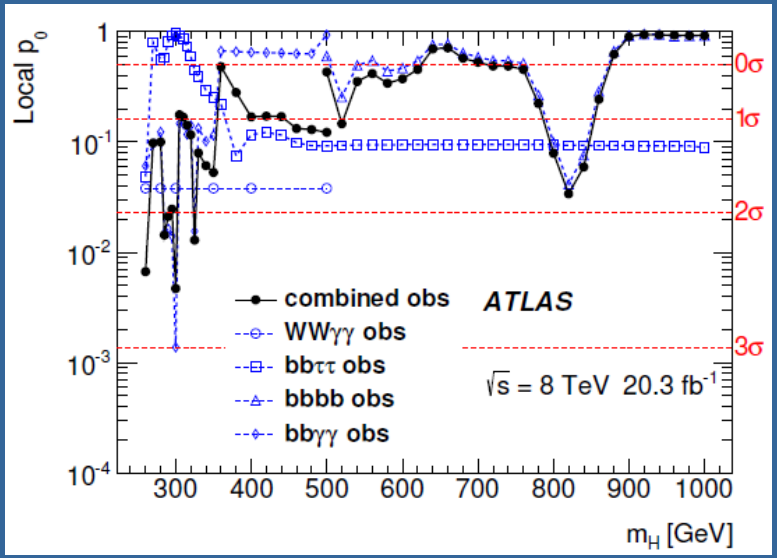
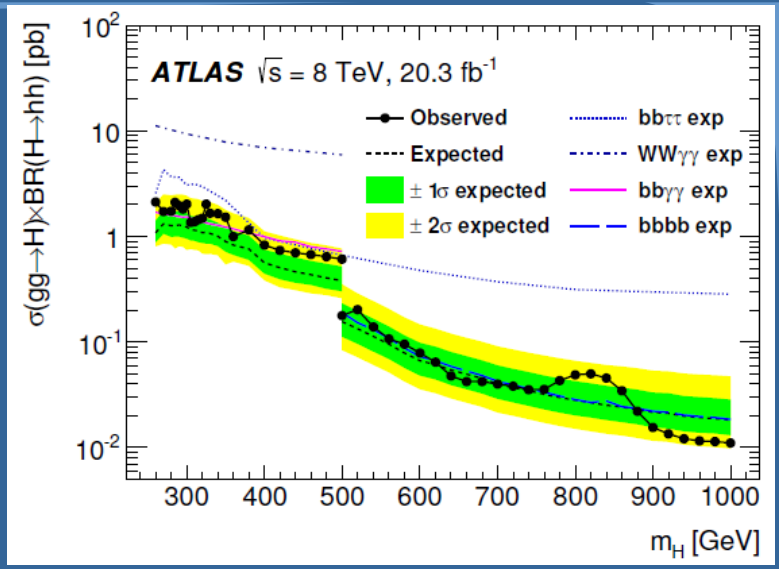
H->hh->WWWW search

Motivation

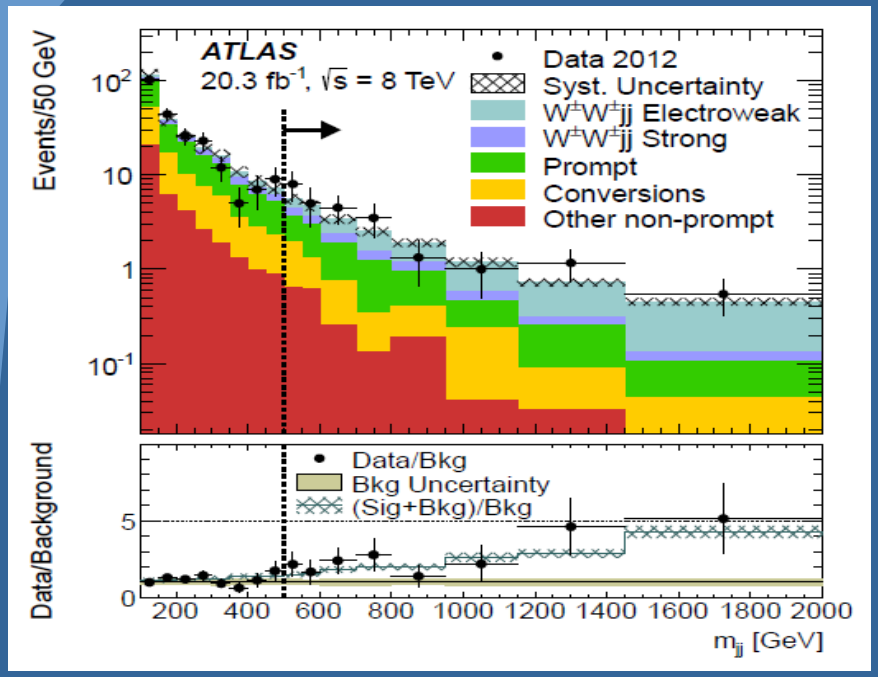




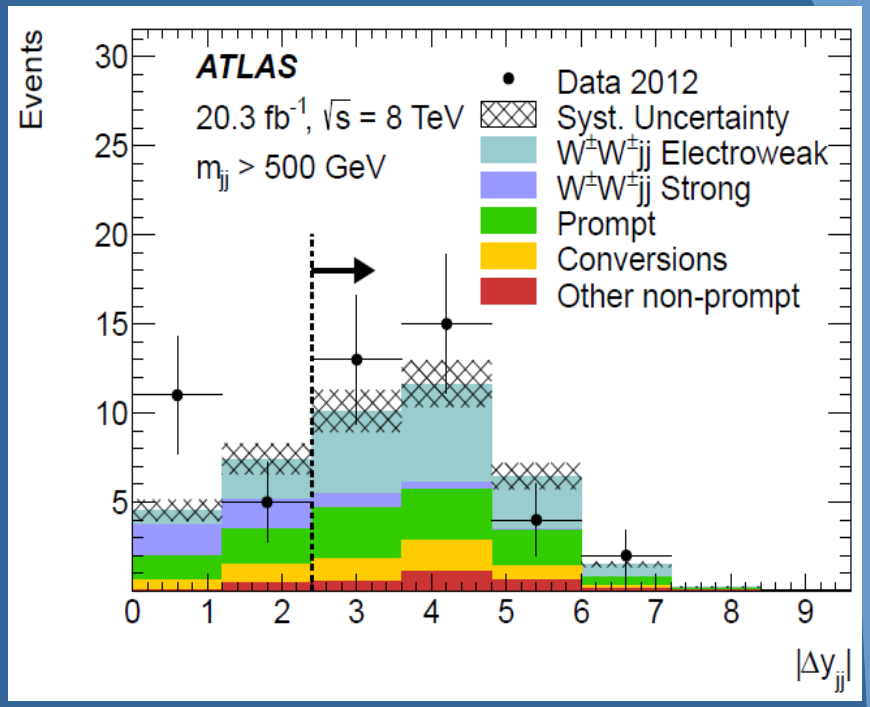
- With run1 data, four channels are taken into account in the analyses and are combined.
- More channels are being exploited : γγττ,WWbb…

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**

H->hh->WWWW Channel

$\frac{\sigma \cdot Br(wwww \to l^{\pm}\nu l^{\pm}\nu qqqq)}{\sigma \cdot Br(ww\gamma\gamma \to l\nu qq\gamma\gamma)}$ = 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 Multi-leptons, missing ET and/or jets**
- ✓ **Will first try same sign lepton channel including different flavors.**

MC generation

- Signal:
- Using MadGraph5 HeavyScaler to generate gg -> H - >hh
- 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 parton shower
- Only mH=300 GeV samples now

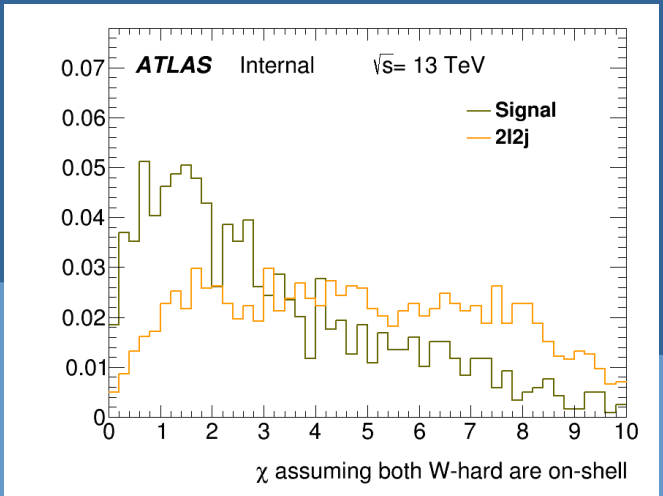
Basic selections

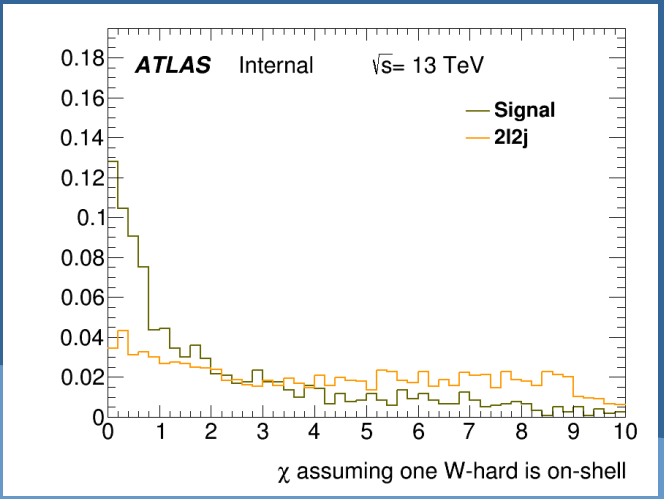
- At least 2 same sigh leptons(electron or muon) Pt>10GeV, isolated
- At least 4 jets, Pt > 25GeV, isolated

Categorization

- We plan to divide events into 3 categories based on the on-shell W decay hardronically : HH HL LL
- A cut on X may be useful, and the truth matching check is on-going

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





Background components

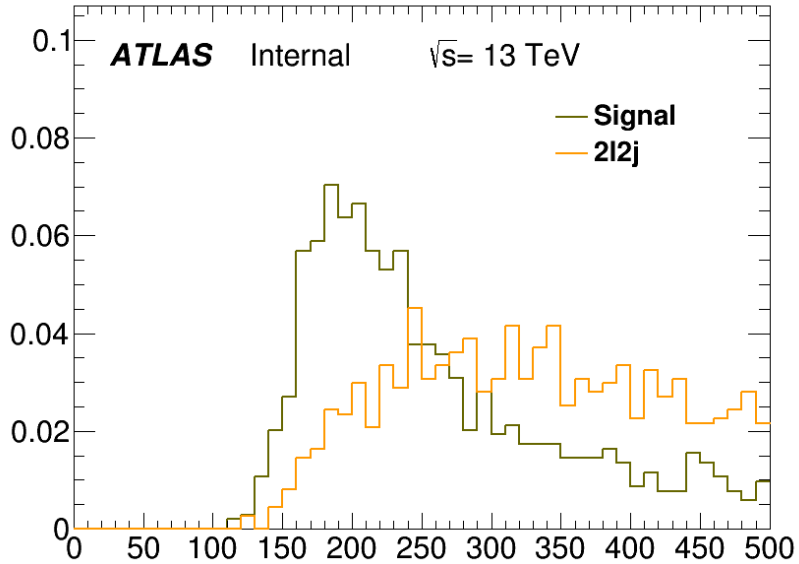
- Real SS background
  - E.g. WZ+jets, $W^{\pm}W^{\pm}$+jets,
  - $l^{\pm}\nu l^{\pm}\nu qqqq$,Generated with MadGraph5, inclusively,
  - Also need to consider process with less jets and pileup
- Background due to charge miss ID
  - tt~, WW+jets, Z/gamma + jets
  - Generated exclusively? Or inclusively, using MadGraph5 p p > l+ l- v v j j j j
- Background due to fake
  - Jet fake as lepton, photon reconstructed as lepton…

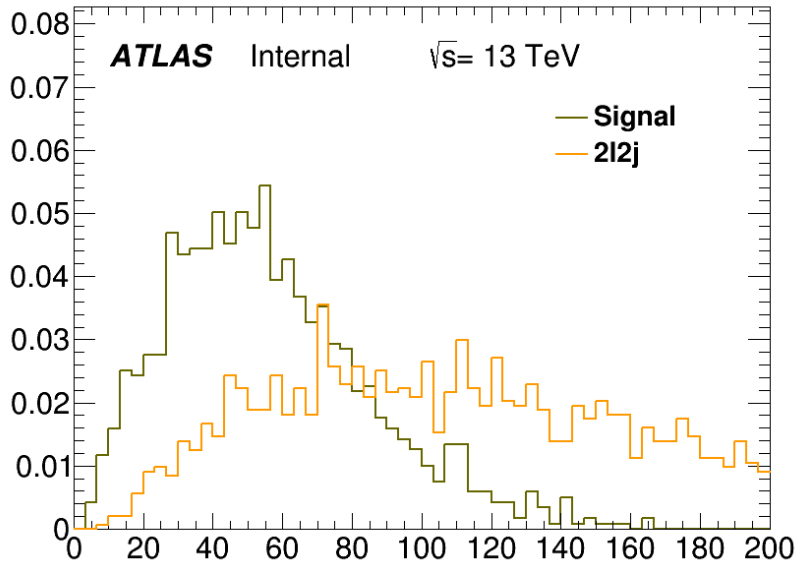
Parton shower *VS* matrix element

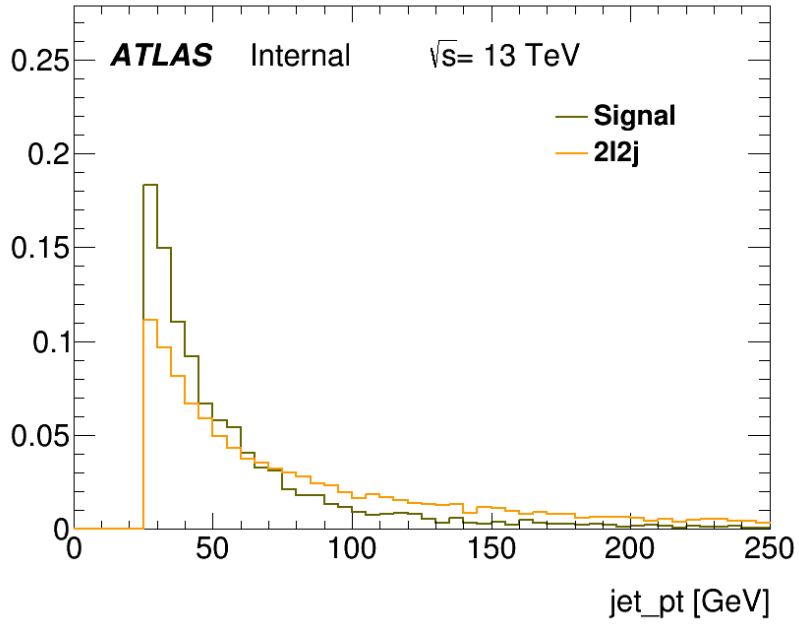
- Comparing l+ l+ v v j j with 2 jets from parton shower with l+ l+ v v j j j j

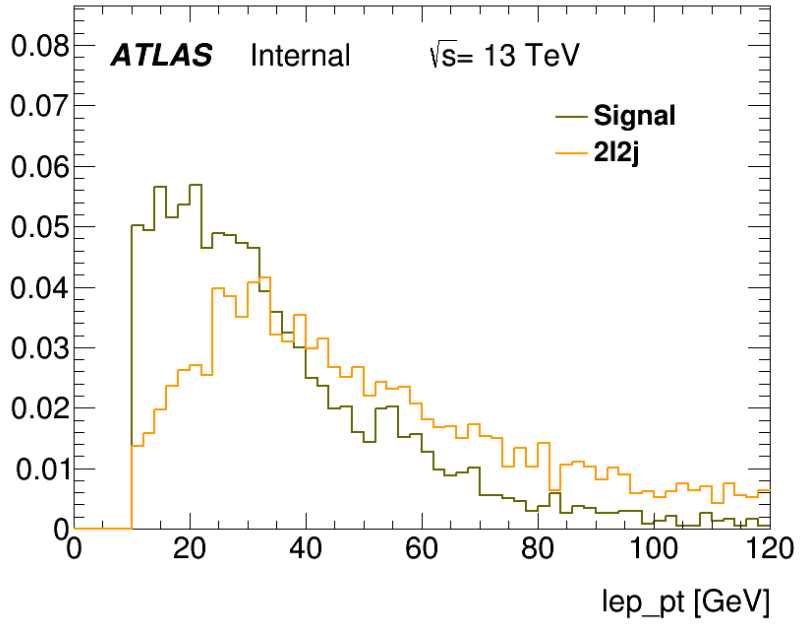
PROCESS	Xsection(fb)	Efficiency	Final (fb)
l+l+vvjj	5.3	40%	2.1
l+l+vvjjjj	2.4	80%	1.9

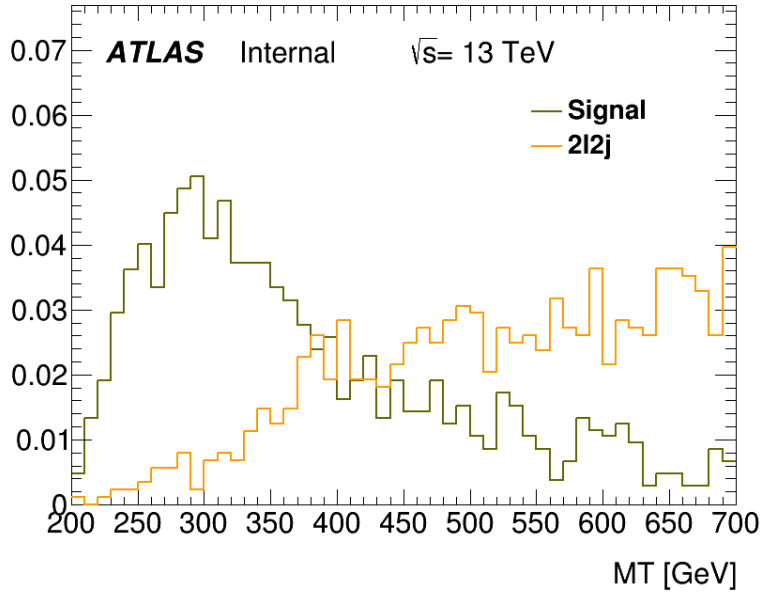
- May due to the configuration of parton shower

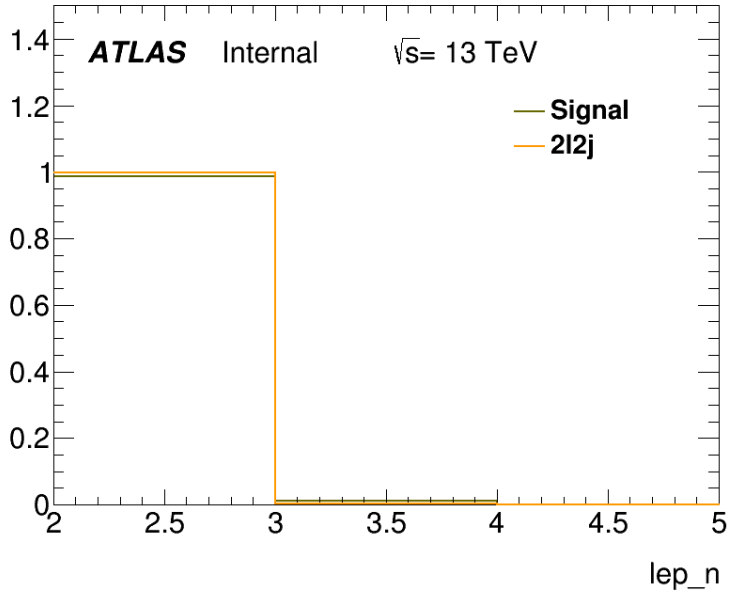

ATLAS Internal √s= 13 TeV
Signal
2l2j
Mjjjjj [GeV]

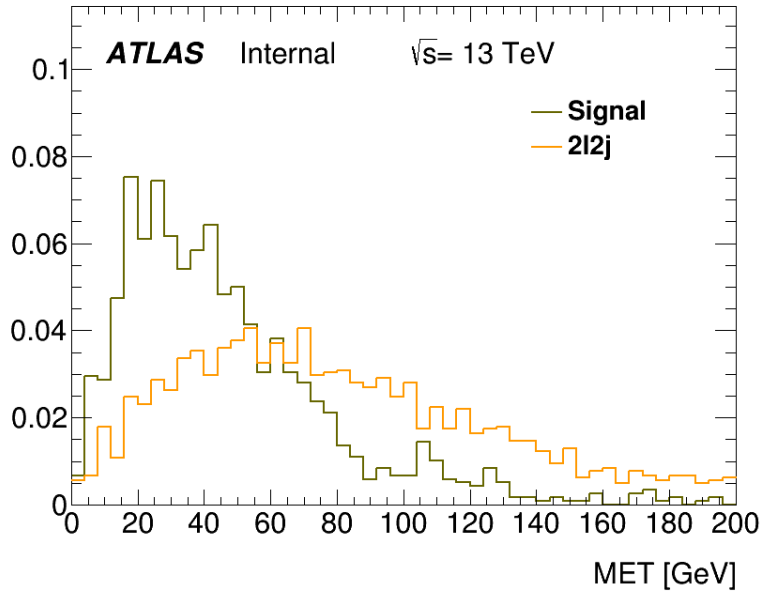

ATLAS Internal √s= 13 TeV
Signal
2l2j
Mll [GeV]

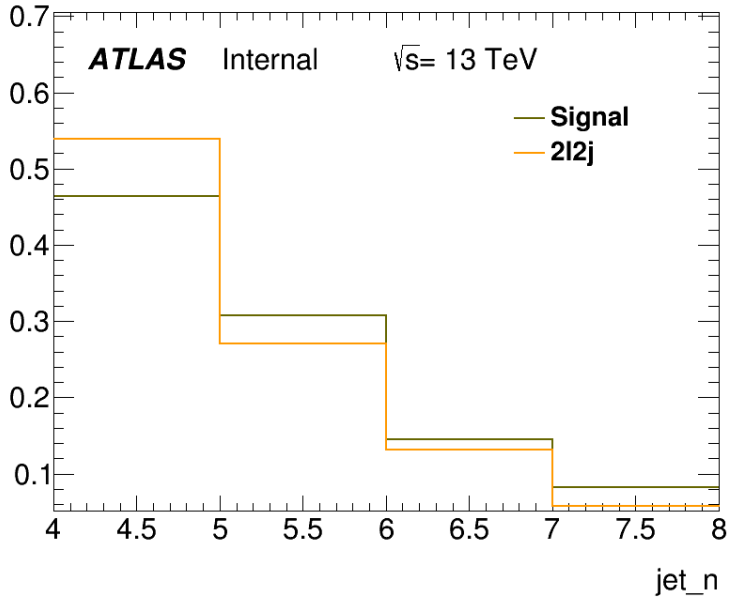

ATLAS Internal √s= 13 TeV
Signal
2l2j
jet_pt [GeV]


ATLAS Internal √s= 13 TeV
Signal
2l2j
lep_pt [GeV]


ATLAS Internal √s= 13 TeV
Signal
2l2j
MT [GeV]


ATLAS Internal √s= 13 TeV
Signal
2l2j
lep_n


ATLAS Internal √s= 13 TeV
Signal
2l2j
MET [GeV]


ATLAS Internal √s= 13 TeV
Signal
2l2j
jet_n

To do

- To develop cuts for specific category
  - 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 samples: signal
- Check whether there are some bkg samples already available.
  - Present the analyses in WW, exotic groups and get feedback