Update on W/Z-tagged dijets

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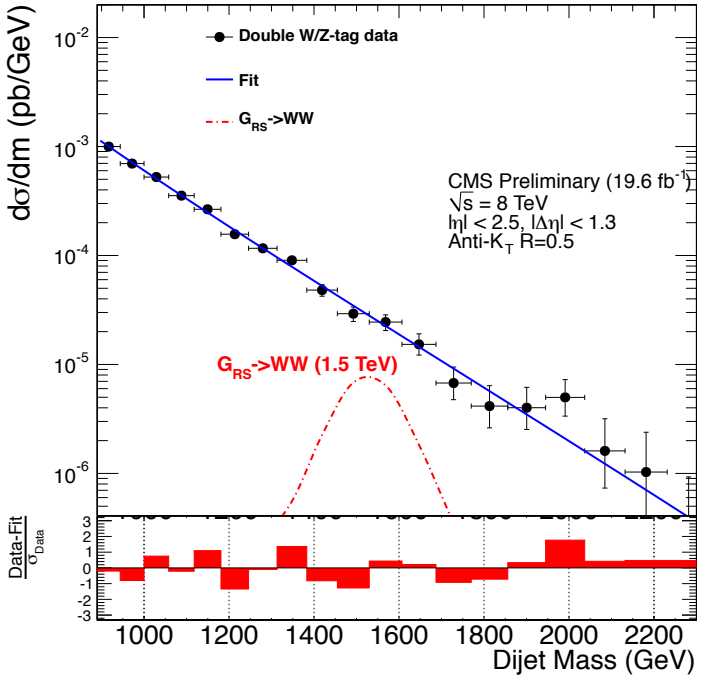
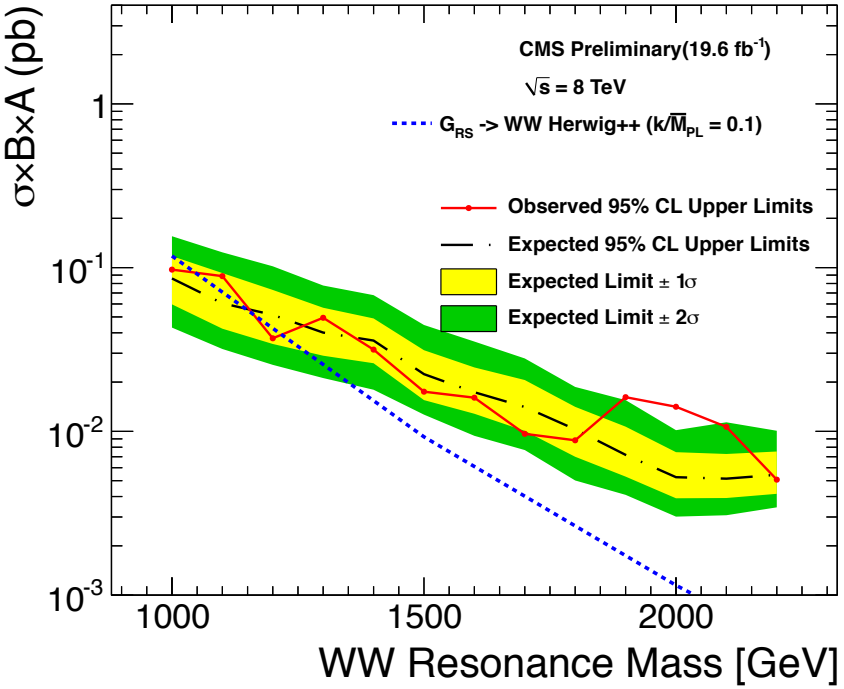
Status of the analysis

- Pre-approved on Feb 7th
- Update to full dataset (18.6/fb→19.6/fb) and posted new AN v5 and PAS v4
- Comments from ARC: https://twiki.cern.ch/twiki/bin/view/CMS/EXO12024review
  - 80% answered
- Main question left:
  - What is the significance of the excess in the double W/Z-tagged category at 2 TeV?





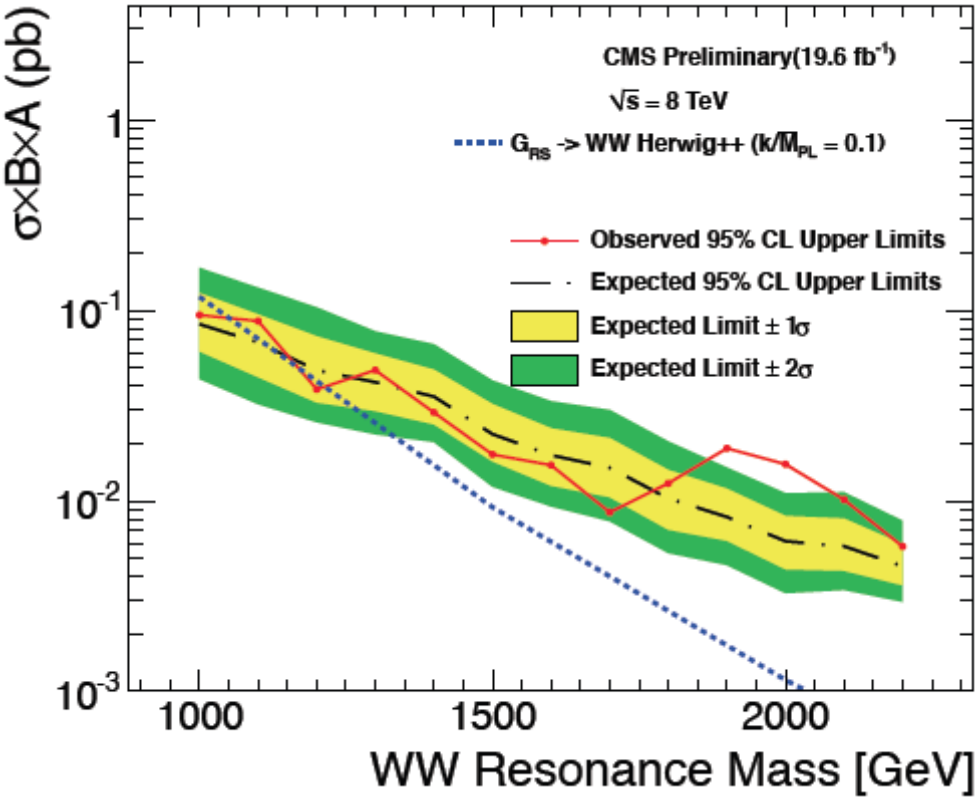
Studies in this talk

- Set up cross check analysis to confirm the bump
  - Done. Synced on the data distribution in 2-tag M_{jj}>1.65 TeV
- Make event displays of all interesting events
- Check if bump is an artifact of the jet algorithm and substructure tagger

Remove duplicate events

- Found small fraction of duplicate events during synchronization
  - Reduced pull of the bin at 2 TeV from 2.08 to 1.76 sigma

PAS v3



duplicate events removed

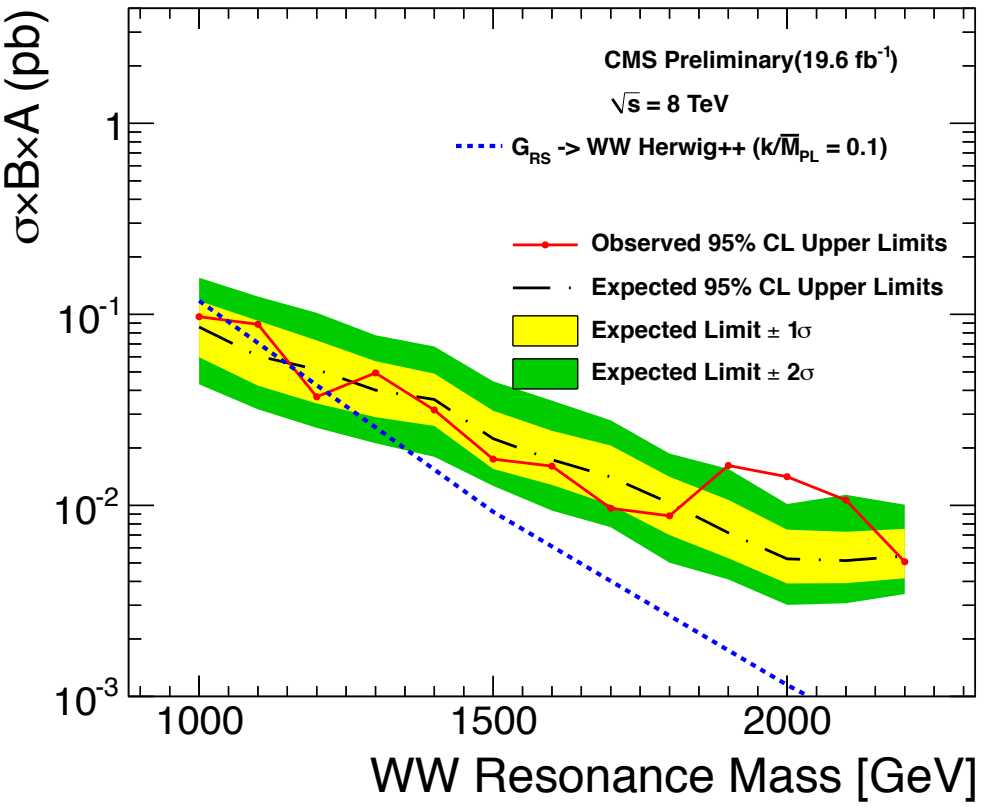
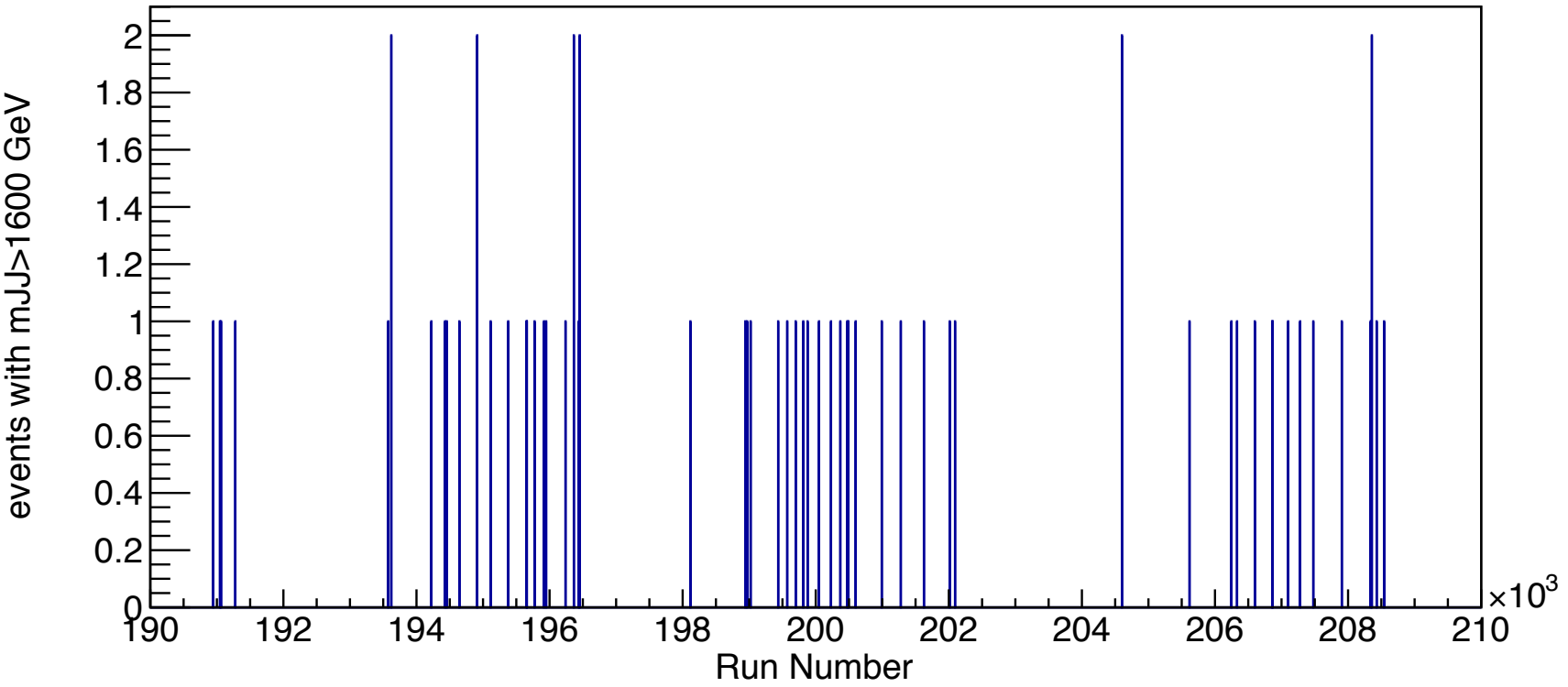


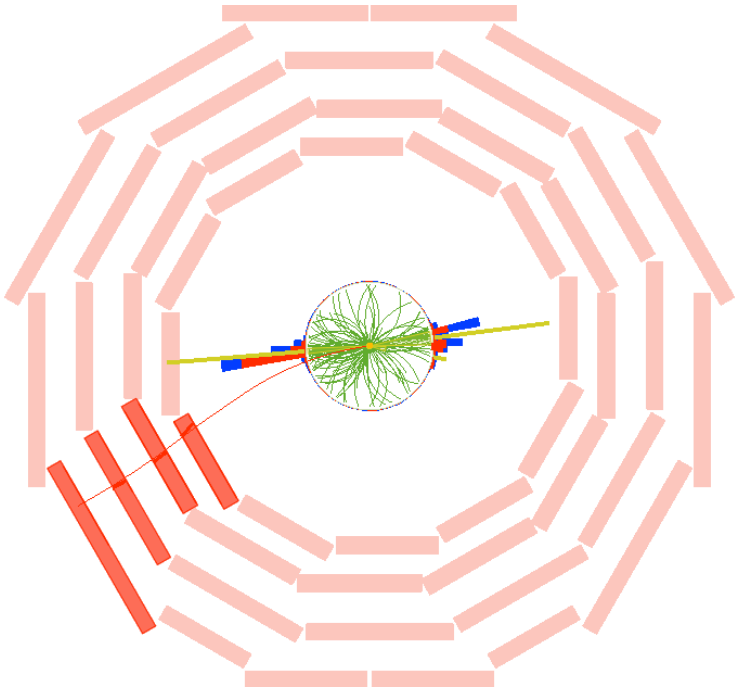
Table of events

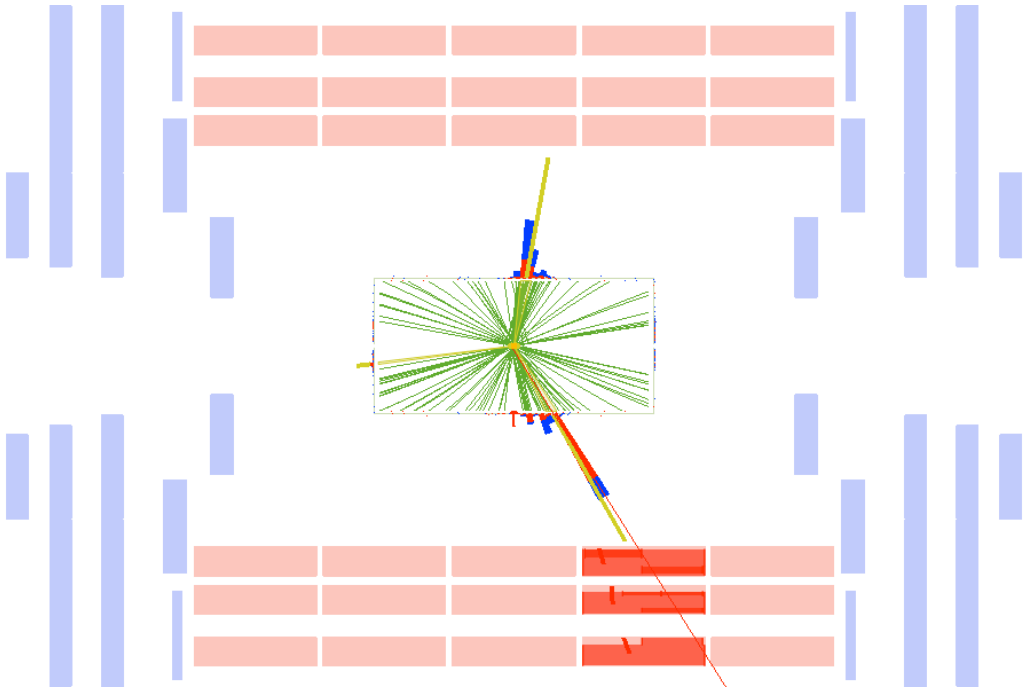
- Table of events of interesting 2-tag events with M_{jj}>1.6 TeV: https://twiki.cern.ch/twiki/bin/view/CMS/EXO12024eventdisplays



Event displays

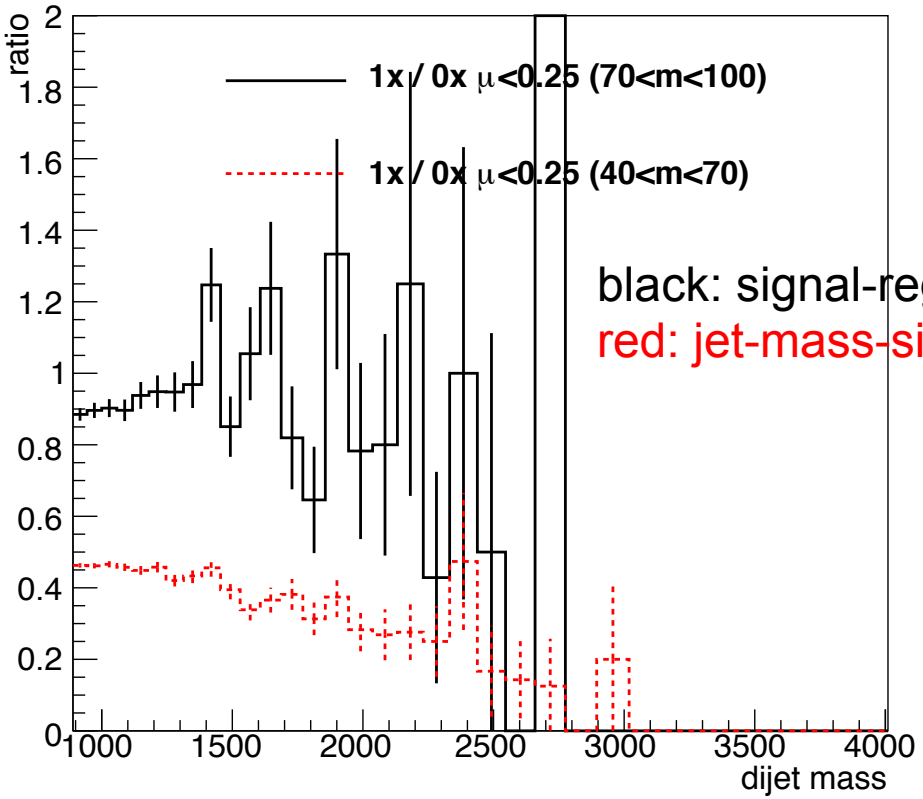
- Event displays of interesting 2-tag events with M_{jj}>1.6 TeV: https://twiki.cern.ch/twiki/bin/view/CMS/EXO12024eventdisplays
- Events have no strange features

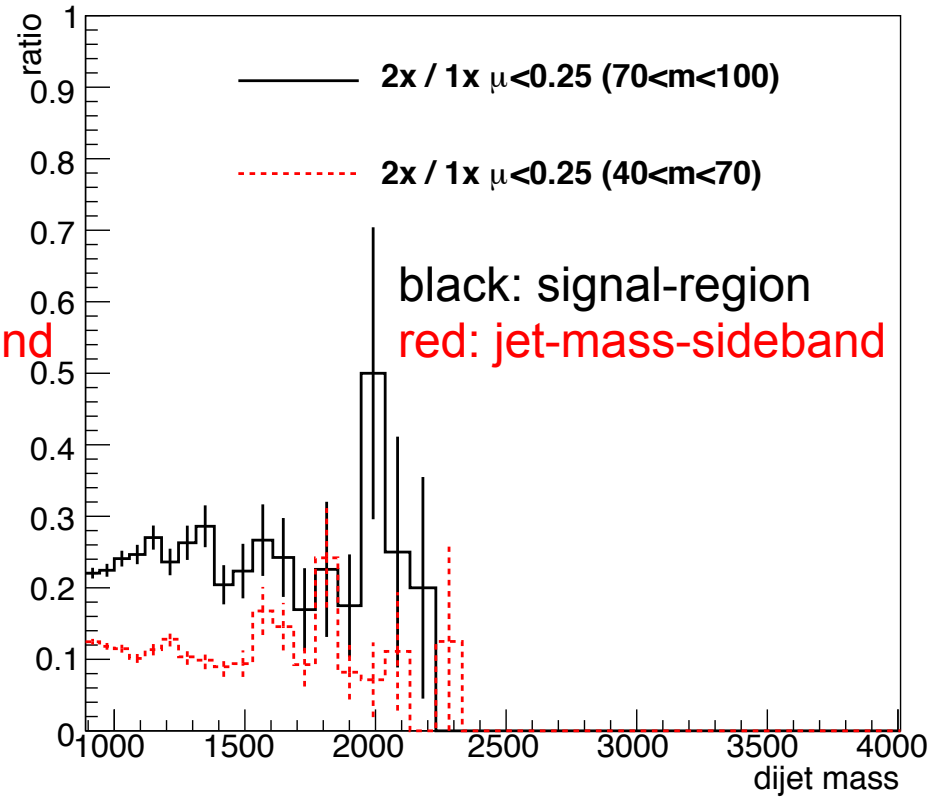




Cross check tagger in sideband

- Is the pruning + massdrop producing a bump?

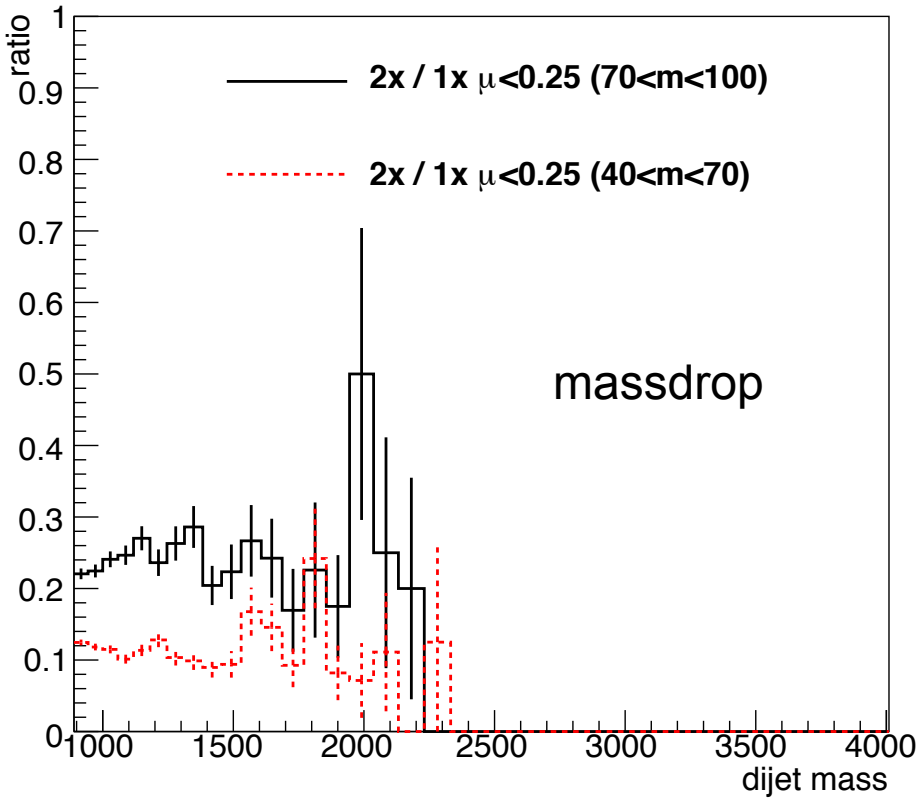


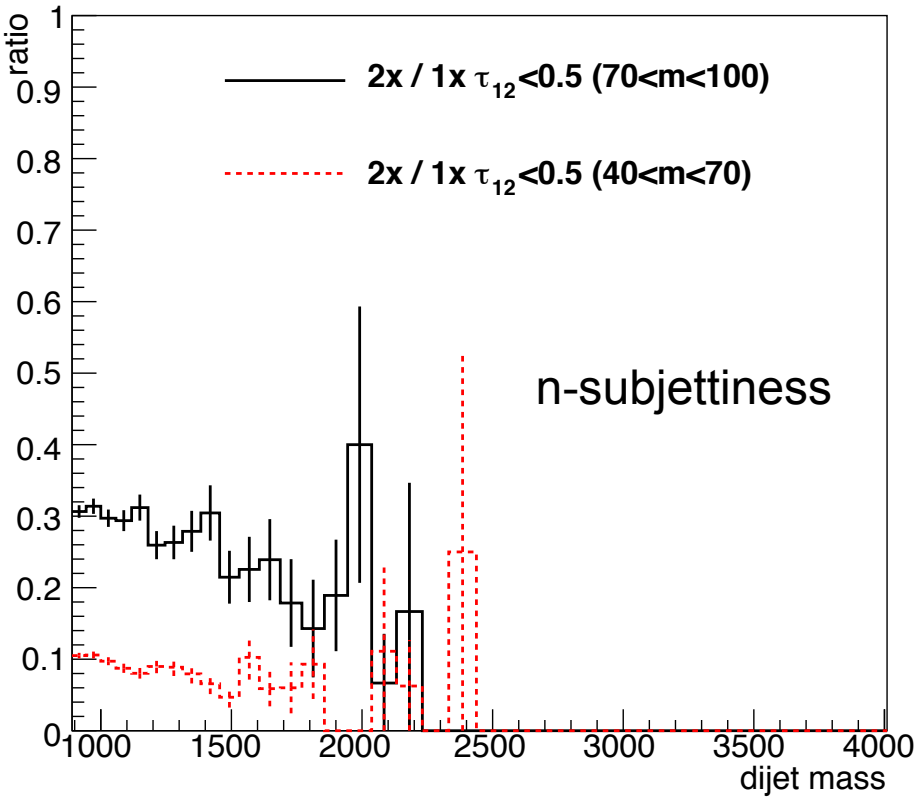


- No, because no bump observed in the jet-mass-sideband (40<m<70)

Cross check with other tagger

- Is this an artifact of the massdrop?

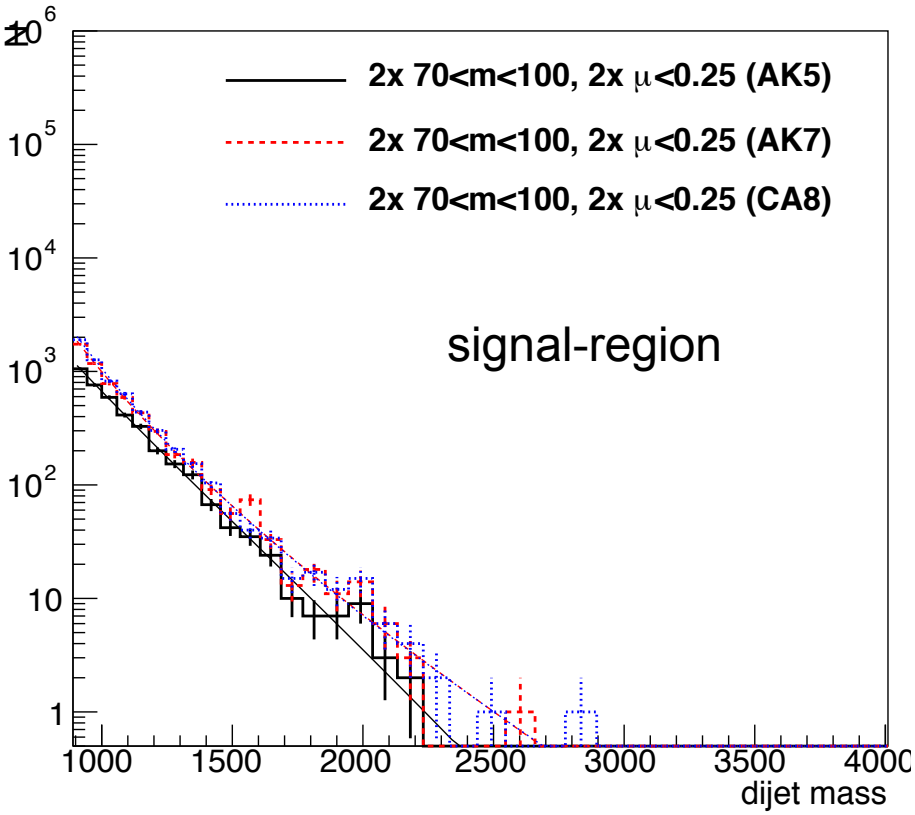


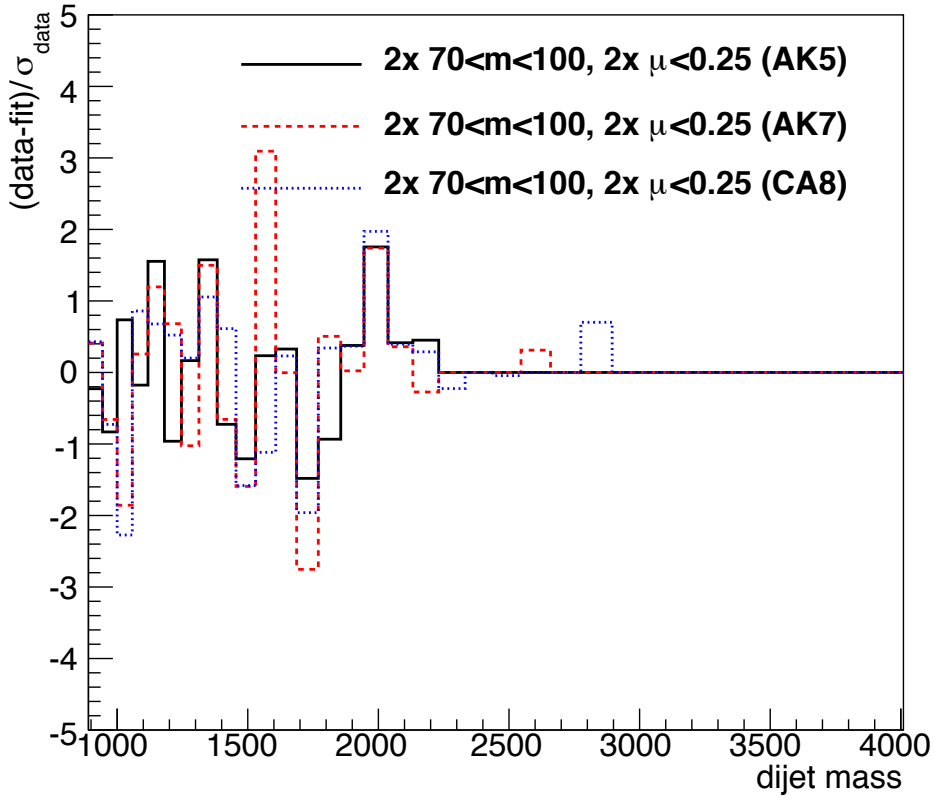


- No, because it persists when using n-subjettiness tagger instead of massdrop tagger

Cross check with other jet algorithm

- Is this an artifact of the jet algorithm used for dijet mass reconstruction?
- (using CA8 for tagging in all cases)

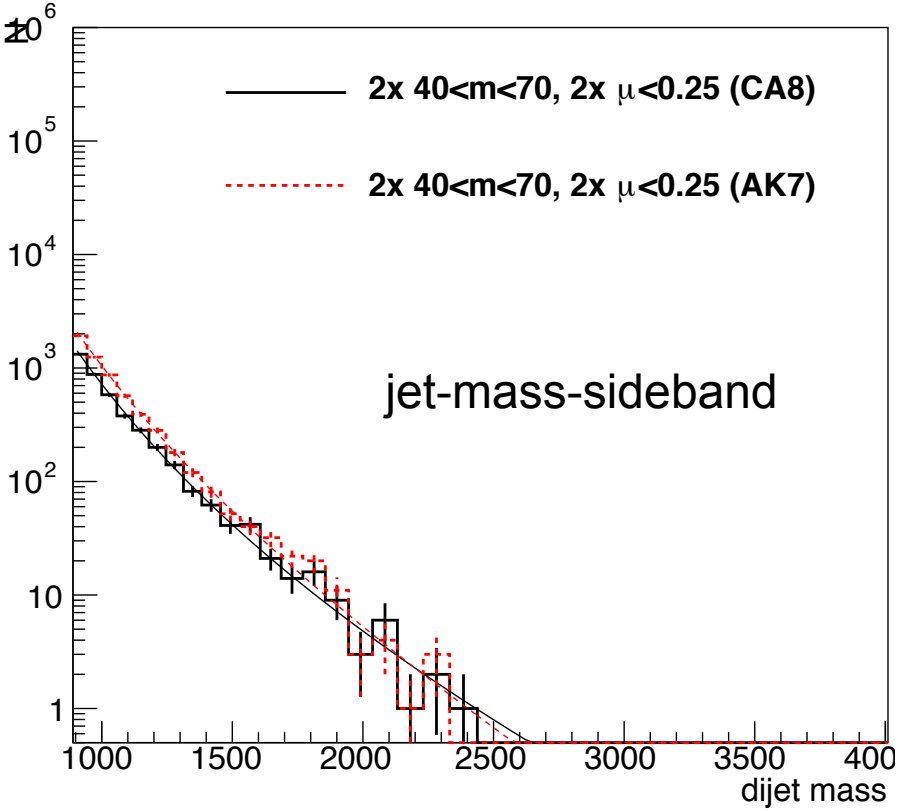


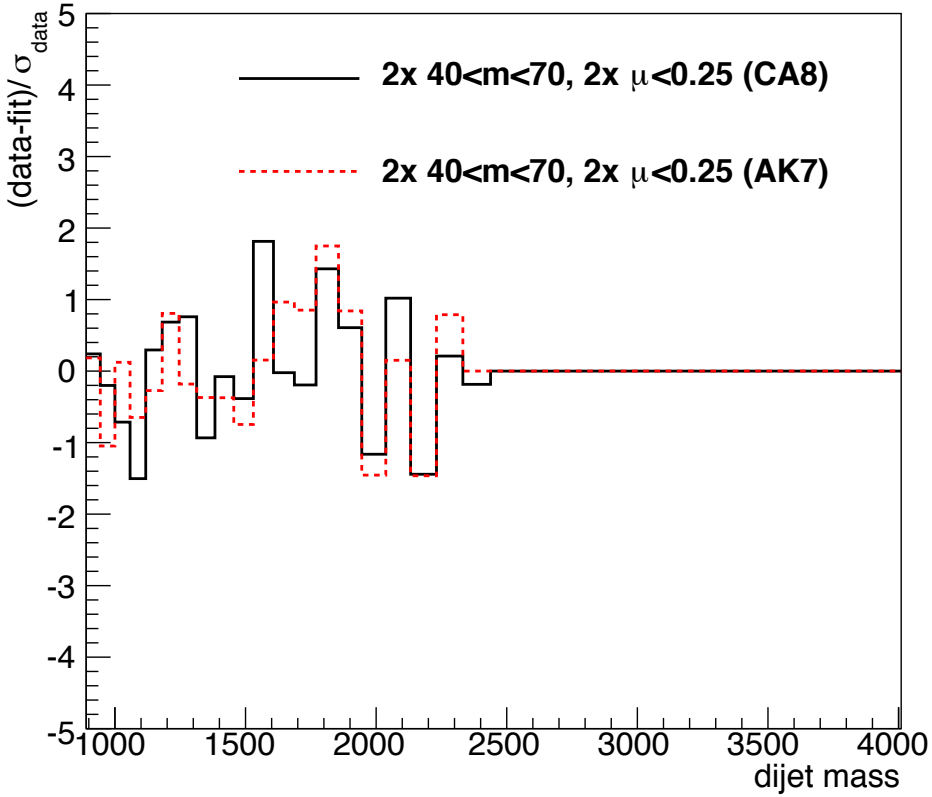


- No, because bump persists when using AK7/CA8 instead of AK5 for dijet mass reconstruction

Cross check jet algorithm in sideband

- Is this an artifact of the jet algorithm used for tagging?



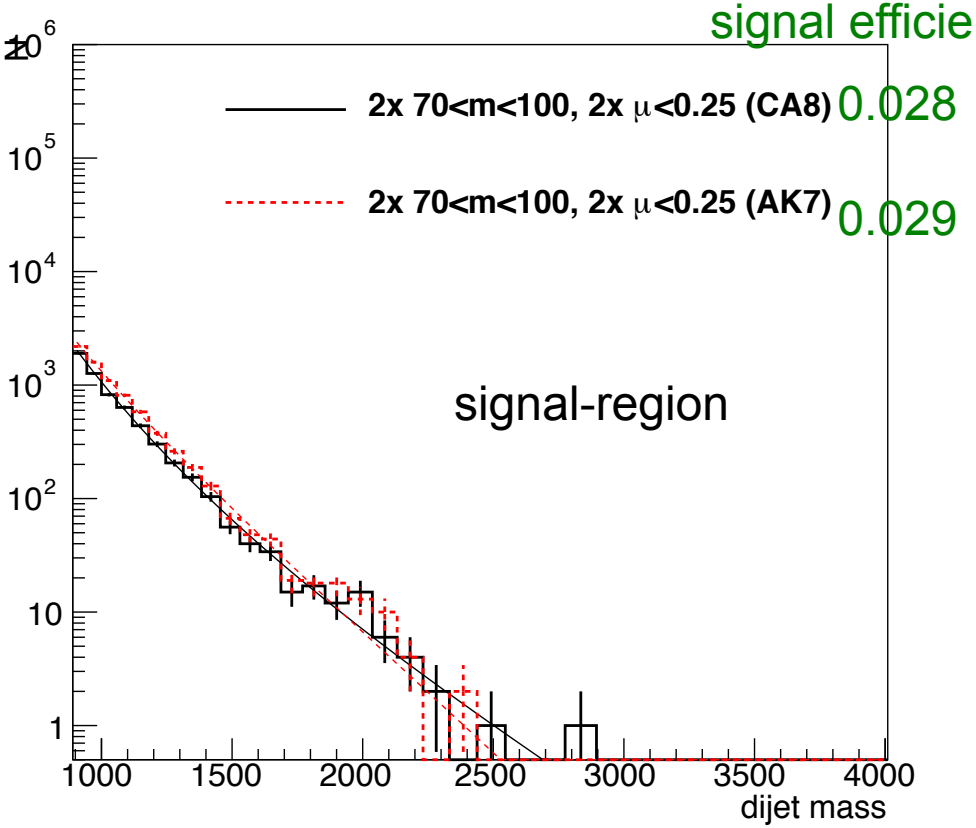


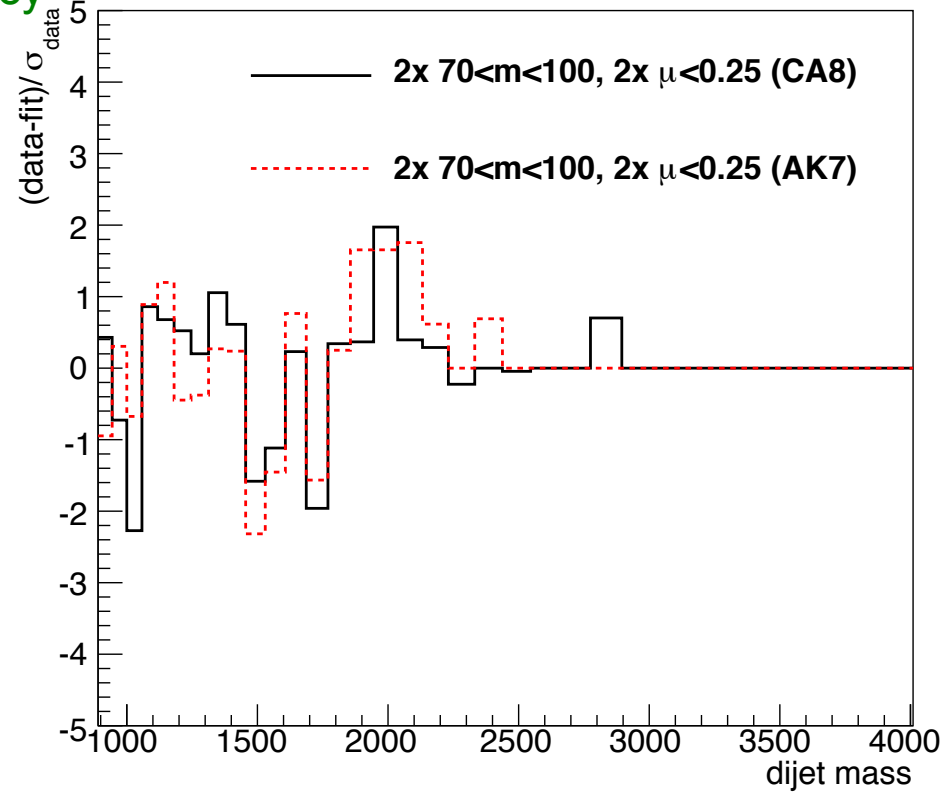
- No, because the background shape is the same for AK7 instead of CA8

Cross check with other jet algorithm

- Is this an artifact of the jet algorithm used for tagging?

RSG→WW (2TeV)
signal efficiency=

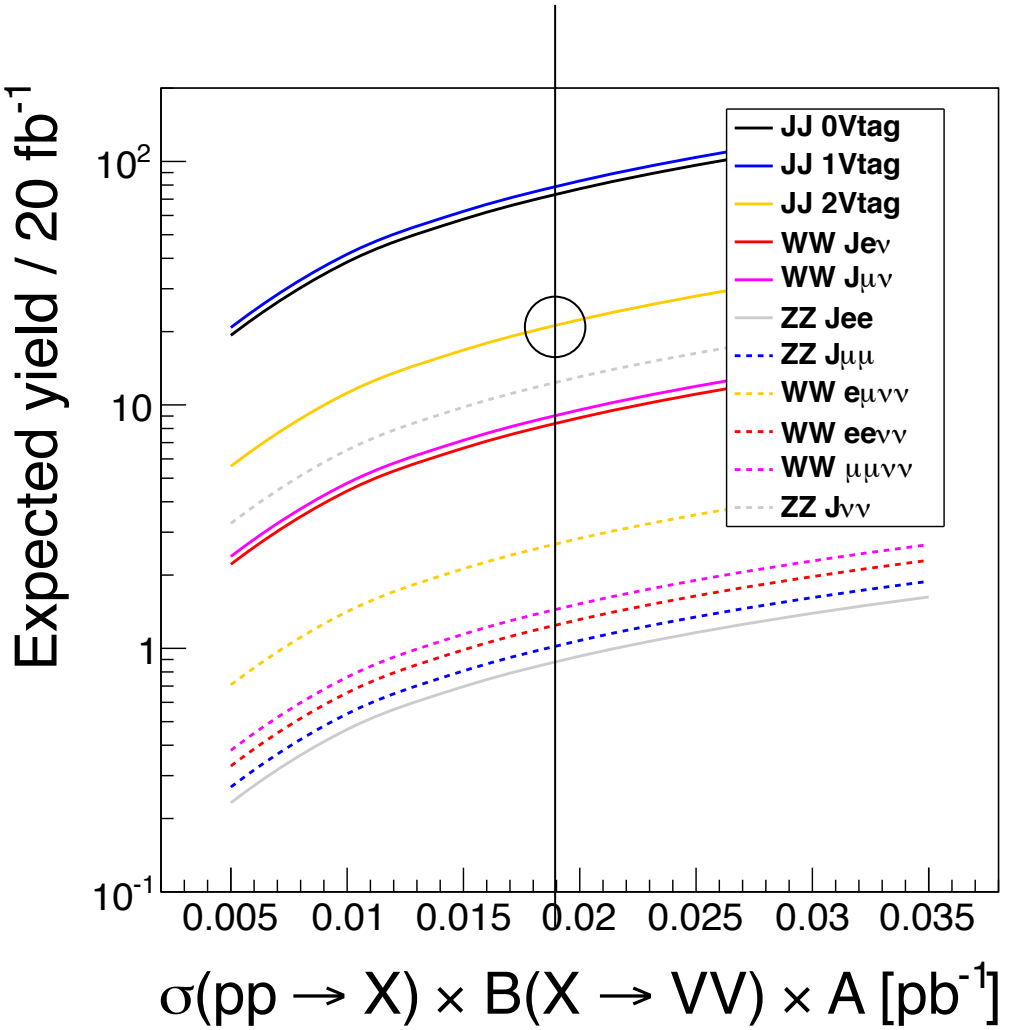




- No, because bump persists when using AK7 instead of CA8

Expectation from other channels

- How many events expected from other VV channels?
- If we see 20 events in the 2-tag we should expect
  - 80 1-tag events
  - 80 0-tag events
  - 14 ZZ -> j nu nu
  - 10 WW-> j mu nu
  - 8 WW-> j e nu
  - 4 WW-> e mu nu nu
  - 2 ZZ -> mu mu nu nu
  - 2 ZZ -> e e nu nu
  - 1 ZZ -> j mu mu
  - 1 ZZ -> j e e
- Assumptions
  - effWtag = 0.35
  - effMu = 0.70
  - effEle = 0.65
  - effTau = 0
  - BR_WtoLnu = 0.1080
  - BR_WtoHAD = 1.-3.*BR_WtoLnu
  - BR_ZtoLL = 0.0337
  - BR_ZtoNN = 0.2000
  - BR_ZtoHAD = 1.-3.*BR_ZtoLL-BR_ZtoNN
  - BR_XtoWW = 0.66
  - BR_XtoZZ = 0.33



Different categories

- The analysis as documented in the PAS has inclusive 0-tag and 1-tag categories which are not used to search for VV resonances

- Study here the exclusive categories

0x 70<m<100	1x 70<m<100 0x mu<0.25	1x 70<m<100 1x mu<0.25	2x 70<m<100 0x mu<0.25	2x 70<m<100 1x mu<0.25	2x 70<m<100 2x mu<0.25

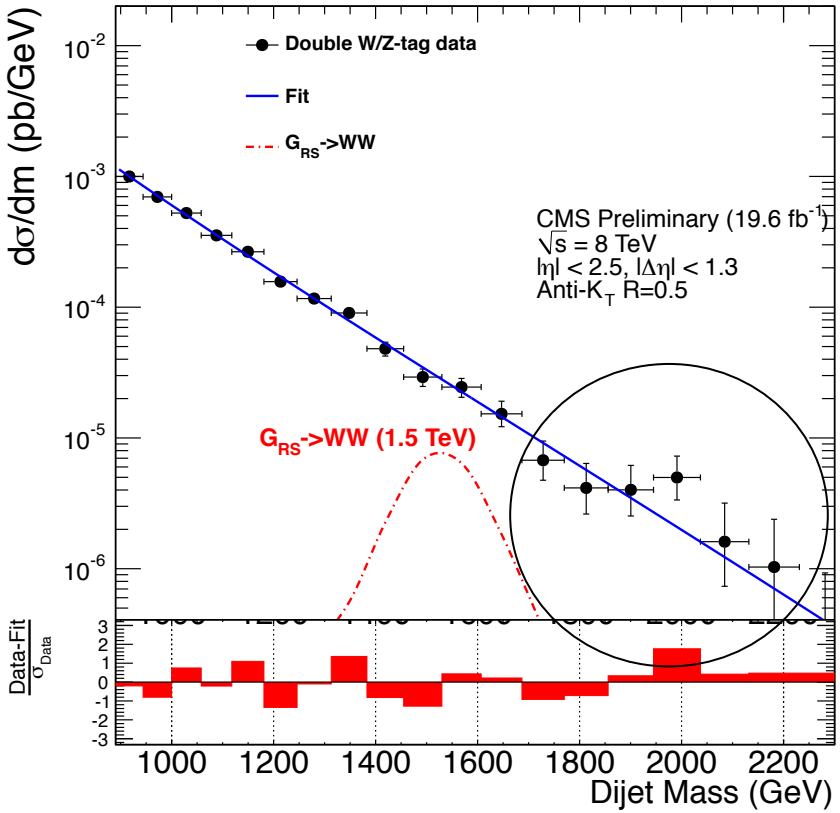
Plans for the analysis

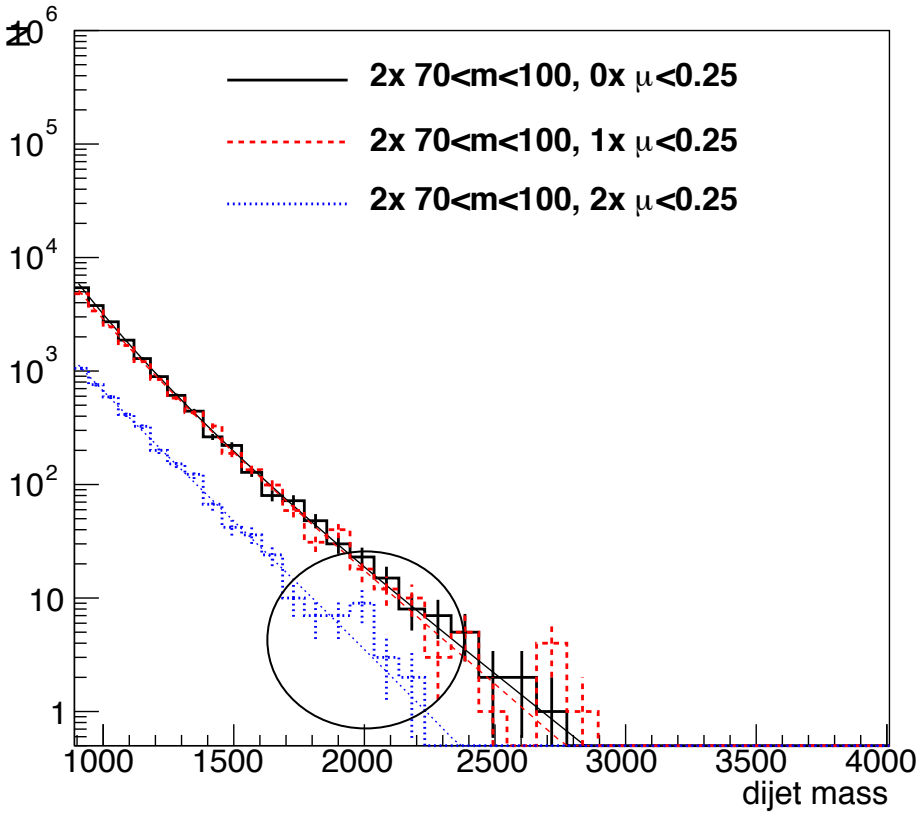
- Look if bump is also seen in 0-tag and 1-tag exclusive categories
  - Calculations just finished today
- Confirm the observed and expected limit with Higgs “combine” tool
  - Technical setup done, now running the limits
- Estimate the local and global significance with “combine”
- Set up optimized analysis with improved tagger and categories
- Check if bump is confirmed in semi-leptonic analyses
  - Analyses are setup and checking control regions before unblinding
  - EXO-12-022: X → ZZ/WZ
    https://indico.cern.ch/getFile.py/access?contribId=2&resId=0&materialId=slides&confId=239351
  - EXO-12-021 : X → WW/WZ
    https://indico.cern.ch/getFile.py/access?contribId=5&resId=0&materialId=slides&confId=236628

Backup

Cross check analysis

- Found a small fraction of duplicate events during synchronization
  - Slightly reduced pull of the bin at 2 TeV from 2.08 to 1.76 sigma
- Jet variables agree within 10^{-6}
- Selected events in 2-tag Mjj>1.65 TeV agree 100%
- Cross check analysis reproduces the bump





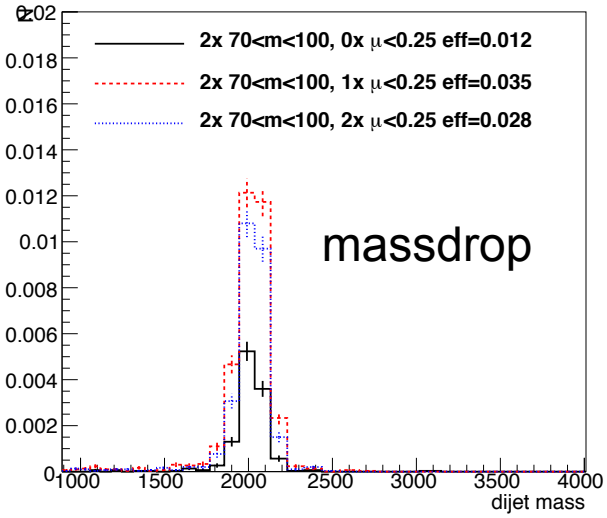
Multijet meeting
7 March 2013

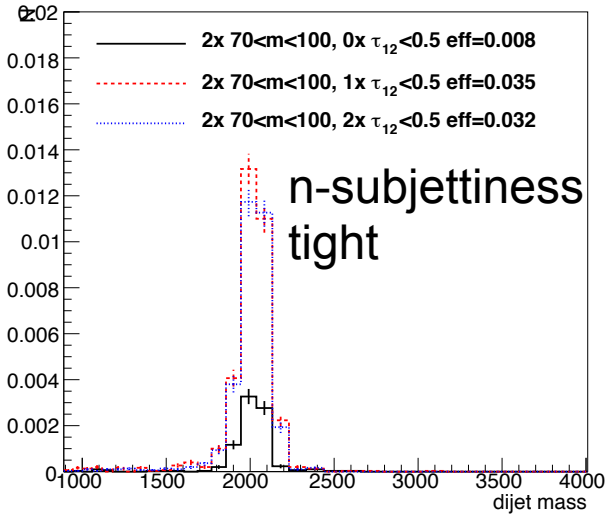
Andreas Hinzmann

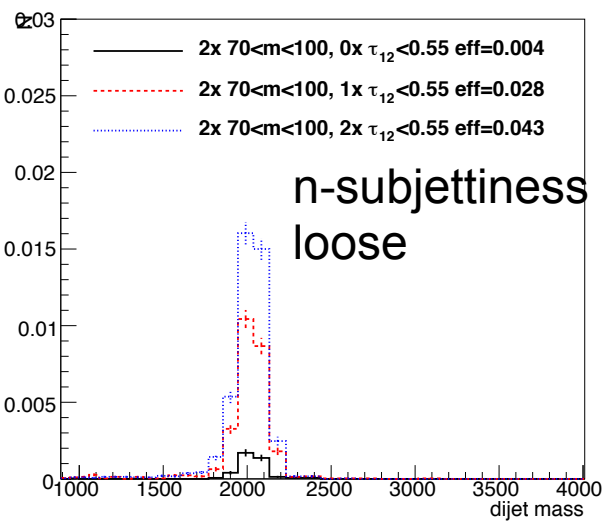
More categories

- Increase sensitivity by splitting up in categories and make them exclusive
  - 0x 70<m<100
  - 1x 70<m<100, 0x μ<0.25
  - 1x 70<m<100, 1x μ<0.25
  - 2x 70<m<100, 0x μ<0.25
  - 2x 70<m<100, 1x μ<0.25
  - 2x 70<m<100, 2x μ<0.25

RSG→WW (2TeV)



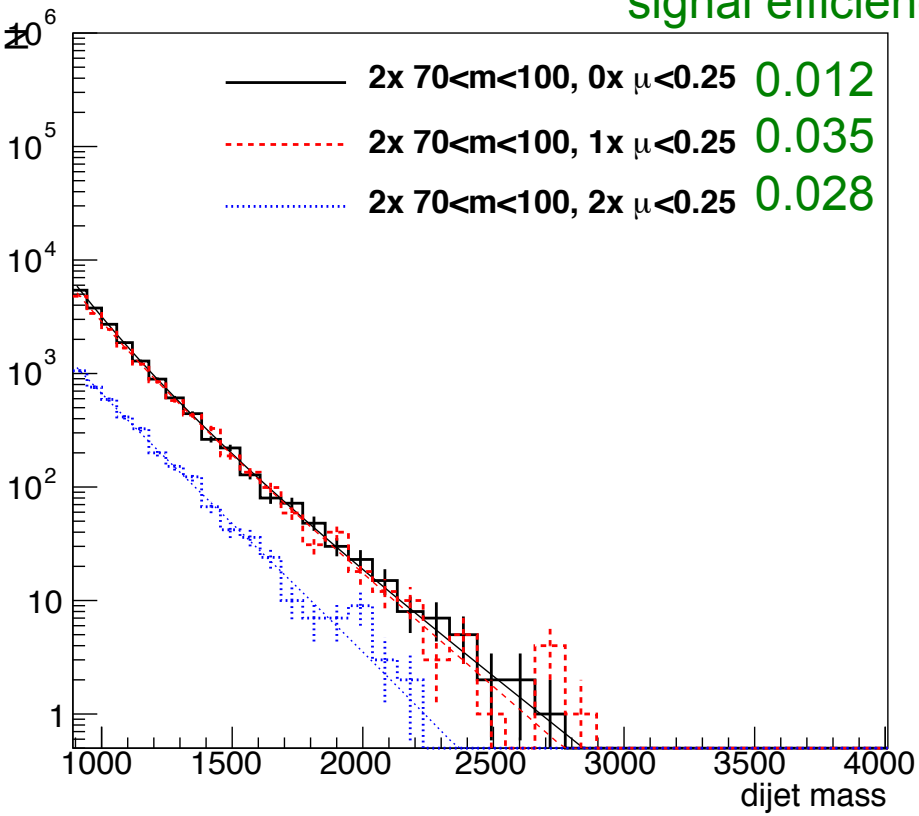


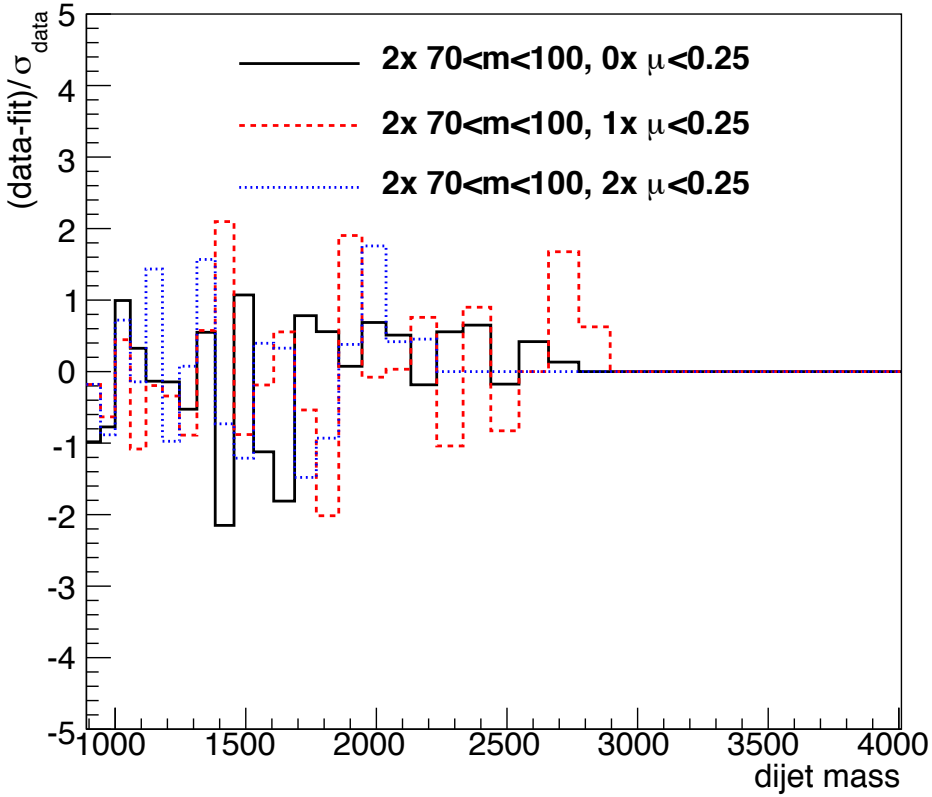


Questions

- Do we see the excess in more than one sample? Does it look like a VV excess?

RSG→WW (2TeV)
signal efficiency=



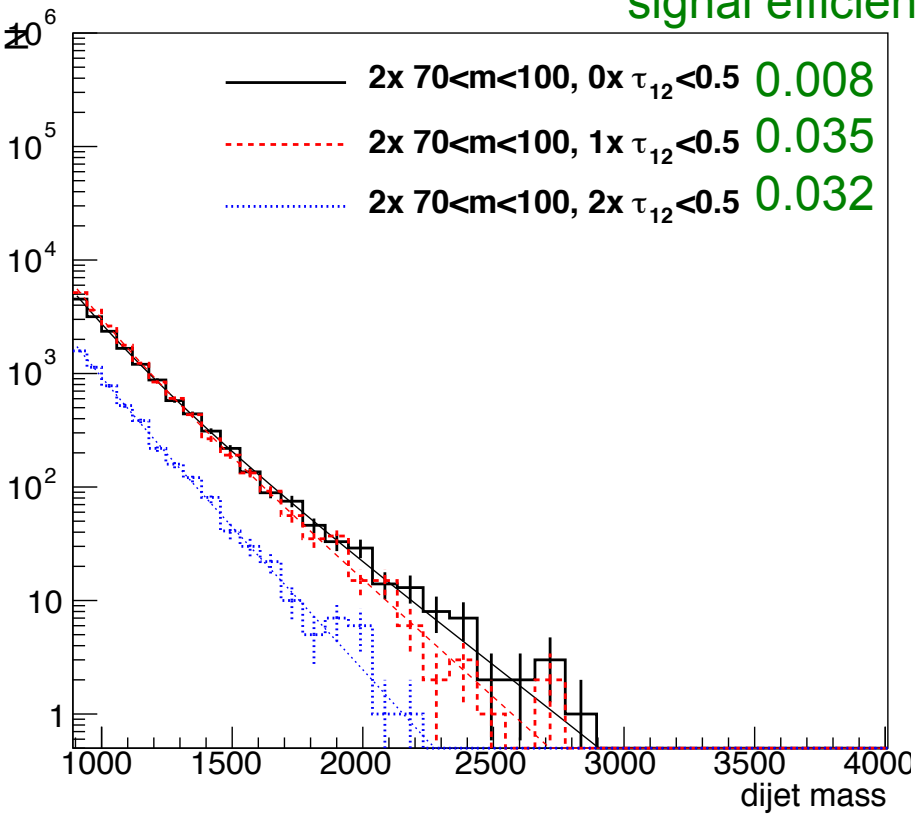


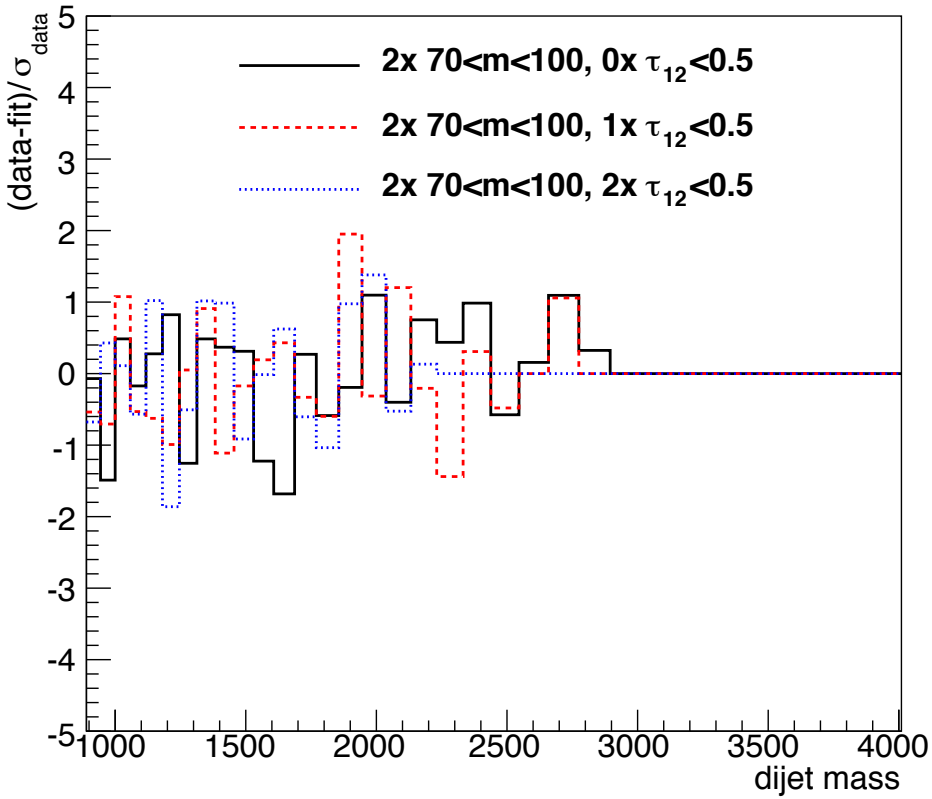
- Bump in 1-massdrop-tag and 2-massdrop-tag category, however shifted by 1 bin and doesn't scale exactly with the signal efficiency
- Nothing in 0-massdrop-tag category (expect ~1/3 of the signal in 2-massdrop-tag)

Questions

- Do we see the excess in more than one sample? Does it look like a VV excess?

RSG→WW (2TeV)
signal efficiency=



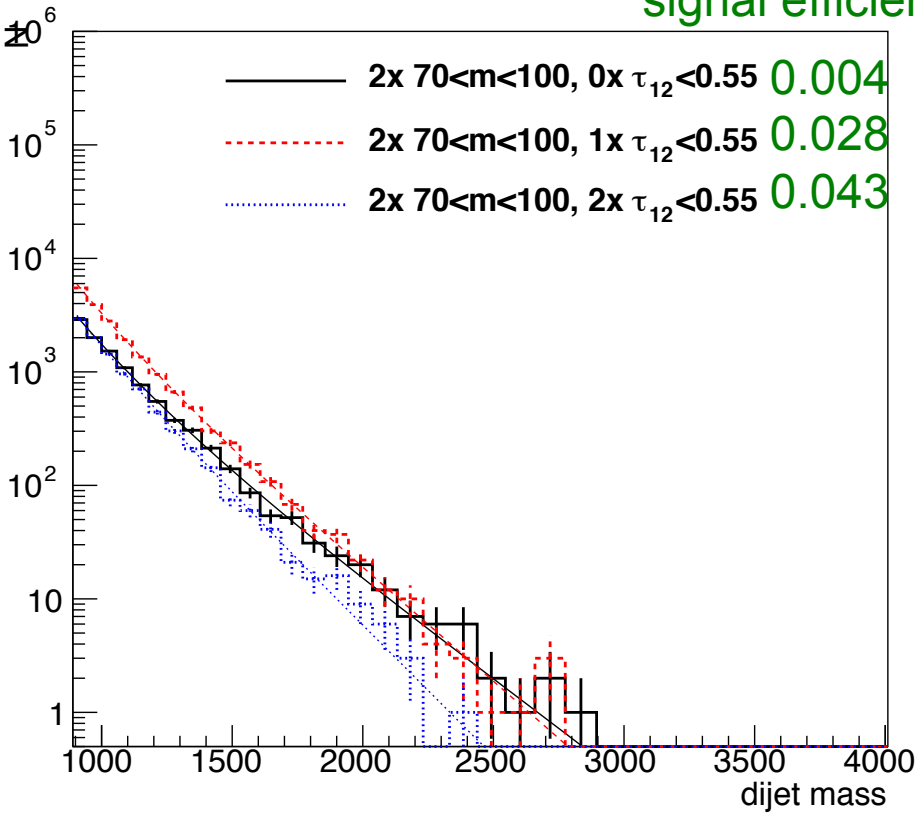


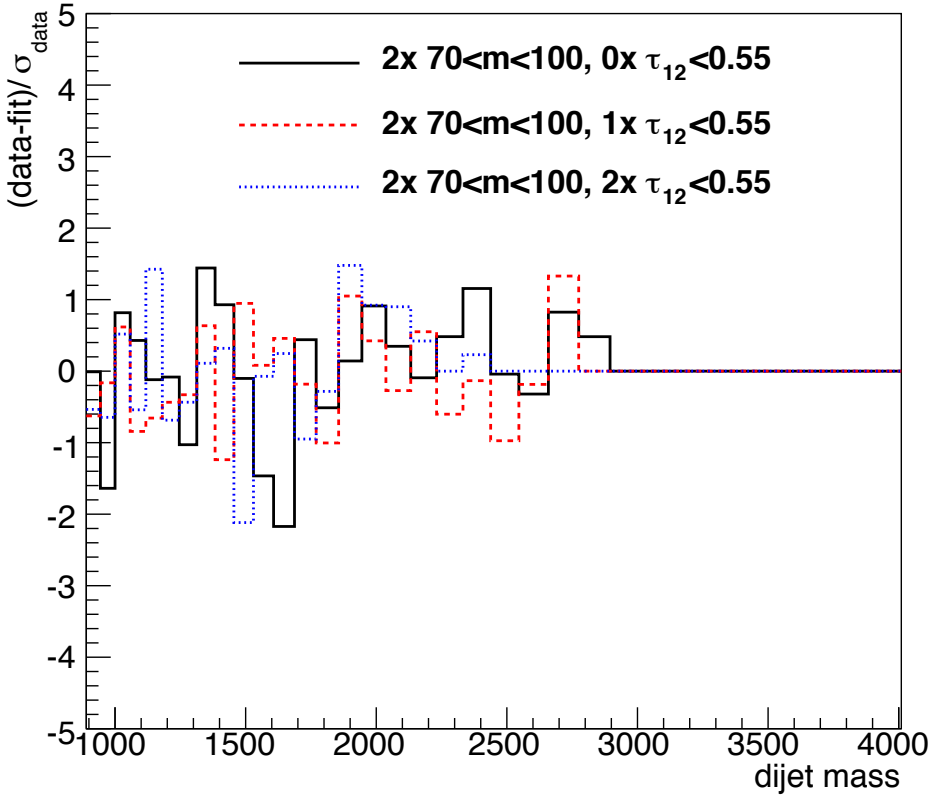
- Bump persists with n-subjettiness tagger

Questions

- Do we see the excess in more than one sample? Does it look like a VV excess?

RSG→WW (2TeV)
signal efficiency=

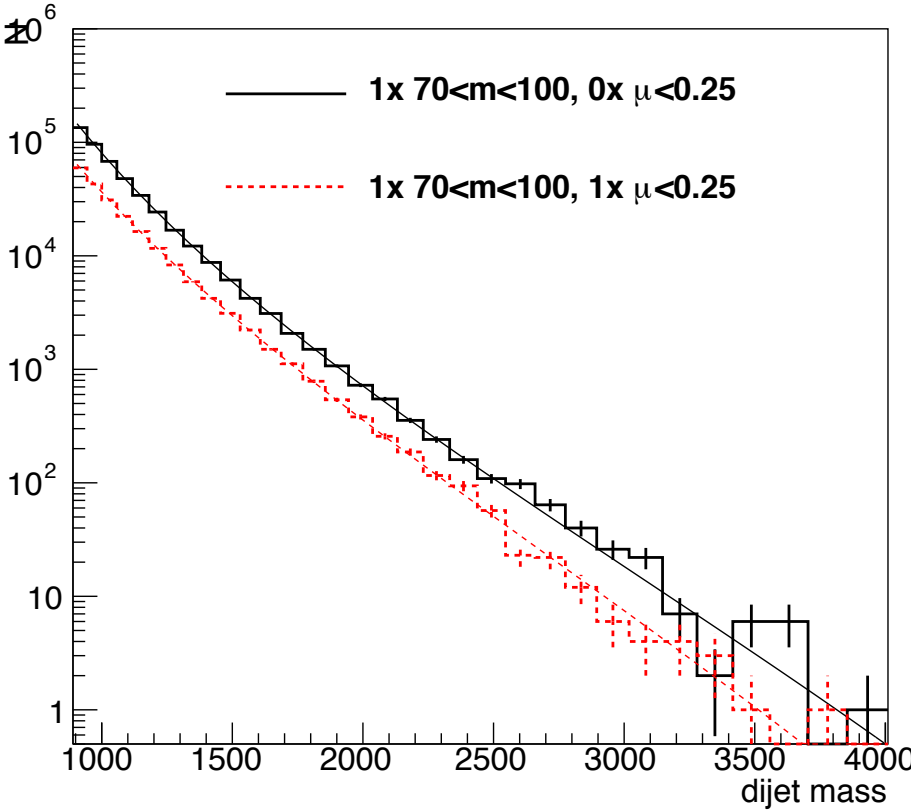


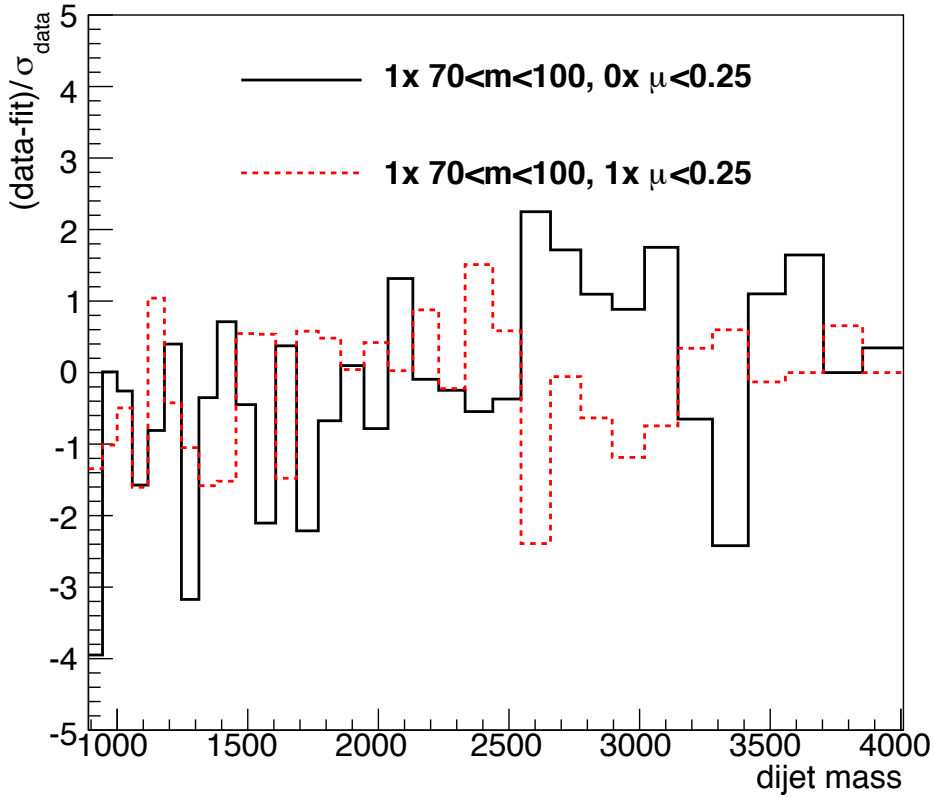


- Bump persists with n-subjettiness loose tagger

Questions

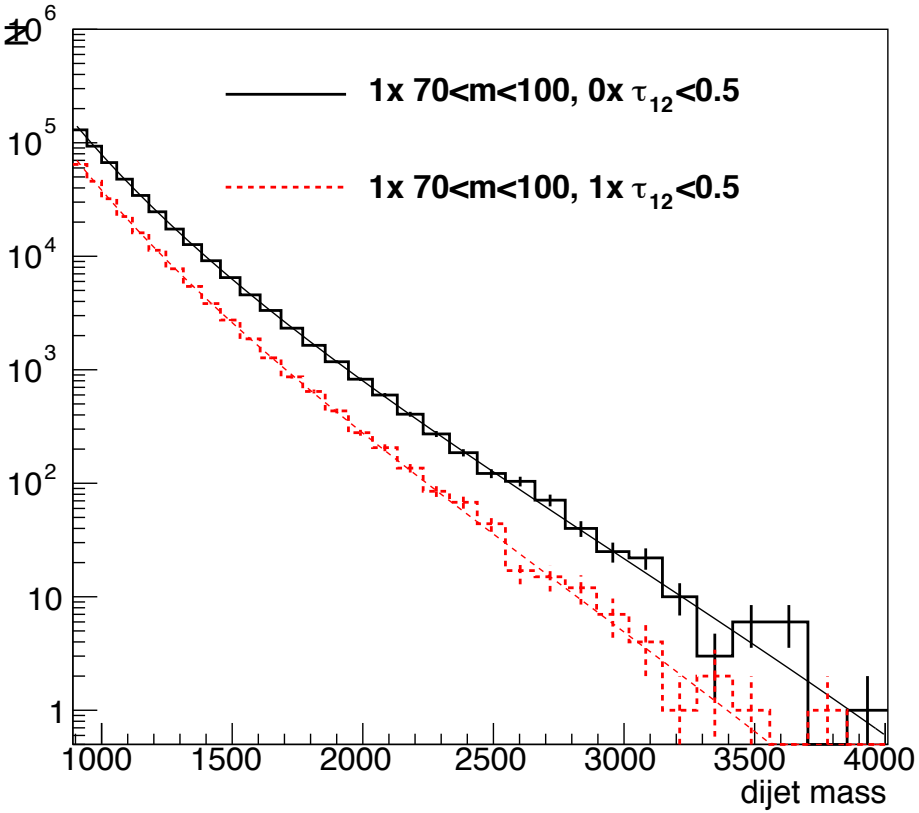
- Do we see the excess in more than one sample? Does it look like a VV excess?

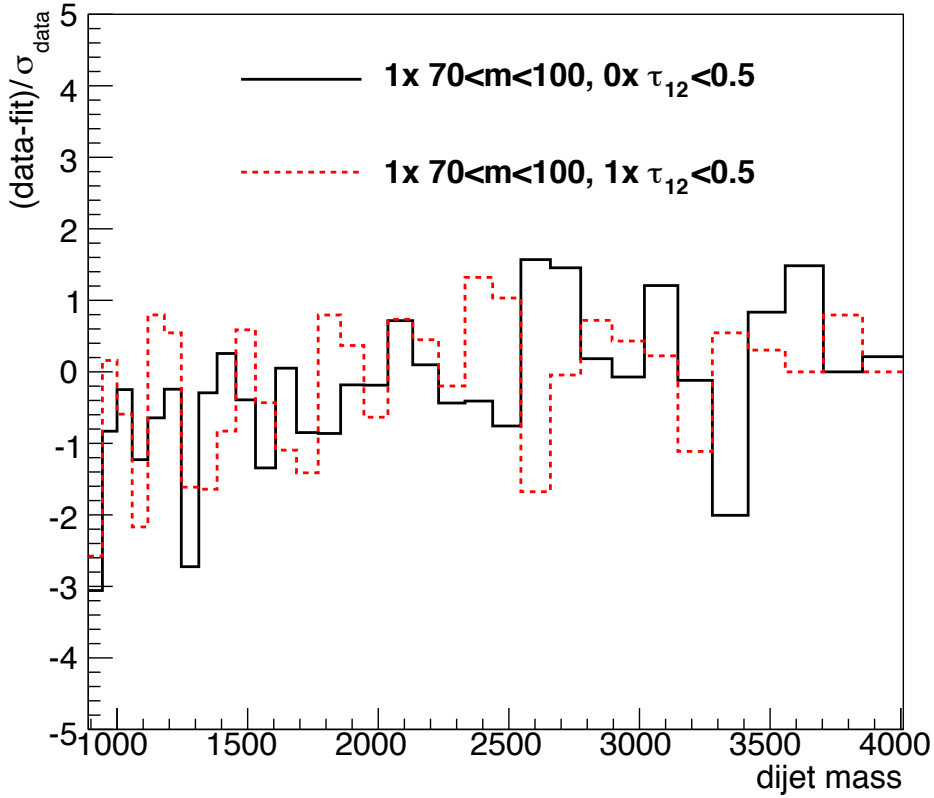




Questions

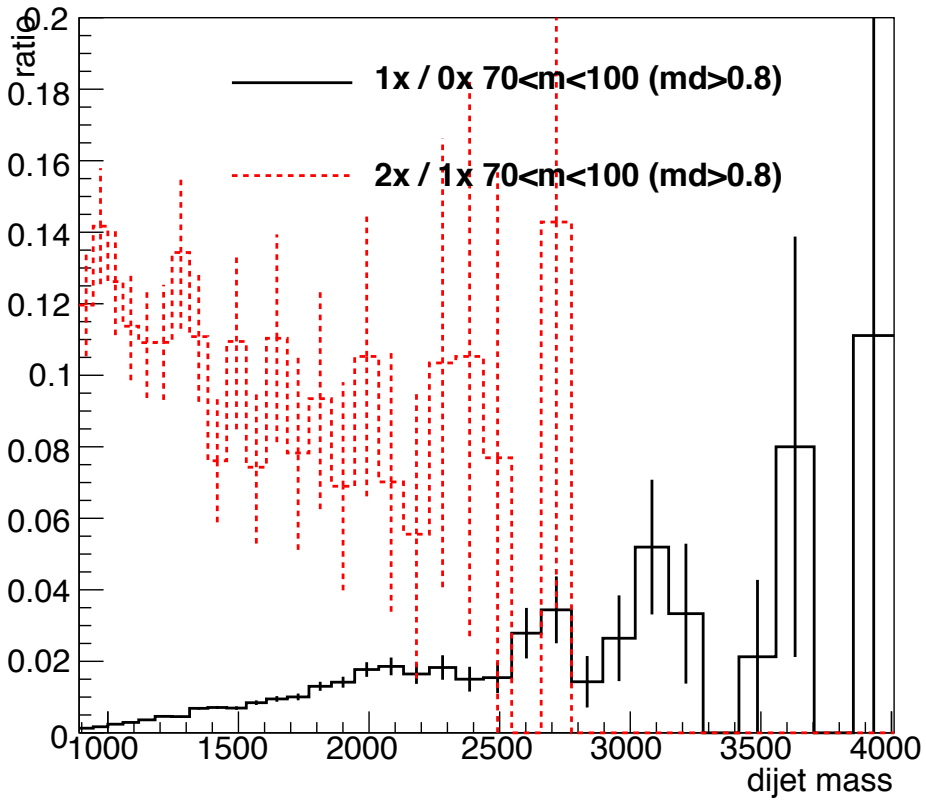
- Do we see the excess in more than one sample? Does it look like a VV excess?





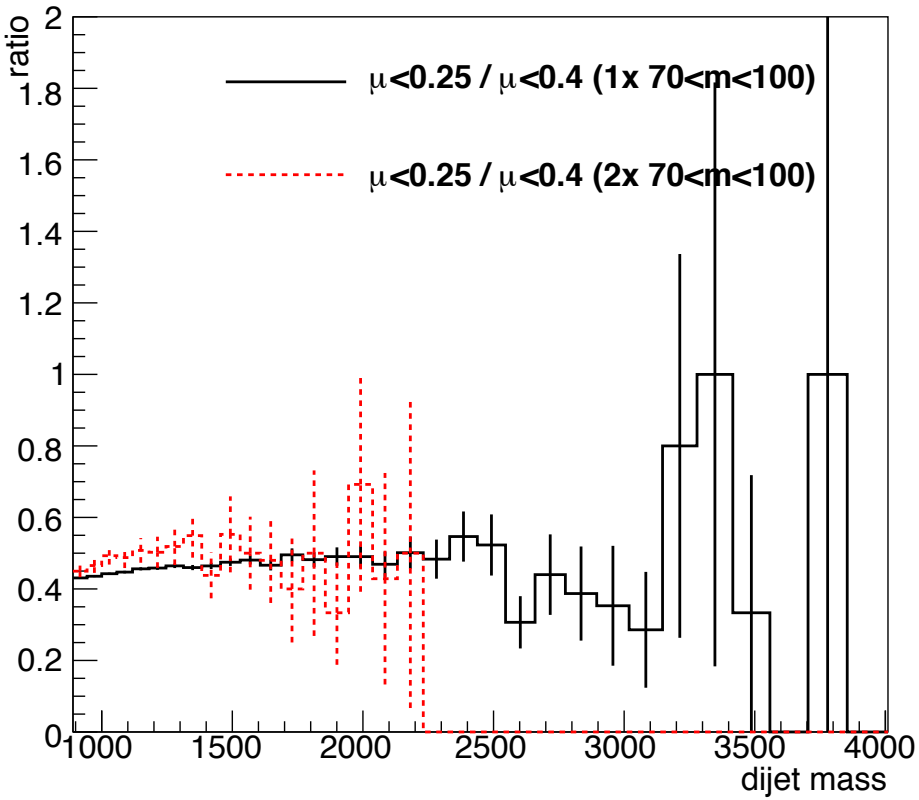
Questions

- Is the jet mass producing a bump?



Questions

- Does the bump scale with the expected signal efficiency?



- Yes, because is scales more than expected from background