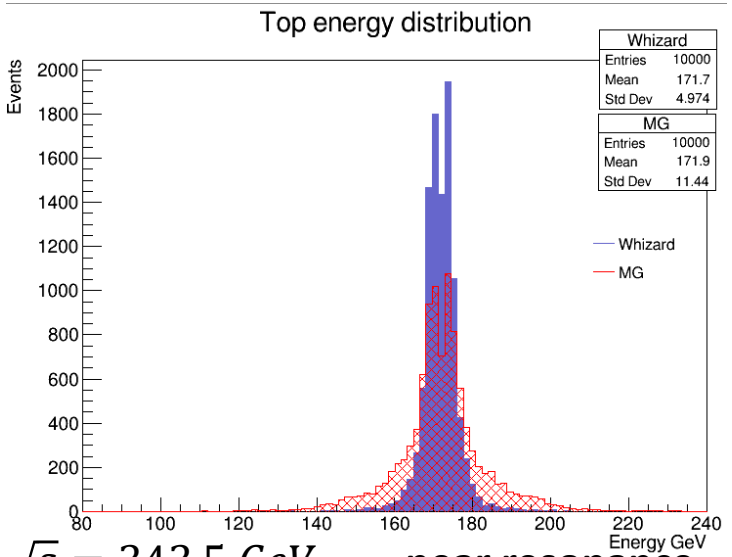
MadGraph : SM



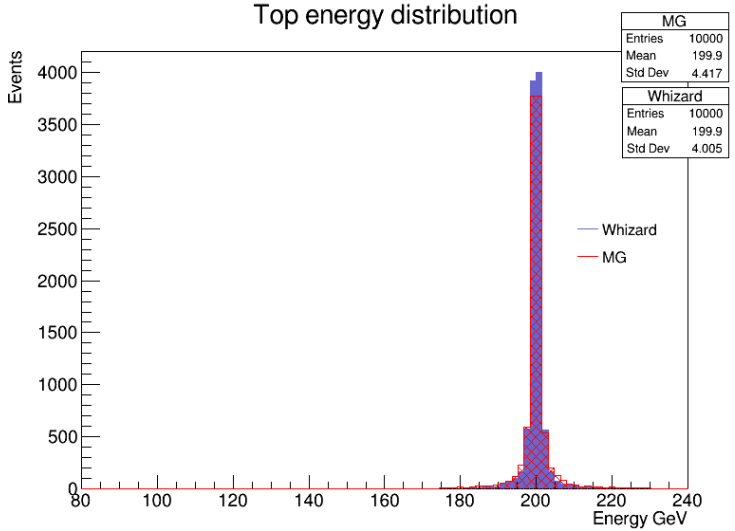
$\sqrt{s} = 335\ GeV$ **before threshold**



$\sqrt{s} = 342\ GeV$ **threshold**



$\sqrt{s} = 343{,}5\ GeV$ **near resonance**



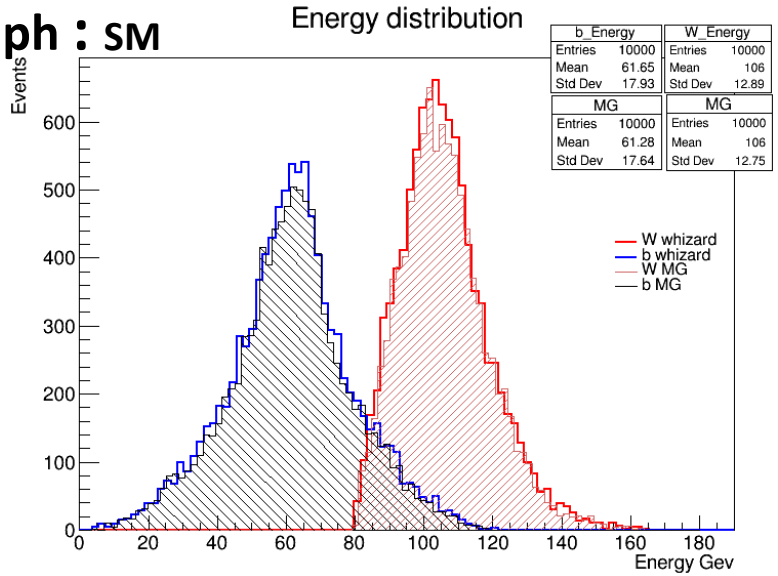
$\sqrt{s} = 400\ GeV$ **After resonance**

➡ <u>At threshold and near resonance :</u> differences come from the model used

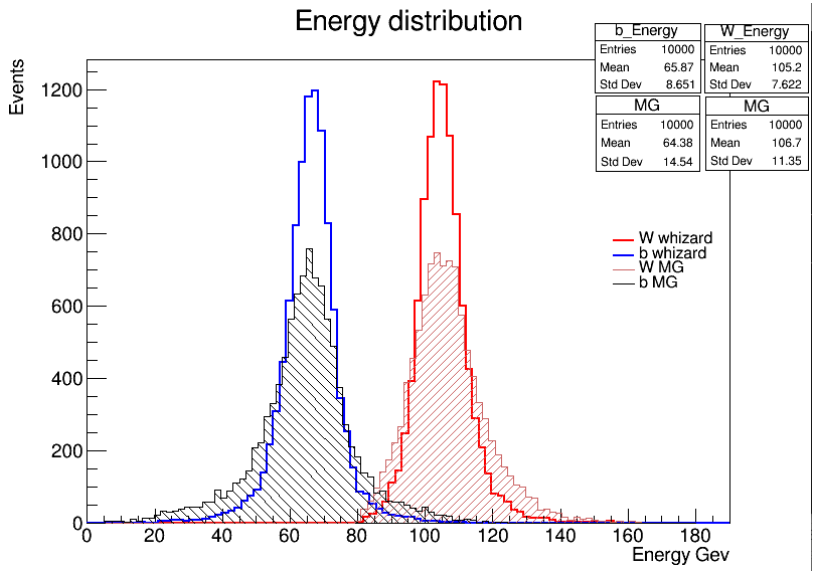
W and b distribution-Comparison

Whizard : SM_tt_threshold

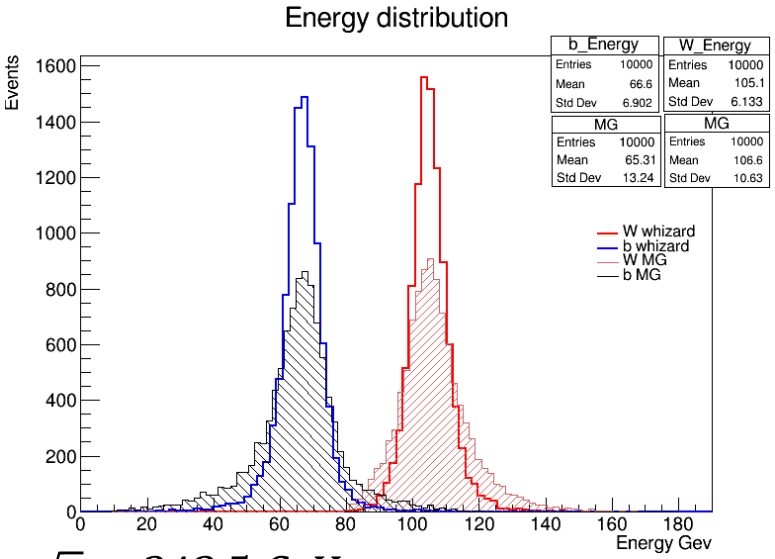
MadGraph : SM



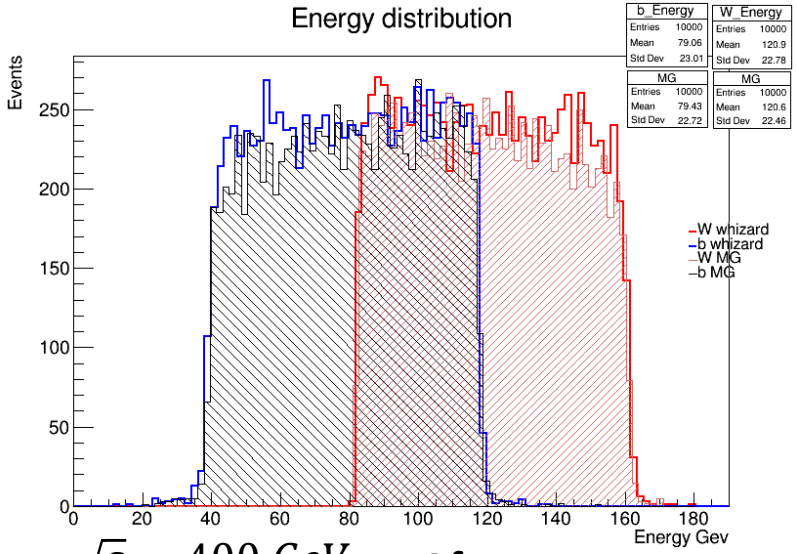
$\sqrt{s} = 335\ GeV$ **before threshold**



$\sqrt{s} = 342\ GeV$ **threshold**



$\sqrt{s} = 343{,}5\ GeV$ **near resonance**



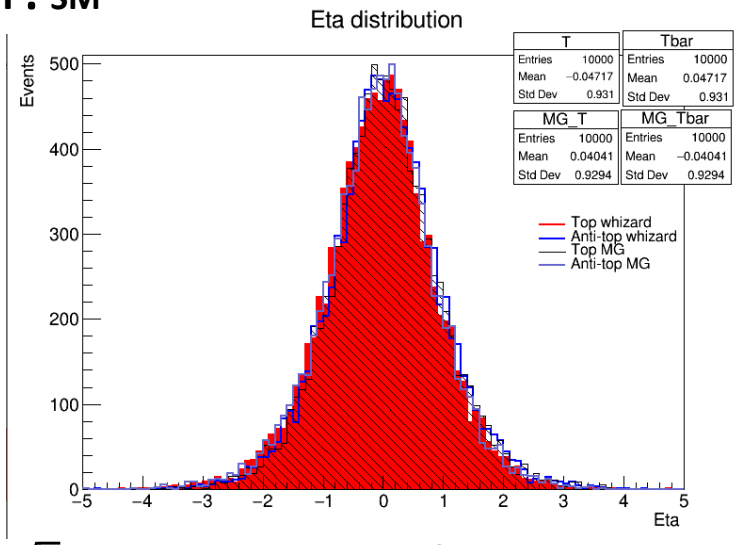
$\sqrt{s} = 400\ GeV$ **After resonance**

➡ <u>At threshold and near resonance</u> : differences come from the model used

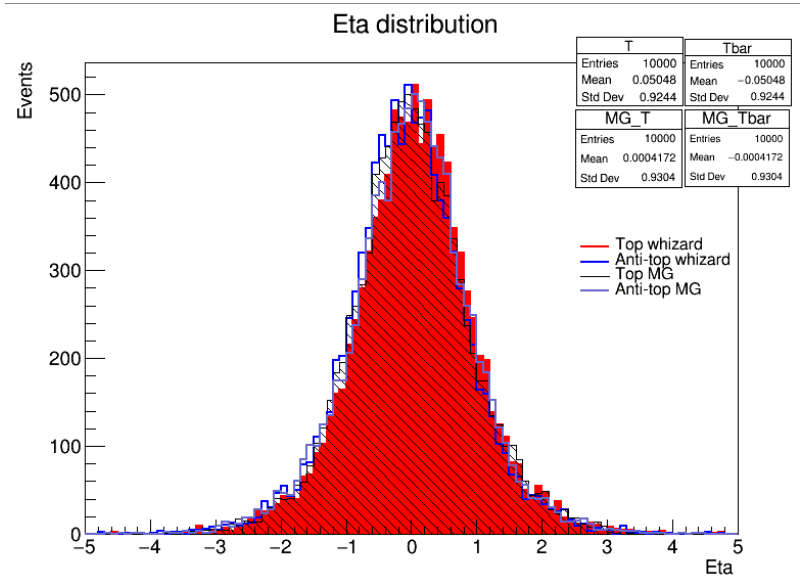
Angular distribution-Comparison

Whizard : SM_tt_threshold

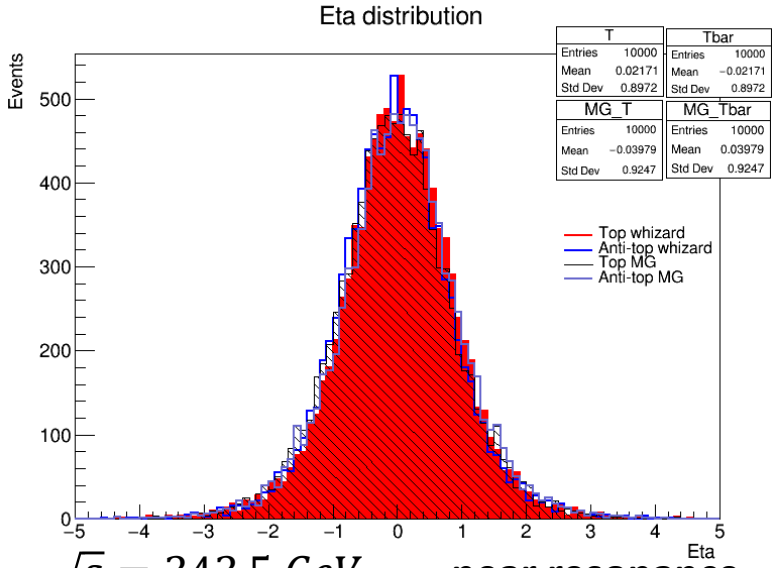
MadGraph : SM



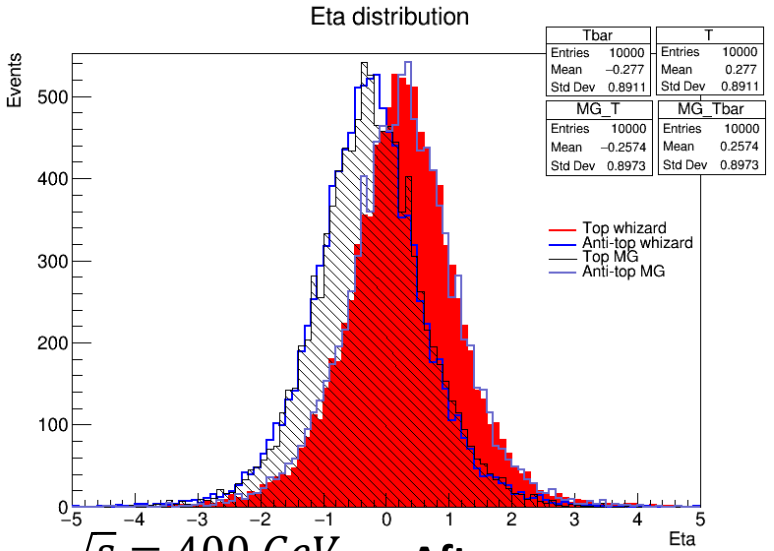
$\sqrt{s} = 335\ GeV$ **before threshold**



$\sqrt{s} = 342\ GeV$ **threshold**



$\sqrt{s} = 343{,}5\ GeV$ **near resonance**



$\sqrt{s} = 400\ GeV$ **After resonance**

➡ Great agreement between Whizard and MadGraph distributions

Conclusion

- Top mass from SM_tt_threshold better for comparison
  - Some inconvenience remain
- Variables kinematics , evolution with $\sqrt{s}$ increasing
- Beam effect : mainly in the distribution tails
- Whizard and MG : similar shape for the top quark invariant mass
  - At threshold and near resonance : differences come from the model used