

Validation plots for H4l ggF 0,1,2 jets production

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Introduction: What's new

- Updated MG5 process definition (after feedback from ATLAS generator mailing list):

```
import model HC_NLO_X0_UF0-heft
define p = g u c d s b u~ c~ d~ s~ b~
define j = g u c d s b u~ c~ d~ s~ b~
generate p p > x0 , x0 > l+ l- l+ l- /t
```

- Updated hard process definition for pythia:
PYTHIA8_Process = "pp>(h>LEPTONS)"
- Updated ptj and ptb cutoff in MG5 in order to have the same value as ktDurham: 30 GeV (was 20 GeV)

⇒ Still no difference in distributions from first glance, will have closer look this afternoon

- Got joboptions from WW fiducial cross section MG5 production, which are also producing MC's exclusive in N jets, maybe this will help

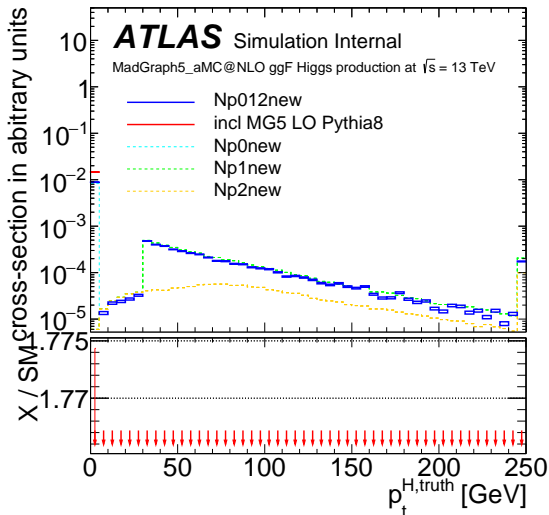
Introduction

- Goal: ggF $H \rightarrow ZZ \rightarrow 4\ell$ production with inclusive number of jets
- For inclusive sample majority are 0-jet events and we have roughly 25% 1-jet, 5% 2-jet events
- Idea: In order to increase statistics split inclusive ggF sample in three ggF samples with N additional partons ($N = 0, 1, 2$)

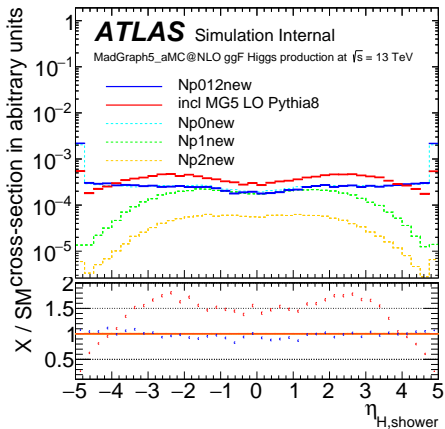
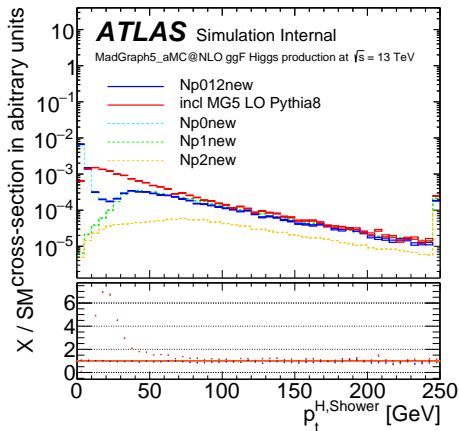
Overview of samples, cross checks and objects

- ggF samples, that we want to request:
 - Np0: pp \rightarrow x0, x0 \rightarrow l+l+l+l- & jet matching in pythia
 - Np1: pp \rightarrow x0 j , x0 \rightarrow l+l+l+l- & jet matching in pythia
 - Np2: pp \rightarrow x0 jj, x0 \rightarrow l+l+l+l- & jet matching in pythia
- Cross check samples:
 - incl: pp \rightarrow x0 , x0 \rightarrow l+l+l+l- & showering in pythia
 - Np012: pp \rightarrow x0, x0 \rightarrow l+l+l+l- , add process pp \rightarrow x0 j , x0 \rightarrow l+l+l+l- , add process pp \rightarrow x0 jj , x0 \rightarrow l+l+l+l- & jet matching in pythia
- Cross checks:
 - 1 Np012 vs. Np0 + Np1 + Np2 stacked \rightarrow ok
 - 2 Np012 vs. incl \rightarrow see differences
- Objects:
 - Higgs before showering: status 22
 - Higgs after showering: status 62
 - truth Z: status 22
 - Jets: Output container of antikt algorithm with R=0.4 AntiKt4TruthJets ('contaminated' by electrons/photons)

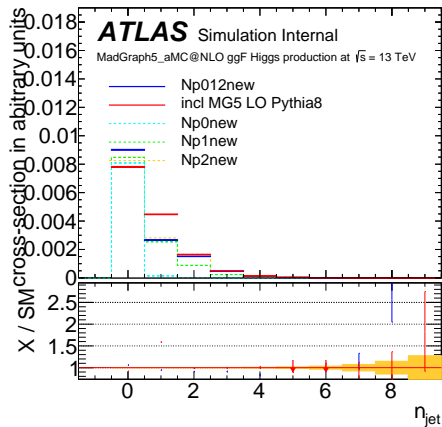
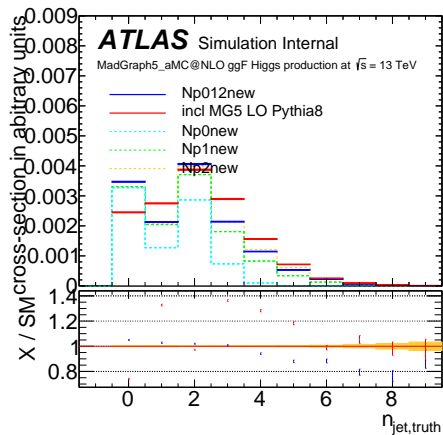
Higgs before showering



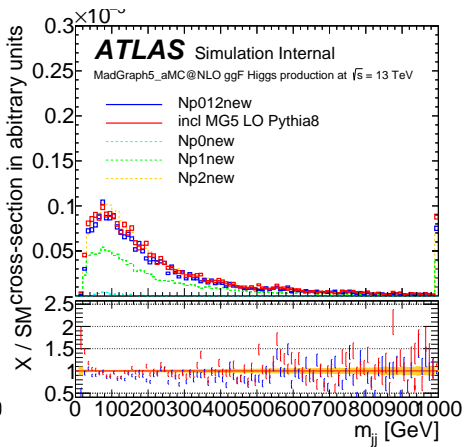
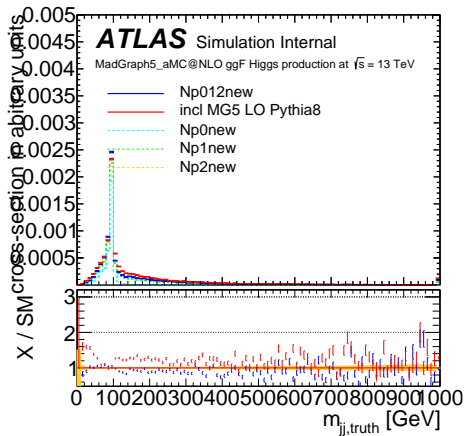
Higgs after showering ($p_{T,H} > 1 \text{ MeV}$)



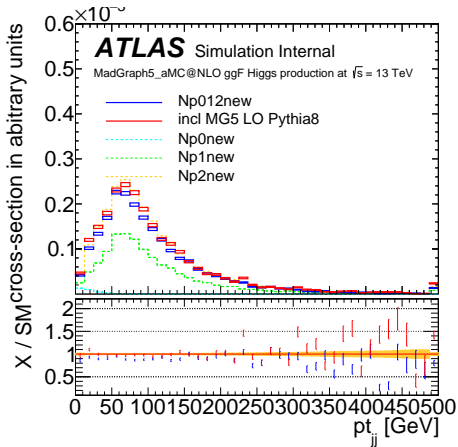
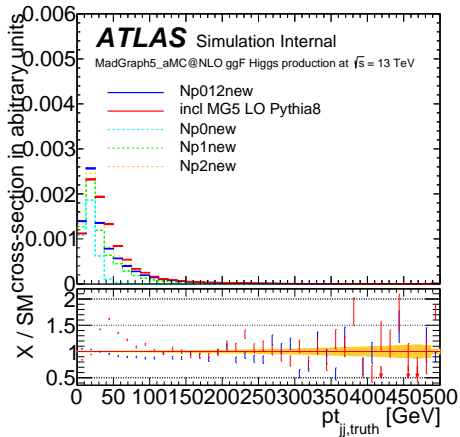
n_{jets} : AntiKt4TruthJets before (left) and after e-jet removal (right)



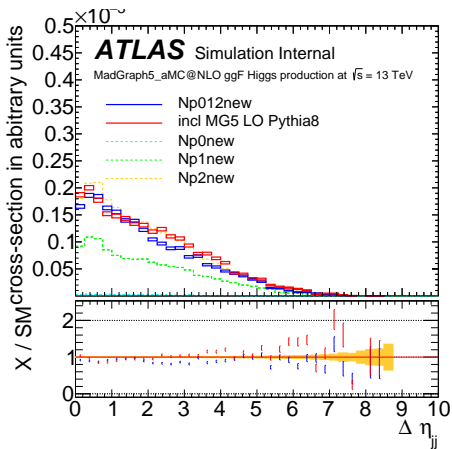
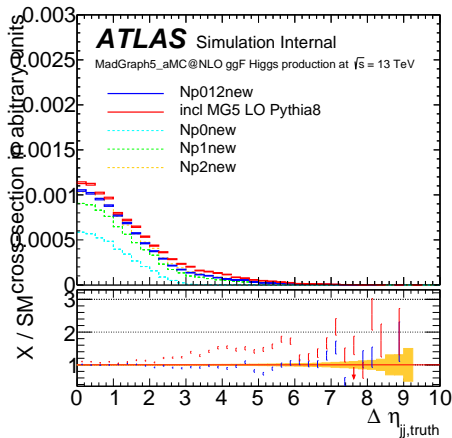
Dijets: m_{jj} before (left) and after e-jet removal (right)



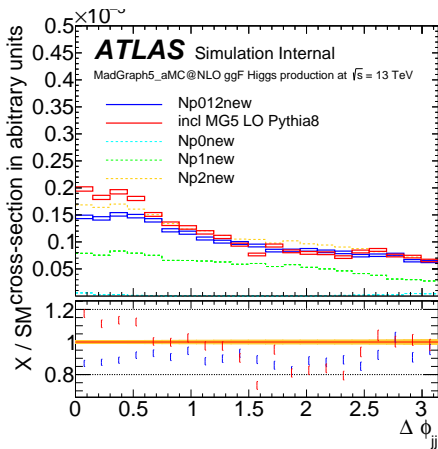
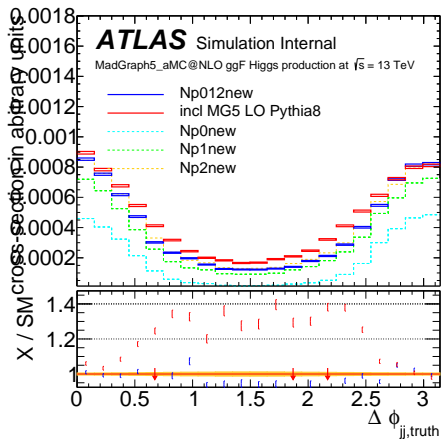
Dijets: pt_{jj} before (left) and after e-jet removal (right)



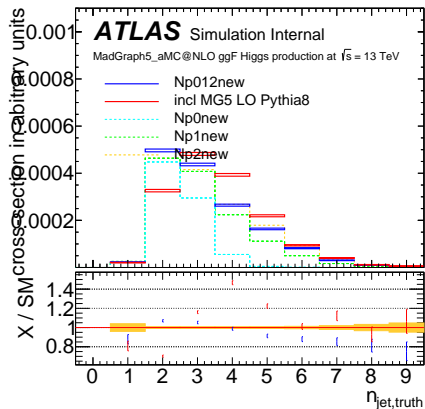
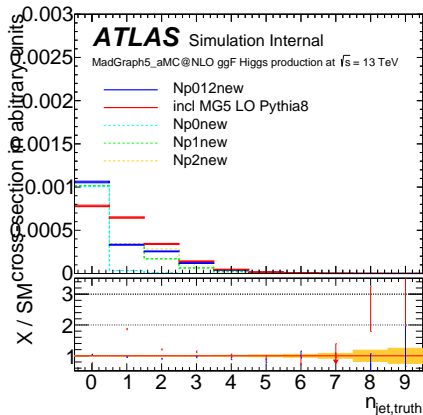
Dijets: detajj before (left) and after e-jet removal (right)



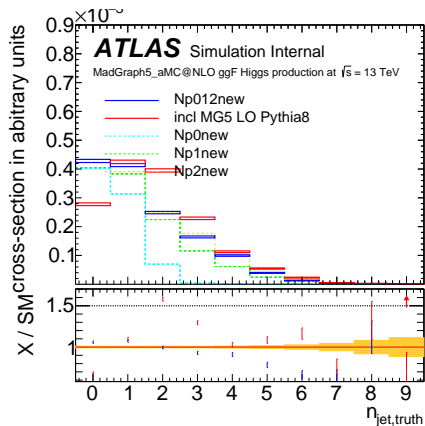
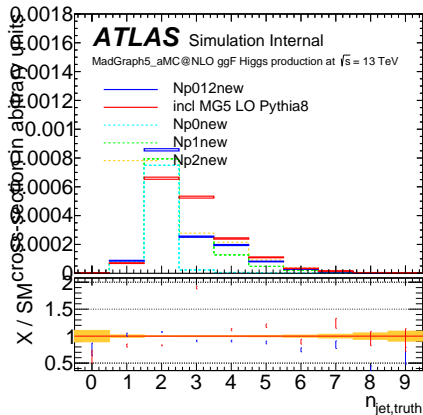
Dijets: d ϕ_{jj} before (left) and after e-jet removal (right)



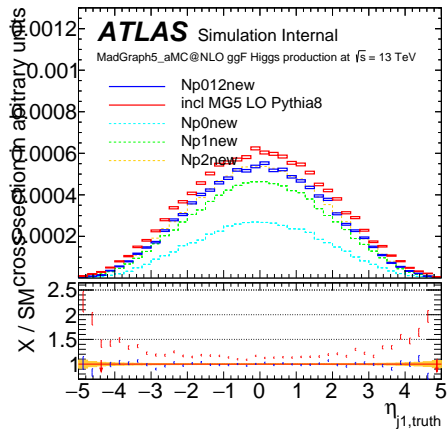
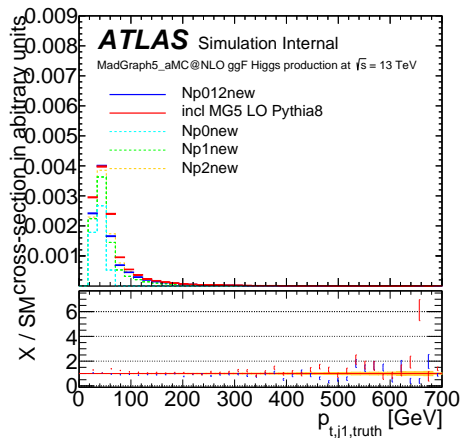
n_{jets} before electron-jet overlap removal for 4mu and 4e final states



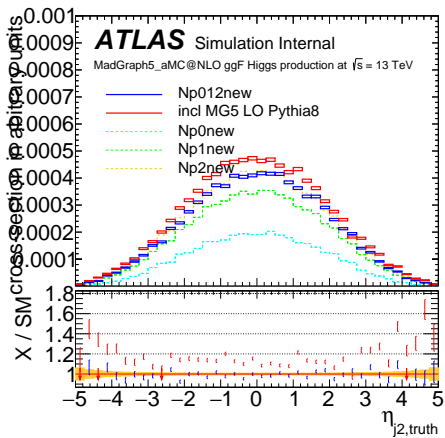
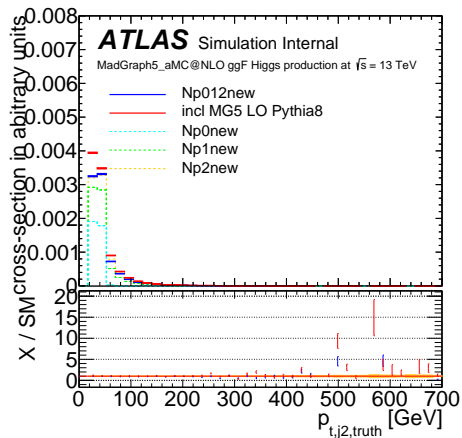
n_{jets} before electron-jet overlap removal for 2e2mu and 2mu2e final states



Jets truth: Leading jet



Jets truth: Subleading jet



Cross sections

sample	$\cos(\alpha)$	κ_{SM}	κ_{Hgg}	cross section [pb^{-1}]
incl	1.0	1.0	1.0	0.002058
Np012	1.0	1.0	1.0	0.003658
Np0	1.0	1.0	1.0	0.002069
Np1	1.0	1.0	1.0	0.001116
Np2	1.0	1.0	1.0	0.000495