Compare Pythia8 and MadGraph5 with high masses of heavy Higgs in 2HDM (update)

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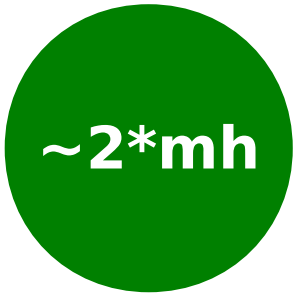
IHEP, Beijing
13-01-14

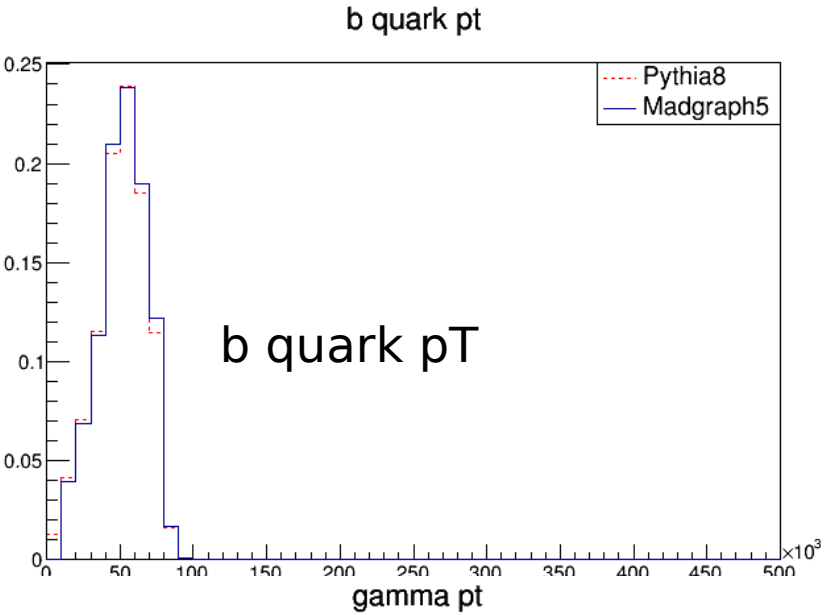
Introduction

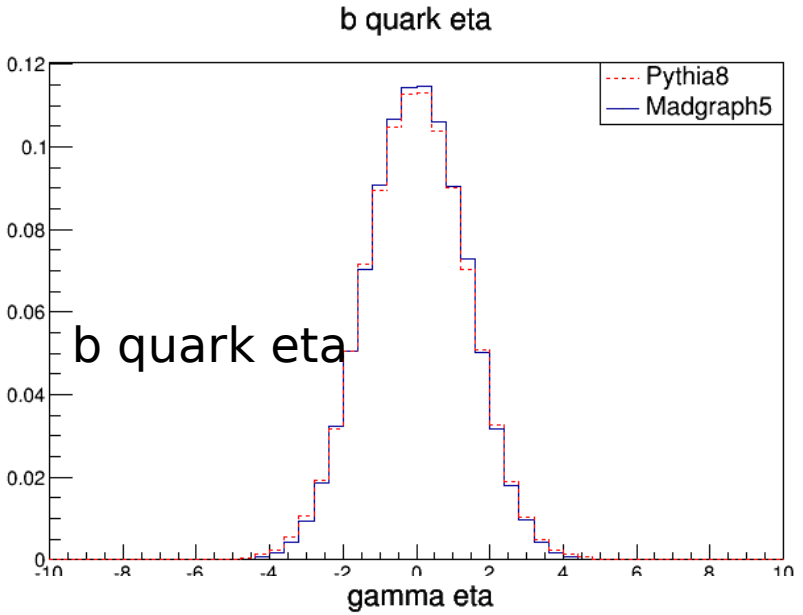
- No loop calculation is ready for gg->A/H in MadGraph5 (MG5) for the time being
  - hopefully available in this month, waiting for good news from Fabio
- Heft is implemented
- Check, up to which mass point of the neutral heavy higgs, heft in MG5 can work, since theoratically heft is valid only when mH<2*m(top)
- The check is realized by comparing MG5 to Pythia8 (PY8)
- This is an update of the previous comparison before Xmas
  - Previously, no narrow width, PY8 shows wrong distribution at high mass regime
  - Apply narrow width in PY8 by simply constraining the mass NEW
- Setting all the time the same mass for H, A and H+/- (GeV)
  - 260, 300, 340, 350, 400, 500, 600, 700, 800, 1000, 1500
- Generate one processes
  - gg->H->hh->bbgammagamma
- In this talk, comparisons are all implemented in parton level
  - MG5 and Pythia8 both implemented standalone
  - Read their output lhe files directly
- Only few mass points are shown in the talk, please see the attachement for more

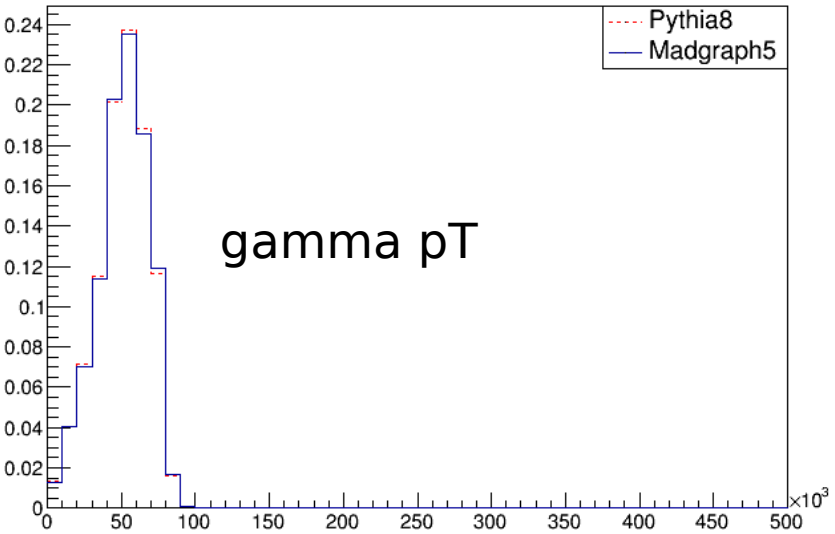
mH = 260 GeV

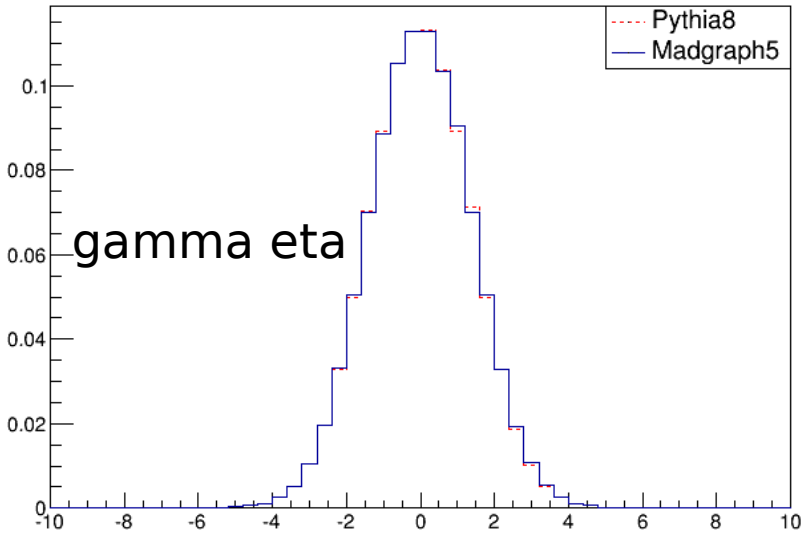


H->hh->bbyy

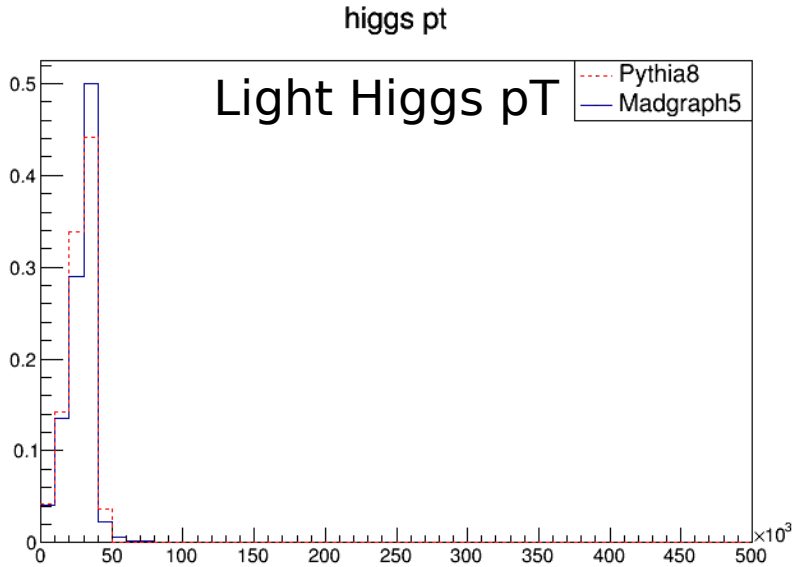

b quark pt
Pythia8
Madgraph5
b quark pT
×10^3

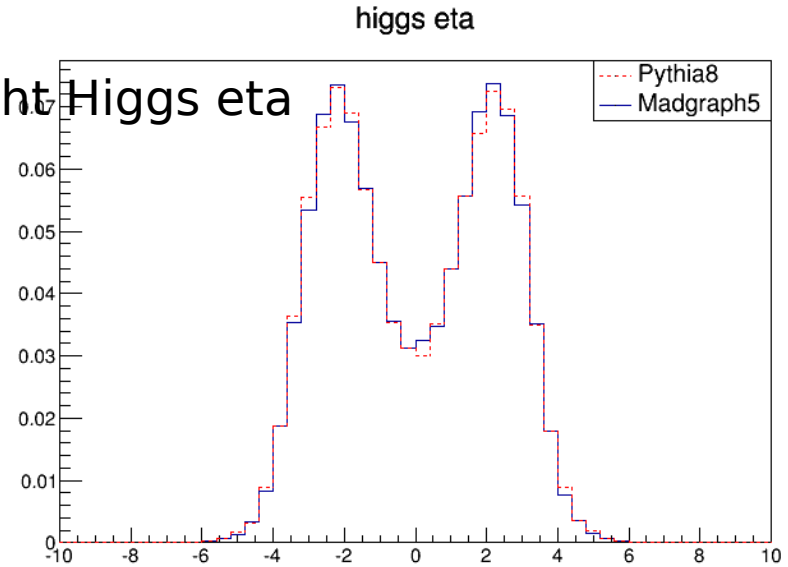

b quark eta
Pythia8
Madgraph5
b quark eta

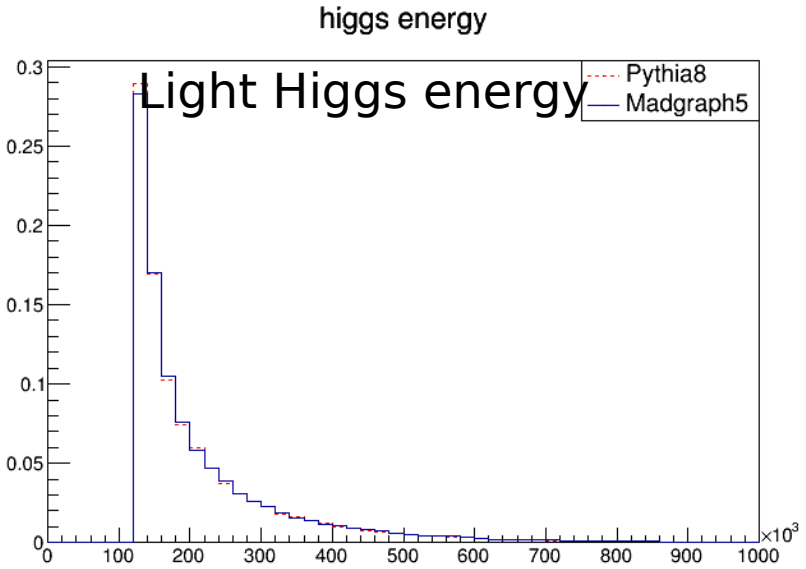

gamma pt
Pythia8
Madgraph5
gamma pT
×10^3

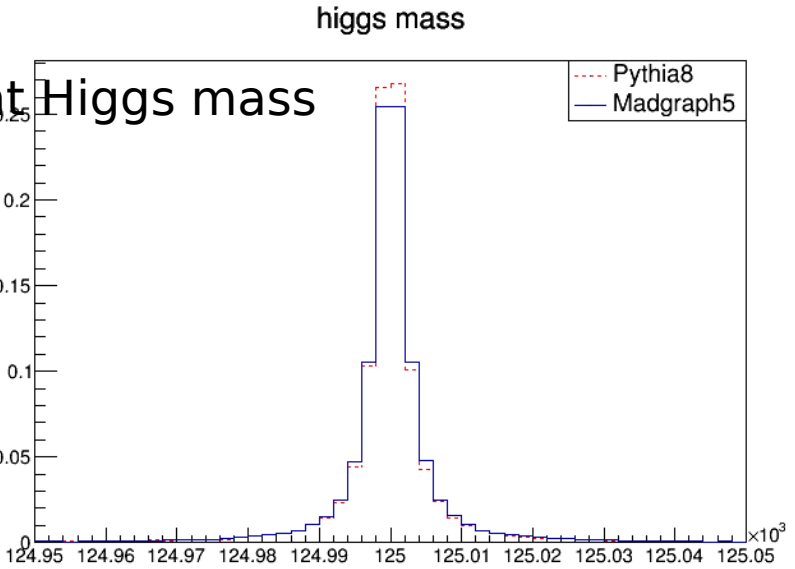

gamma eta
Pythia8
Madgraph5
gamma eta

H->hh->bbyy

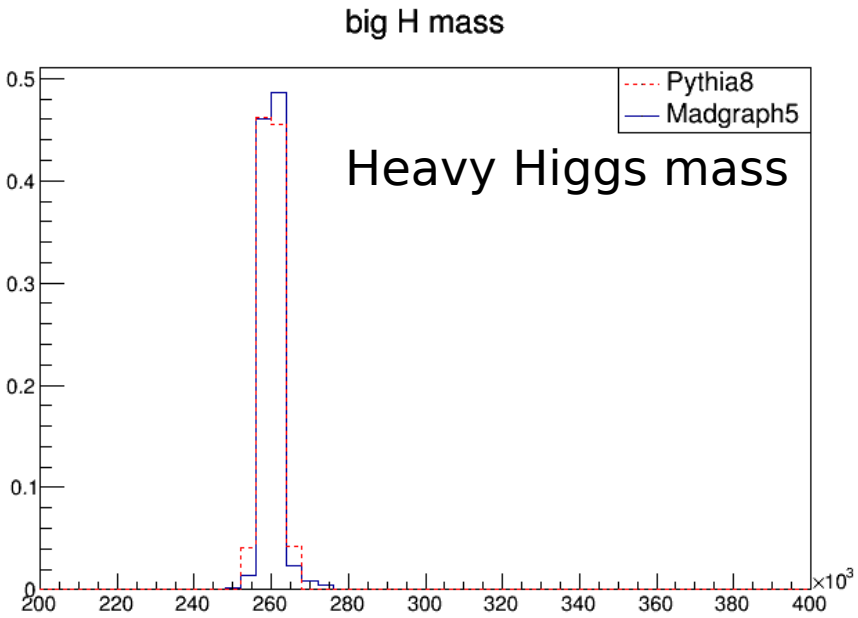

higgs pt
Light Higgs pT
Pythia8
Madgraph5
×10^3

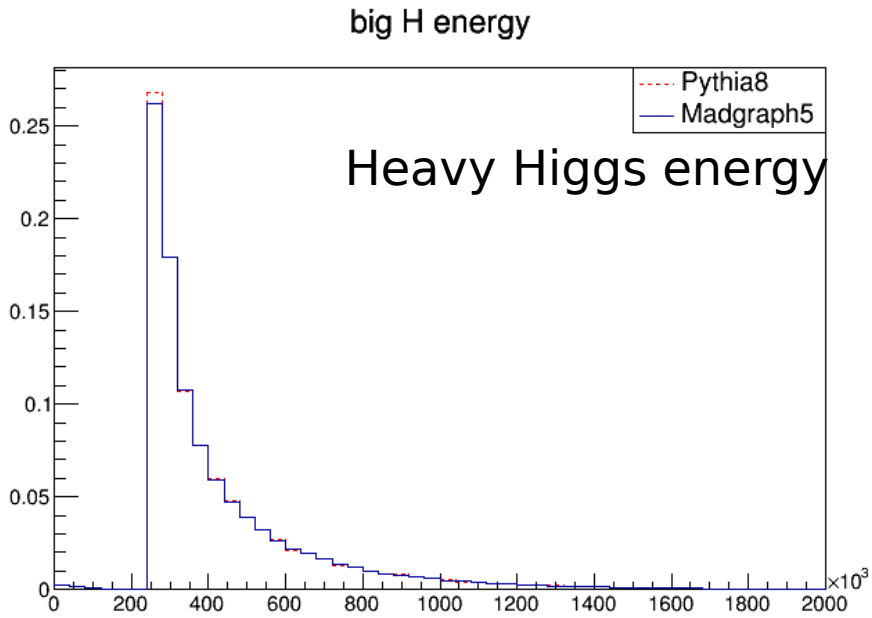

higgs eta
Light Higgs eta
Pythia8
Madgraph5


higgs energy
Light Higgs energy
Pythia8
Madgraph5
×10^3

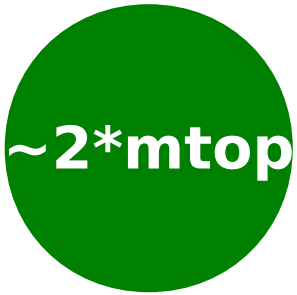

higgs mass
Light Higgs mass
Pythia8
Madgraph5
×10^3

H->hh->bbyy

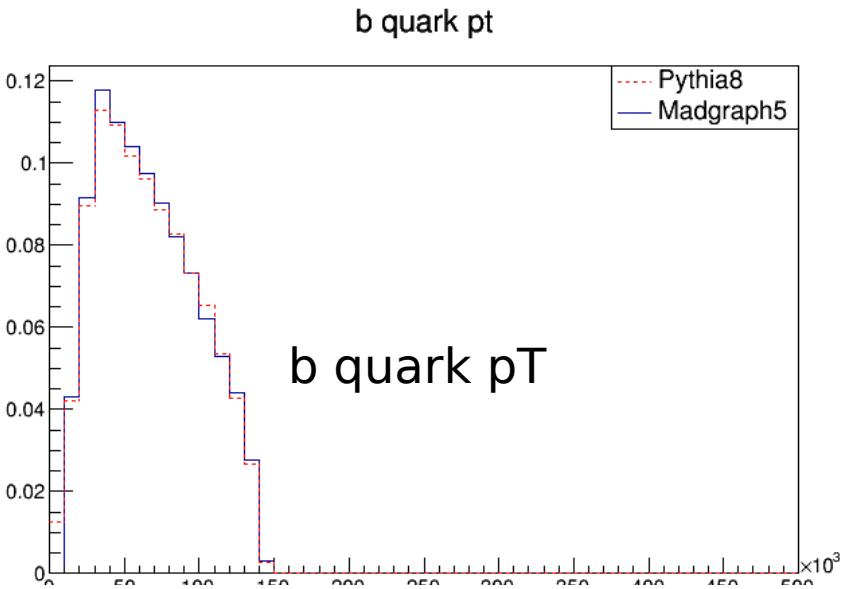

big H mass
Pythia8
Madgraph5
Heavy Higgs mass
0.5
0.4
0.3
0.2
0.1
0
200
220
240
260
280
300
320
340
360
380
400
×10^3

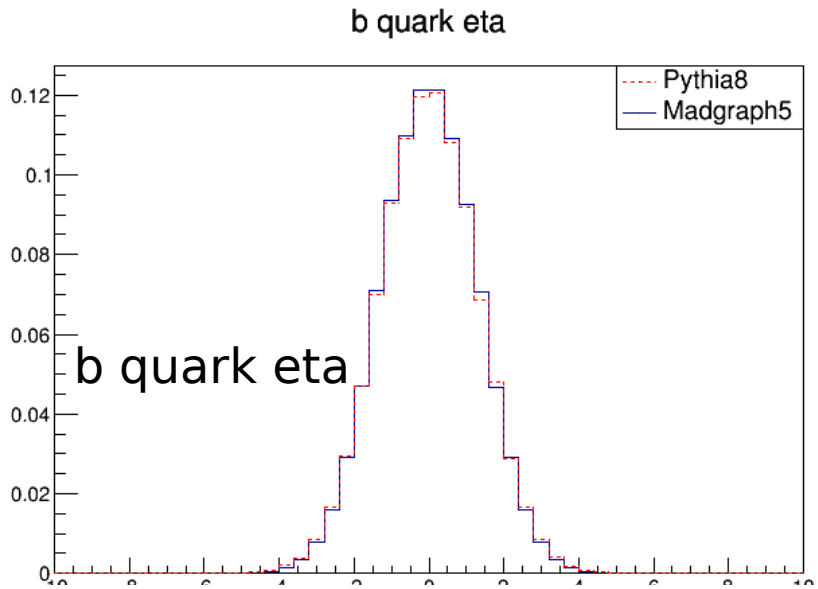

big H energy
Pythia8
Madgraph5
Heavy Higgs energy
0.25
0.2
0.15
0.1
0.05
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
×10^3

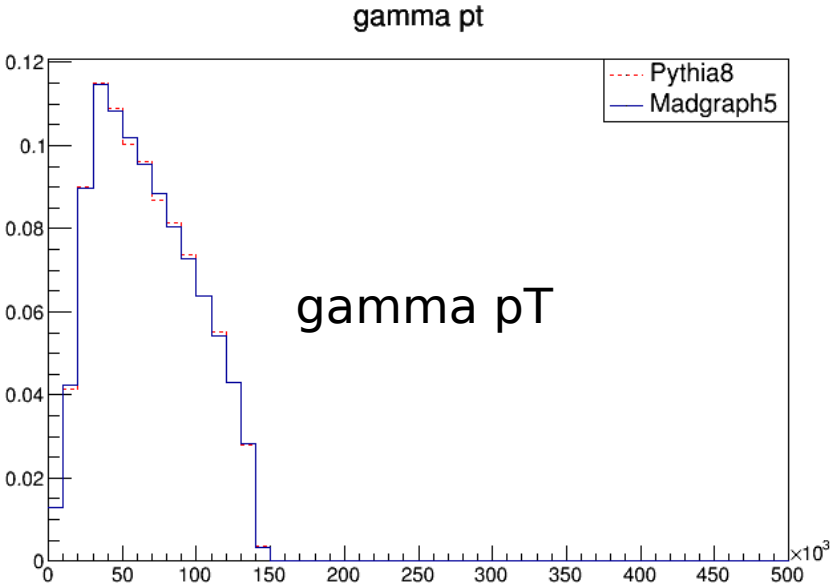
mH = 340 GeV

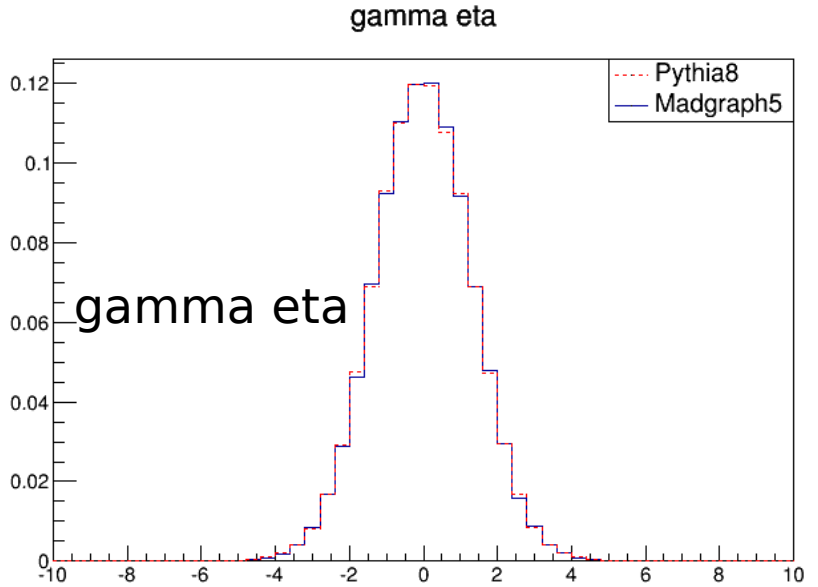


H->hh->bbyy


b quark pt
Pythia8
Madgraph5
b quark pT
0.12
0.1
0.08
0.06
0.04
0.02
0
×10^3


b quark eta
Pythia8
Madgraph5
b quark eta
0.12
0.1
0.08
0.06
0.04
0.02
0


gamma pt
Pythia8
Madgraph5
gamma pT
0.12
0.1
0.08
0.06
0.04
0.02
0
0 50 100 150 200 250 300 350 400 450 500
×10^3


gamma eta
Pythia8
Madgraph5
gamma eta
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0.1
0.08
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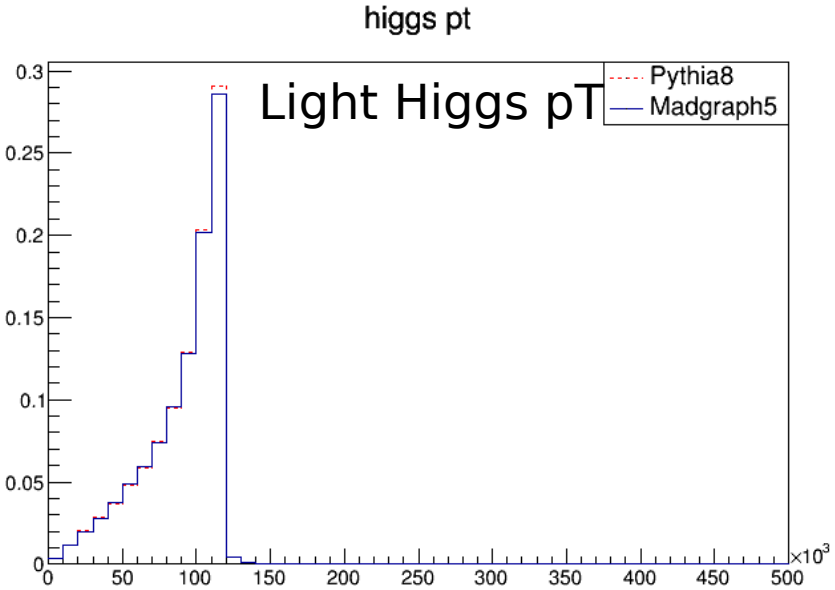
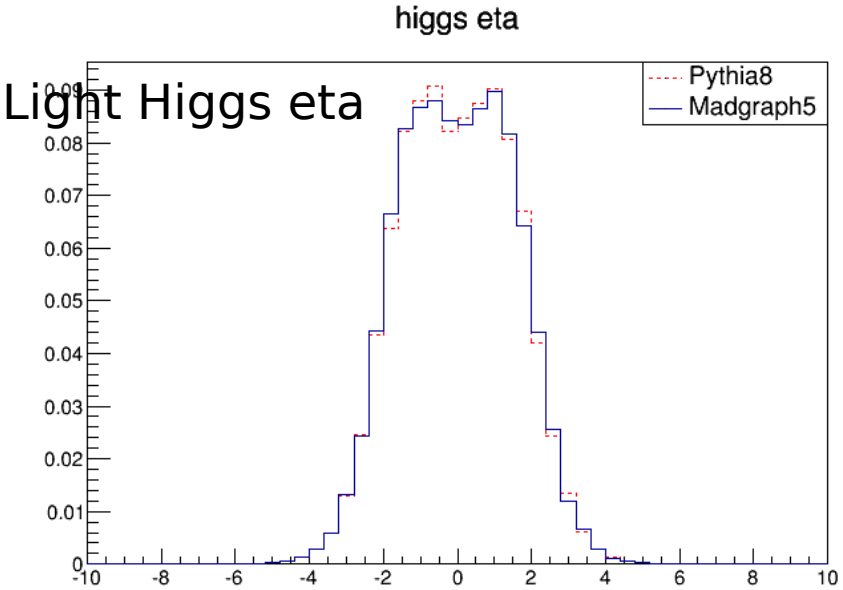
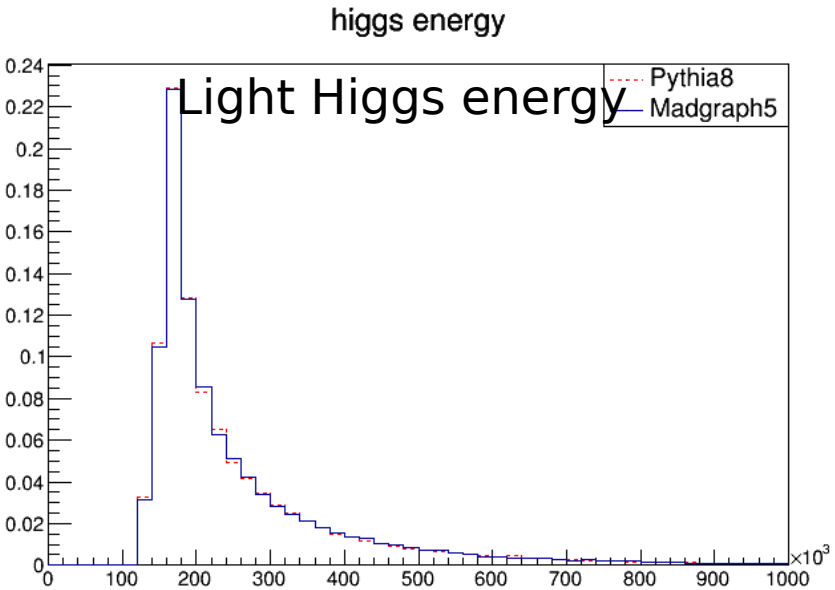
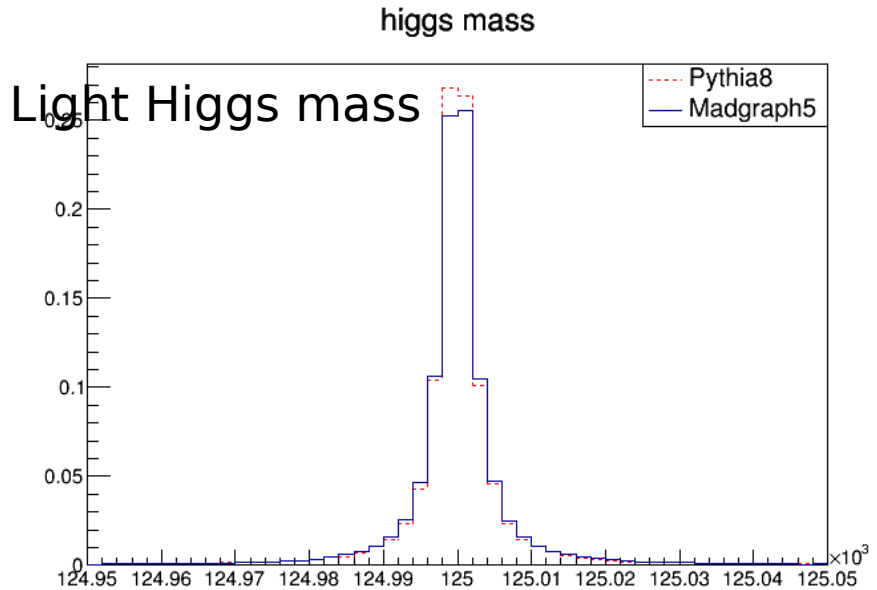
0.04
0.02
0
-10 -8 -6 -4 -2 0 2 4 6 8 10

H->hh->bbyy

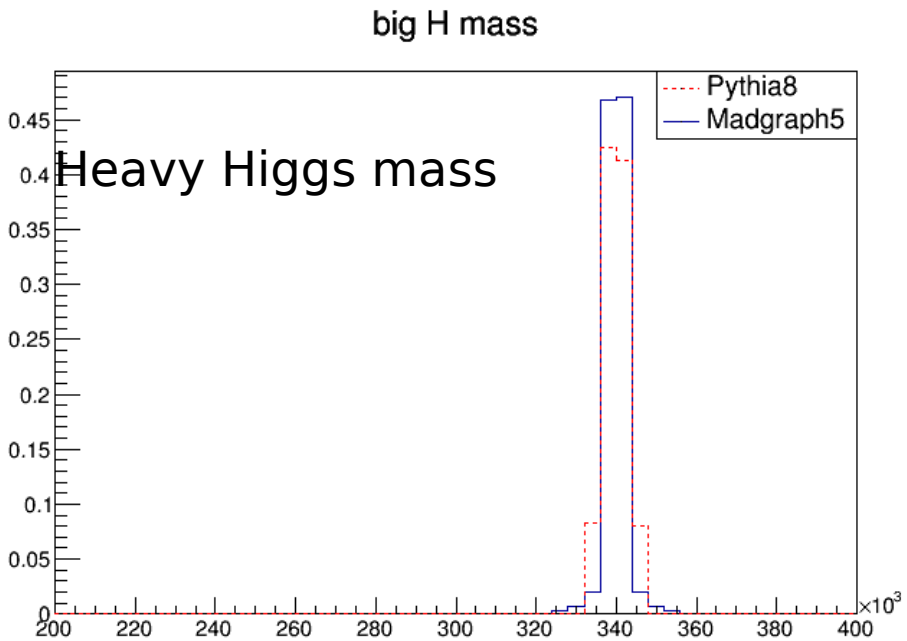

higgs pt
Light Higgs pT
Pythia8
Madgraph5
×10³

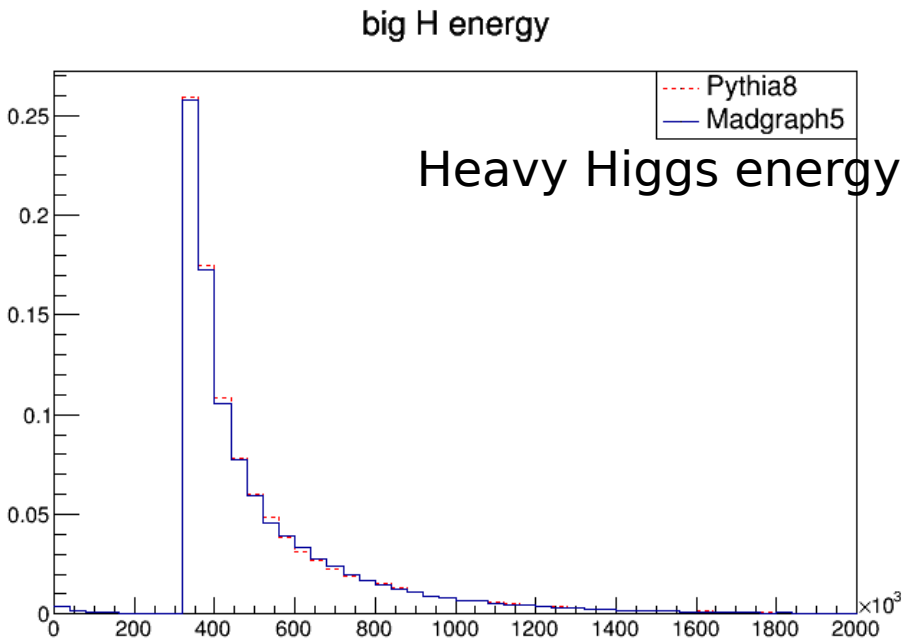

higgs eta
Light Higgs eta
Pythia8
Madgraph5


higgs energy
Light Higgs energy
Pythia8
Madgraph5
×10³


higgs mass
Light Higgs mass
Pythia8
Madgraph5
×10³

H->hh->bbyy


big H mass
Pythia8
Madgraph5
Heavy Higgs mass
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
200
220
240
260
280
300
320
340
360
380
400
×10^3


big H energy
Pythia8
Madgraph5
Heavy Higgs energy
0.25
0.2
0.15
0.1
0.05
0
0
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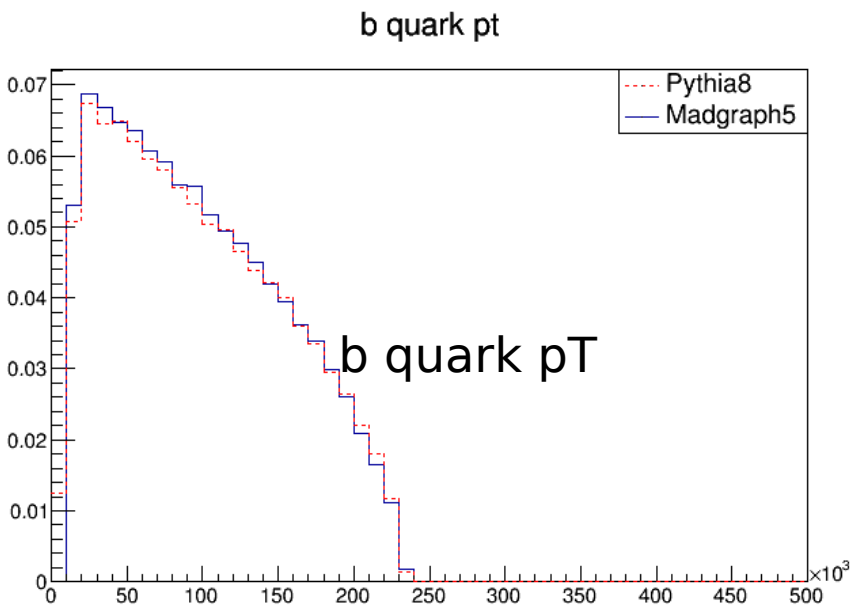
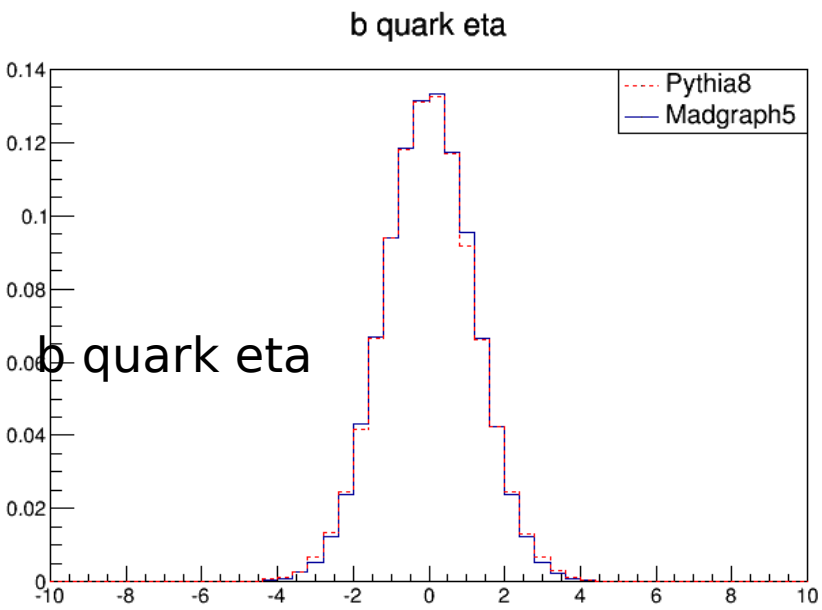
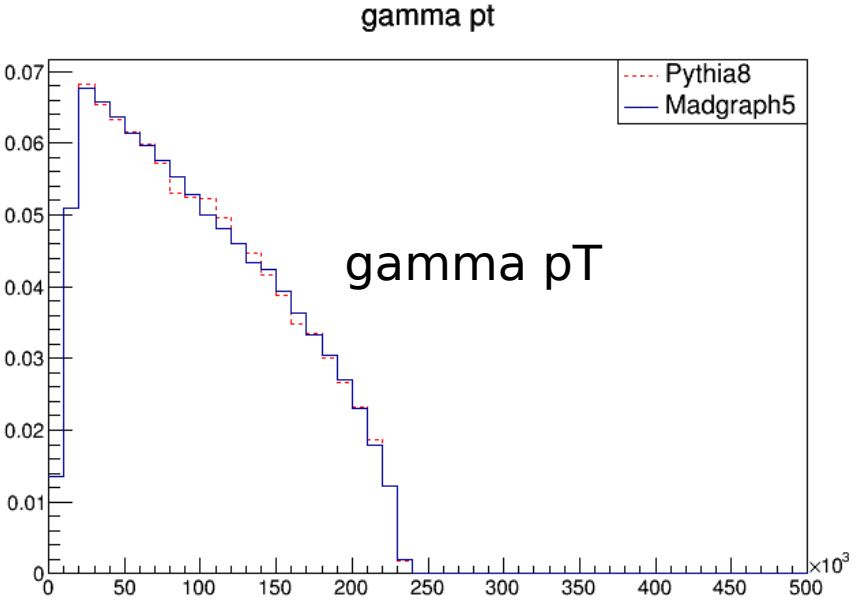
400
600
800
1000
1200
1400
1600
1800
2000
×10^3

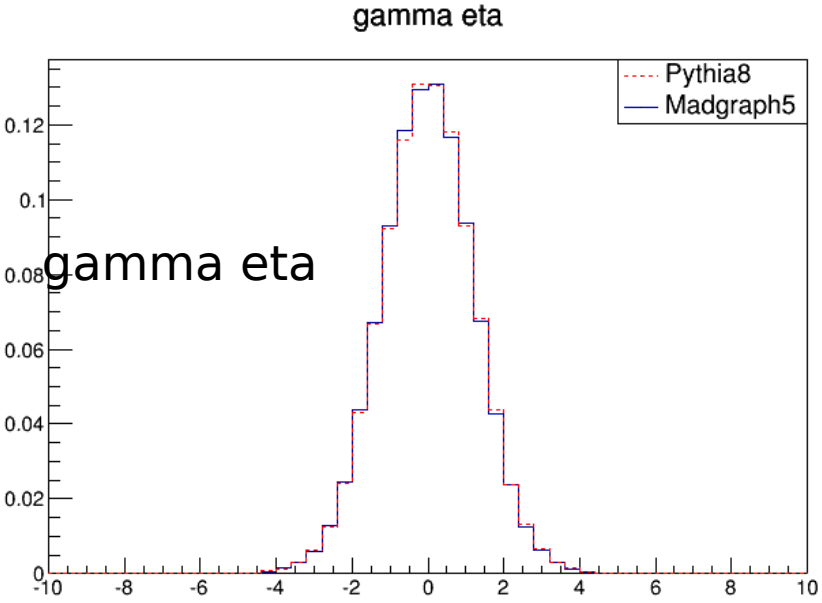
mH = 500 GeV

H->hh->bbyy

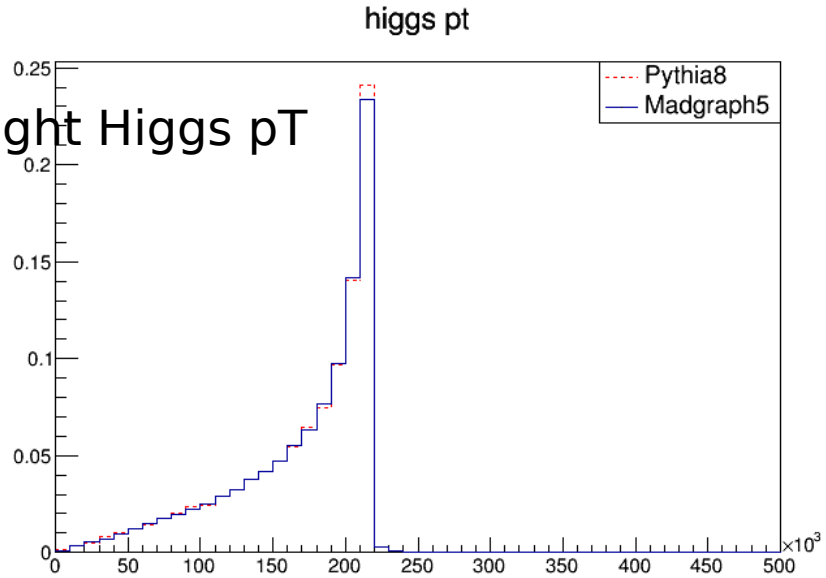

b quark pt
Pythia8
Madgraph5
b quark pT
×10^3


b quark eta
Pythia8
Madgraph5
b quark eta

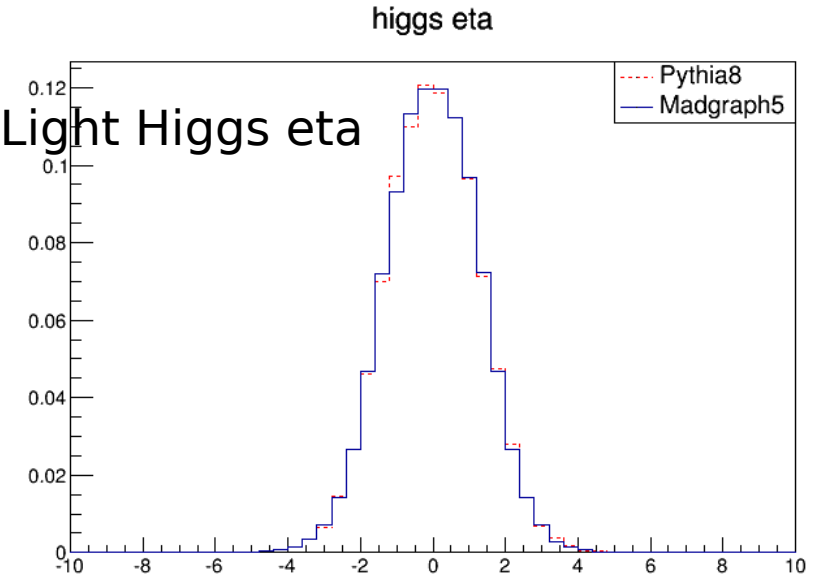

gamma pt
Pythia8
Madgraph5
gamma pT
×10^3


gamma eta
Pythia8
Madgraph5
gamma eta

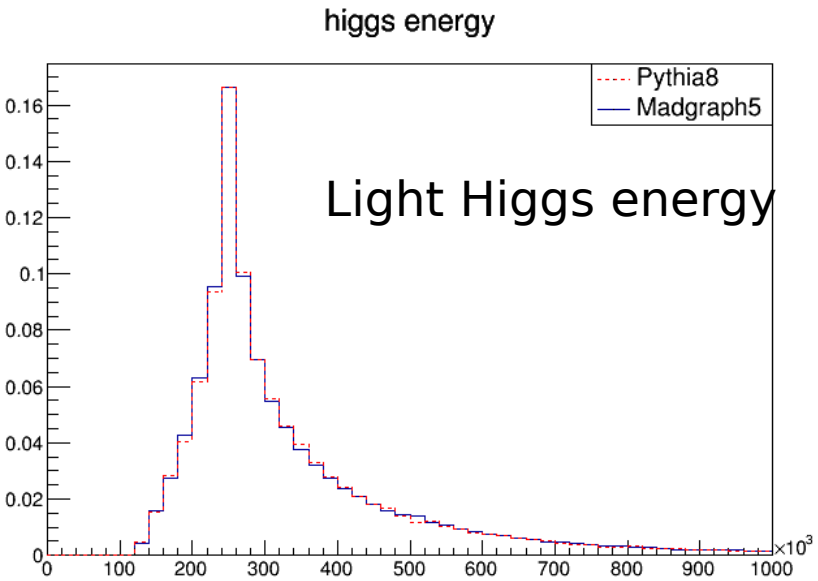
H->hh->bbyy



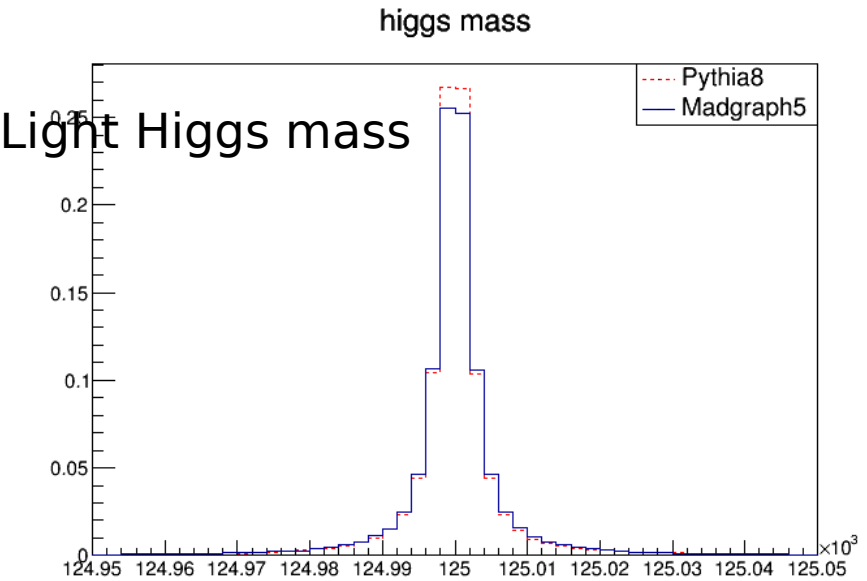
Light Higgs pT



Light Higgs eta

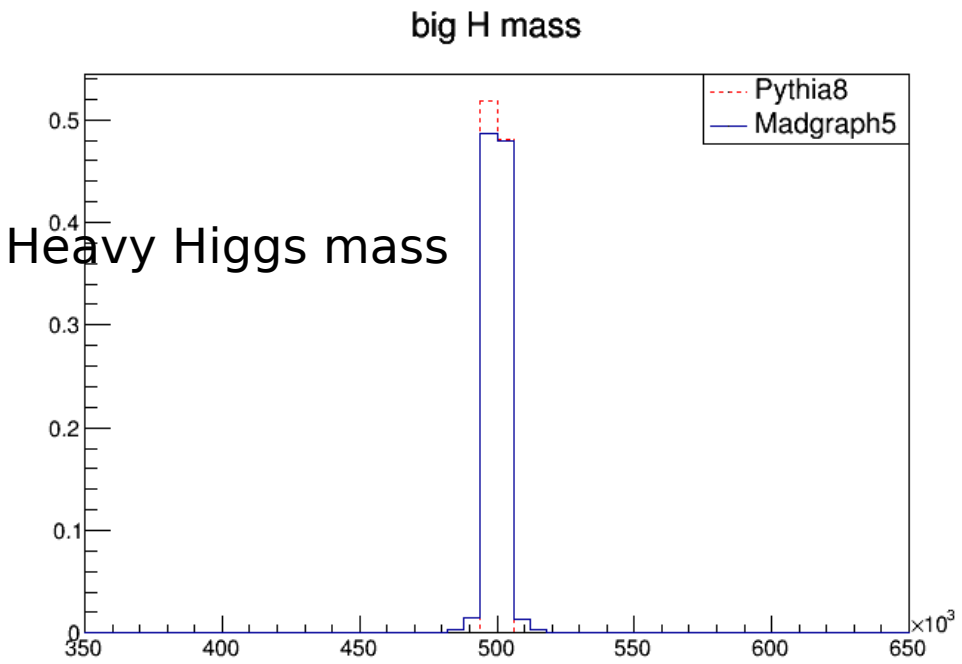


Light Higgs energy

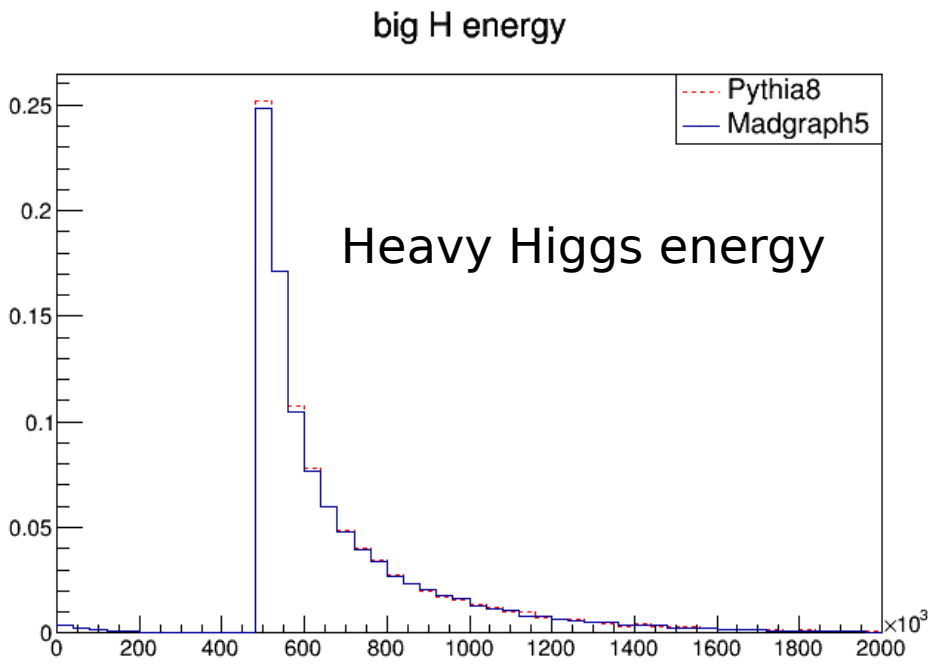


Light Higgs mass

H->hh->bbyy



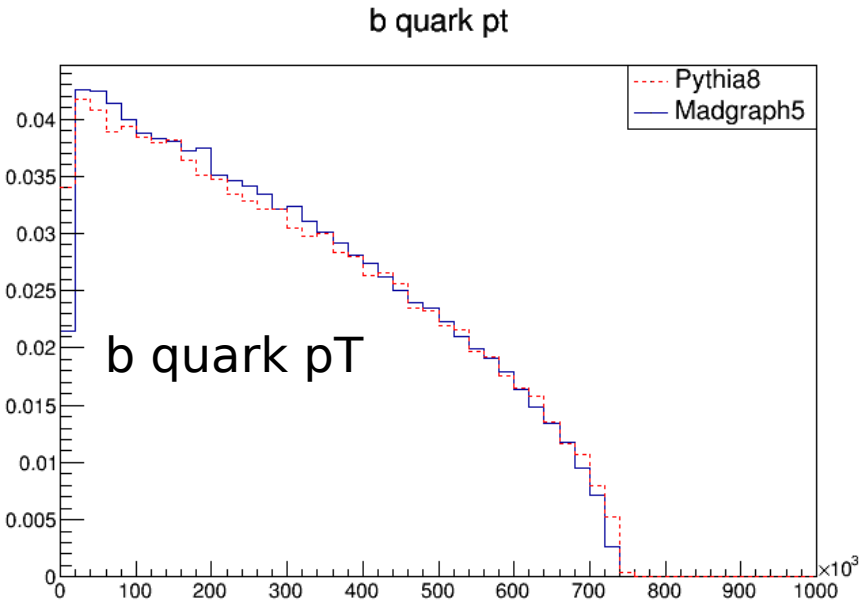
Heavy Higgs mass

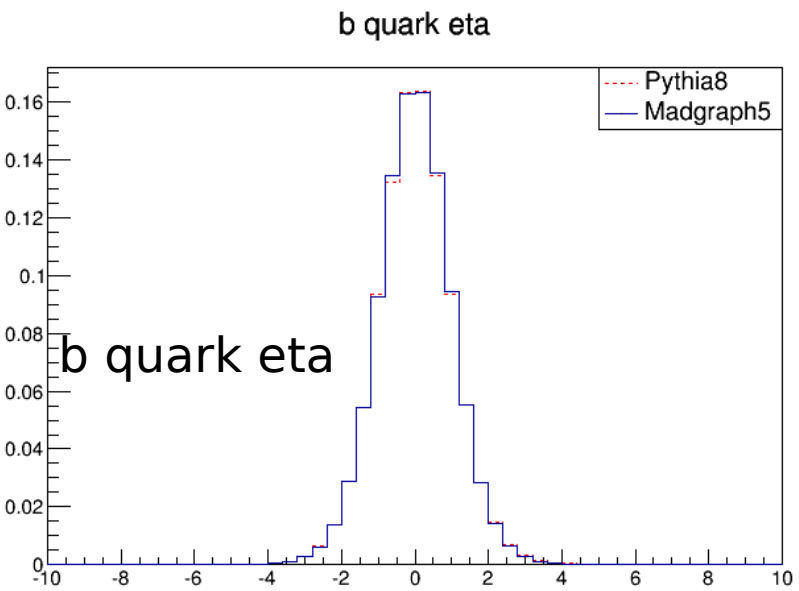


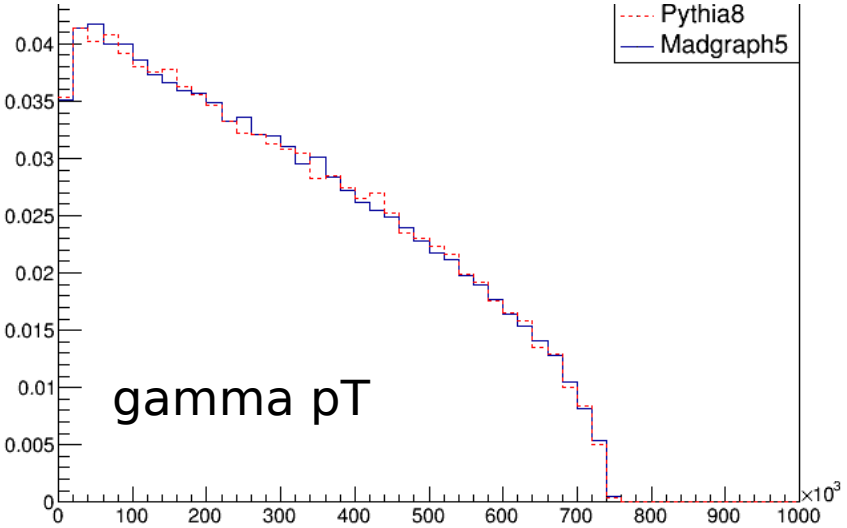
Heavy Higgs energy

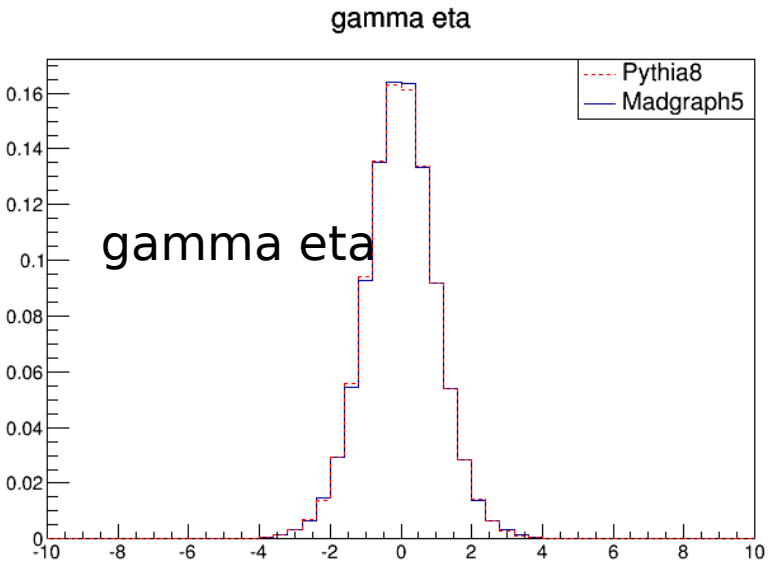
mH = 1500 GeV

H->hh->bbyy

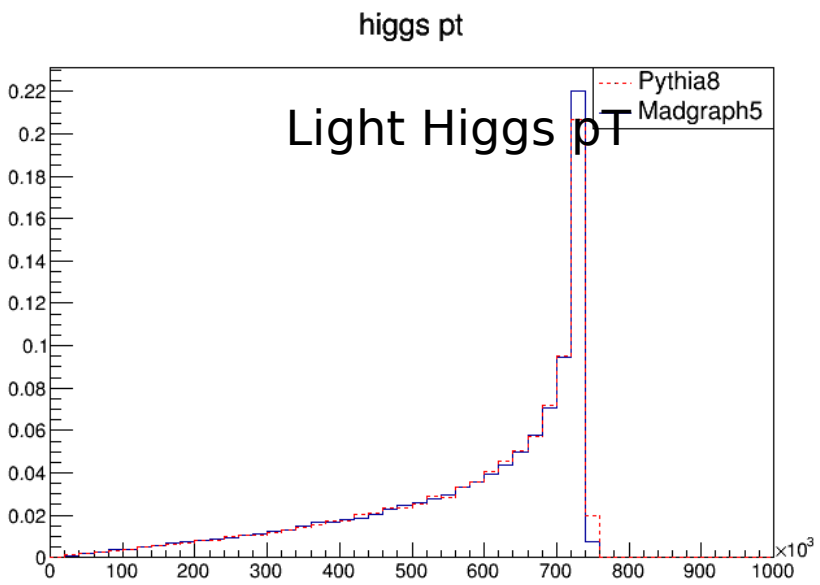

b quark pt
Pythia8
Madgraph5
b quark pT
×10^3

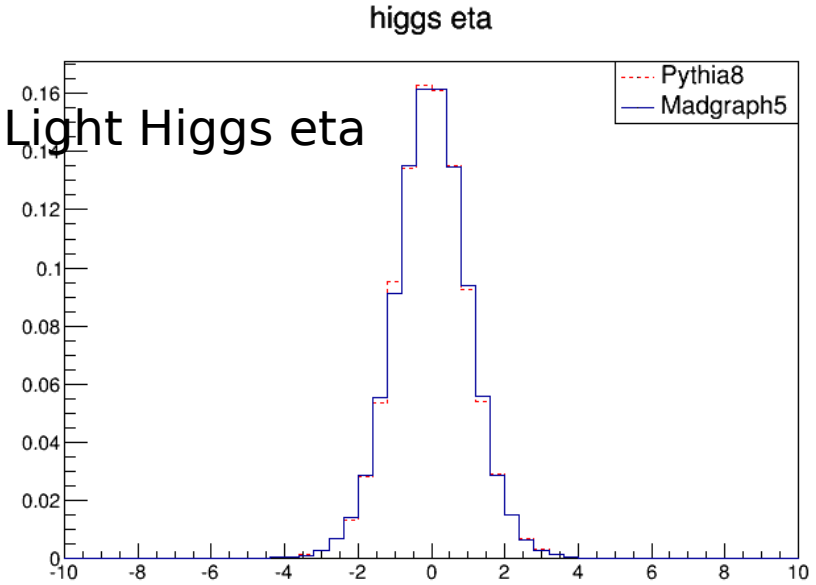

b quark eta
Pythia8
Madgraph5
b quark eta

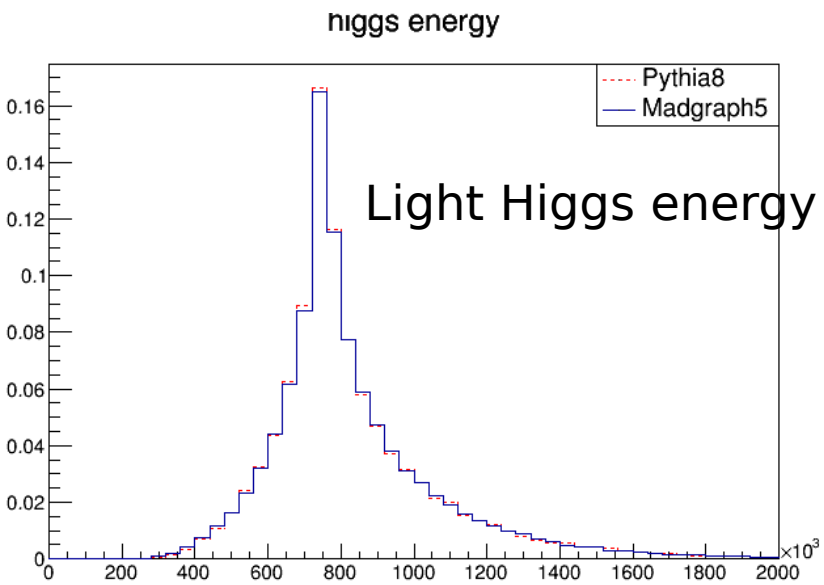

Pythia8
Madgraph5
gamma pT
×10^3

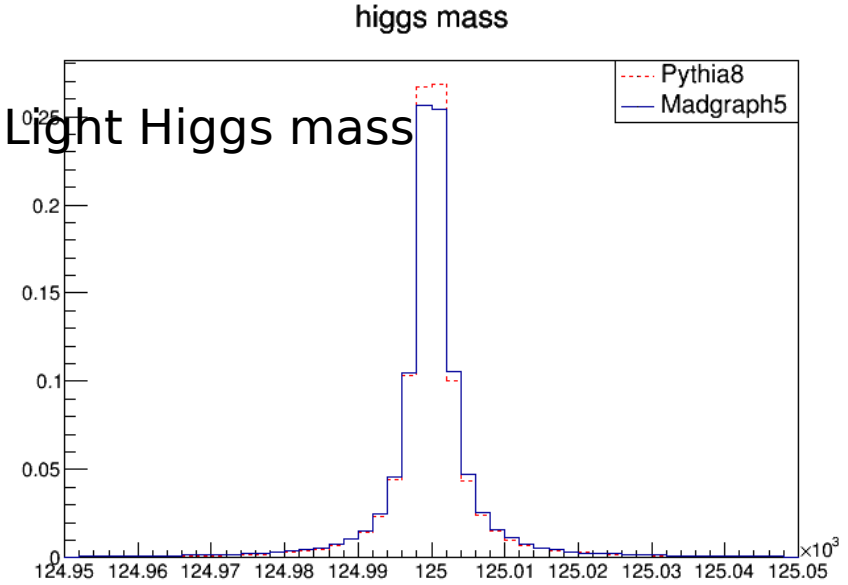

gamma eta
Pythia8
Madgraph5
gamma eta

H->hh->bbyy

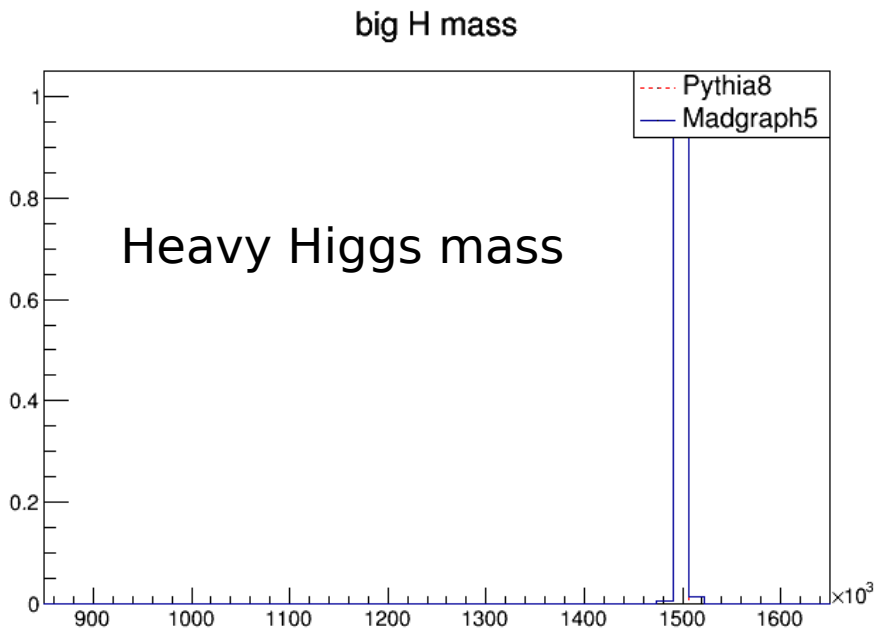

higgs pt
Pythia8
Madgraph5
Light Higgs pT
×10³

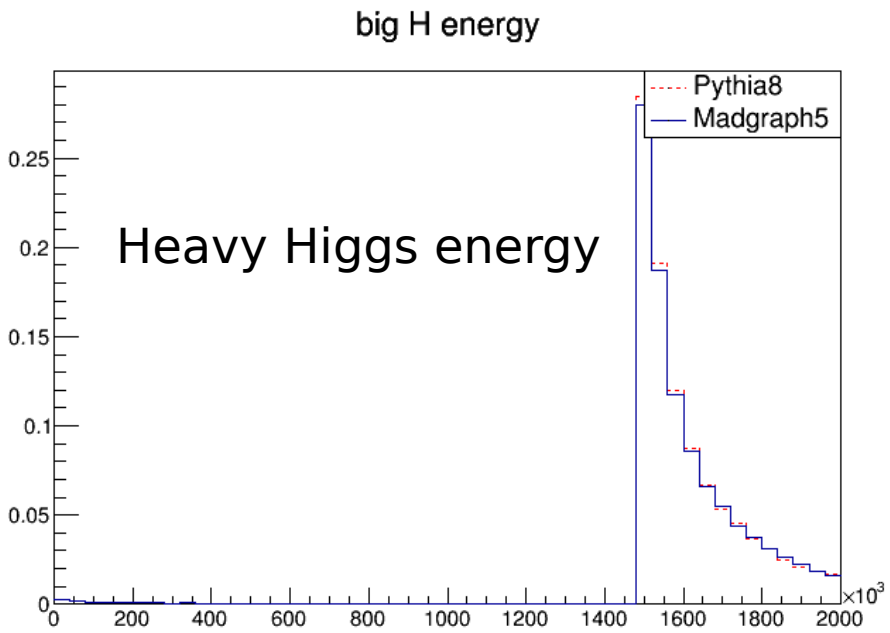

higgs eta
Pythia8
Madgraph5
Light Higgs eta


higgs energy
Pythia8
Madgraph5
Light Higgs energy
×10³


higgs mass
Pythia8
Madgraph5
Light Higgs mass
×10³

H->hh->bbyy


big H mass
Pythia8
Madgraph5
Heavy Higgs mass
1
0.8
0.6
0.4
0.2
0
900
1000
1100
1200
1300
1400
1500
1600
×10^3


big H energy
Pythia8
Madgraph5
Heavy Higgs energy
0.25
0.2
0.15
0.1
0.05
0
0
200
400
600
800
1000
1200
1400
1600
1800
2000
×10^3

Conclusion

- With the implementation of narrow width, PY8 gives proper distributions
- Compare heft in MG5 to PY8, all kinematics show reasonably good agreements

Many thanks to Nikolaos and Liron for their tremendous help on the instructions of the generator configurations

Backup

Please check all the mass points in the attachement