WEEKLY

Huijun

Works on HSG1

- Preparing the “basic category” code for HSG1 for h010
- Two terms:
  - catCoup_Moriond2016
    - Only VBF categroy
  - CatCoup_dev
    - All 7 categories are included, under developing

Feedback from SM ssWW group

- Samples:
  - We can share some samples (sig, bkg)
  - https://twiki.cern.ch/twiki/bin/viewauth/AtlasProtected/VbsWWRun2Study
  - Additional jets are missing.
- Derivation frame work
  - We may share the frame for HWW and ssWW
  - https://indico.cern.ch/event/375697/contribution/3/attachments/748827/1027308/HWWxAODFramework.pdf
- Electron charge Miss-id Tool :
  - No reply yet from Kristin

Backup

- Proposal talk on SM meeting 20th, Nov. 2015

Proposal study on H->hh->WWWW analysis

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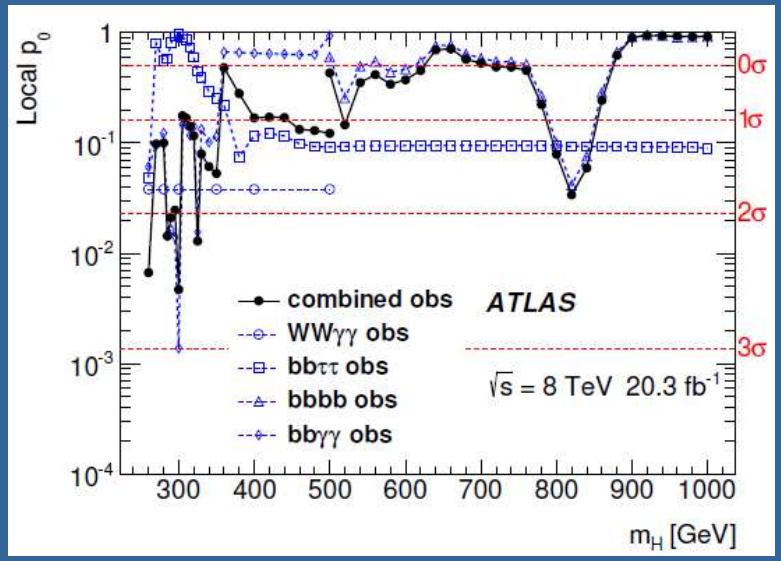
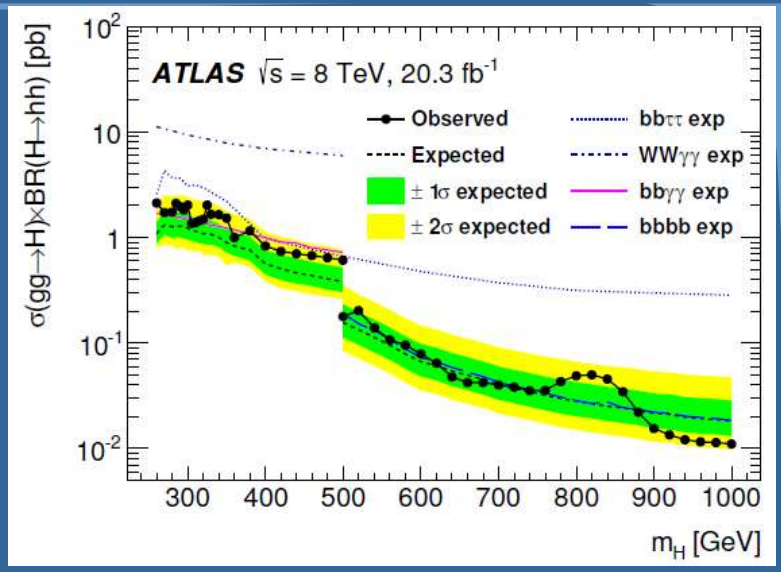
Huijun ZHANG, Maosen ZHOU

Motivation

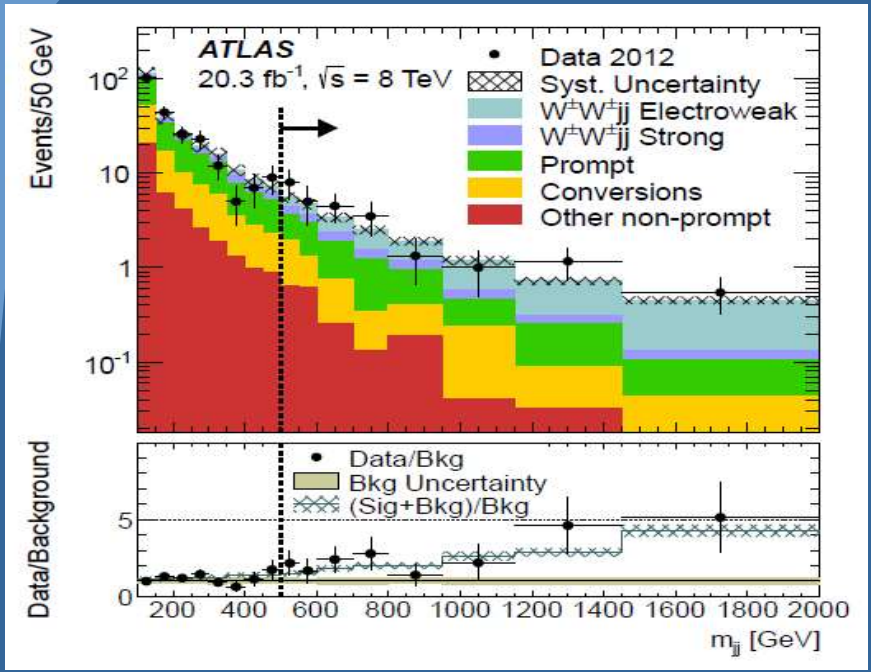




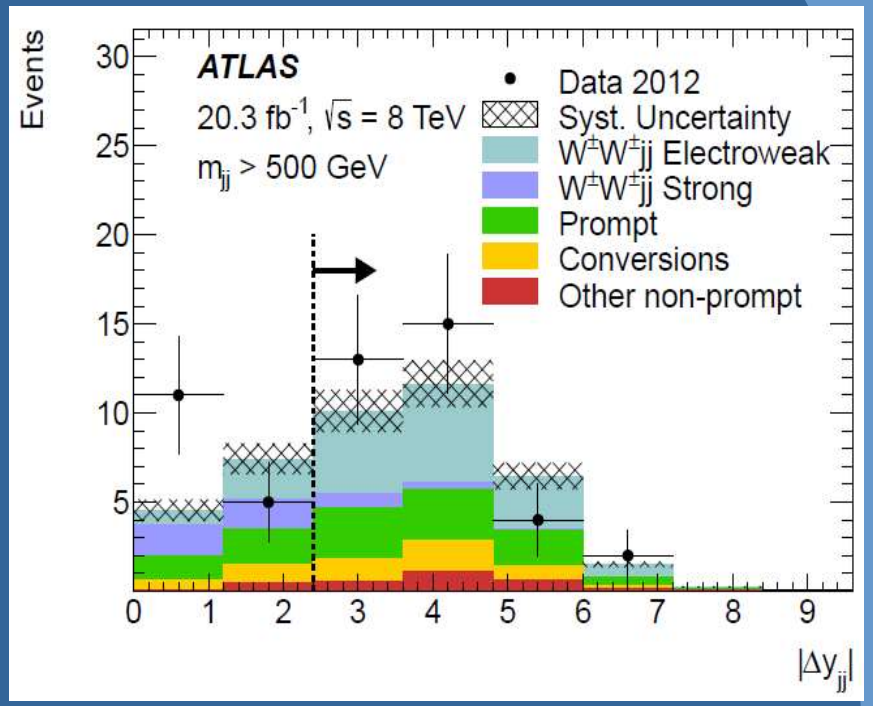
- With run1 data, four channels are taken into account in the analyses and are combined.
- More channels are being exploited : γγττ, WWbb…

Motivation

Electroweak production $W^{\pm}W^{\pm}jj$ search : CERN-PH-EP-2014-079, arXiv:1405.6241v2



Inclusive $W^{\pm}W^{\pm}jj$
Significance :
Observed: **4.5σ**
Expected: **3.6σ**



VBS:
Obs.:**3.4σ**
Exp.: **2.8σ**

Motivation

- The studies by Baur, Plehn, and Rainwater in PRL 89 (2002), 151801 seem interesting and could be useful for discovery heavy Higgs at HL-LHC running.

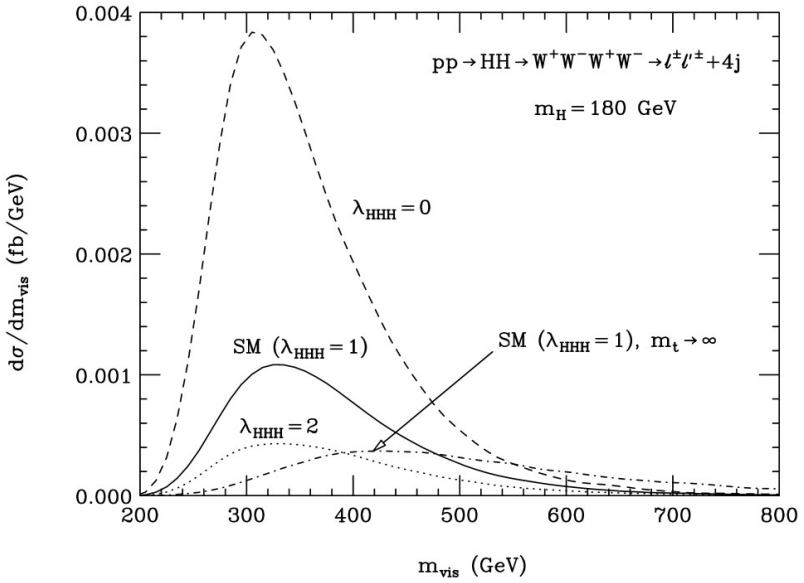
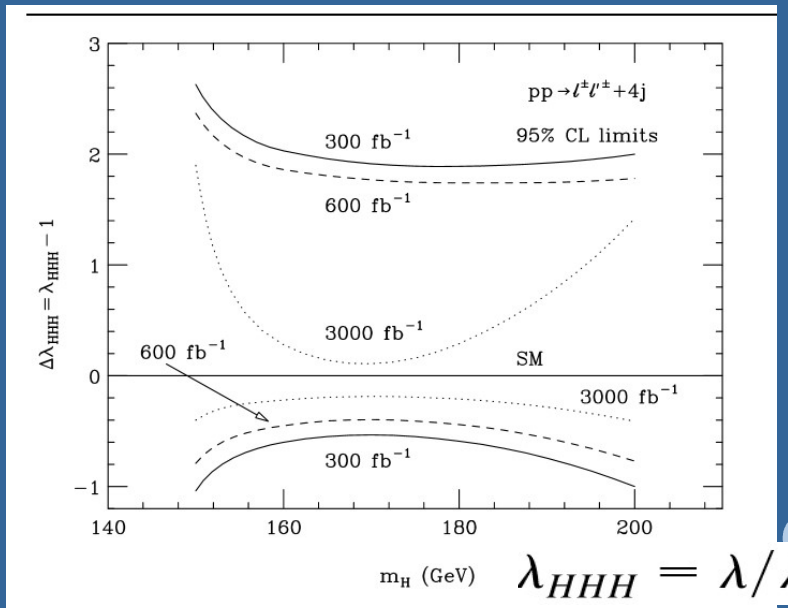


FIG. 3. The $m_{\rm vis}$ distribution of the signal for $m_H = 180$ GeV in the SM (solid curve), for $\lambda_{HHH} = \lambda/\lambda_{\rm SM} = 0$ (dashed line) and for $\lambda_{HHH} = 2$ (dotted line). The dot-dashed line shows the SM cross section in the large m_t limit. Qualitatively similar results are obtained for other values of m_H.



$\lambda_{HHH} = \lambda/\lambda_{\rm SM}$

FIG. 4. Limits achievable at 95% C.L. for $\Delta\lambda_{HHH} = \lambda_{HHH} - 1$ ($\lambda_{HHH} = \lambda/\lambda_{\rm SM}$) in $pp \to \ell^{\pm}\ell'^{\pm} + 4j$ at the LHC. Bounds are shown for integrated luminosities of 300 fb^{-1} (solid lines), 600 fb^{-1} (dashed lines), and 3000 fb^{-1} (dotted lines). The allowed region is between the two lines of equal texture. The Higgs boson self-coupling vanishes for $\Delta\lambda_{HHH} = -1$.

H->hh->WWWW Channel

$\frac{\sigma \cdot Br(wwww \to l^{\pm}vl^{\pm}vqqqq)}{\sigma \cdot Br(ww\gamma\gamma \to lvqq\gamma\gamma)}$ = 6.5 $\frac{\sigma \cdot Br(wwww \to lvlvlvqq)}{\sigma \cdot Br(ww\gamma\gamma \to lvqq\gamma\gamma)}$ = 2.2 $\frac{\sigma \cdot Br(wwww \to lvlvlvqq)}{\sigma \cdot Br(ww\gamma\gamma \to lvqq\gamma\gamma)}$ = 0.7

- ✓ **The events have signature with leptons, missing ET and/or jets**
- ✓ **Will first try same sign lepton channel including different flavors.**
- ✓ **May also include 3 and/or 4 lepton channel**

Some pre-analysis based on truth ntuple

- samples:
  - Using MadGraph5 HeavyScaler to generate gg -> H - >hh, where mH=300 GeV
  - Using MadGraph5 SM to generate

    p p > l+ l+ j j j j vl vl
- Using Pythia within ATHENA FRAMEWORK to do the SM h decay, and PS and Frag.
- Some p p > l+ l+ j j vl vl sample are also generated to check the multiple jet difference due parton shower and matrix element

Basic selections

- At least 2 SS leptons(electron or muon) Pt>10GeV, isolated
- At least 4 jets, Pt > 25GeV, isolated

Parton shower *VS* matrix element

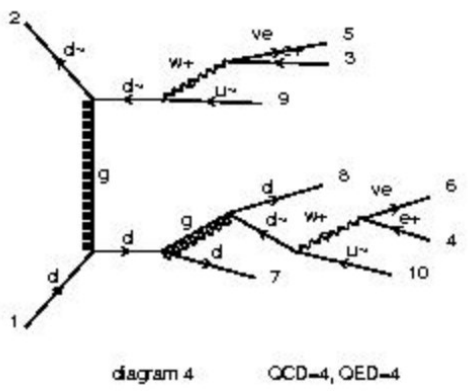
- Comparing l+ l+ v v j j with 2 jets from parton shower with l+ l+ v v j j j j

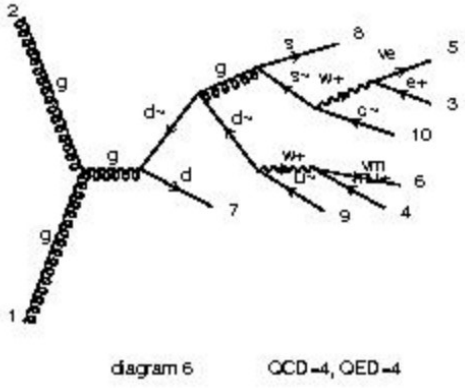
PROCESS	Xsection(fb)	Efficiency	Final (fb)
l+l+vvjj	5.3	40%	2.1
l+l+vvjjjj	2.4	80%	1.9

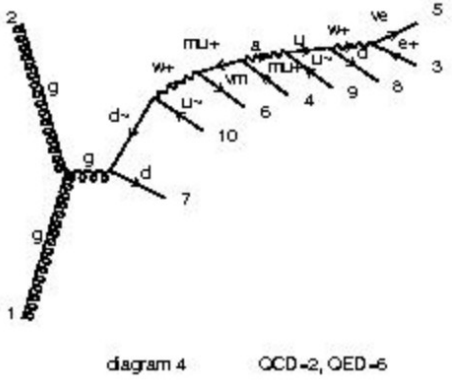
- May due to the configuration of parton shower

Background estimation

- Real SS background
  - WZ+jets, $W^{\pm}W^{\pm}$+jets…
  - SM WH ZH ttH
  - Currently we only have p p −> $l^{\pm}vl^{\pm}vqqqq$, Generated with MadGraph5, inclusively to check the cross section and the diagrams
  - Need to generate in separately, also to check if there are some samples already available
  - Also need to consider pileup effects







Background estimation

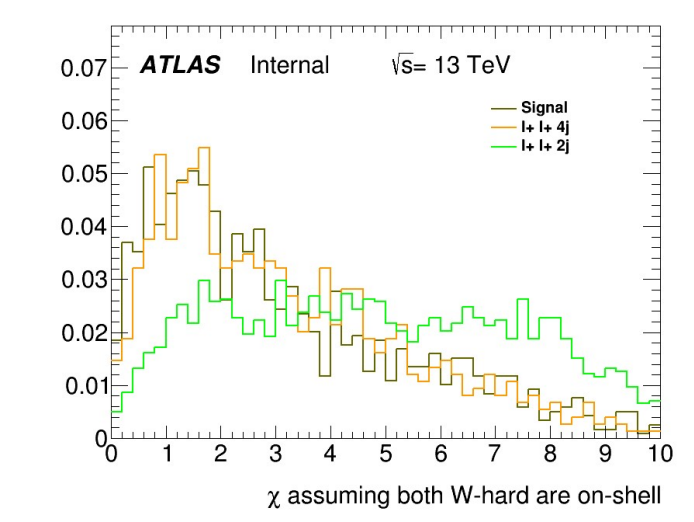
- Background due to electron charge miss ID
  - tt~, WW+jets, Z/gamma + jets
  - SM higgs: VBF GGF ZH
  - Need to be generated separately
  - Need advises from experts
- Background due to fake
  - Jet fake as lepton, photon reconstructed as lepton…
  - e.g. Wγ , Zγ , W+ jets…
  - Need to be generated separately

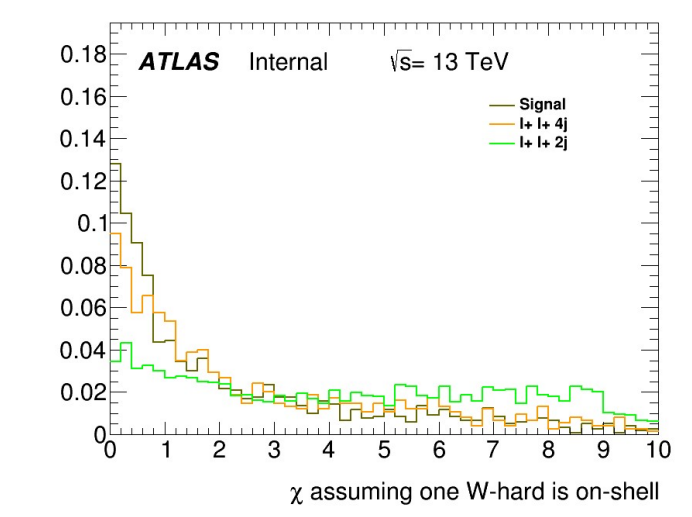
To distinguish jets from W

- We plan to divide events into 3 categories based on the on-shell W decay hadronically

- A Minimal X method is tested

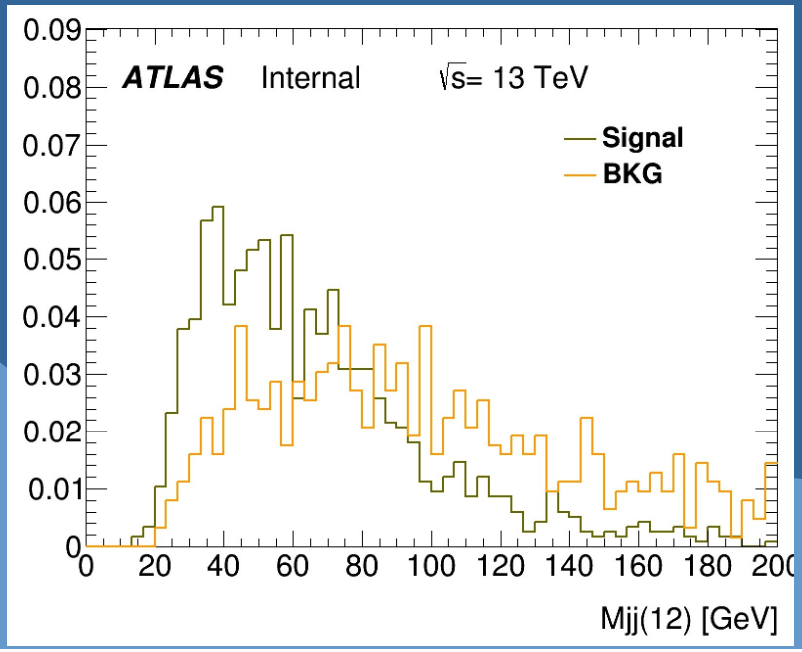
$$X = \sqrt{\left(\frac{M1-Mw}{\sigma(M1)}\right)^2+\left(\frac{M2-Mw}{\sigma(M2)}\right)^2}, \quad \text{where } \sigma(M) = 0.1 * M$$

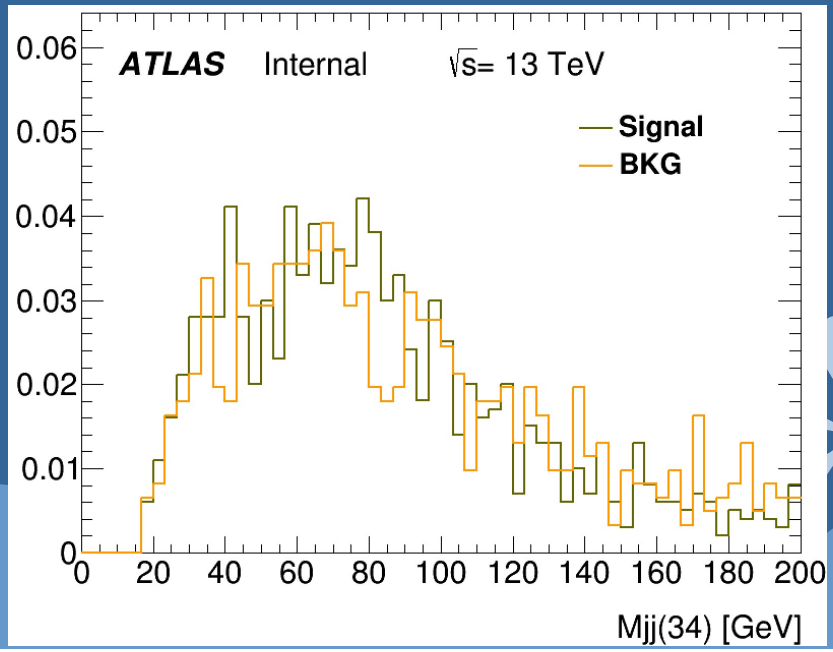




Using the lepton to pick out jets

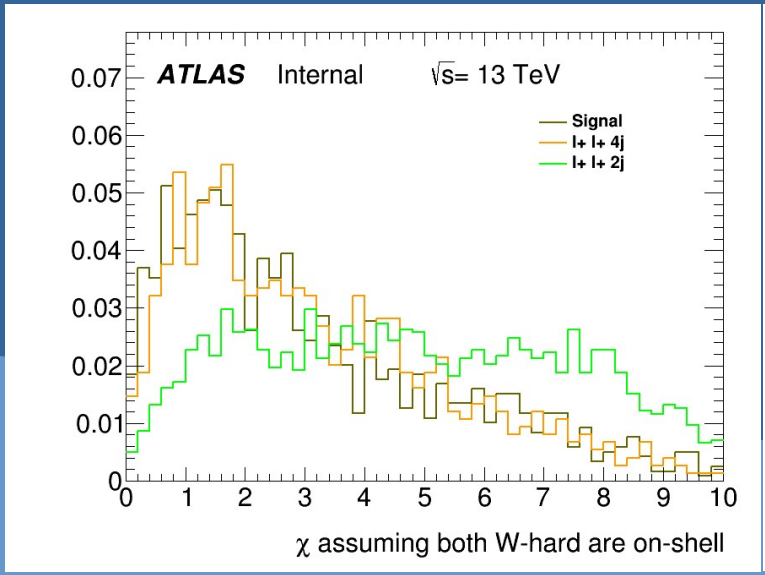
- Suggest by Weiming, using the 2jets closest to the leading lepton as the first pair and sub-leading as well.
- truth matching check may be useful to compare both methods, but there are some technical issue…
- Other advises from experts?

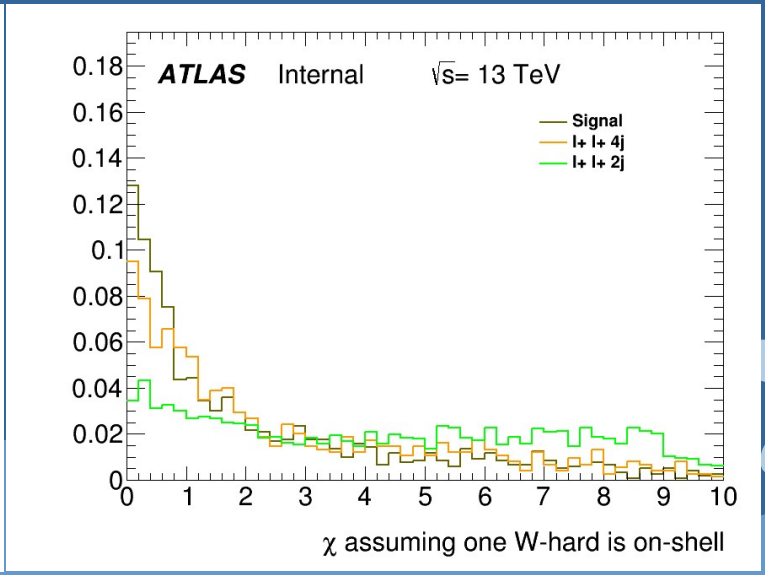


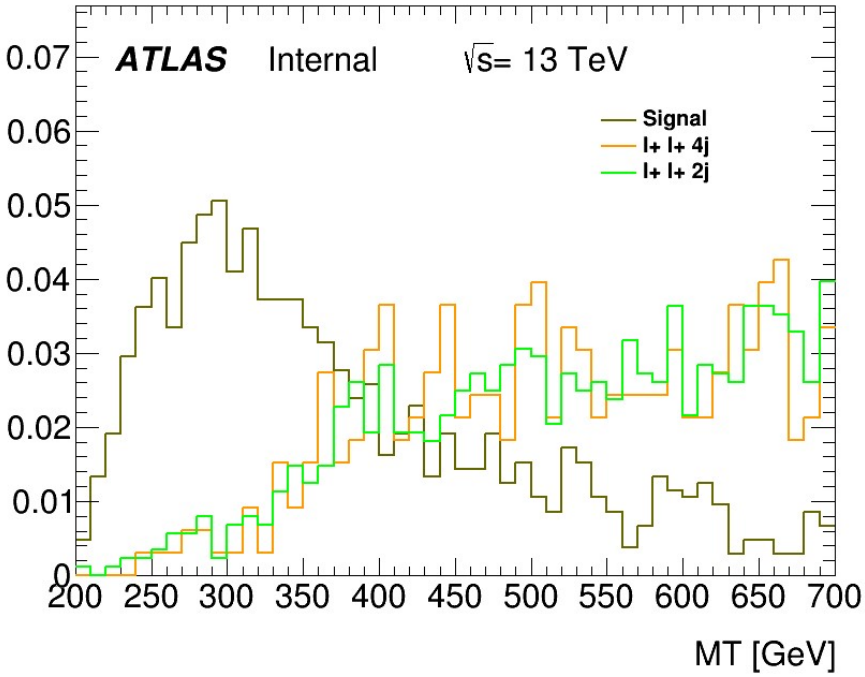


MVA study

- A simple MVA selection with 6 variables is applied to have a glance at sensitivities
- Input variables



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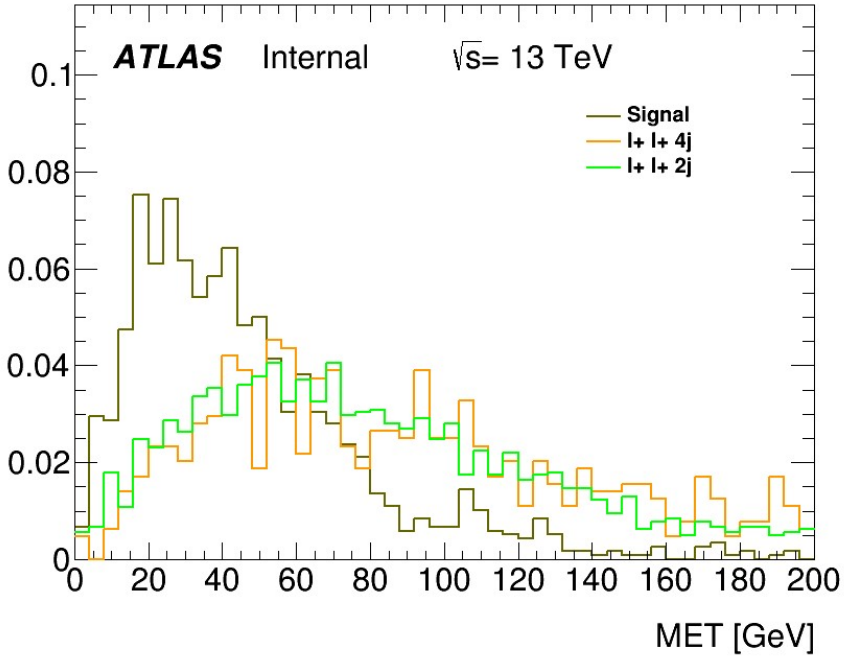
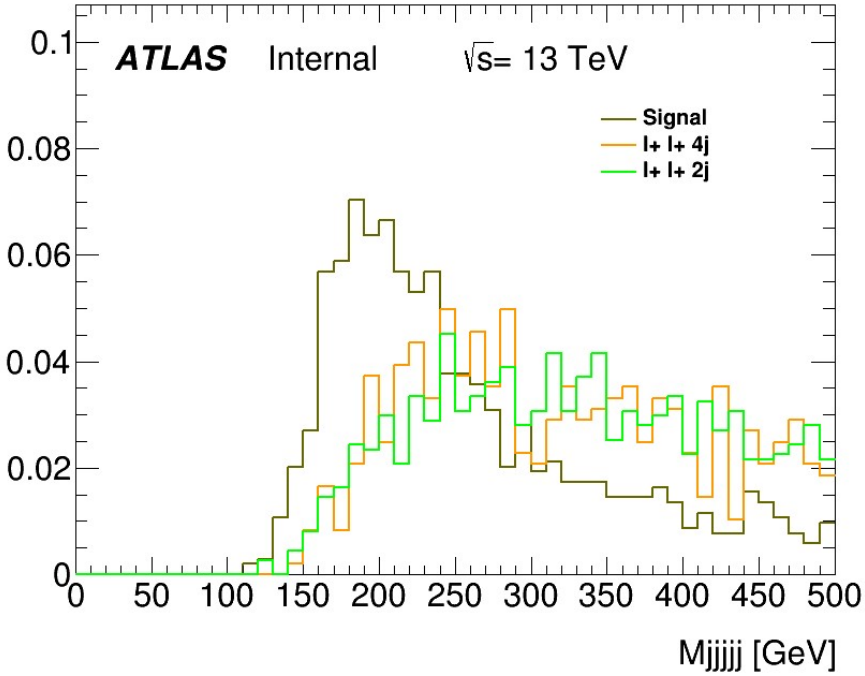
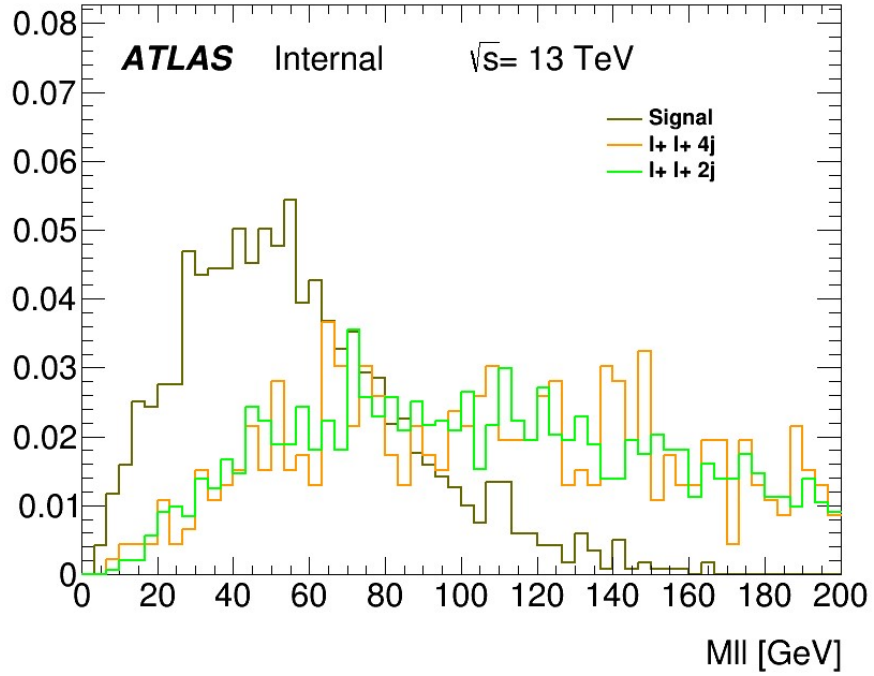
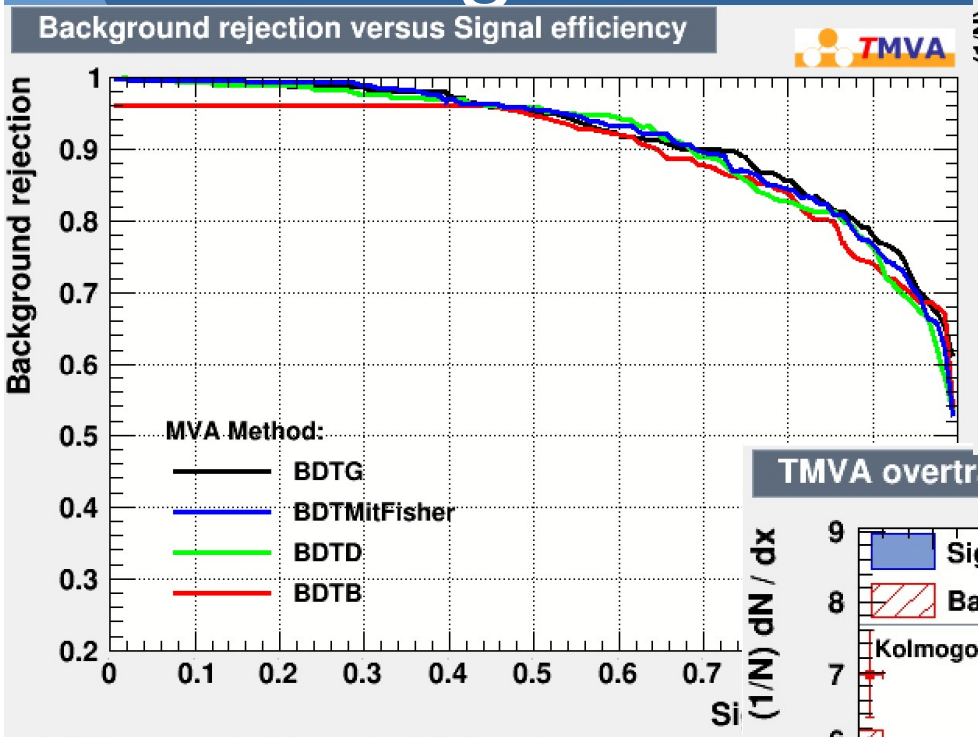
Signal
l+ l+ 4j
l+ l+ 2j
MT [GeV]

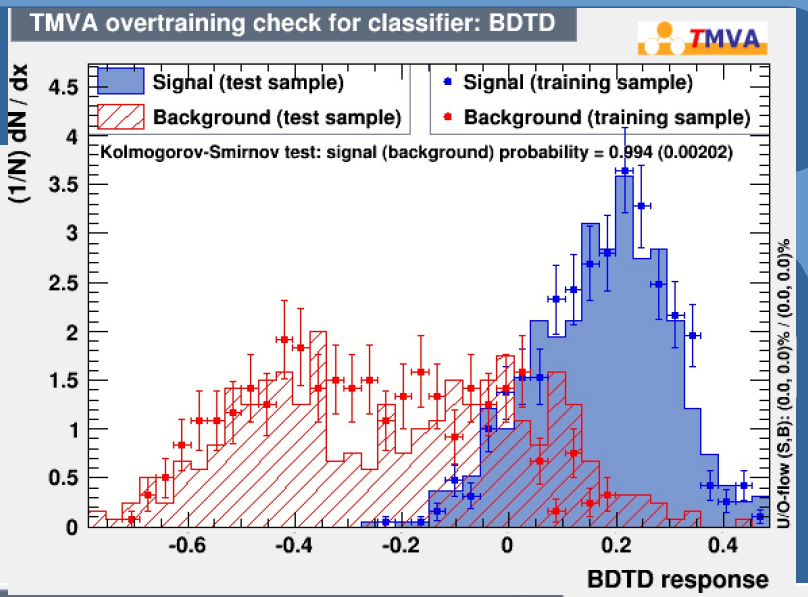

ATLAS Internal √s= 13 TeV
Signal
l+ l+ 4j
l+ l+ 2j
MET [GeV]

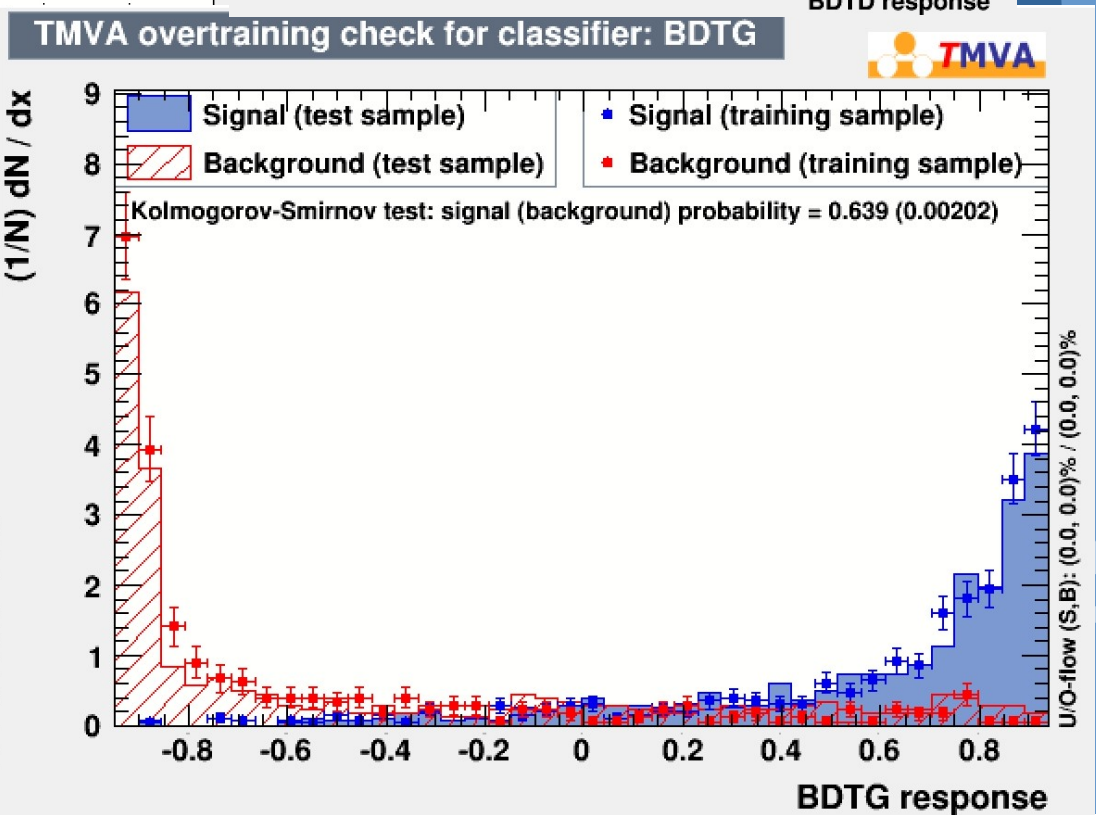

ATLAS Internal √s= 13 TeV
Signal
l+ l+ 4j
l+ l+ 2j
Mjjjjj [GeV]

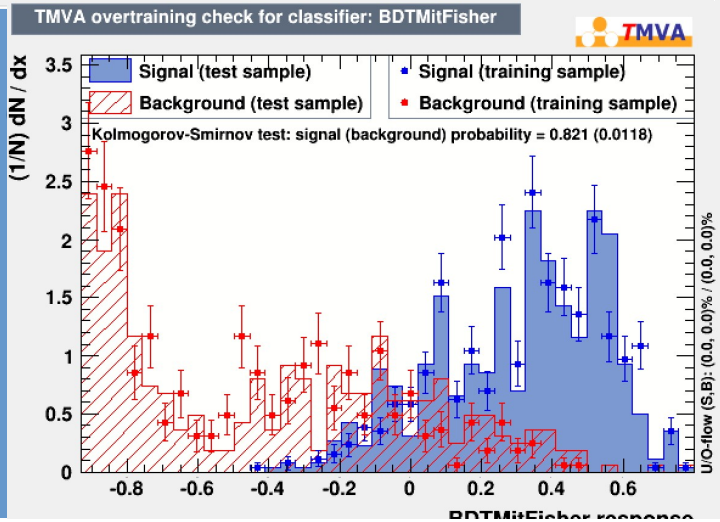

ATLAS Internal √s= 13 TeV
Signal
l+ l+ 4j
l+ l+ 2j
Mll [GeV]

Training result



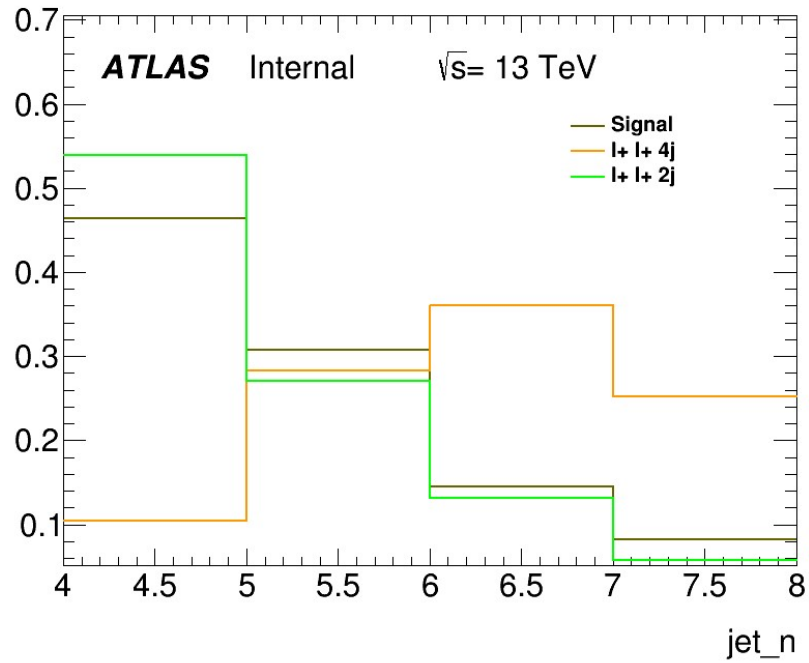


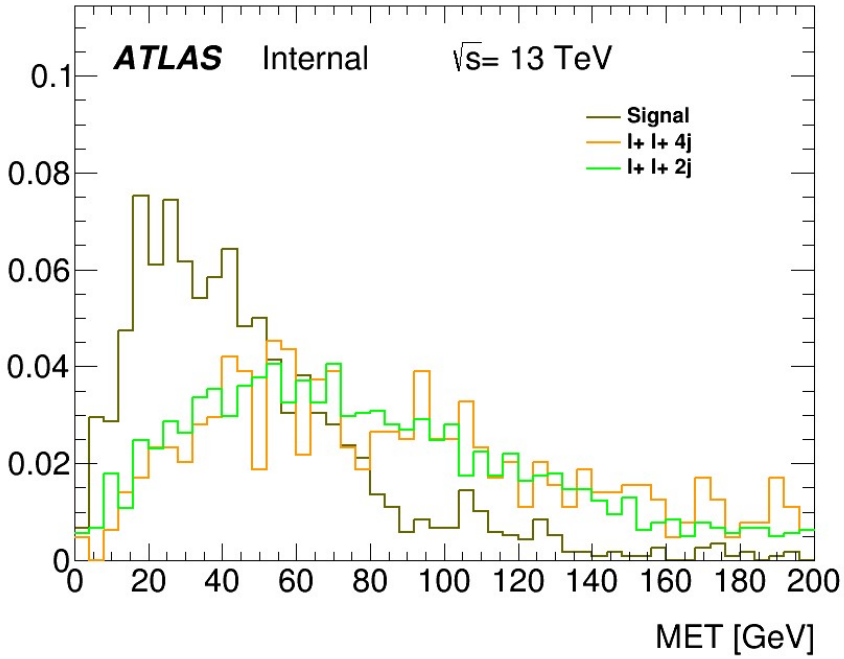


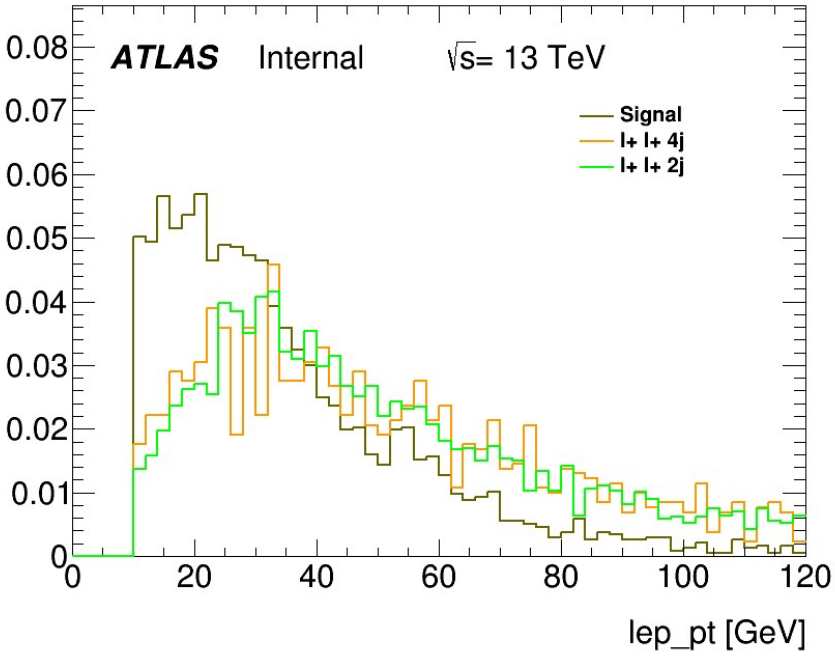


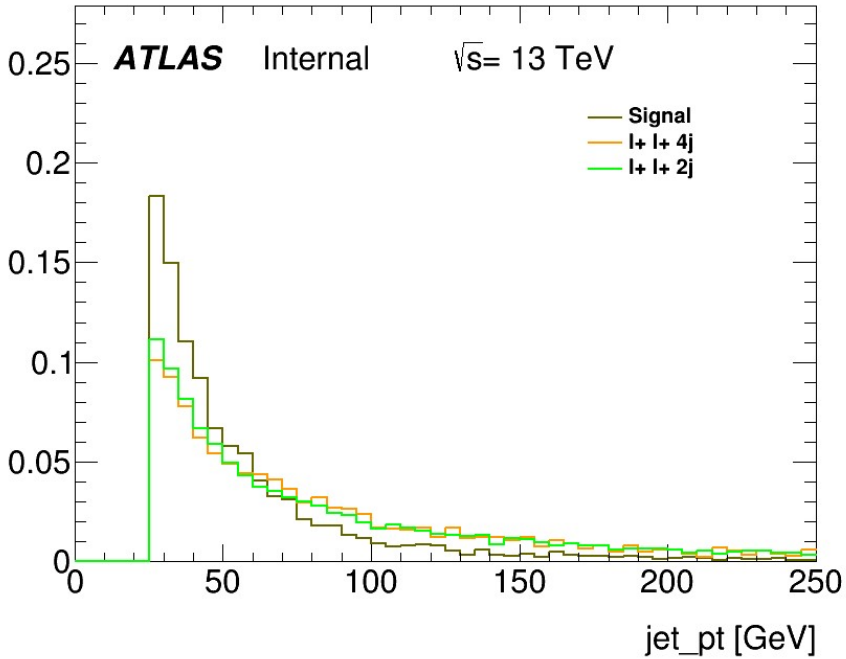
To do

- To find a proper derivation package
- To investigate cuts for separate categories
  - same sign leptons + missing et + 4jet (on-shell)
  - same sign leptons + missing et + 4jet (off-shell, one on-shell and one off-shell)
  - three lepton +missing et + jets or 4leptons(another story)
- ~~Request official signal samples~~
- Check whether there are some bkg samples already available.


ATLAS Internal √s= 13 TeV
Signal
l+ l+ 4j
l+ l+ 2j
jet_n


ATLAS Internal √s= 13 TeV
Signal
l+ l+ 4j
l+ l+ 2j
MET [GeV]


ATLAS Internal √s= 13 TeV
Signal
l+ l+ 4j
l+ l+ 2j
lep_pt [GeV]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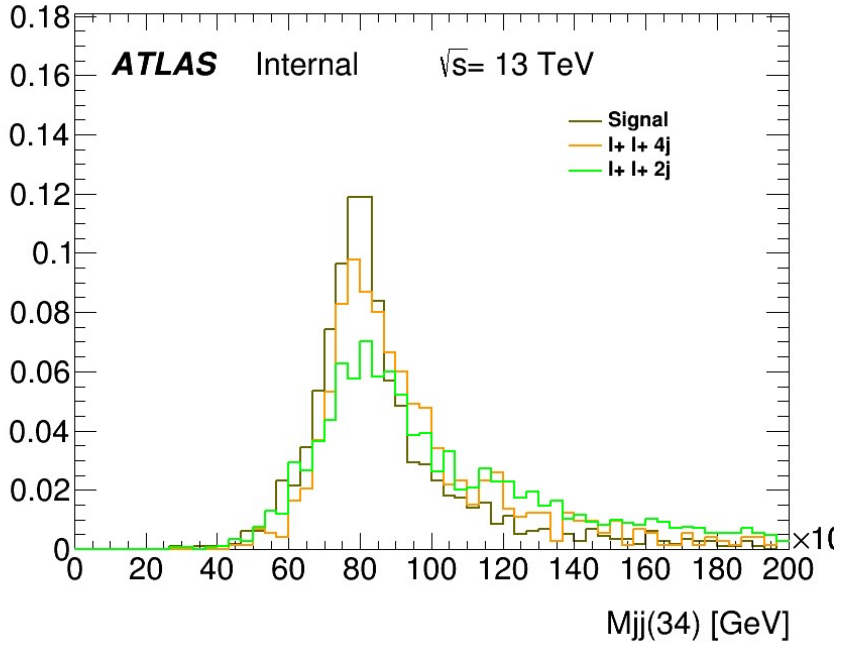
Signal
l+ l+ 4j
l+ l+ 2j
jet_pt [GeV]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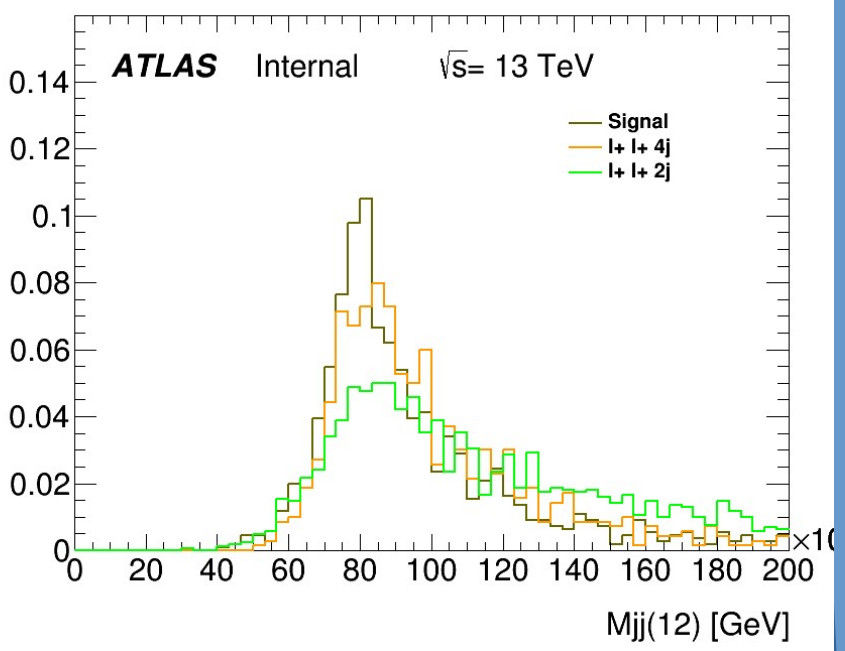
Signal
l+ l+ 4j
l+ l+ 2j
Mjj(34) [GeV]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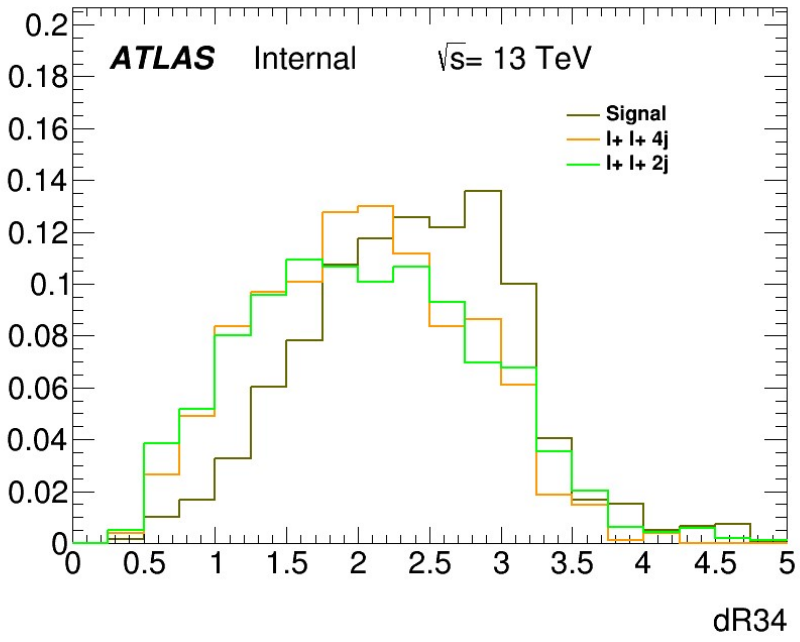
Signal
l+ l+ 4j
l+ l+ 2j
Mjj(12) [GeV]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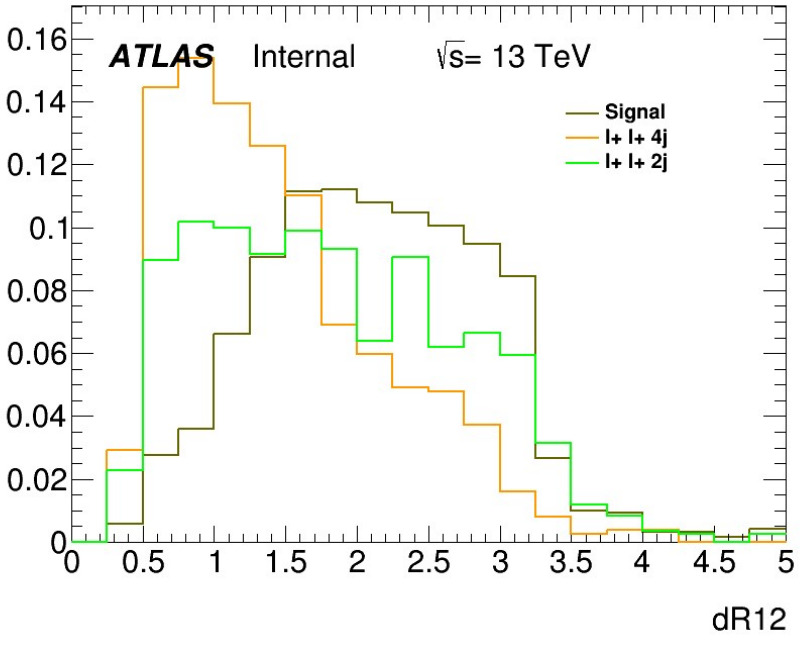
Signal
l+ l+ 4j
l+ l+ 2j
dR34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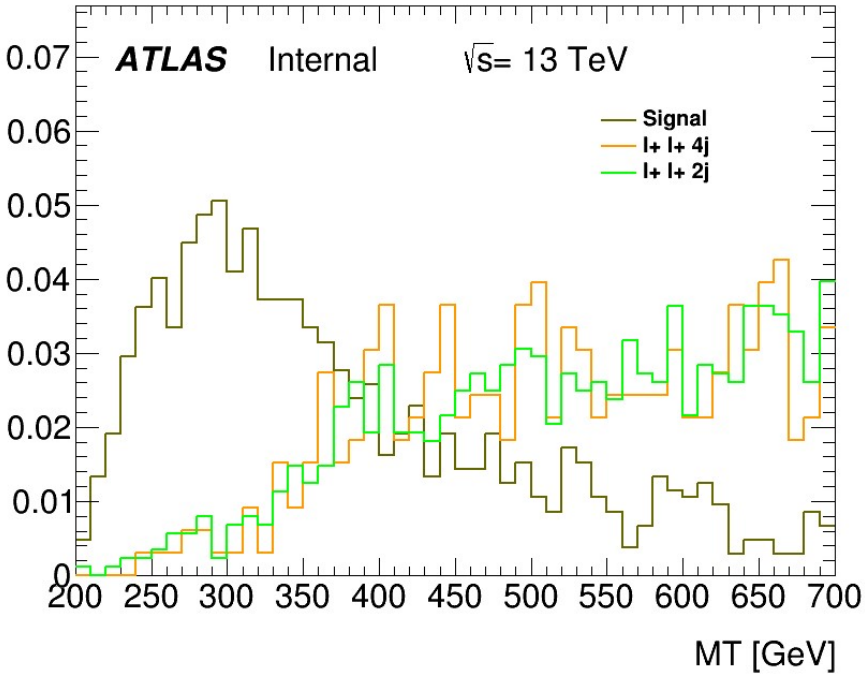
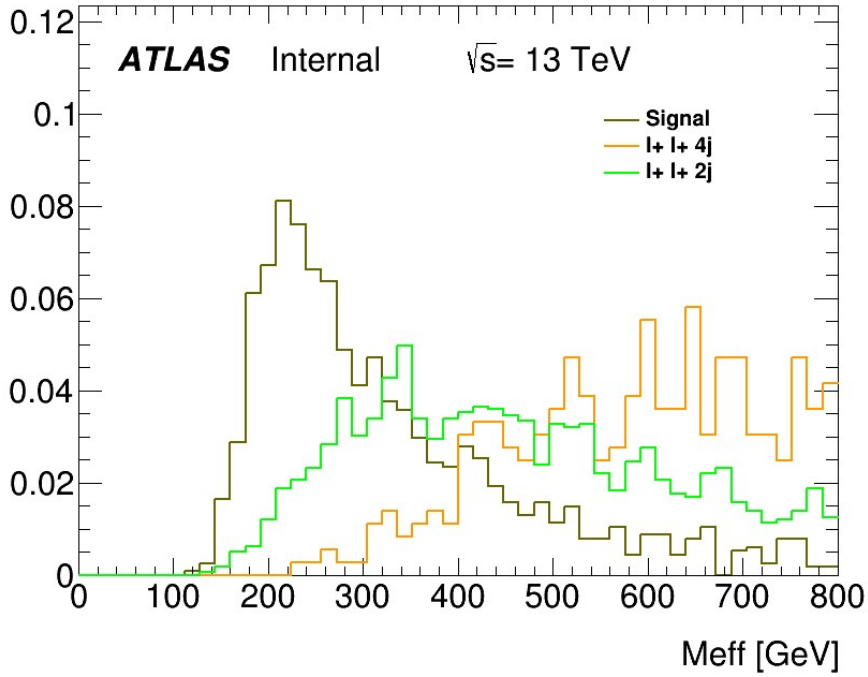
Signal
l+ l+ 4j
l+ l+ 2j
dR12


ATLAS Internal √s= 13 TeV
Signal
l+ l+ 4j
l+ l+ 2j
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
200 250 300 350 400 450 500 550 600 650 700
MT [GeV]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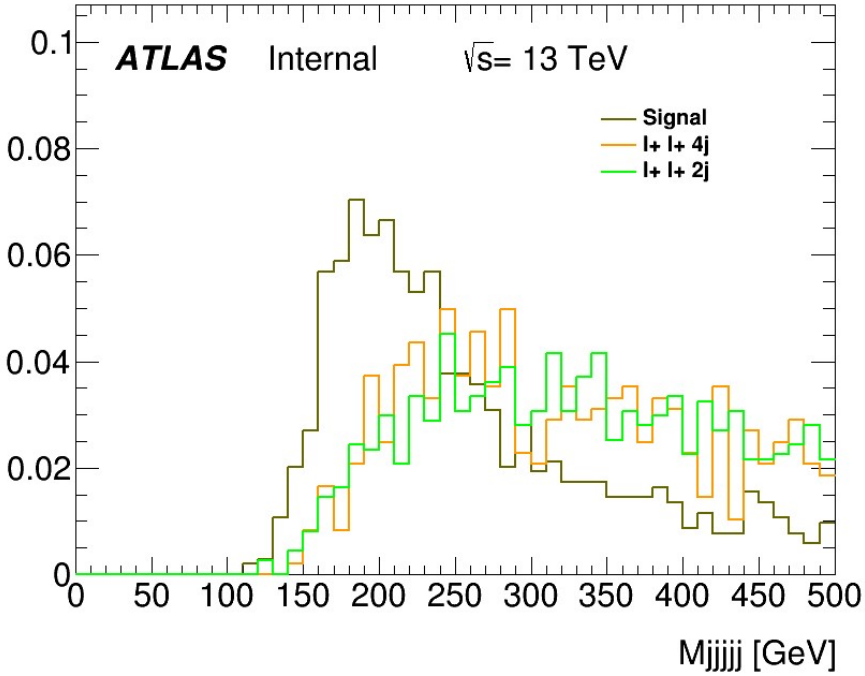
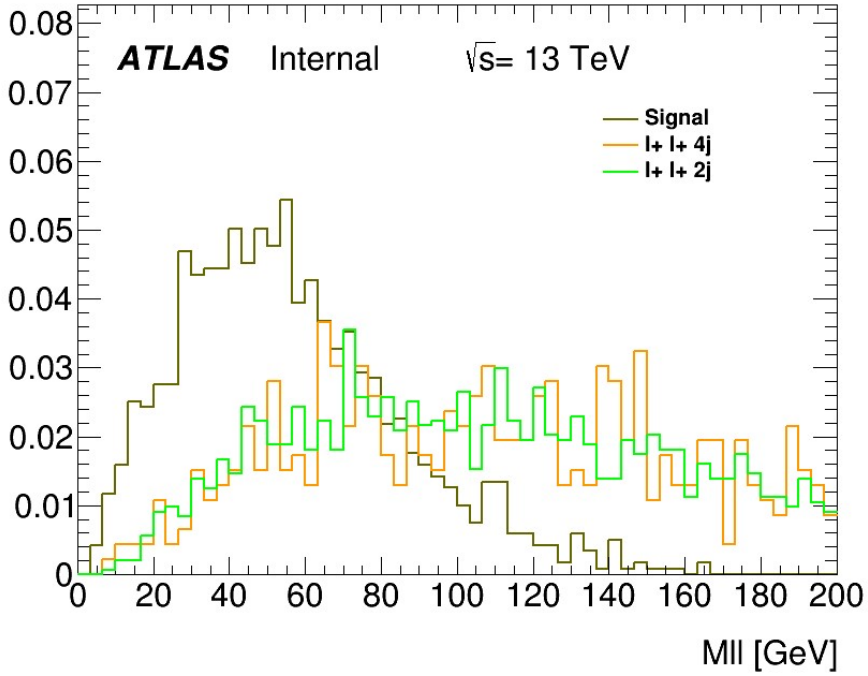
Signal
l+ l+ 4j
l+ l+ 2j
0.12
0.1
0.08
0.06
0.04
0.02
0
0 100 200 300 400 500 600 700 800
Meff [GeV]


ATLAS Internal √s= 13 TeV
Signal
l+ l+ 4j
l+ l+ 2j
0.1
0.08
0.06
0.04
0.02
0
0 50 100 150 200 250 300 350 400 450 500
Mjjjjj [GeV]


ATLAS Internal √s= 13 TeV
Signal
l+ l+ 4j
l+ l+ 2j
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0 20 40 60 80 100 120 140 160 180 200
Mll [GeV]