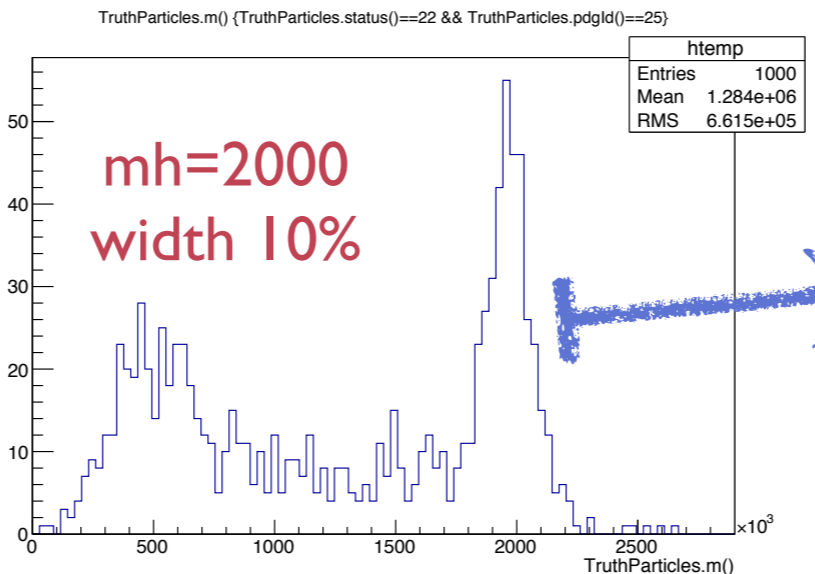
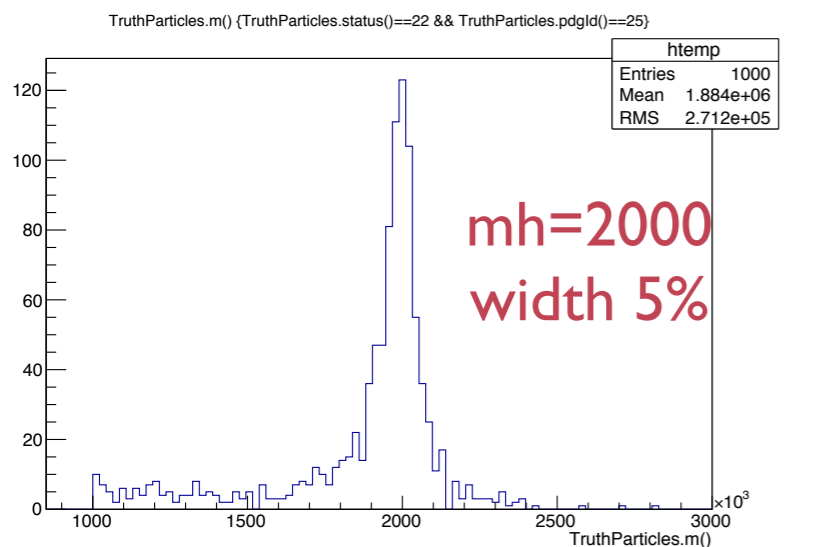
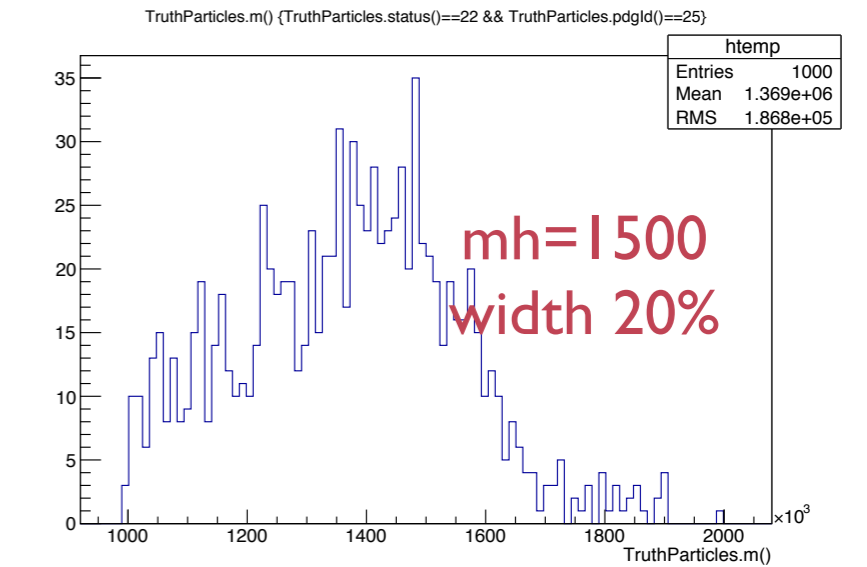
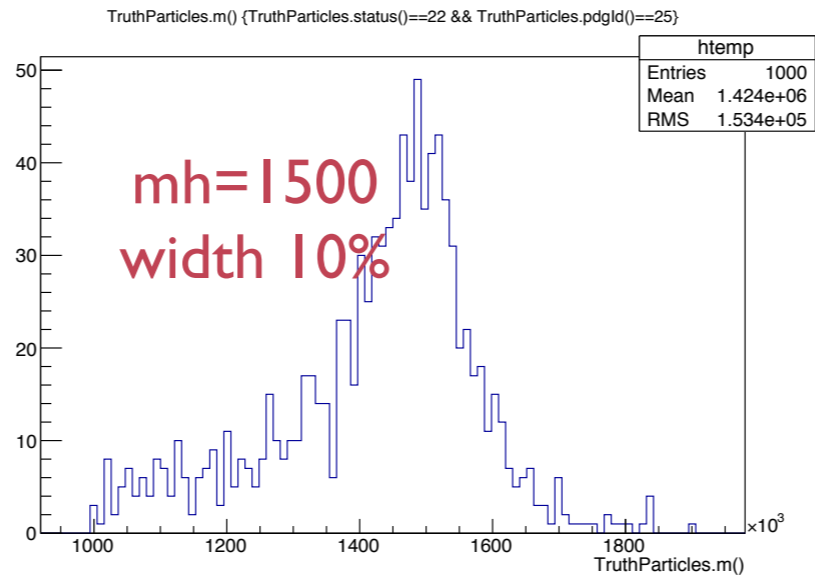
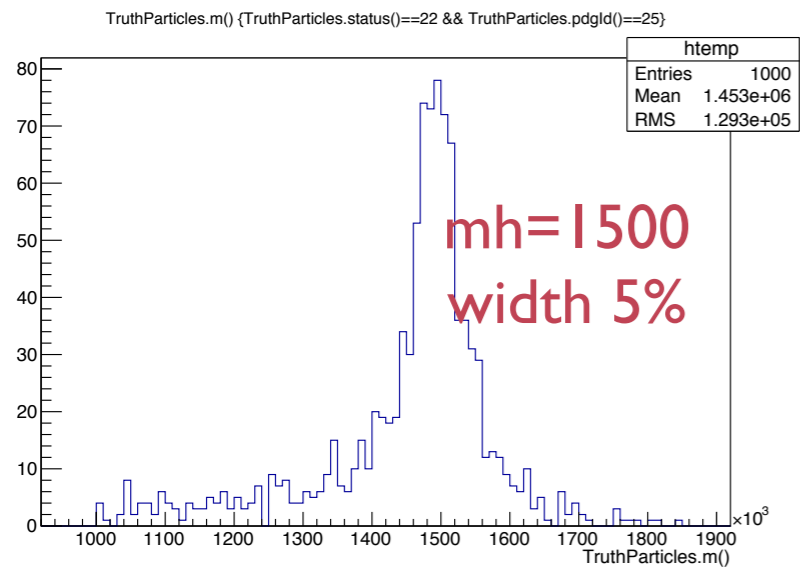
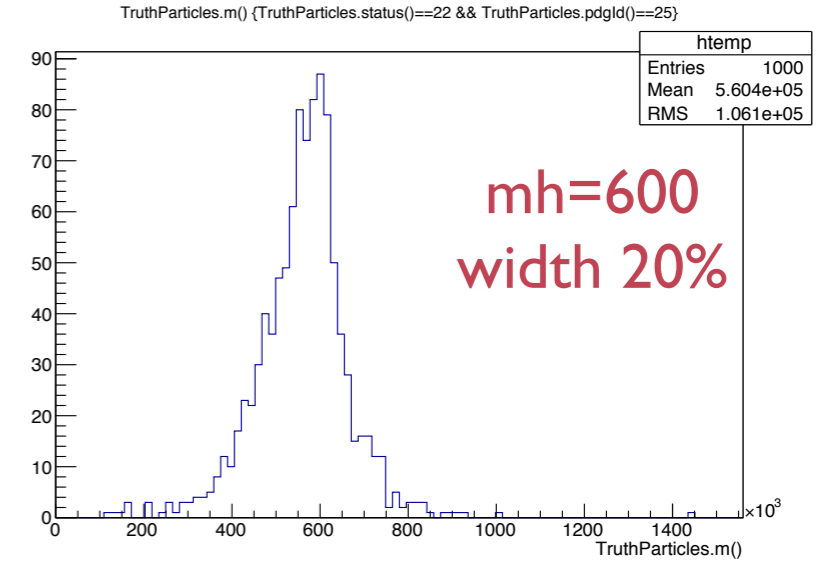
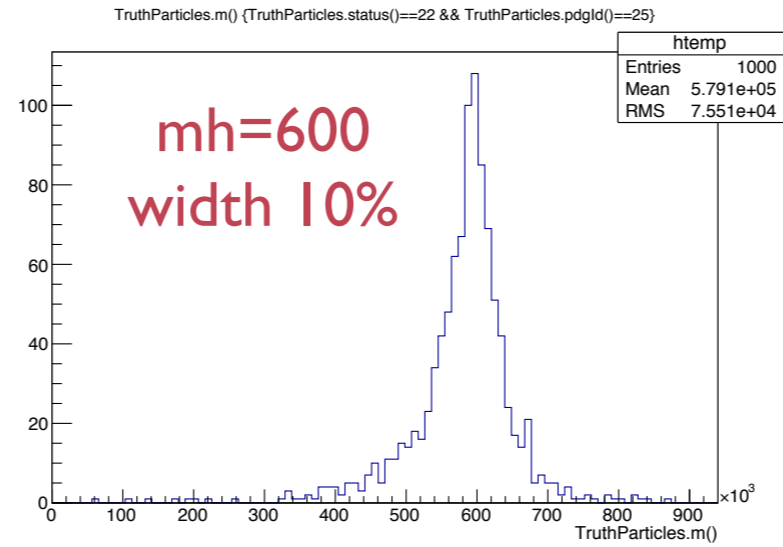
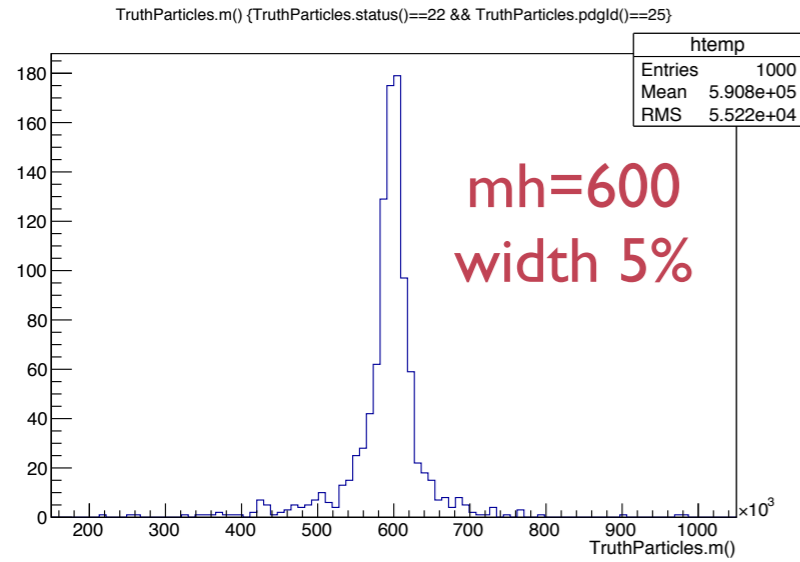


# ‘High mass validation non Narrow width’

In ATLAS we wanted to study different Higgs width and the dependence of the kinematics from the width in the case no narrow width approximation is used.

We have tried ( using powheg+pythia8)

- different masses:  $m_h=600, 1500, 2000$  GeV
- and different widths: 5%, 10% 20% of  $m_h$

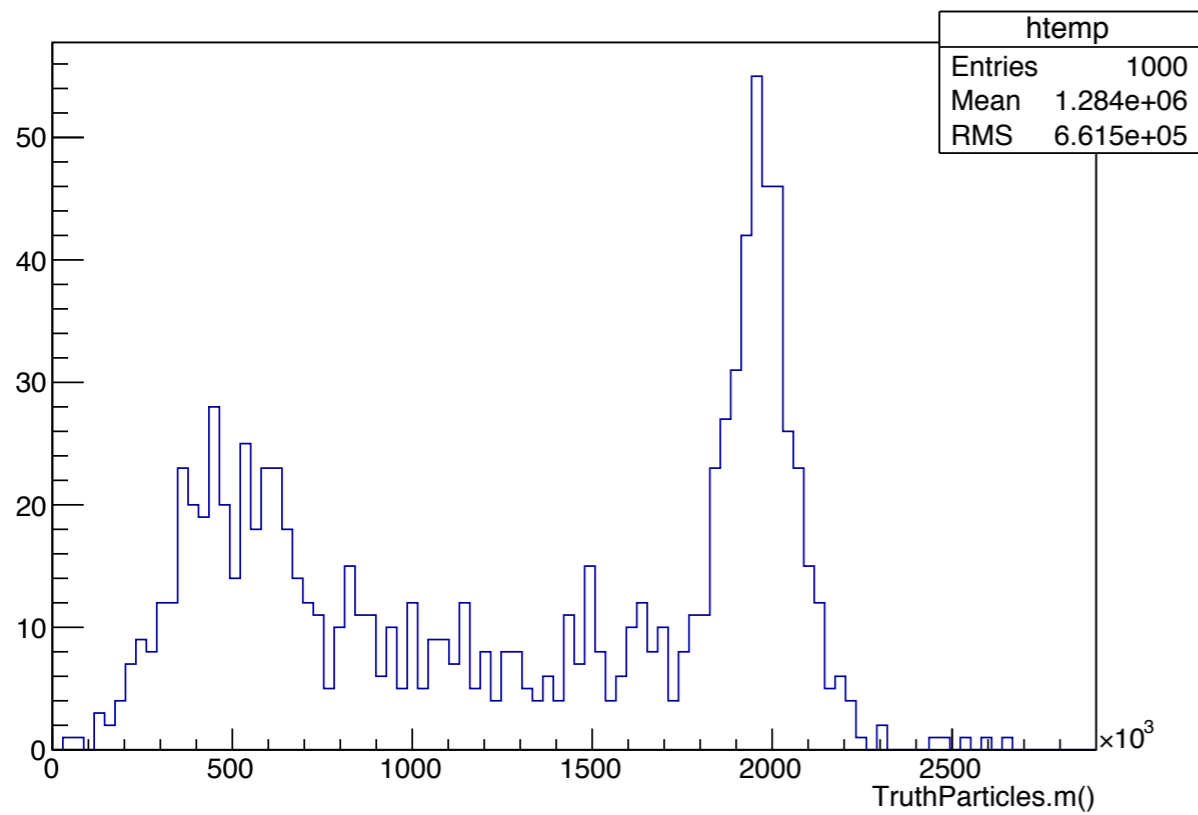


shoulder appears:  
this shoulder is also present in  
2HDM scans.

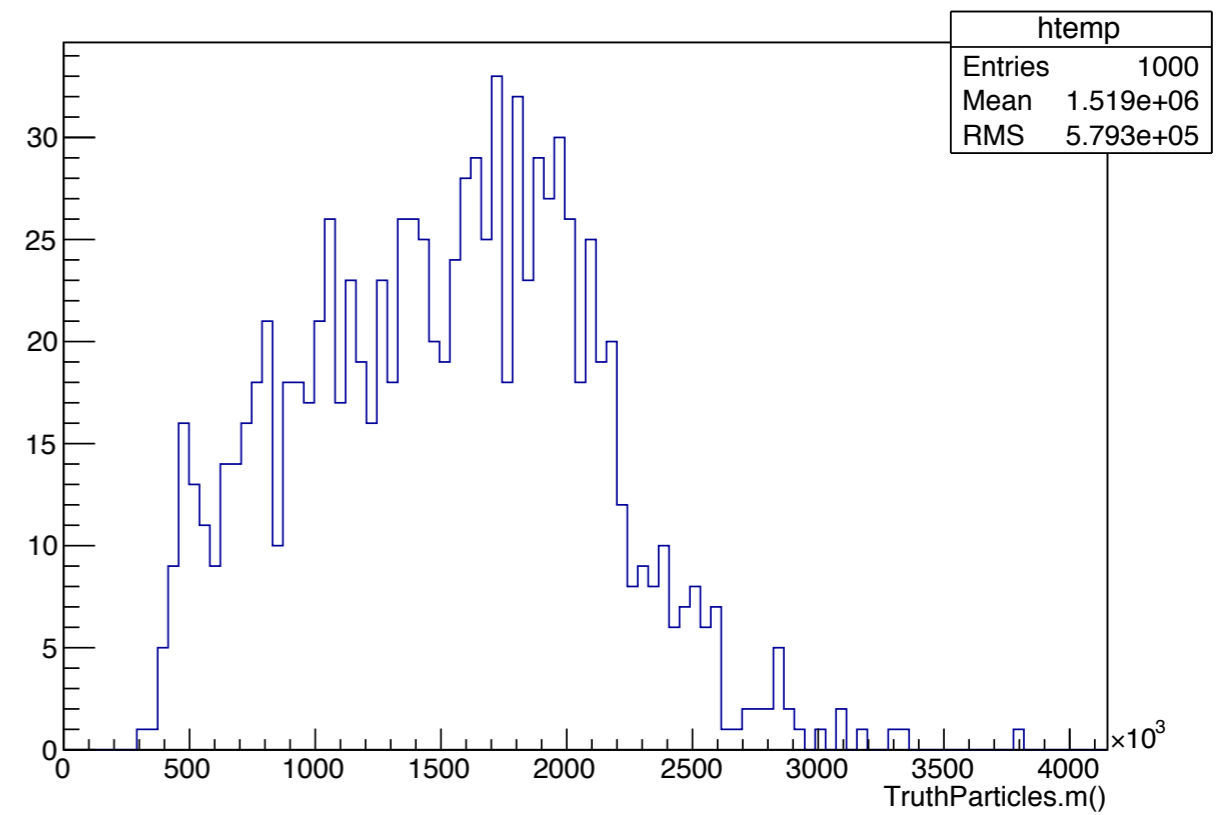
mh=2000  
width 10%

CPS  
mh=2000

TruthParticles.m() {TruthParticles.status()==22 && TruthParticles.pdgid()==25}



TruthParticles.m() {TruthParticles.status()==22 && TruthParticles.pdgid()==25}



# Investigations

Is this shoulder physical?

**black:** MC@NLO manual (4.16),  $\Gamma_H=200$  GeV

**red:** MC@NLO manual (4.16),  $\Gamma_H=3.639$  TeV (computed in the SM)

**blue:** MC@NLO manual (4.14),  $\Gamma_H=3.639$  TeV (computed in the SM)



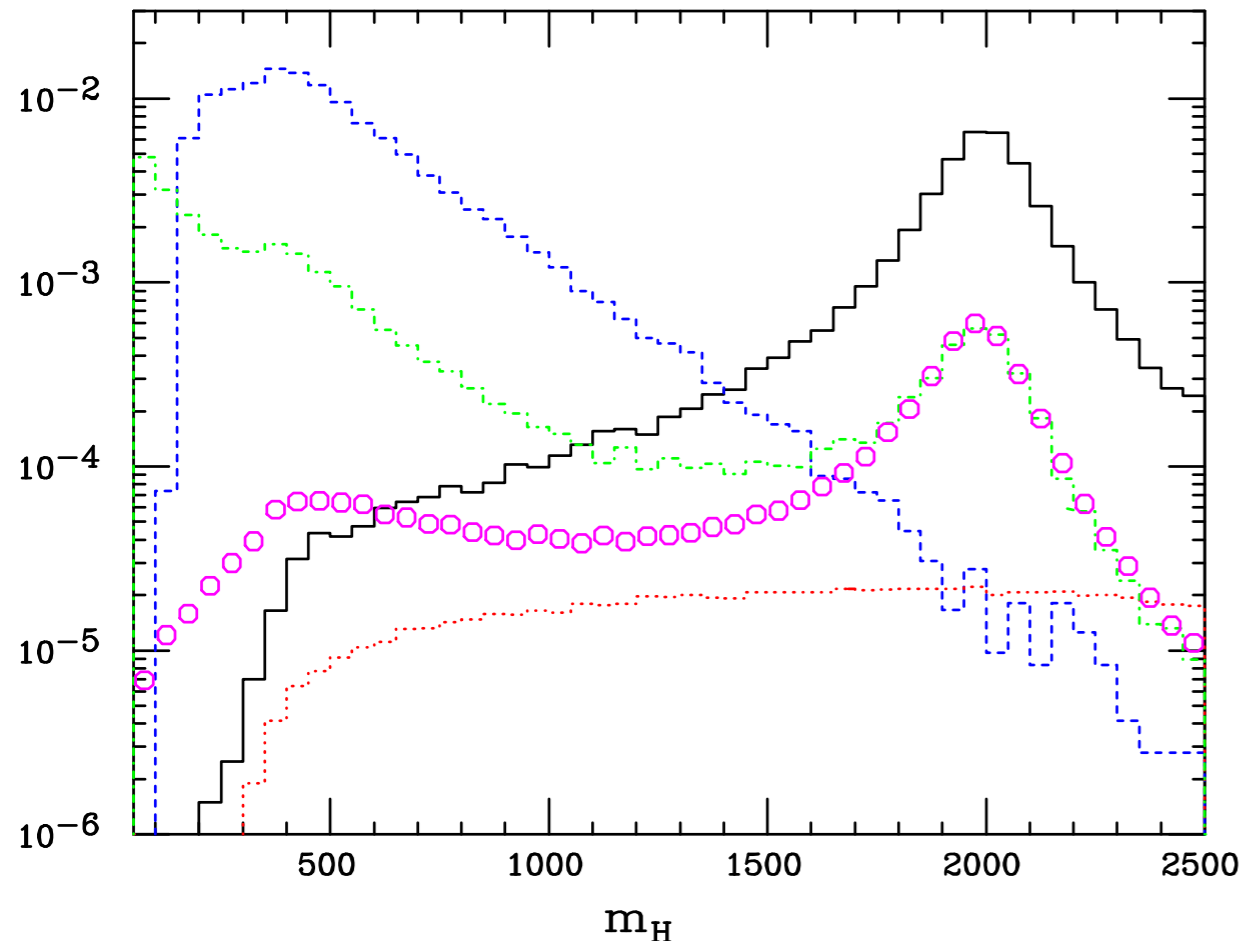
Use BR calculated at generated mass

**green:** MC@NLO manual (4.13),  $\Gamma_H=200$  GeV,

**pink:** MC@NLO manual (4.15, powheg/pythia convention)  $\Gamma_H=200$  GeV



Use BR calculated at pole mass



$$\delta(\hat{s} - M_H^2) \rightarrow \frac{M_H \Gamma_H}{\pi} \frac{1}{(\hat{s} - M_H^2)^2 + M_H^2 \Gamma_H^2}. \quad (4.13)$$

$$\delta(\hat{s} - M_H^2) \rightarrow \frac{\sqrt{\hat{s}} \hat{\Gamma}_H}{\pi} \frac{M_H^4}{\hat{s}^2} \frac{1}{(\hat{s} - M_H^2)^2 + M_H^4 \hat{\Gamma}_H^2 / \hat{s}} \widehat{\text{BR}}(H^0 \rightarrow d_1 d_2), \quad (4.14)$$

$$\delta(\hat{s} - M_H^2) \rightarrow \frac{1}{\pi} \frac{\hat{s} \Gamma_H / M_H}{(\hat{s} - M_H^2)^2 + (\hat{s} \Gamma_H / M_H)^2}, \quad (4.15)$$

$$\delta(\hat{s} - M_H^2) \rightarrow \frac{1}{\pi} \frac{\sqrt{\hat{s}} \hat{\Gamma}_H \widehat{\text{BR}}(H^0 \rightarrow d_1 d_2)}{(\hat{s} - M_H^2)^2 + M_H^2 \Gamma_H^2}, \quad (4.16)$$