H→WW→lvlv at high luminosity: results with AntiKt4LCTopoJets

- Jet rates at different geometries, μ and m_H
  Geometries: FCal, sFCal small gaps; μ=80-200, m_H = 125 and 1000 GeV
- Jet kinematics at different geometries, μ and m_H
- Conclusion
- Plans

Updated:
28.04.2016

A.A. Gavrilyuk, T. Maier (LMU Munich), ***I.I. Tsukerman*** *(thanks to K. Koeneke from HWW group)*
ITEP Moscow, Russia
update of slides shown at sFCal analysis workshop, Munich, 14.04.16

Examples of plots/tables based on tqroot analysis

- Jet multiplicities
- Jets: first, second and third jet p_T and η, $\Delta Y(jj)$, M(jj) for tagging jets
  Run2, μ=80, 140 and 200 for FCal and sFCal geometries separately
  FCal vs sFCal for different μ and m_H

  Plots are given both in logarithmic and linear scales
  Plots are normalized to have the same integral
- Jet and MET-related kinematics at μ=200 for FCal and sFCal-s
  For different flavours (DF), i.e. ($e\mu$ + μe) events only
- Jet and MET-related kinematics at μ=80/140 for FCal and sFCal-s
  See backup slides

Results for m_H =125 GeV: jet multiplicity

Table shows fractions of events after PxAOD **selections, eμ + μe**

		FCal			sFCal		
μ	m_H GeV	N(>0 jet)	N(>1 jet)	N(>2 jet)	N(>0 jet)	N(>1 jet)	N(>2 jet)
80	125	0.903	0.575	0.195	0.931	0.598	0.206
140	125	0.951	0.727	0.413	0.965	0.786	0.484
200	125	0.987	0.917	0.762	0.993	0.956	0.867
R2	125	0.952	0.647	0.176	-	-	-

Run2 and μ=80 cases not very different
Strong increase of jet multiplicity with μ, jet p_T cuts should be tightened
Slightly more jets in sFCal w.r.t. FCal

Results for m_H =1000 GeV: jet multiplicity

Table shows fractions of events after PxAOD **selections, eμ + μe**

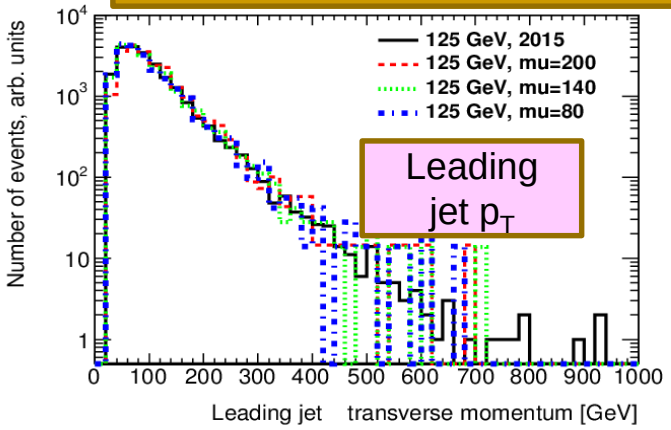
		FCal			sFCal		
μ	m_H GeV	N(>0 jet)	N(>1 jet)	N(>2 jet)	N(>0 jet)	N(>1 jet)	N(>2 jet)
80	1000	0.856	0.463	0.139	0.874	0.507	0.158
140	1000	0.922	0.658	0.365	0.942	0.729	0.447
200	1000	0.976	0.884	0.728	0.990	0.938	0.842
R2	1000	0.898	0.537	0.143	-	-	-

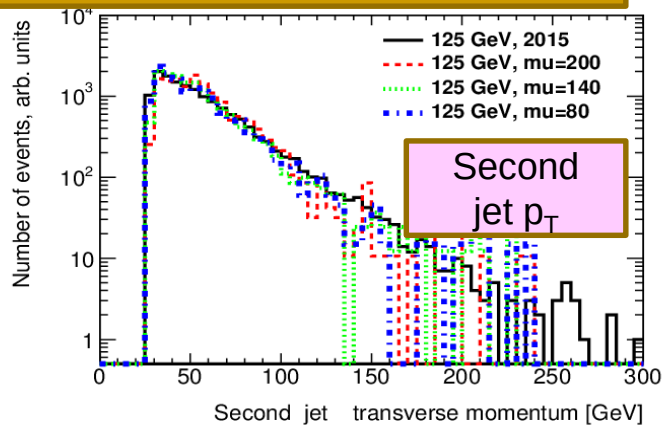
Run2 and μ=80 cases not very different
Strong increase of jet multiplicity with μ, jet p_T cuts should be tightened
We have slightly more jets in sFCal w.r.t. non-degraded FCal

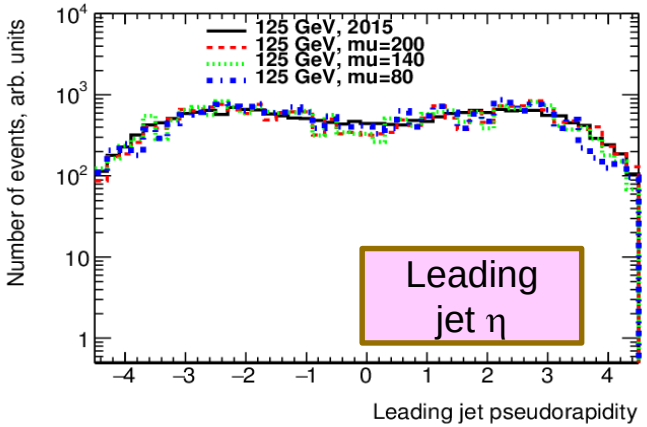
Jet plots as function of μ, m_H =125 GeV

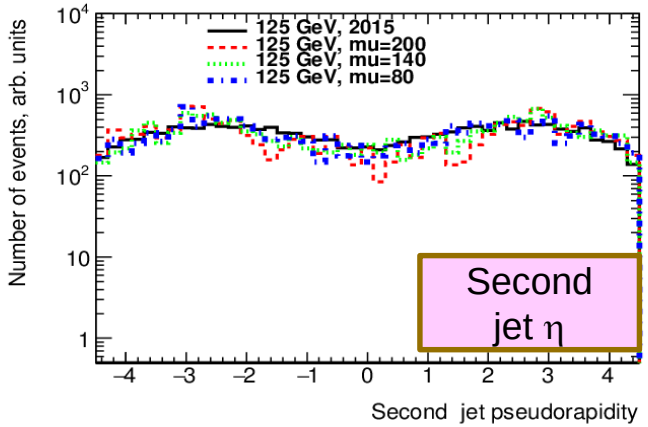
Jet kinematics in H→WW→lvlv events: DF-case

FCal geometry, 125 GeV VBF H, different μ, log scale





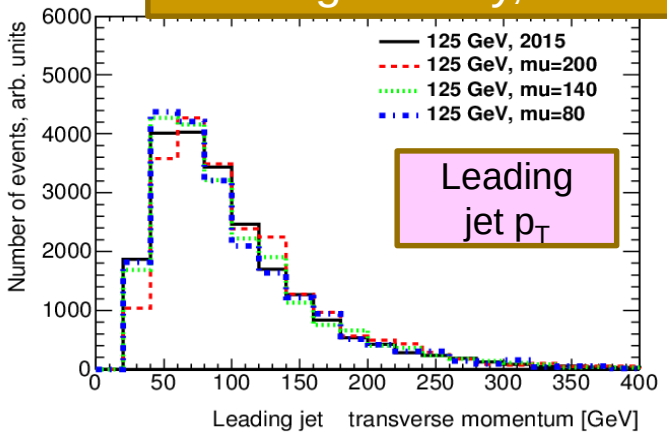


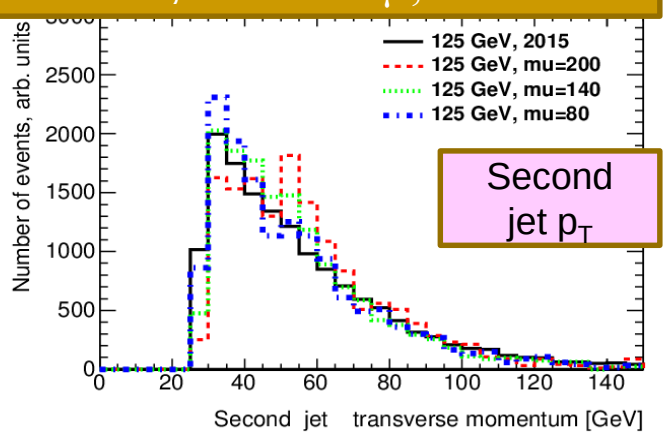


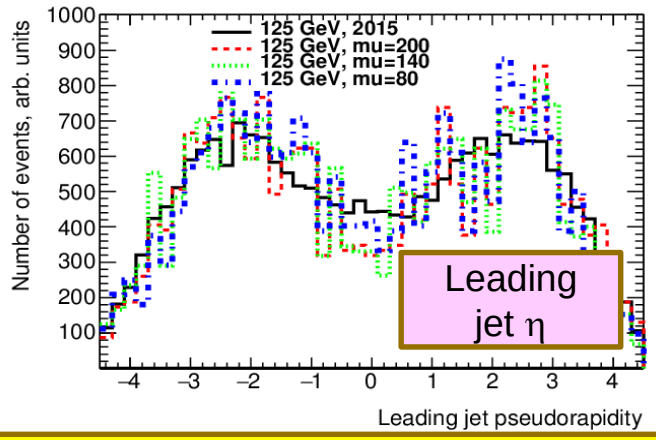
Typical maxima at high $|\eta|$ are more pronounced for second jets
A bit harder jet p_T at higher luminosity, especially for μ=200
A bit more second forward jets at high μ, increasing with μ

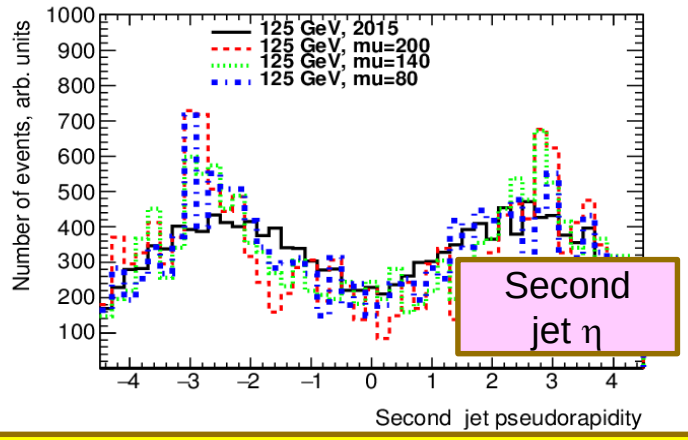
Jet kinematics in H→WW→lvlv events: DF-case

FCal geometry, 125 GeV VBF H, different μ, lin scale









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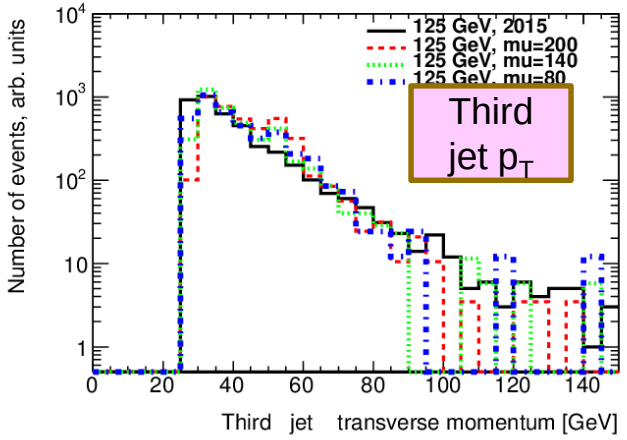
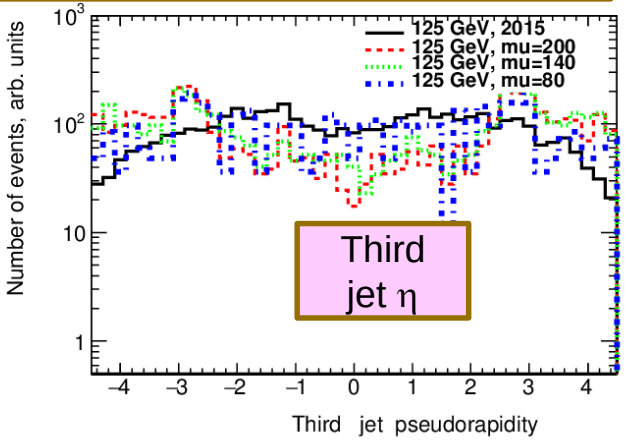
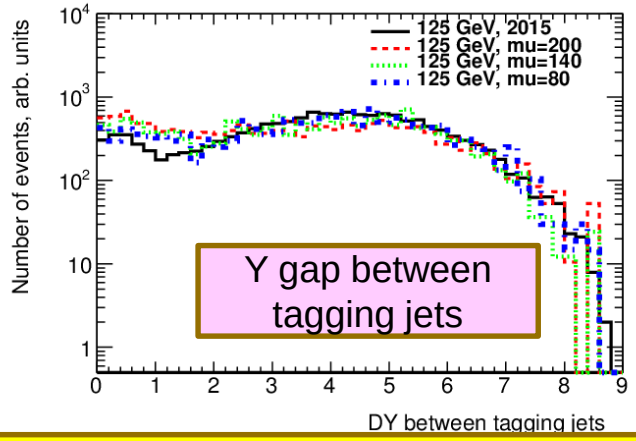
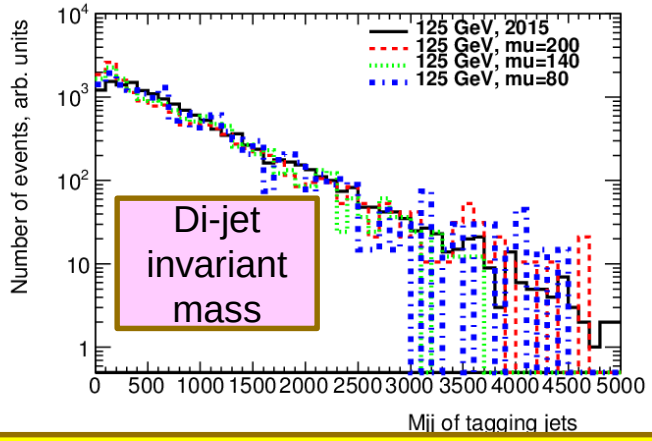
Jet kinematics in H→WW→lvlv events: DF-case

FCal geometry, 125 GeV VBF H, different μ, log scale





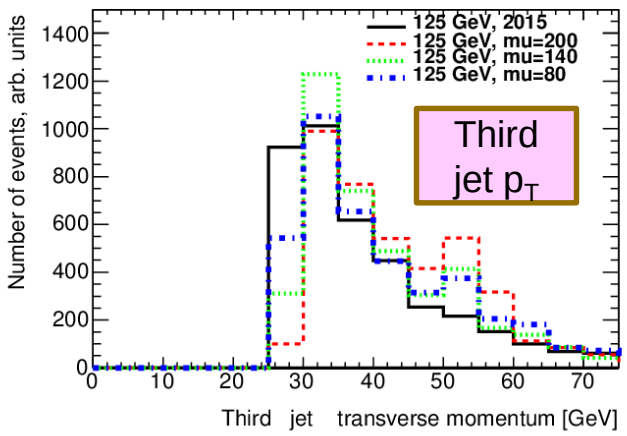


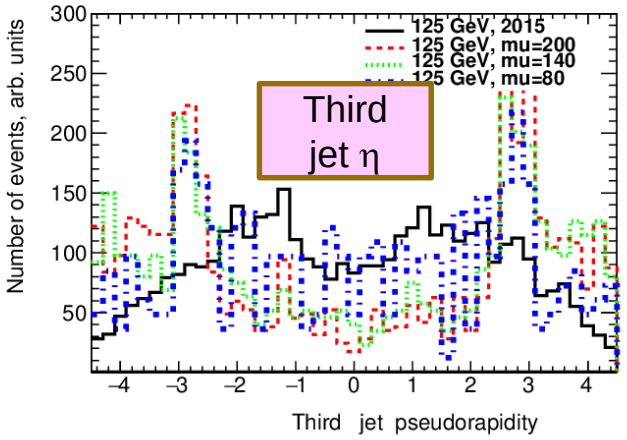


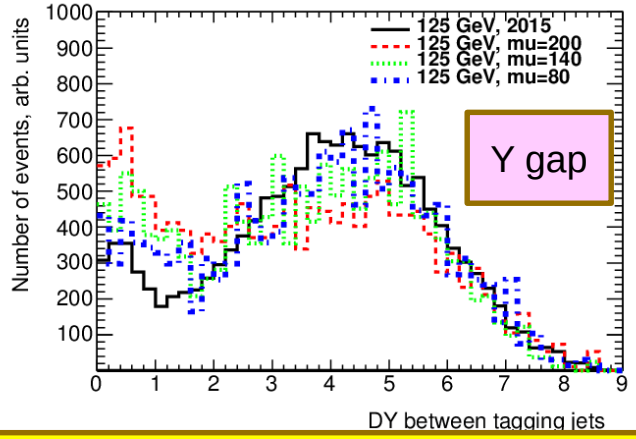
Harder third jet p_T at high luminosity, more forward jets at high μ
More events with low ΔY and M(jj) especially at μ=200

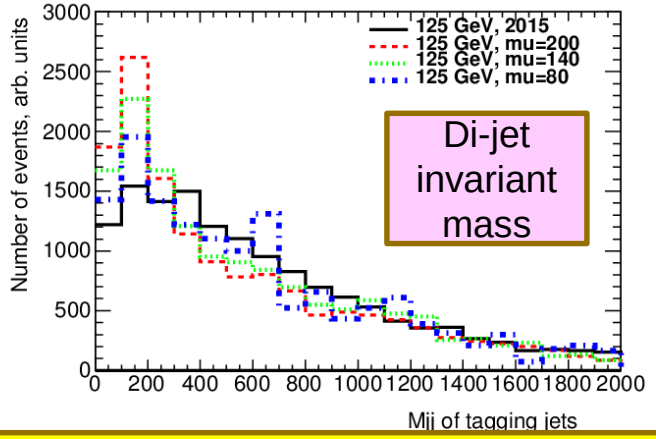
Jet kinematics in H→WW→lvlv events: DF-case

FCal geometry, 125 GeV VBF H, different μ, lin scale





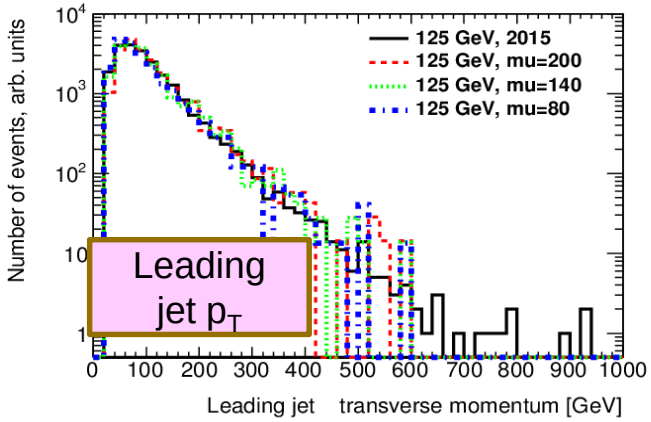


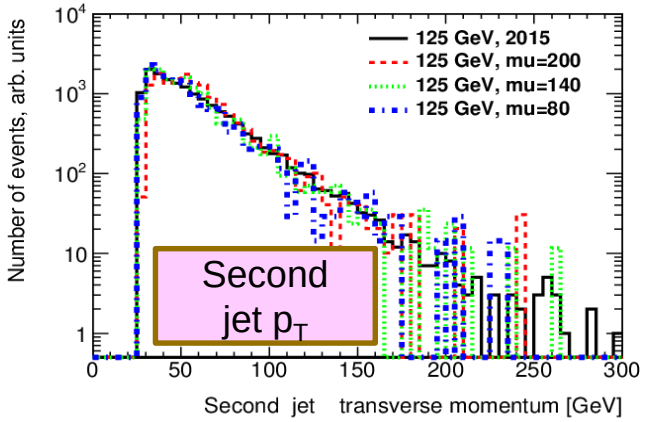


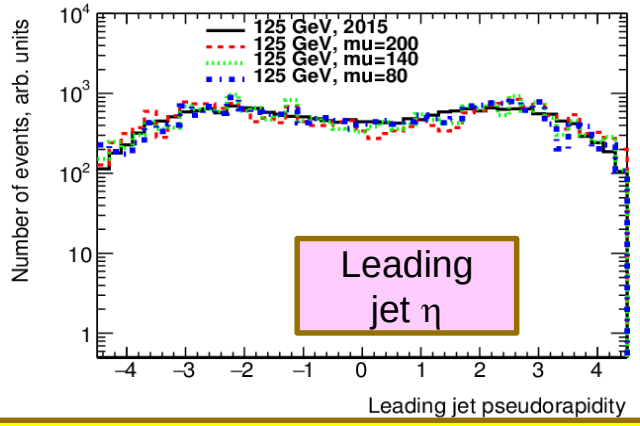
"Bunny ears" are probably seen at EC boundary at high μ
Not enough statistics for third jets to come to definite conclusions

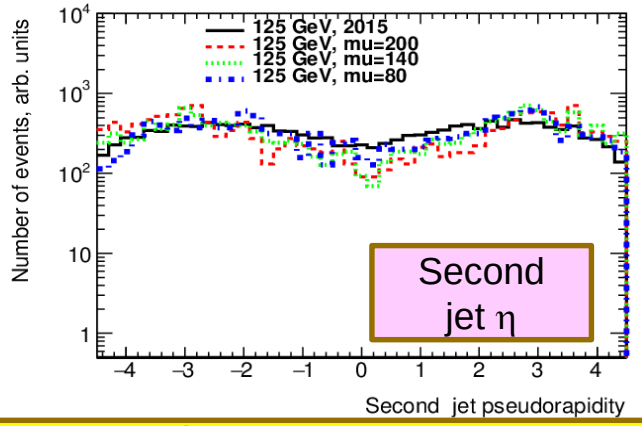
Jet kinematics in H→WW→lvlv events: DF-case

sFCal geometry, 125 GeV VBF H, different μ, log scales









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Jet kinematics in H→WW→lvlv events: DF-case

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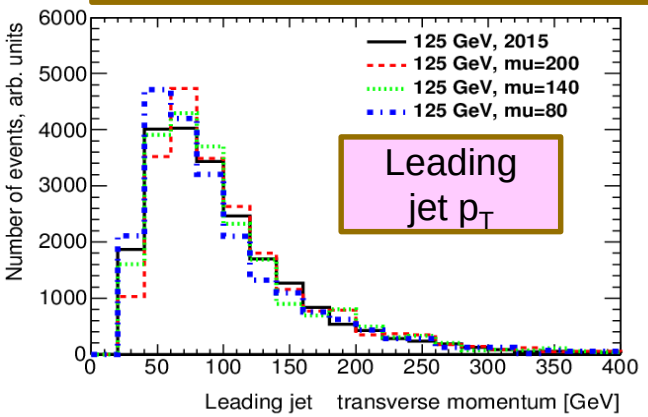

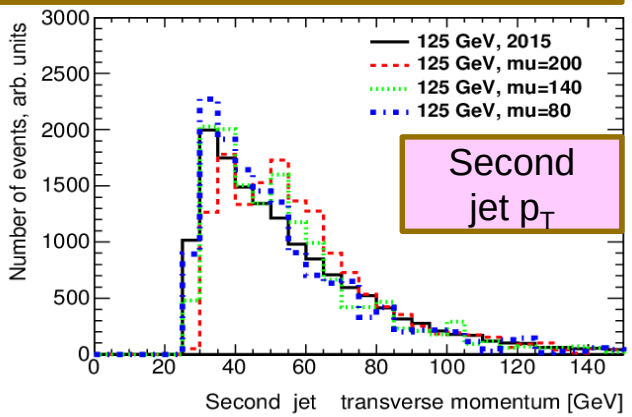

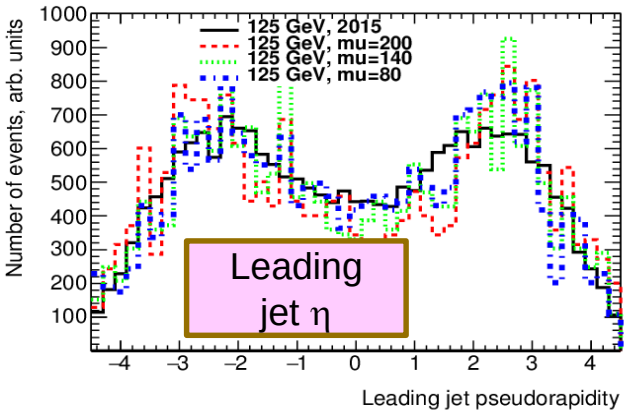

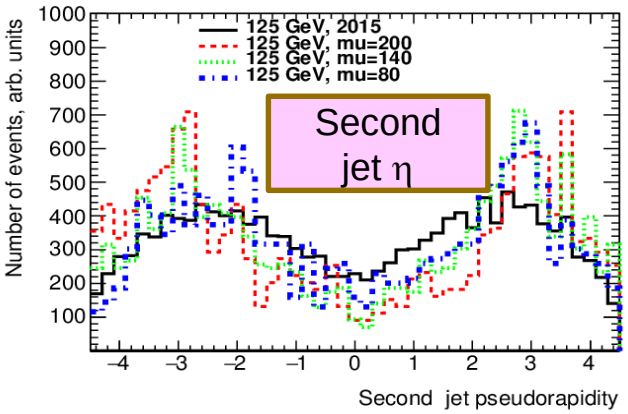

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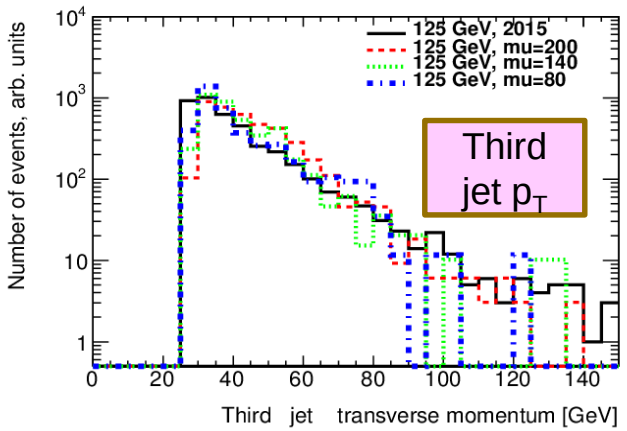

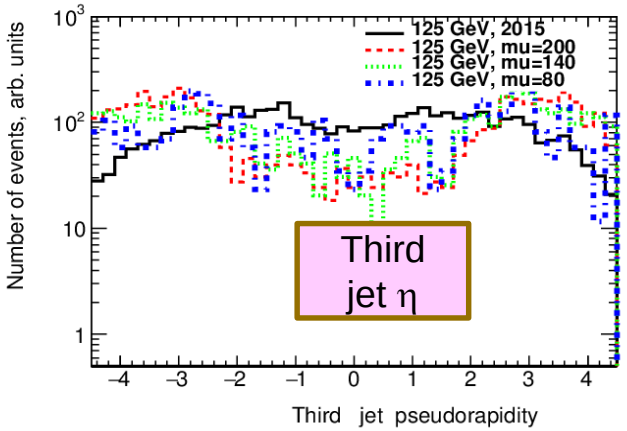

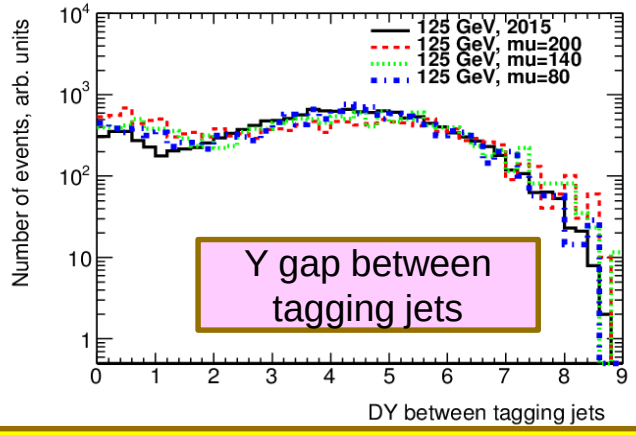

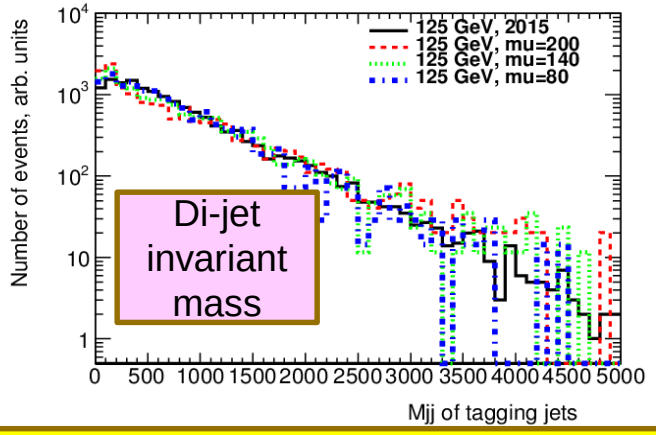

Harder third jet p_T at high luminosity, more forward jet at high μ
More events with low ΔY and M(jj) especially at μ=200

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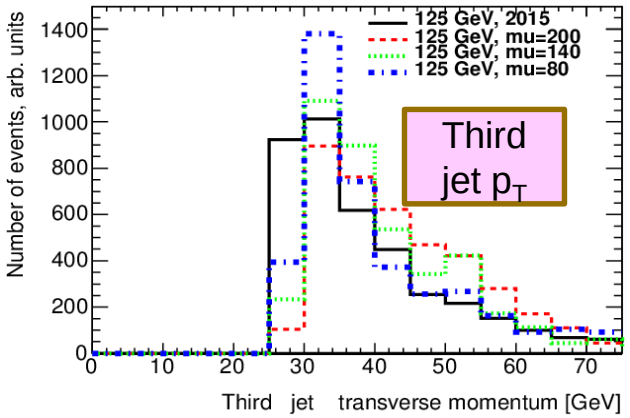
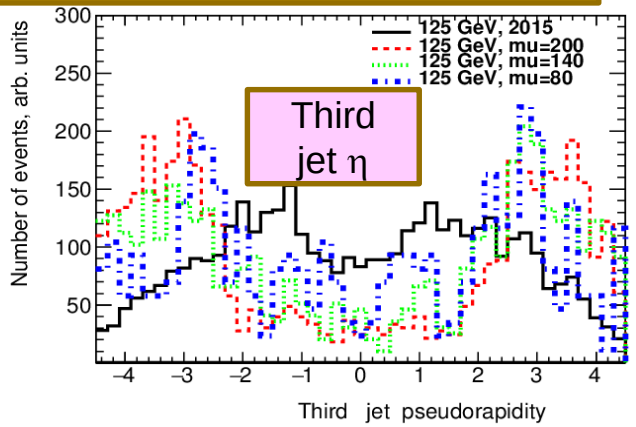
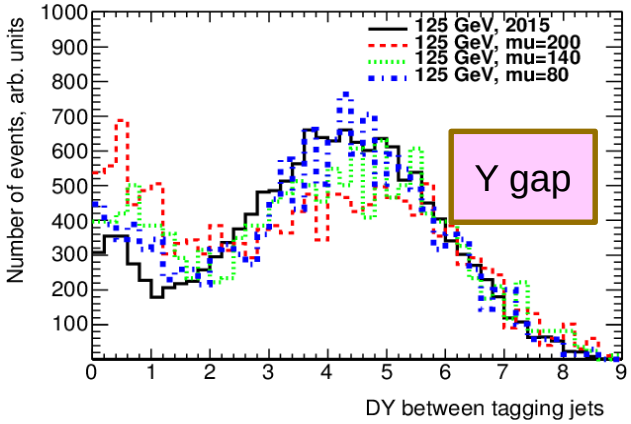
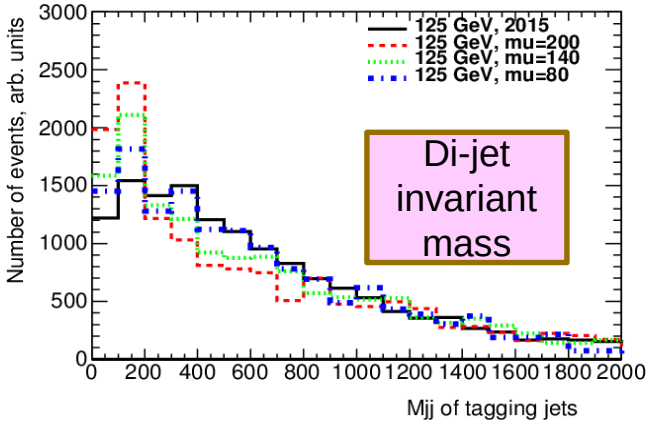
Jet kinematics in H→WW→lvlv events: DF-case

sFCal geometry, 125 GeV VBF H, different μ, lin scale









"Bunny ears" are probably seen at EC boundary at high μ
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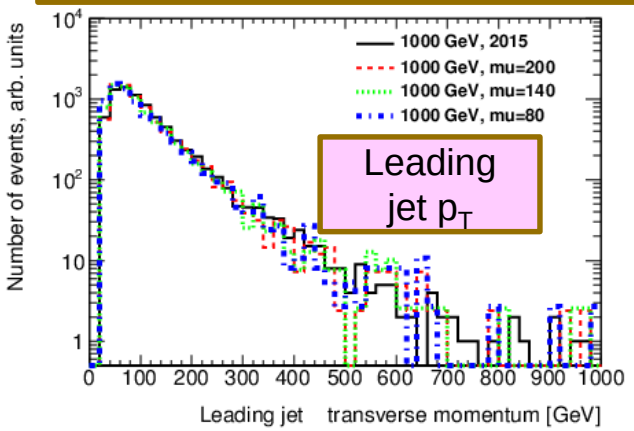
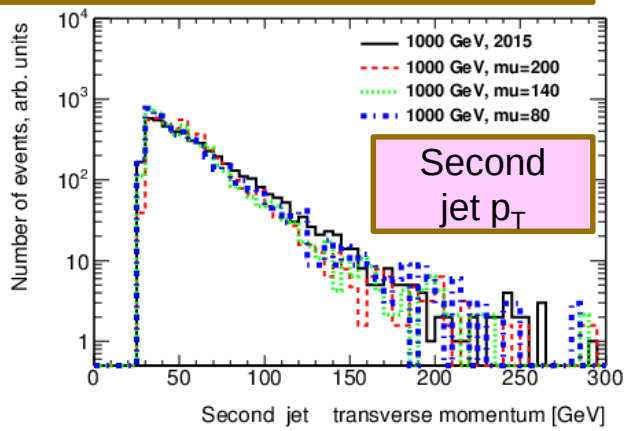
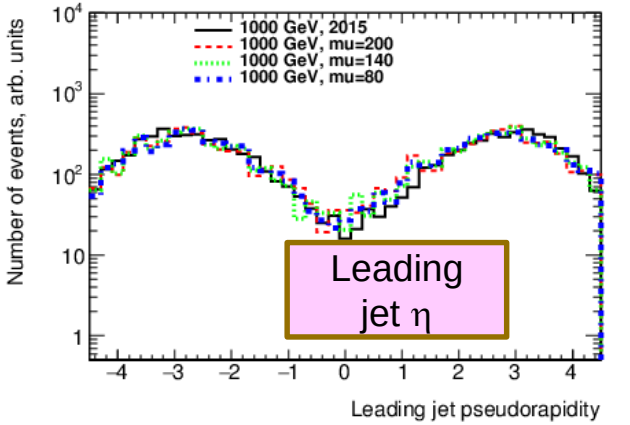
Jet plots as function of μ, m_H =1000 GeV

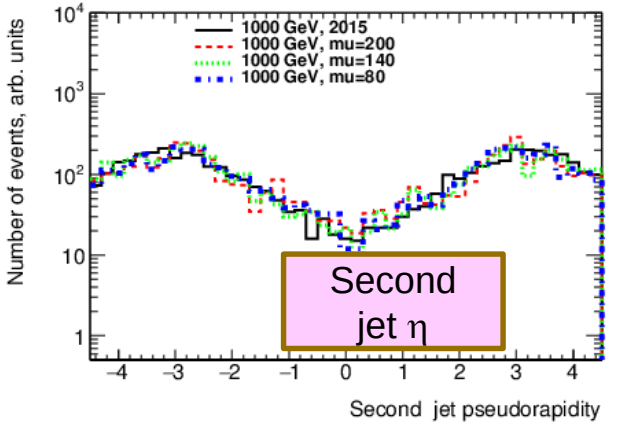
Jet kinematics in H→WW→lνlν events: DF-case

FCal geometry, 1000 GeV VBF H, different μ, log scale









Typical maxima at high ¦η¦ are pronounced both for leading and second jets
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15

Jet kinematics in H→WW→lvlv events: DF-case

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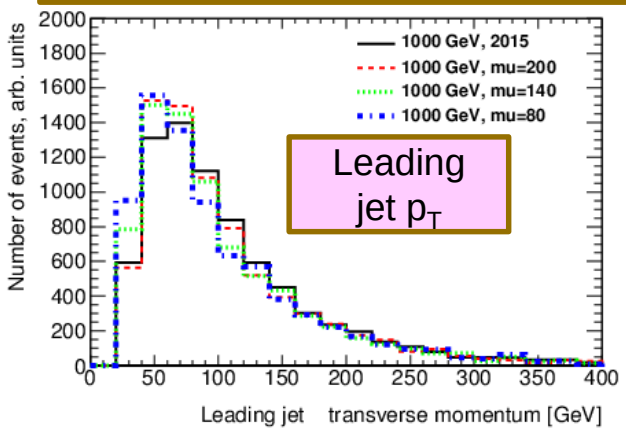

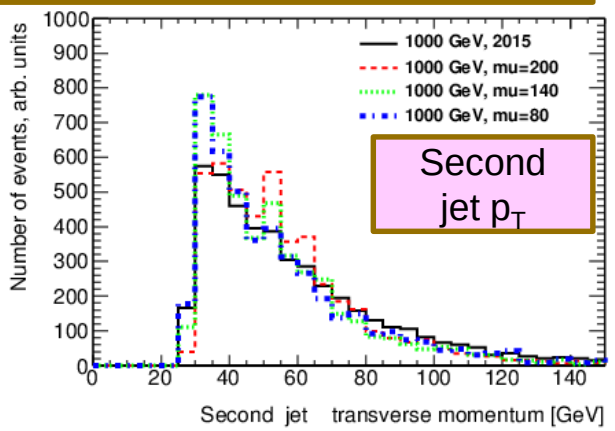

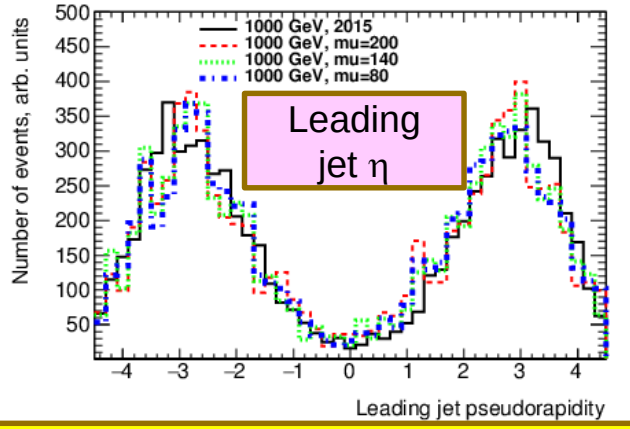

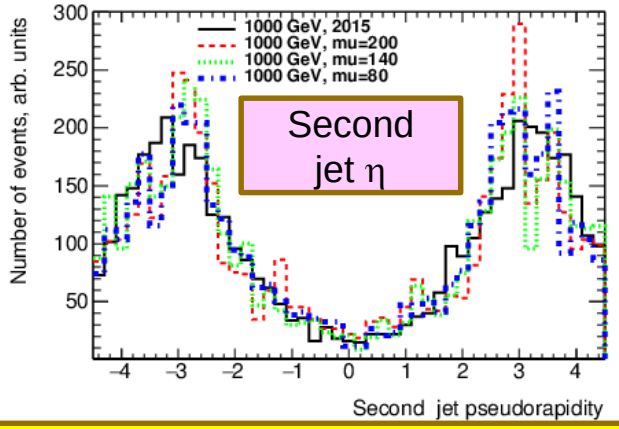

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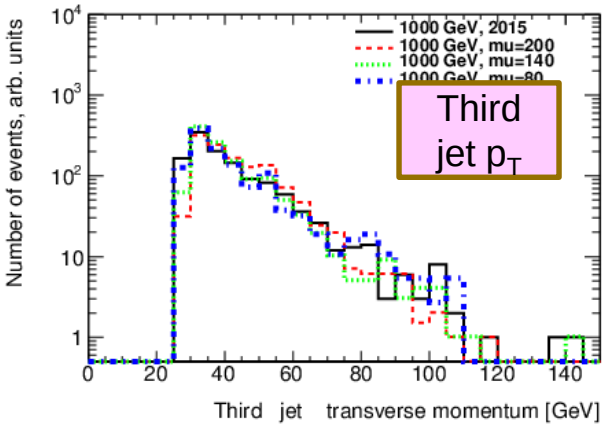

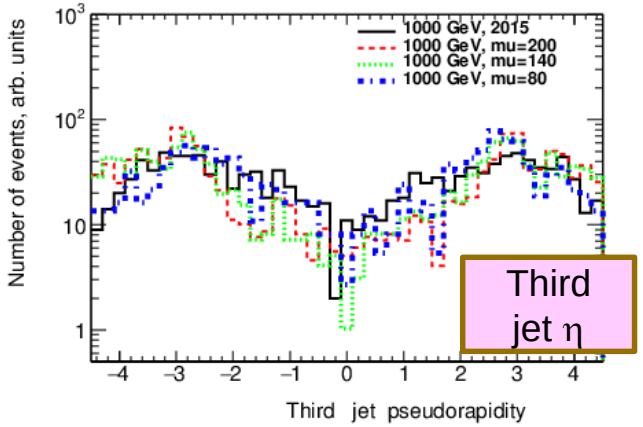

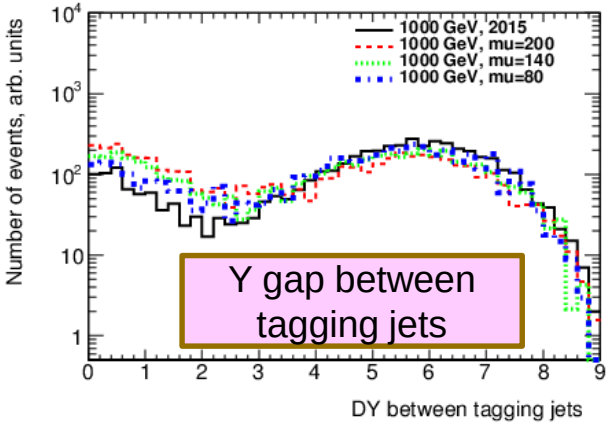

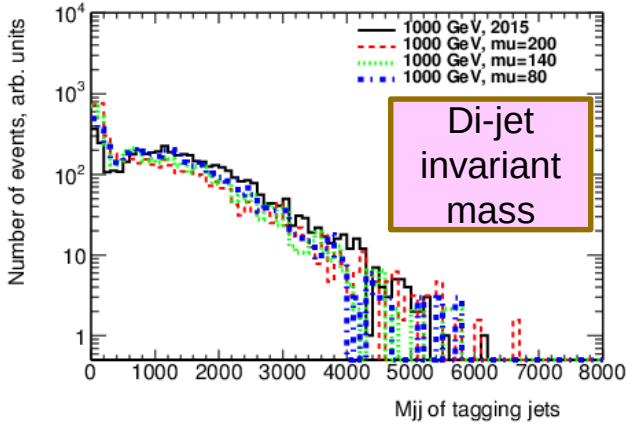

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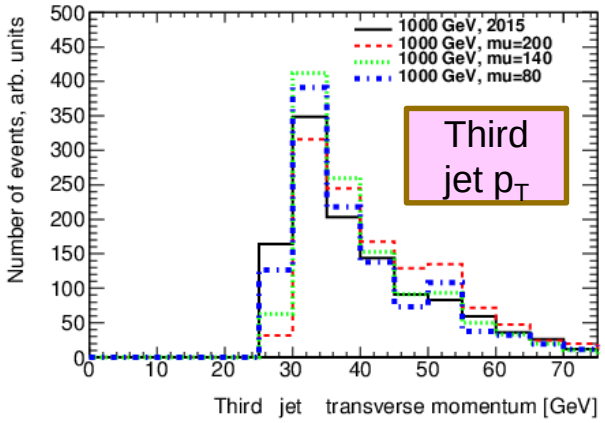

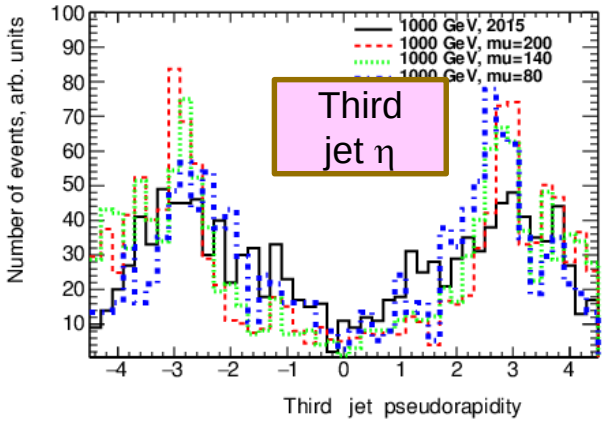

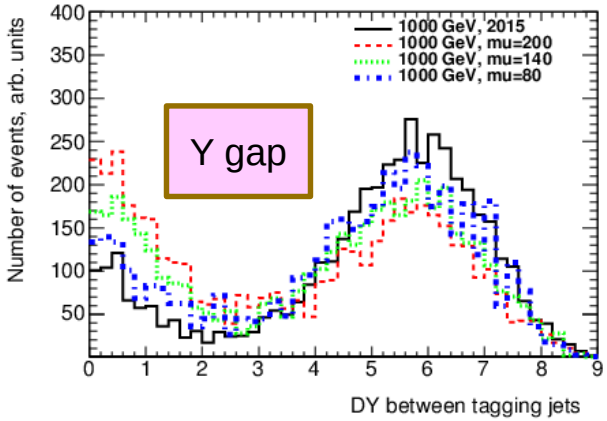

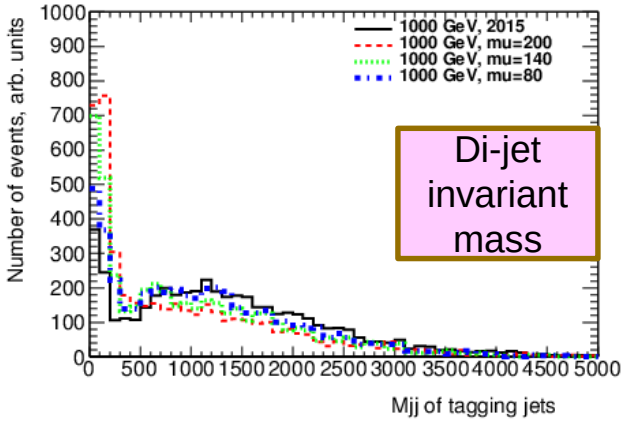

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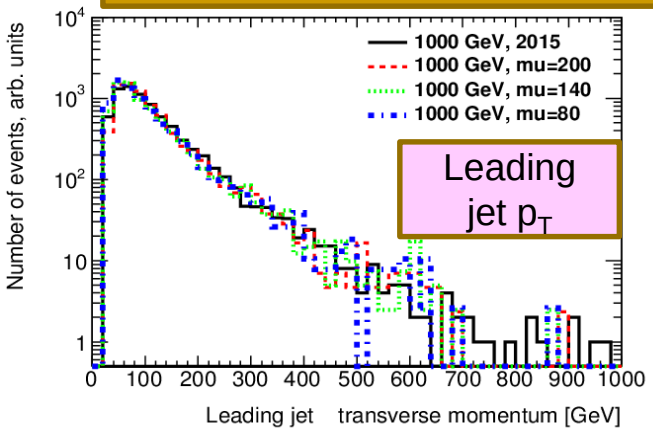
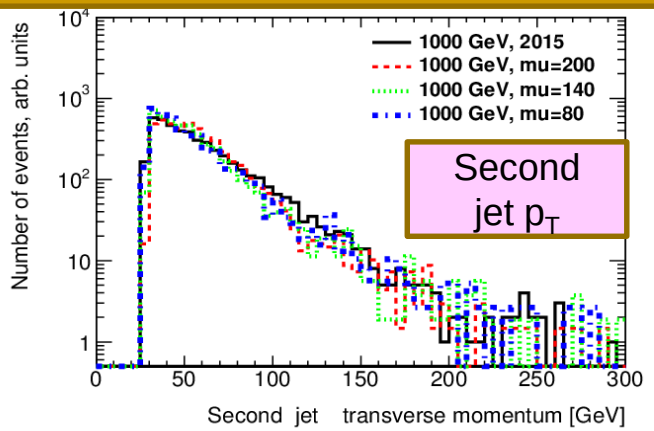
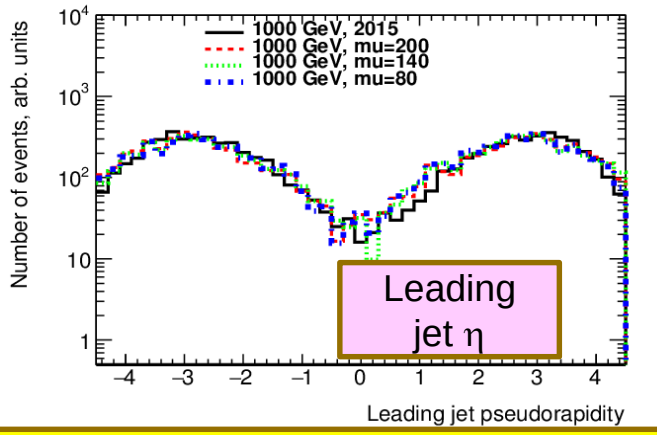
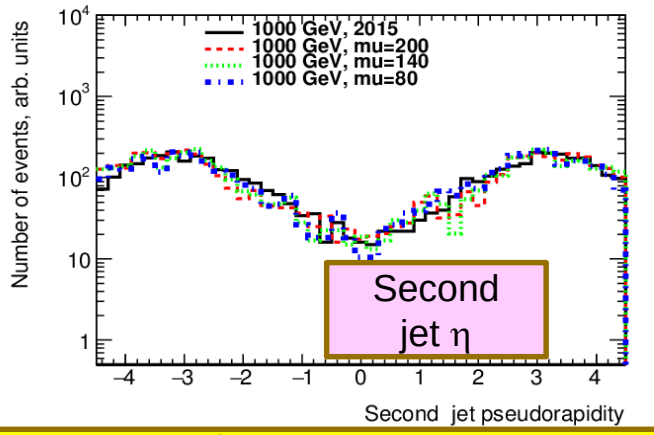
sFCal geometry, 1000 GeV VBF H, different μ, log scales





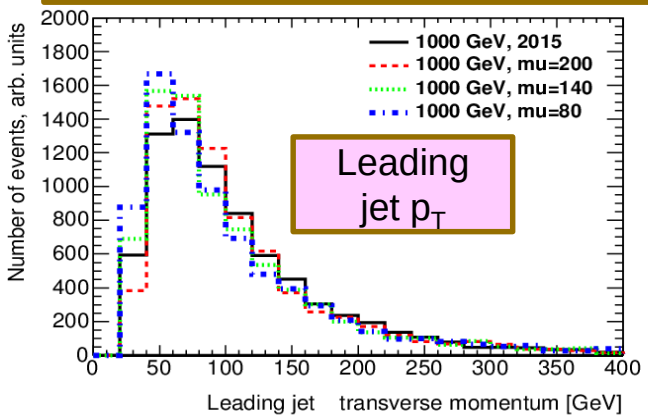


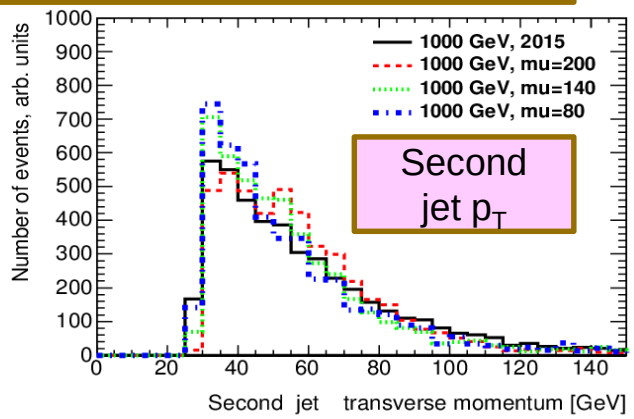


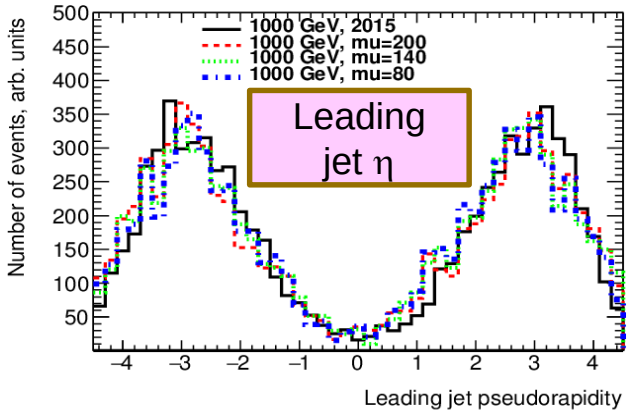
Typical maxima at high |η| are well pronounced for all jets
A bit harder jet p_T at higher luminosity, especially for μ=200
No big increase of forward jets at high μ

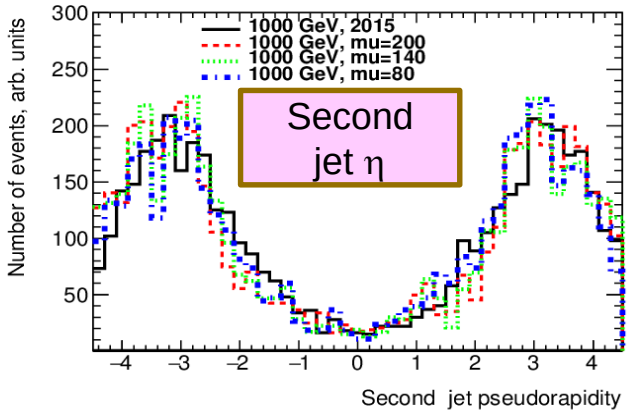
Jet kinematics in H→WW→lvlv events: DF-case

sFCal geometry, 1000 GeV VBF H, different μ, lin scale







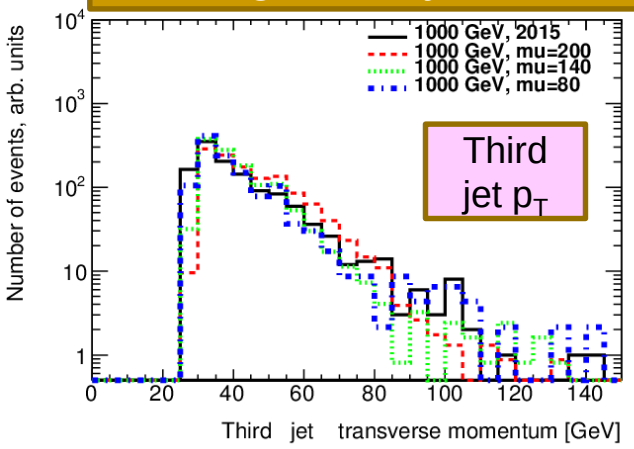


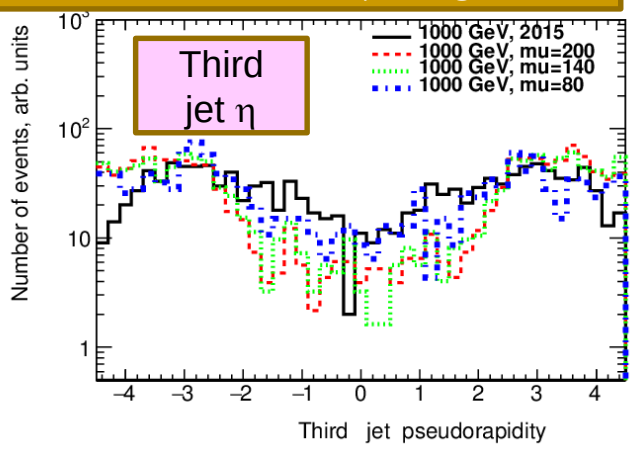
Some right shift in p_T-spectra at high luminosity, especially for μ=200
Better to increase statistic to make definite conclusions about FW region

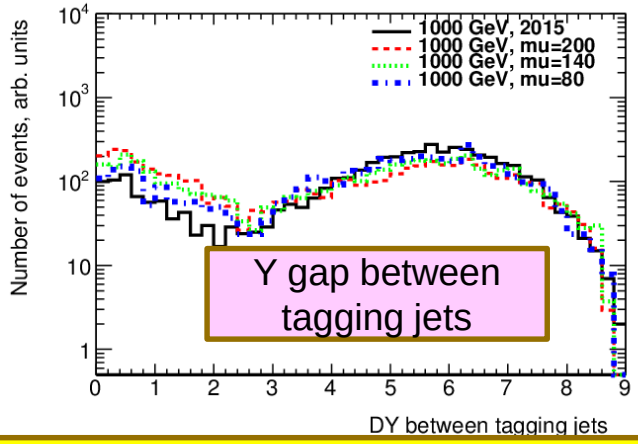
20

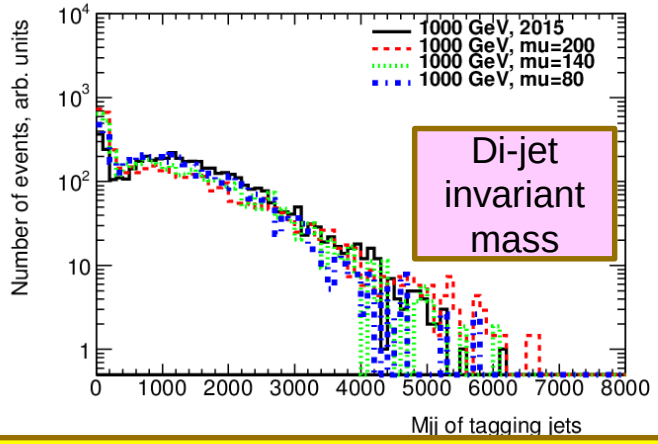
Jet kinematics in H→WW→lvlv events: DF-case

sFCal geometry, 1000 GeV VBF H, different μ, log scale







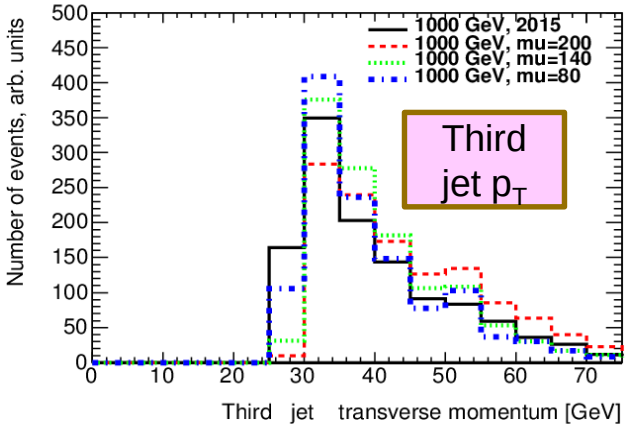


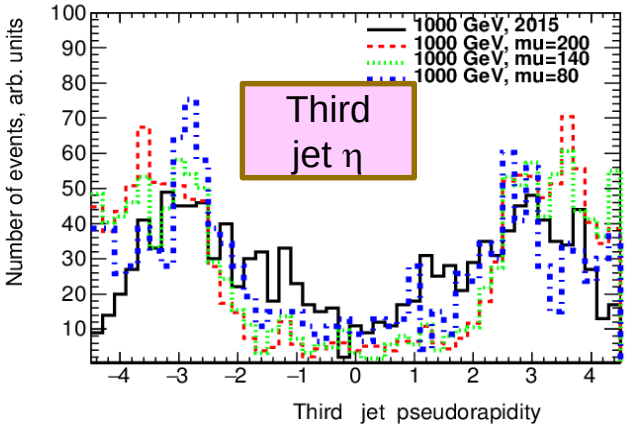
Harder third jet p_T at high lumi, more forward jets at high μ
More events with low ΔY and M(jj) especially at μ=200

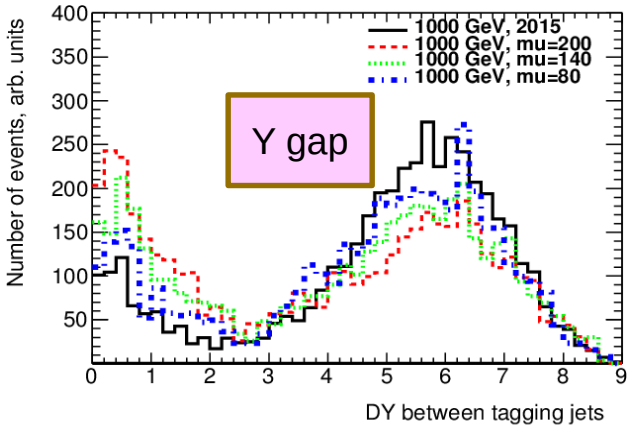
21

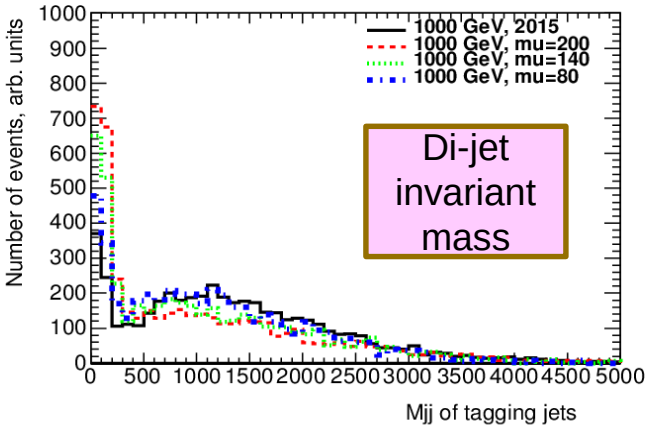
Jet kinematics in H→WW→lvlv events: DF-case

sFCal geometry, 1000 GeV VBF H, different μ, lin scale









"Bunny ears" are probably seen at large η and at high μ?
Not enough statistics for third jets in the forward region

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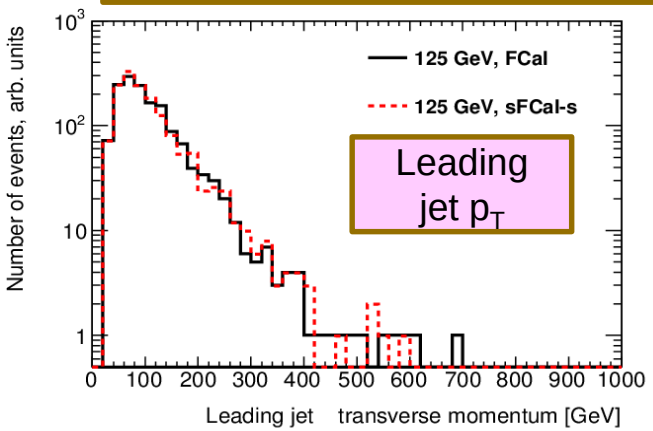
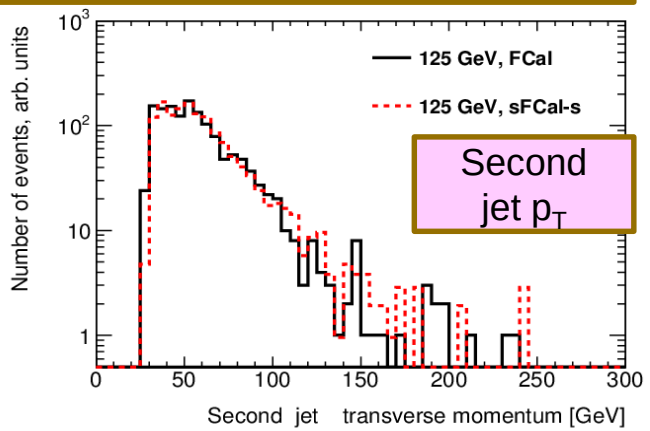
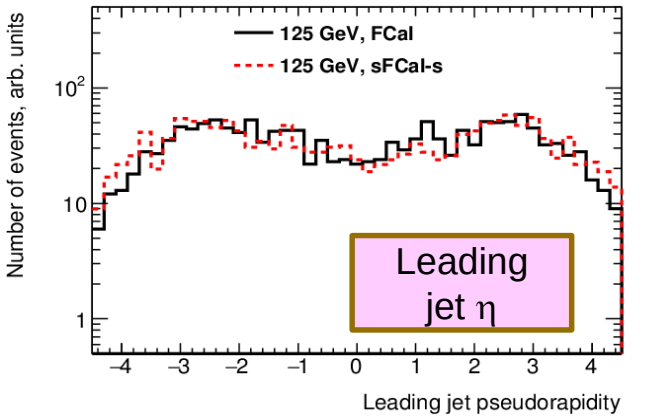
Jet plots as function of geometry, m_H =125 GeV

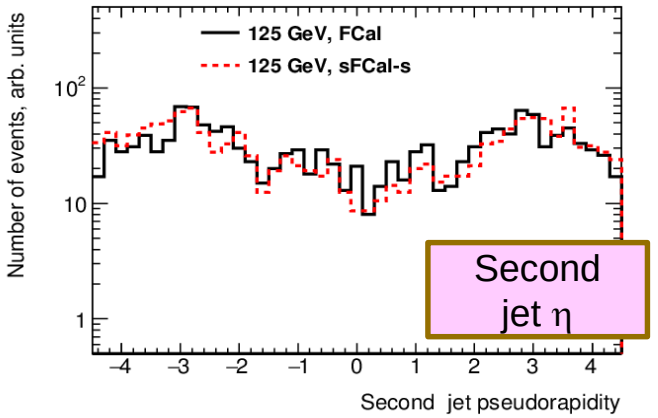
Jet kinematics in H→WW→lvlv events: DF-case

125 GeV VBF H, μ=200, log scale







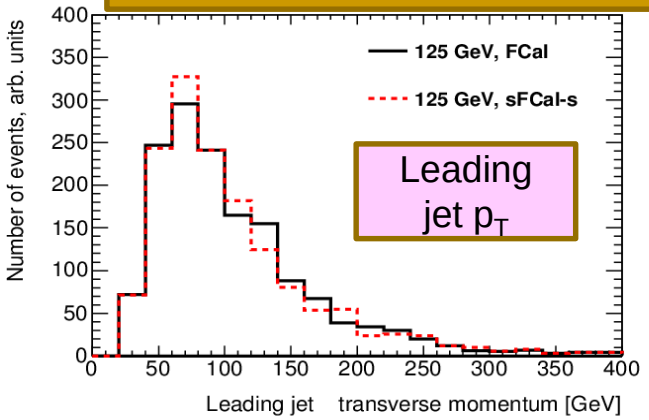


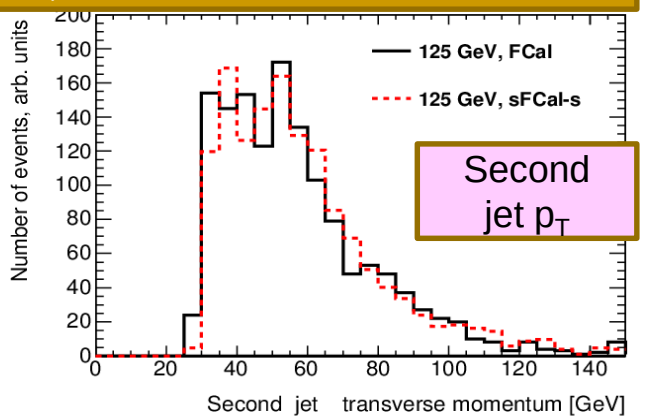
No big difference between FCal and sFCal seen in p_T -spectra
Limited statistics does not allow to make definite conclusion from η plots

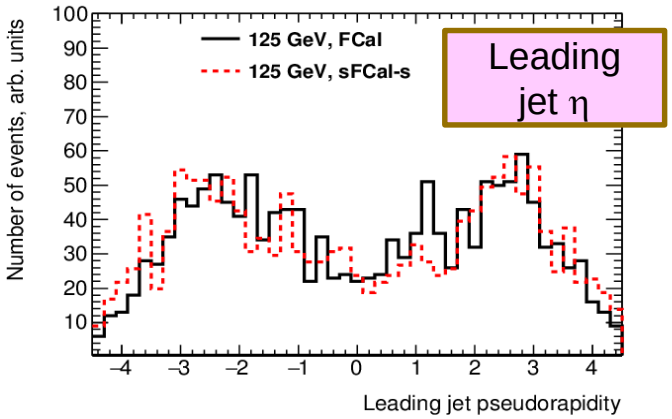
24

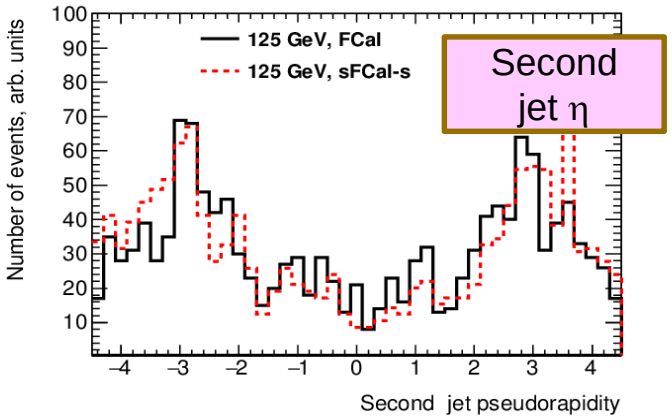
Jet kinematics in H→WW→lvlv events: DF-case

125 GeV VBF H, μ=200, lin scale





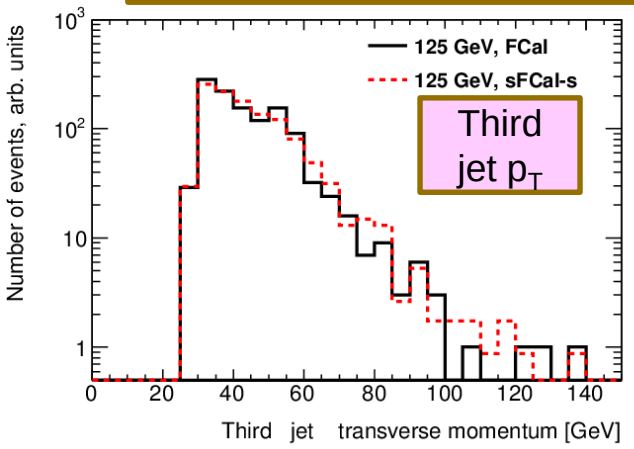


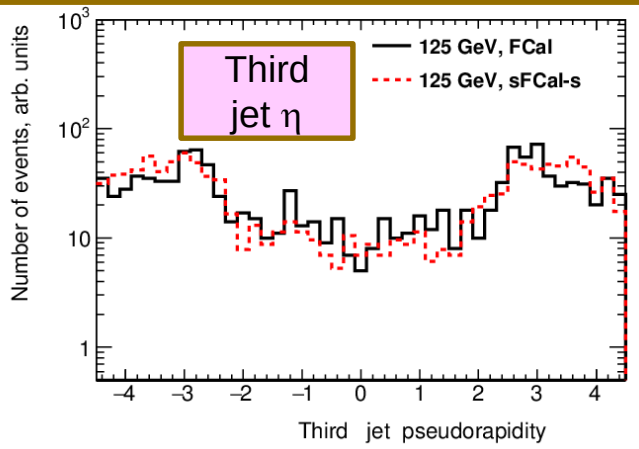


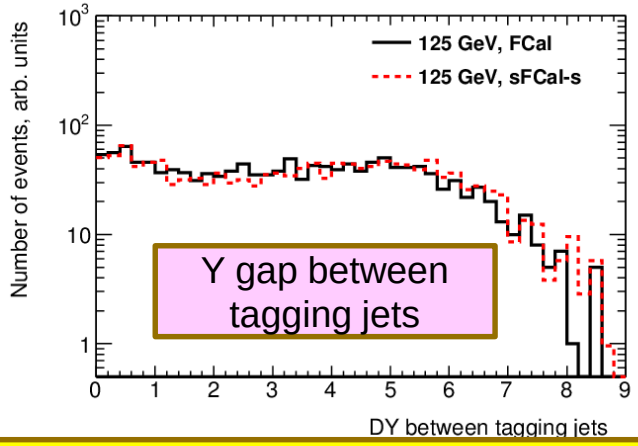
"Bunny ears" at the EC boundary are probably seen in η-spectra
Limited statistics does not allow to make conclusion about forward jets

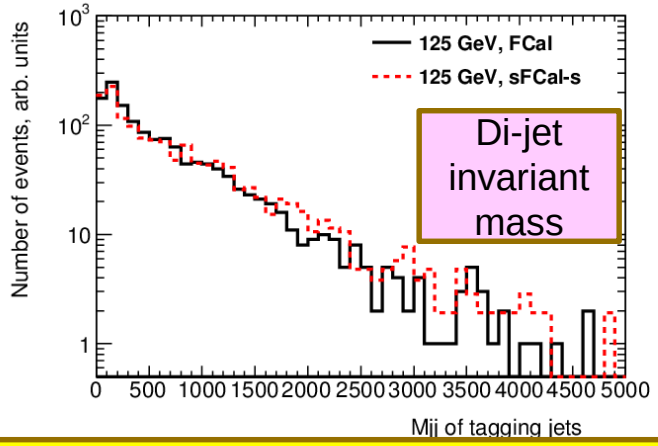
Jet kinematics in H→WW→lvlv events: DF-case

125 GeV VBF H, μ=200, log scale







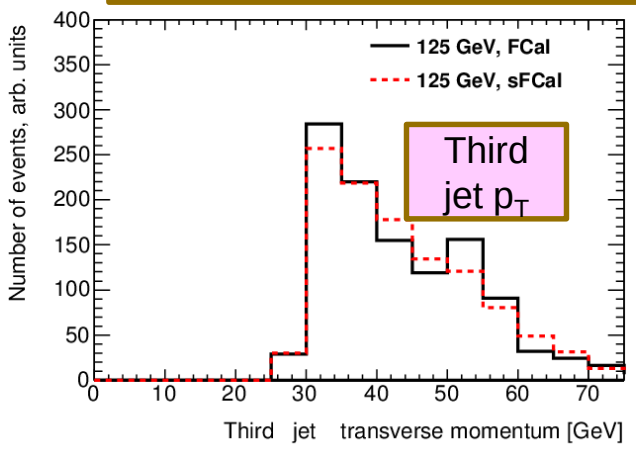


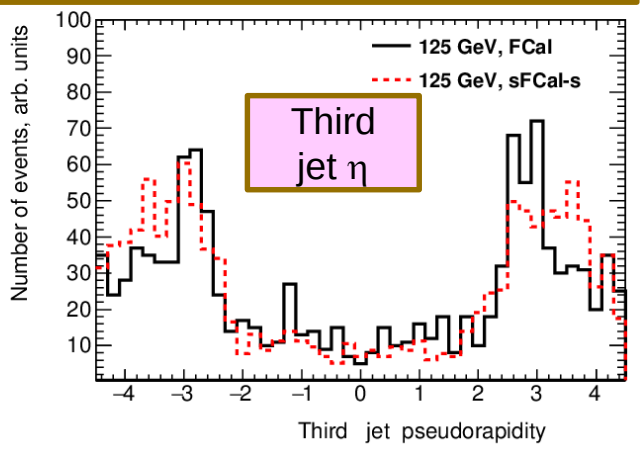
Maybe a bit more jets in sFCal w.r.t. FCal at high μ
ΔY and M(jj) distributions have no sizeable differences

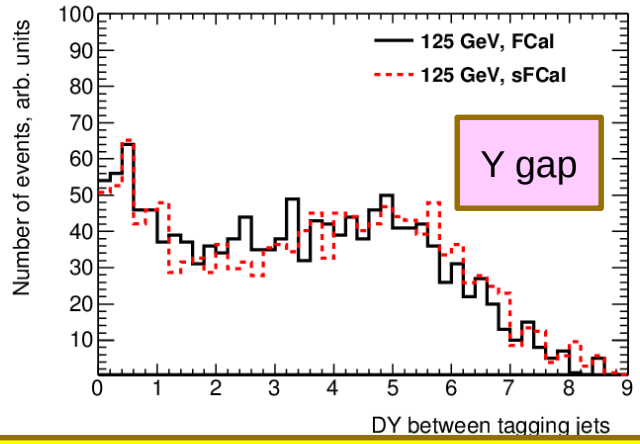
26

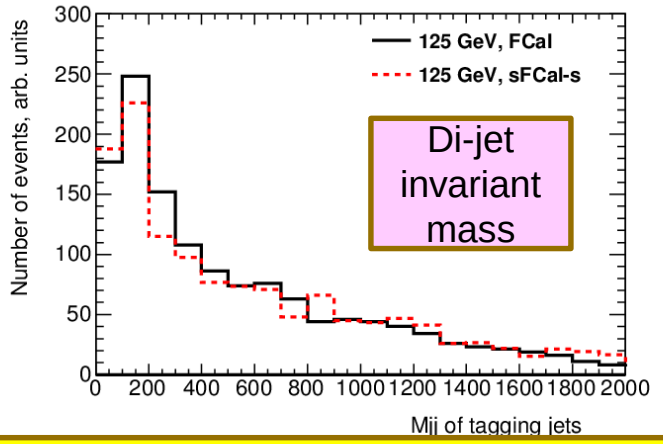
Jet kinematics in H→WW→lvlv events: DF-case

125 GeV VBF H, μ=200, lin scale







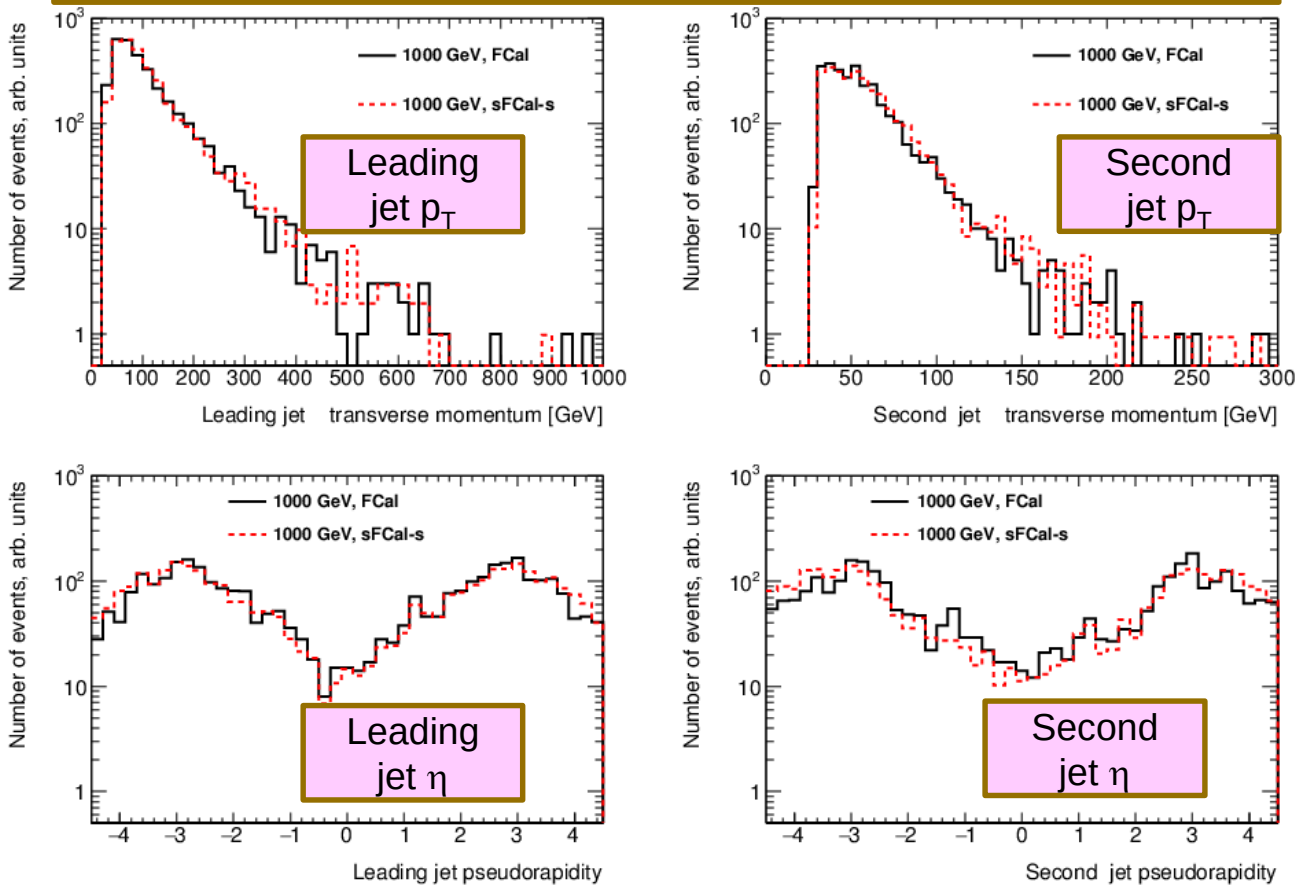


"Bunny years" are probably seen at EC boundary for FCal at high μ
Not enough statistics for third jets

27

Jet kinematics in H→WW→lvlv events: DF-case

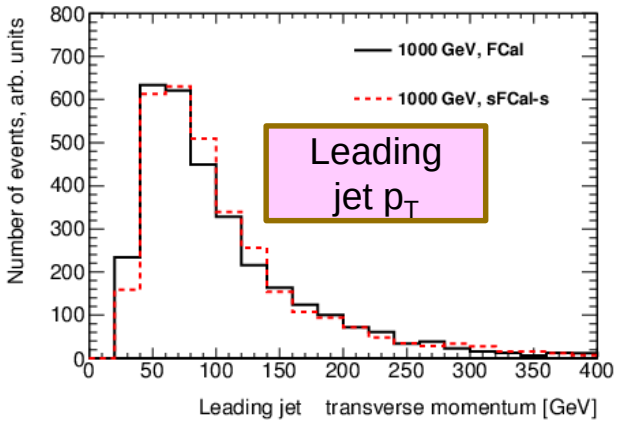
1000 GeV VBF H, μ=200, log scale

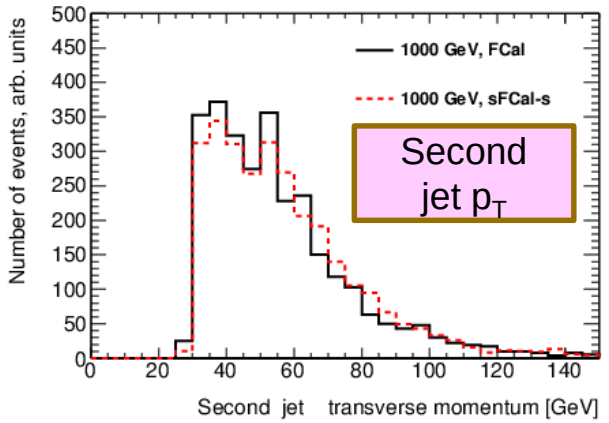


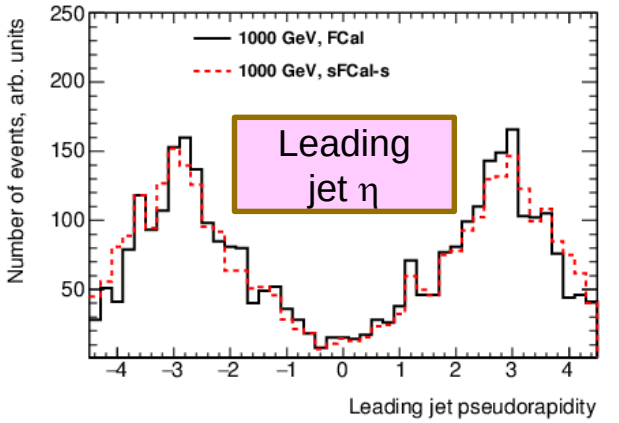
No big difference between FCal and sFCal seen in p_T -spectra
Limited statistics does not allow to make definite conclusion from η plots, although probably we have more jets in sFCal than in FCal

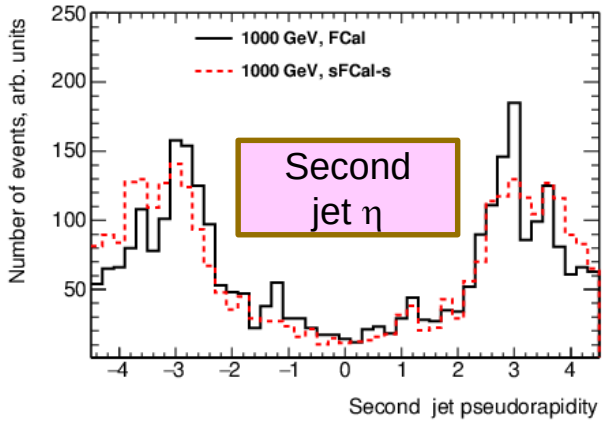
Jet kinematics in H→WW→lvlv events: DF-case

1000 GeV VBF H, μ=200, lin scale





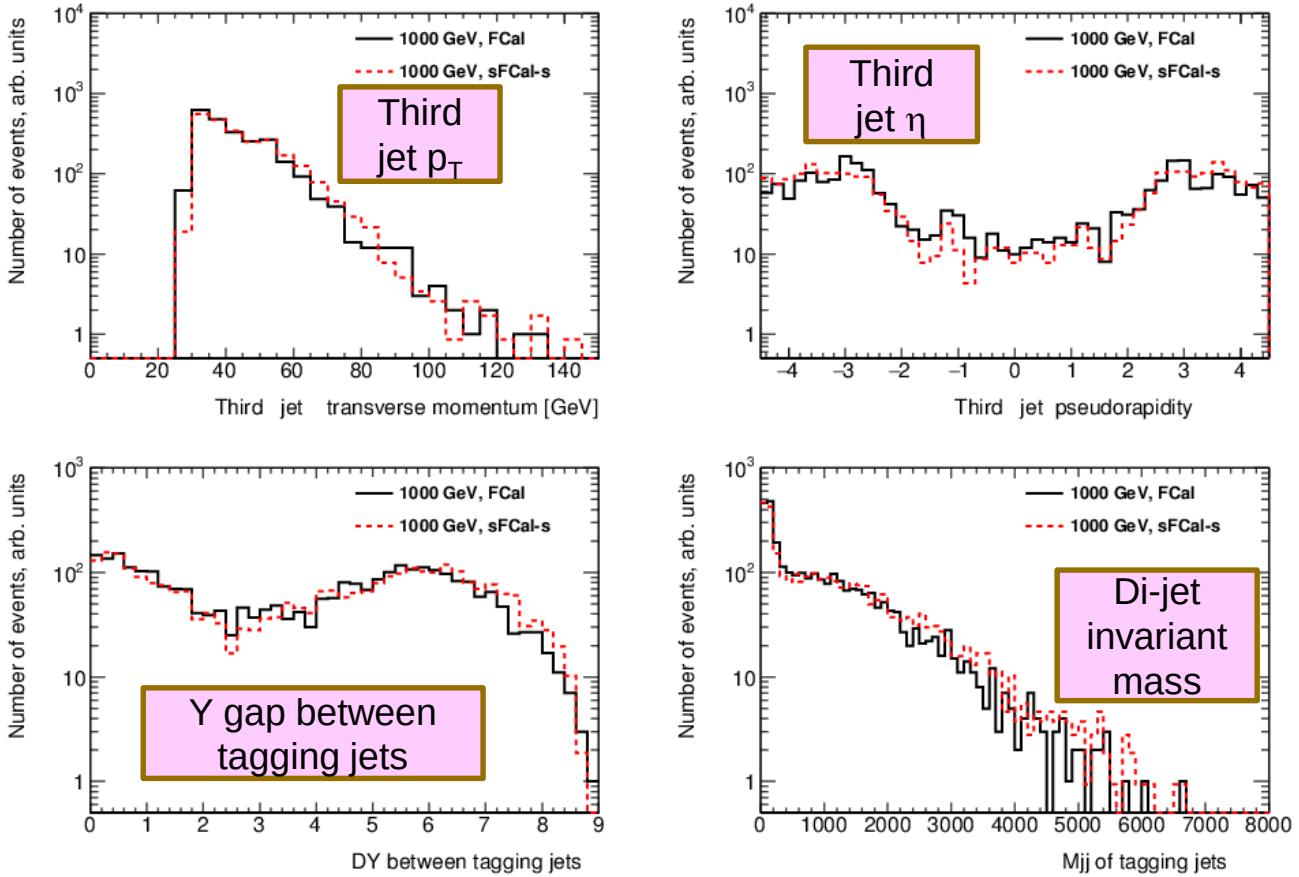




"Bunny ears" at the EC boundary are probably seen in η-spectra
Limited statistics does not allow to make conclusion about forward jets

Jet kinematics in H→WW→lvlv events: DF-case

1000 GeV VBF H, μ=200, log scale

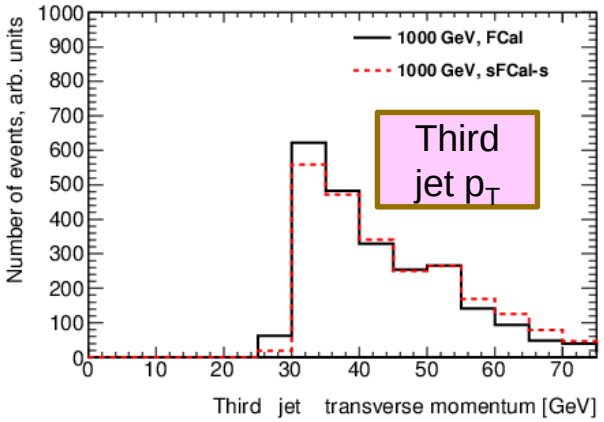


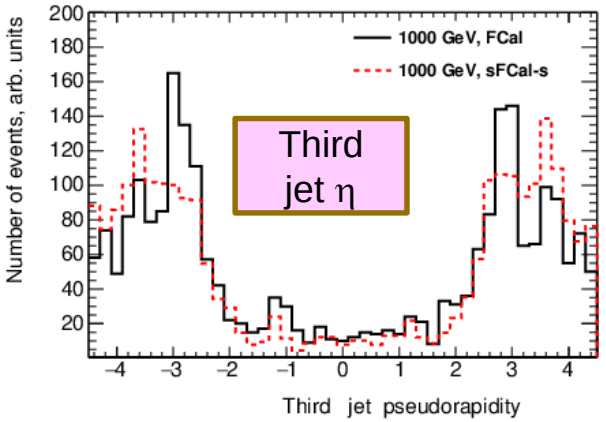
Maybe a bit more jets in sFCal w.r.t. FCal at high μ
ΔY and M(jj) distributions have no sizeable differences

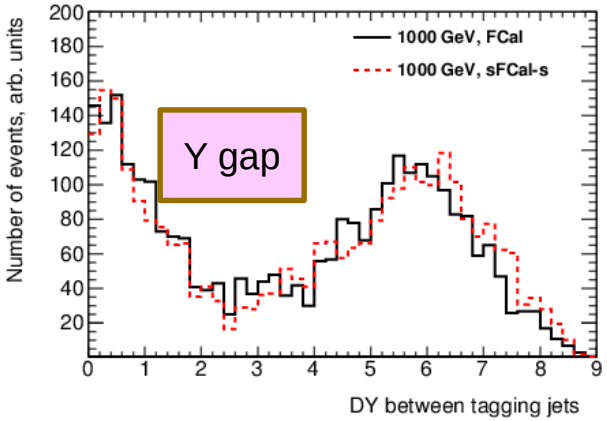
30

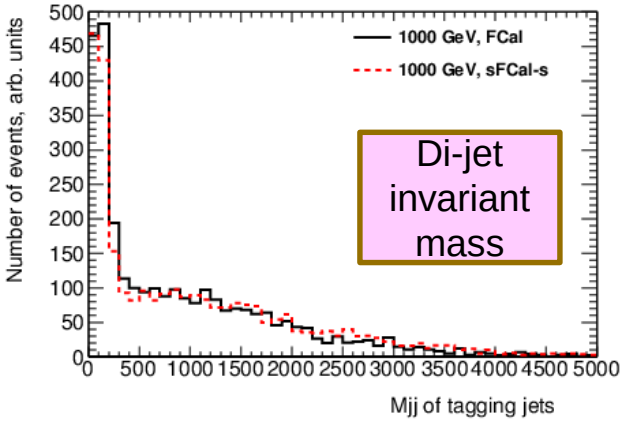
Jet kinematics in H→WW→lvlv events: DF-case

1000 GeV VBF H, μ=200, lin scale









"Bunny years" are probably seen at EC boundary for FCal at high μ
Not enough statistics for third jets

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Conclusion/observations

Comparison of jet kinematics in Run 2 and high μ MC samples for VBF H→WW→lvlv at m_H =125 GeV and 1000 GeV is performed

- For μ=80 no big differences w.r.t. Run2
- Jet multiplicity increases with μ starting from μ =80
- A bit more jets in sFCal w.r.t. non-degraded FCal
- “Bunny ears” at EC boundary near FCal are seen?
- Some increase of average jet p_T with μ
- Results look much better then obtained with Run2 jet calibration

LC4TopoJets taken “as they are” is a good starting point

Problem: need to have more statistics especially for m_H =125 GeV
100K events per sample look sufficient number, HITS exist!
Better to start xAOD production when all fixes related to jets/MET will be ready

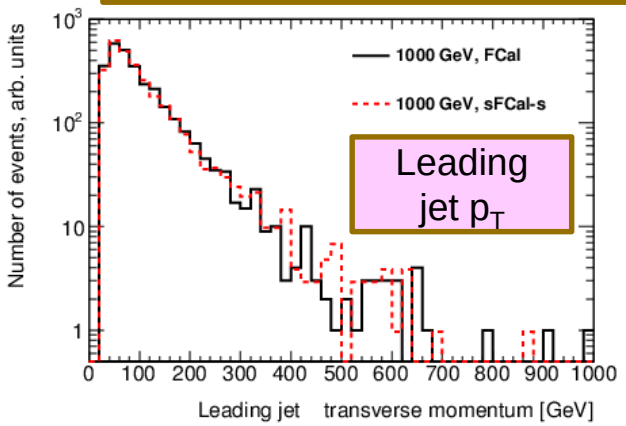
Short-term plans

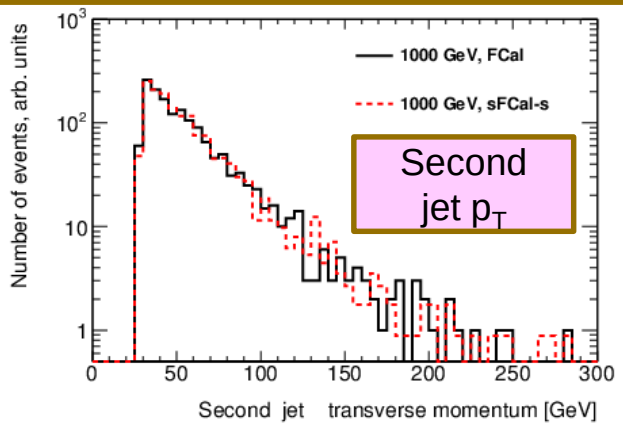
- Production of DxAODs for m_H =1000 GeV for all geometries
  Input files: Sven`s xAODs with towers; **degraded FCal included**
- Further analysis of existing PxAODs inside HWW analysis framework
  m_H =125 GeV, harder cuts on jet p_T, limited η-acceptance etc.
- Produce new PxAODs after green light from sFCal community
  try all geometries and at least two masses, 125 and 1000 GeV
  look at My* jet collections, mostly LCTopo?
  better to do all fixes with jets BEFORE producing PxAODs, we need jobOptions to create DxAOD with “correct” jets (and MET?)
- Analysis of these PxAODs with RootCore and with HWW framework
- DxAODs and PxAODs for all samples including backgrounds
- In parallel: start to prepare COM note based on these studies

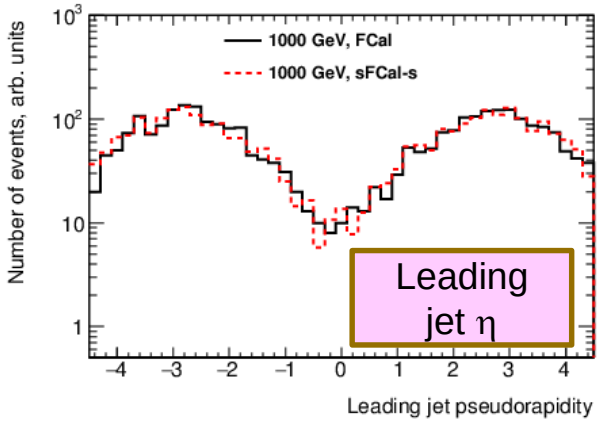
Backup slides

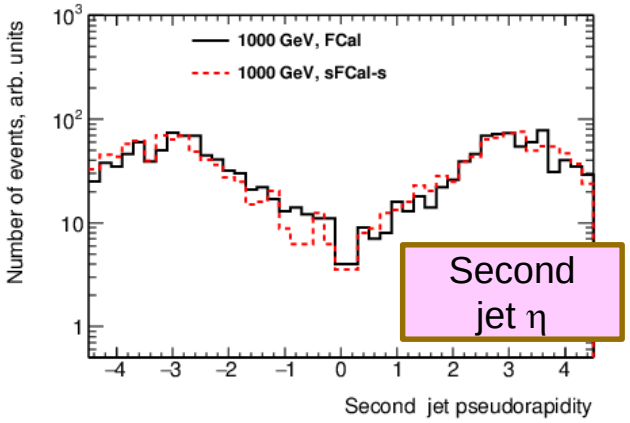
Jet kinematics in H→WW→lvlv events: DF-case

1000 GeV VBF H, μ=80, log scale







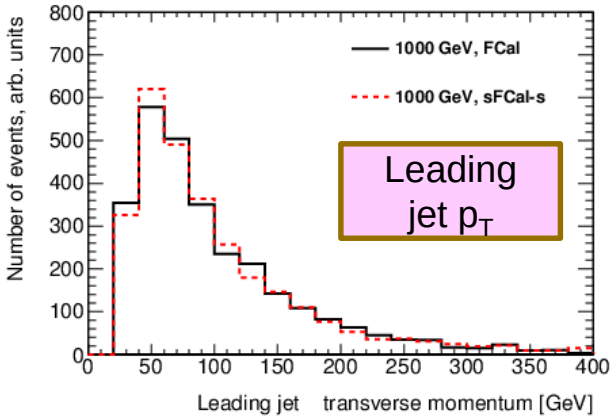


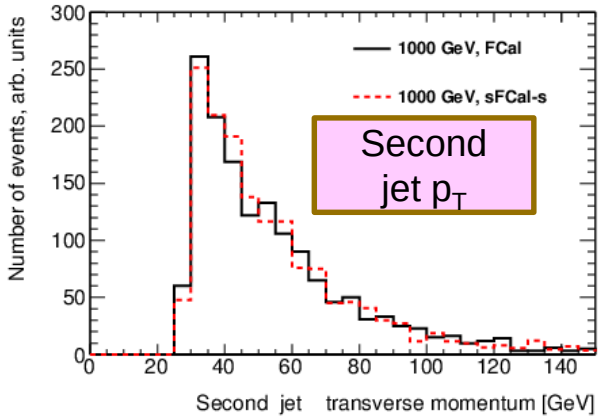
No big difference between FCal and sFCal seen in p_T -spectra
Limited statistics does not allow to make definite conclusion from η plots

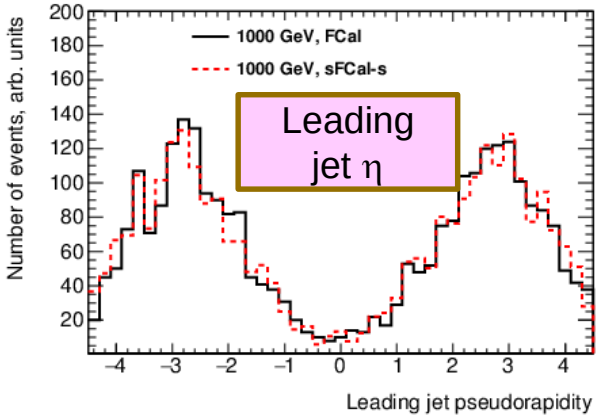
35

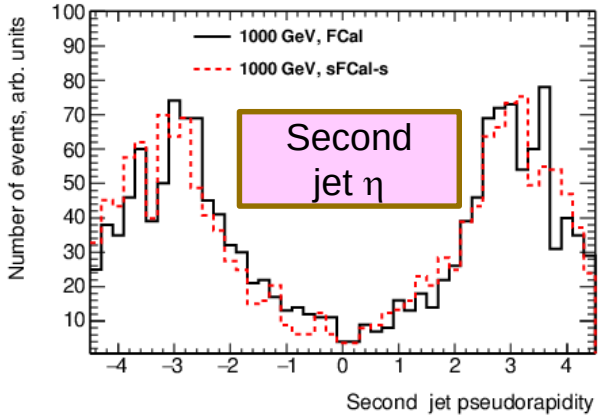
Jet kinematics in H→WW→lvlv events: DF-case

1000 GeV VBF H, μ=80, lin scale







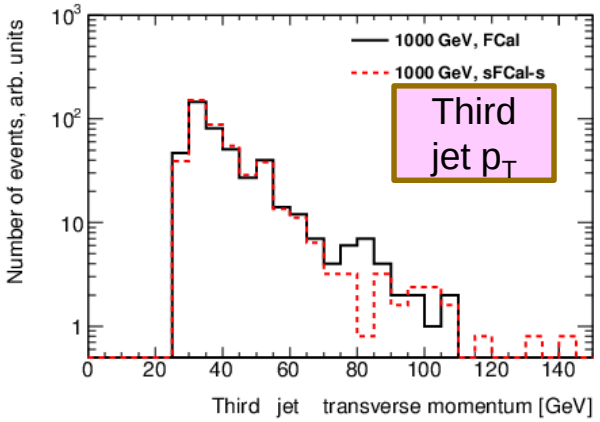


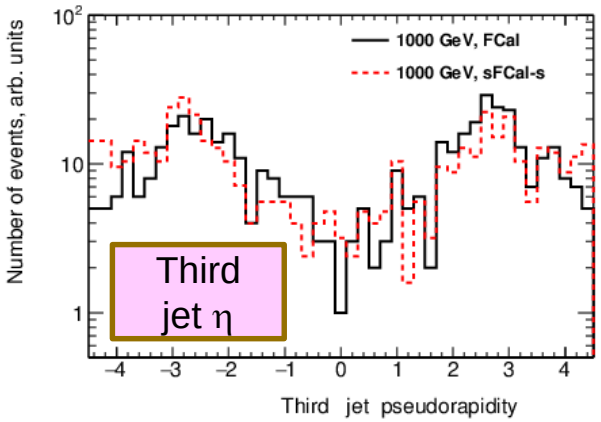
"Bunny ears" at the EC boundary are probably not seen in η-spectra?
Limited statistics does not allow to make conclusion about forward jets

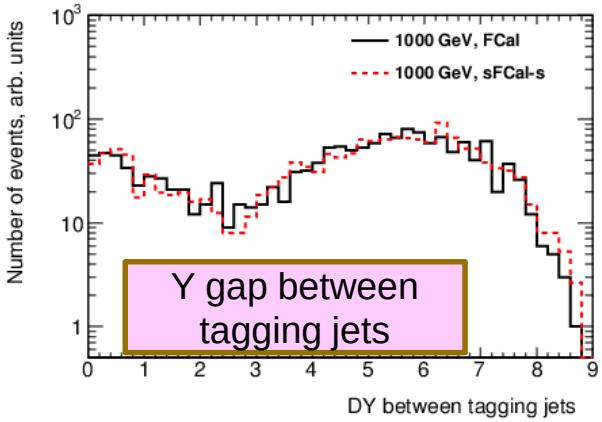
36

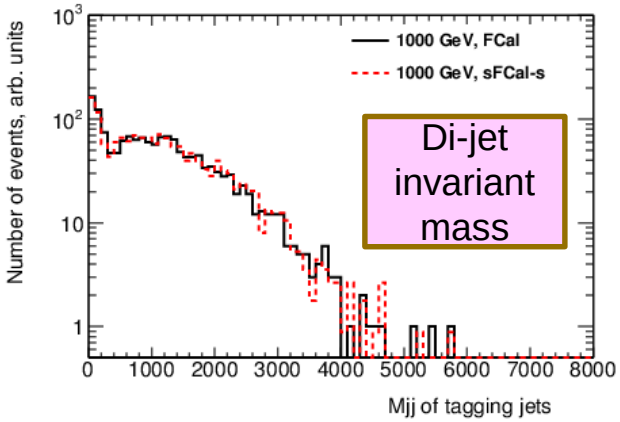
Jet kinematics in H→WW→lvlv events: DF-case

1000 GeV VBF H, μ=80, log scale





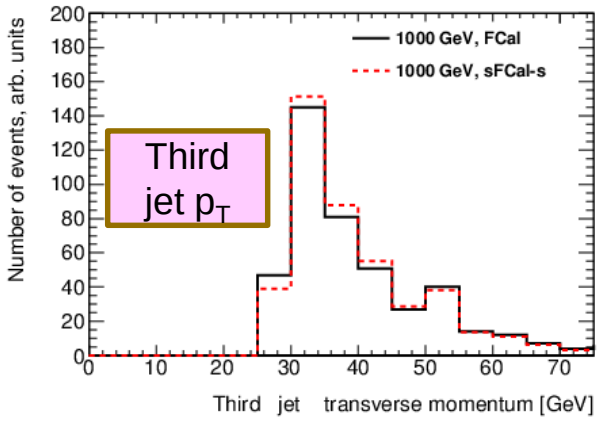


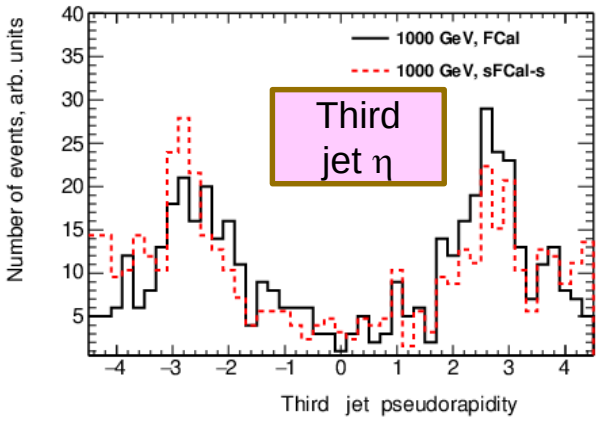


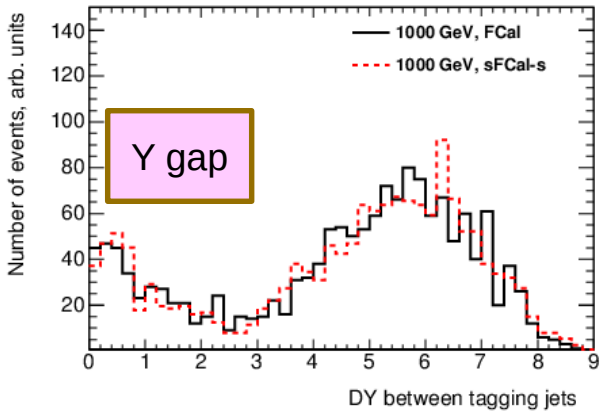
Maybe a bit more jets in sFCal w.r.t. FCal at high μ
ΔY and M(jj) distributions have no sizeable differences

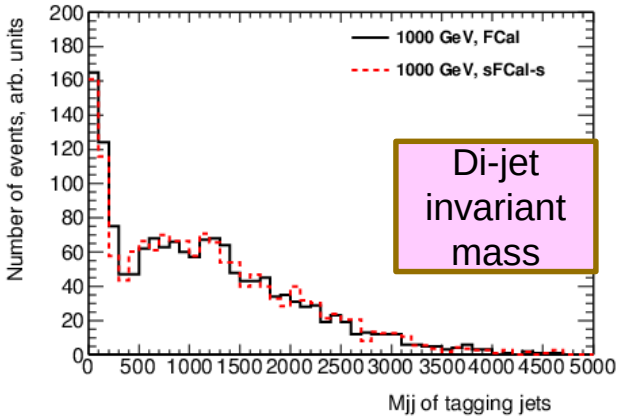
Jet kinematics in H→WW→lvlv events: DF-case

1000 GeV VBF H, μ=80, lin scale









"Bunny years" are probably seen at EC boundary at high μ
Not enough statistics for third jets

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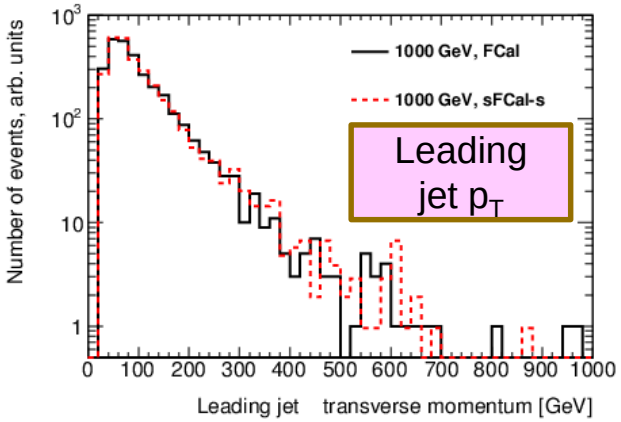
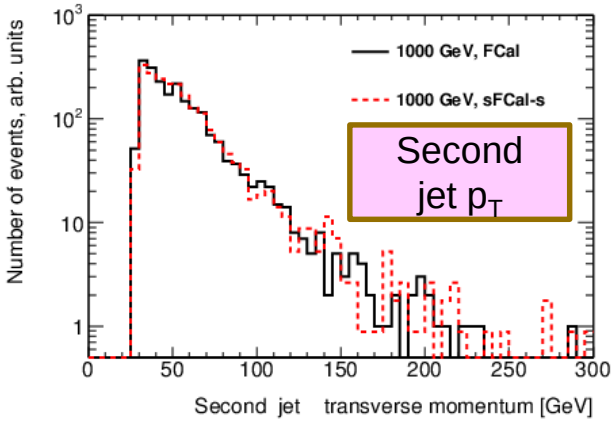
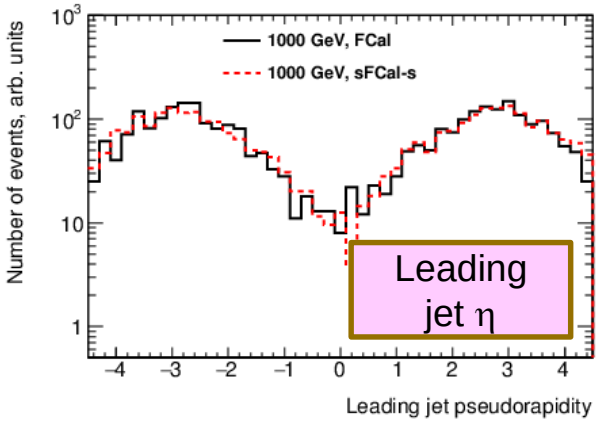
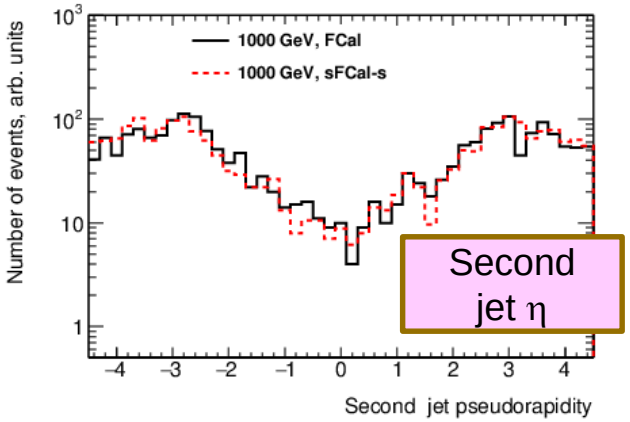
Jet kinematics in H→WW→lvlv events: DF-case

1000 GeV VBF H, μ=140, log scale





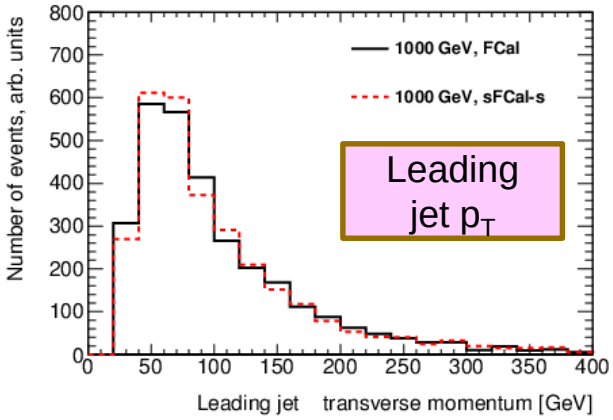


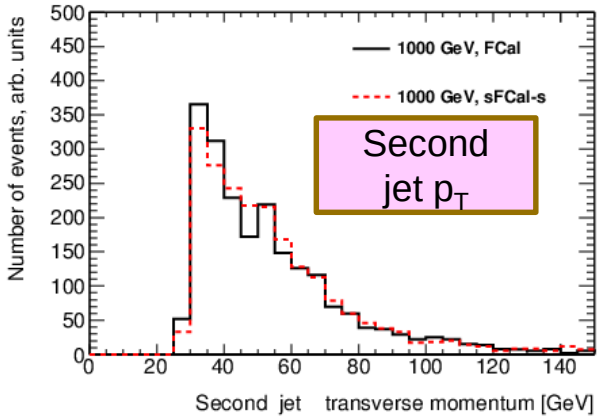


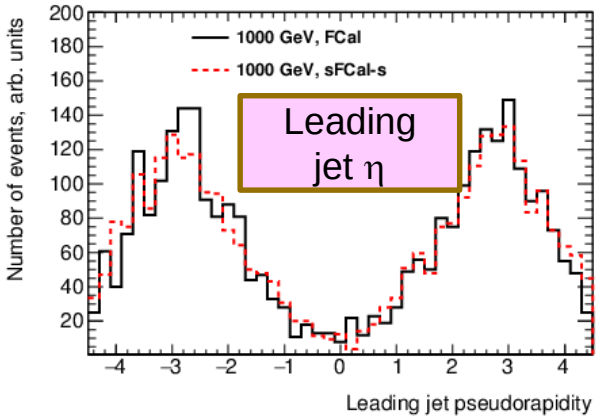
No big difference between FCal and sFCal seen in p_T -spectra
Limited statistics does not allow to make definite conclusion from η plots

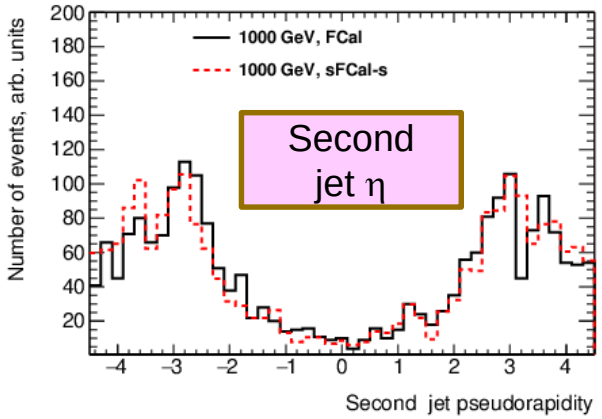
Jet kinematics in H→WW→lvlv events: DF-case

1000 GeV VBF H, μ=140, lin scale





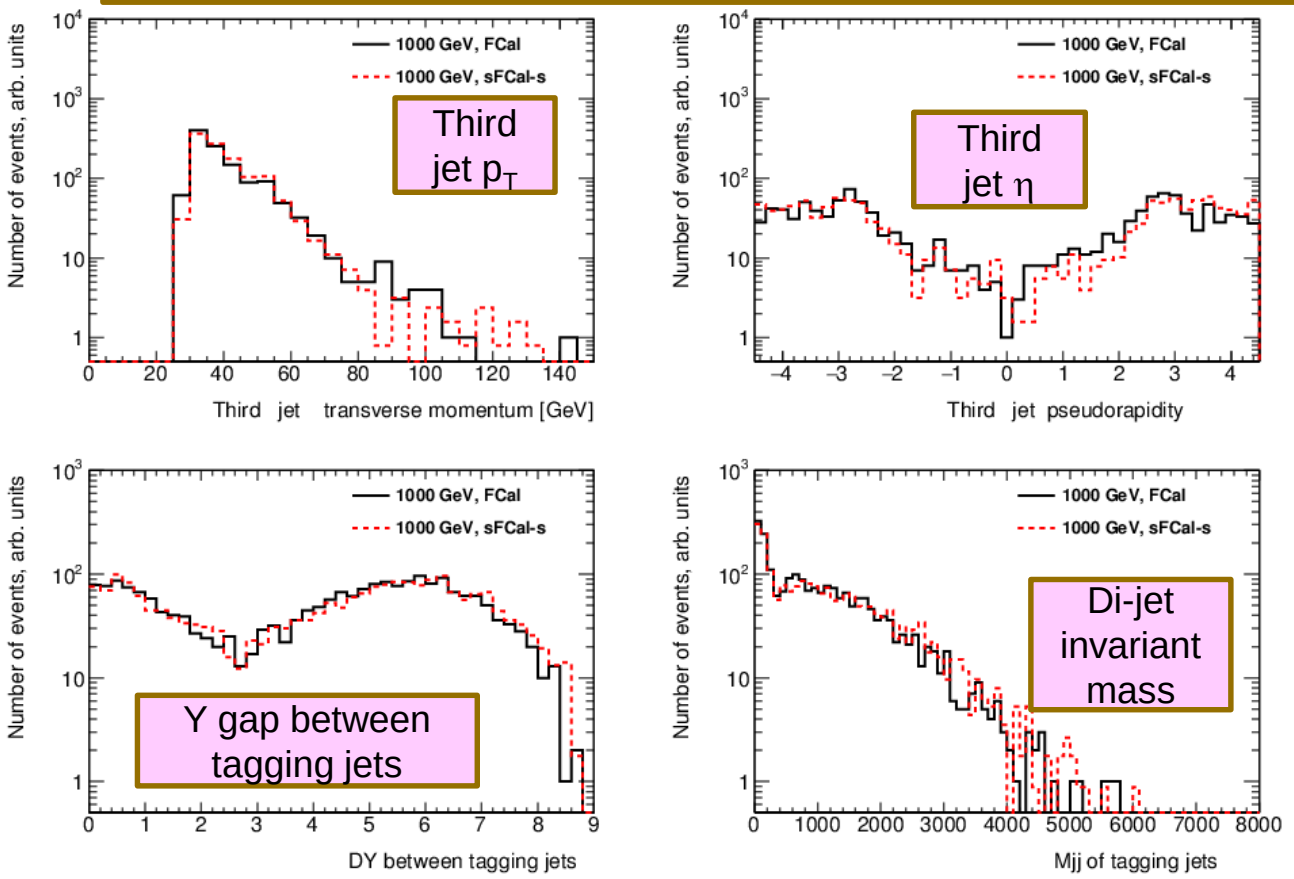




"Bunny ears" at the EC boundary are probably not seen in η-spectra
Limited statistics does not allow to make conclusion about forward jets

Jet kinematics in H→WW→lvlv events: DF-case

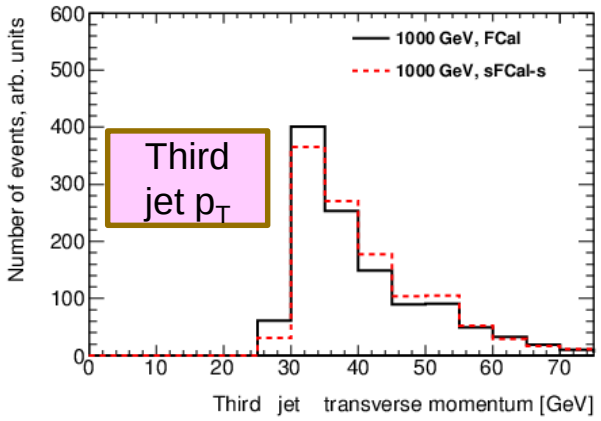
1000 GeV VBF H, μ=140, log scale

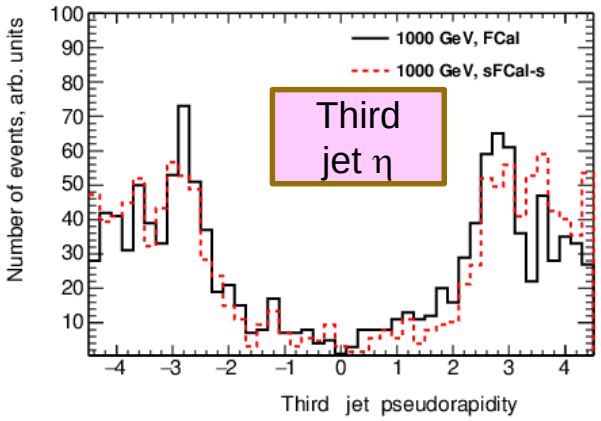


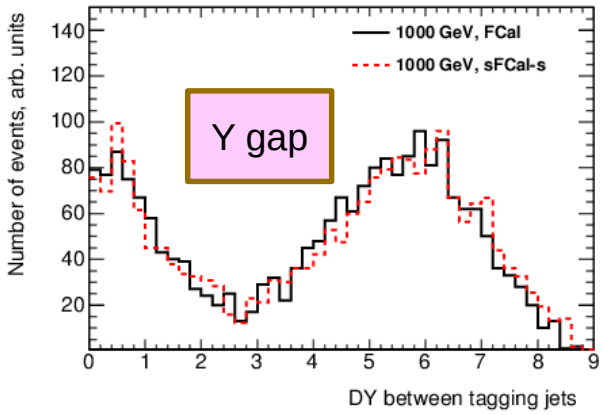
Maybe a bit more jets in sFCal w.r.t. FCal at high μ
ΔY and M(jj) distributions have no sizeable differences

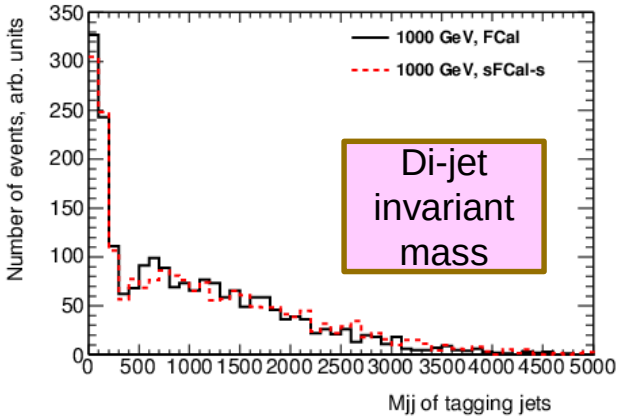
Jet kinematics in H→WW→lvlv events: DF-case

1000 GeV VBF H, μ=140, lin scale









"Bunny years" are seen at EC boundary at high μ
Not enough statistics for third jets

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