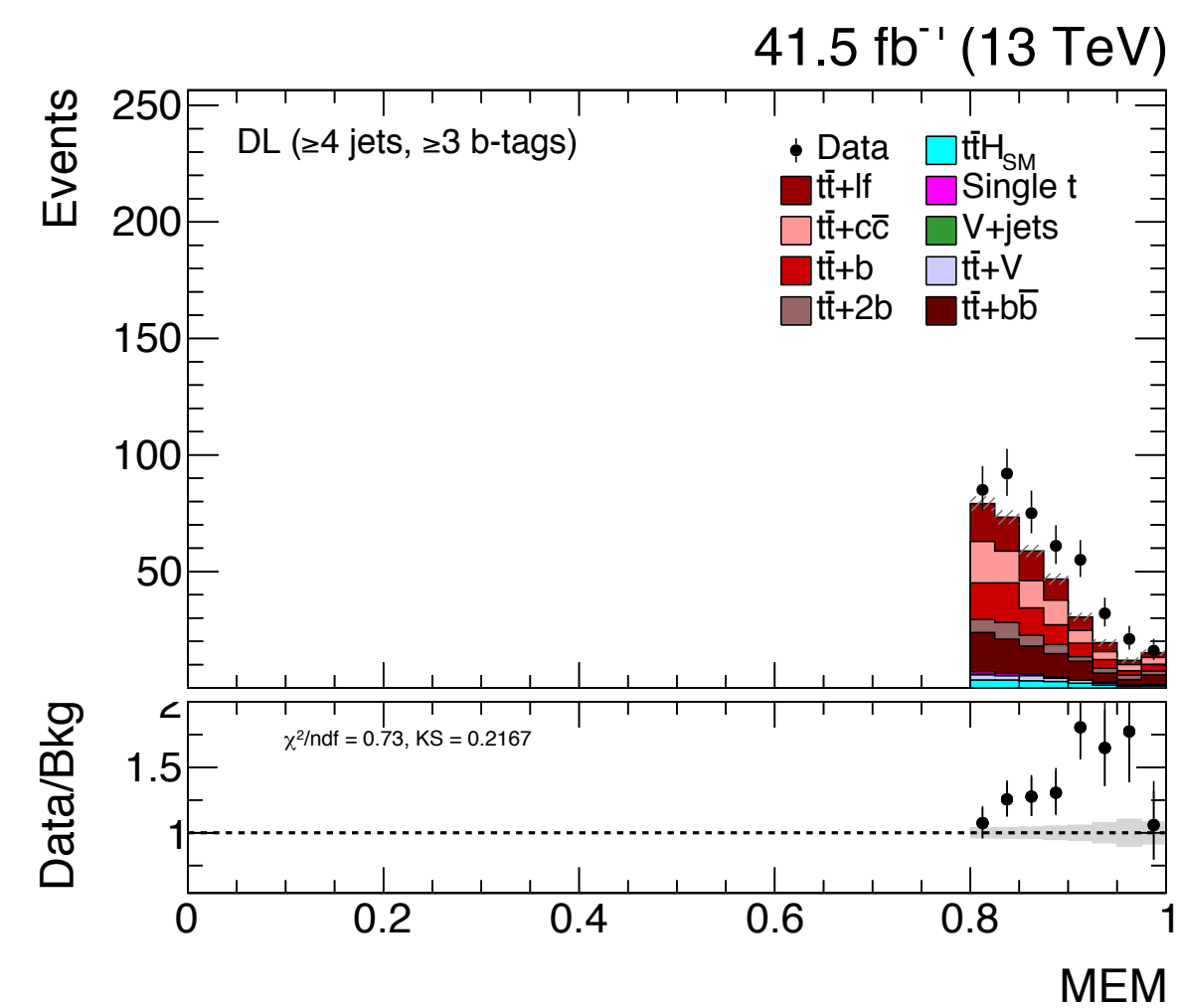
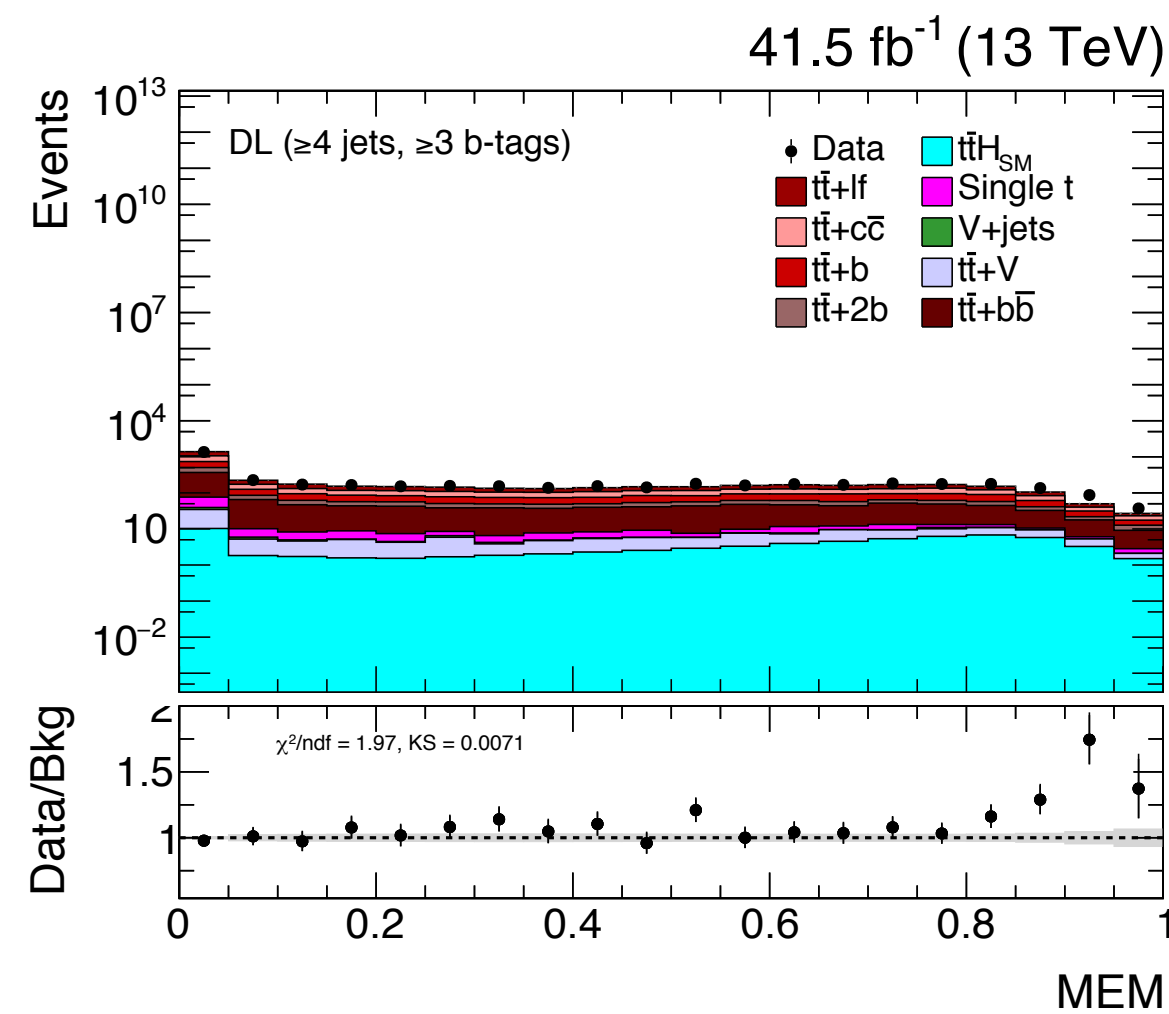
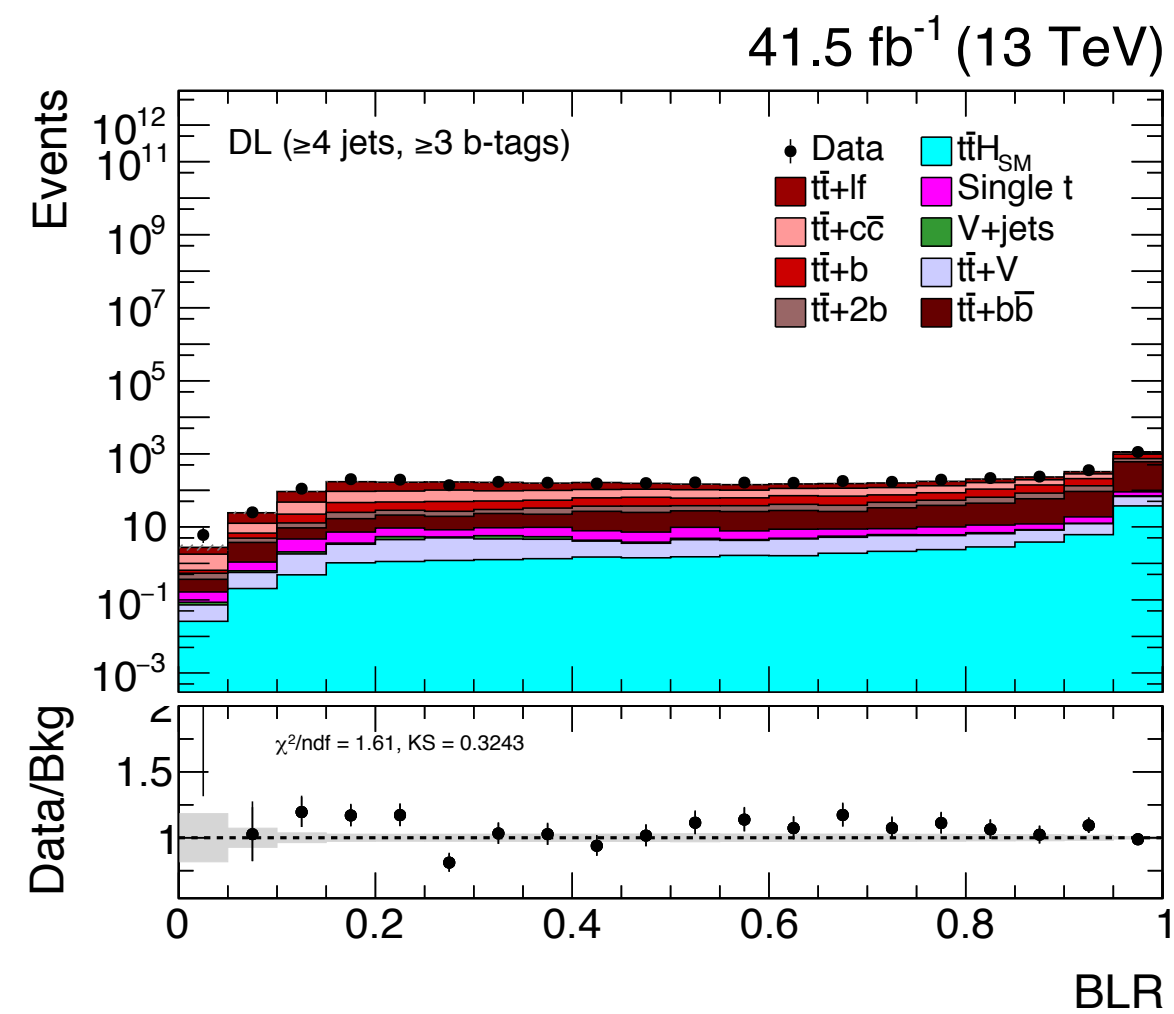
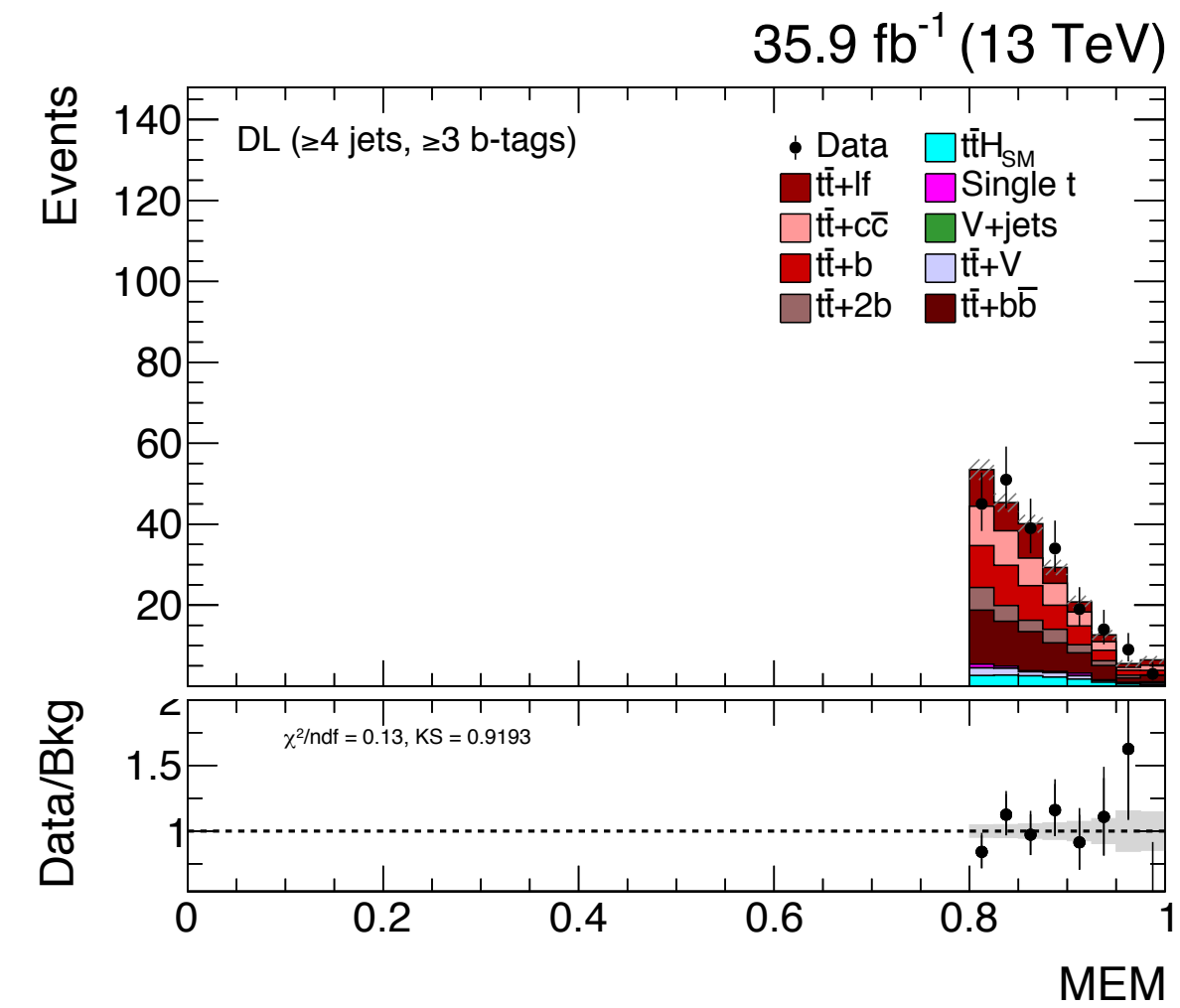
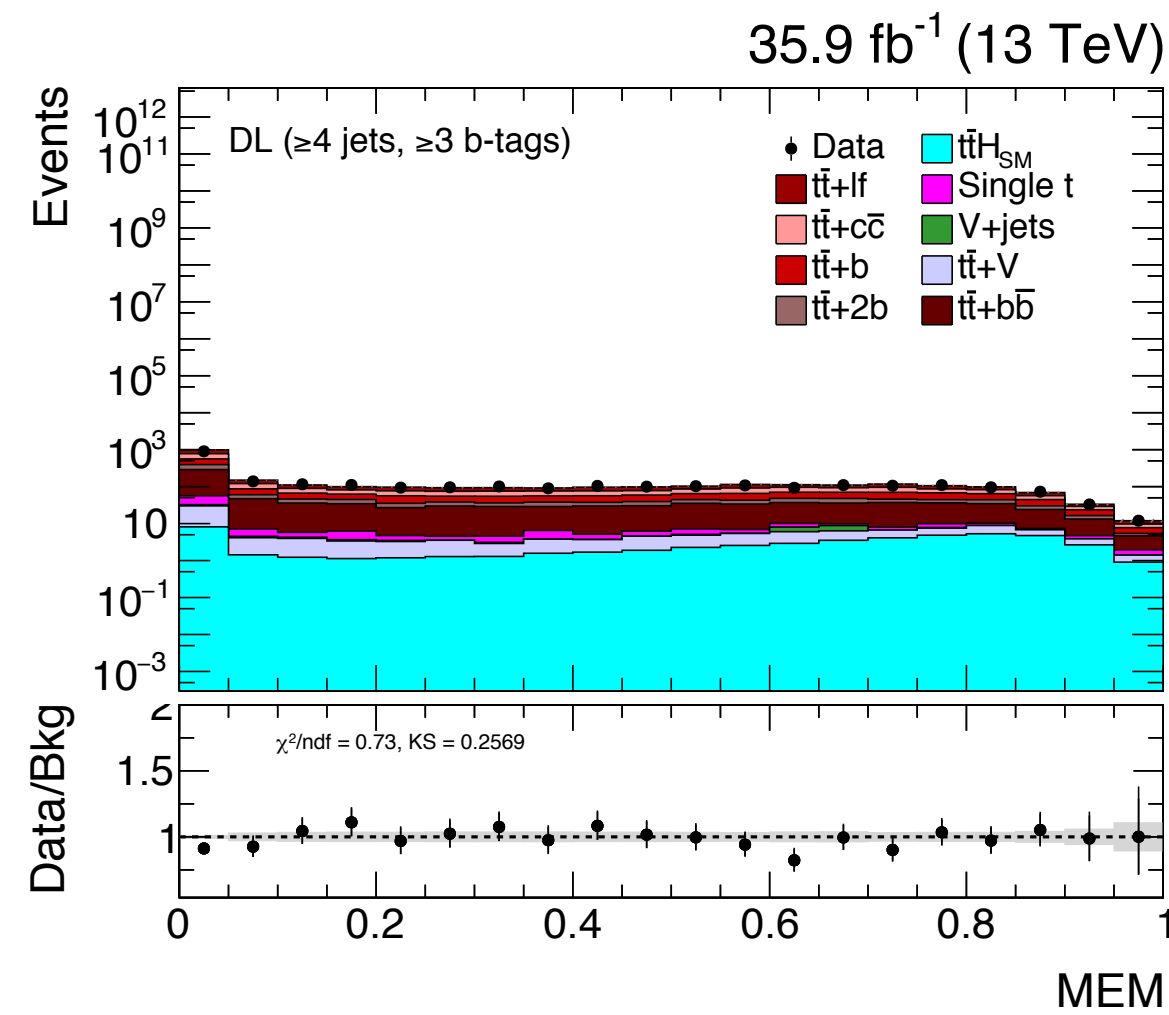
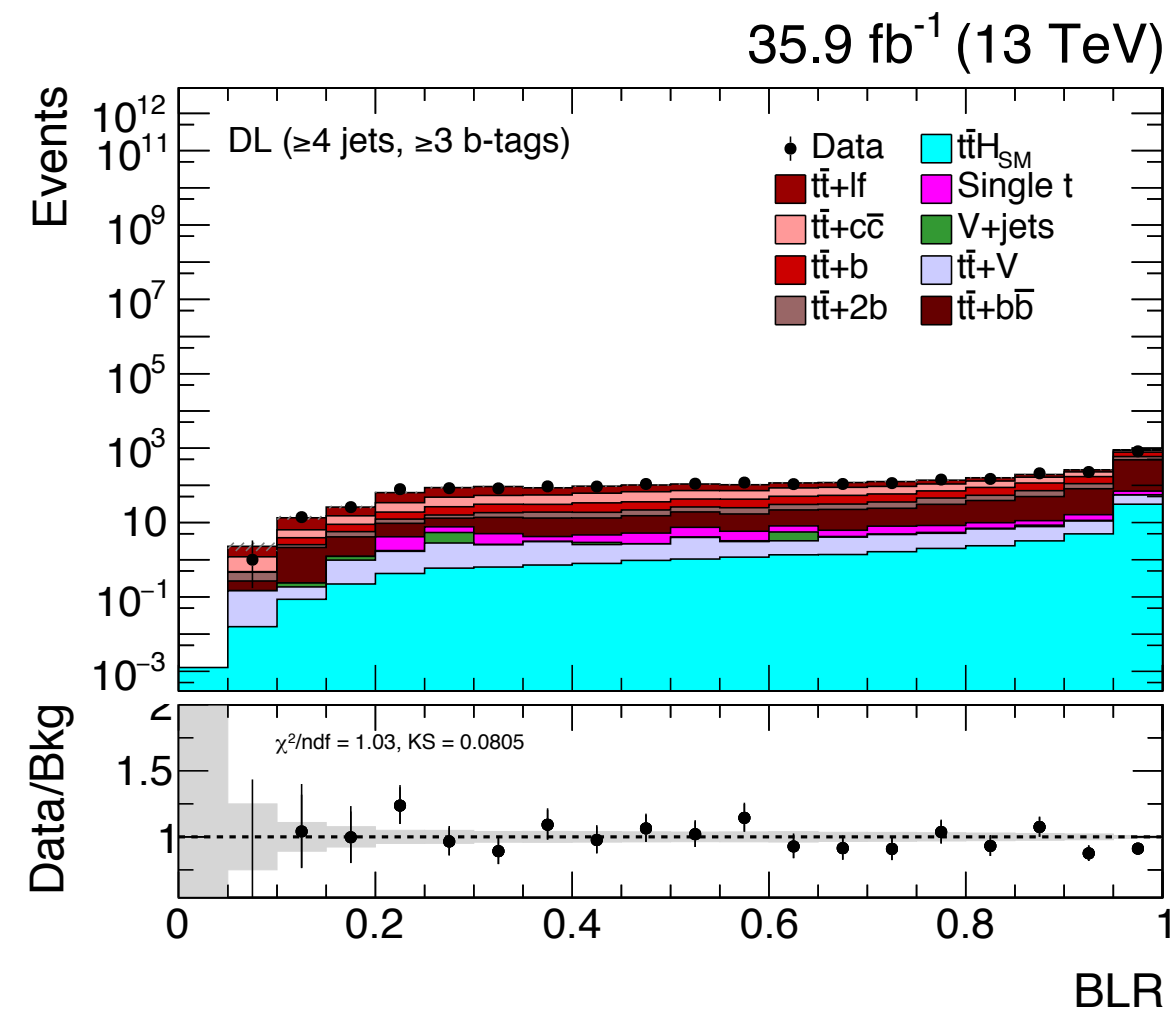


Checks for MEM mismodelling in 2017 (DL)

Valeria & Angela, 24.11.2020

Introduction

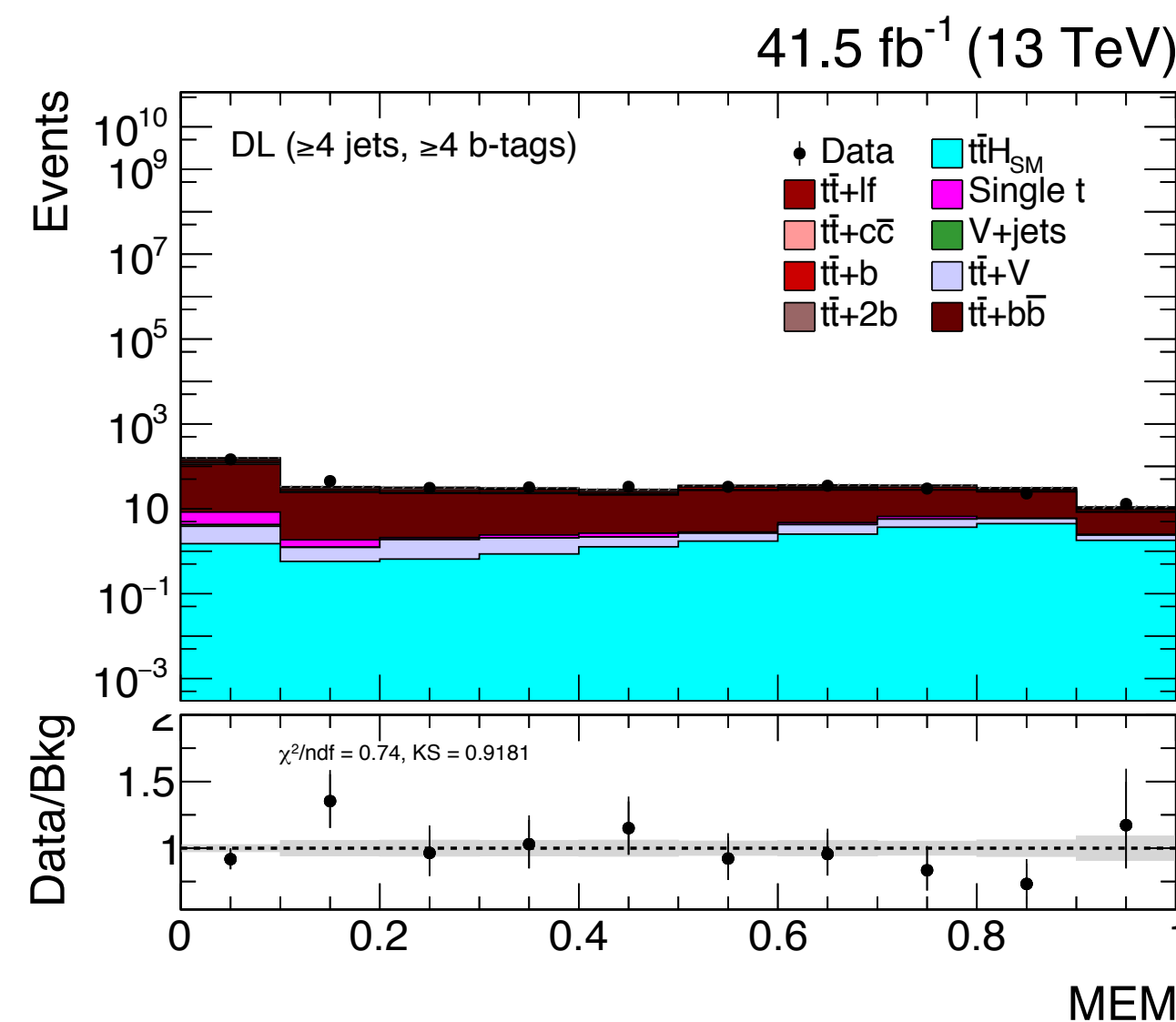
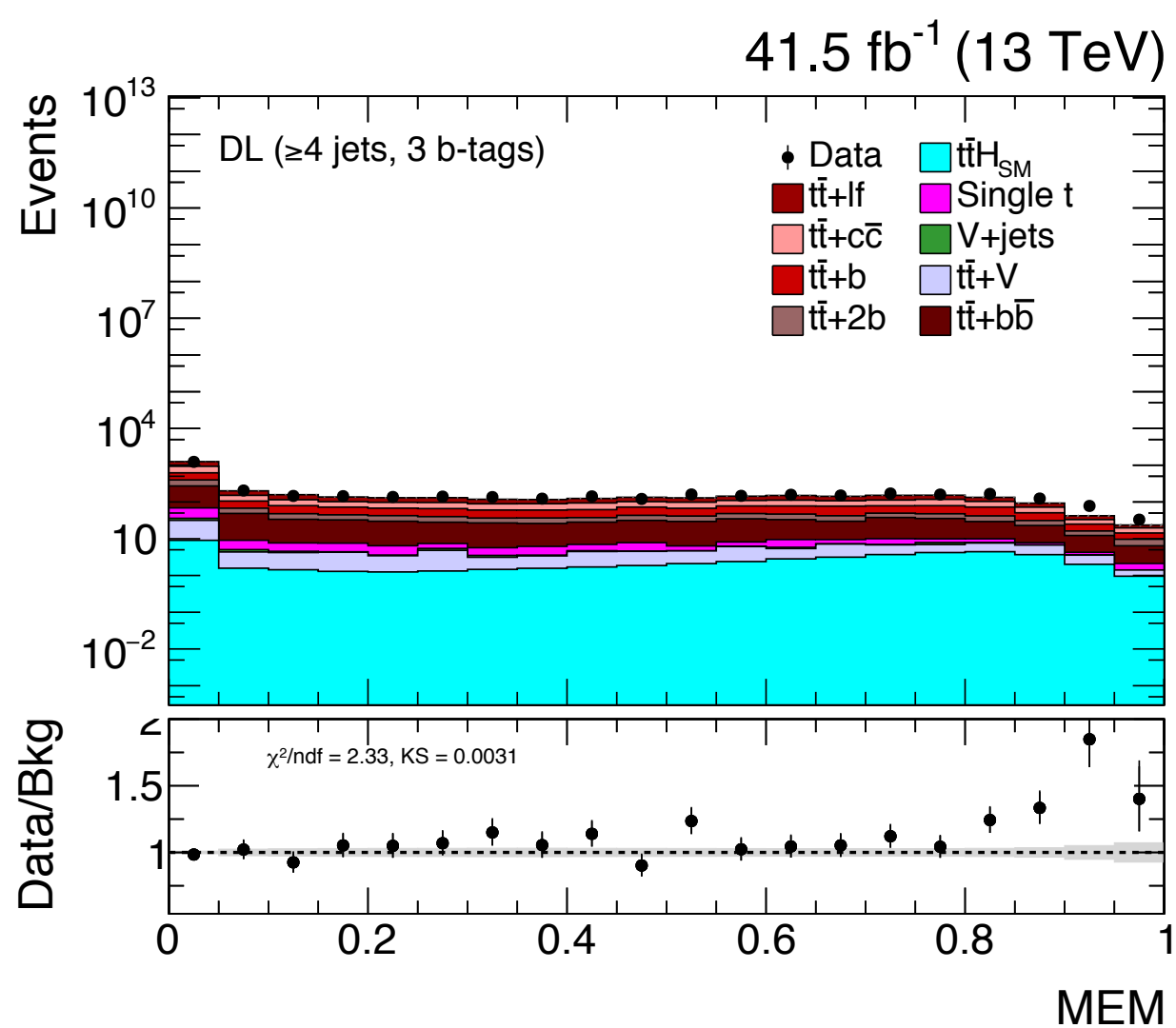
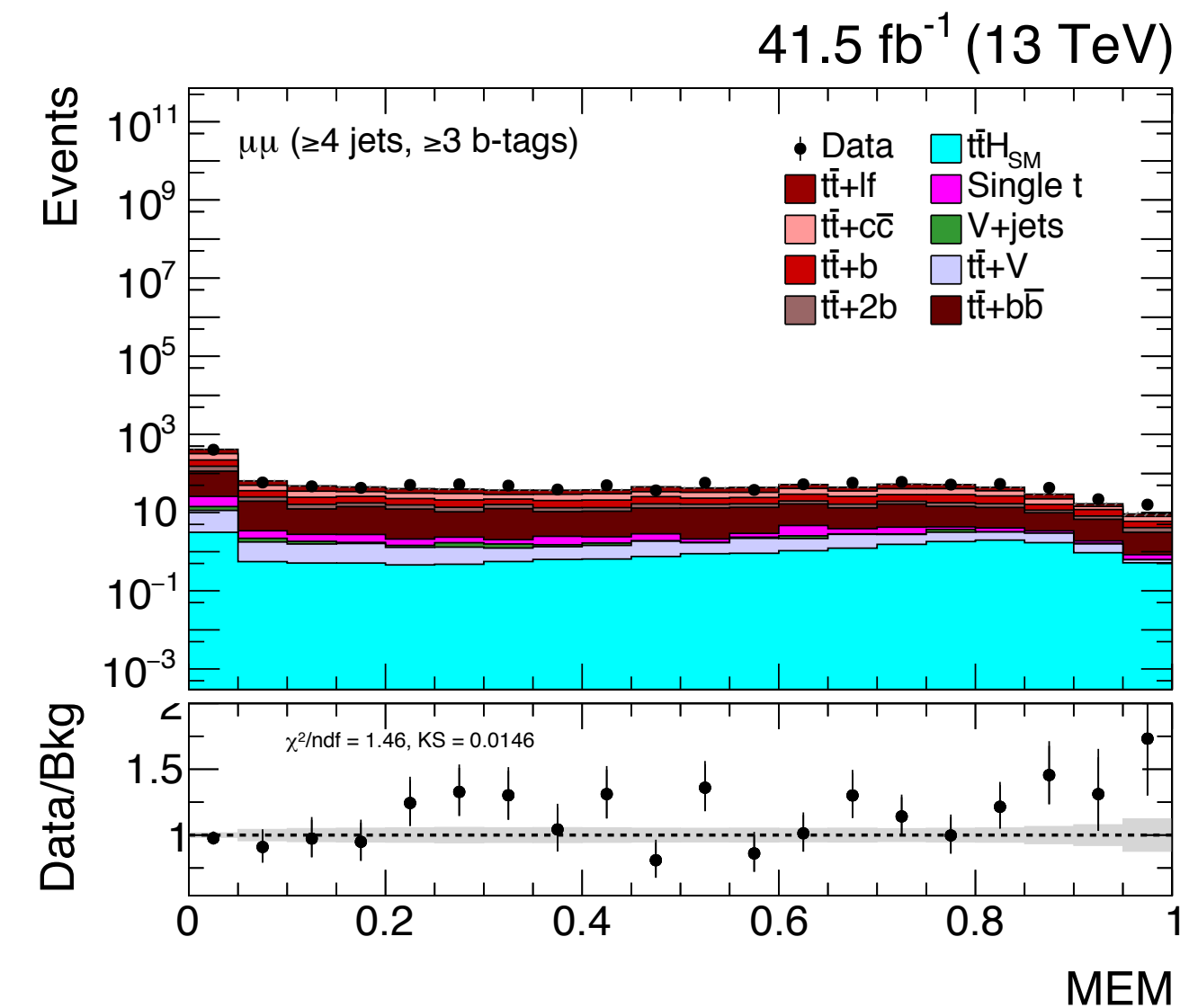
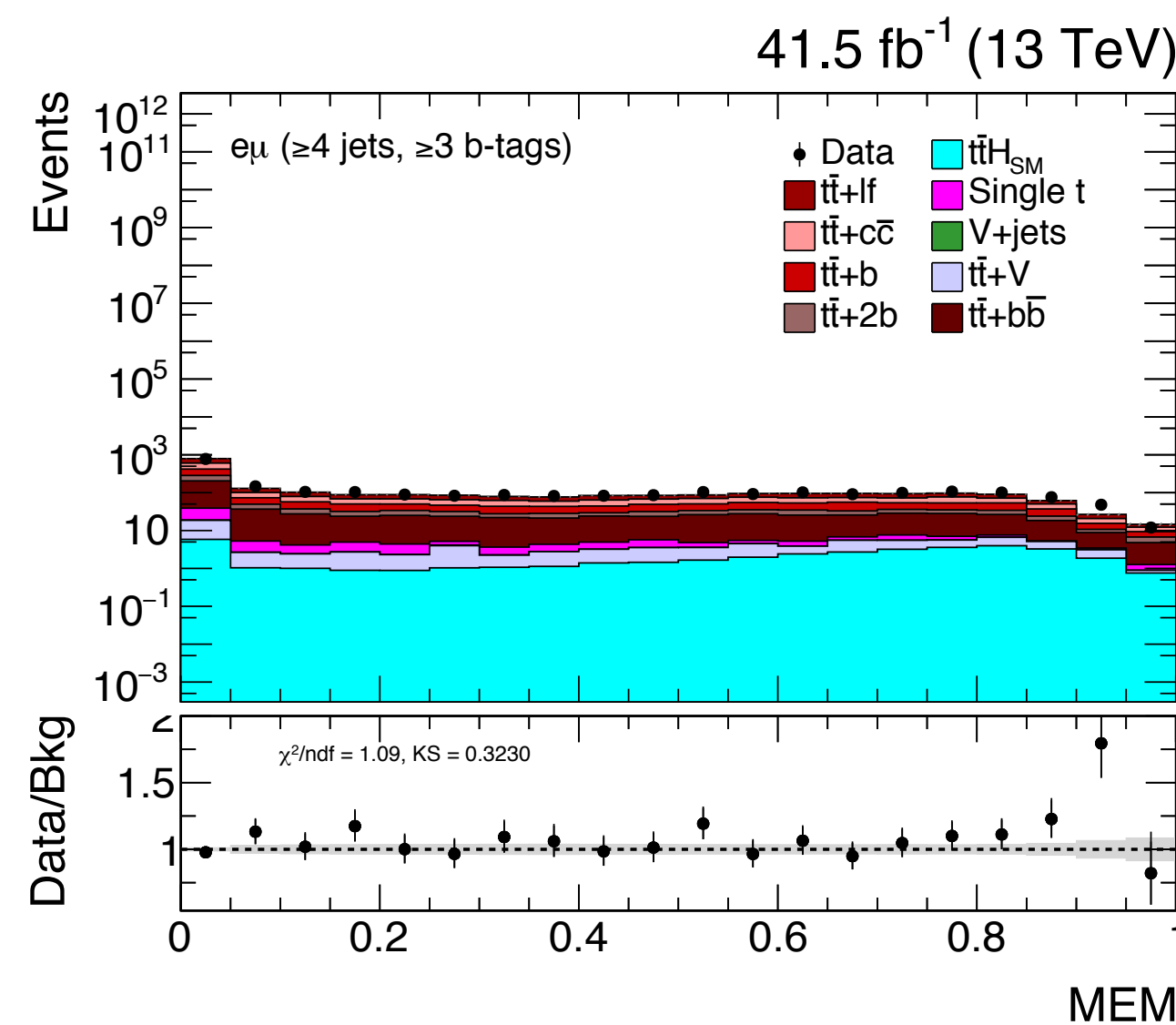
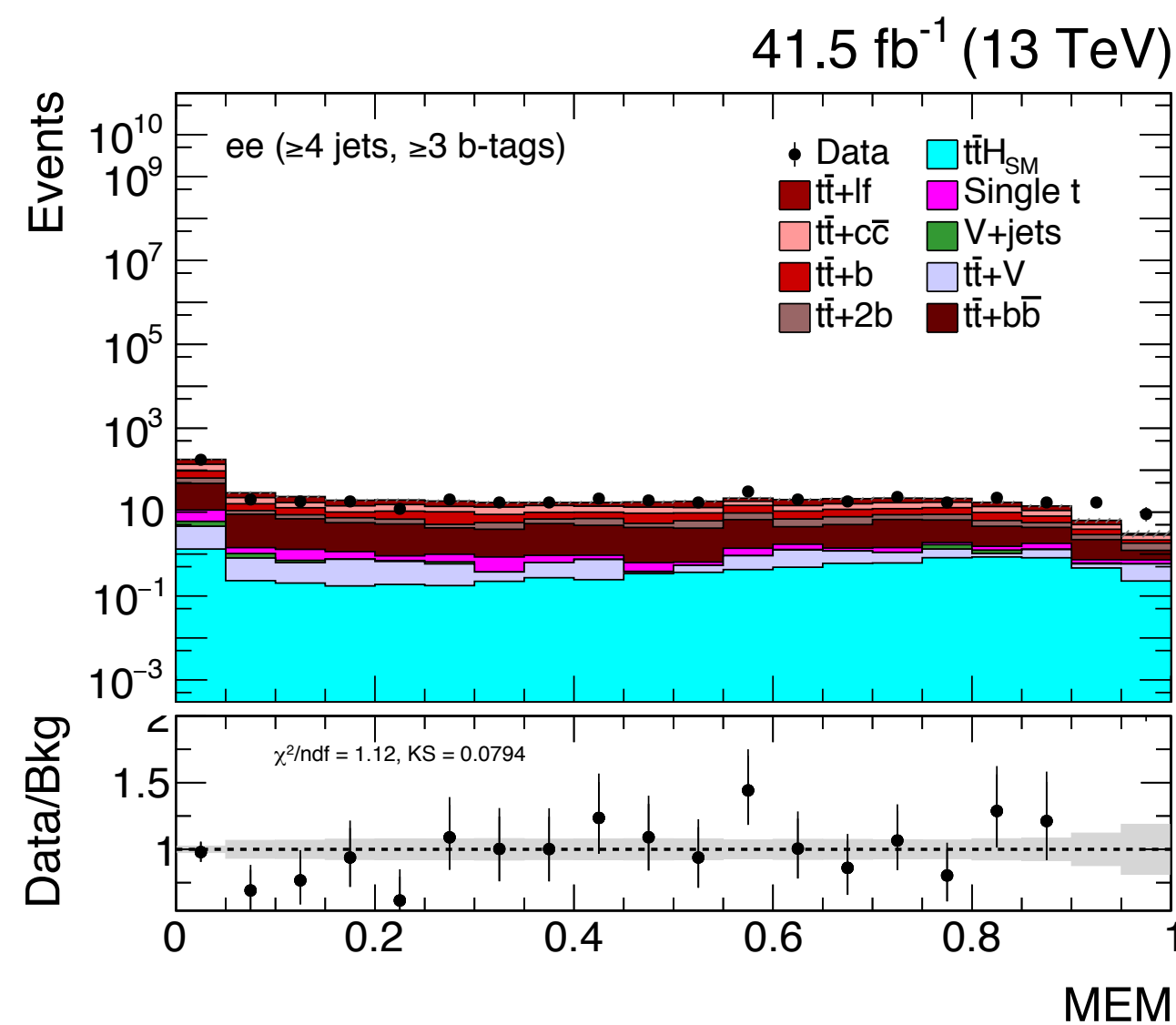
- MEM is the most important variable in the DNN of the DL (4j3b) category
- Passed criteria for input validation, both 1D and 2D GoF, for all years
 - In the 1D fit (2017), post-fit $\mu(\text{tt+B}) = 1.35$ and $\mu(\text{ttH})=2$ (at the boundary).
- Looking at the plots by eye, the high-MEM tail is not well described in 2017 and 2018, while is fine for 2016.



- tt+bb contribution scaled by 1.3
- ttH ($\mu=1$) is stacked
- Uncertainty is stat only.

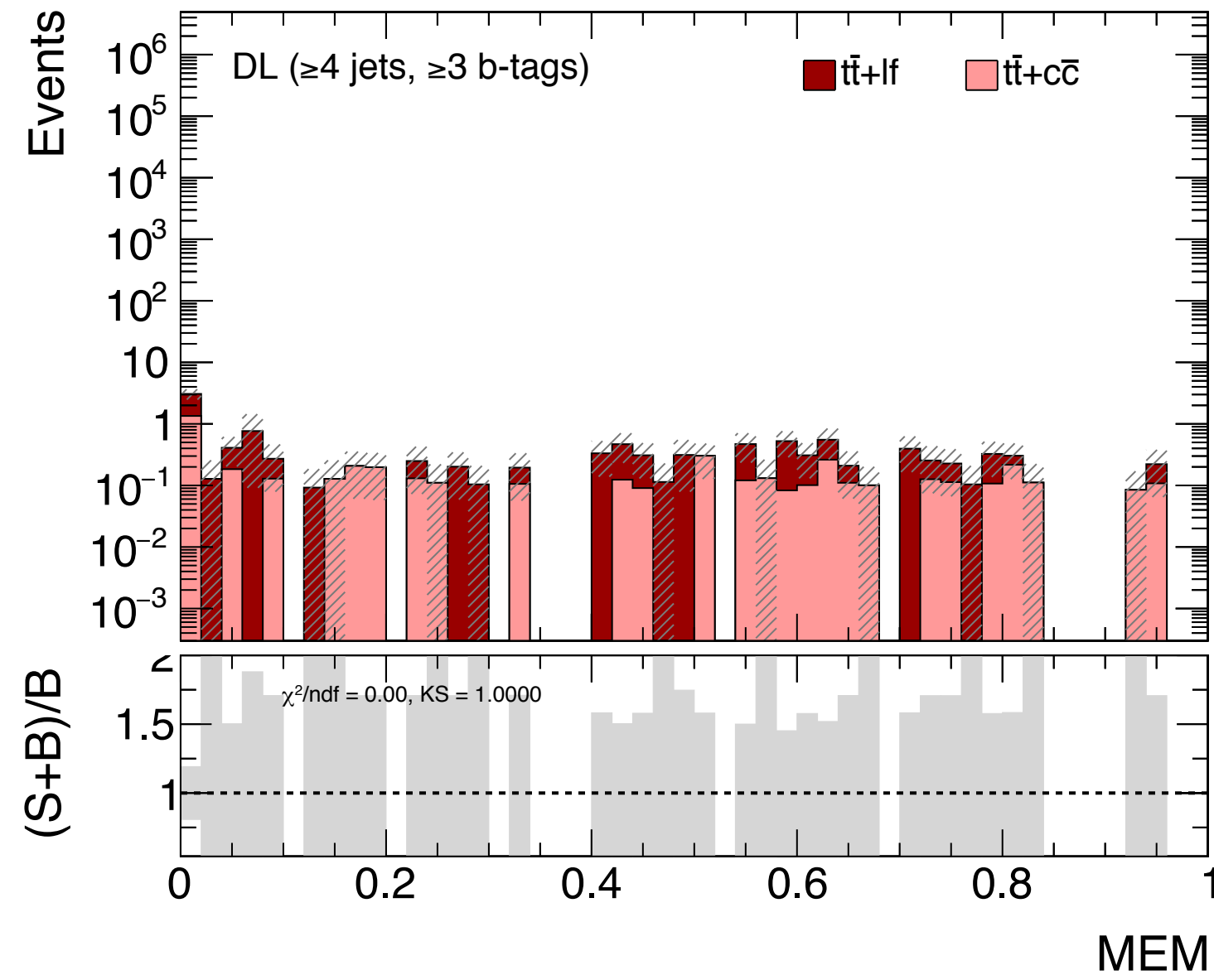
Plots per channel and category

- The mismodelling does not come from one channel in particular among ee, mumu, emu, though ee seems a bit more affected.

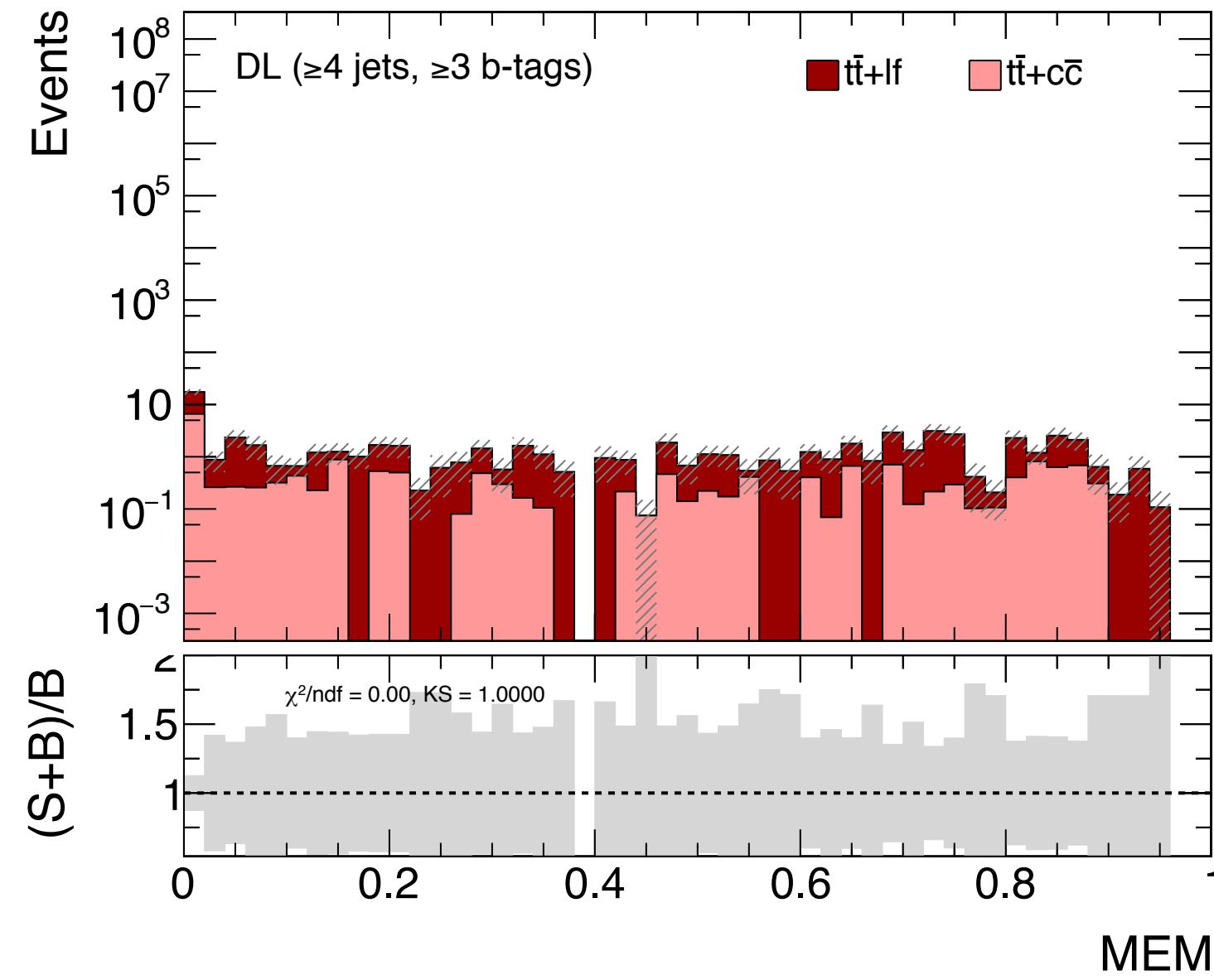


- The >4j>4b events seem better modelled than >4j=3b, but lower stats.
- Furthermore:
 - Using $t\bar{t}+B$ from 5FS instead of 4FS makes things even worse
 - The effect is not coming from btag weights, btag 2D weights, jet pile-up ID weights, top-pt weight (if we were applying it)

35.9 fb⁻¹ (13 TeV)



41.5 fb⁻¹ (13 TeV)



MEM for events with weight > 200

They distribute uniformly as a function of the MEM, but the MEM has a falling distribution at large values.

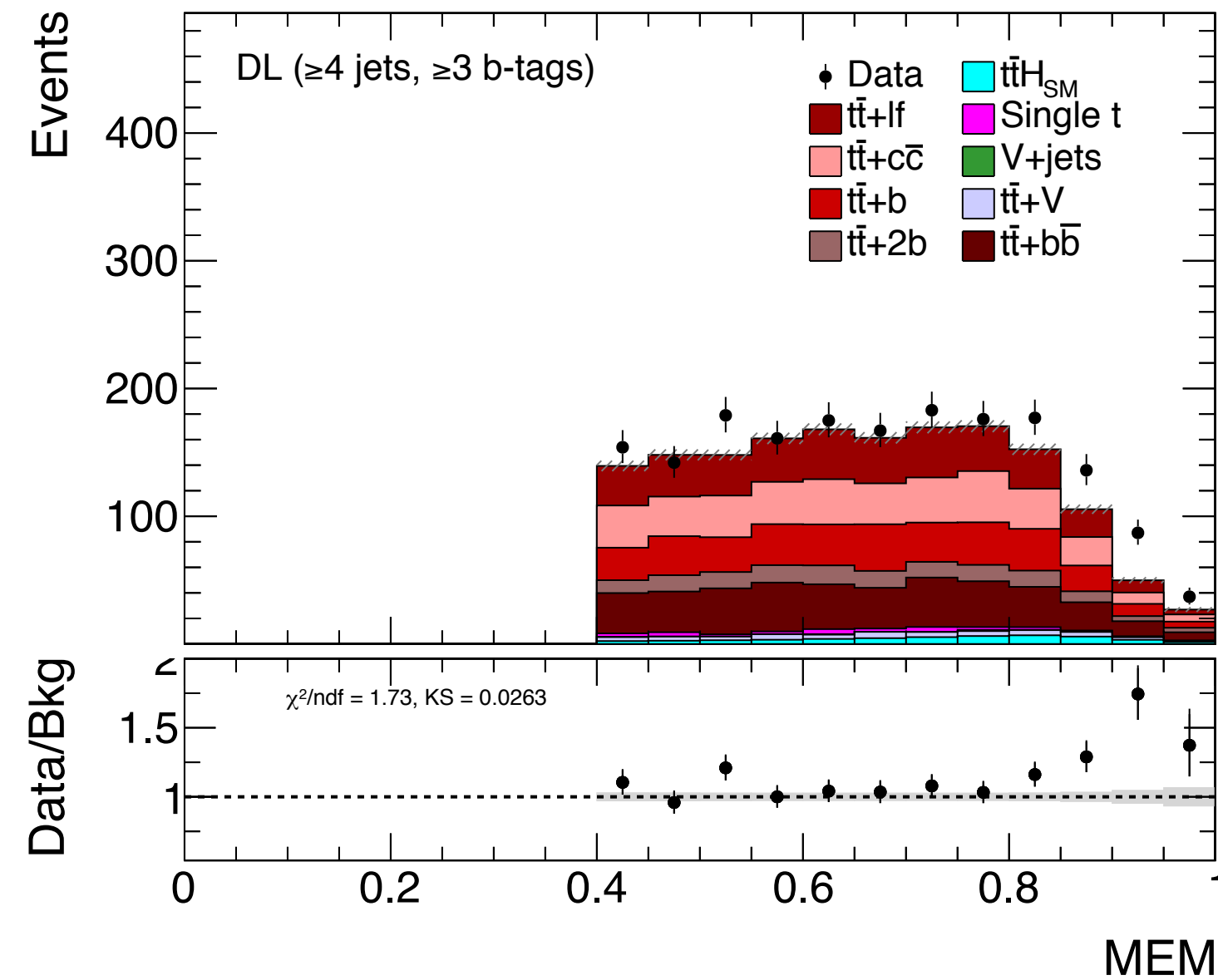
The relative importance of such events is larger there.

Note: only events from the 5FS sample have this large weights.

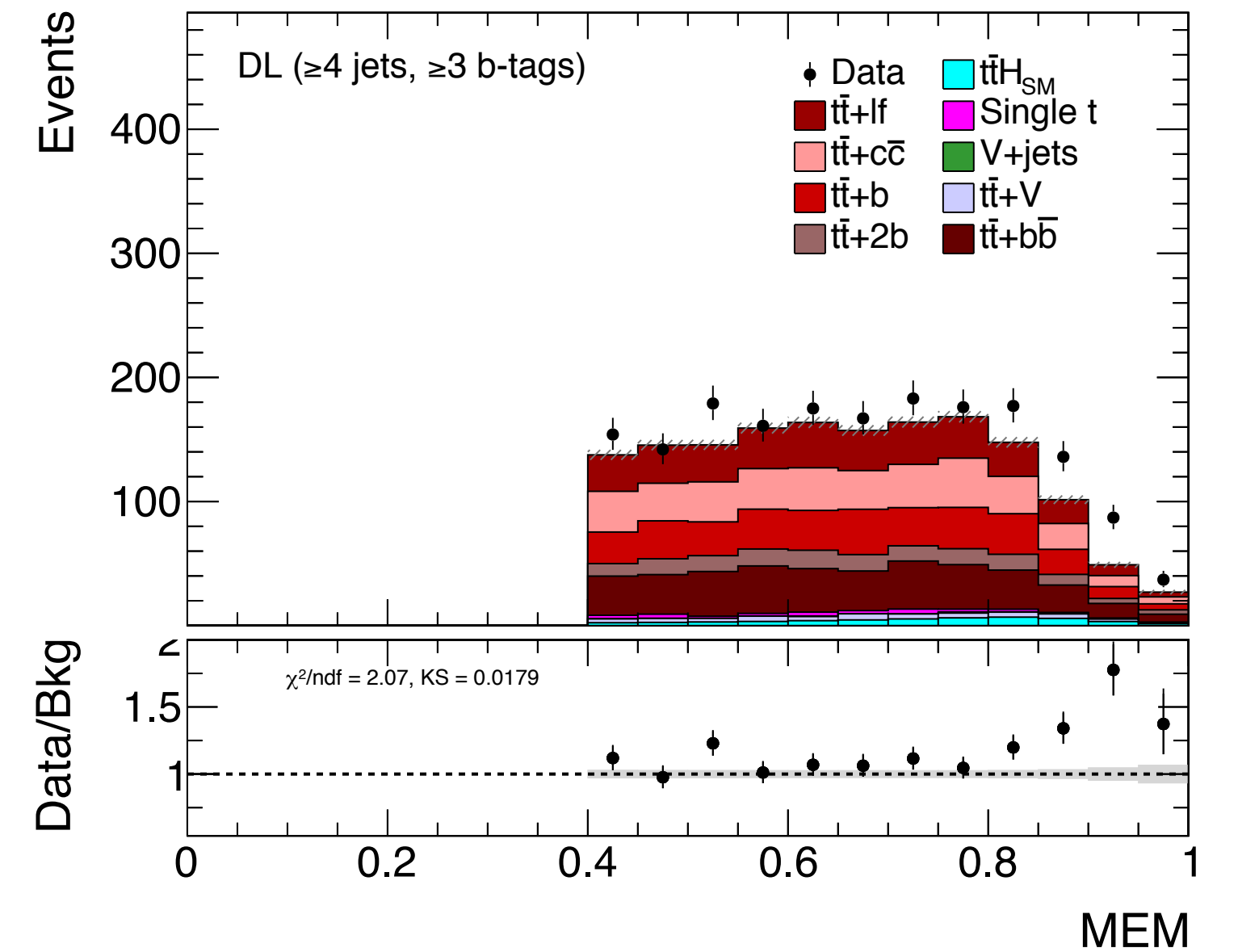
Removing events with weight > 200

One can see a difference by eye in some bins, but it does not justify the trend.

41.5 fb⁻¹ (13 TeV)



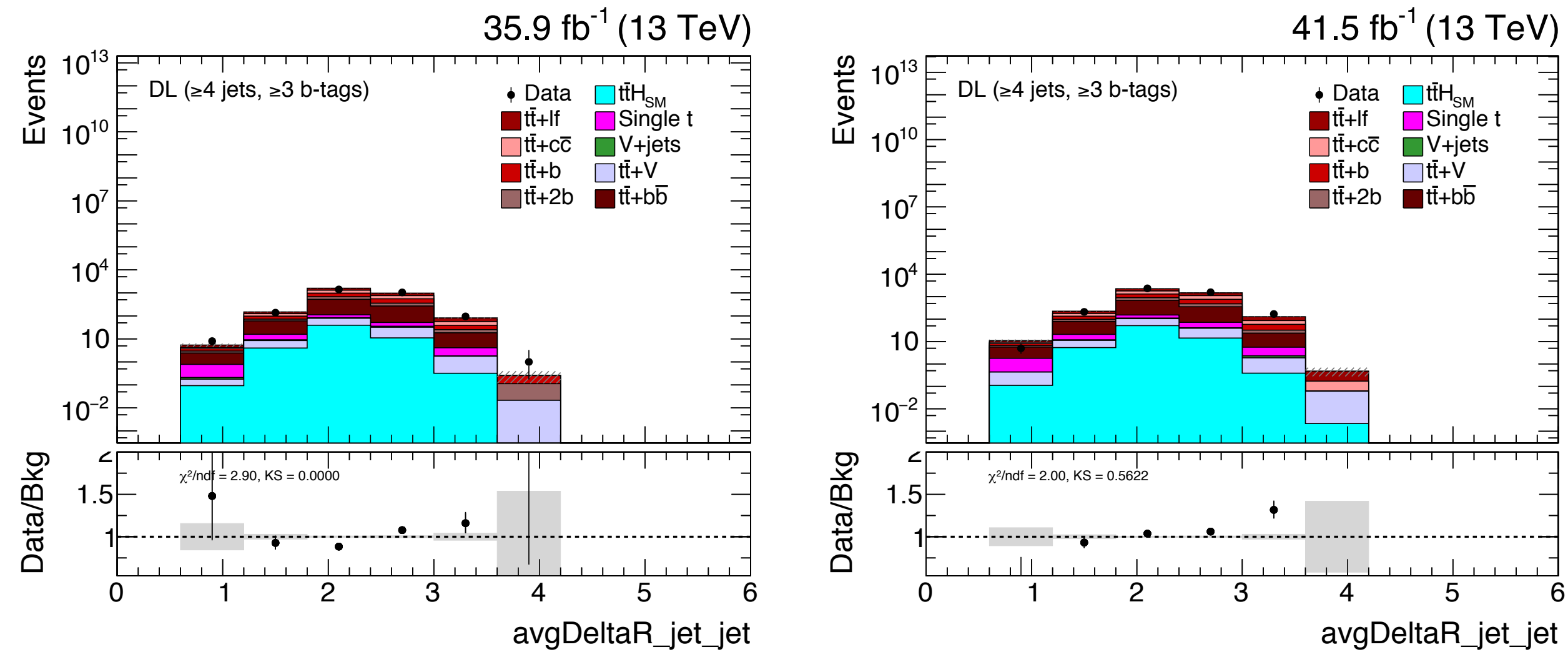
41.5 fb⁻¹ (13 TeV)



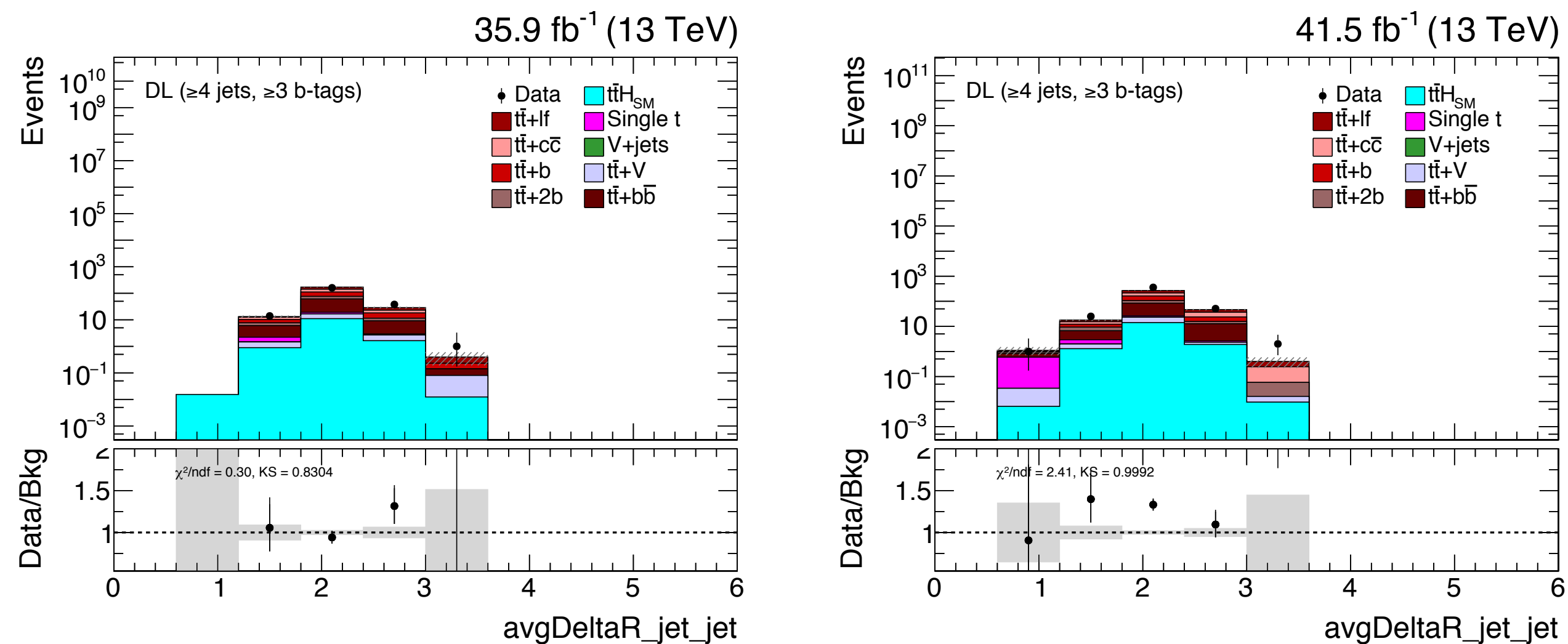
Modelling of input distributions (2016 vs 2017)

- Data/MC agreement of the input distributions used as input for the MEM, i.e. leptons kinematics, MET, jet four-vectors and b-tag scores, indirectly the BLR
 - Both inclusively (all events in 4j3b) and in the problematic region (MEM>0.8)
 - Mismodelling of the jet mass and pt, but is similar in 2016 and 2017
 - Mismodelling of the DeltaR (jj) in 2017 for MEM>0.8 , not observed in 2016

All events

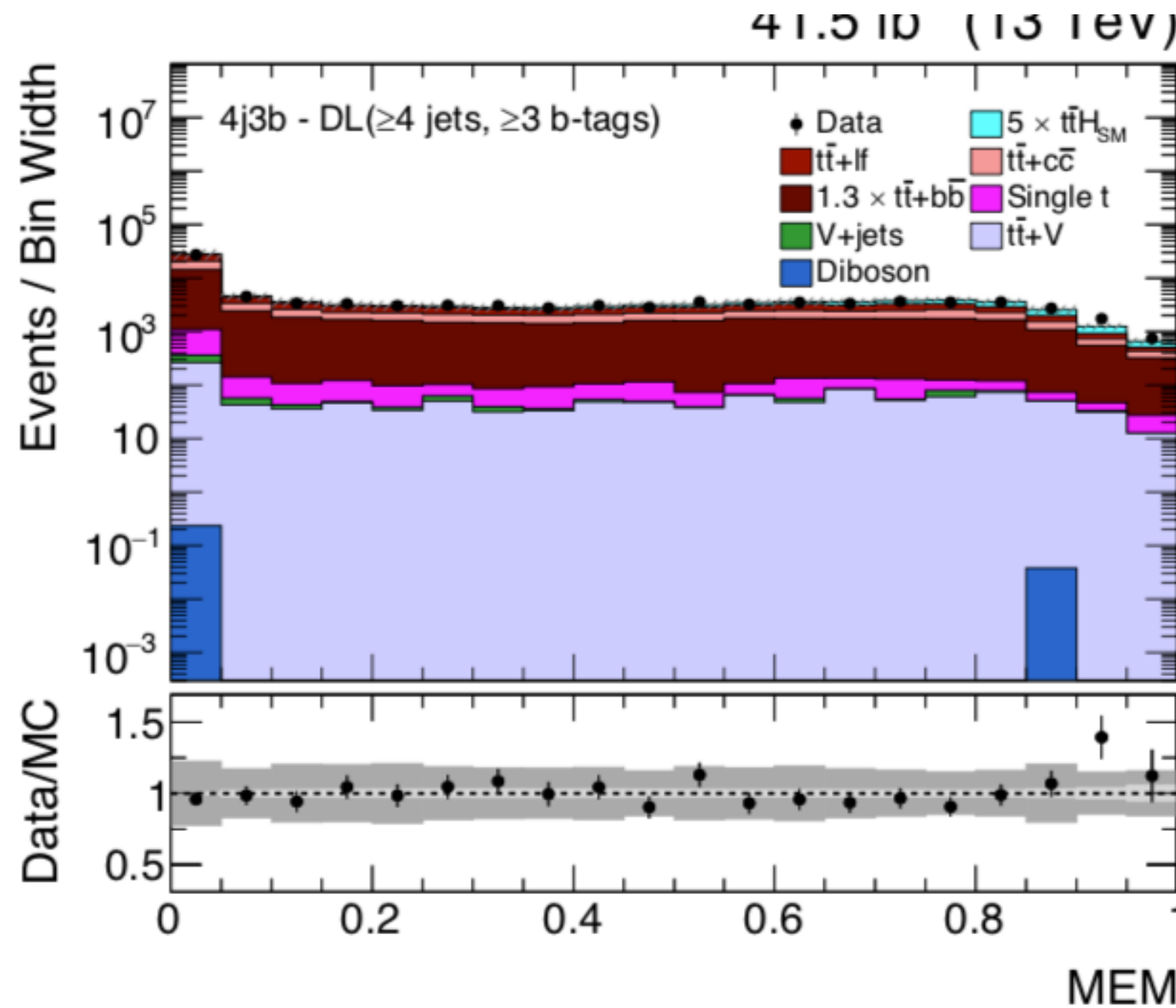


MEM>0.8



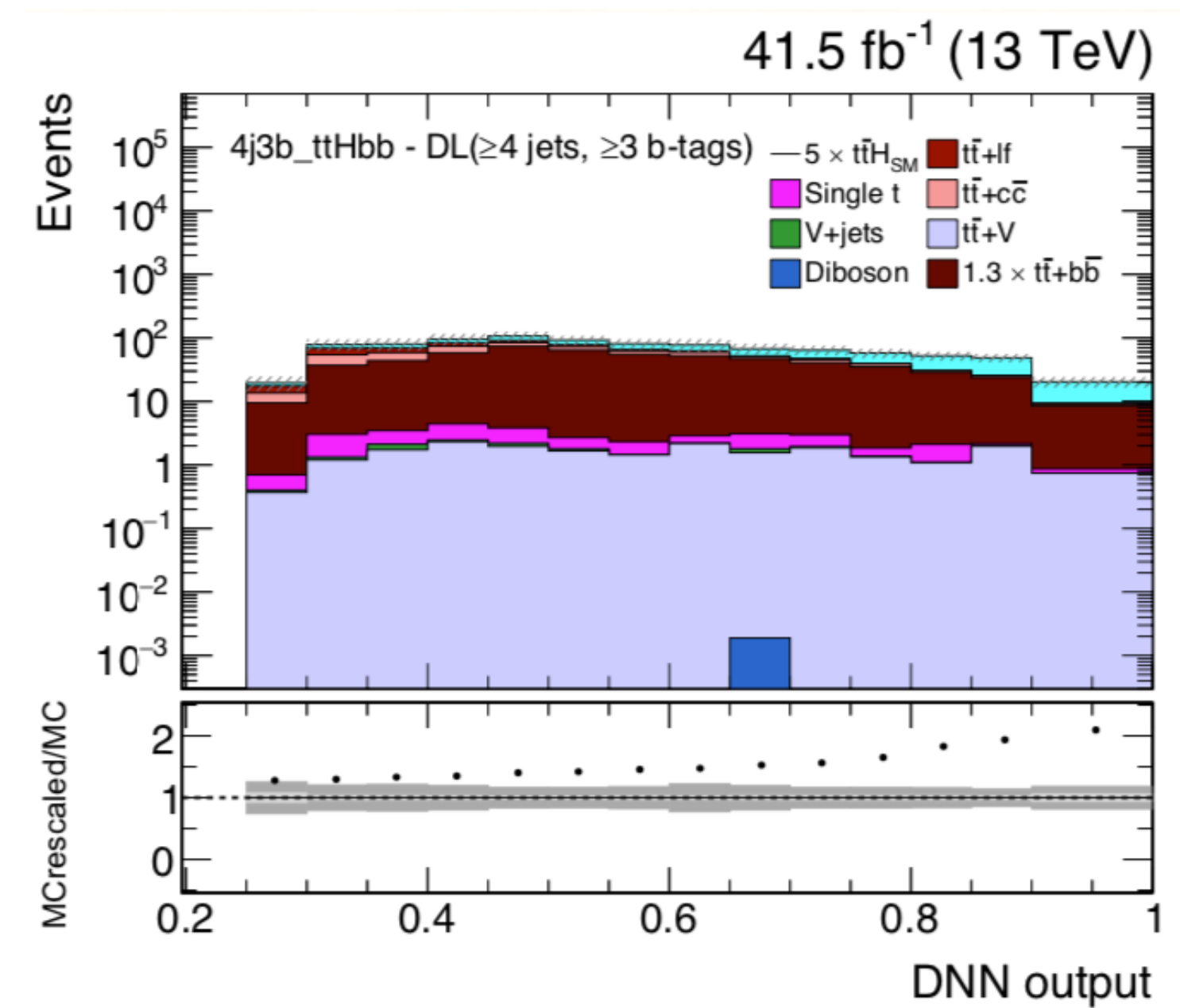
Checks on the DNN output

- Reweighted nominal tt+B by 1.3 and ttH by 5 and compared the MC distributions in the output nodes of the DNN (tt+B and ttH node)
 - Mimicking the observed data behaviour
 - Significant difference in the discriminator output

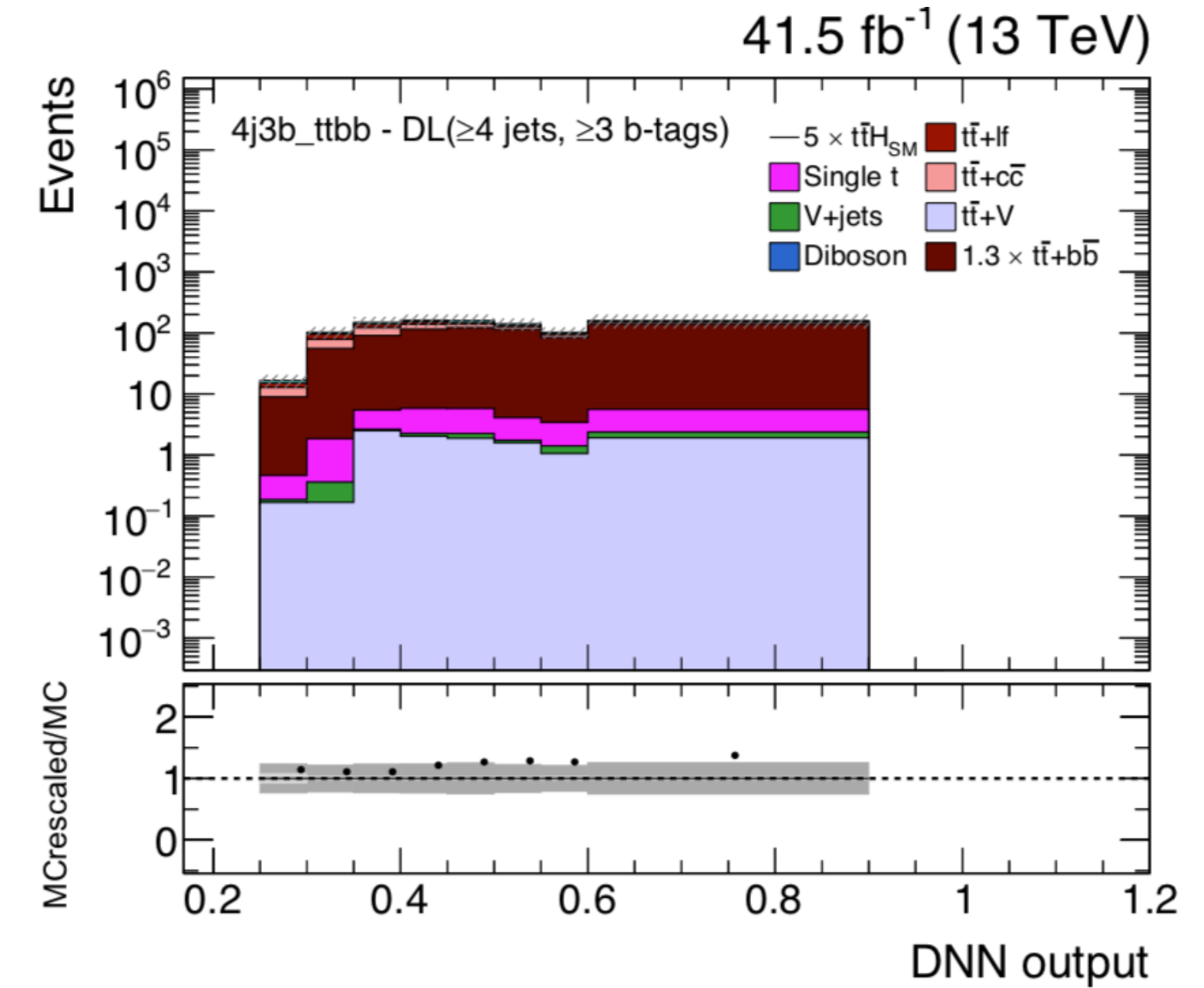


- $ttbb \times 1.3$
- $ttH \times 5$

ttH node



tt+B node



- Weight the whole MC by the observed data/MC discrepancy in the MEM distribution, bin-by-bin
 - Check the change of the discriminator output (ongoing)

Inputs and code for MEM calculation

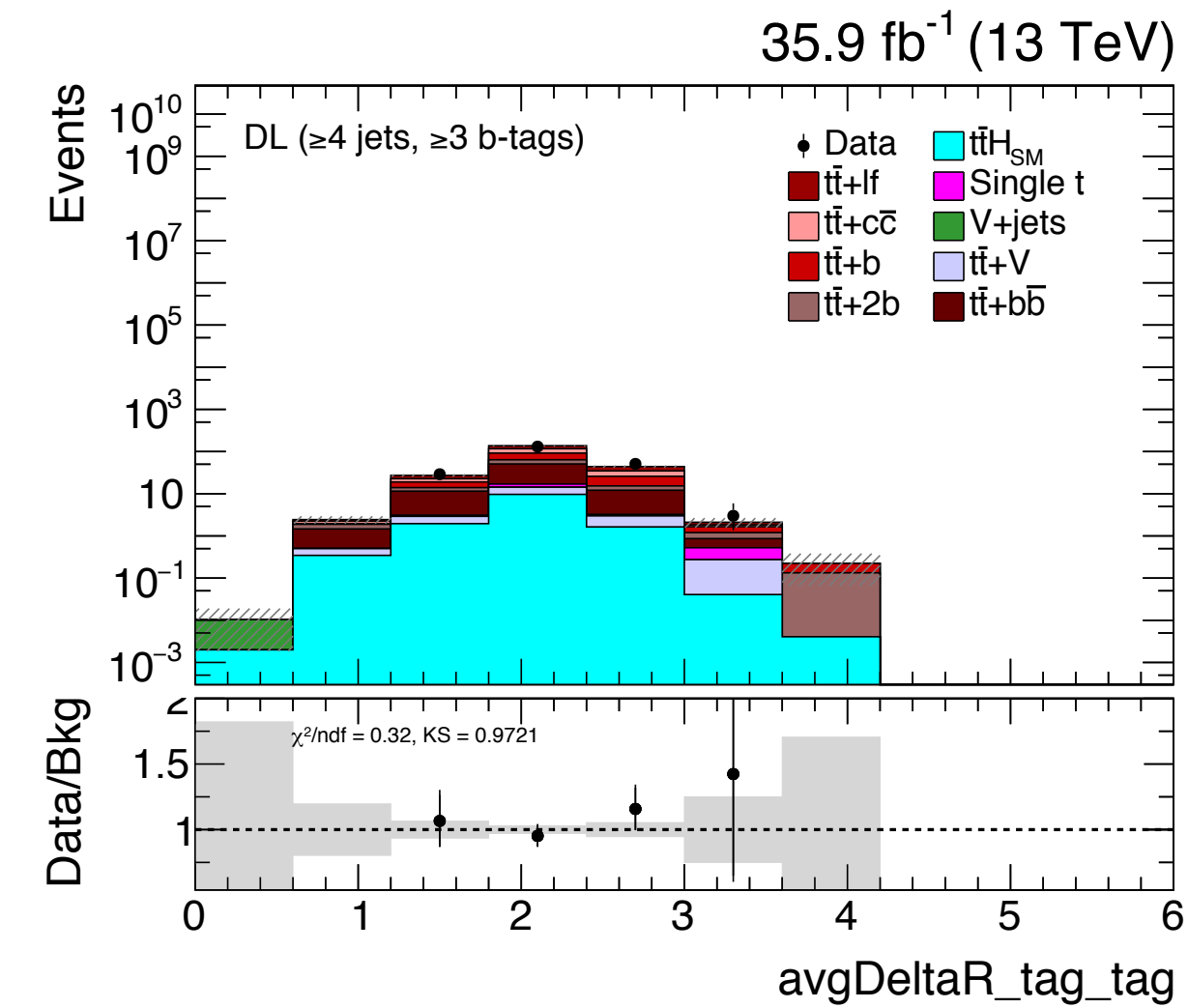
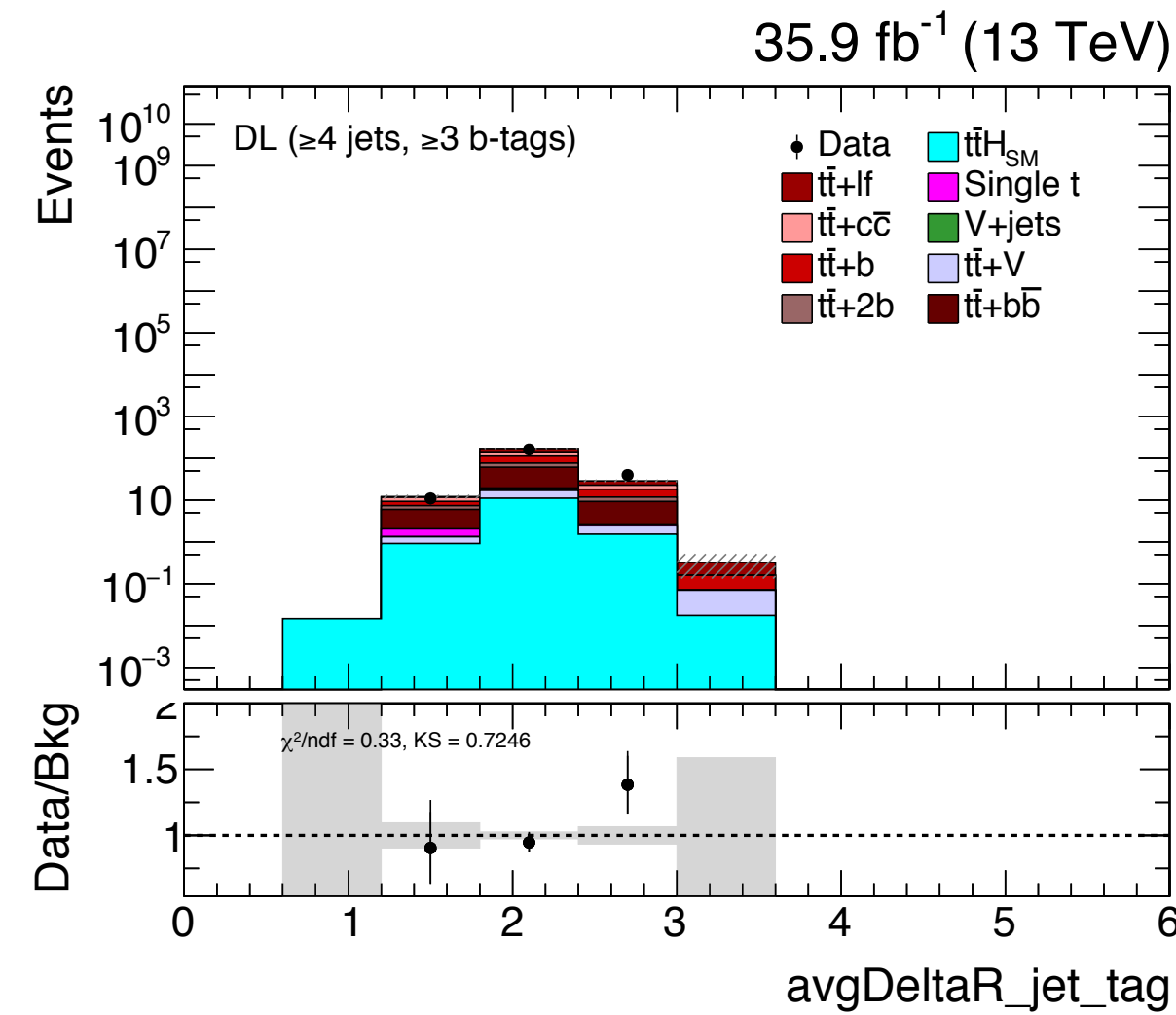
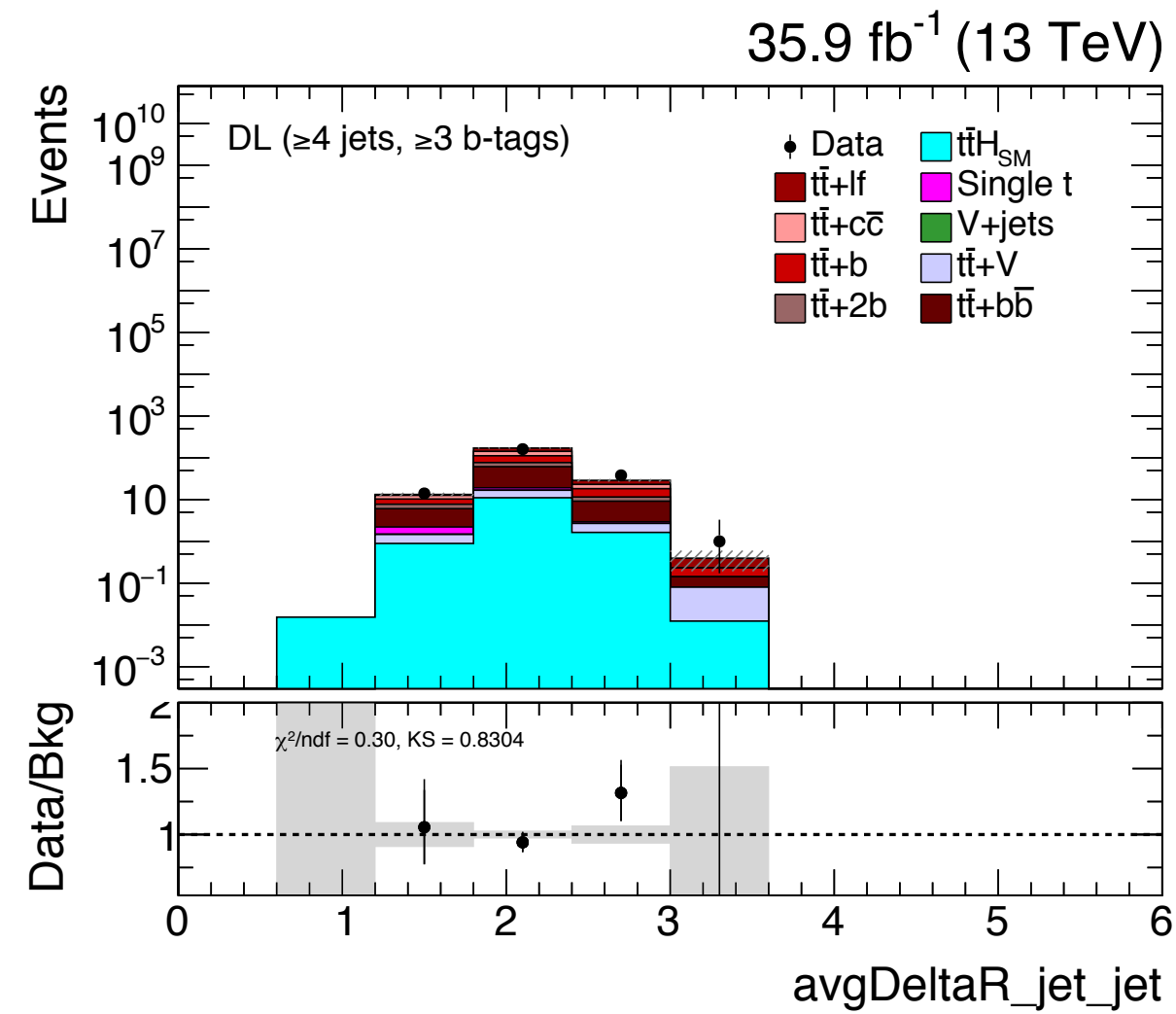
- Details of the calculation
 - Input functions (transfer factors, btag probabilities) are the same as used in SL channel
 - They are year-dependent, assignment in the configuration is correct
 - The code of the MEMIntegratorStandalone is updated, same as SL (modulo a small local change)
- Moreover:
 - Same behaviour is observed by Maren both in the SL and DL channels.
 - Caveat: she is using DeepCSV and tt+B from the 5FS sample, and analysing only 2017 —> much closer to HIG-18-030, where this behaviour was not observed.
 - Trying to reproduce the MEM values for some SL events for HIG-19-011 did not succeed.
 - She is checking some DL events as well (ongoing)

Backup

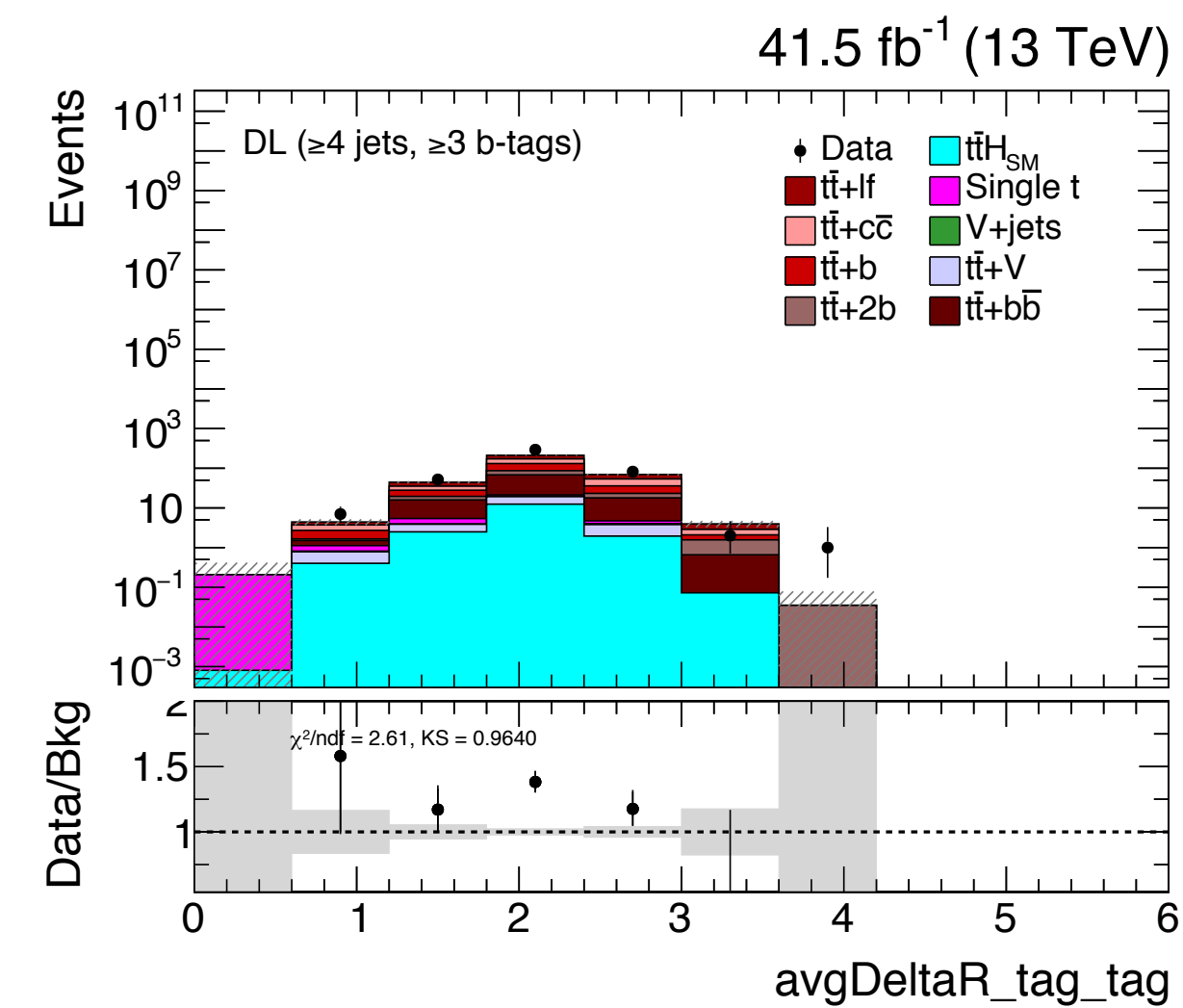
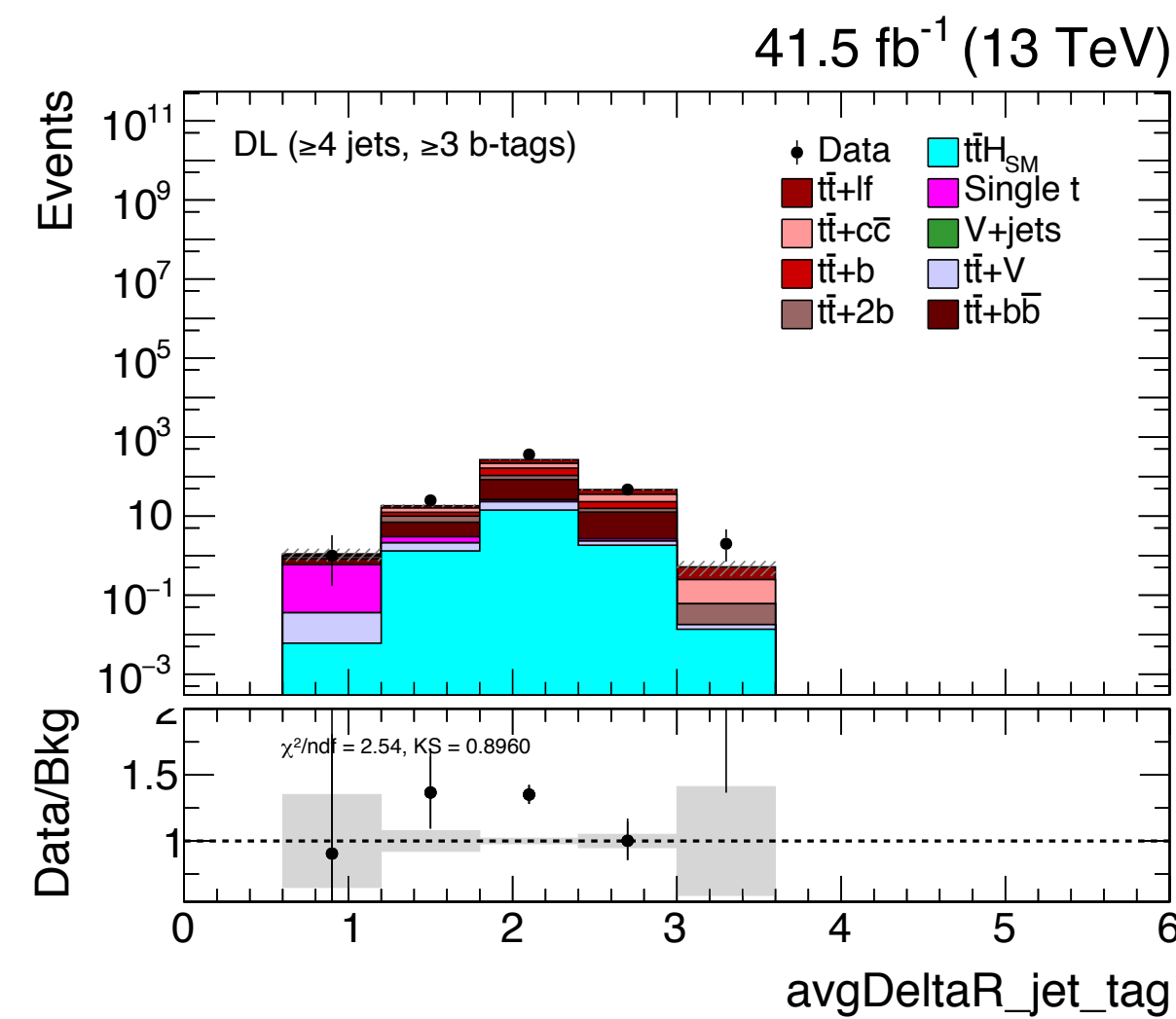
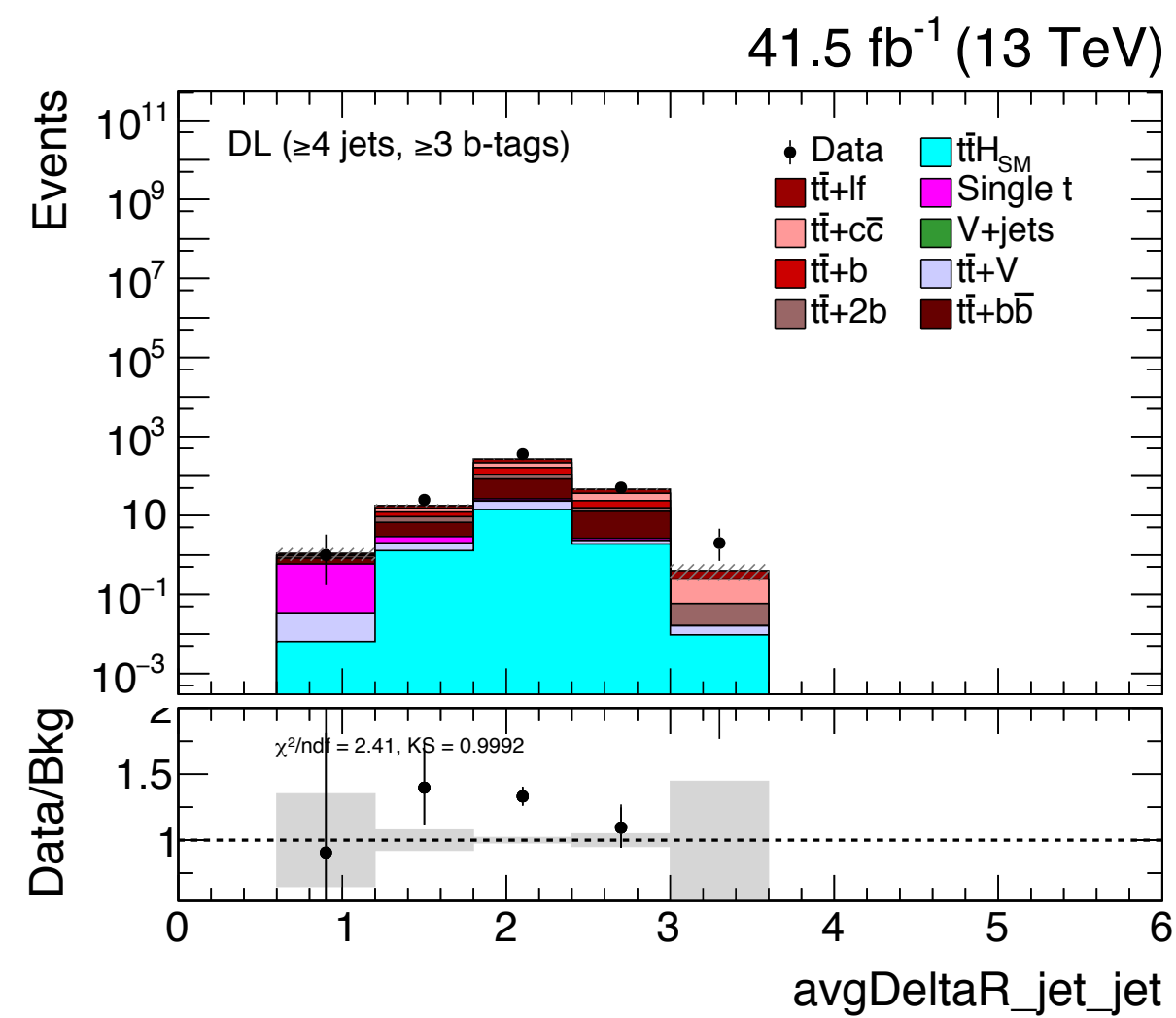
What we have checked so far

- Checks done for 2017
- The mismodelling does not come from one channel in particular among ee, mumu, emu. The $>4j>4b$ events seem better modelled than $>4j=3b$, but lower stats.
- Using tt+B from 5FS instead of 4FS makes things even worse
- The effect is not coming from btag weights, btag 2D weights, jet pile-up ID weights, top-pt weight (if we were applying it)
- Data/MC agreement of the input distributions used as input for the MEM, i.e. leptons kinematics, MET, jet four-vectors and b-tag scores, indirectly the BLR
 - Both inclusively (all events in $4j3b$) and in the problematic region ($MEM>0.8$)
 - Mismodelling of the jet mass and pt, but is similar in 2016 and 2017
 - Mismodelling of the DeltaR (jj) in 2017 for $MEM>0.8$, not observed in 2016
- Effect of events with large weights
 - Removing MC events with weight >200 does not change the picture
- Details of the calculation
 - Input functions (transfer factors, btag probabilities) are the same as used in SL channel
 - They are year-dependent, assignment in the configuration is correct
 - The code of the MEMIntegratorStandalone is updated, same as SL (modulo a small local change)
- Effect on the discriminator
 - Reweighted nominal tt+B by 1.3 and ttH by 5 and compared the MC distributions in the output nodes of the DNN (tt+B and ttH node)
 - Mimicking the observed data behaviour
 - Significant difference in the discriminator output
 - Weight the whole MC by the observed data/MC discrepancy in the MEM distribution, bin-by-bin
 - Check the change of the discriminator output (ongoing)
- Moreover:
 - Same behaviour is observed by Maren both in the SL and DL channels.
 - Caveat: she is using DeepCSV and tt+B from the 5FS sample, and analysing only 2017 —> much closer to HIG-18-030, where this behaviour was not observed.
 - Trying to reproduce the MEM values for some SL events for HIG-19-011 did not succeed.
 - She is checking some DL events as well (ongoing)

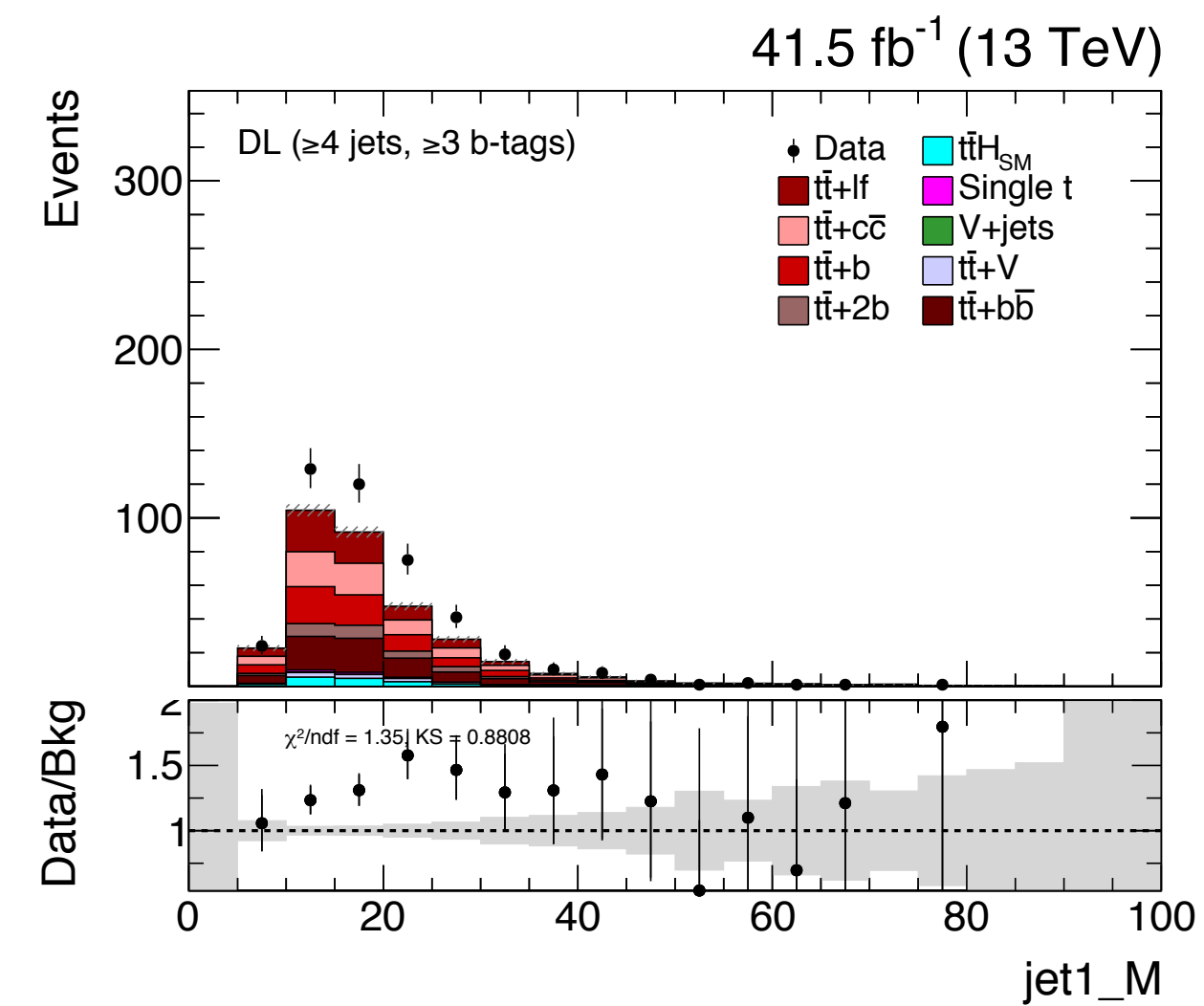
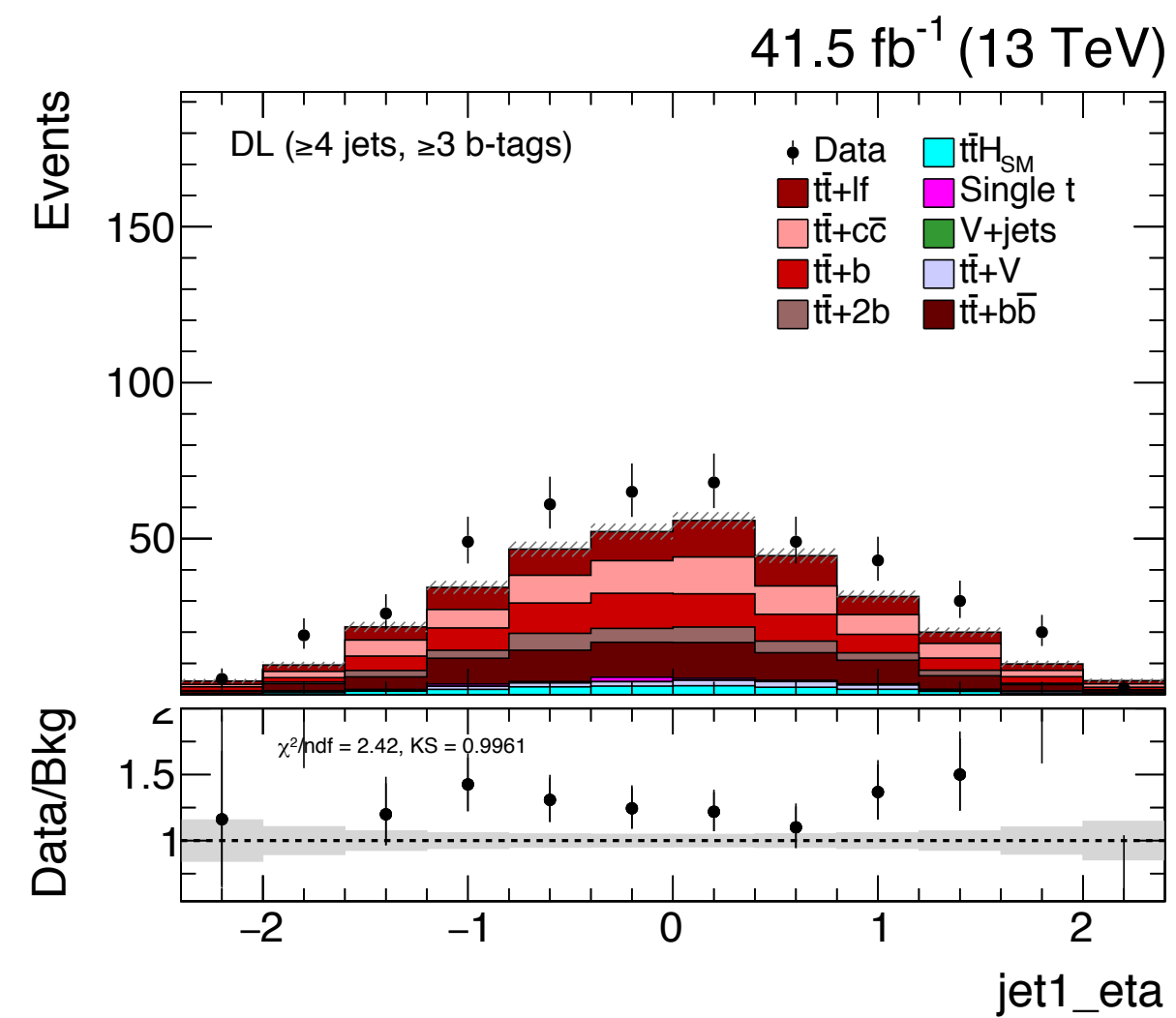
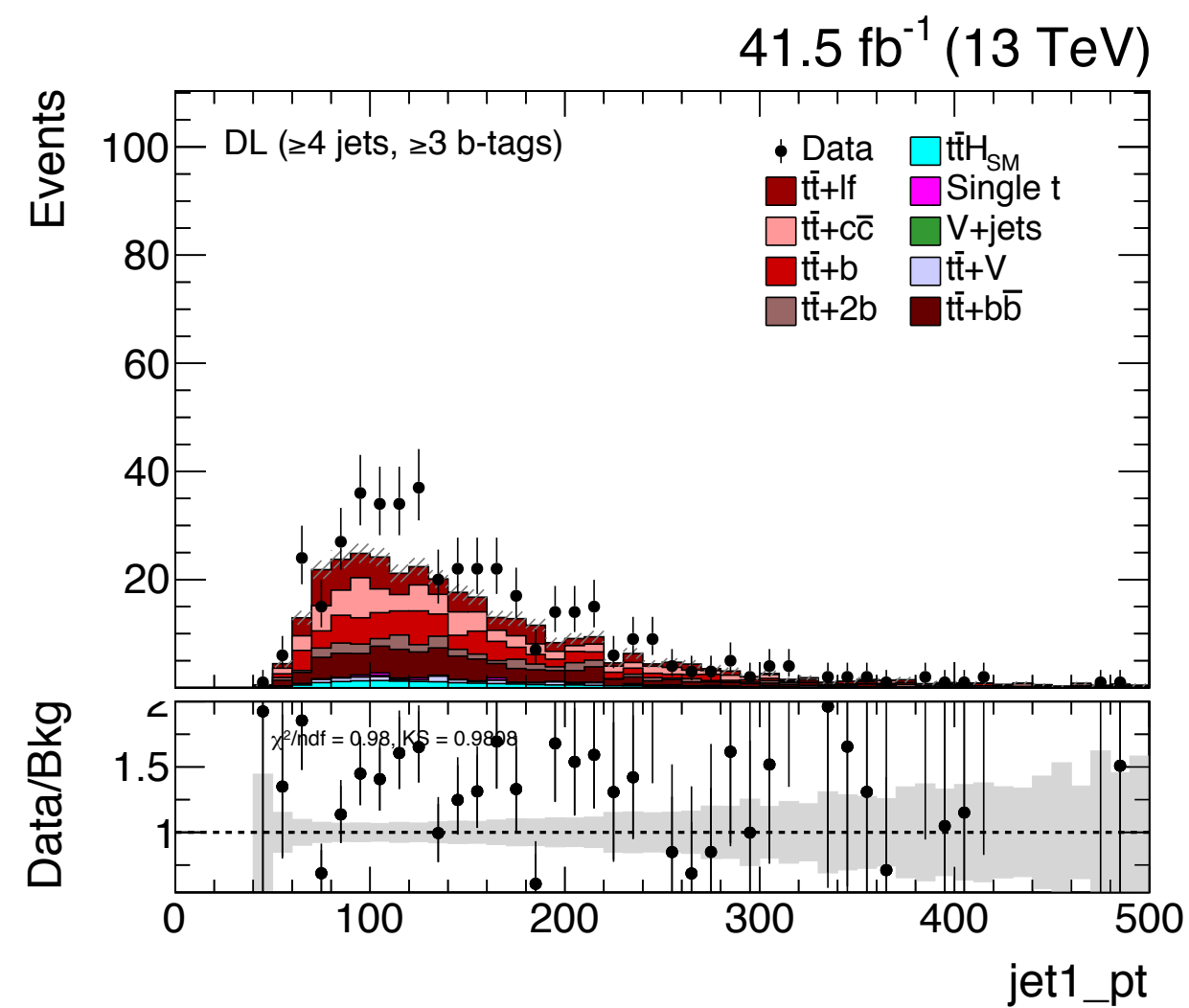
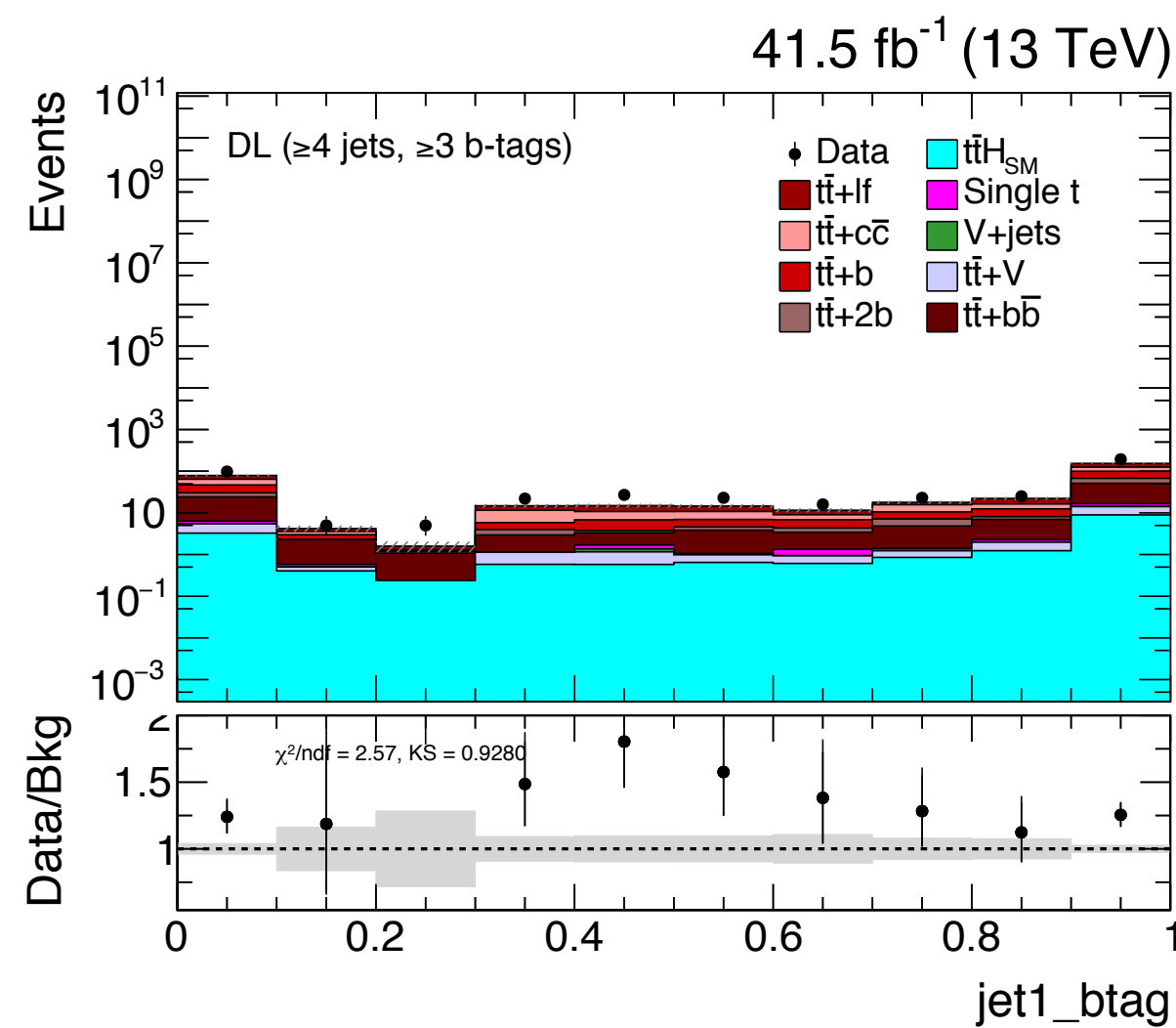
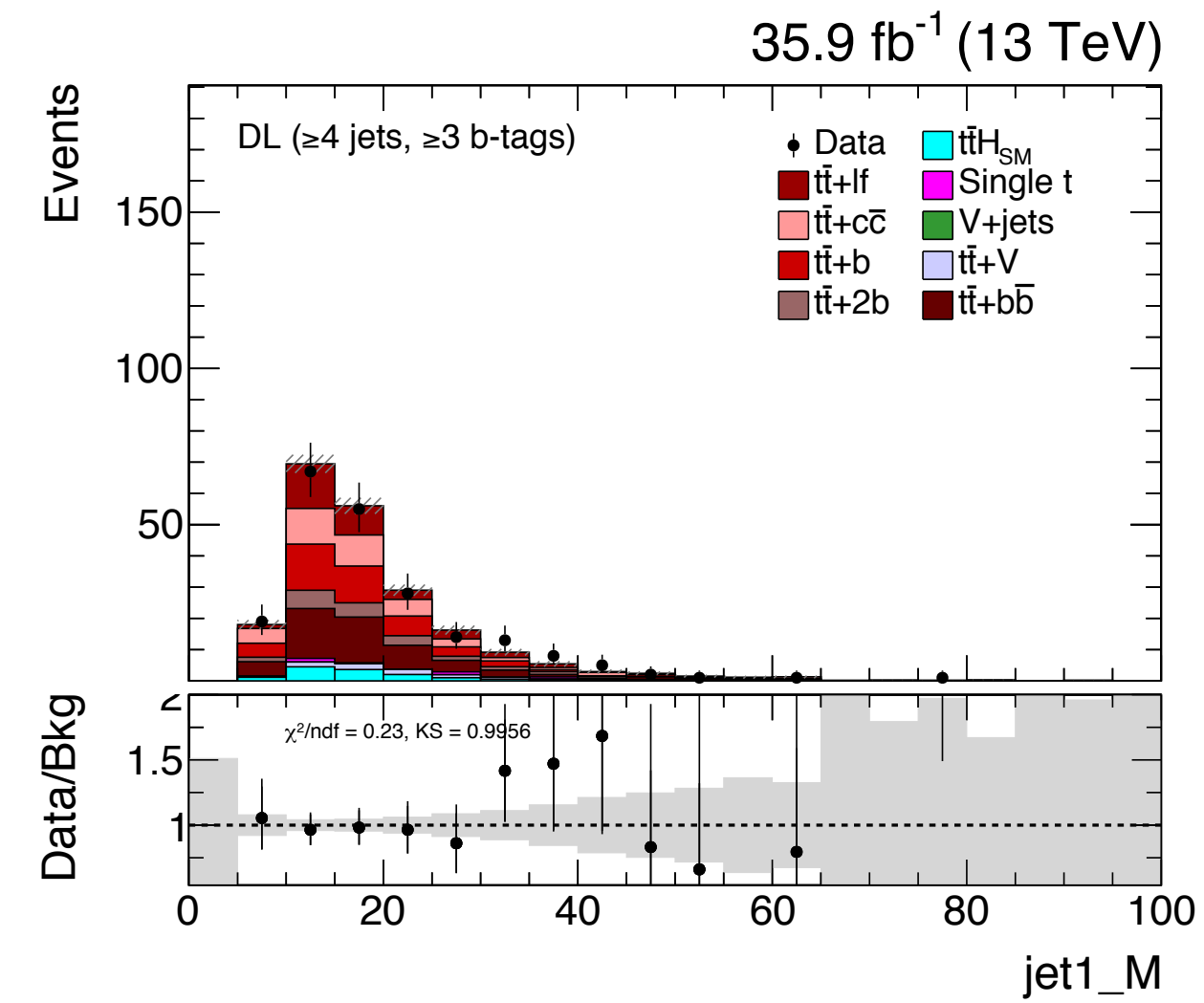
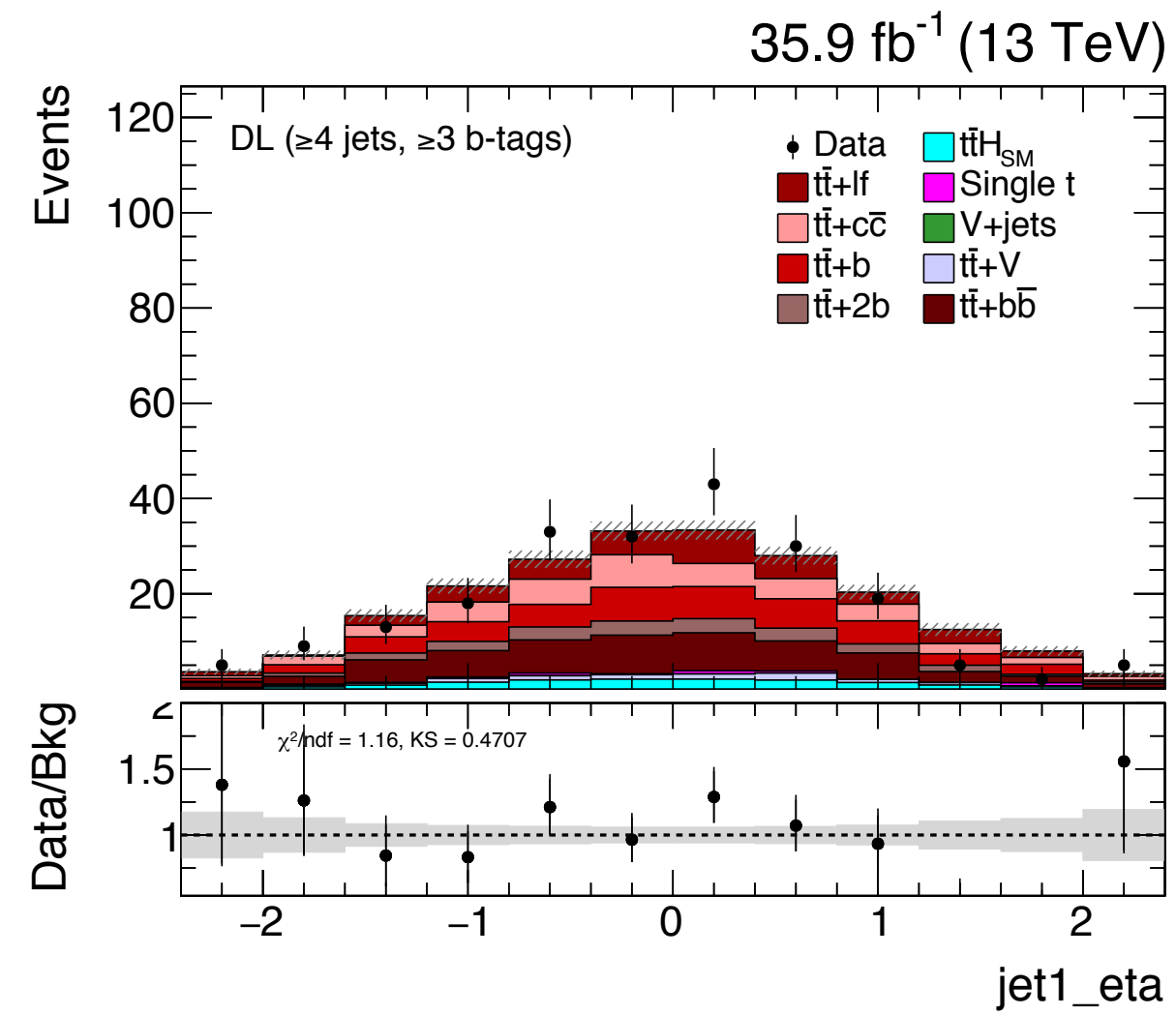
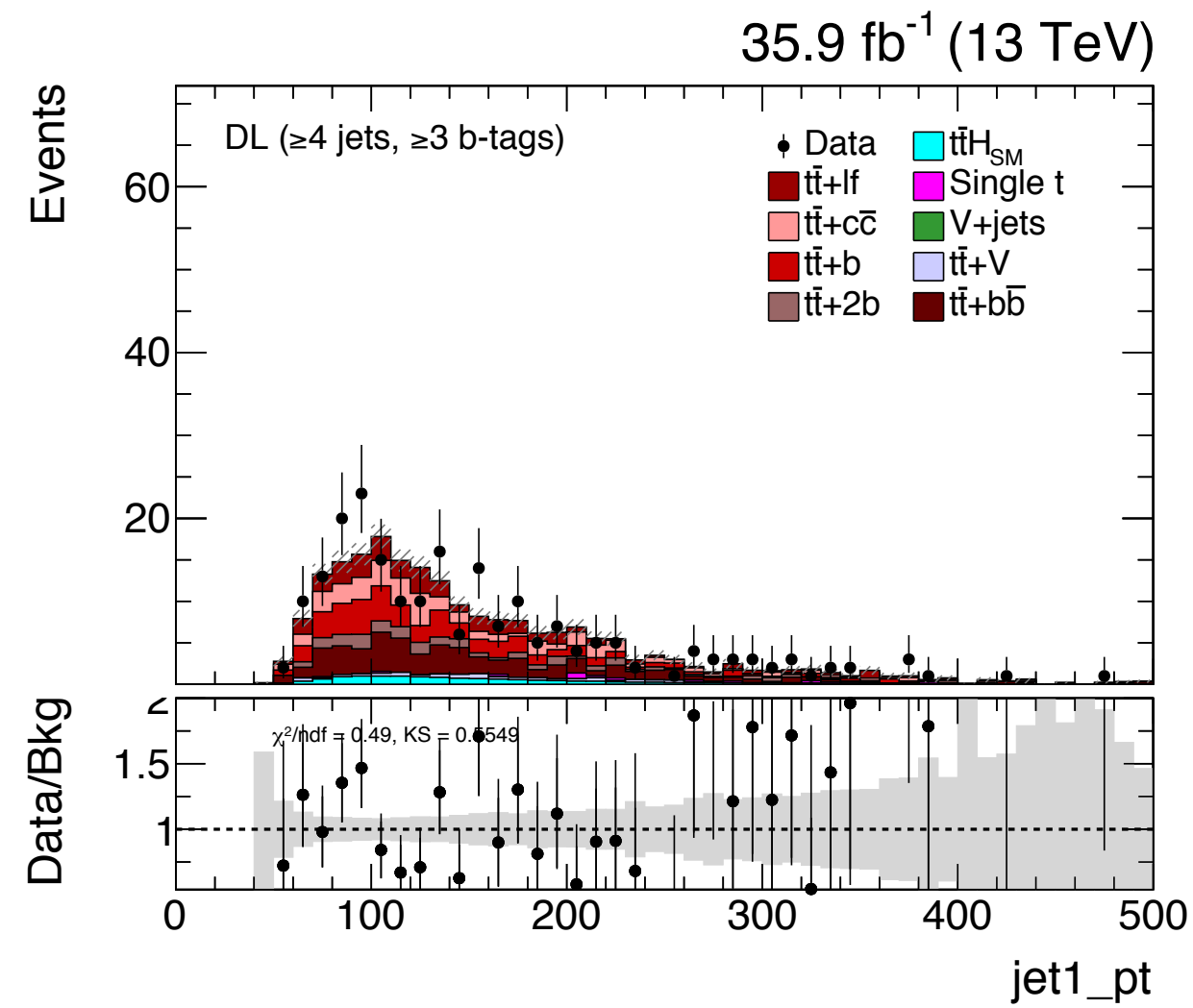
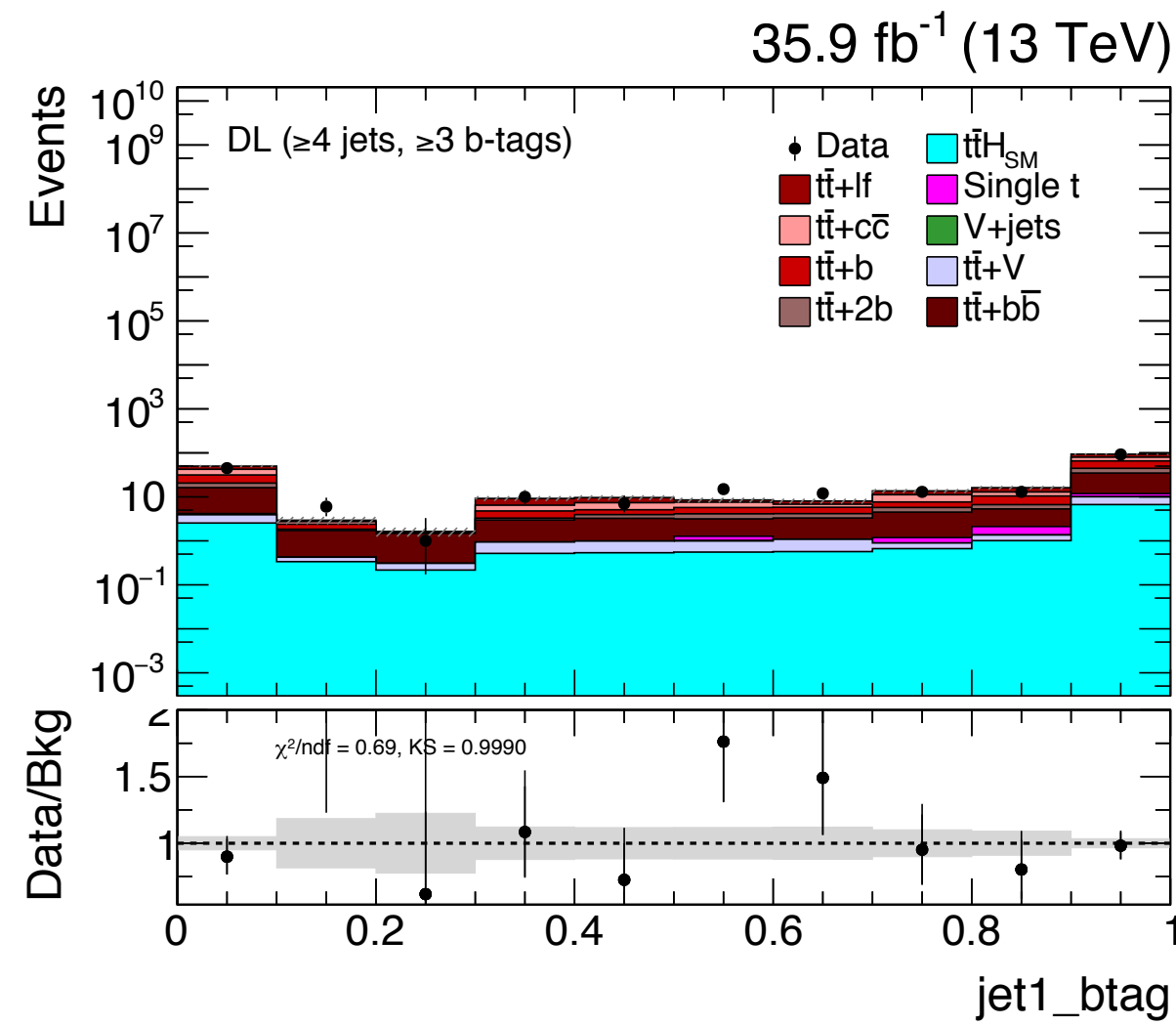
Comparing distributions for 2016 vs 2017, for MEM>0.8



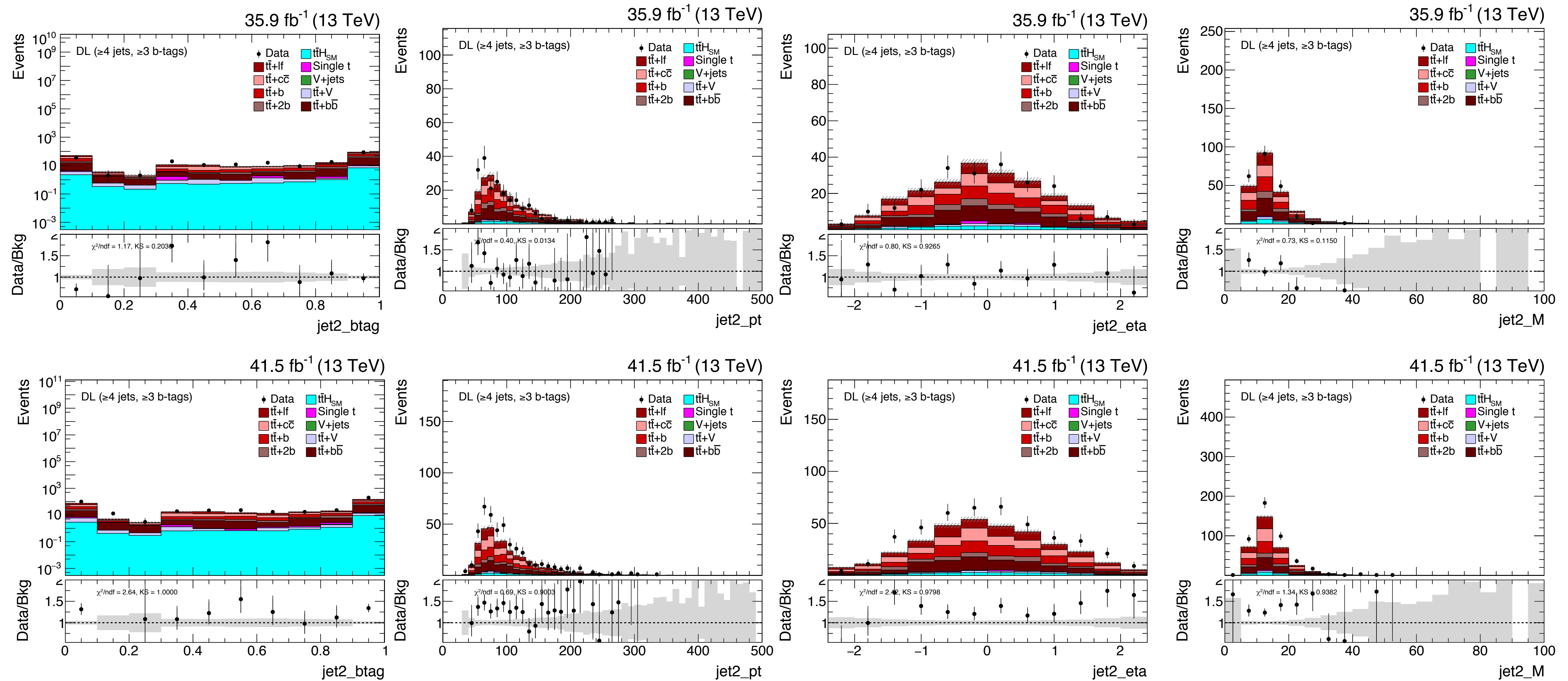
The largest differences are observed in the DeltaR variables
Seem better modelled in 2016 than in 2017
Such variables do not enter the MEM directly, but are strongly correlated with it



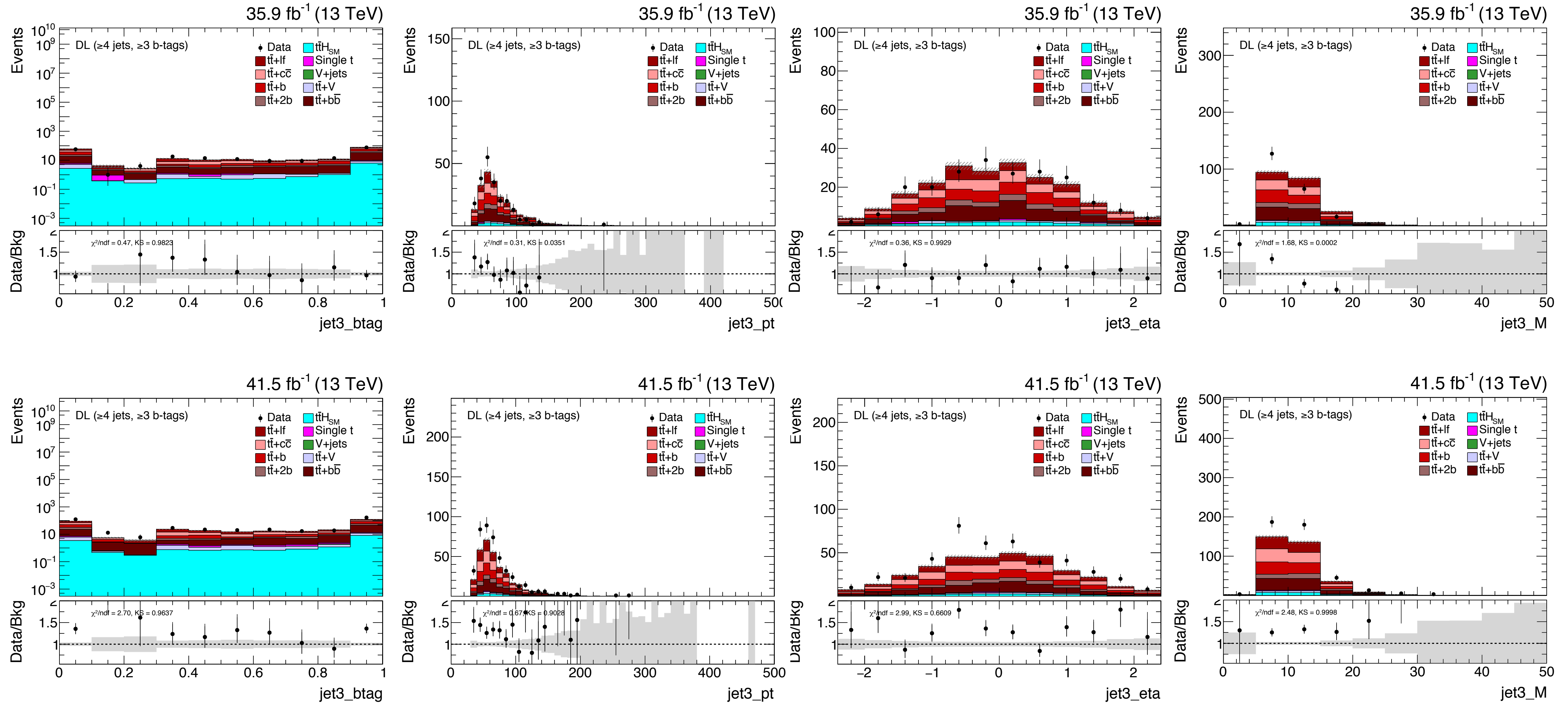
Comparing distributions for 2016 vs 2017, for MEM>0.8



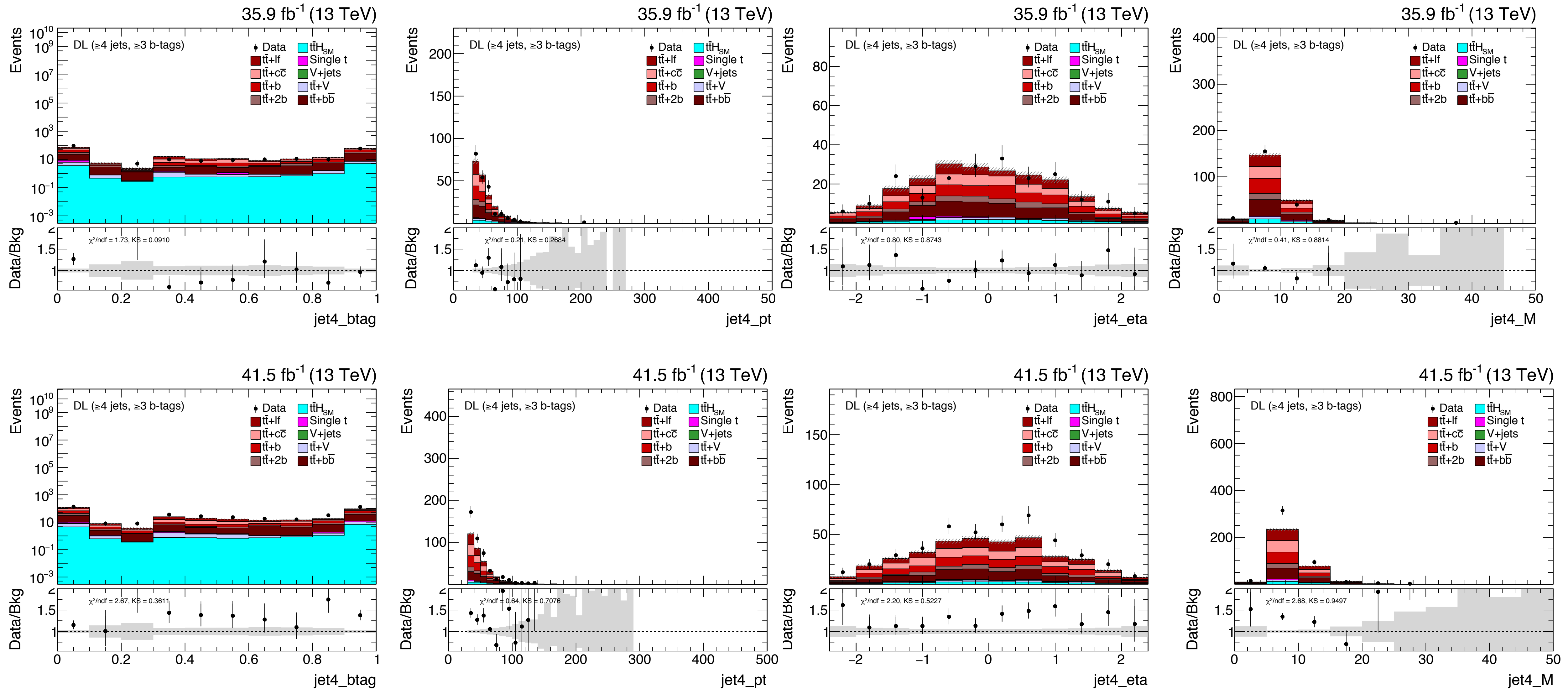
Comparing distributions for 2016 vs 2017, for MEM>0.8



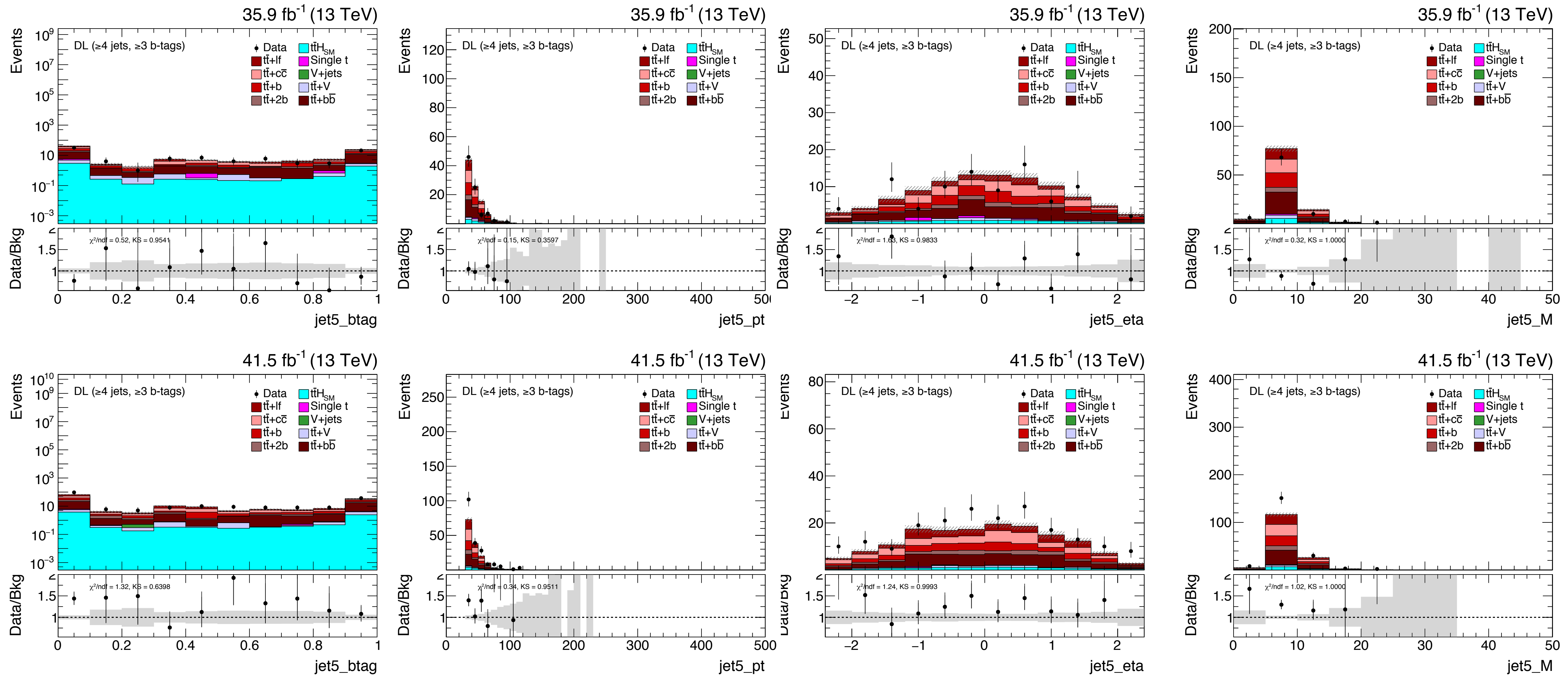
Comparing distributions for 2016 vs 2017, for MEM>0.8



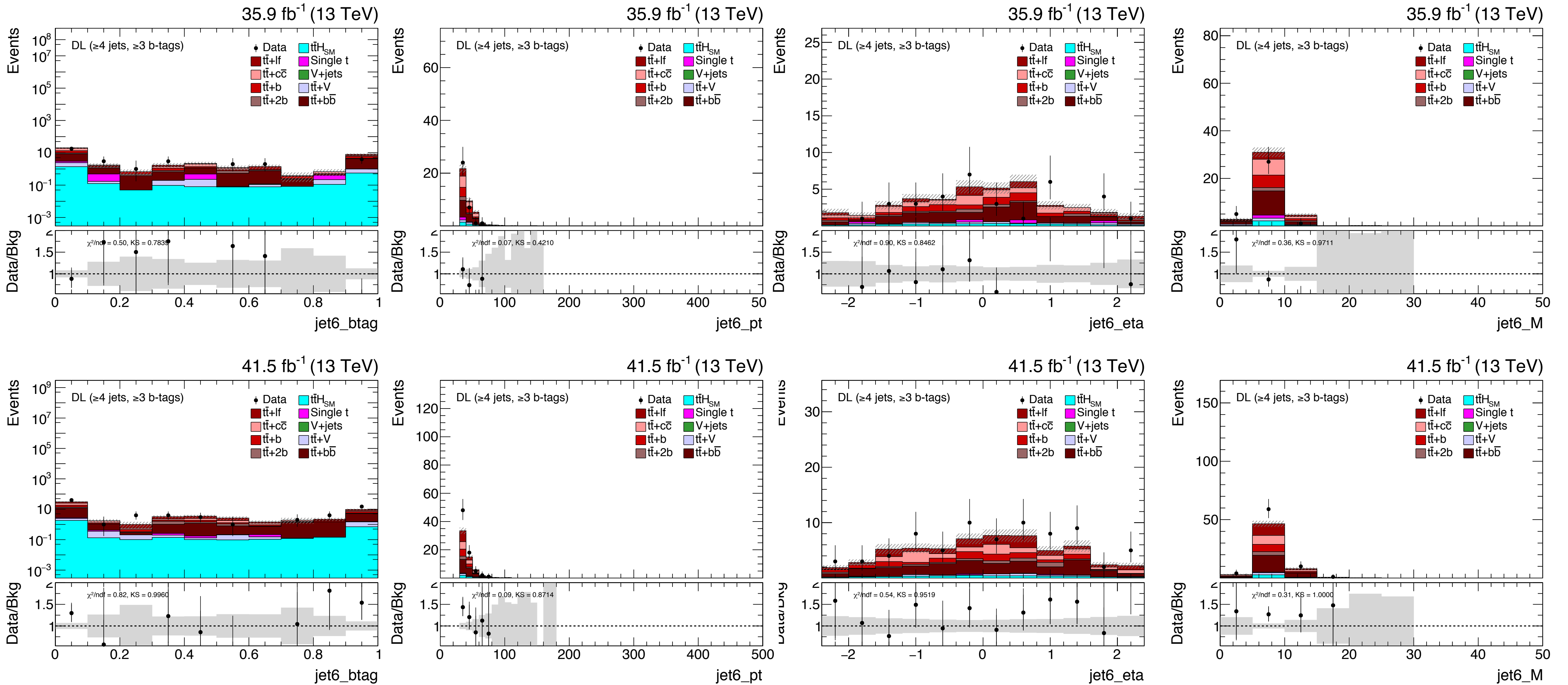
Comparing distributions for 2016 vs 2017, for MEM>0.8



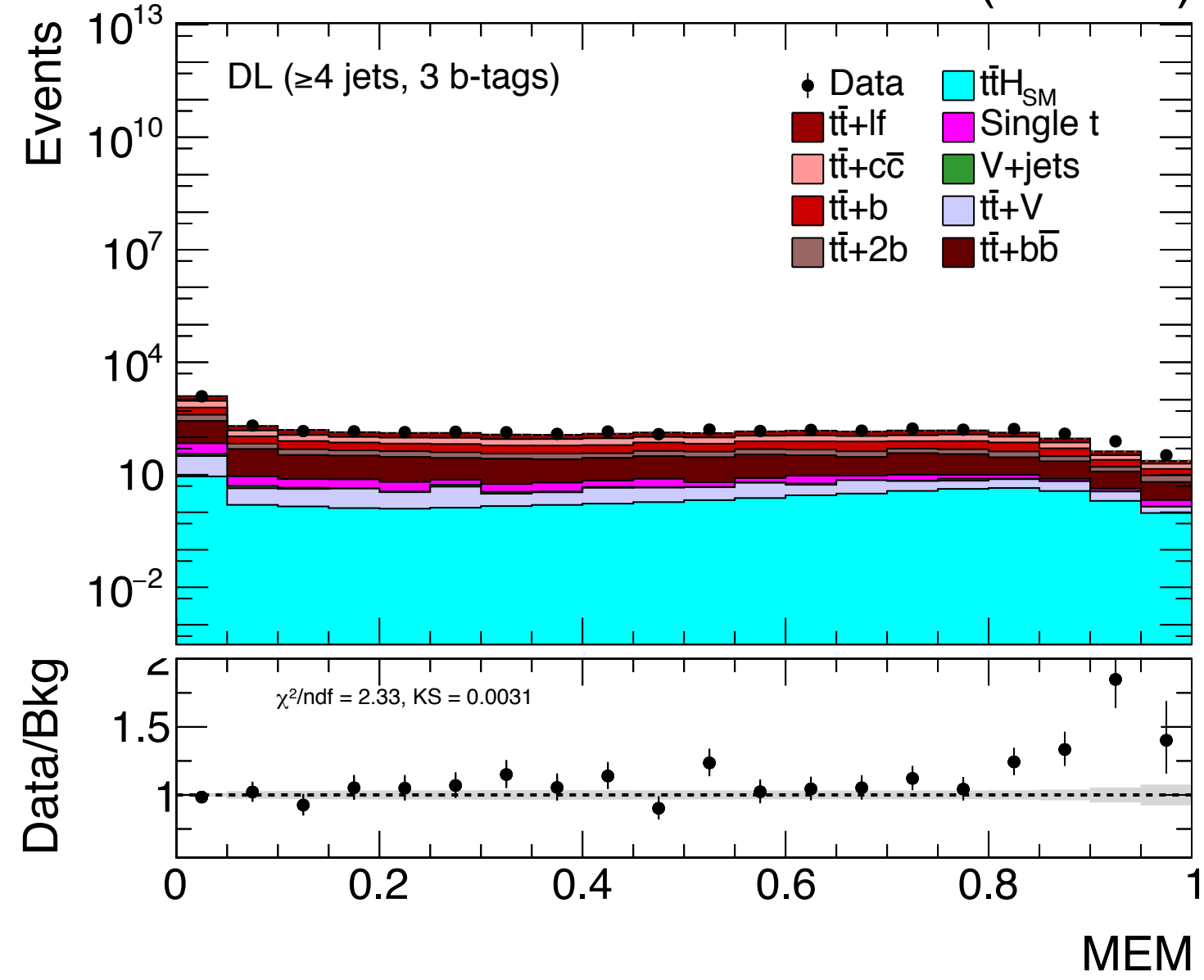
Comparing distributions for 2016 vs 2017, for MEM>0.8



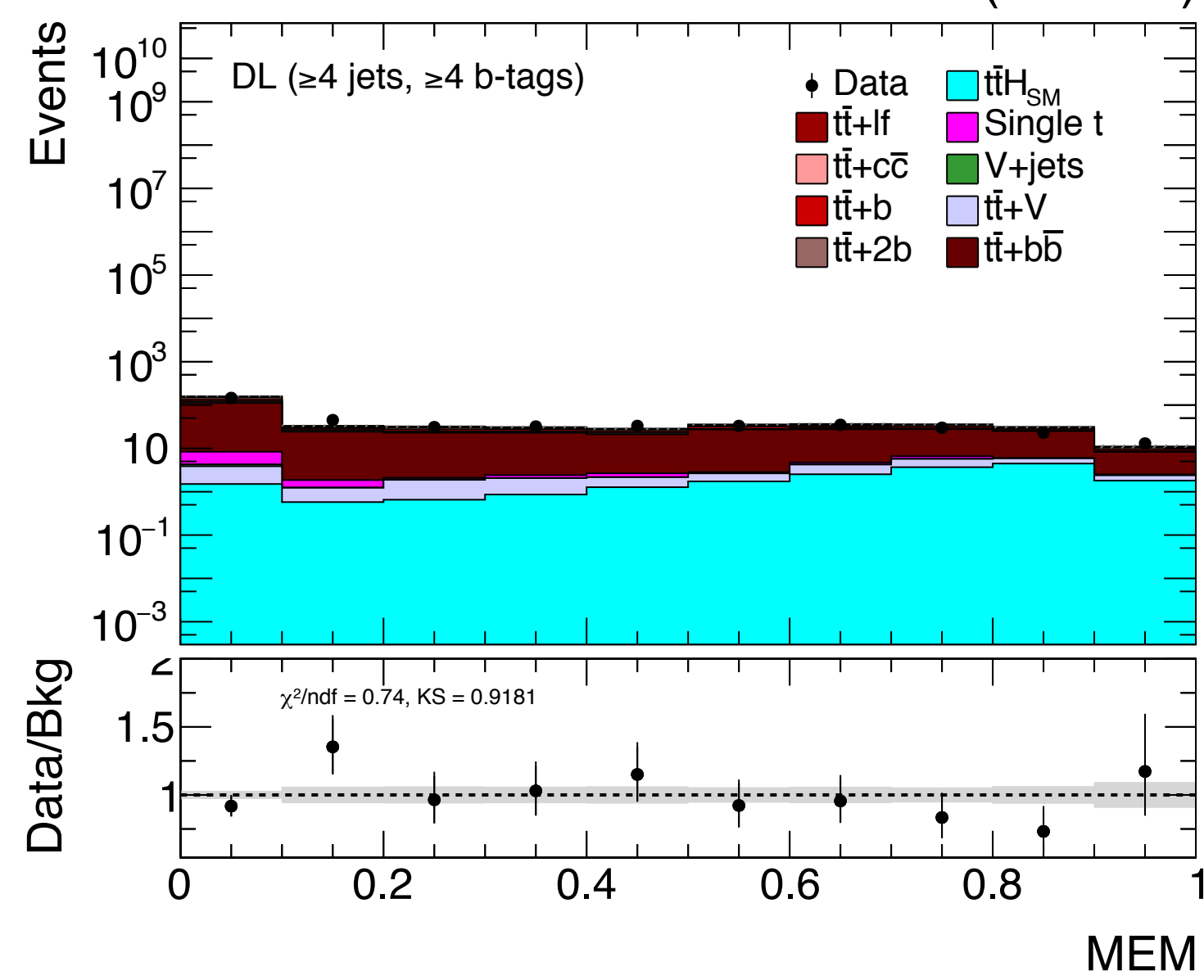
Comparing distributions for 2016 vs 2017, for MEM>0.8



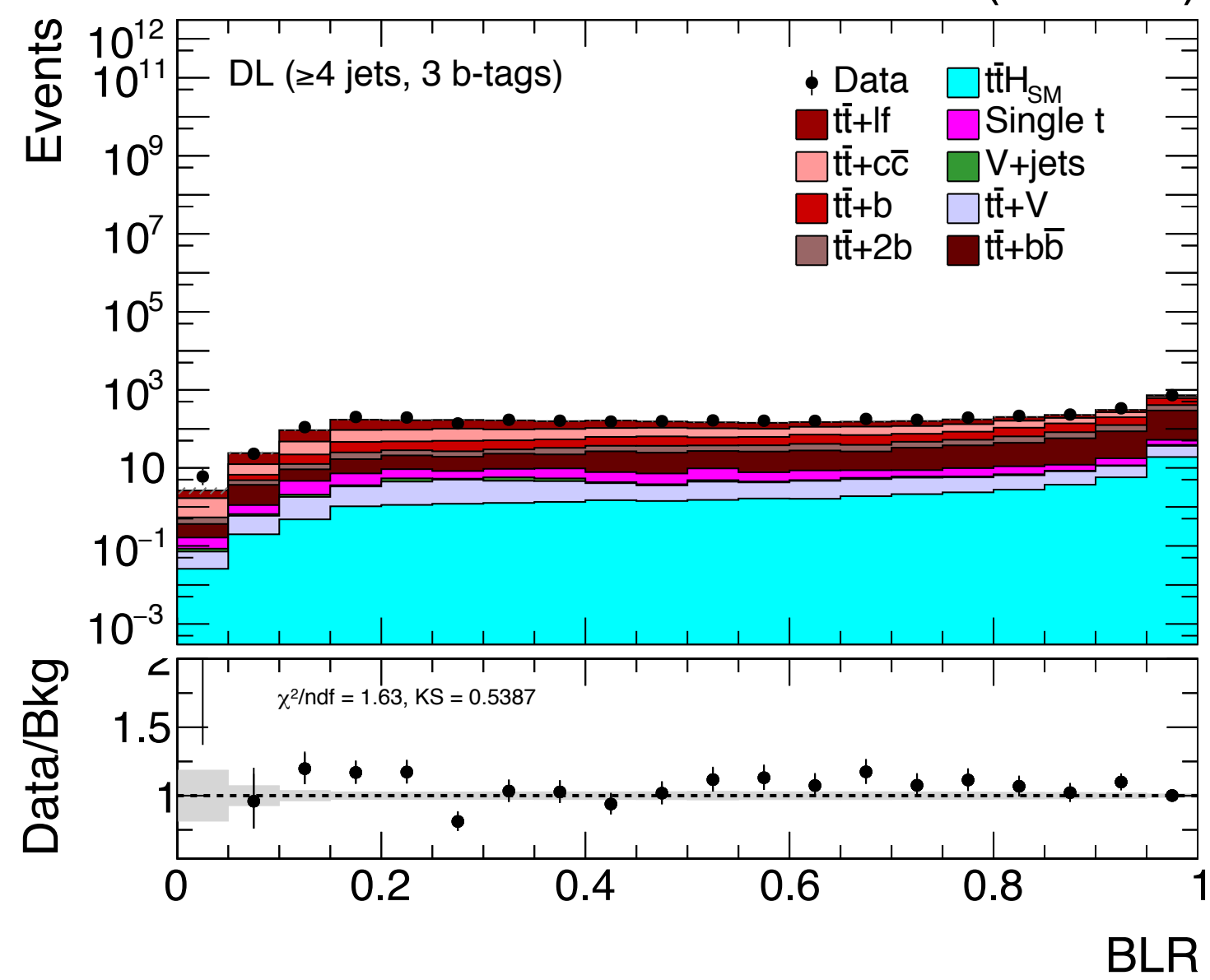
41.5 fb⁻¹ (13 TeV)



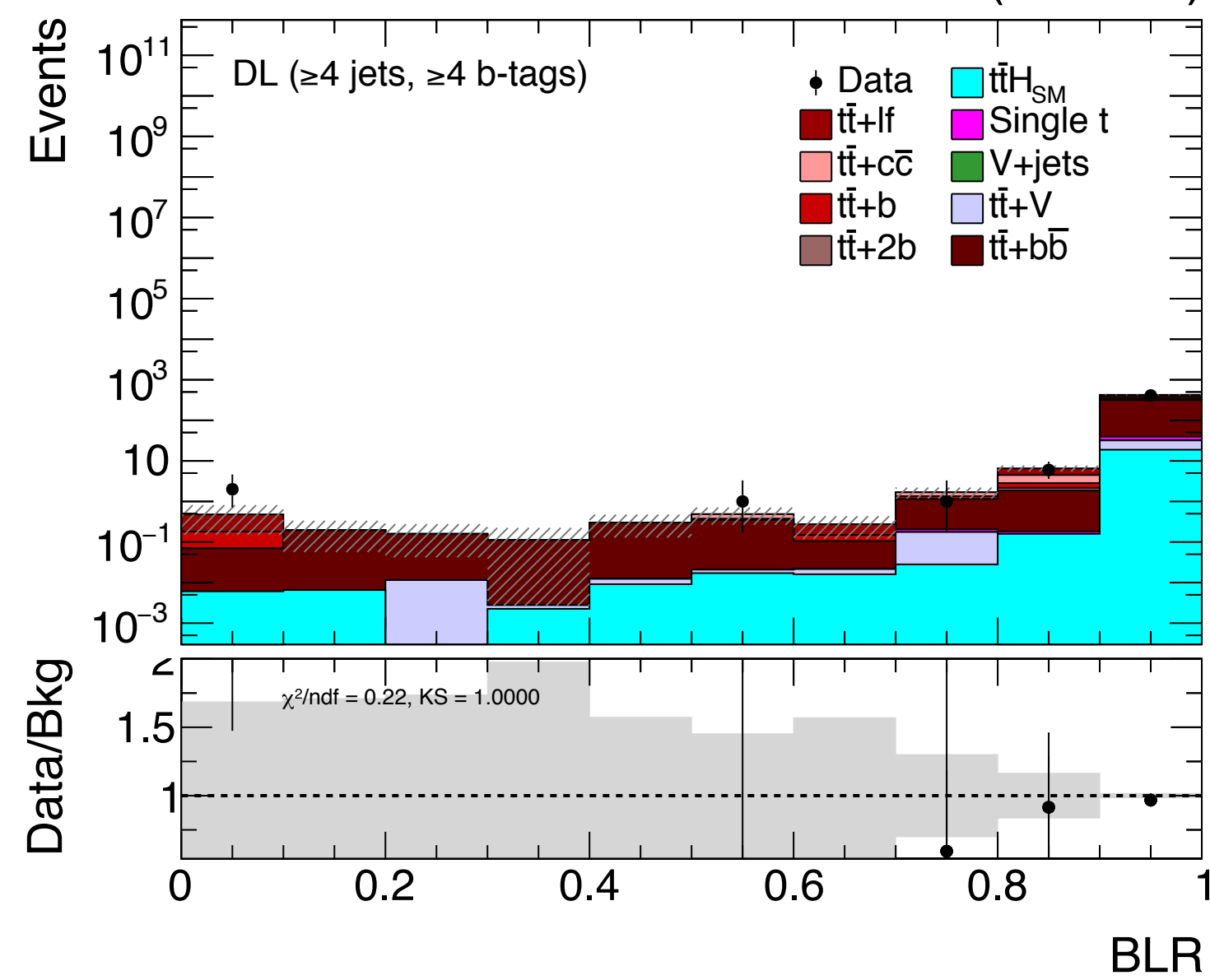
41.5 fb⁻¹ (13 TeV)



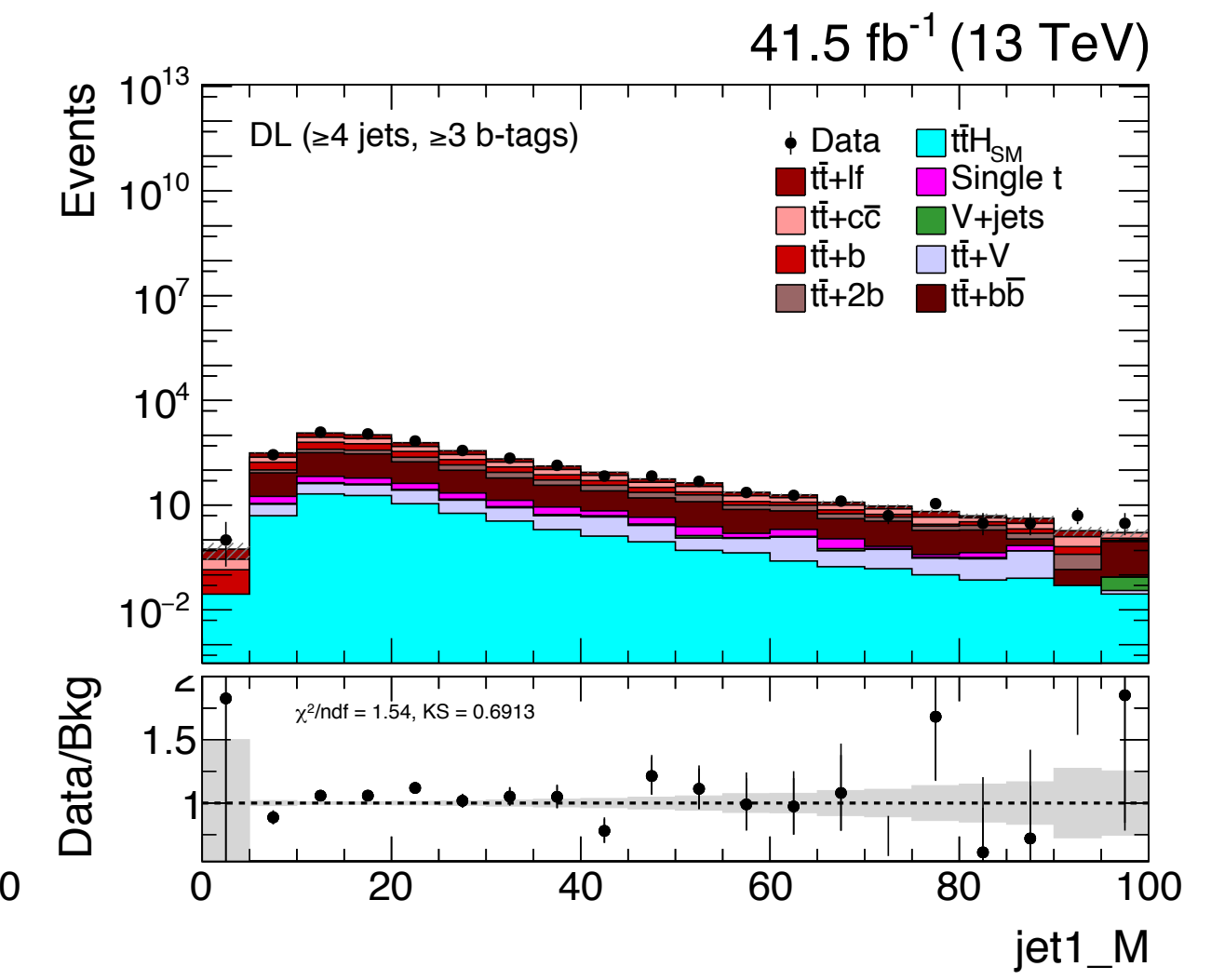
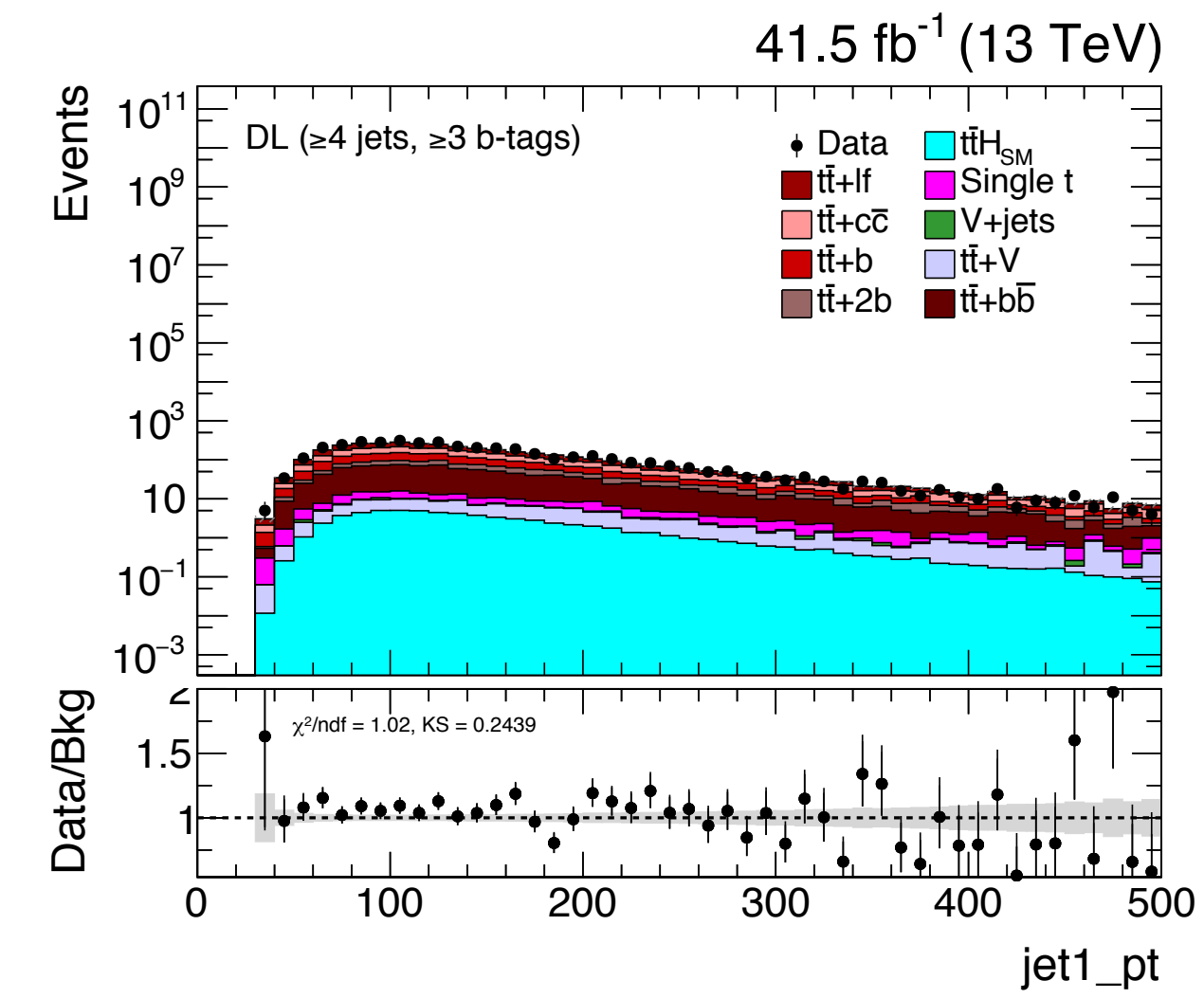
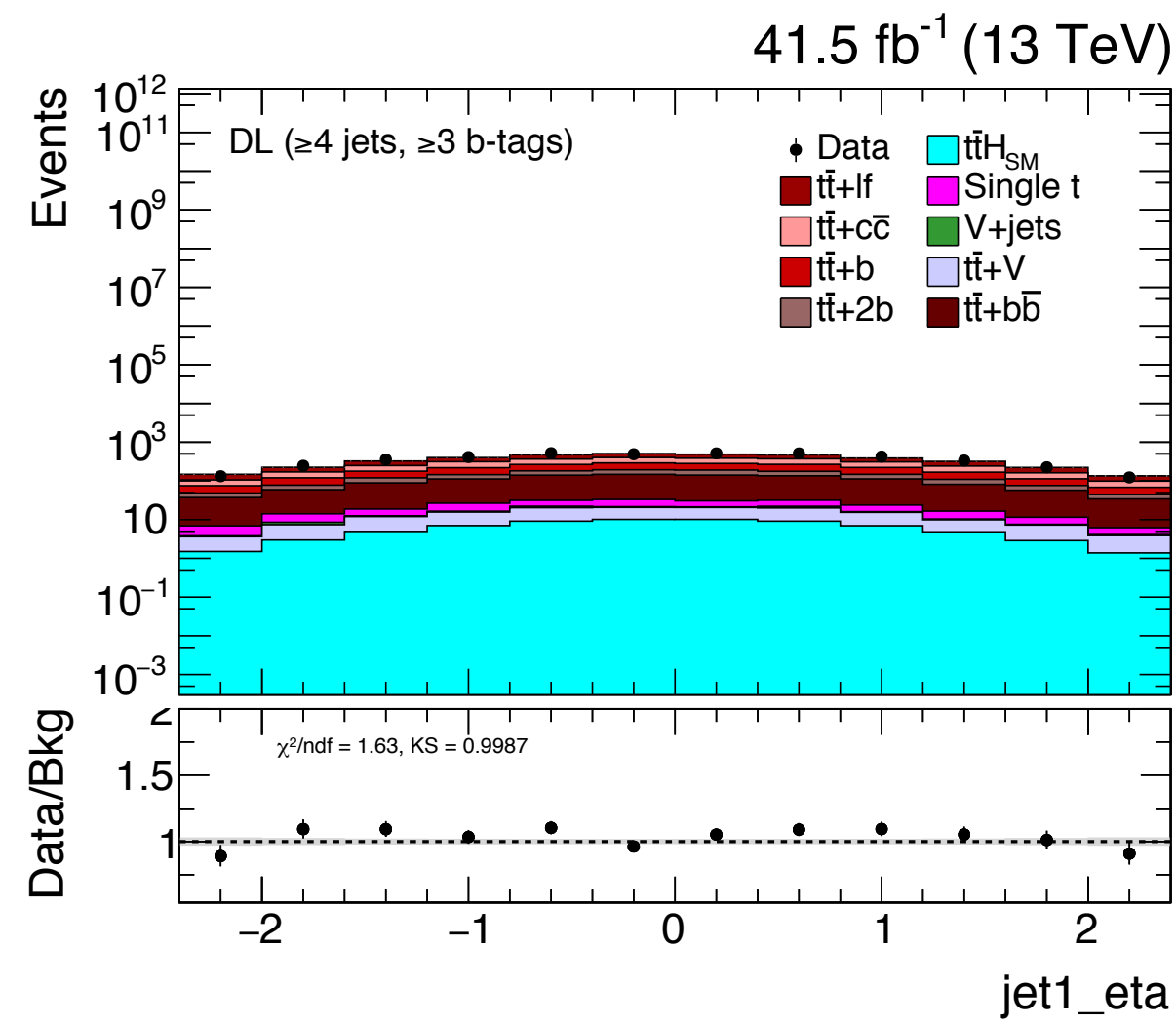
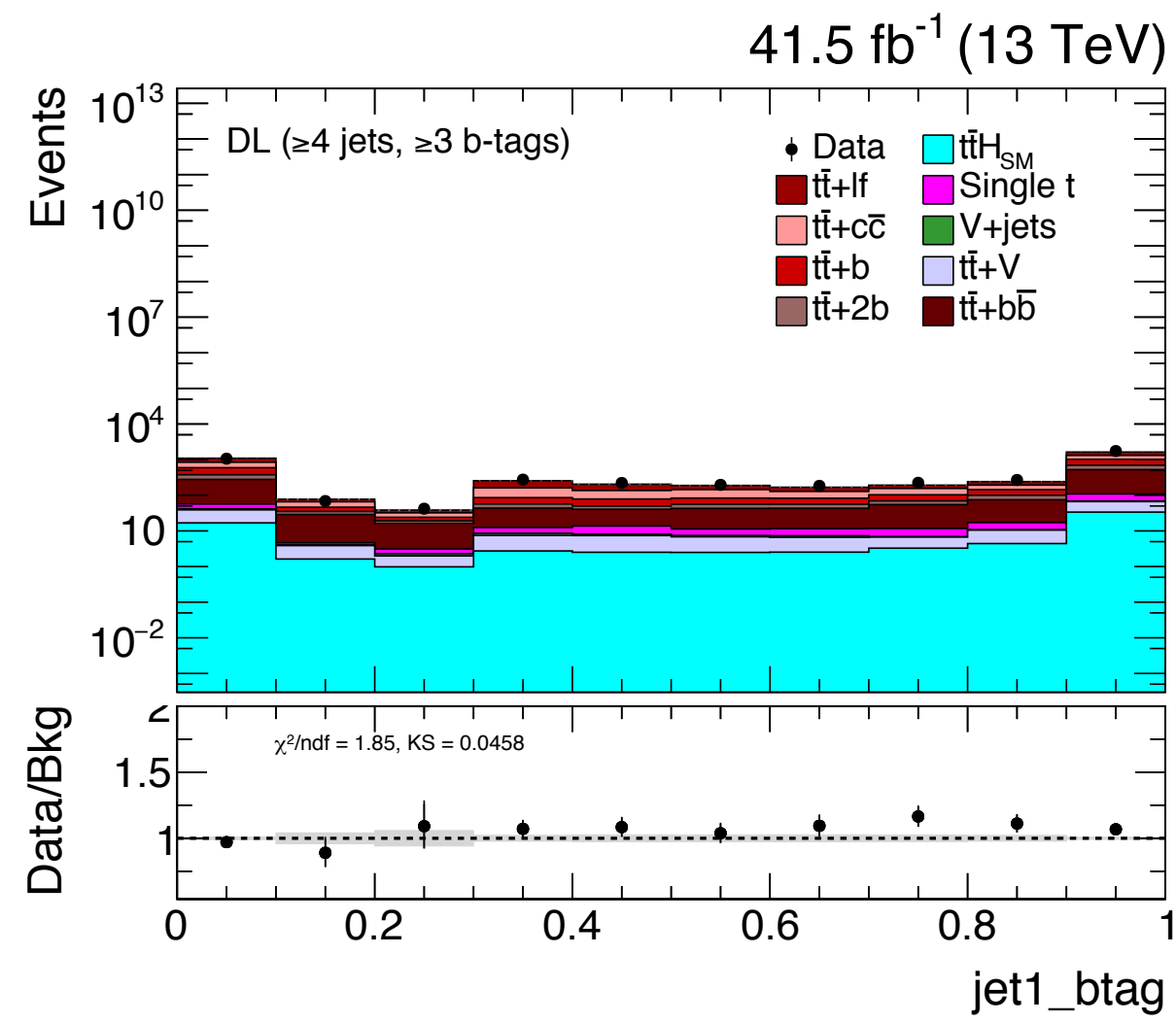
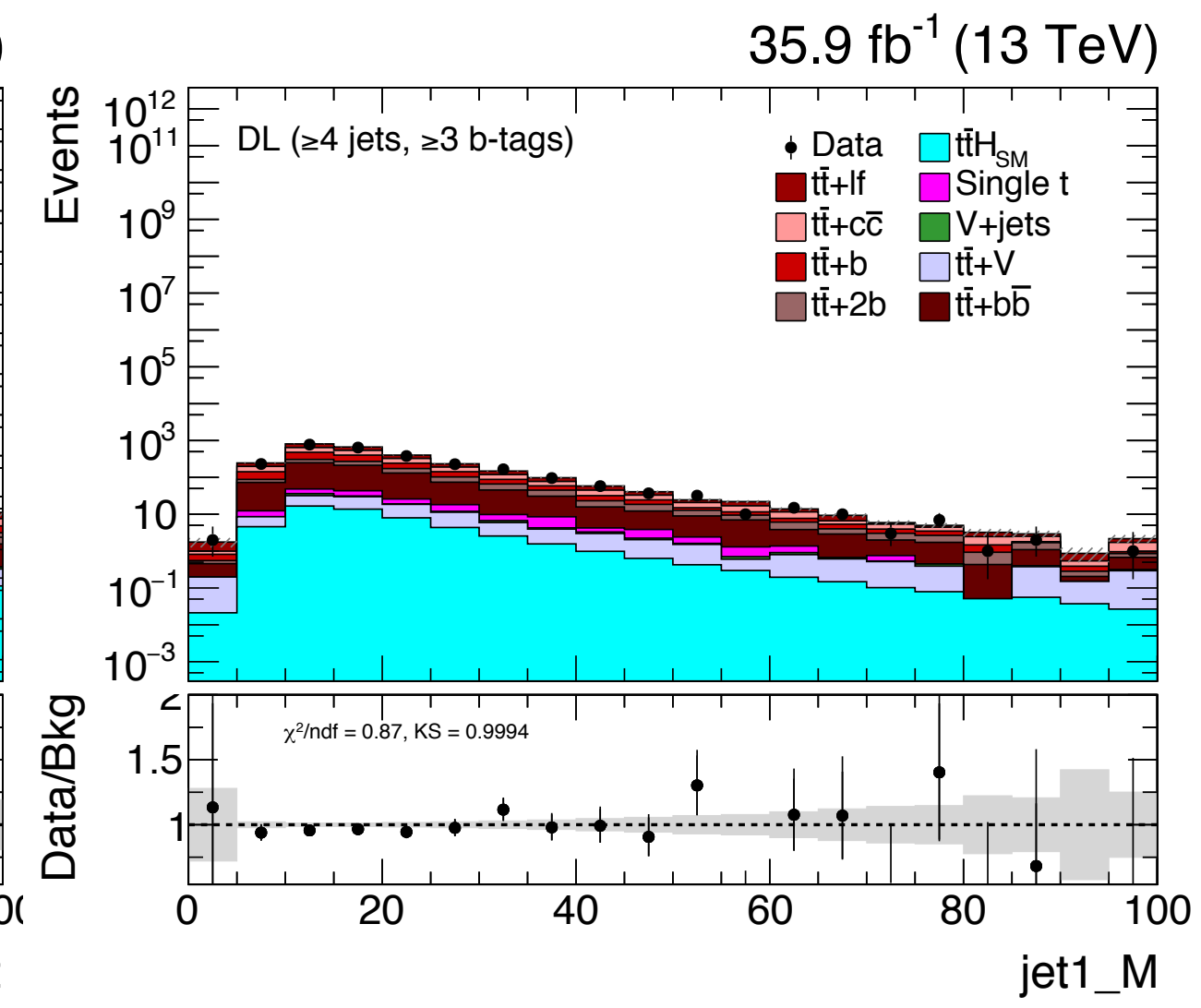
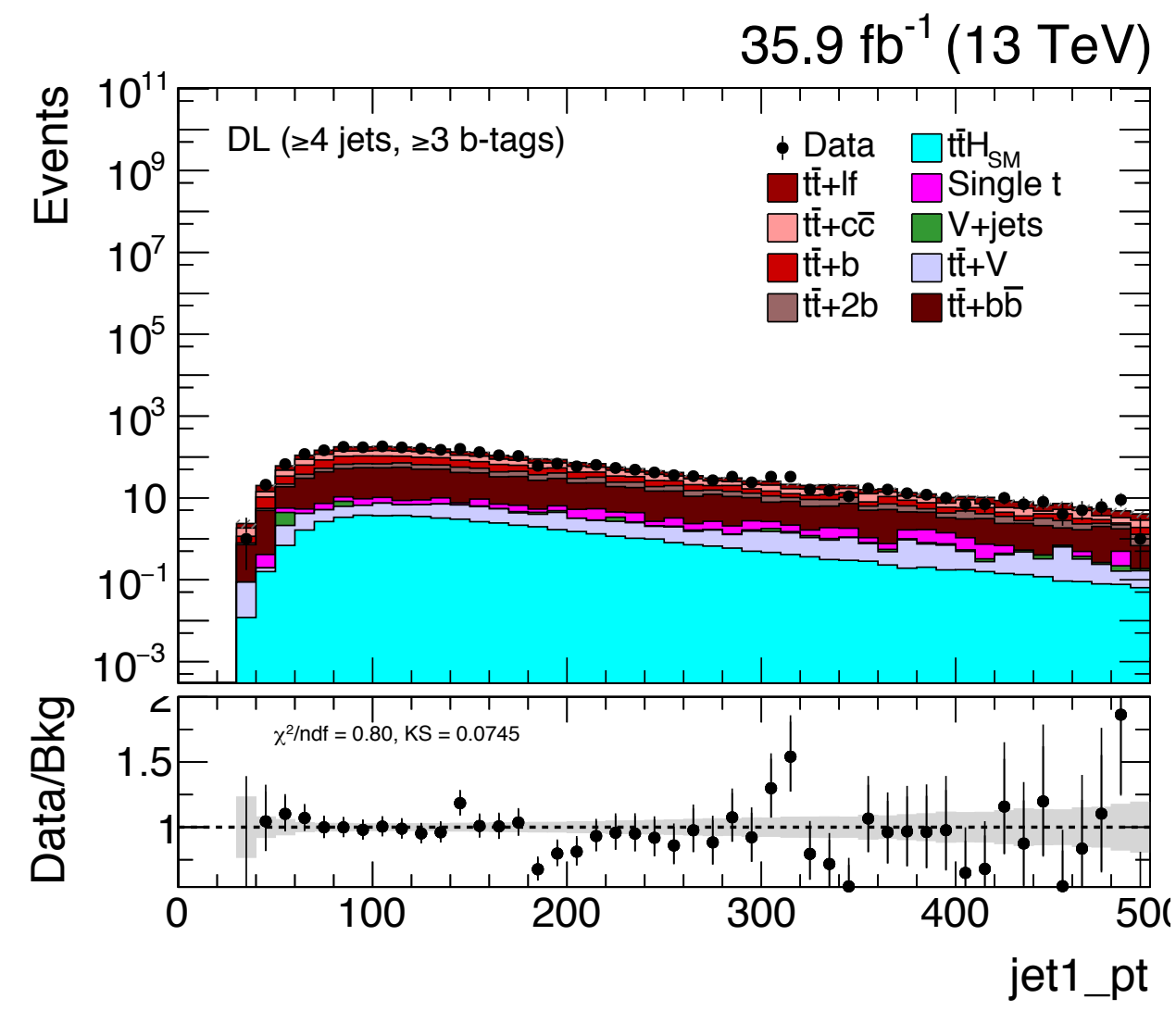
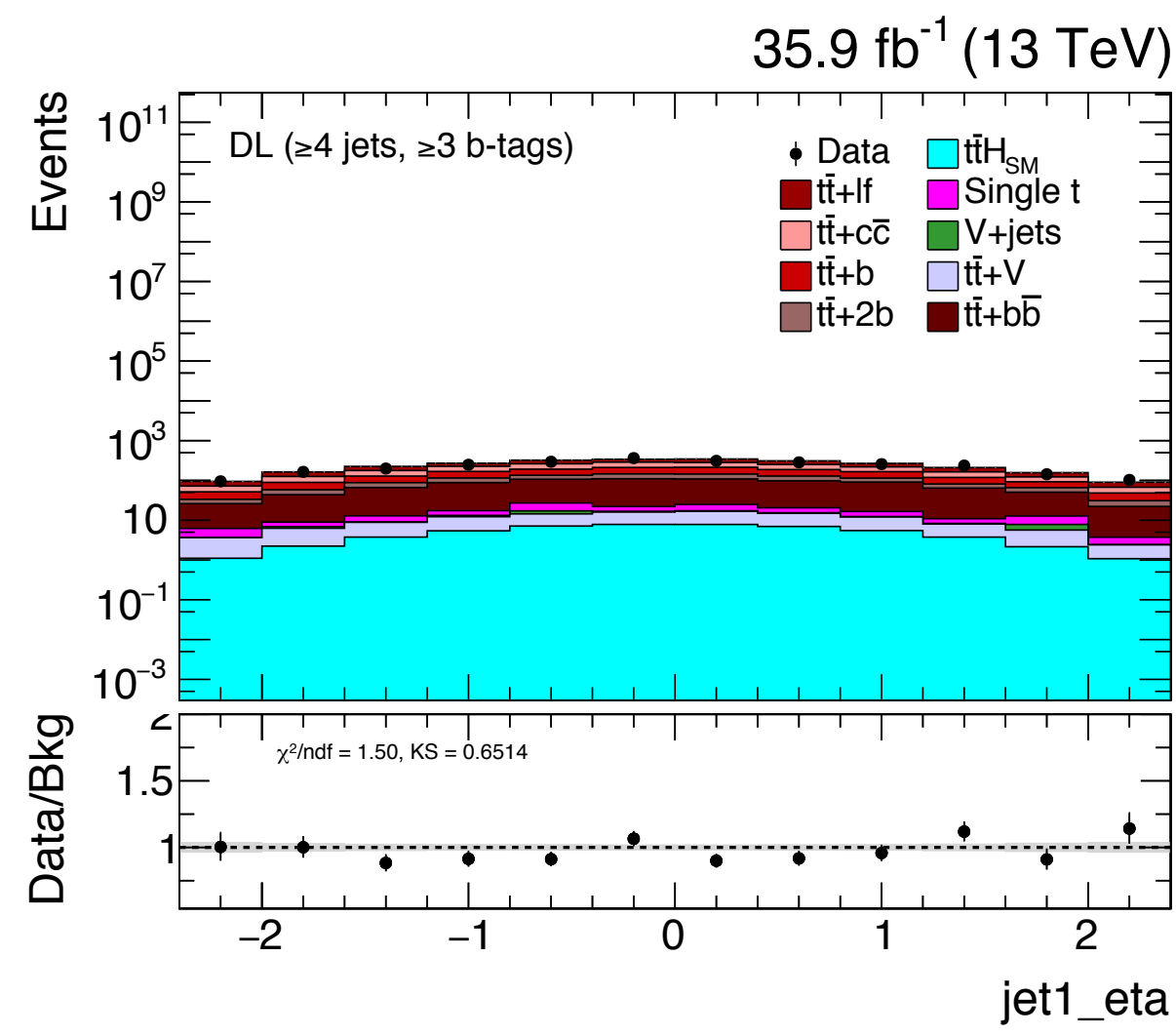
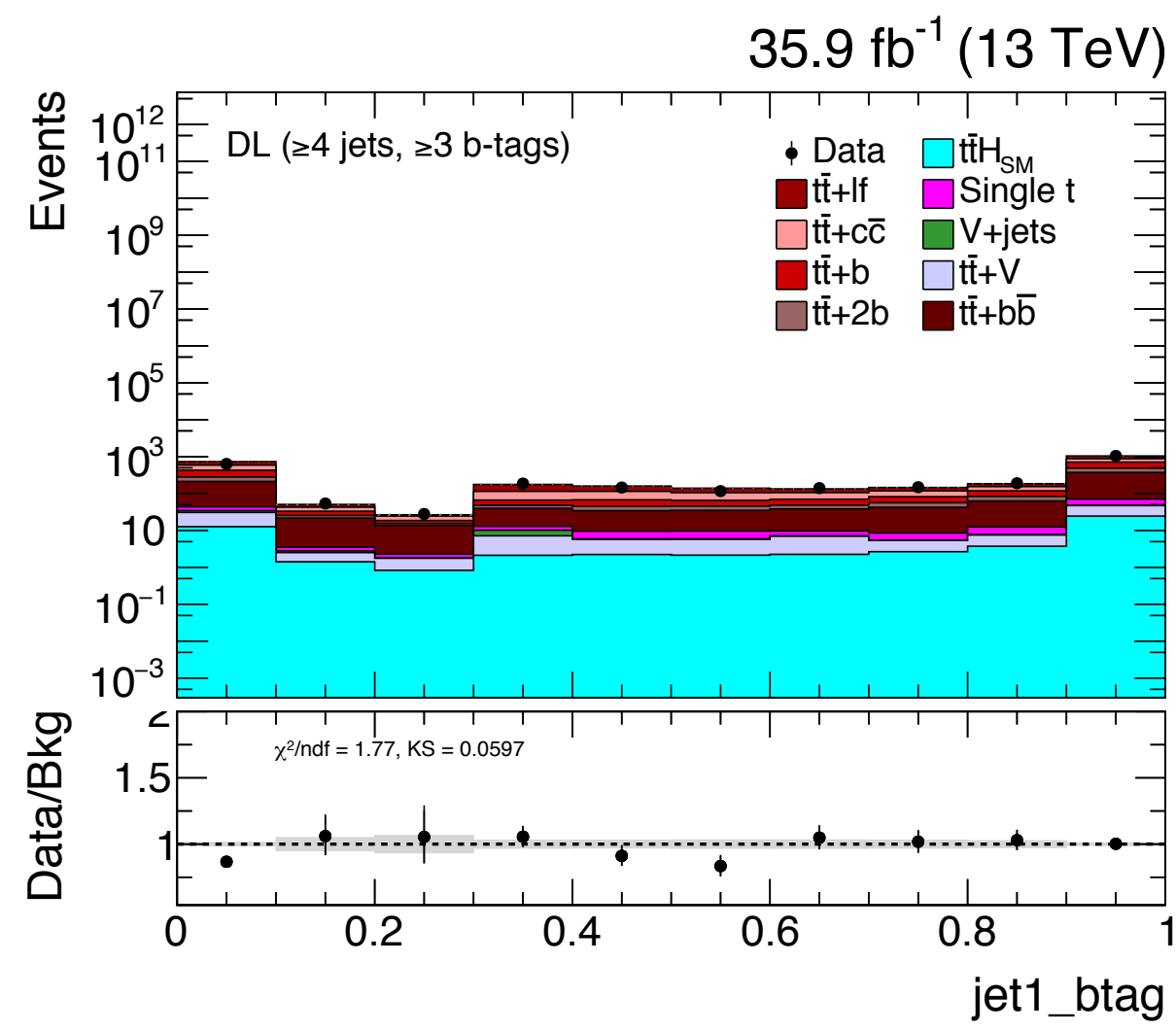
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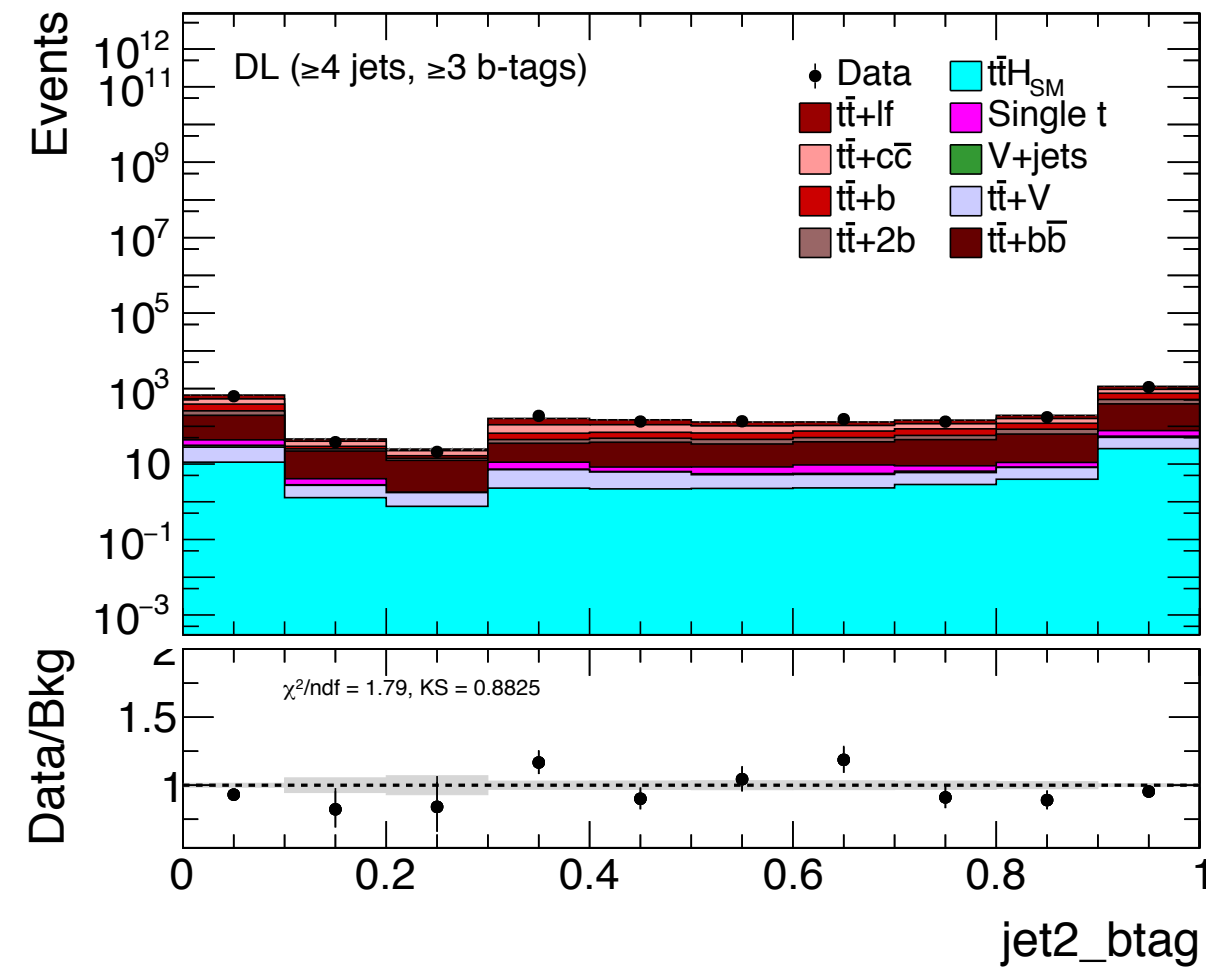
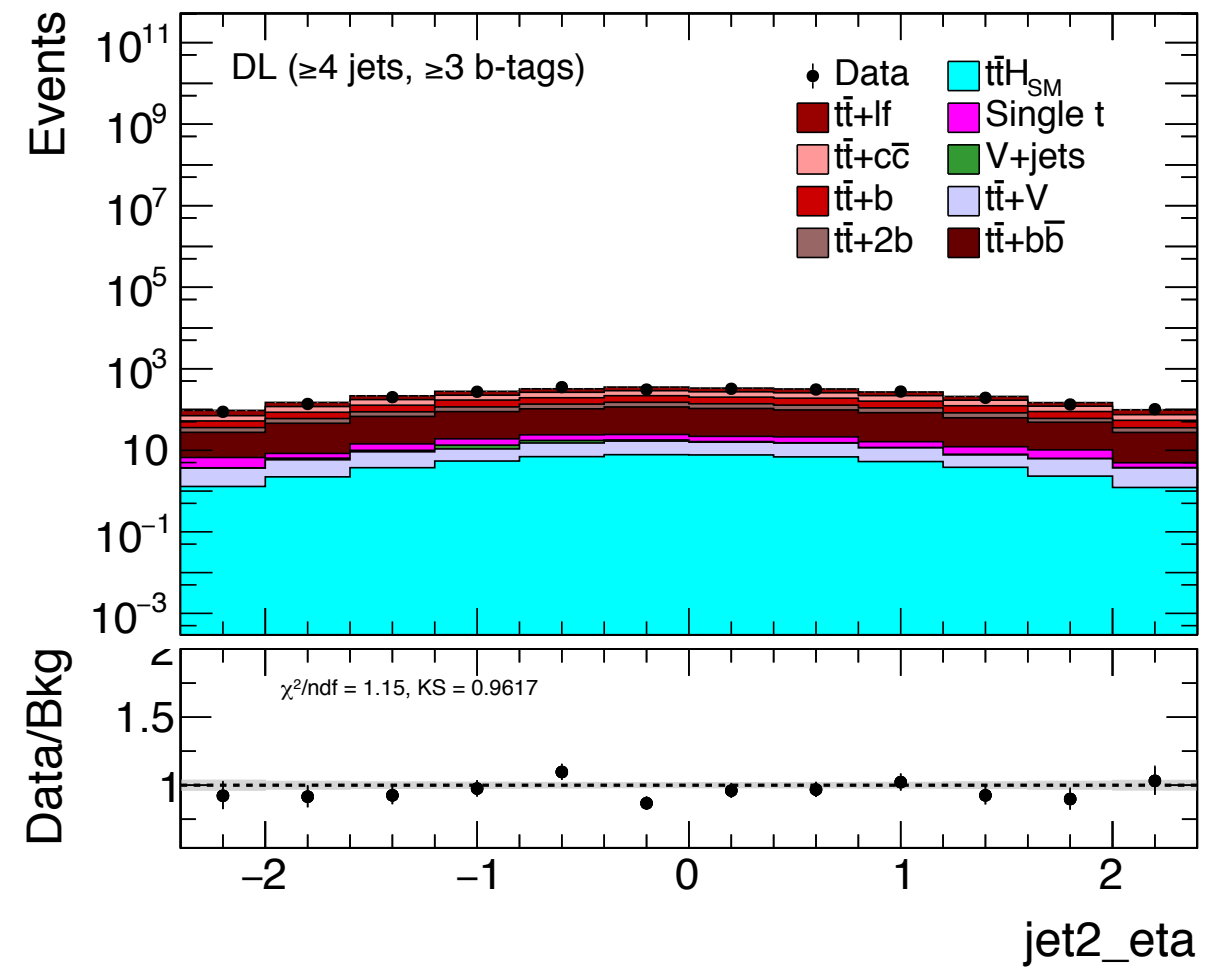
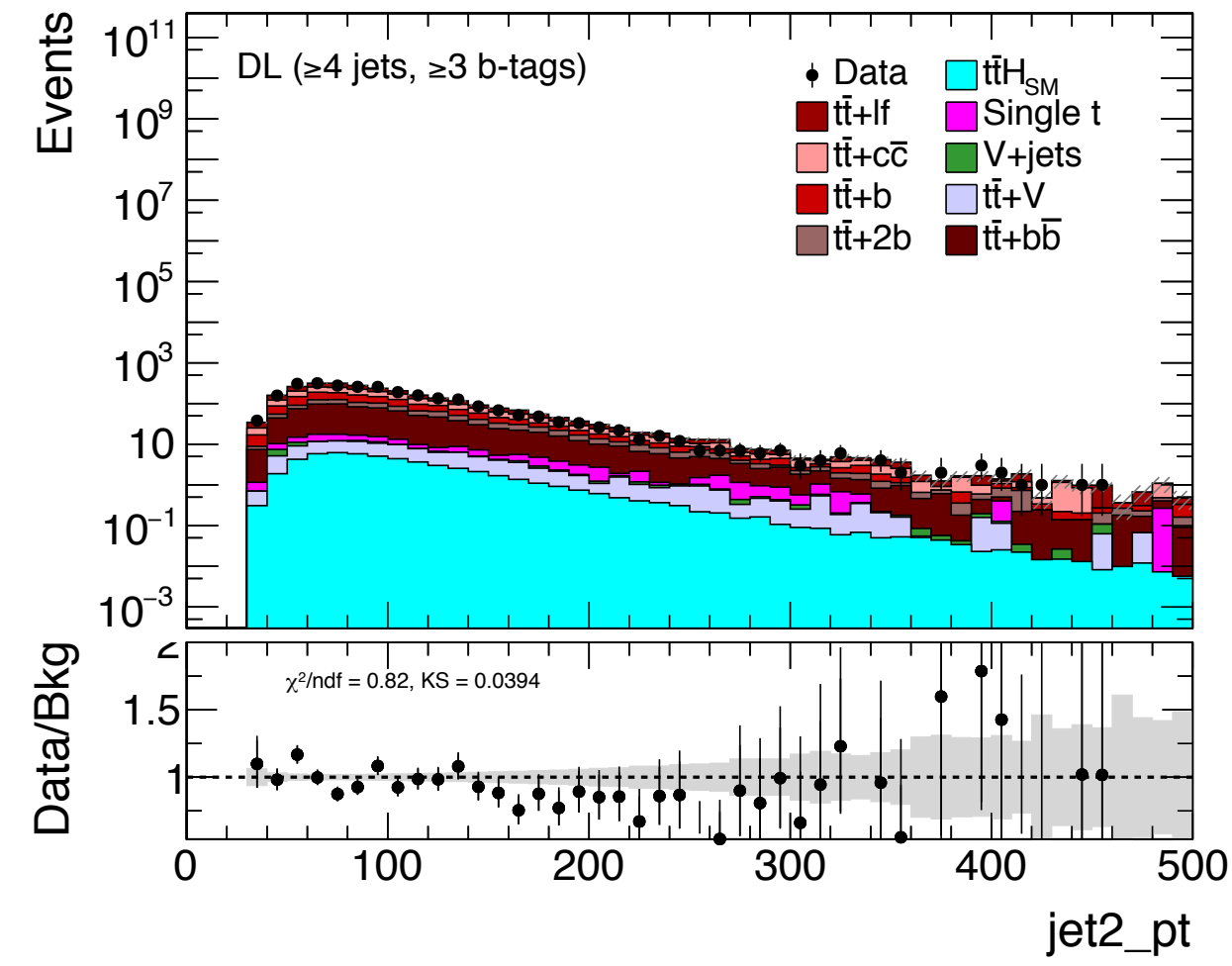
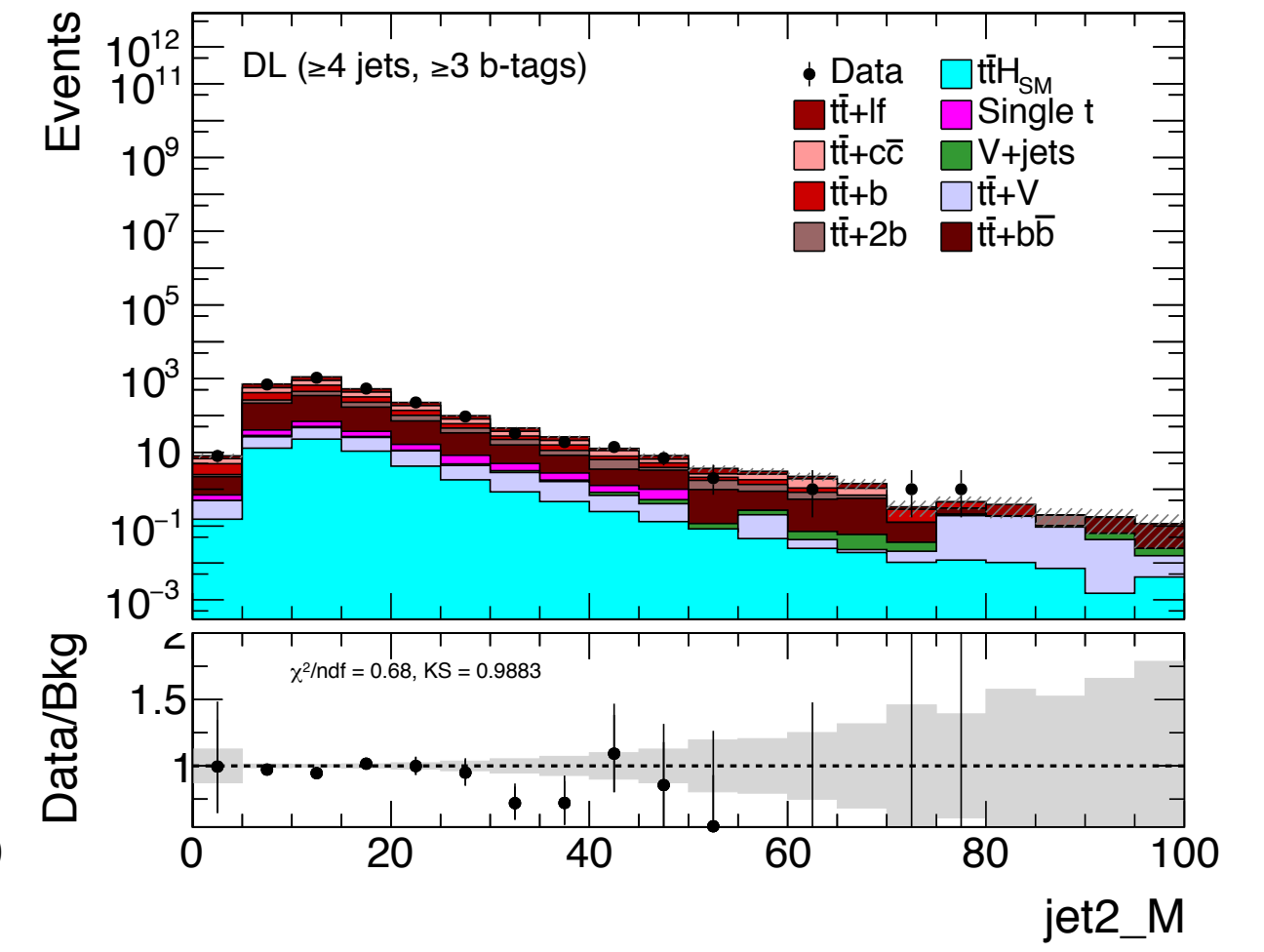
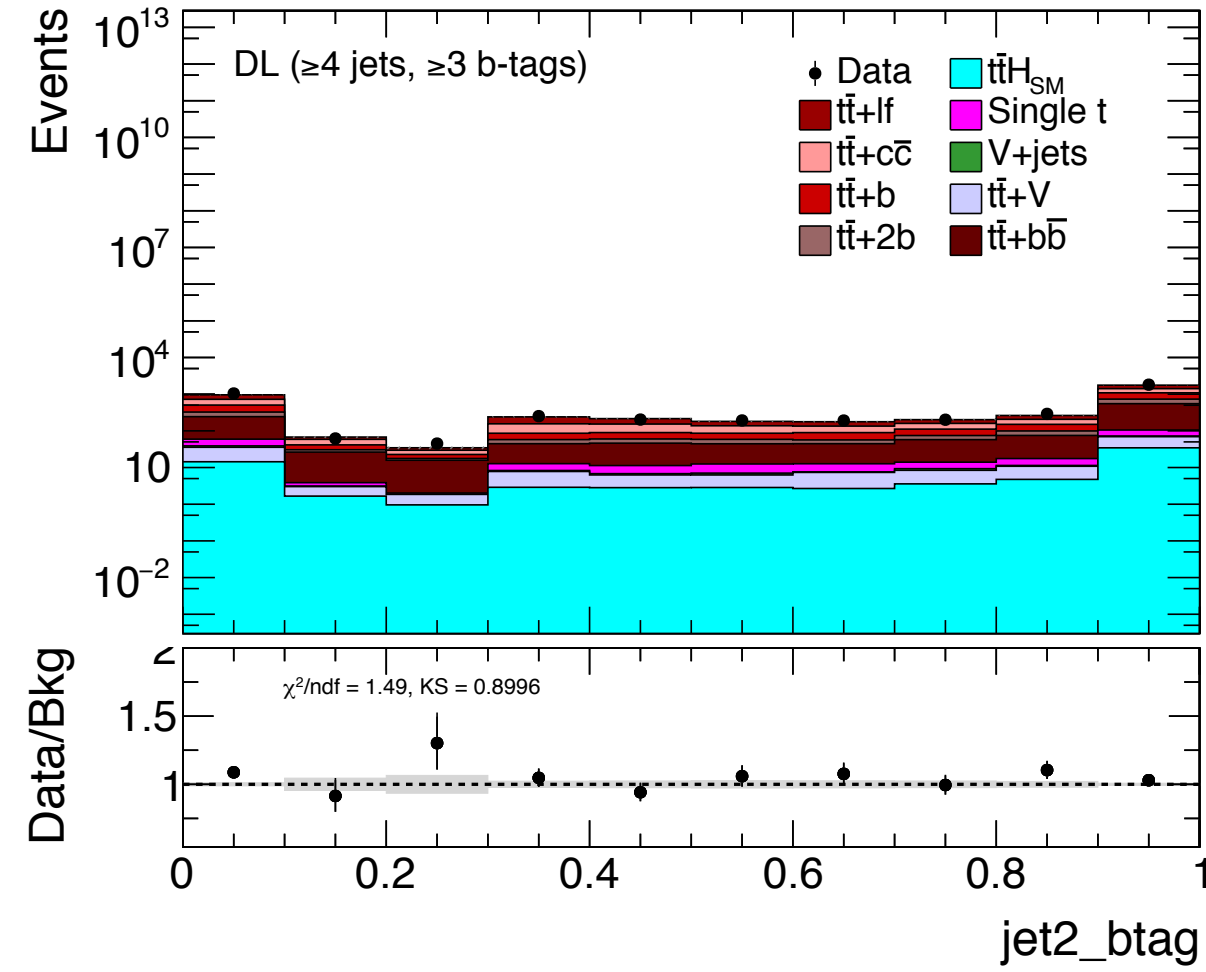
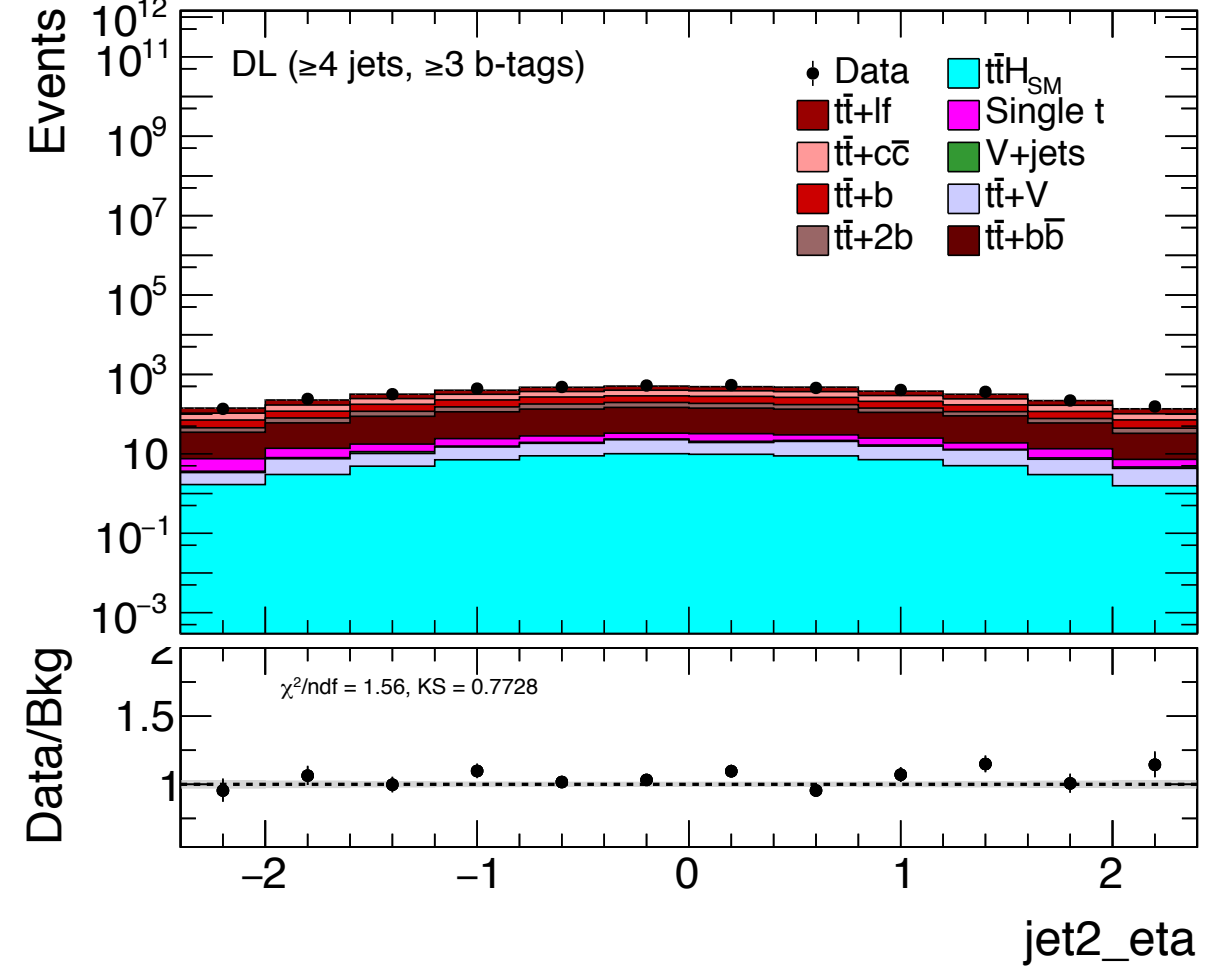
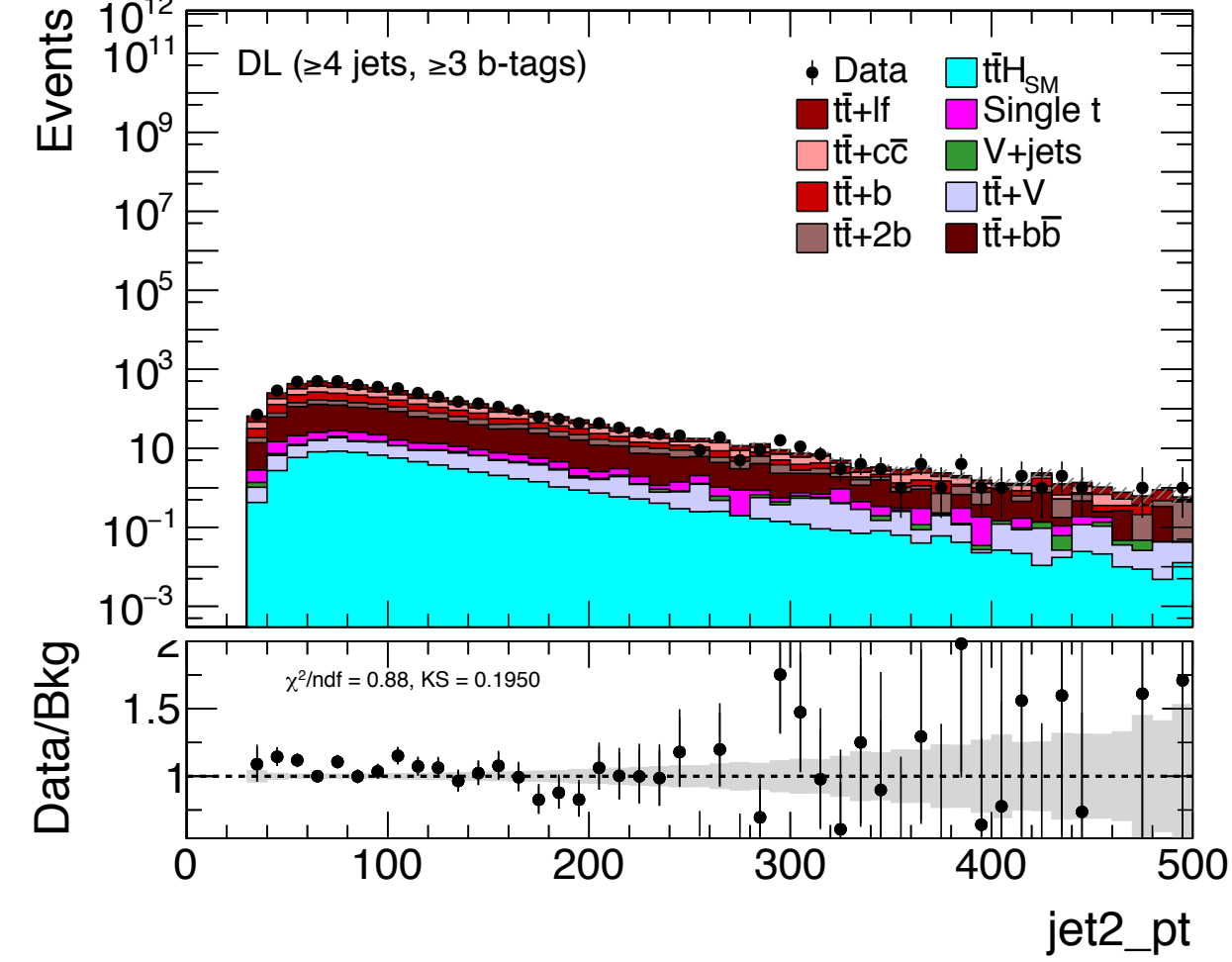
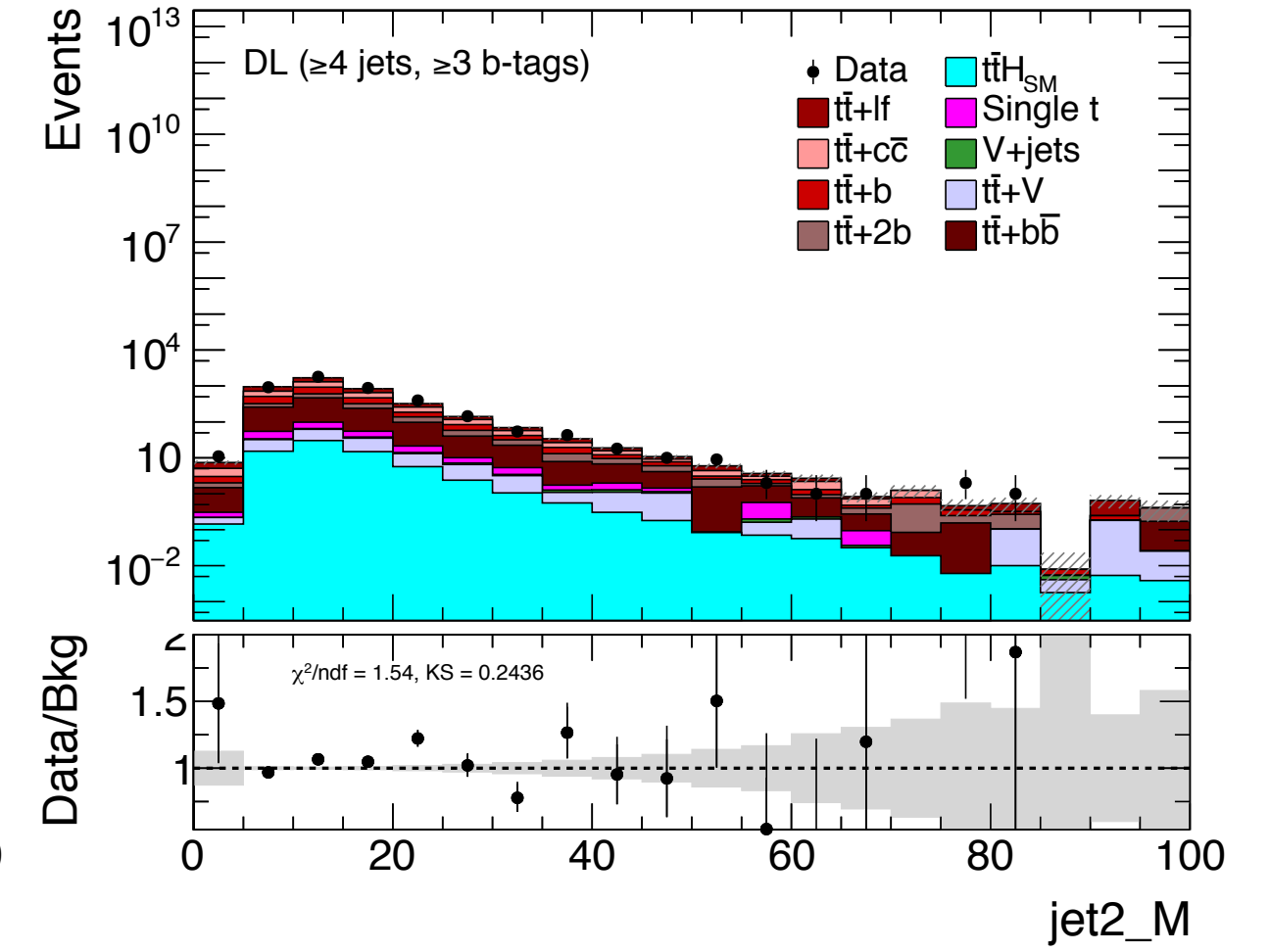


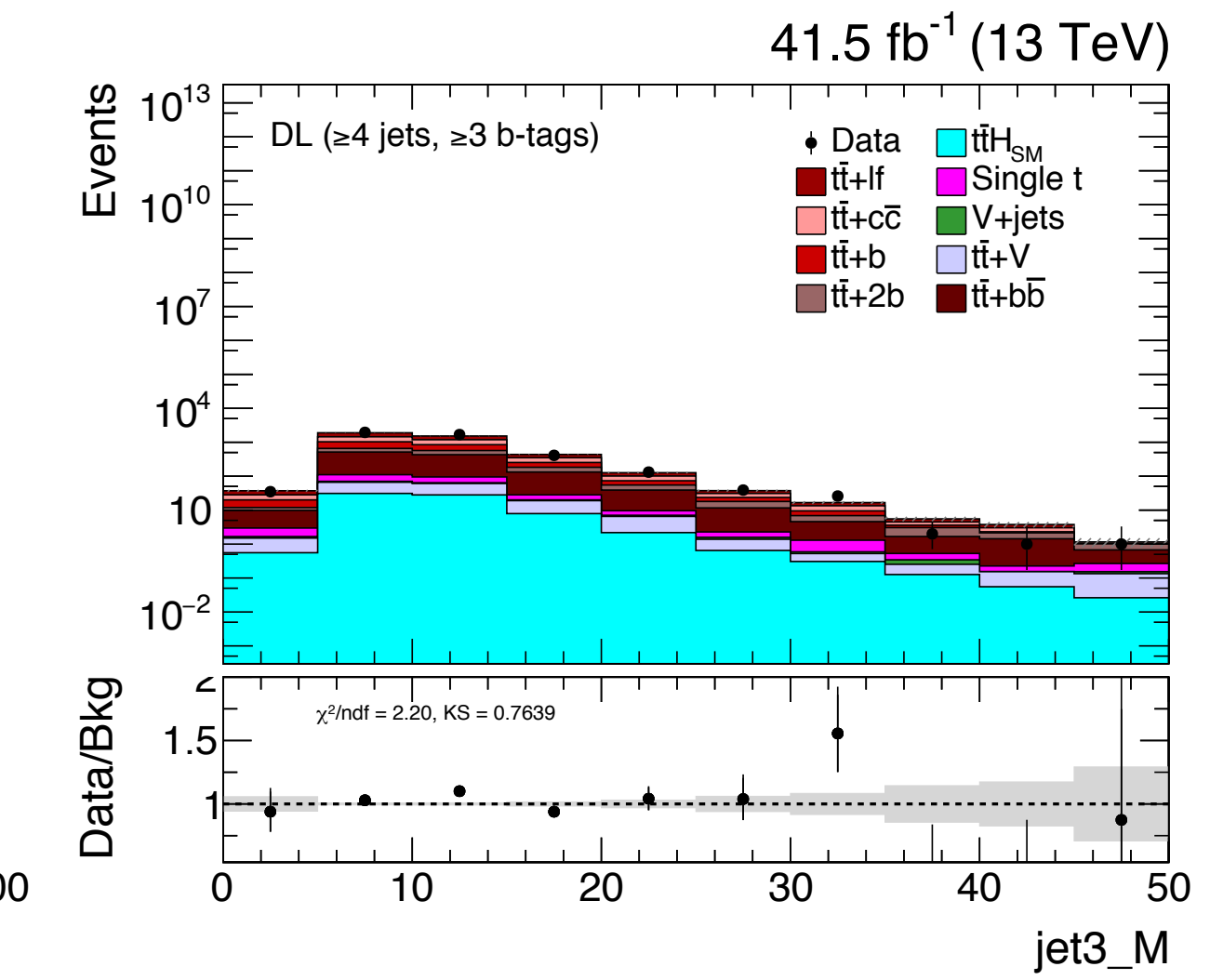
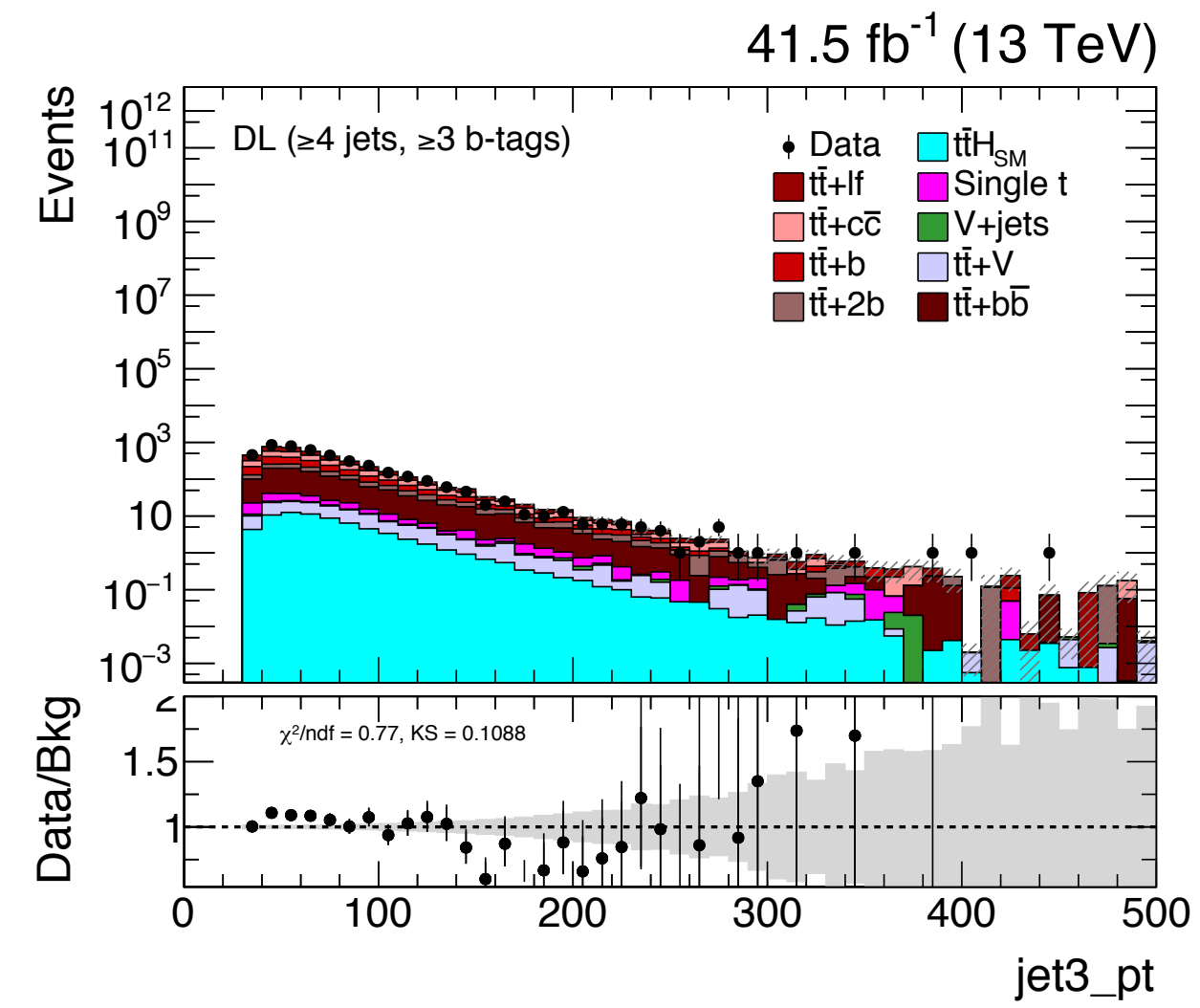
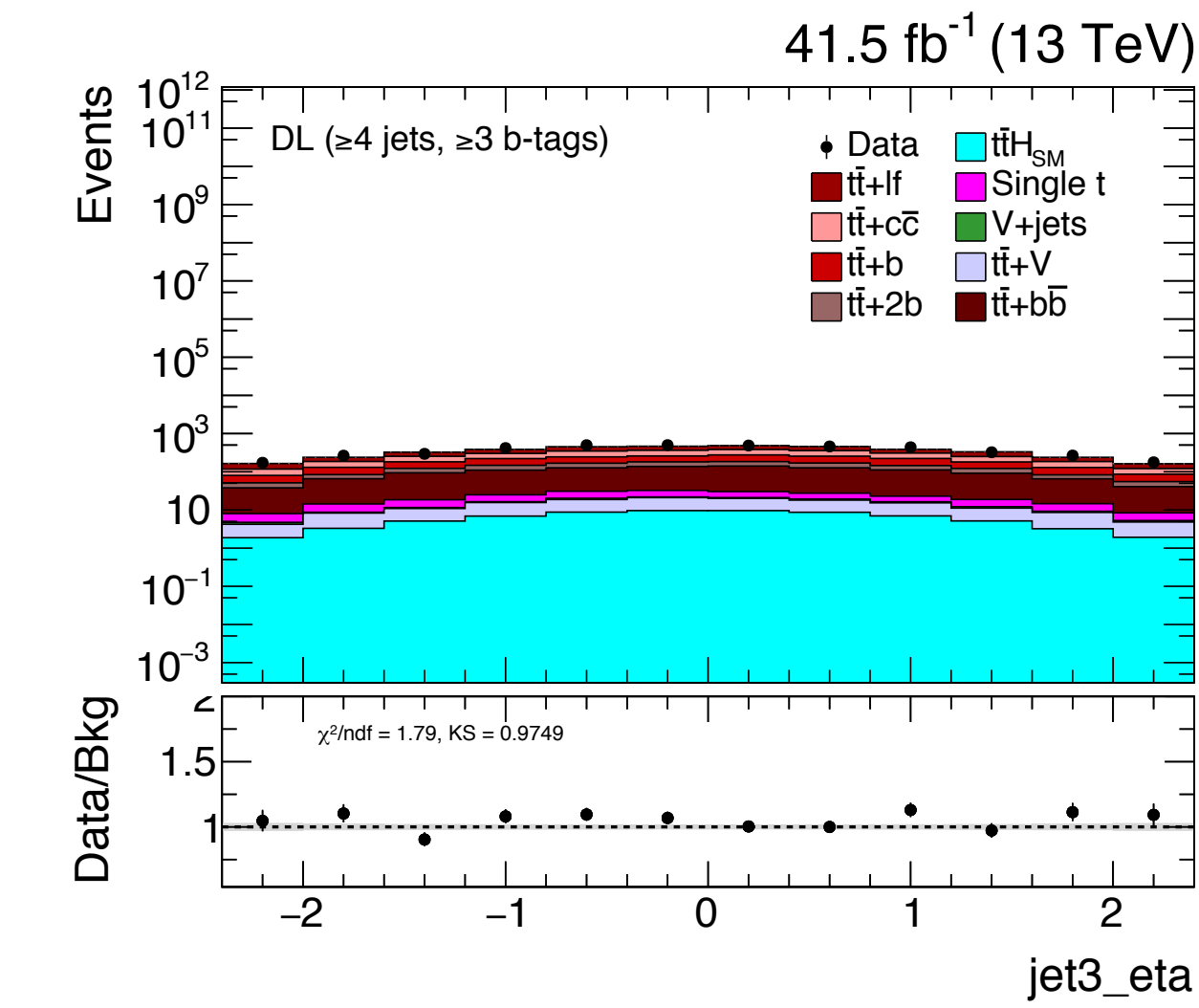
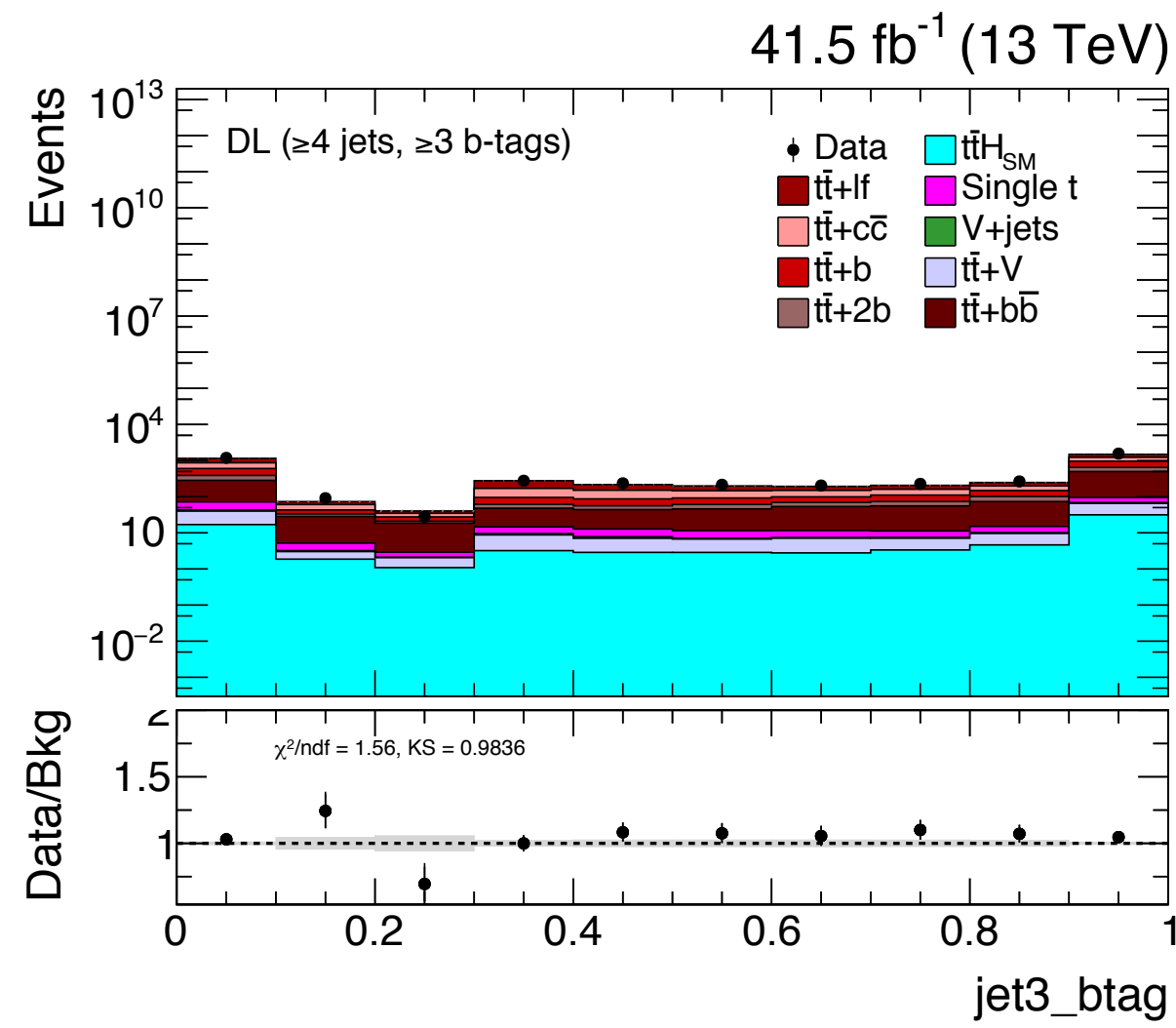
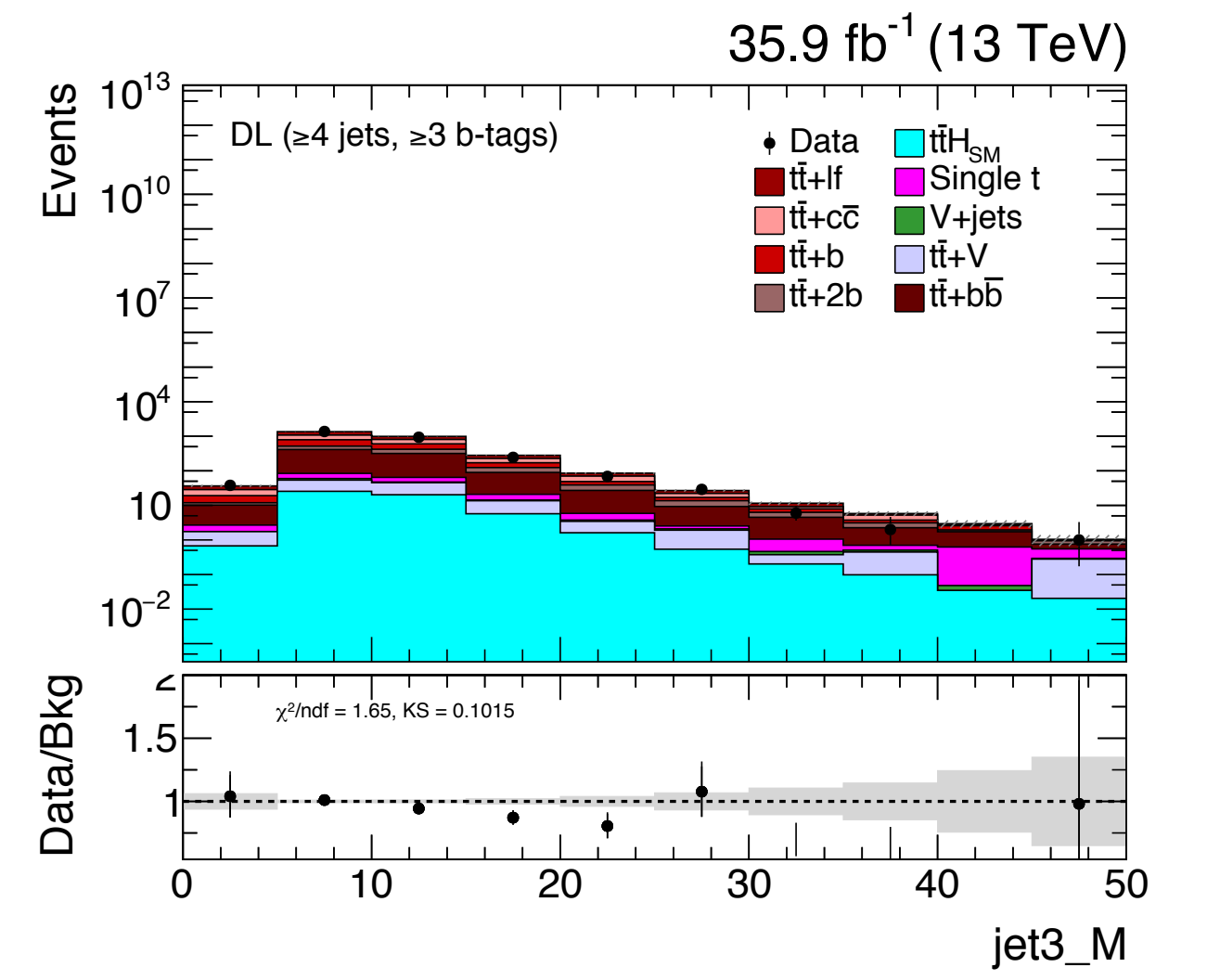
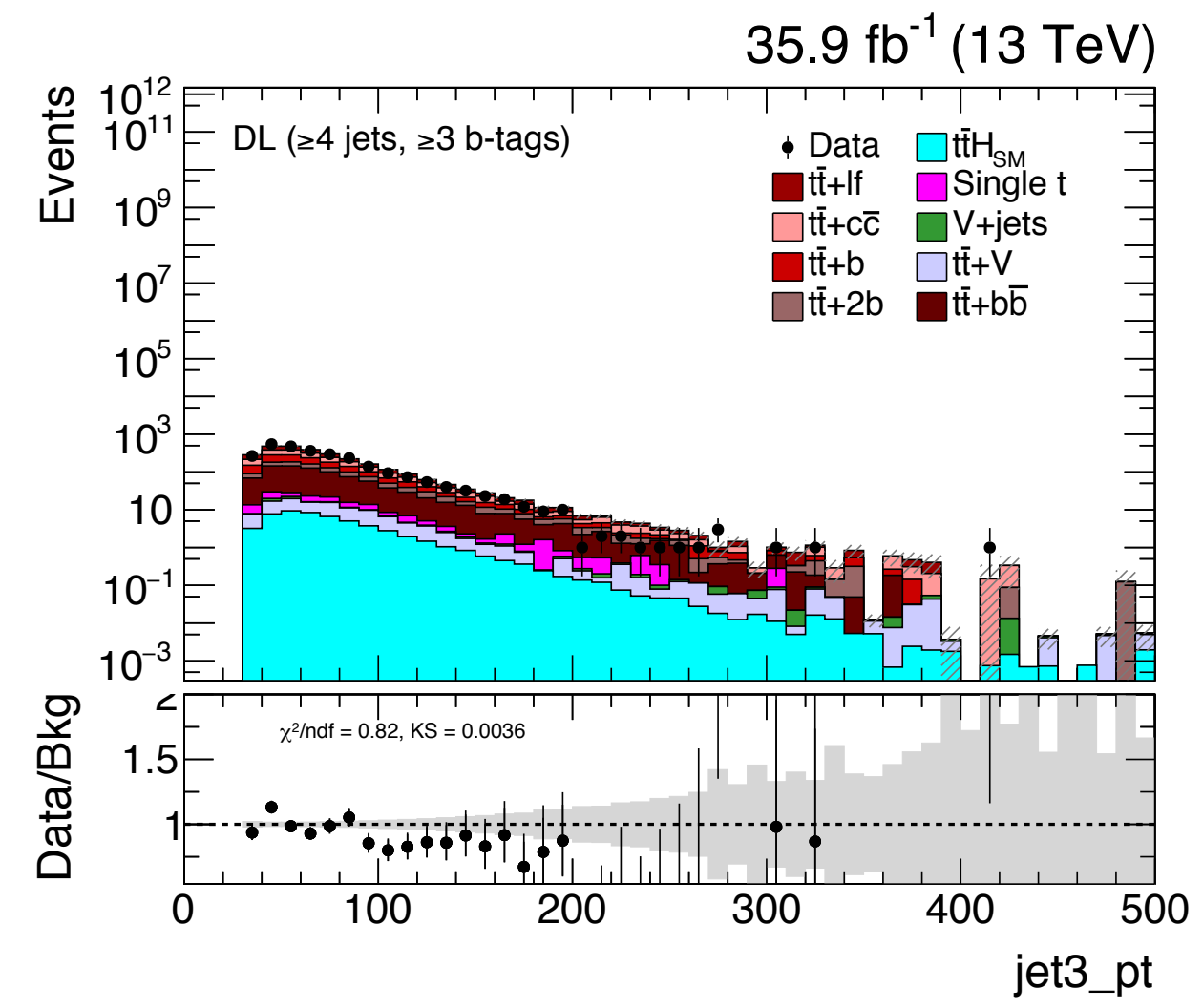
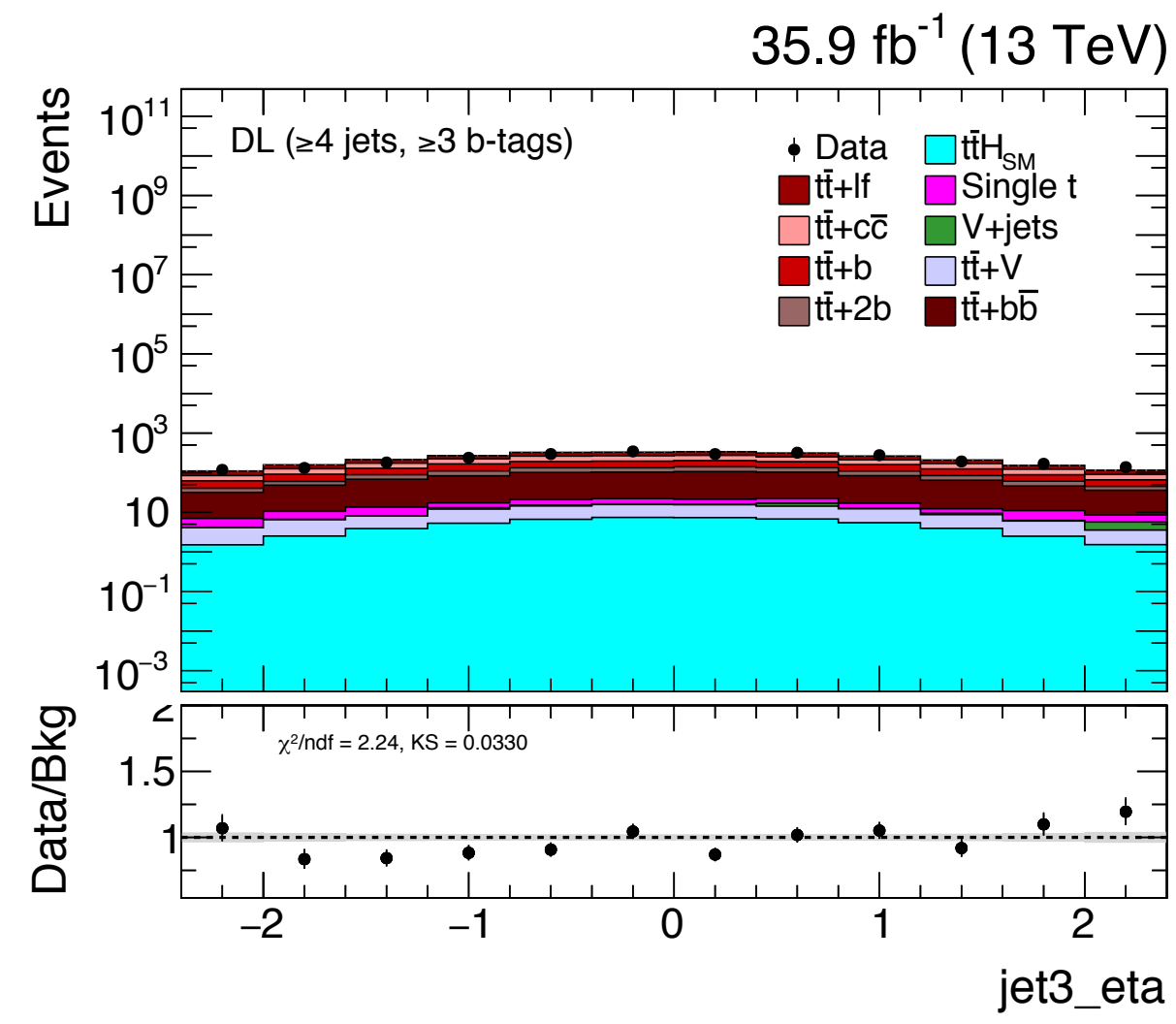
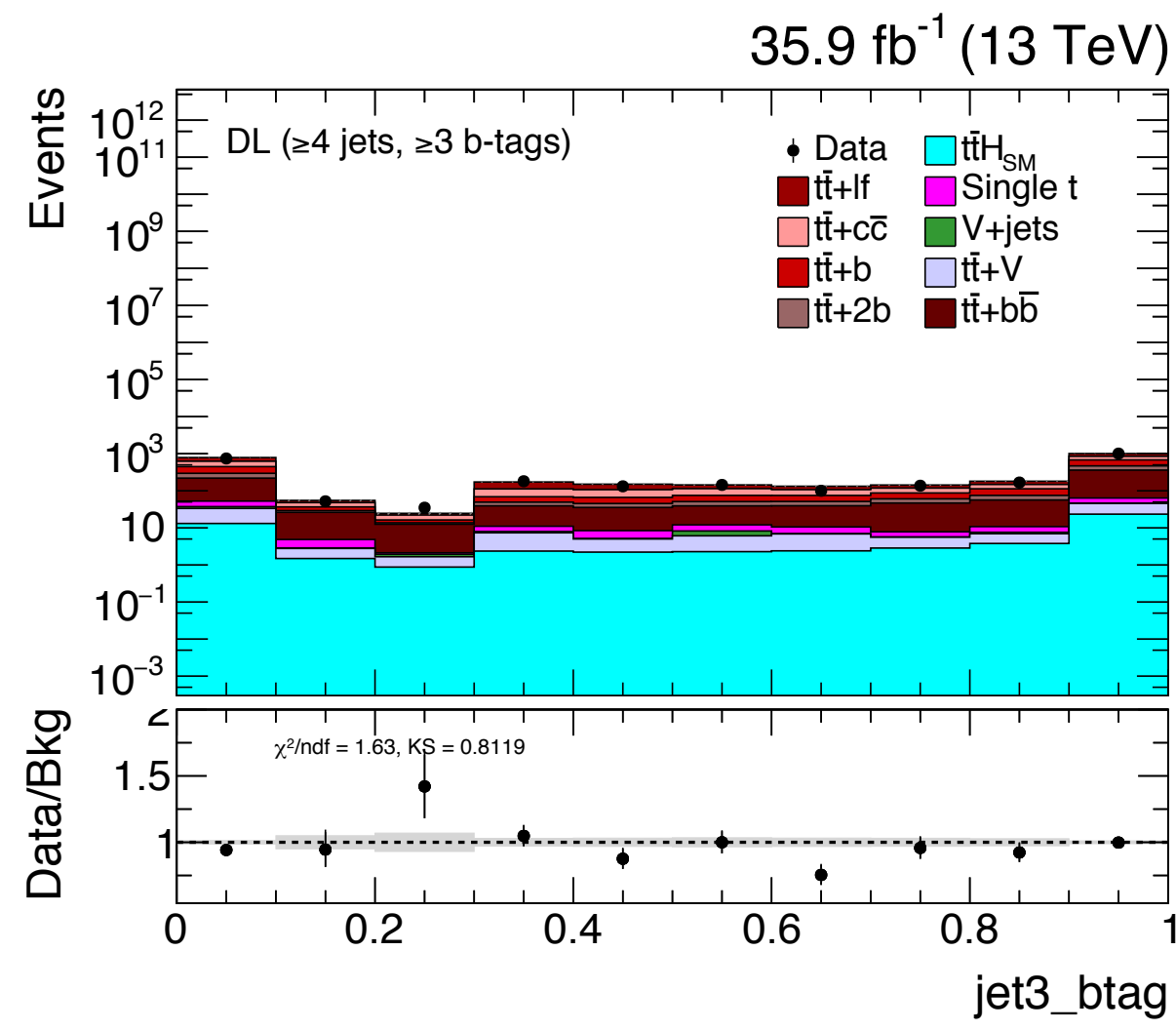
41.5 fb⁻¹ (13 TeV)

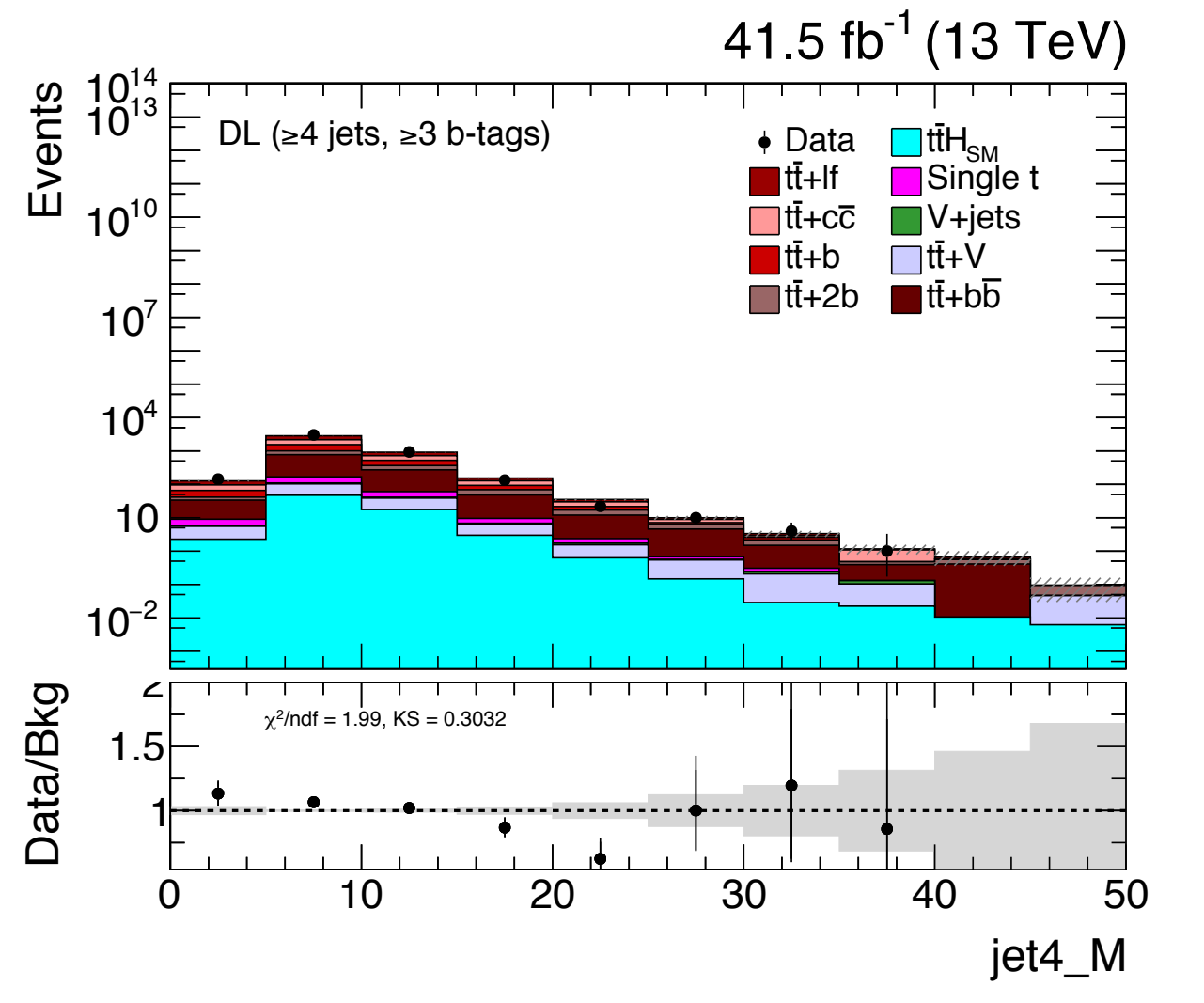
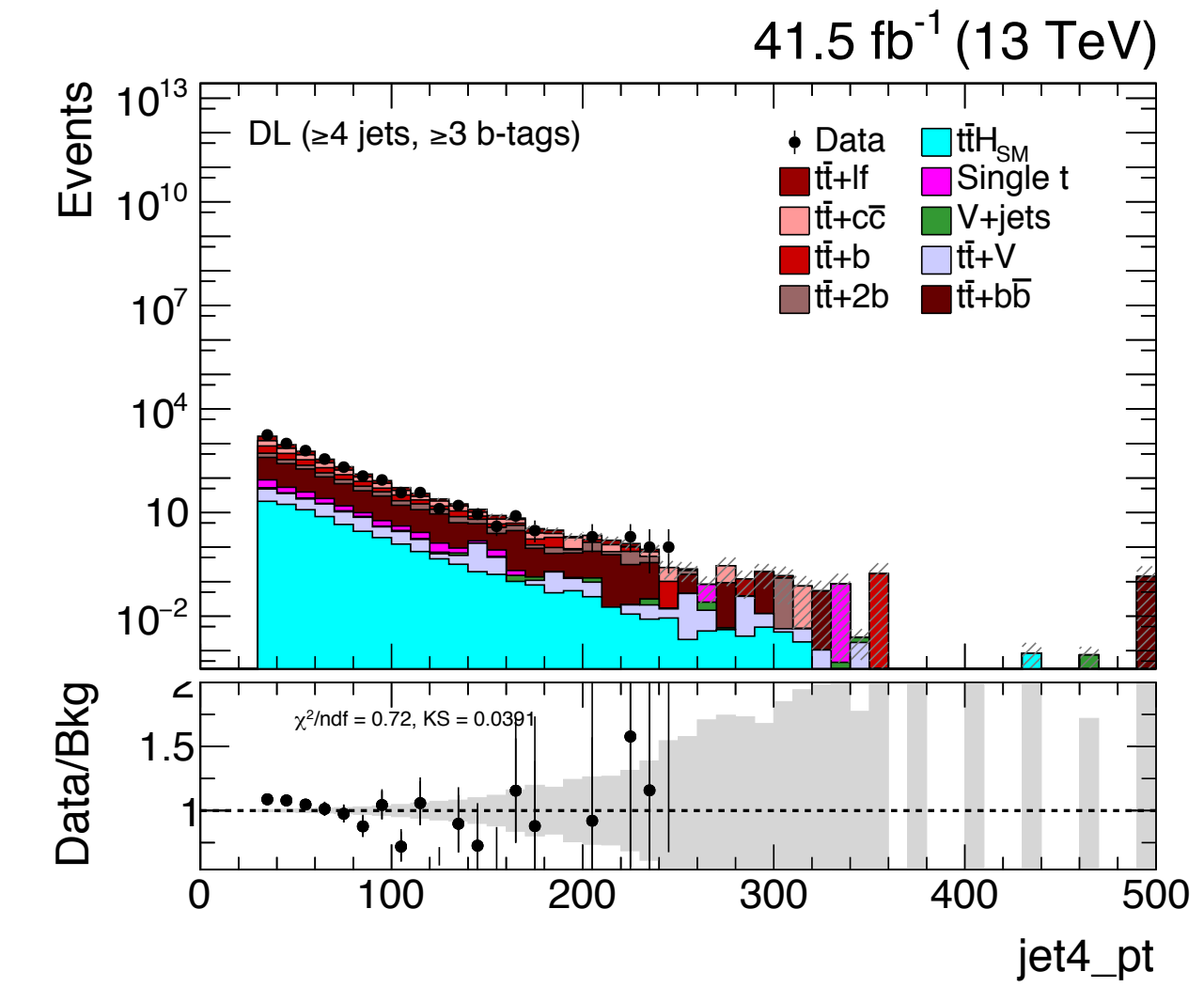
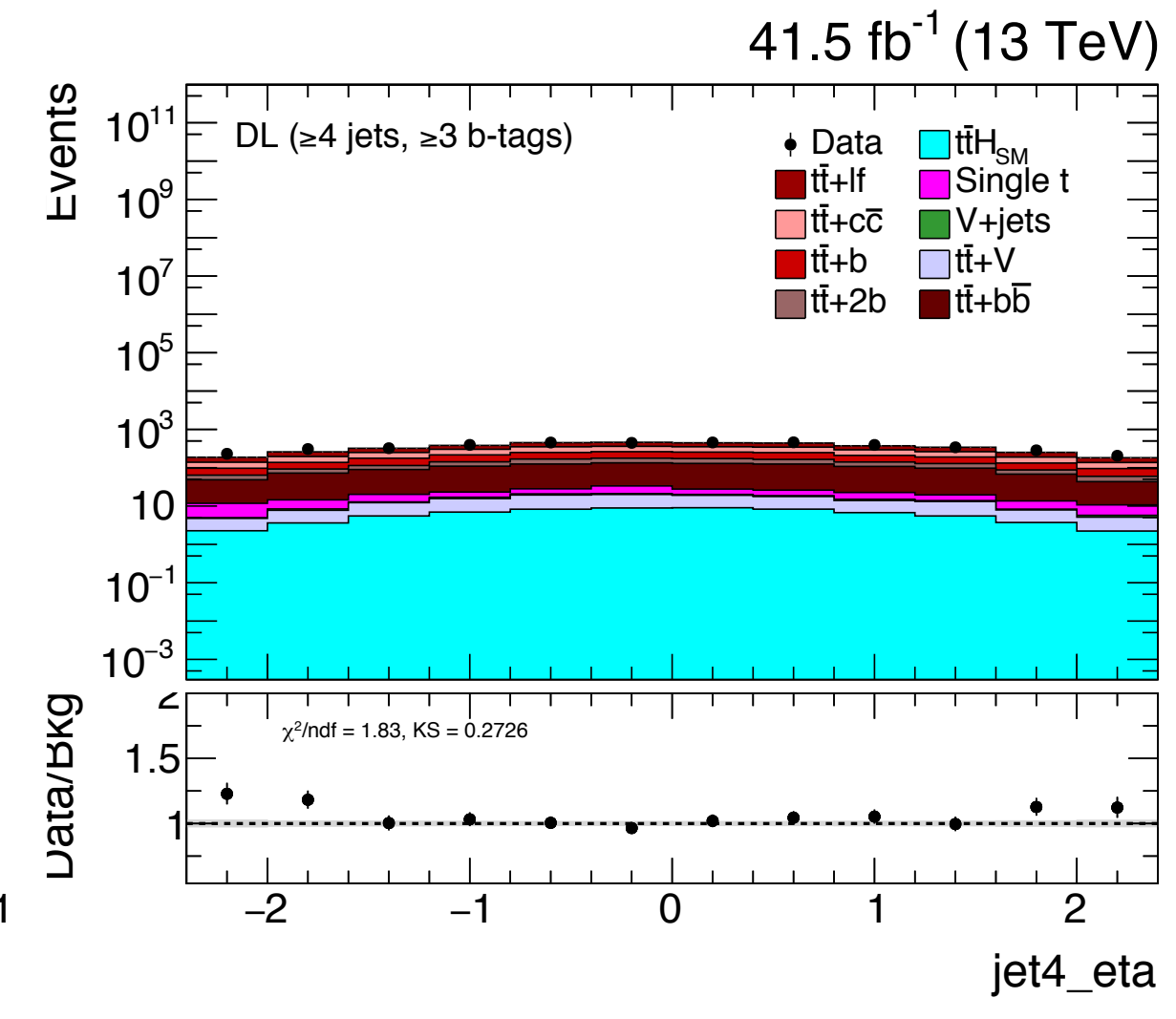
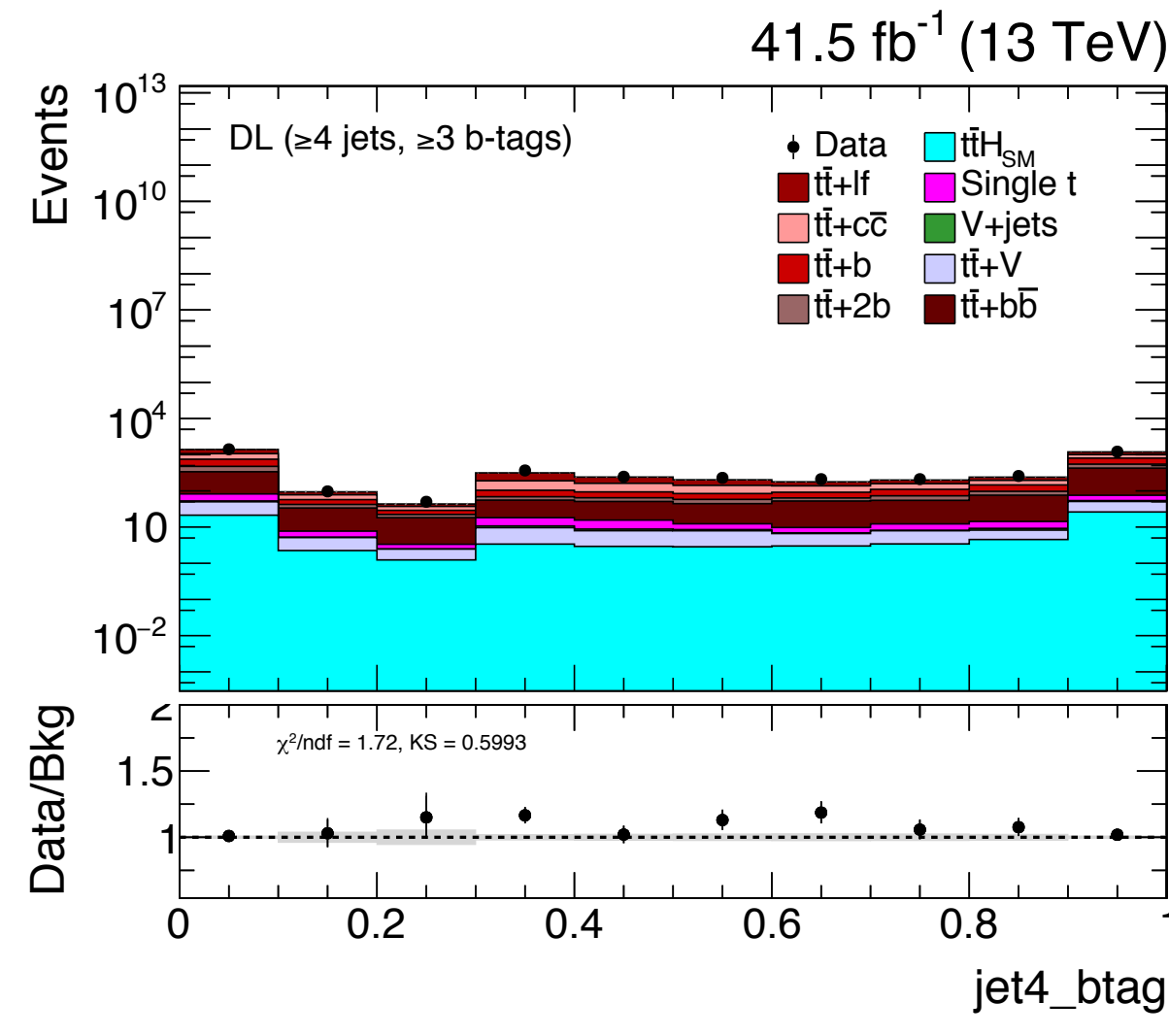
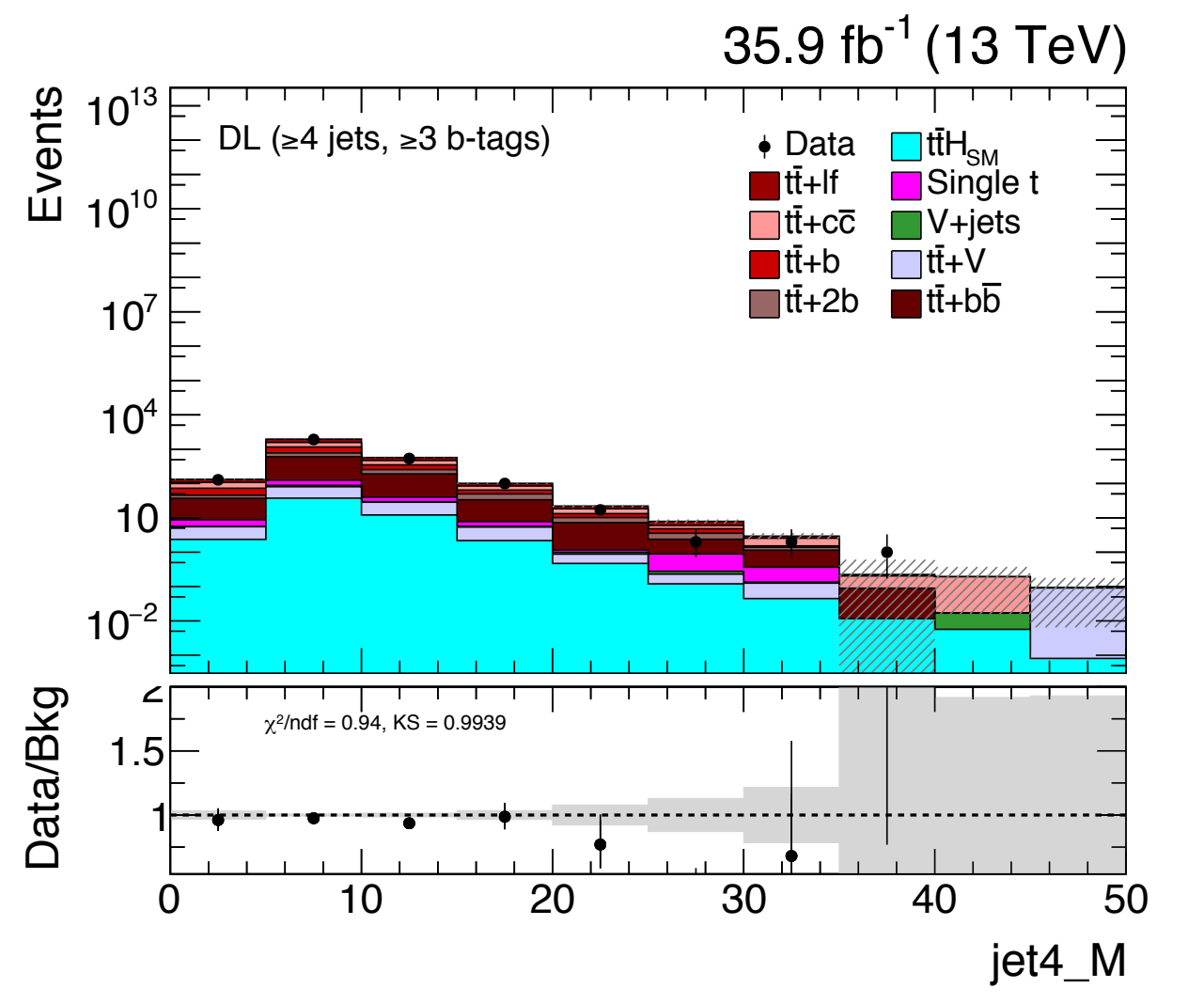
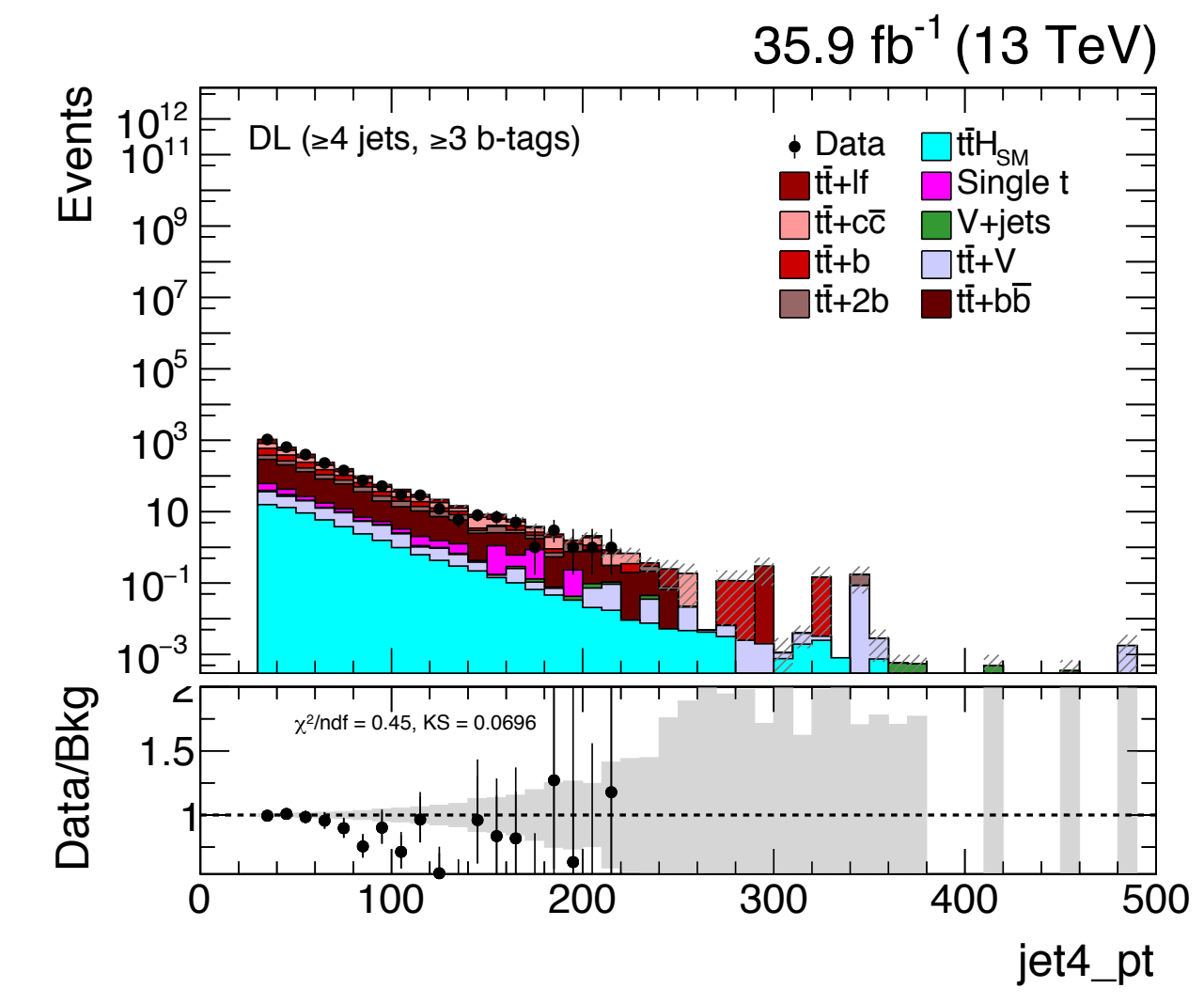
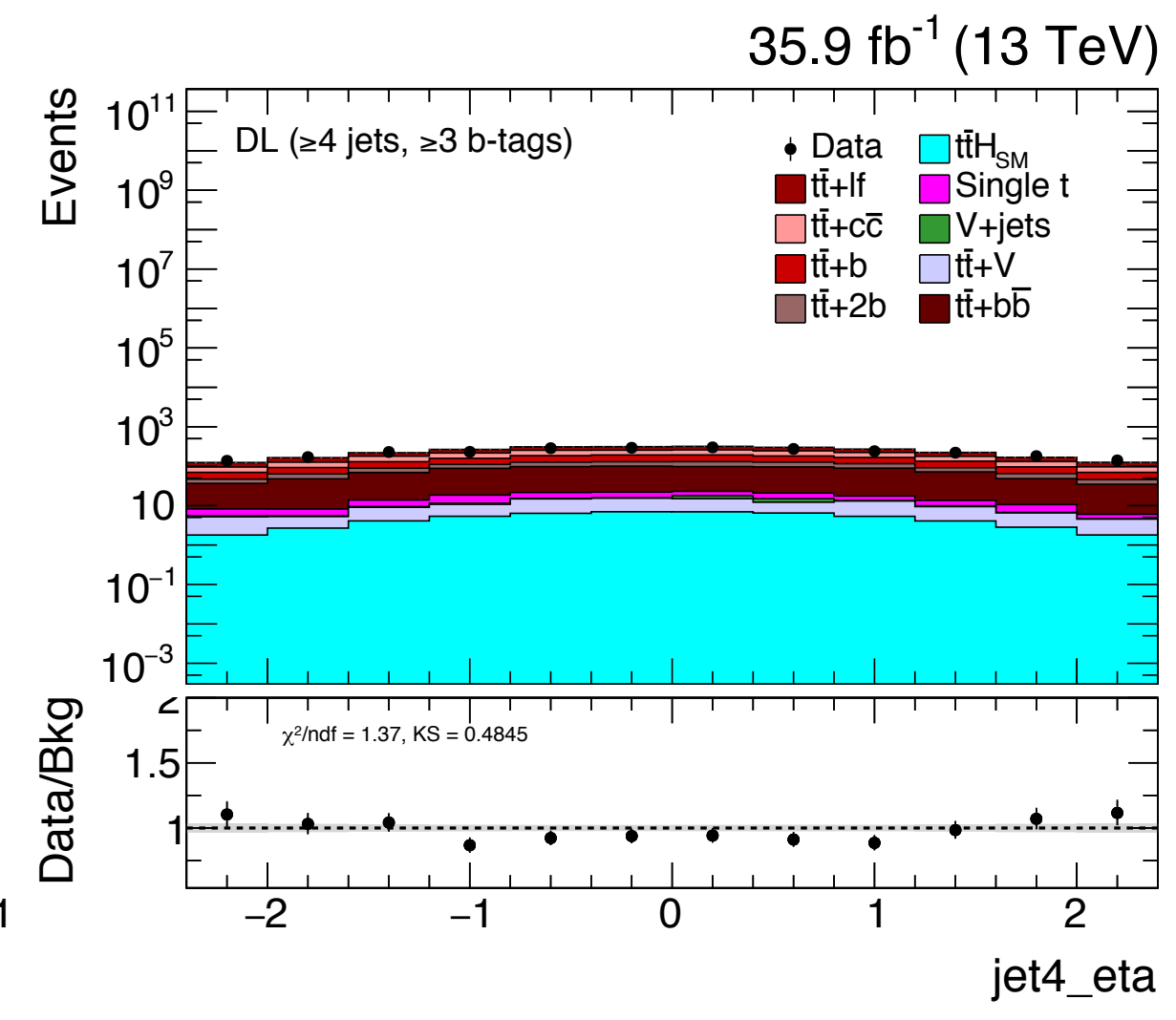
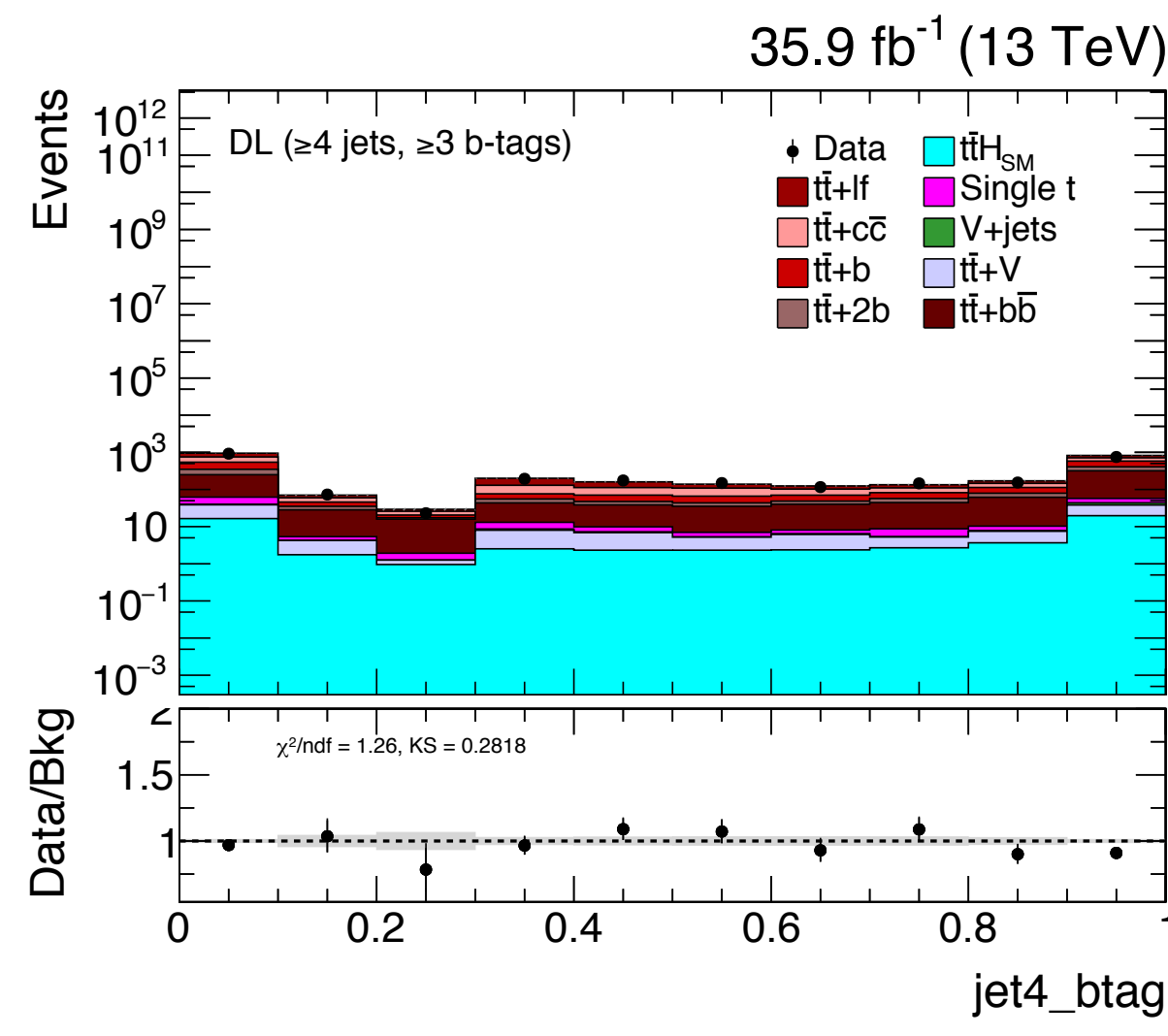


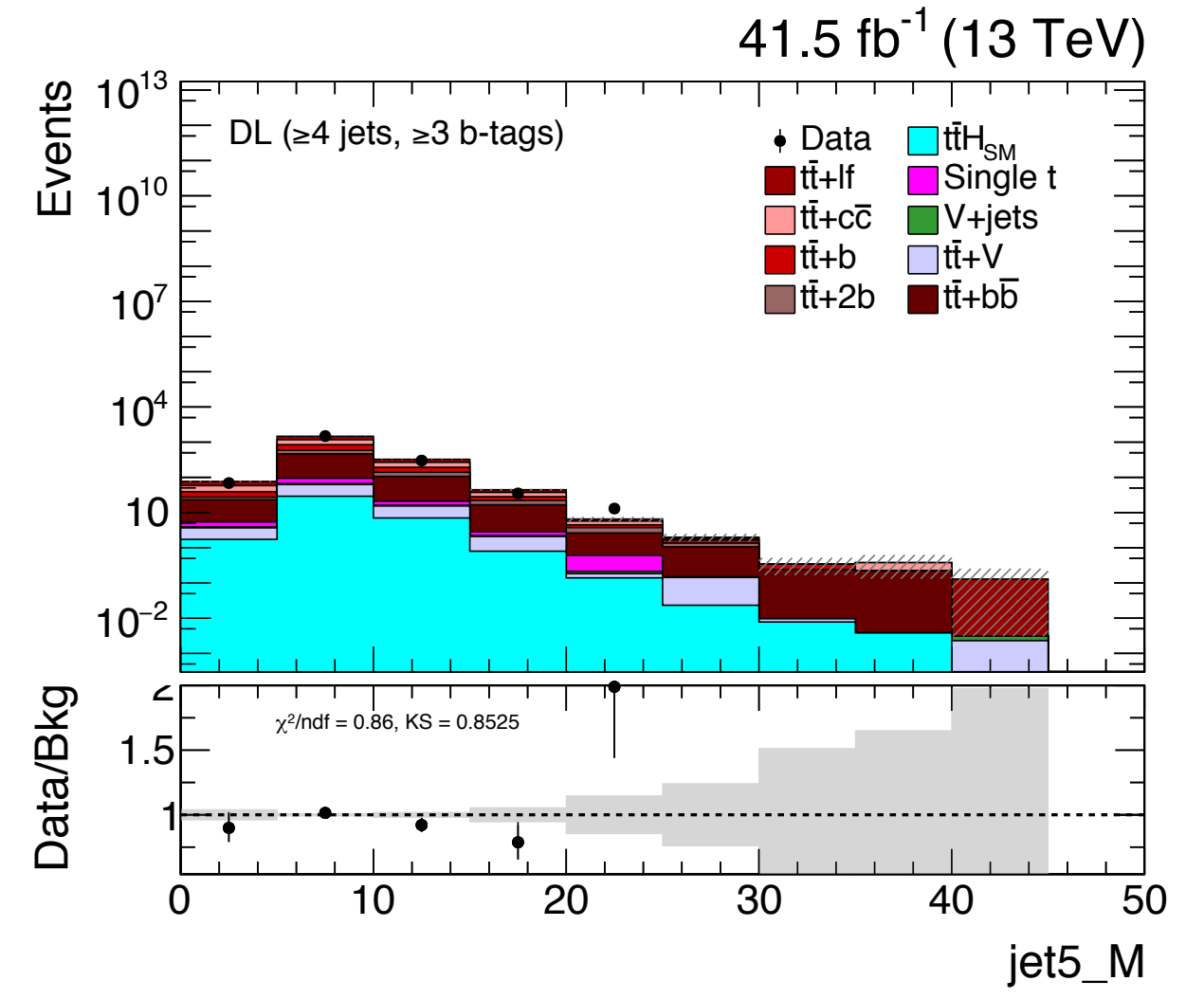
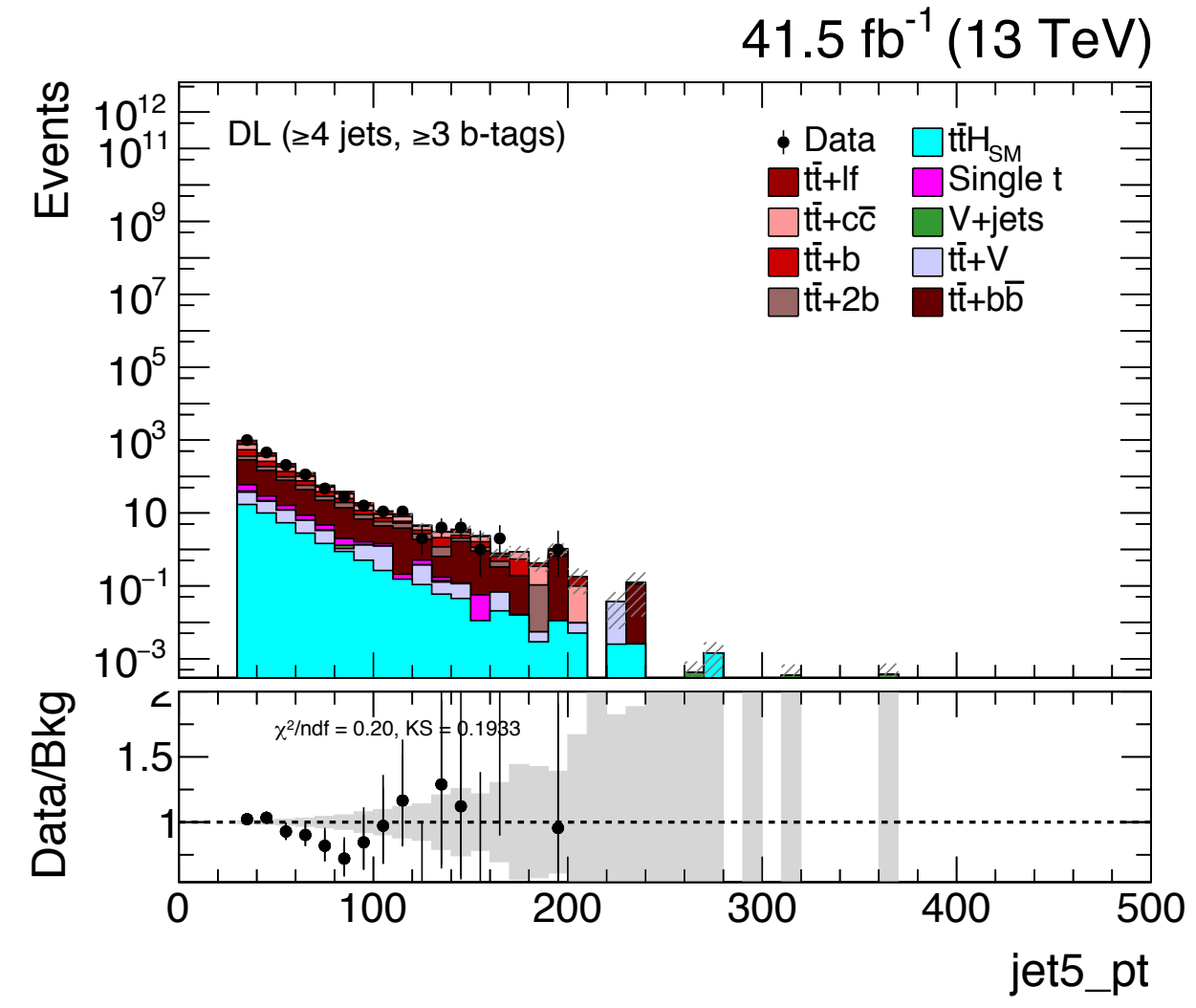
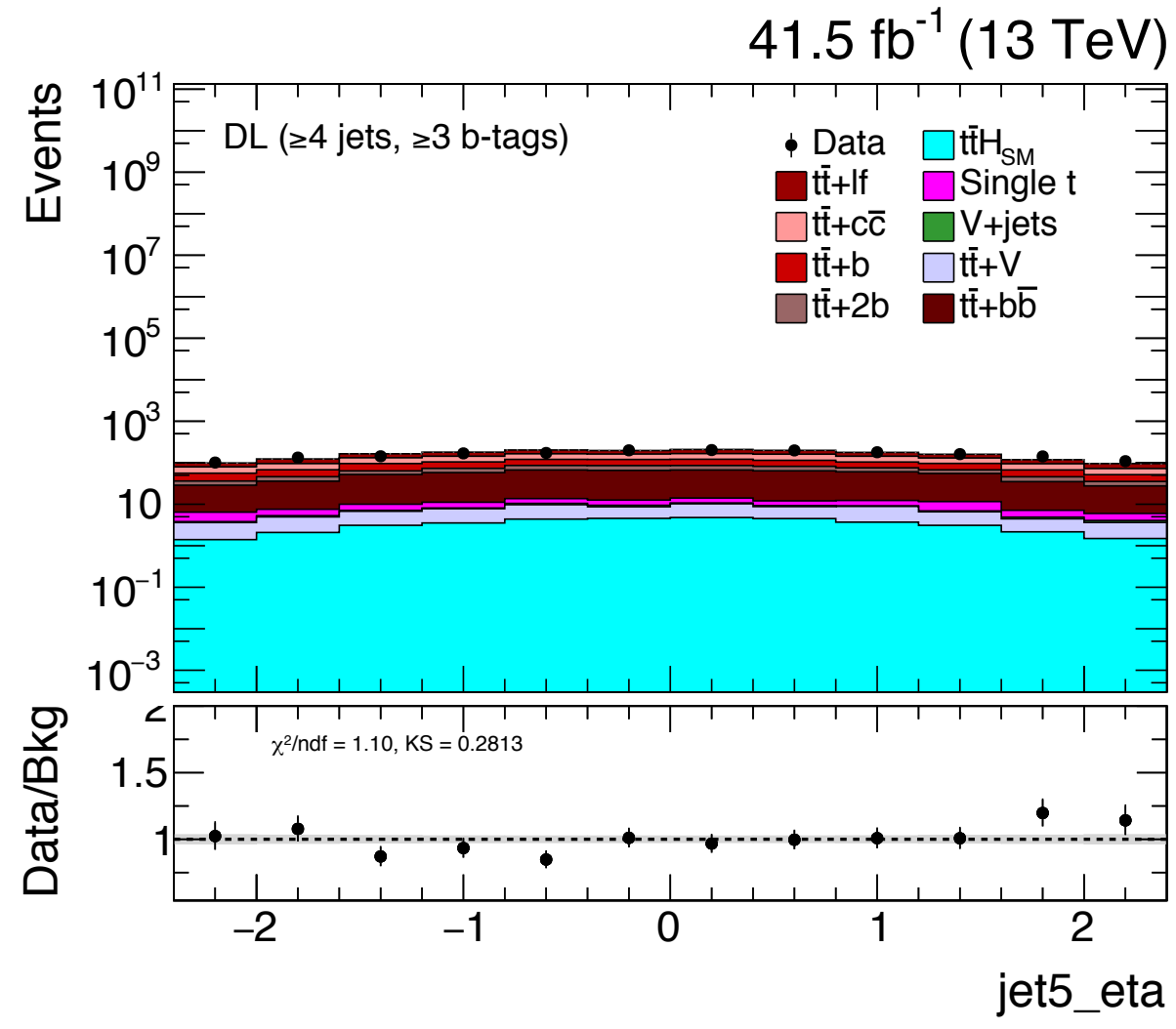
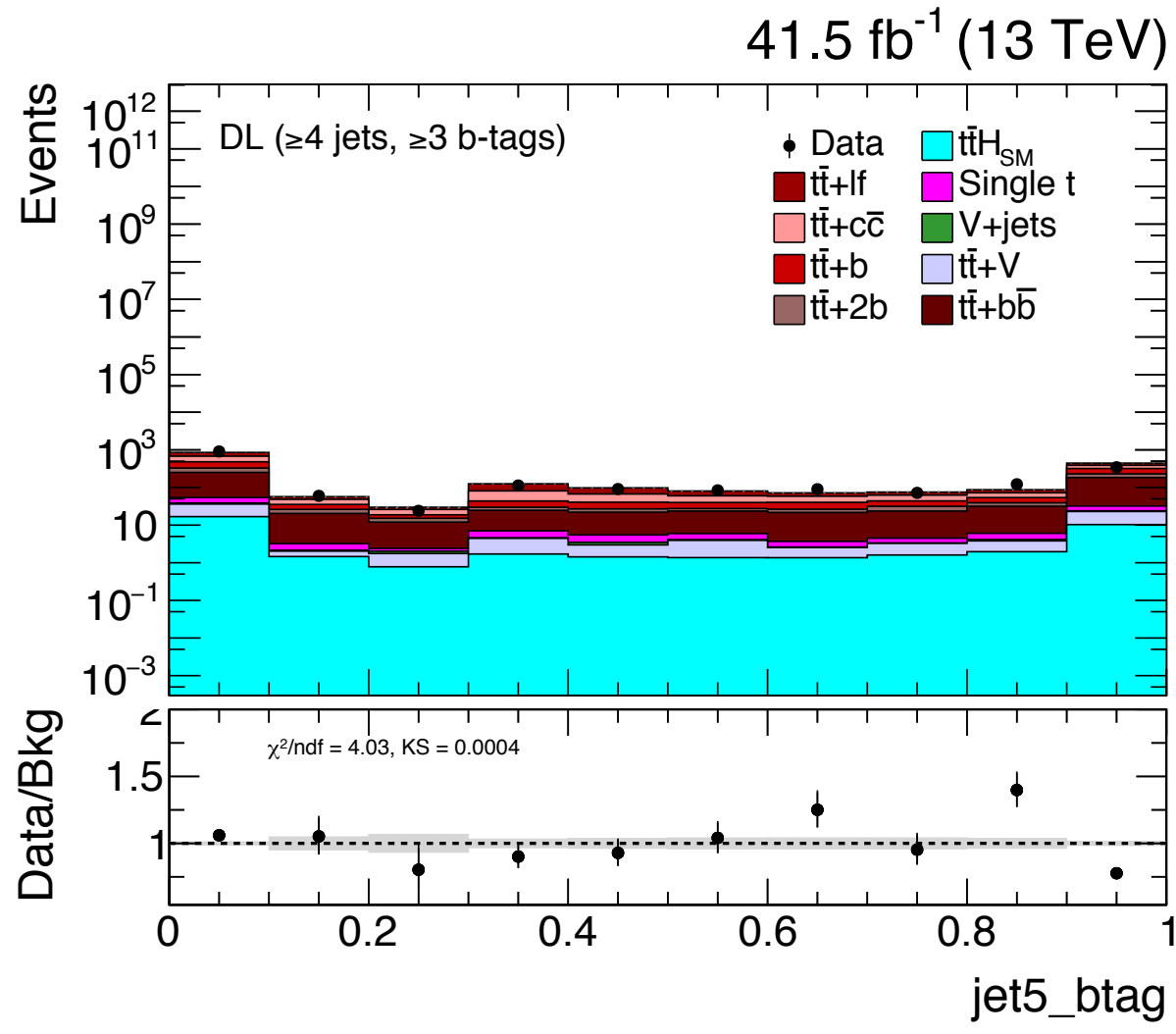
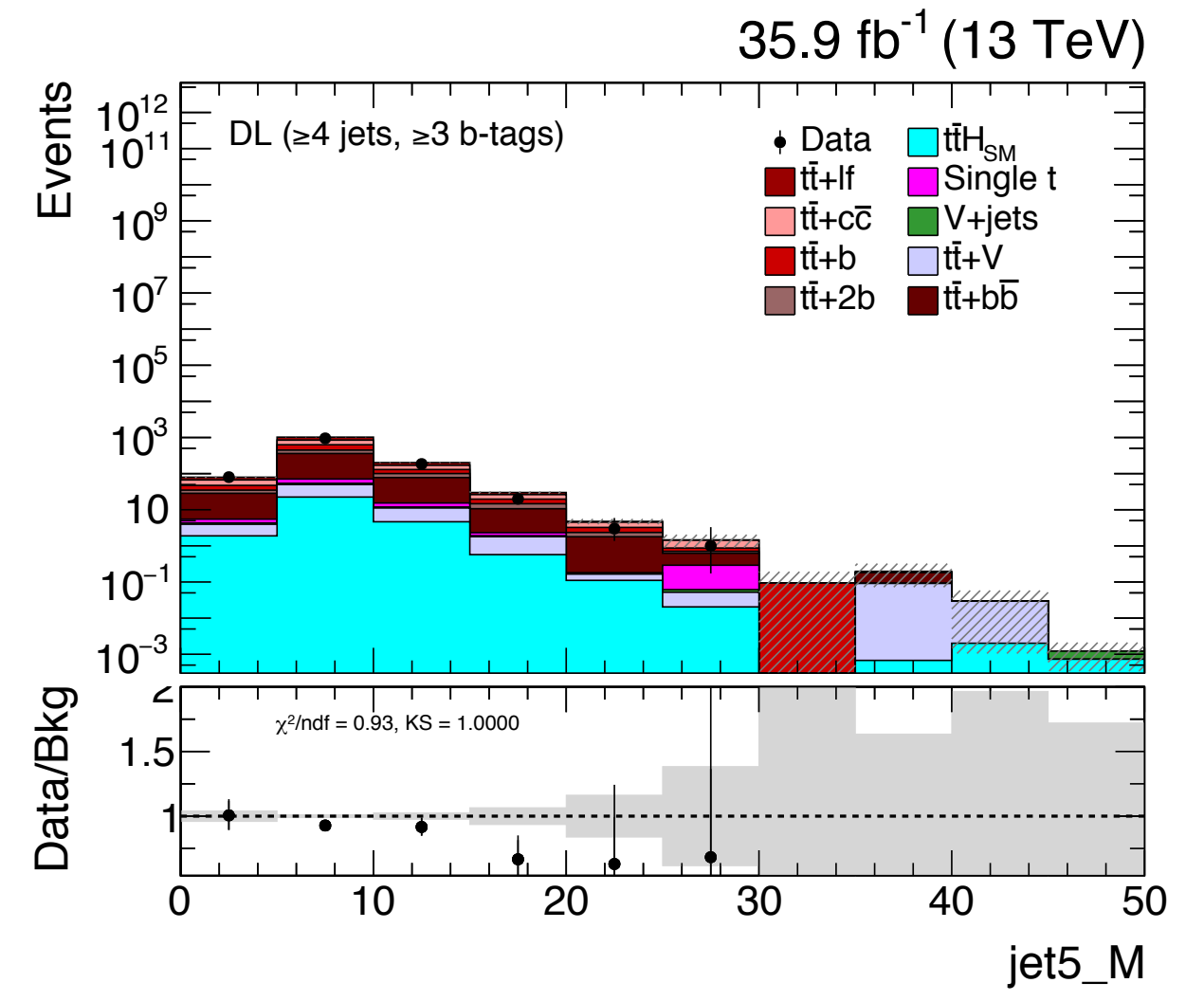
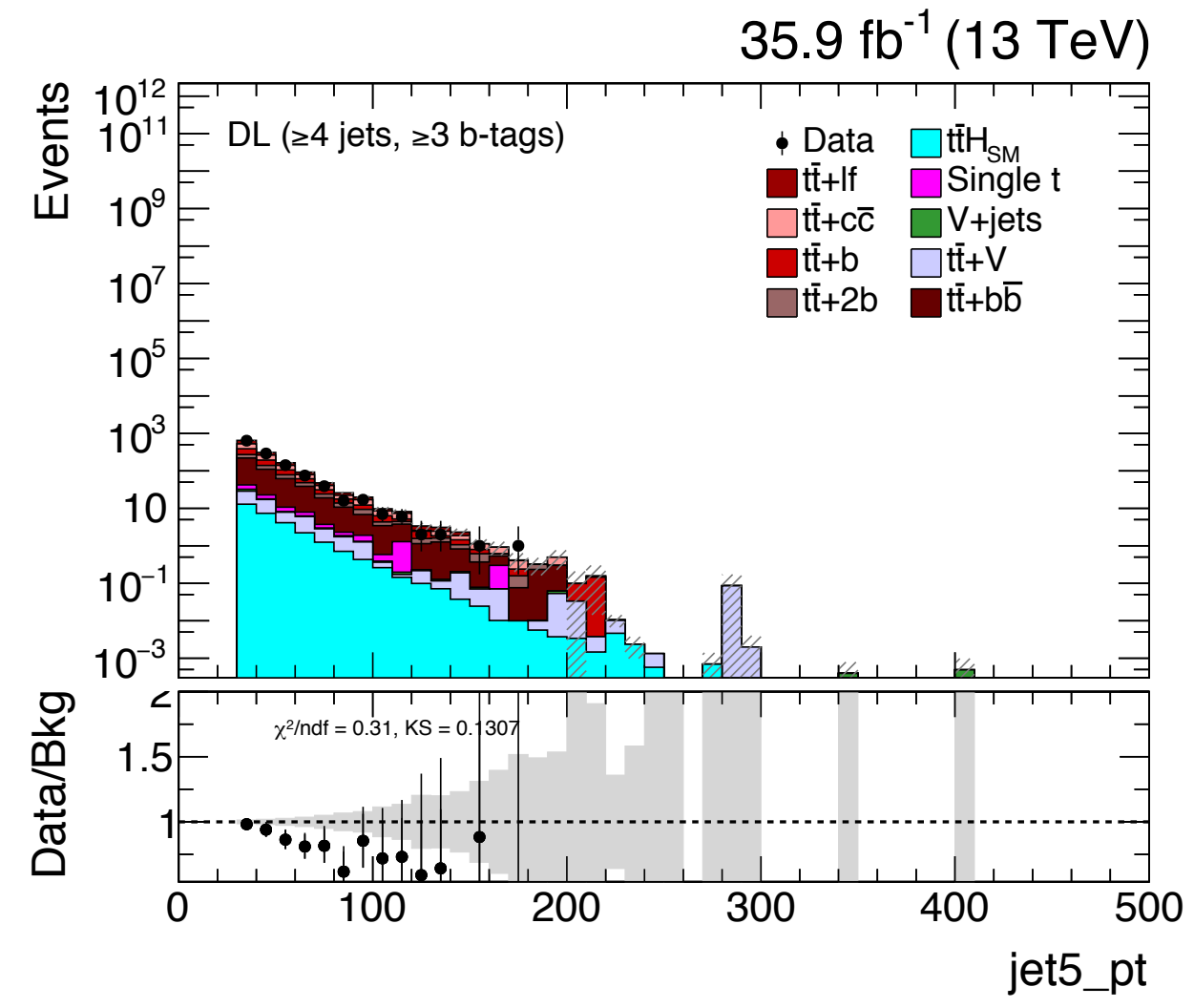
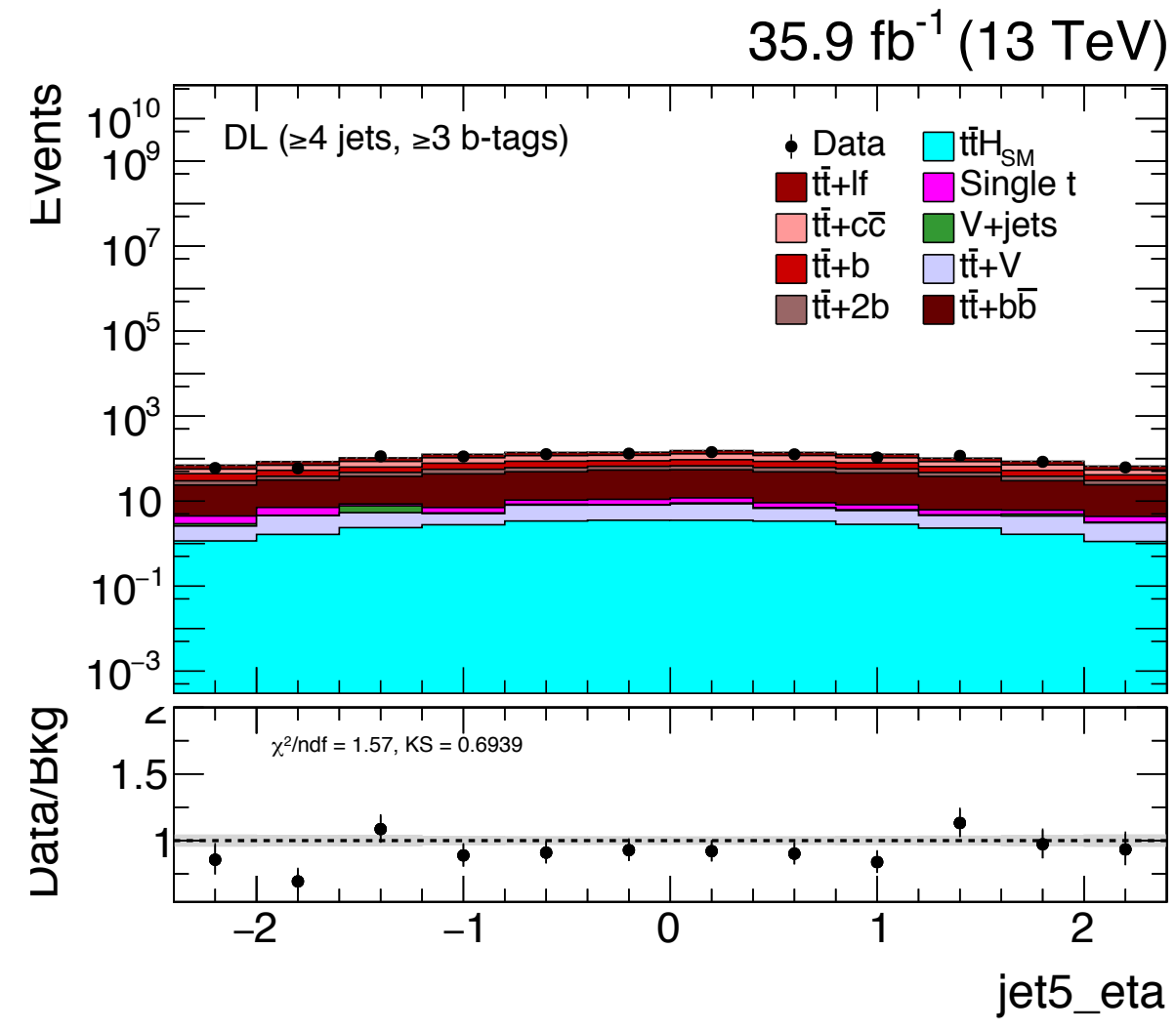
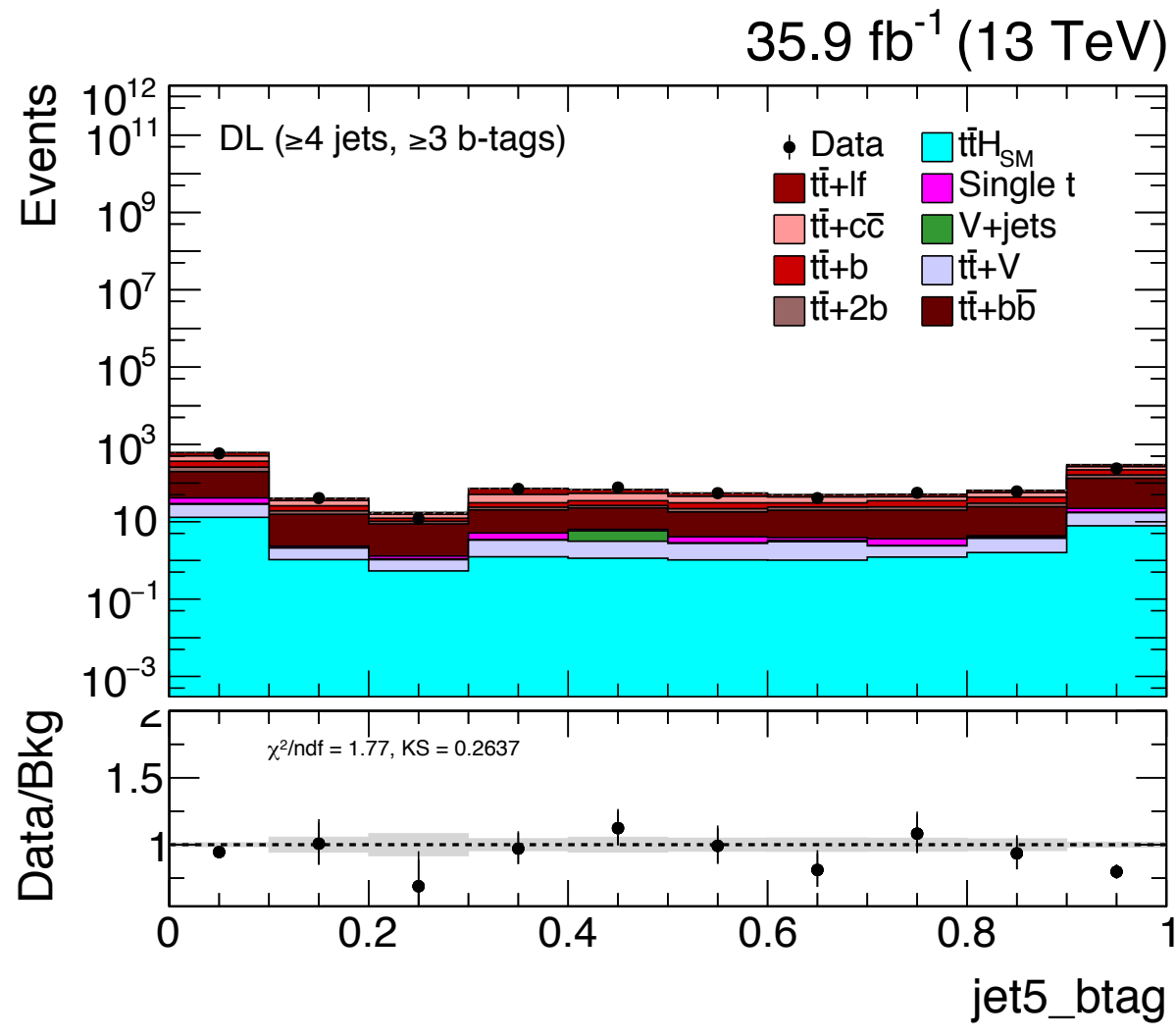
MEM and BLR
2017
in 4j,_{=3b} and 4j4b



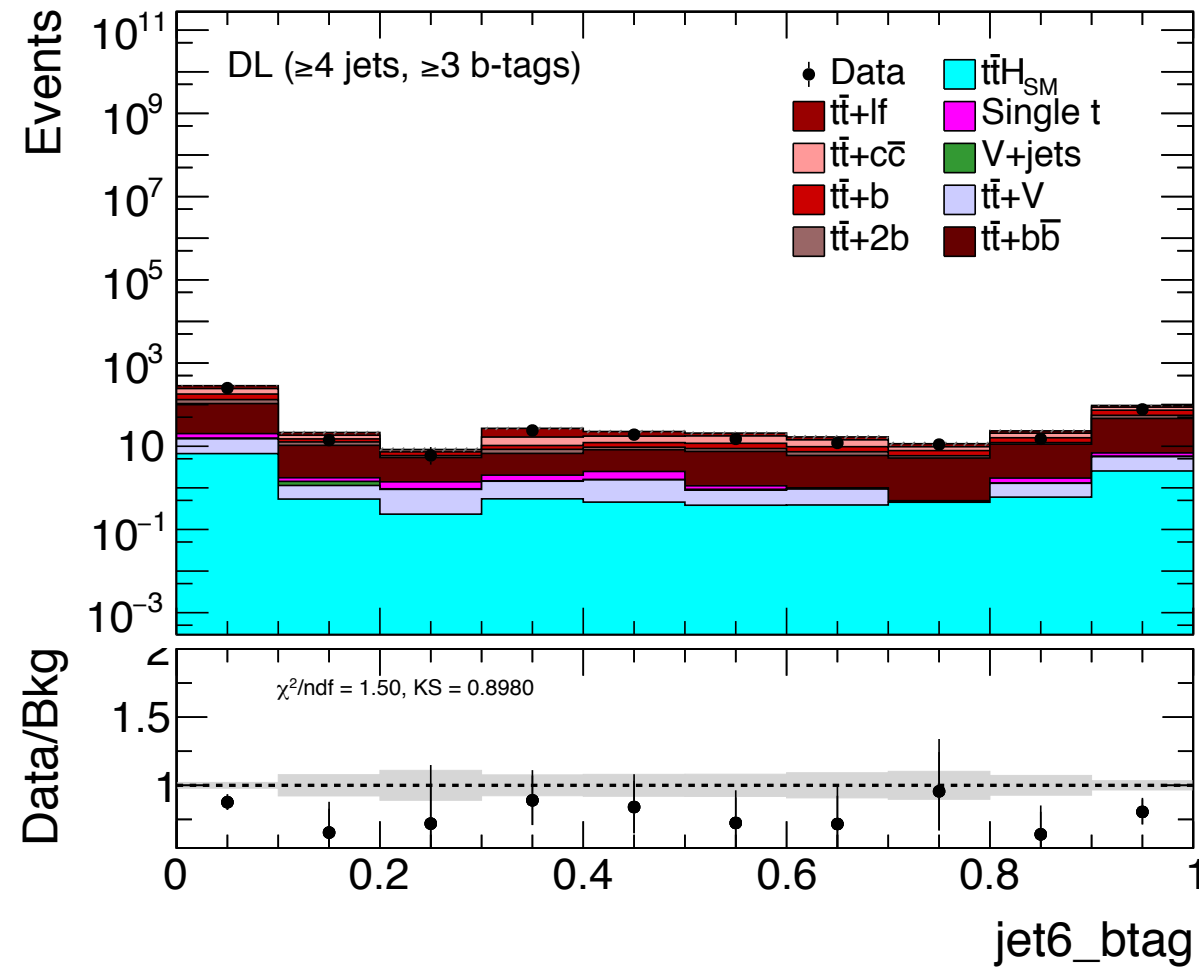
35.9 fb⁻¹ (13 TeV)35.9 fb⁻¹ (13 TeV)35.9 fb⁻¹ (13 TeV)35.9 fb⁻¹ (13 TeV)41.5 fb⁻¹ (13 TeV)41.5 fb⁻¹ (13 TeV)41.5 fb⁻¹ (13 TeV)41.5 fb⁻¹ (13 TeV)



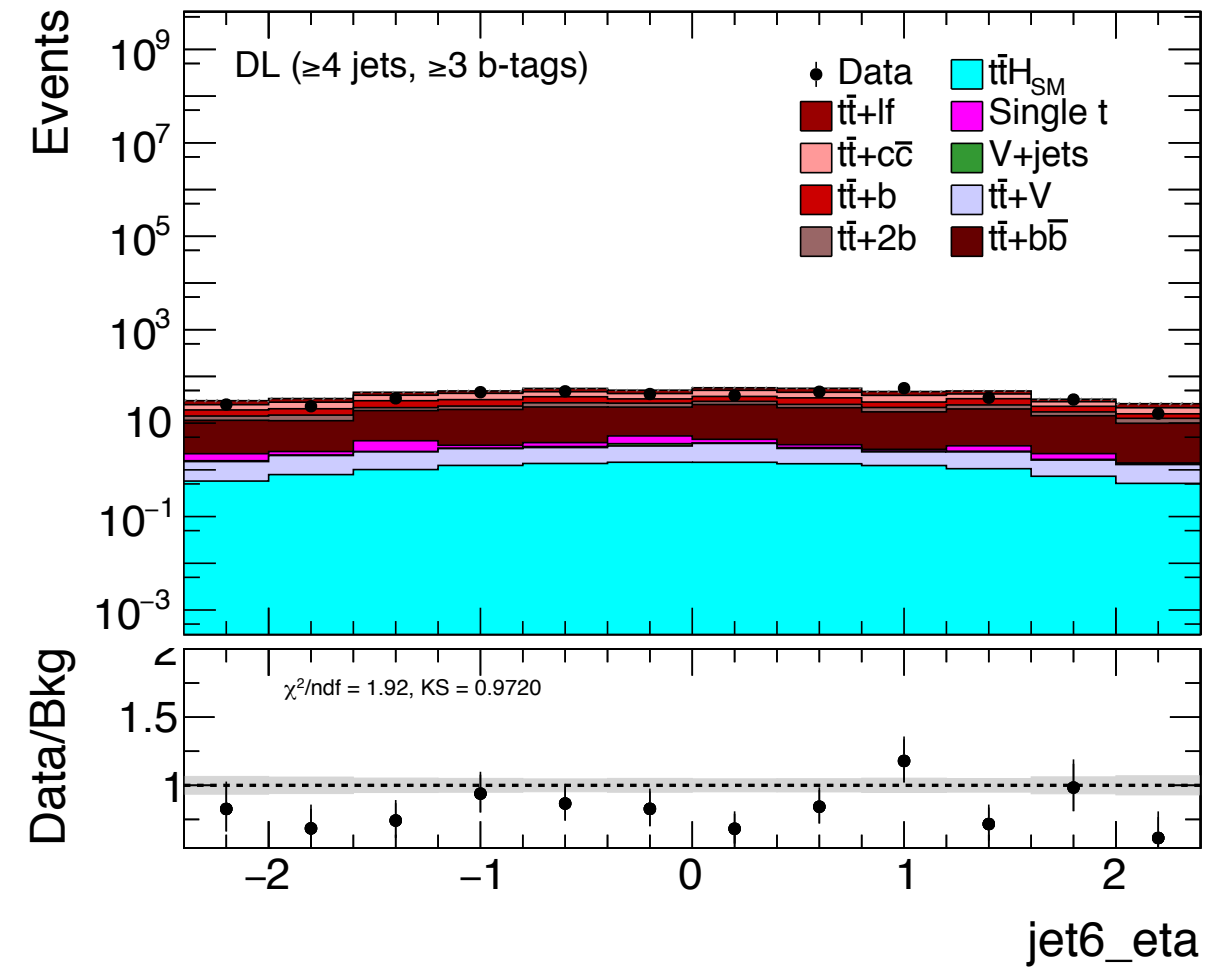




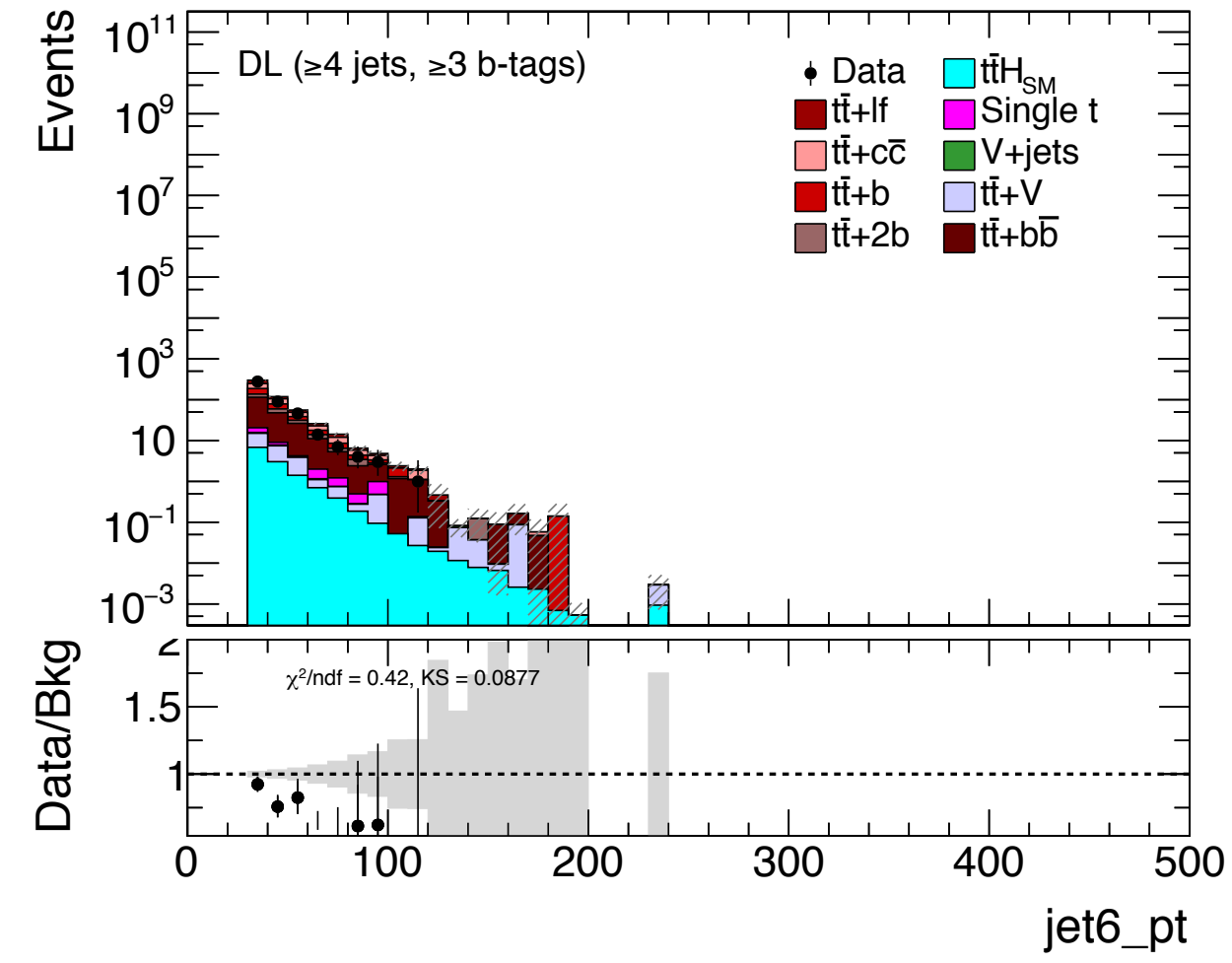
35.9 fb⁻¹ (13 TeV)



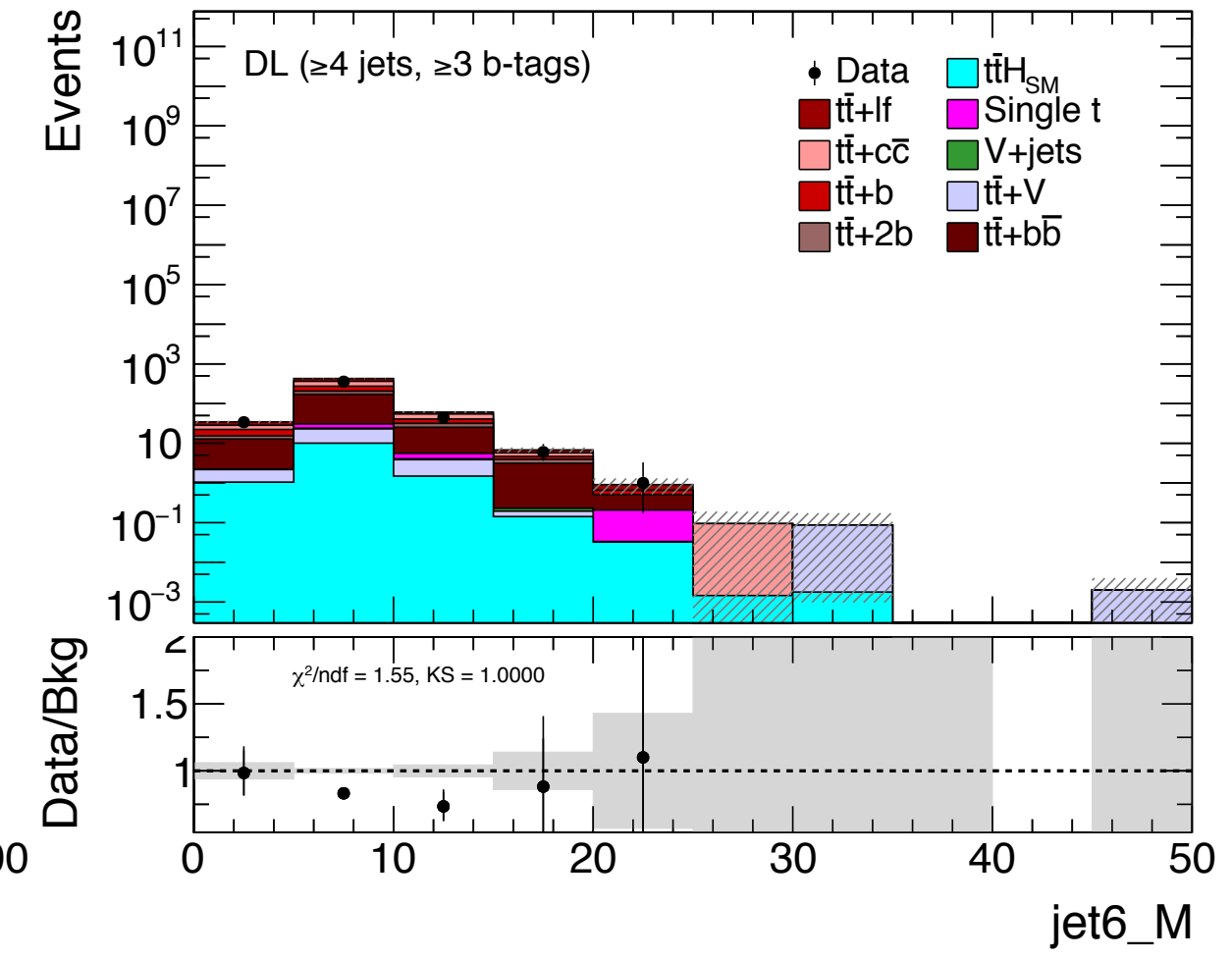
35.9 fb⁻¹ (13 TeV)



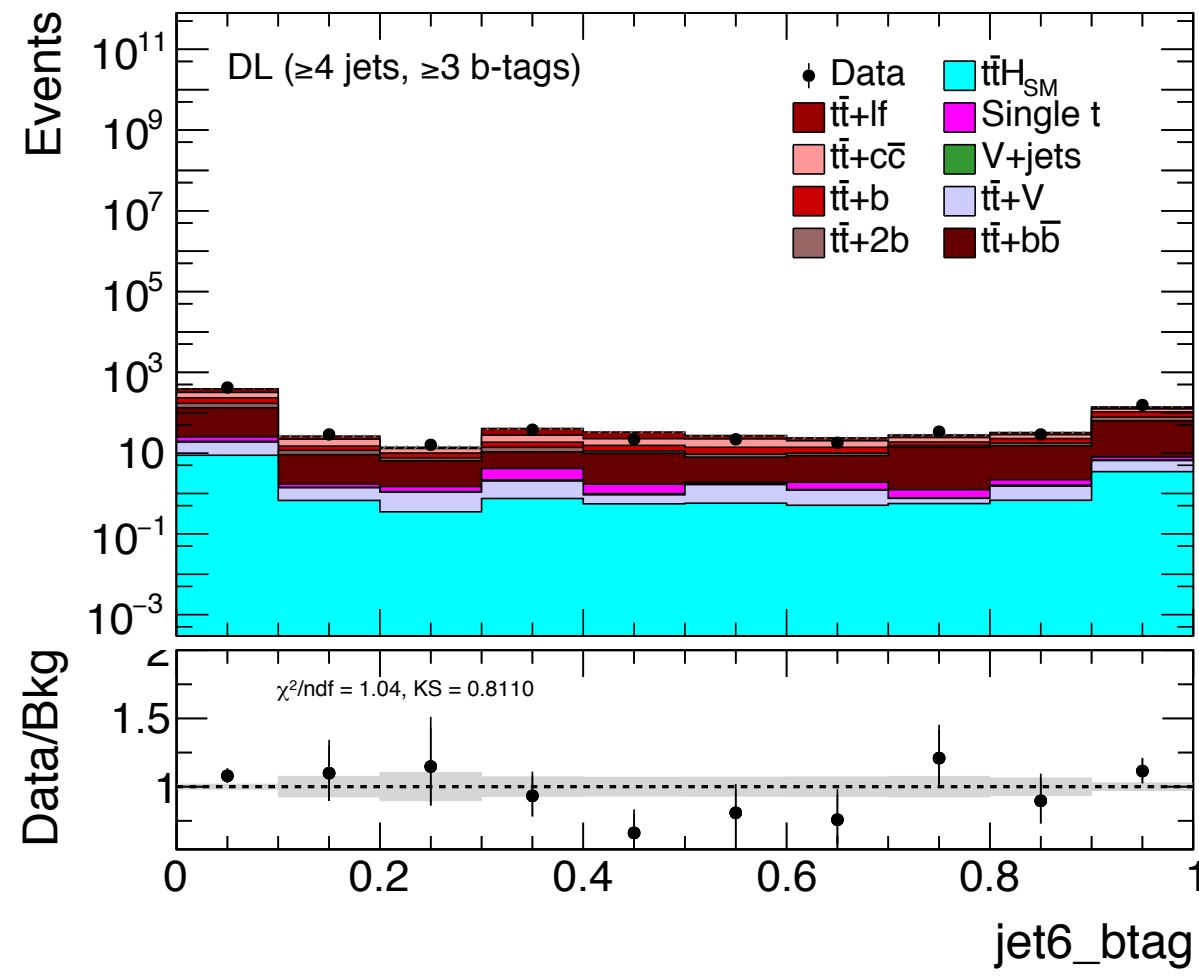
35.9 fb⁻¹ (13 TeV)



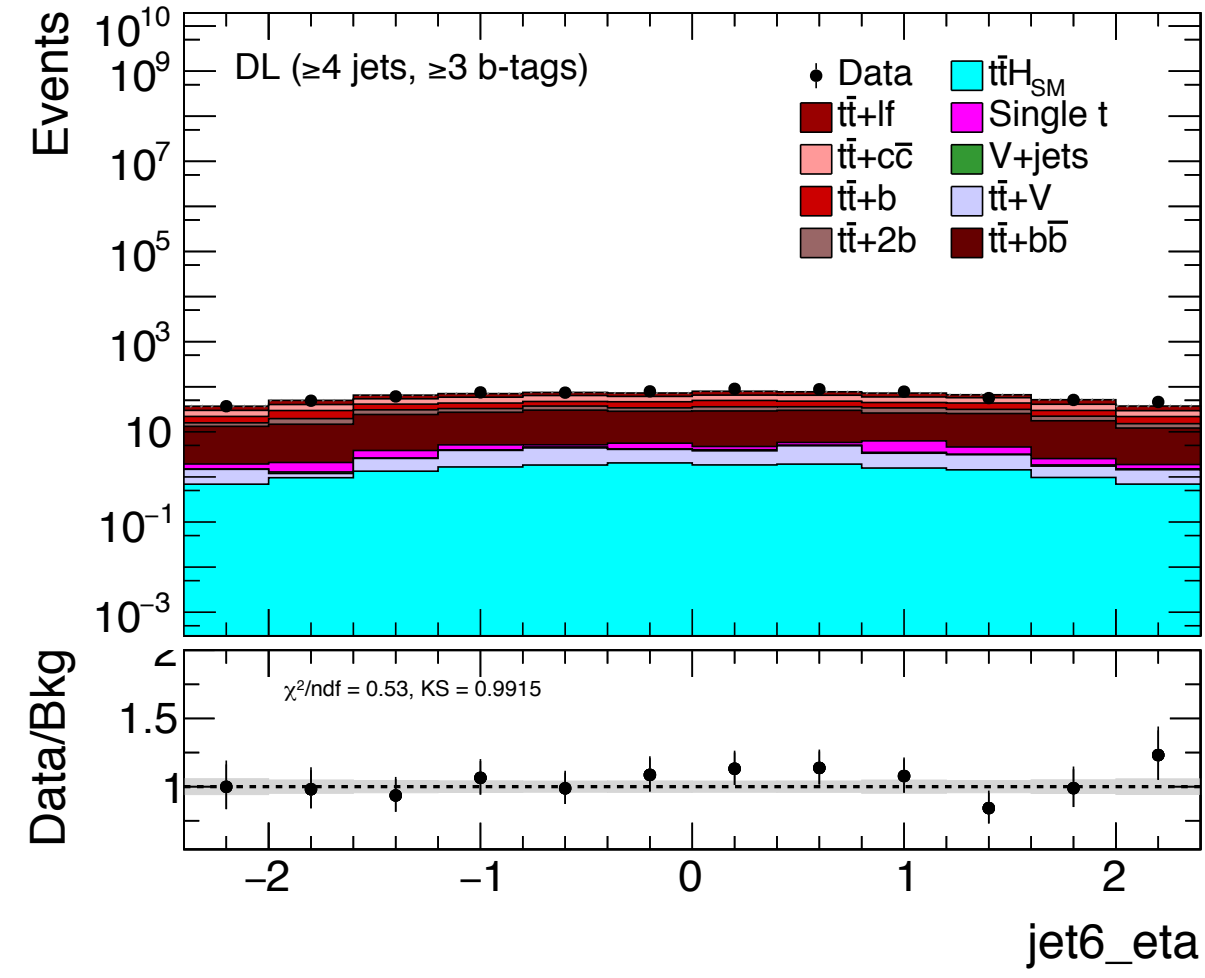
35.9 fb⁻¹ (13 TeV)



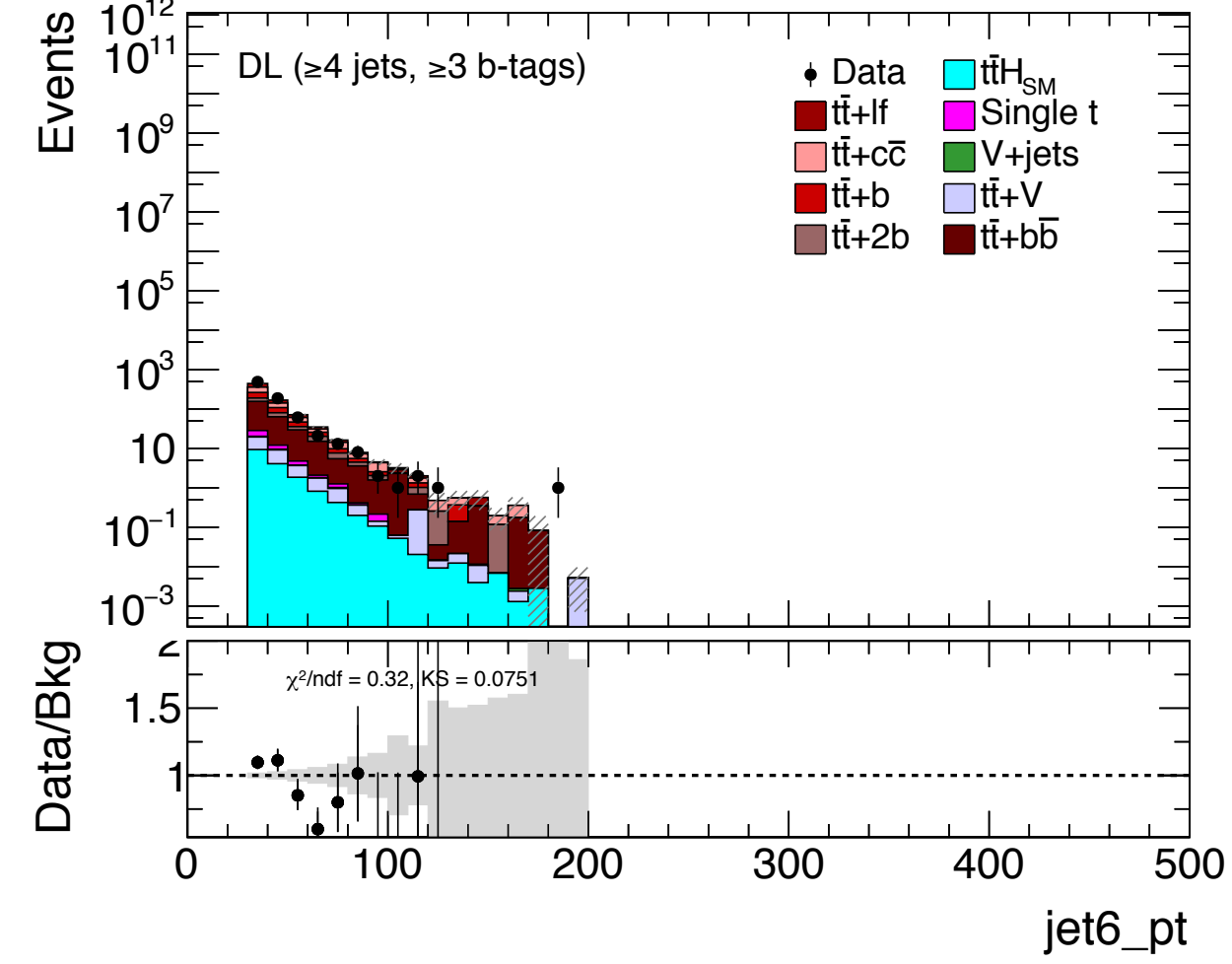
41.5 fb⁻¹ (13 TeV)



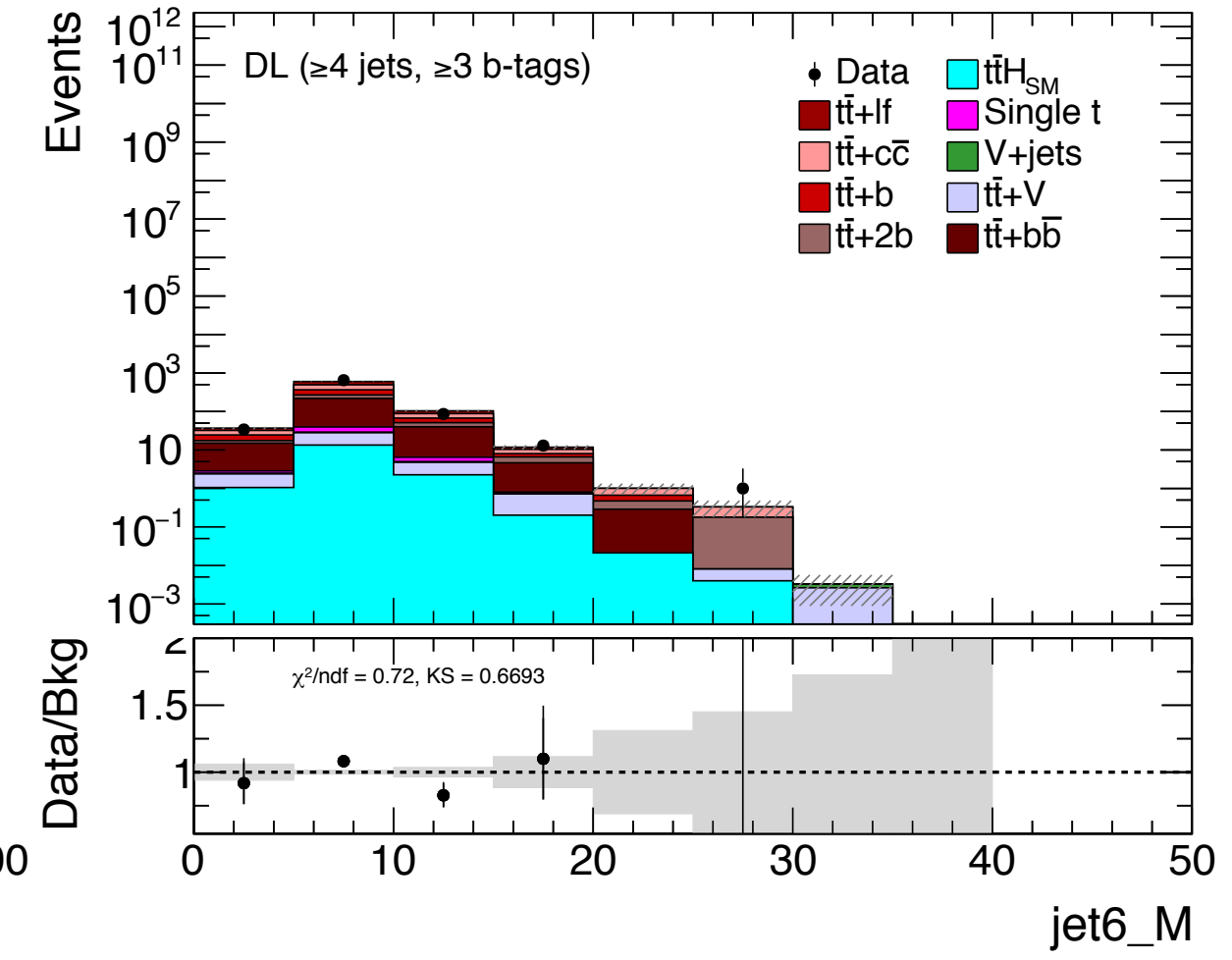
41.5 fb⁻¹ (13 TeV)

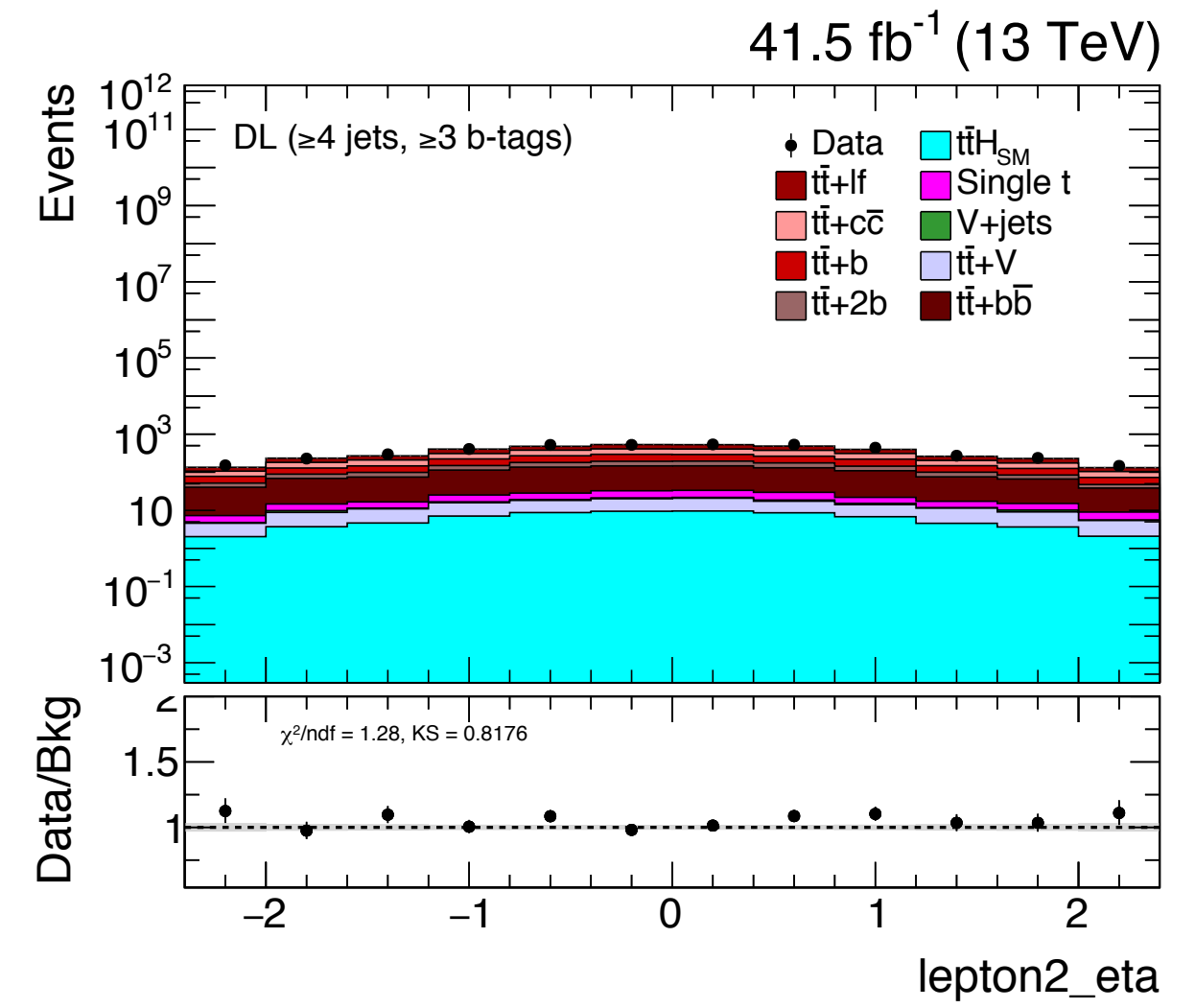
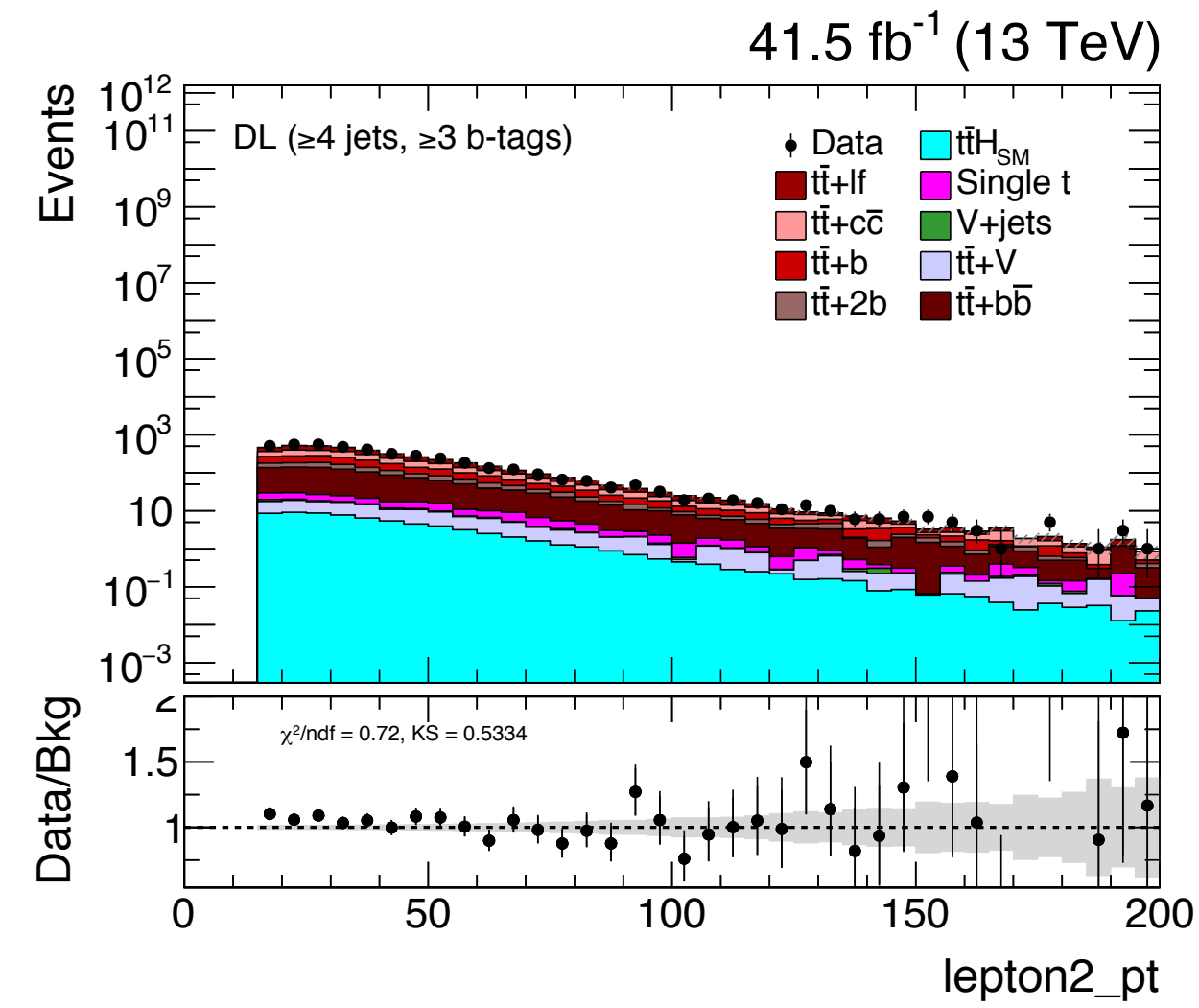
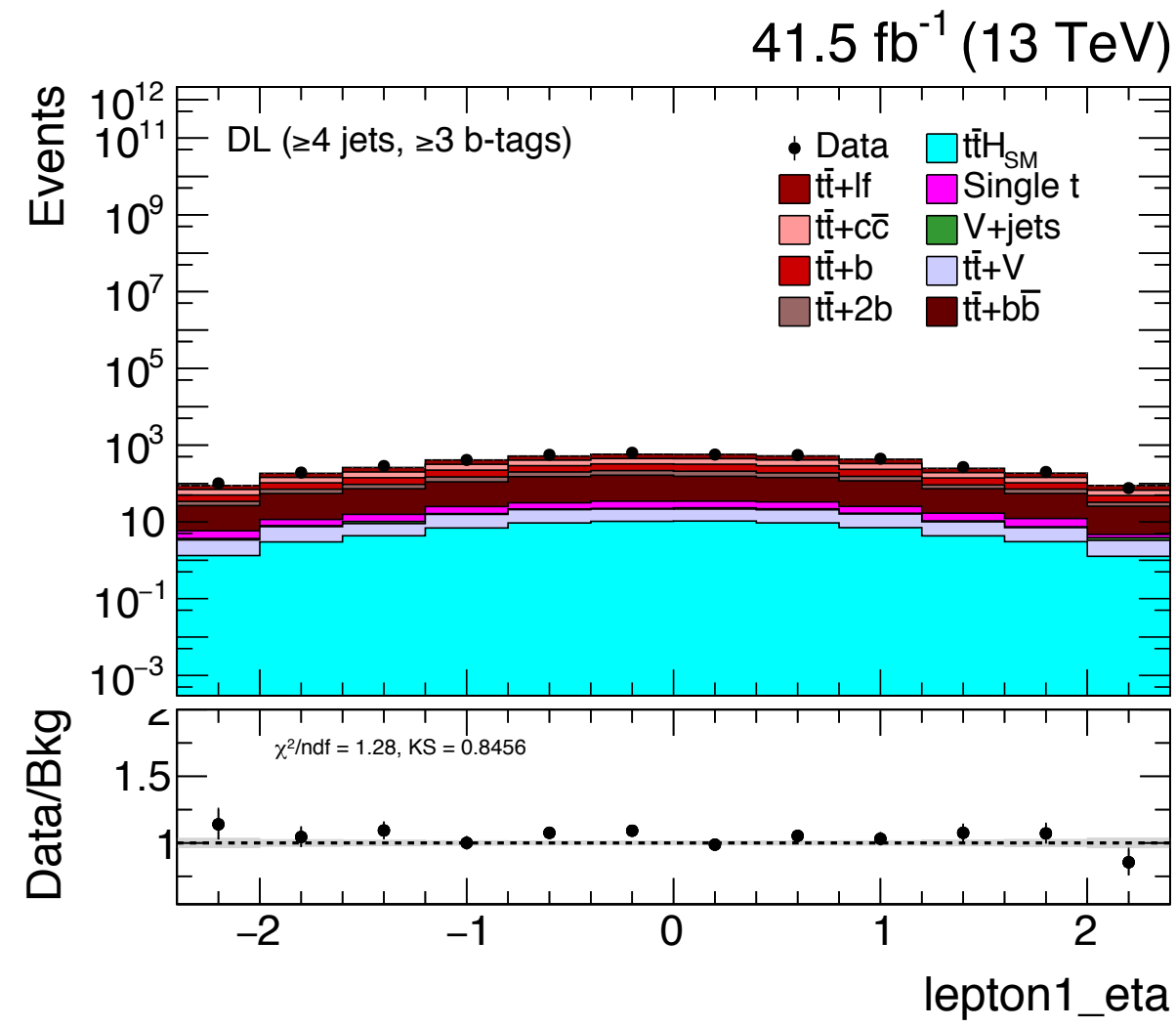
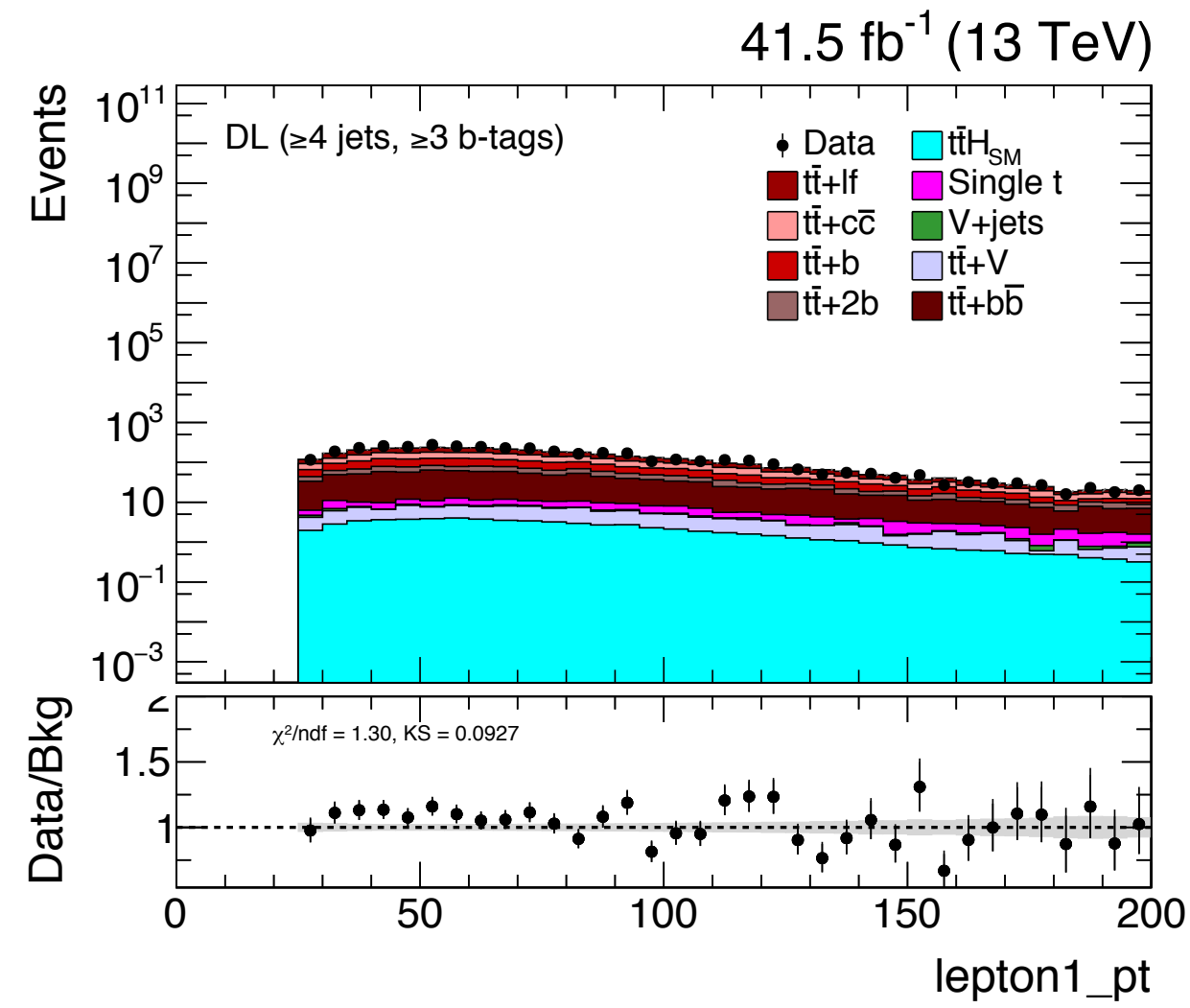
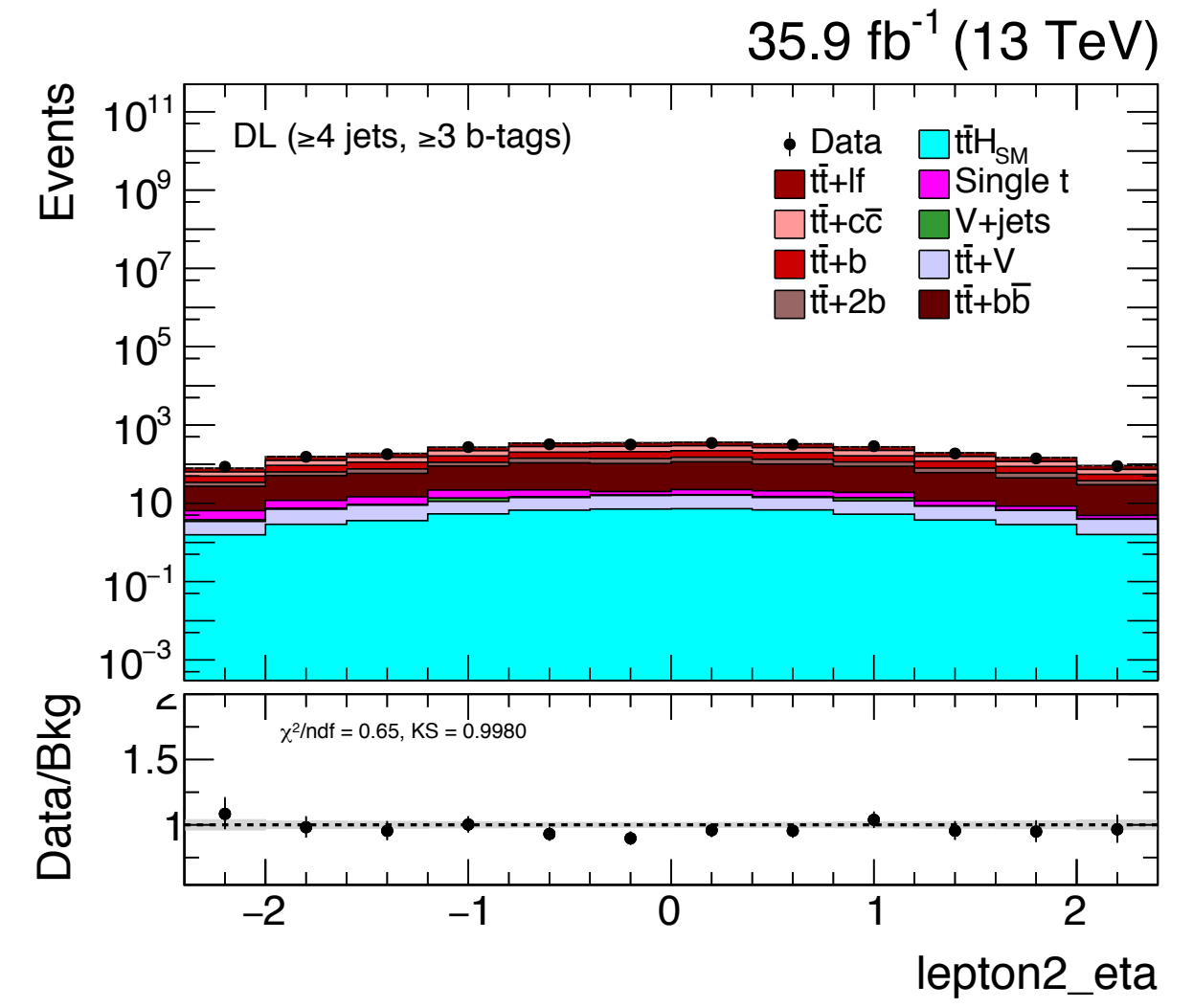
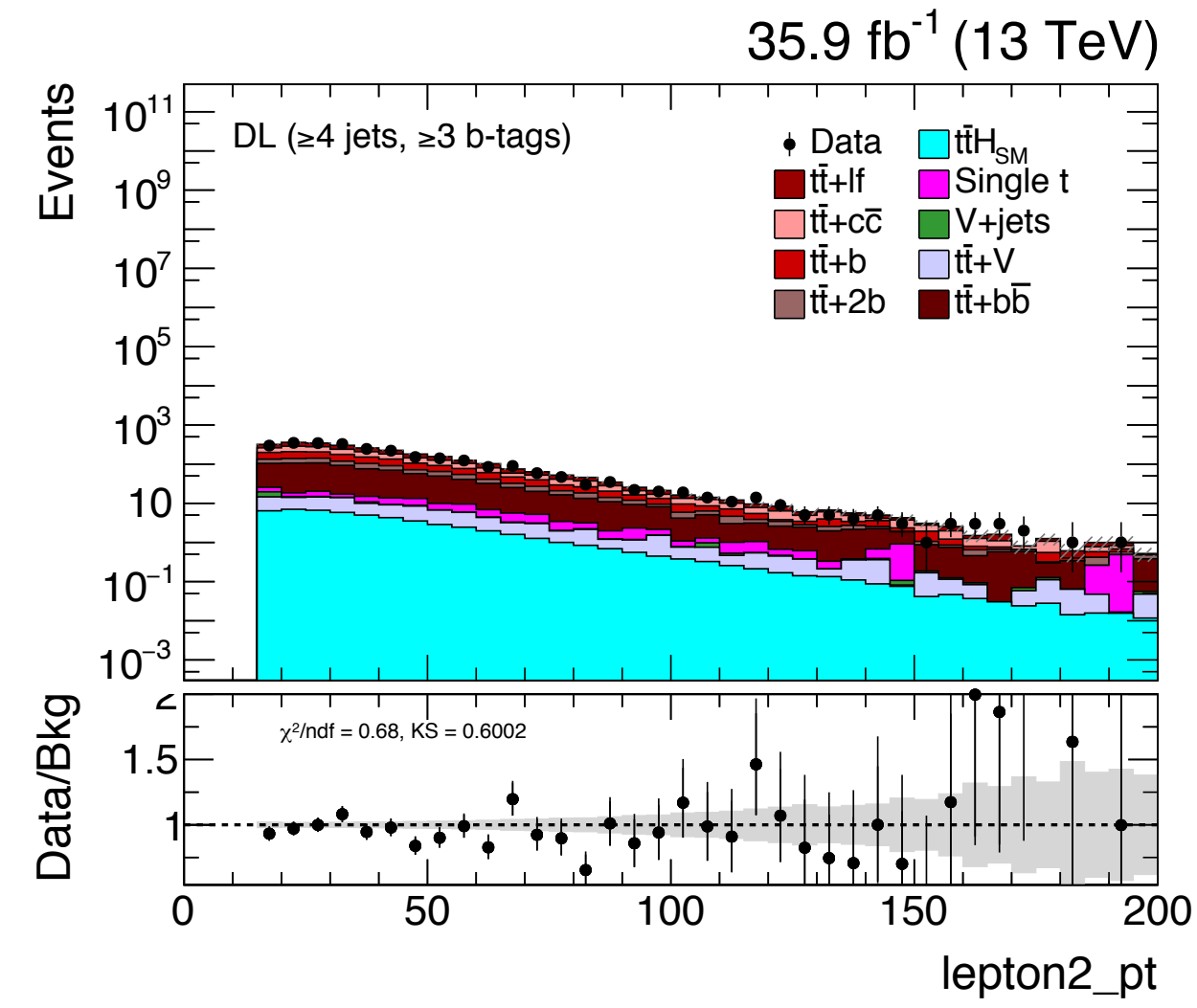
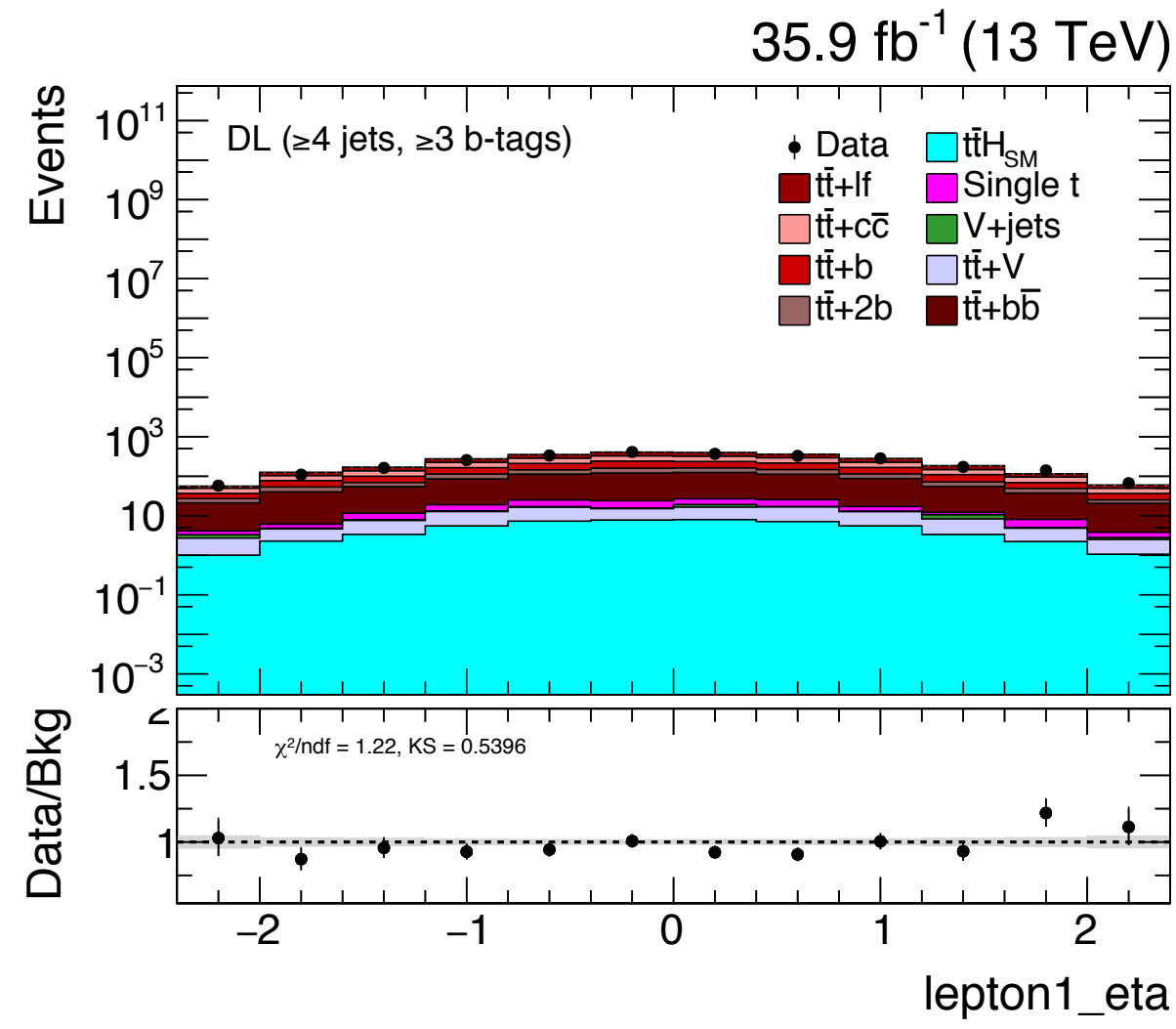
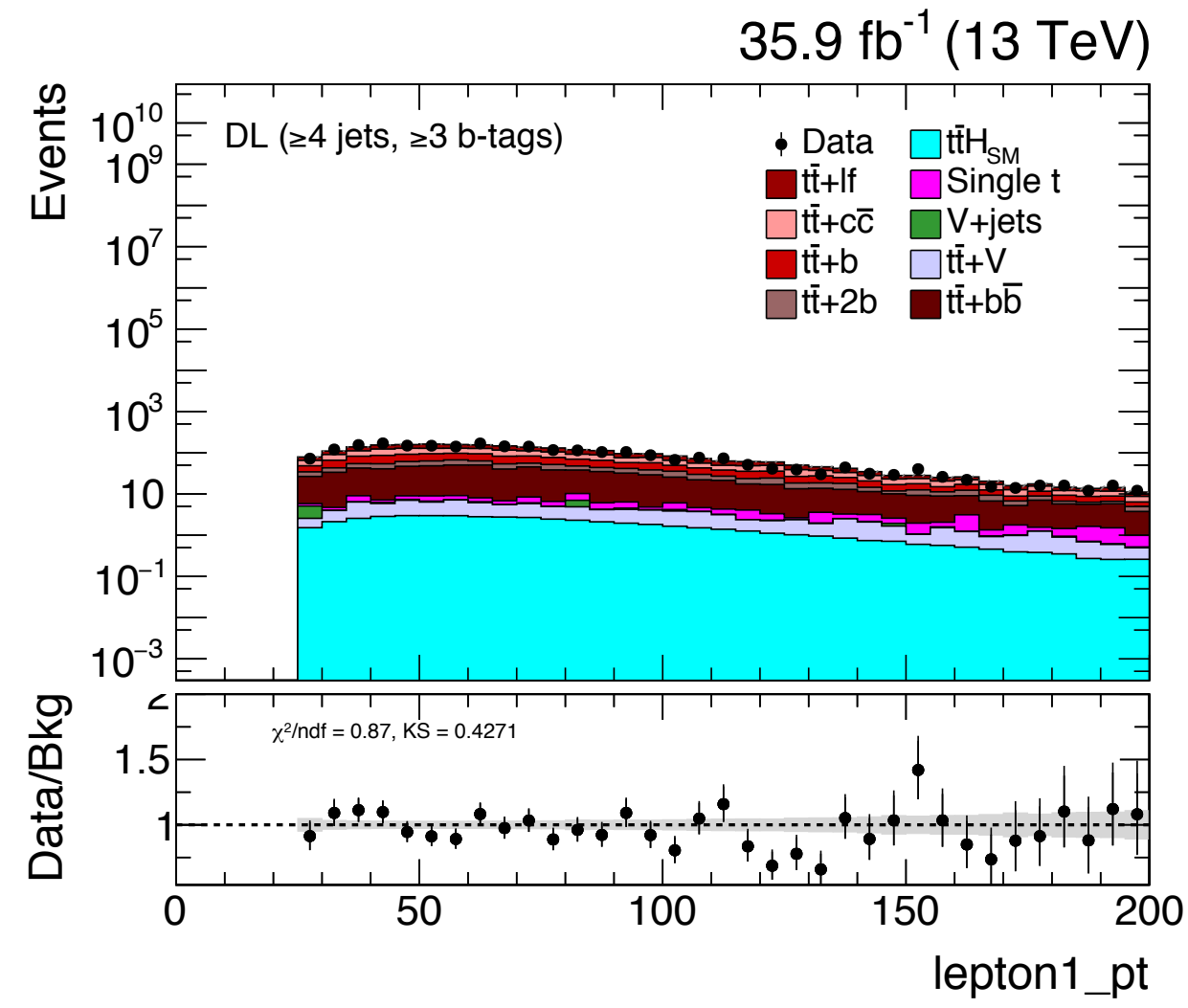


41.5 fb⁻¹ (13 TeV)

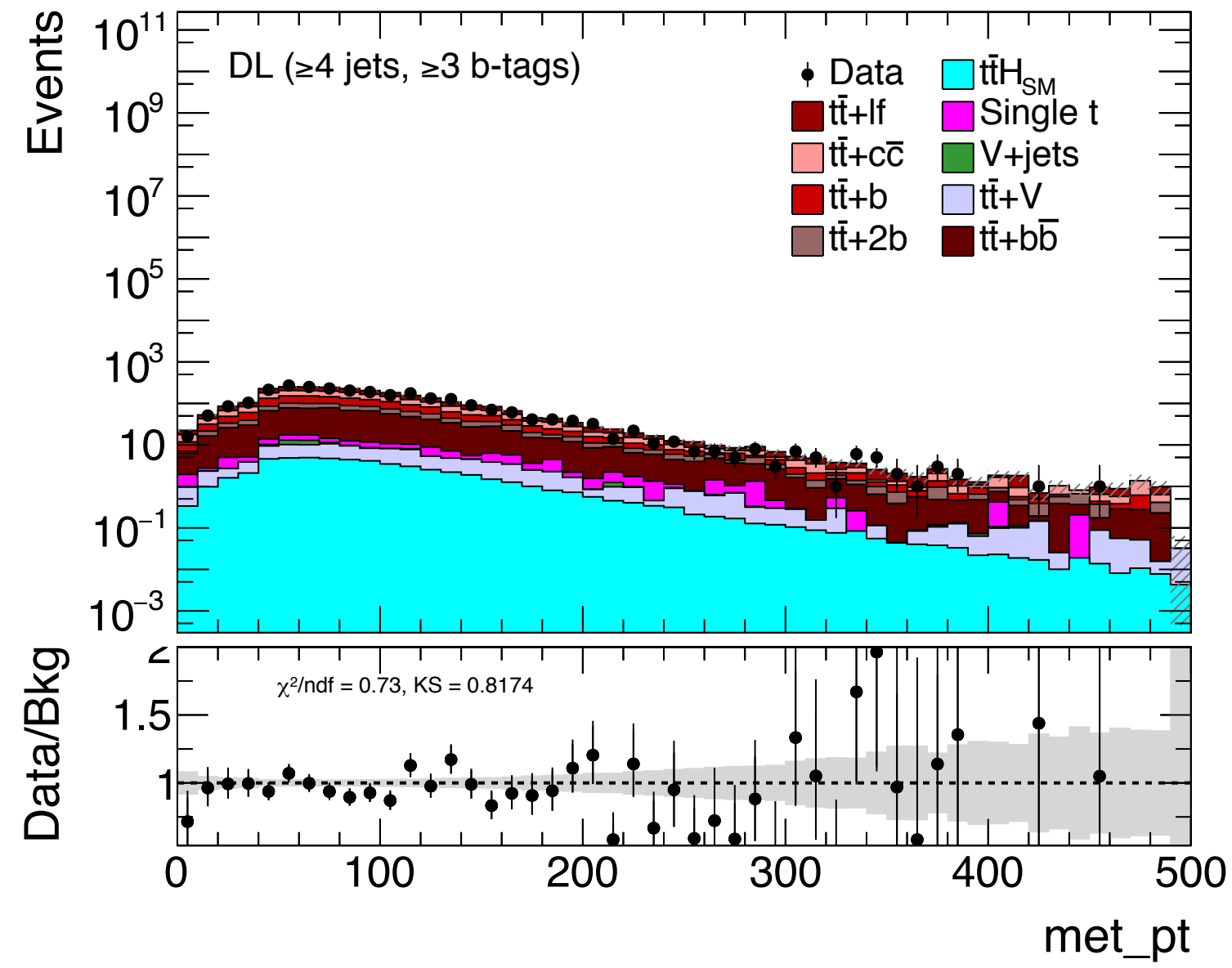


41.5 fb⁻¹ (13 TeV)

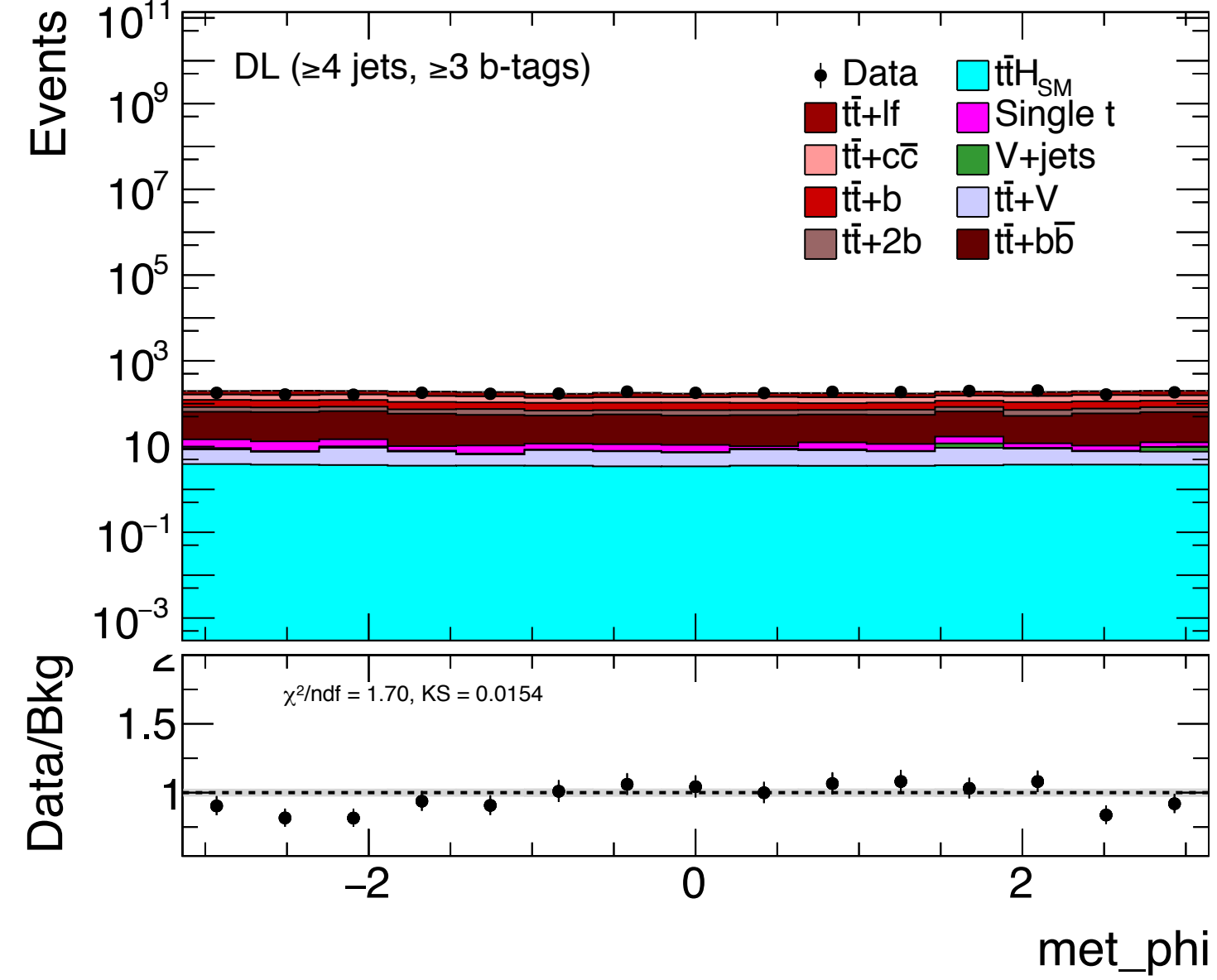




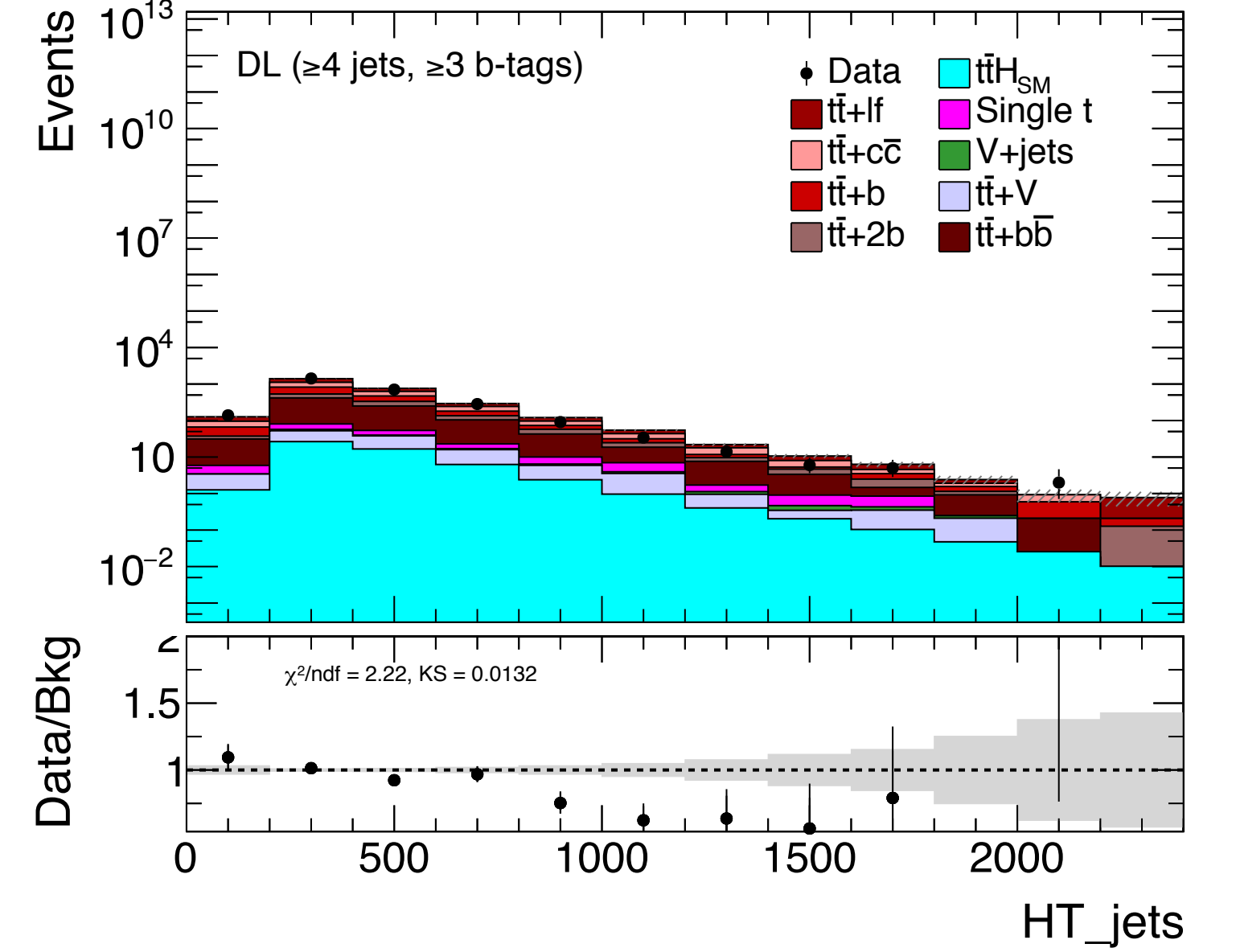
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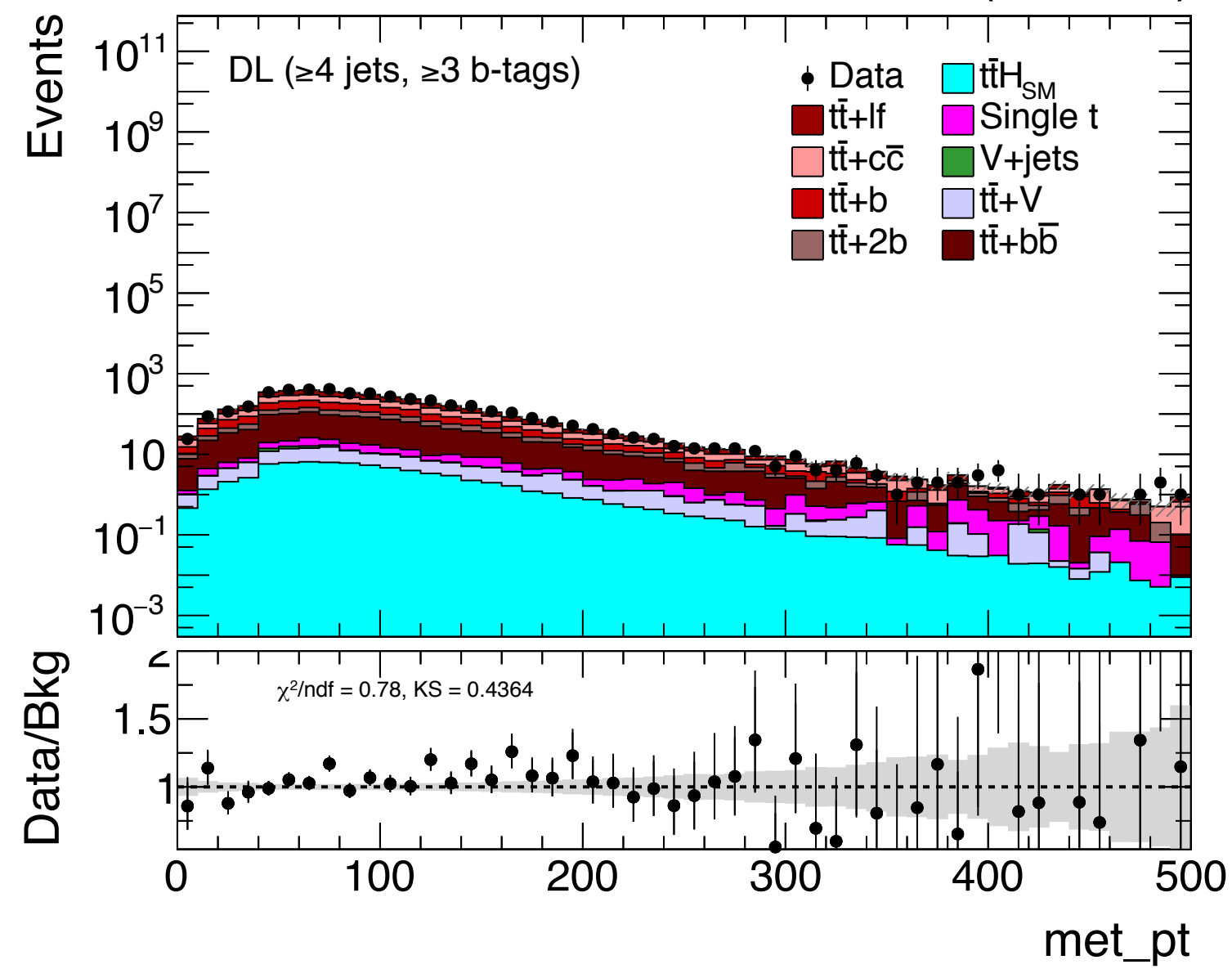
35.9 fb⁻¹ (13 TeV)



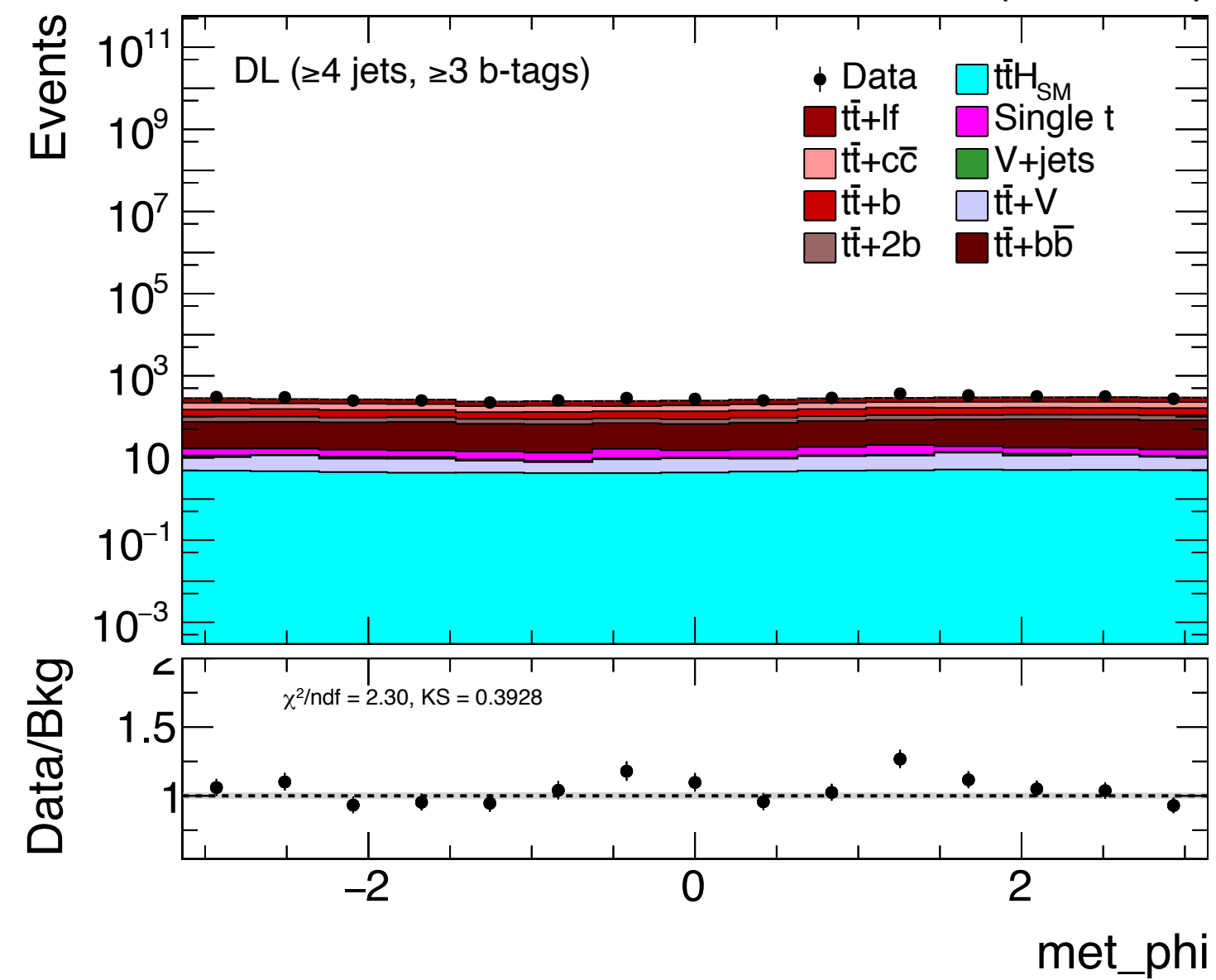
35.9 fb⁻¹ (13 TeV)



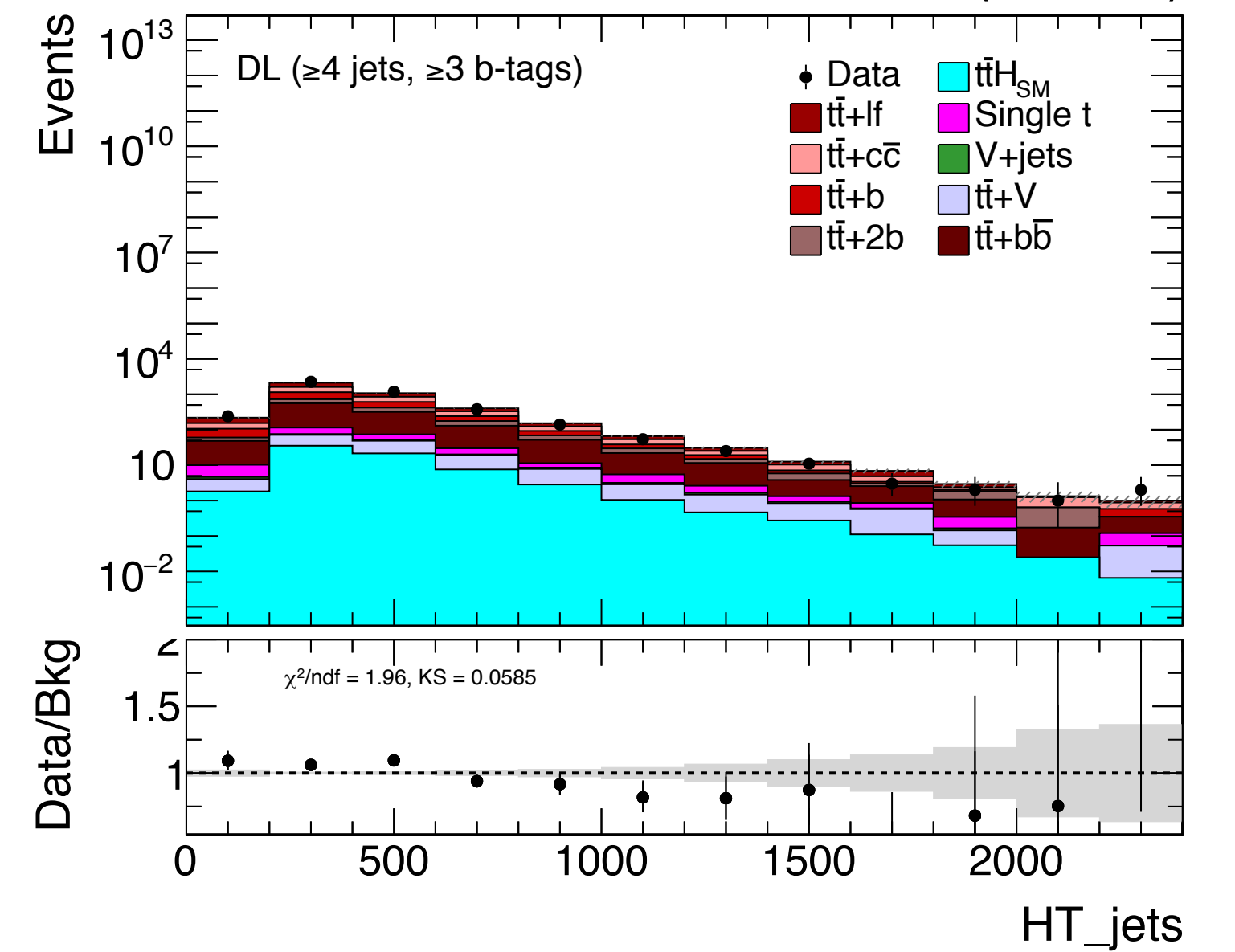
41.5 fb⁻¹ (13 TeV)

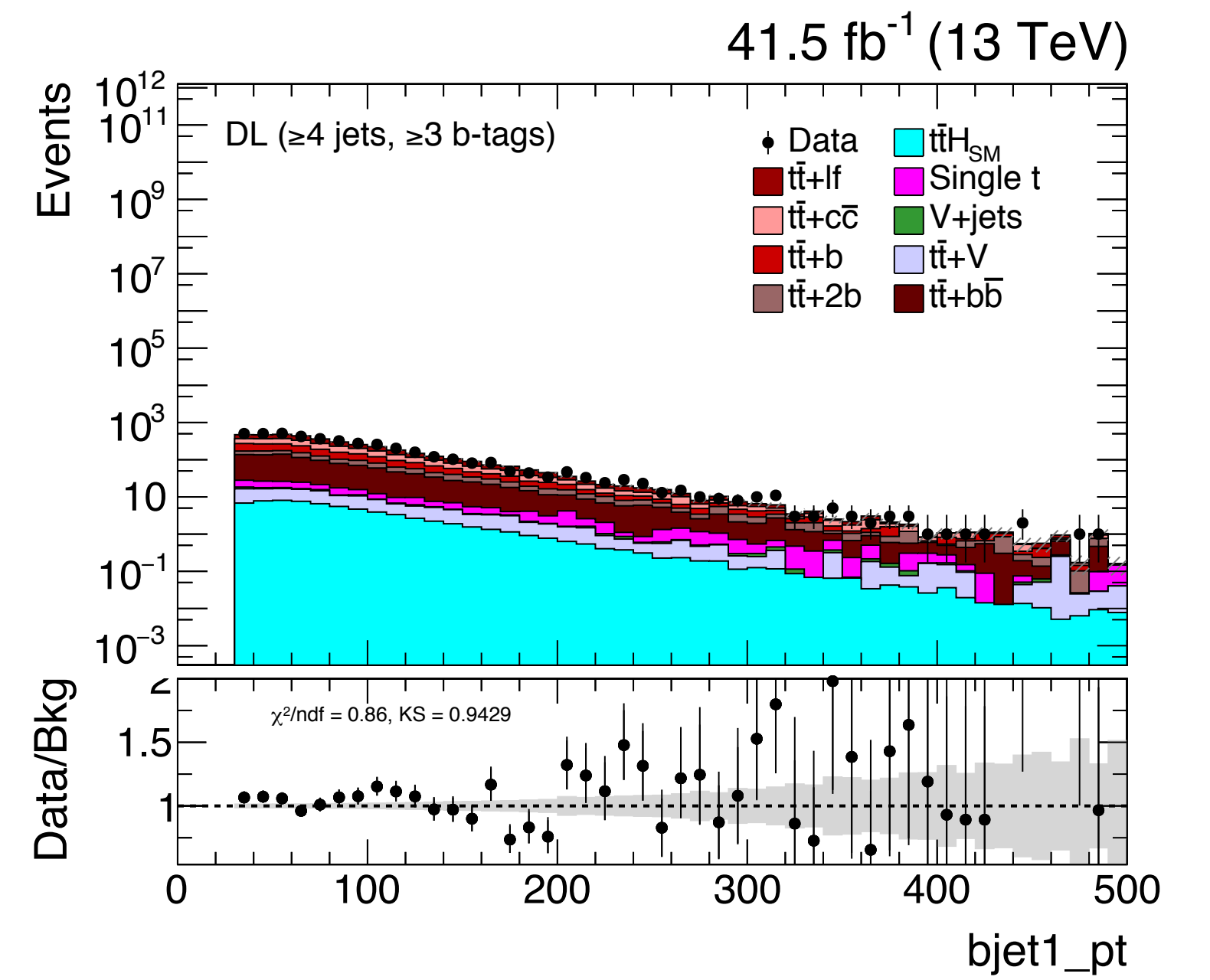
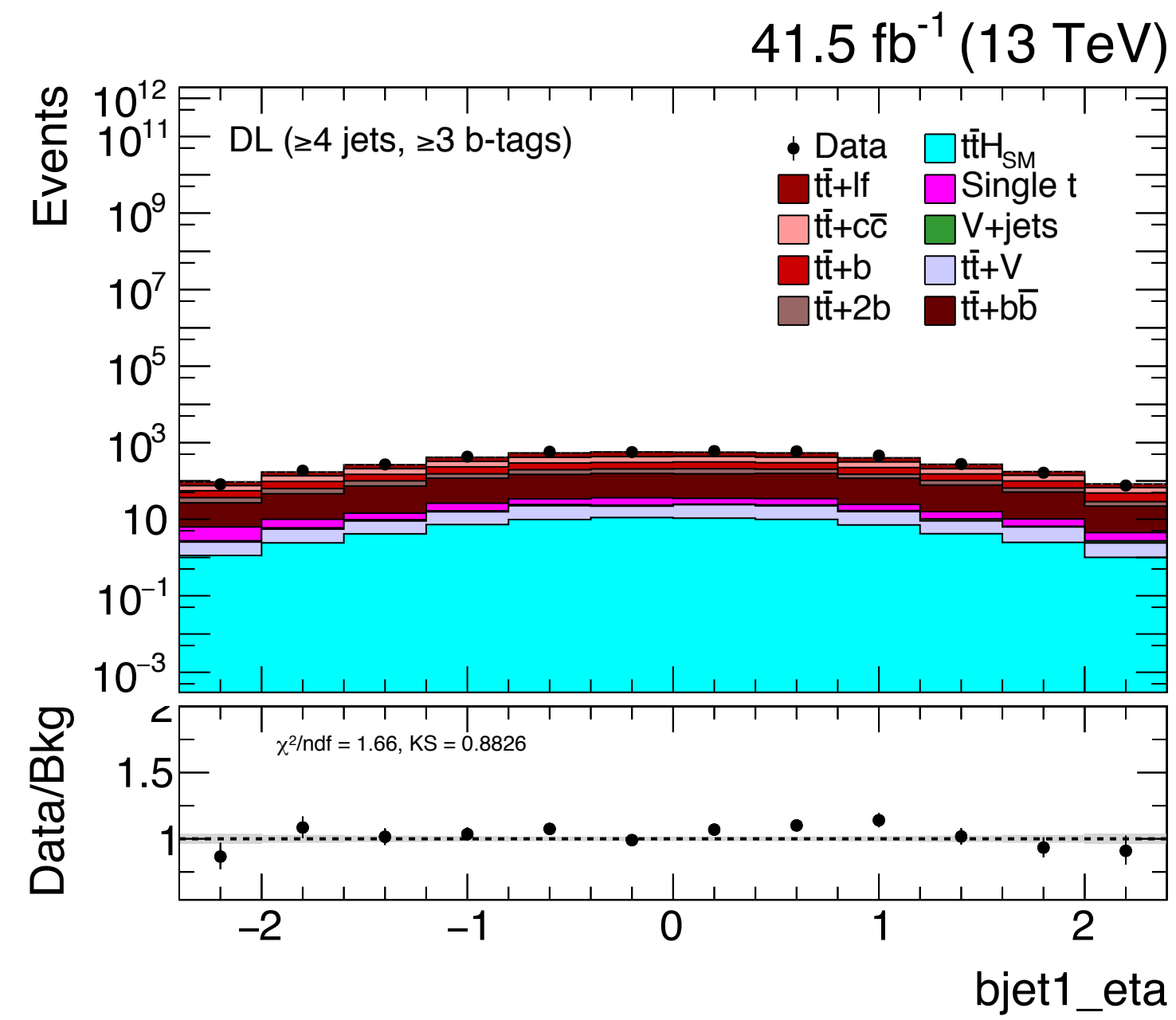
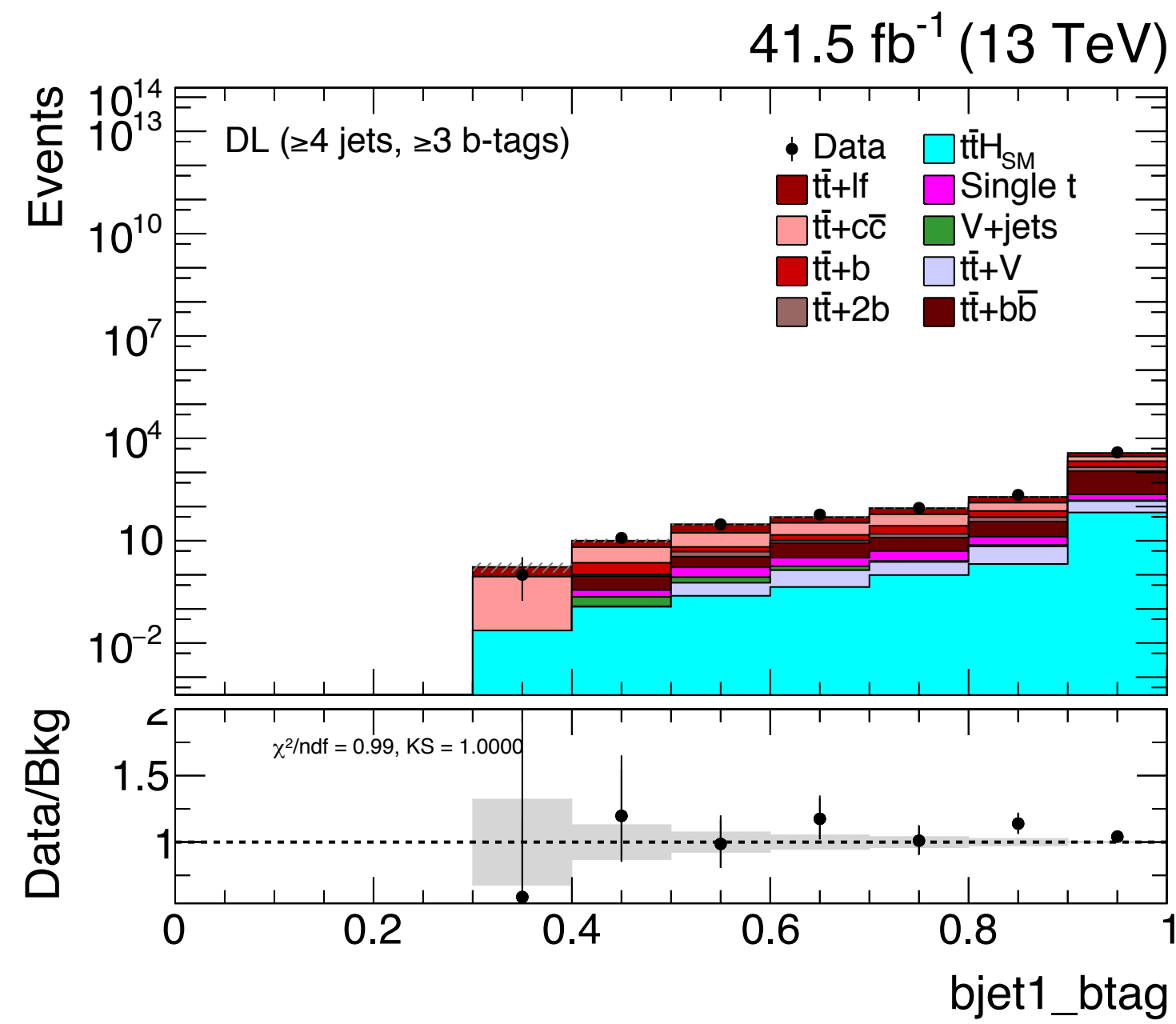
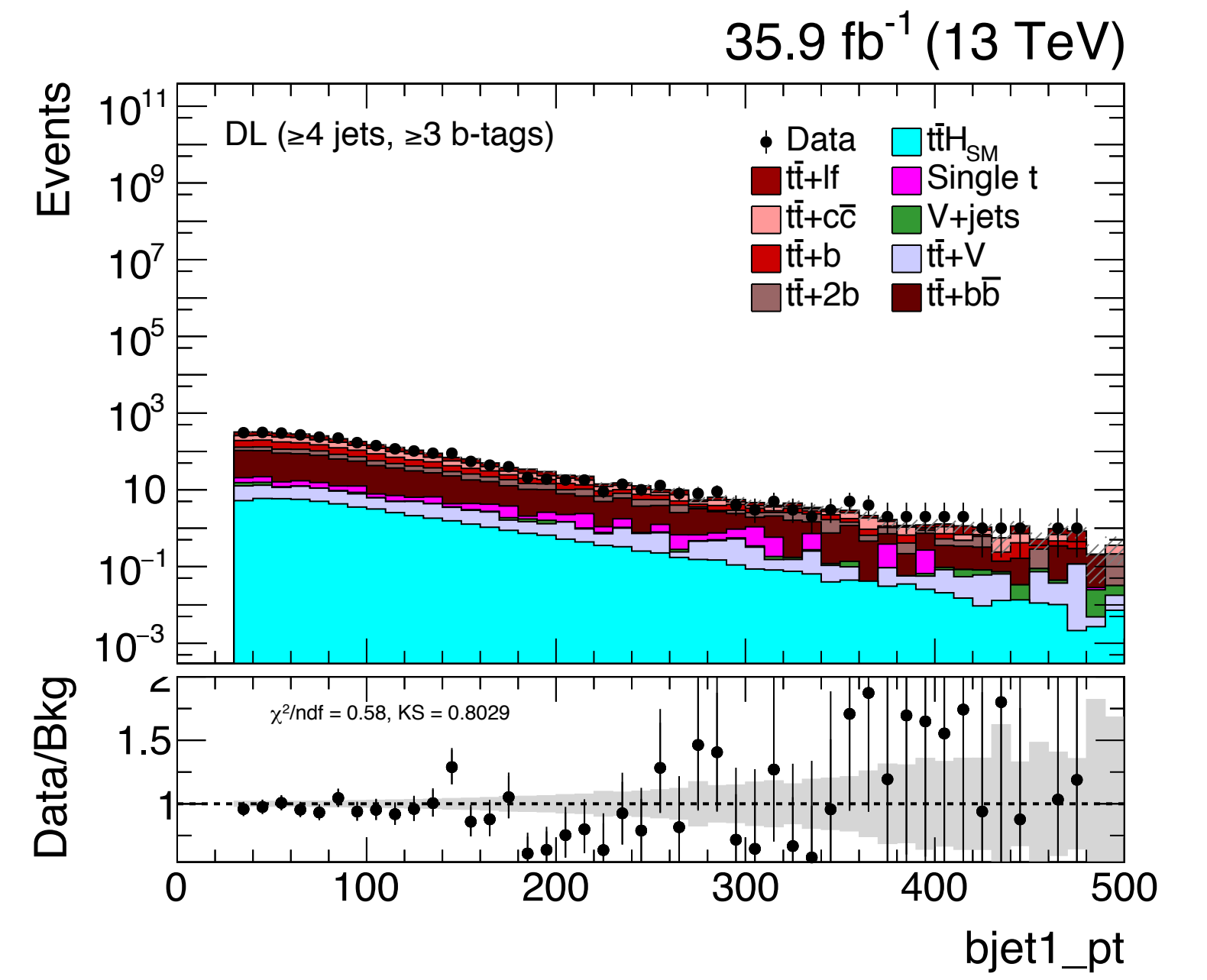
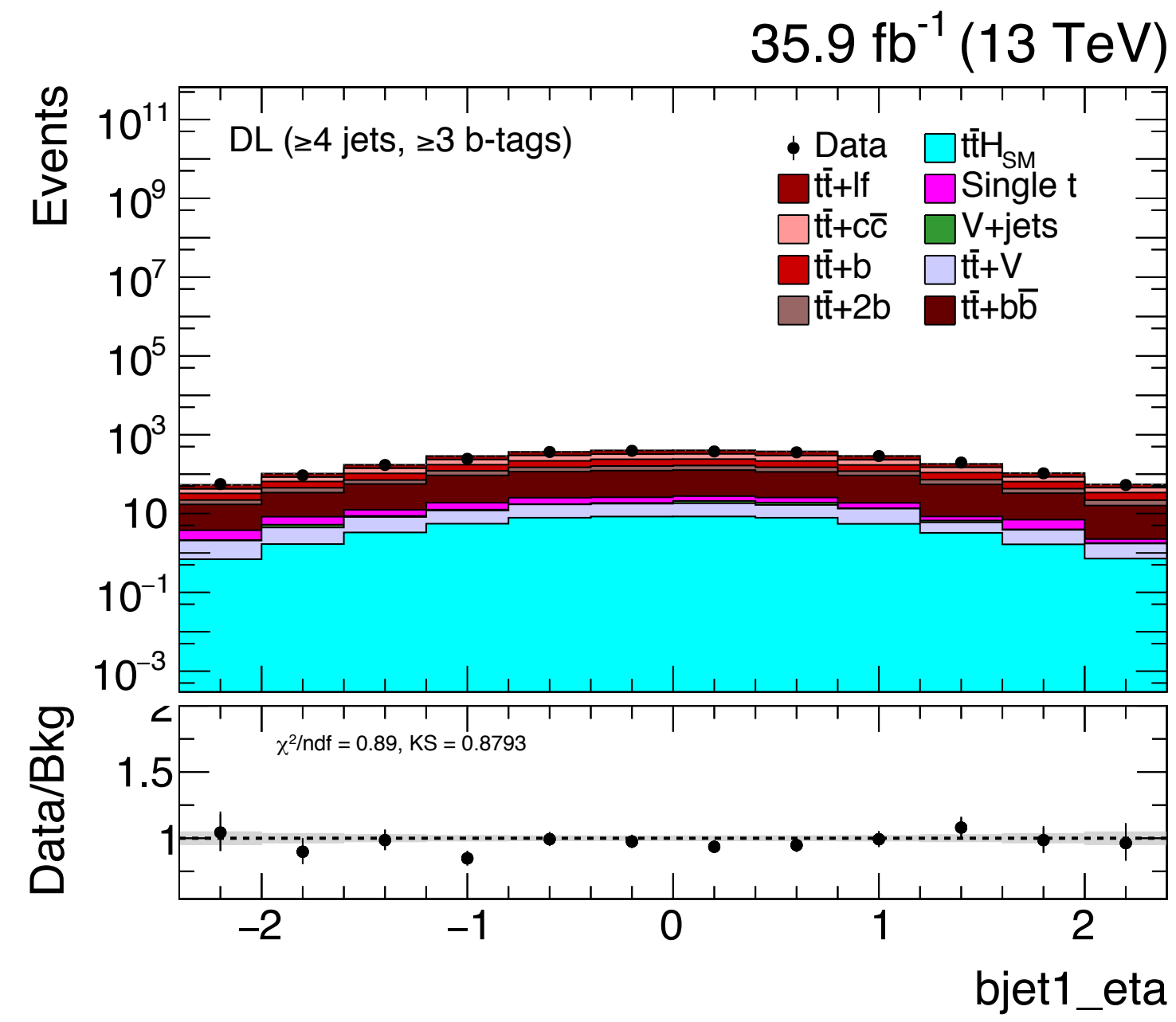
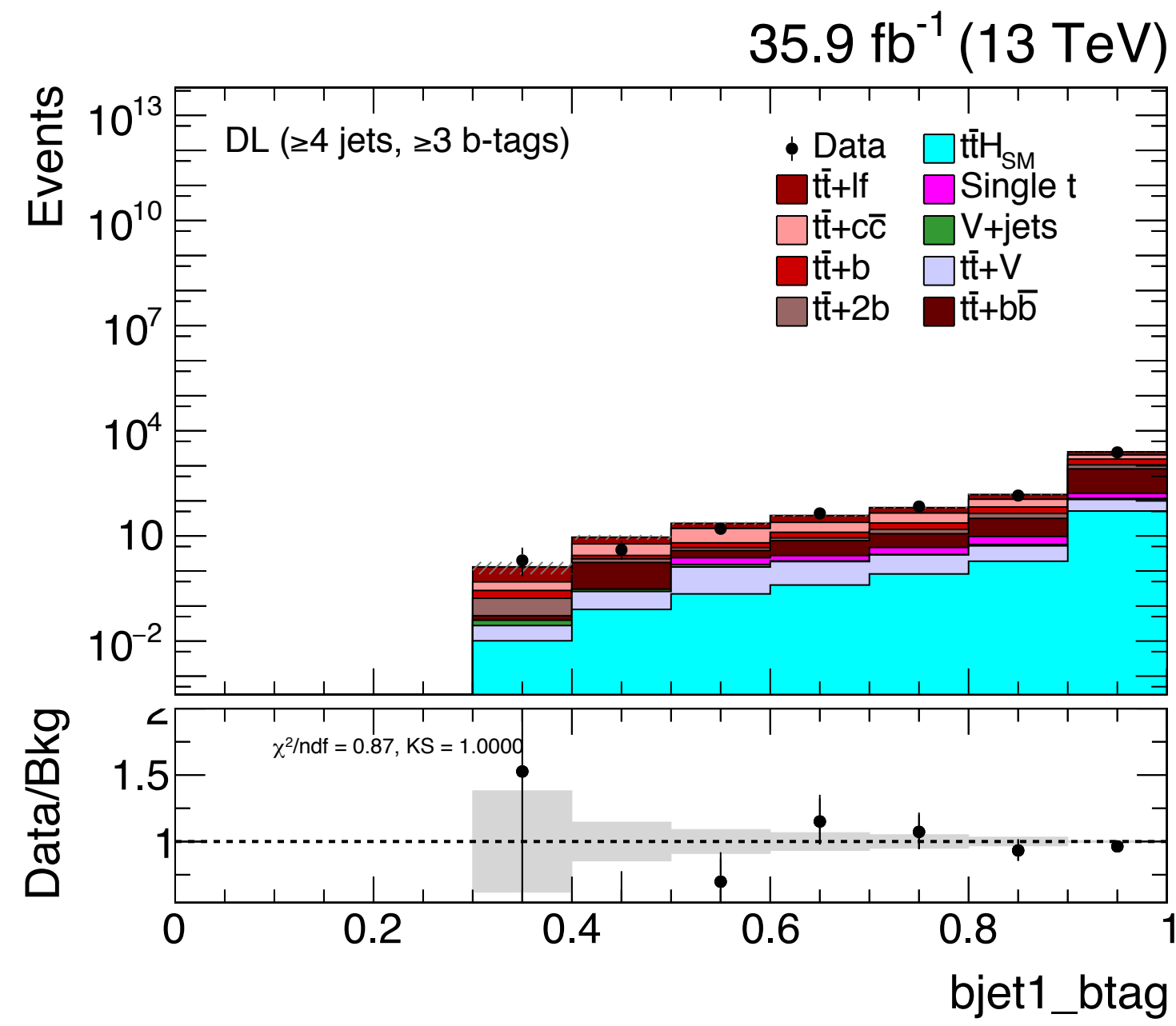


41.5 fb⁻¹ (13 TeV)

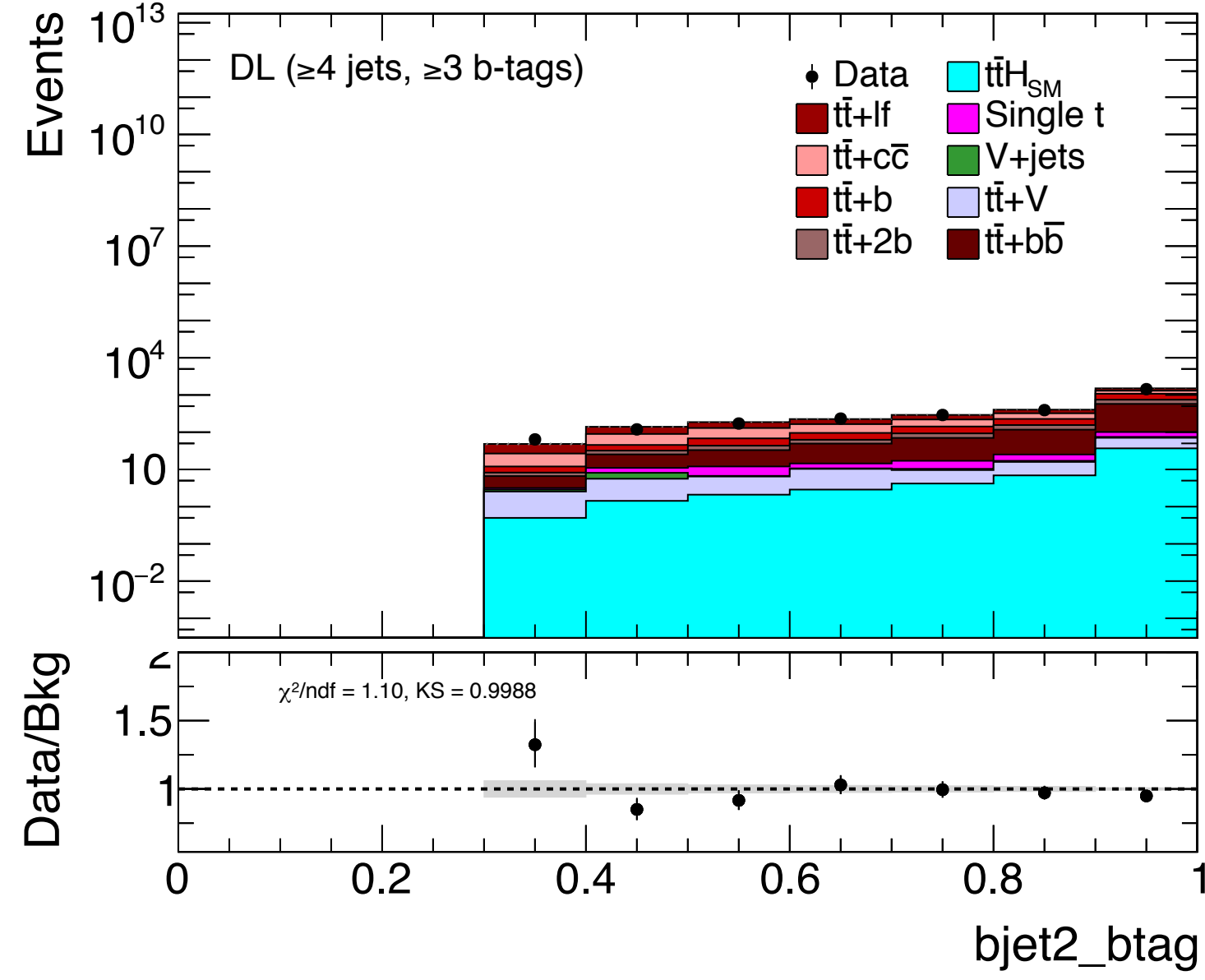


41.5 fb⁻¹ (13 TeV)

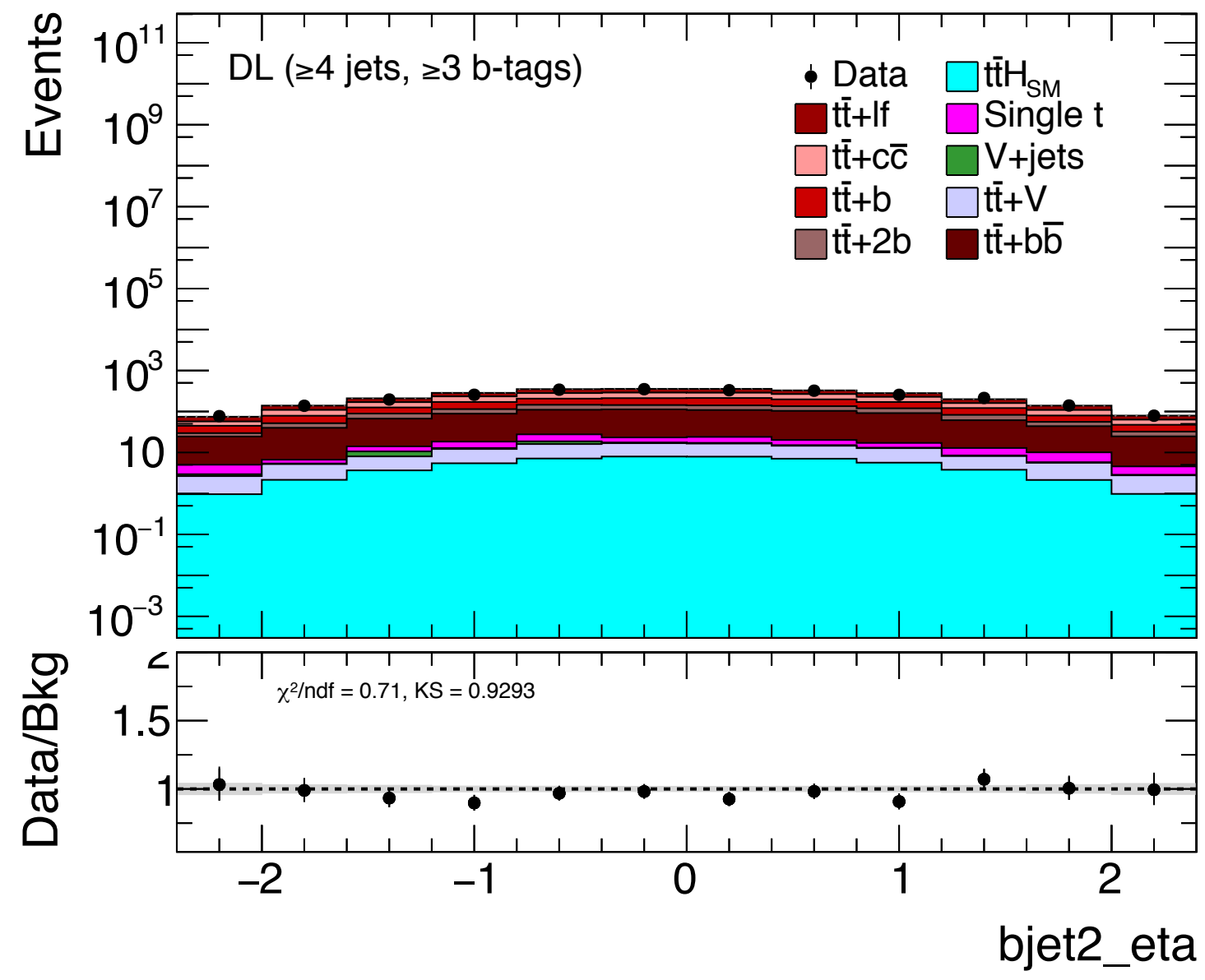




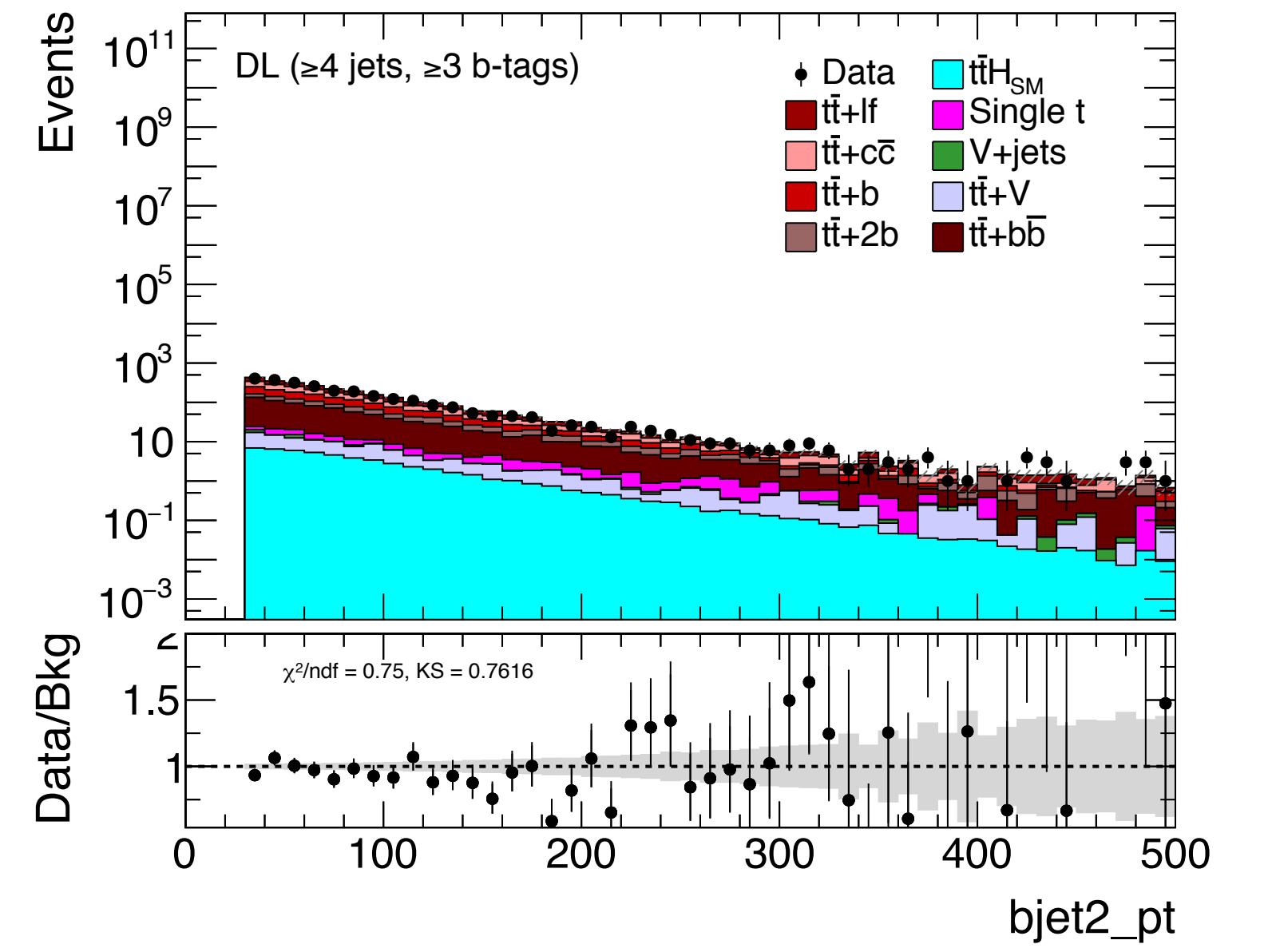
35.9 fb⁻¹ (13 TeV)



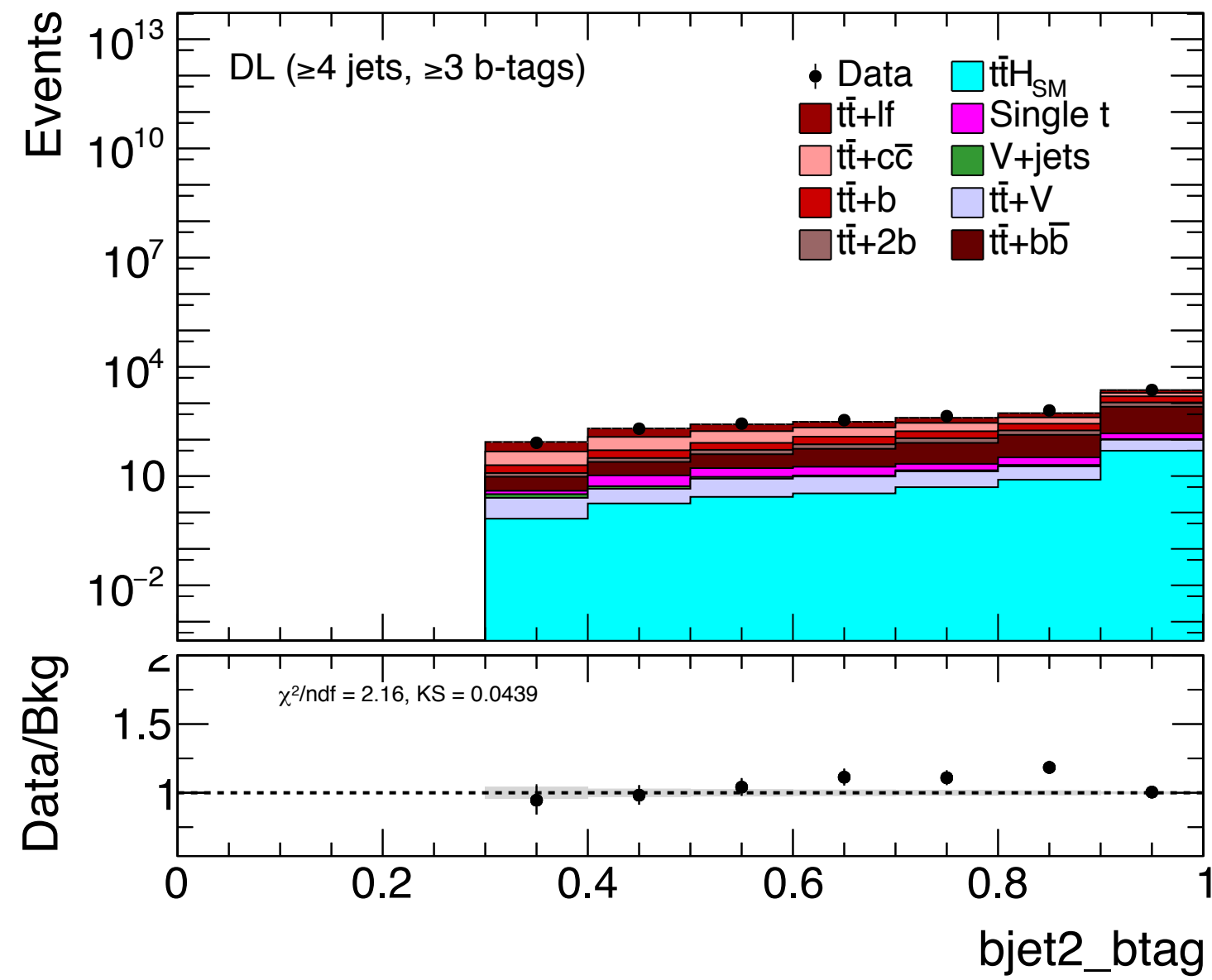
35.9 fb⁻¹ (13 TeV)



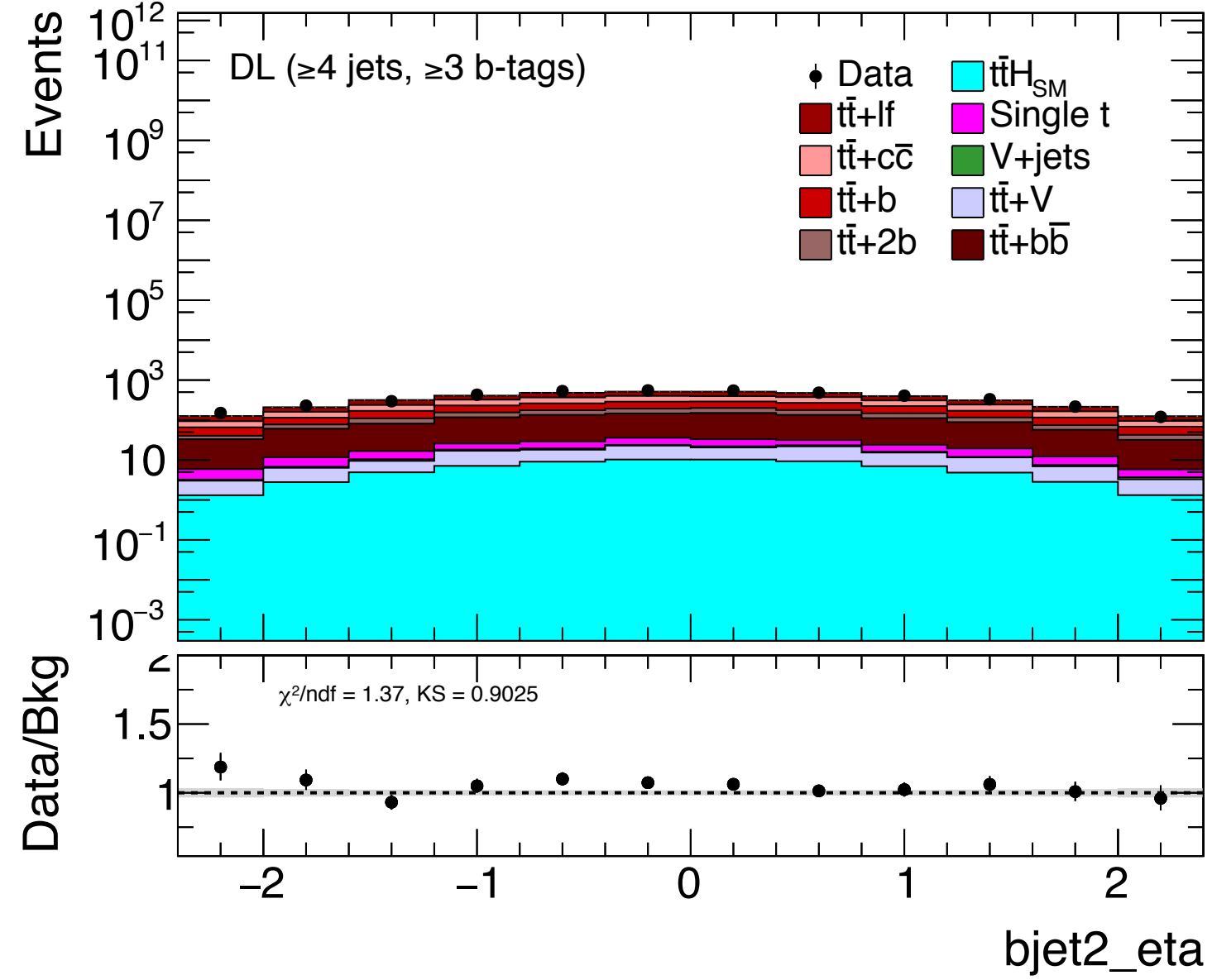
35.9 fb⁻¹ (13 TeV)



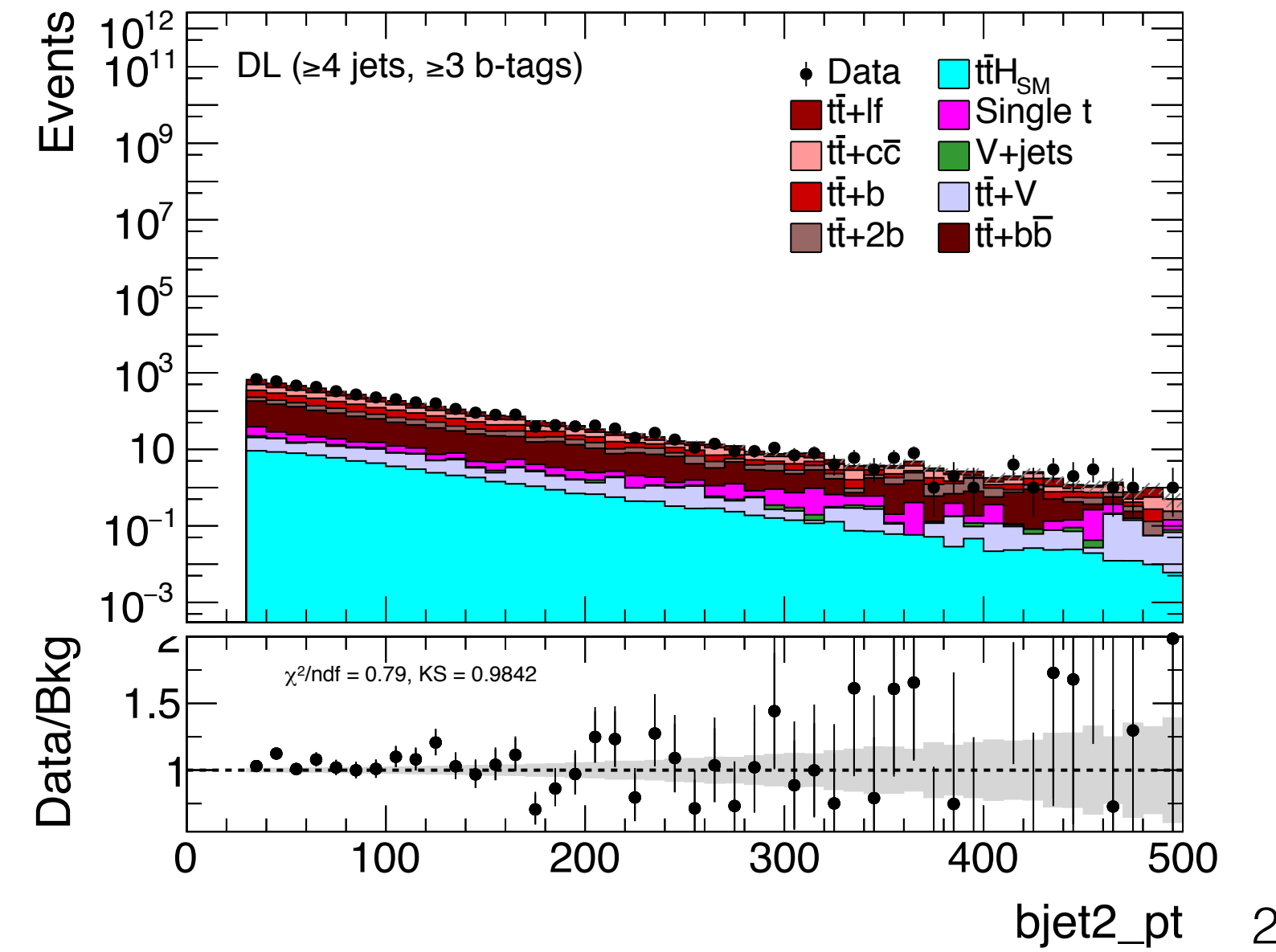
41.5 fb⁻¹ (13 TeV)

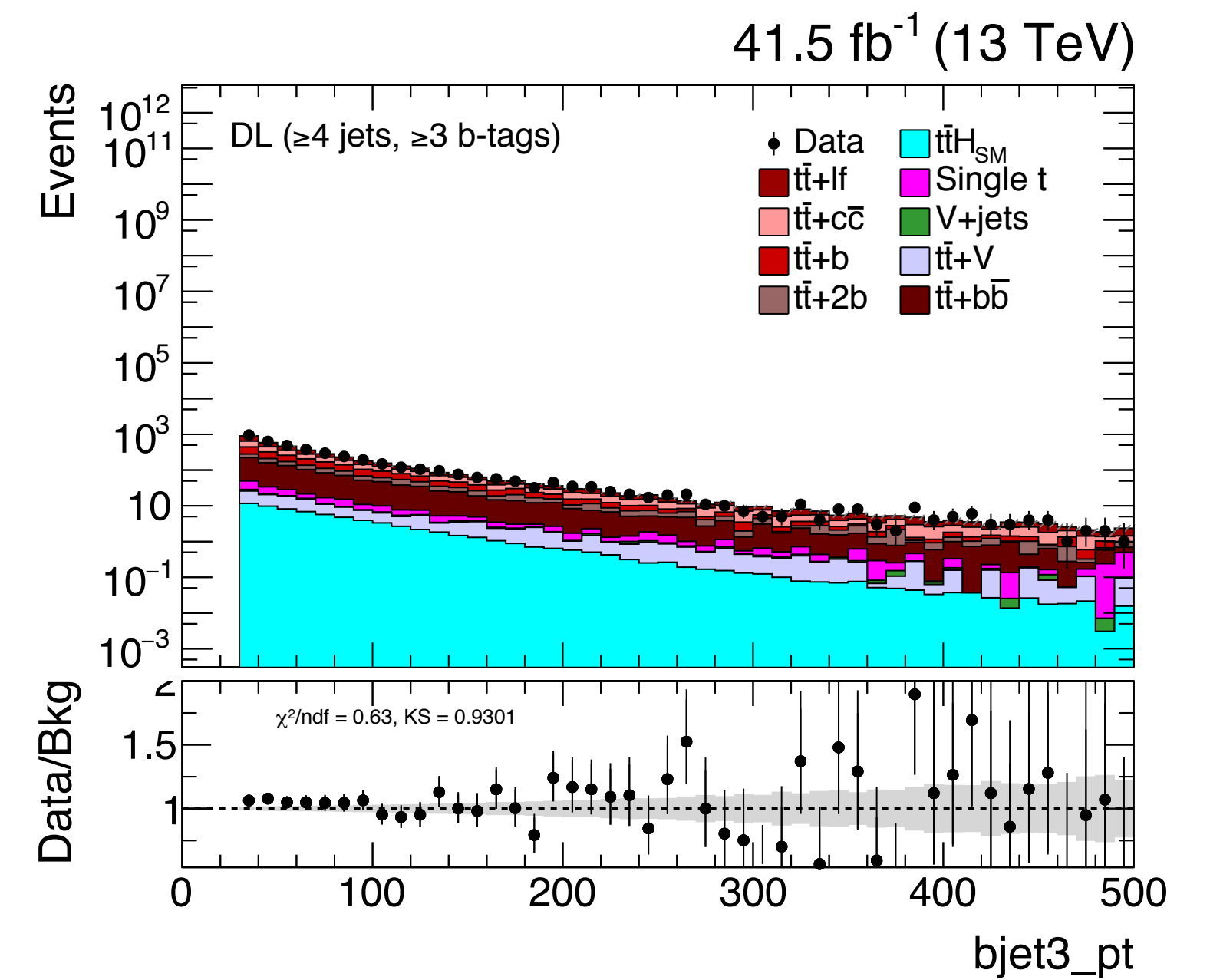
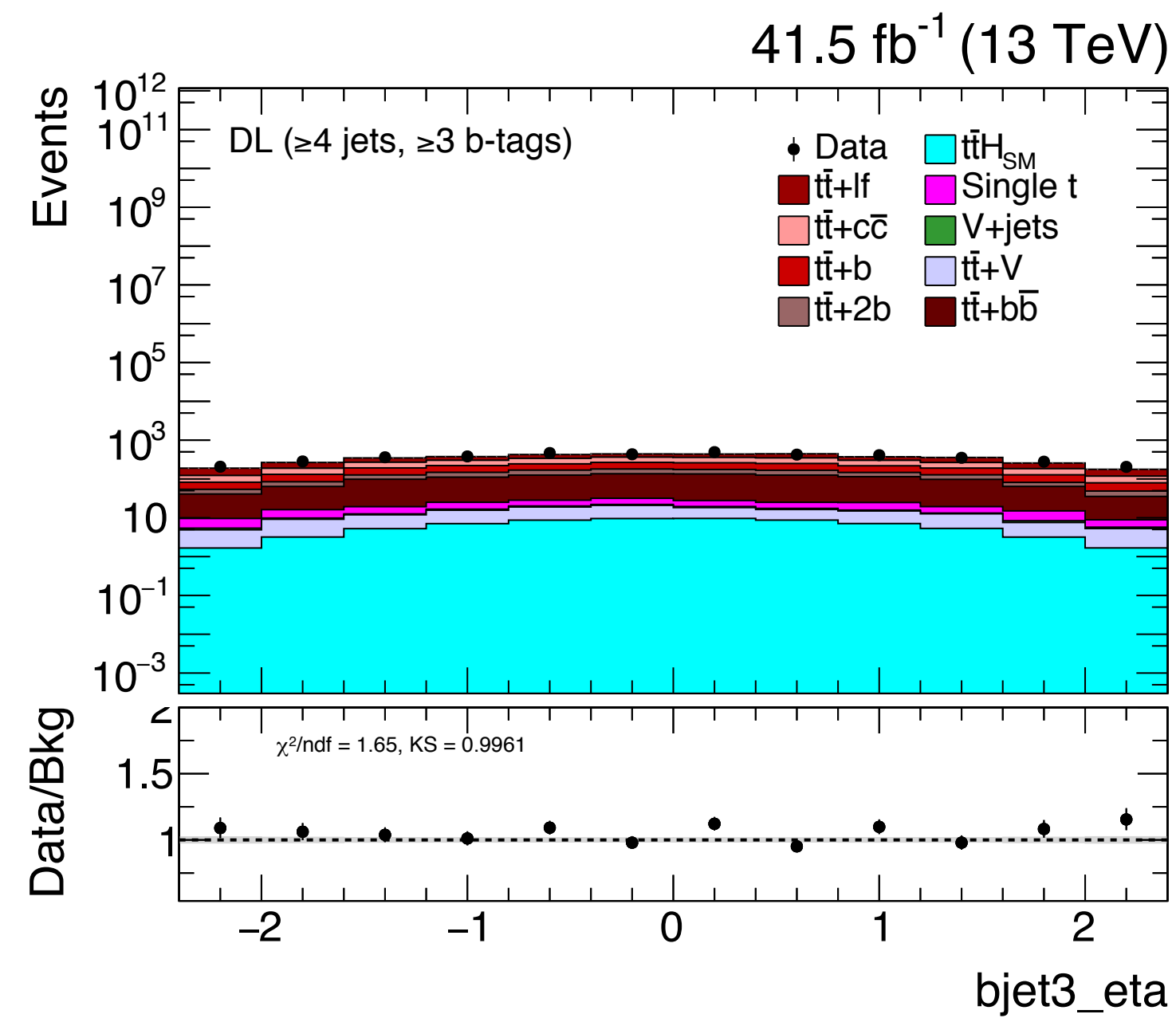
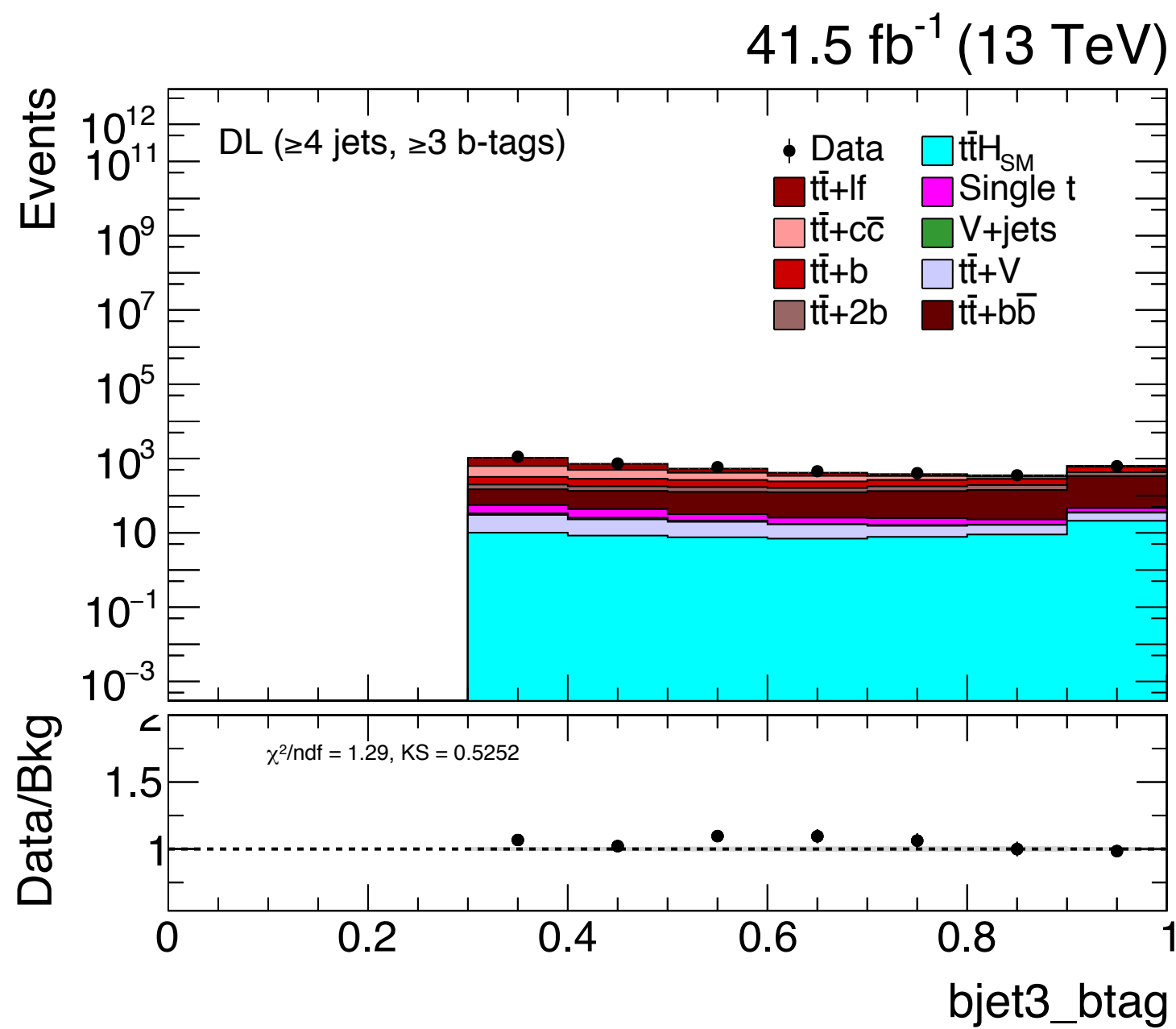
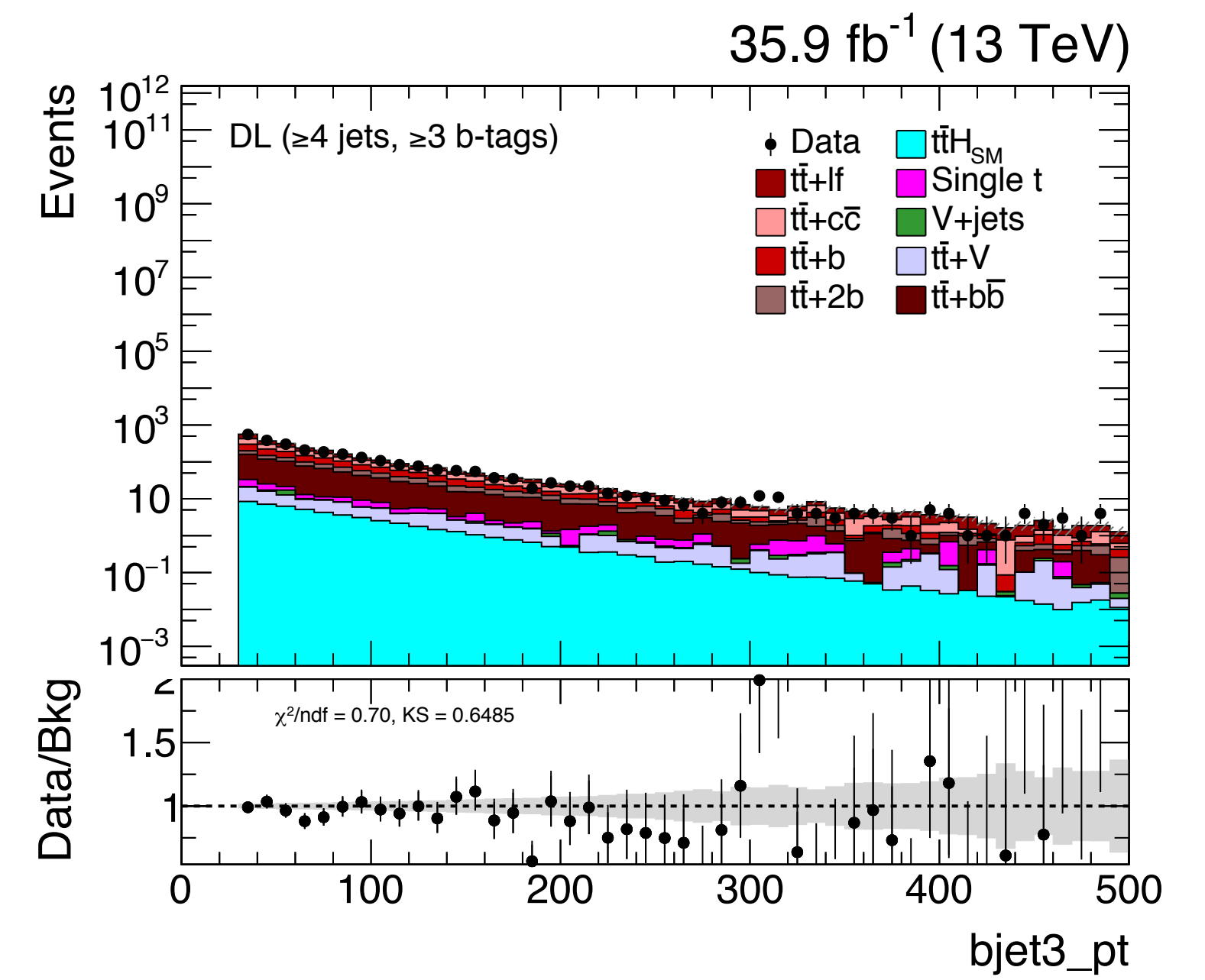
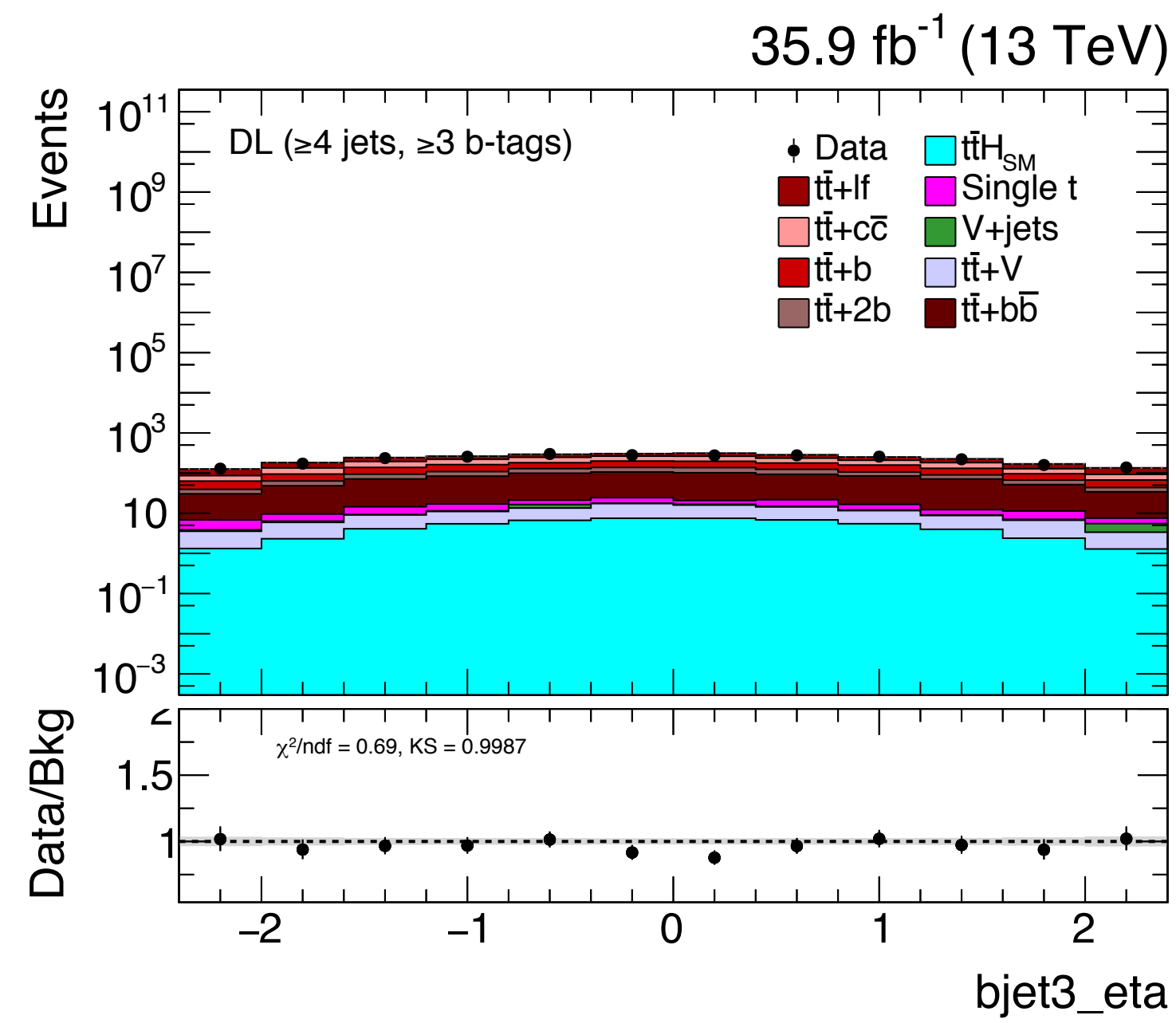
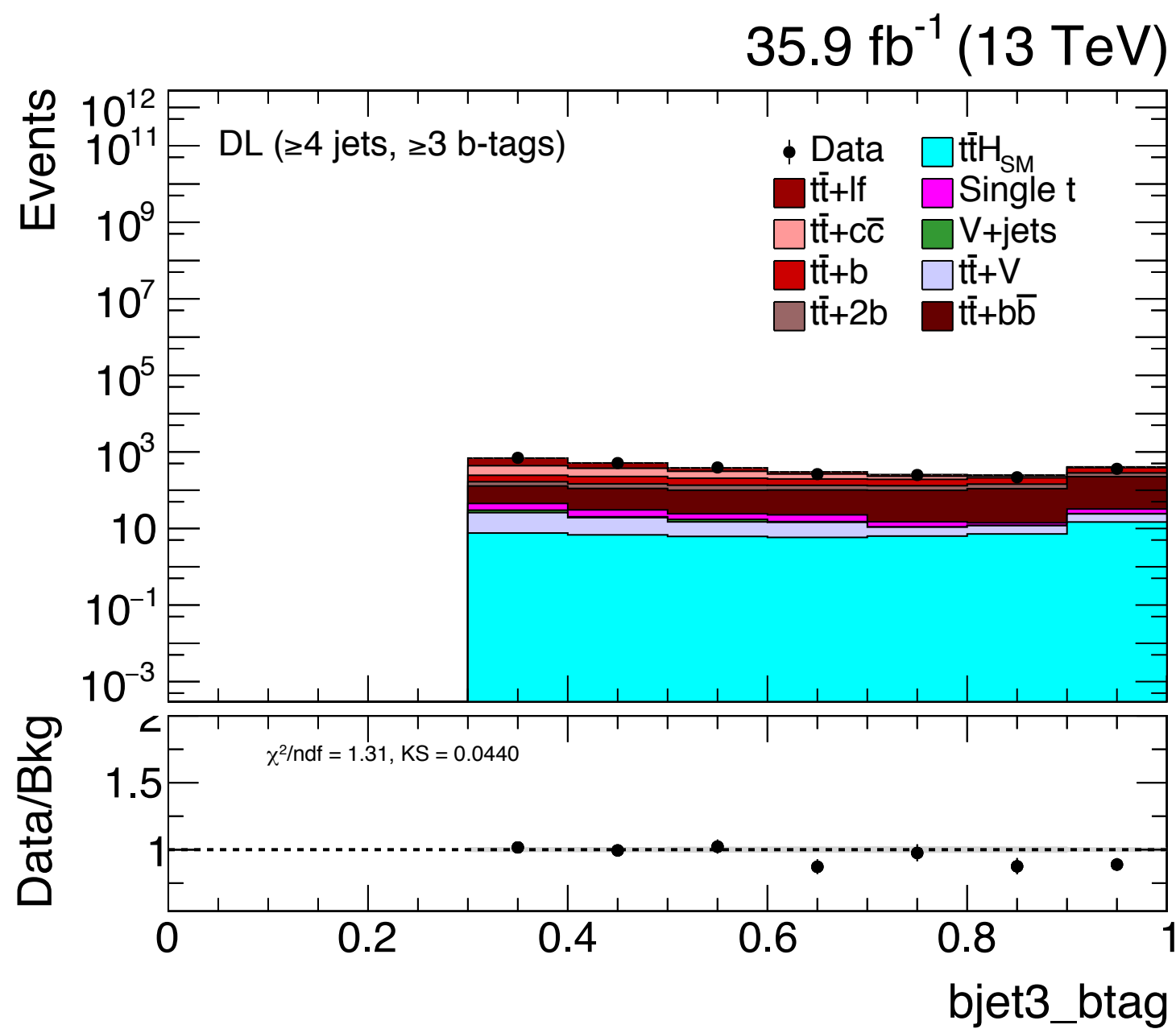


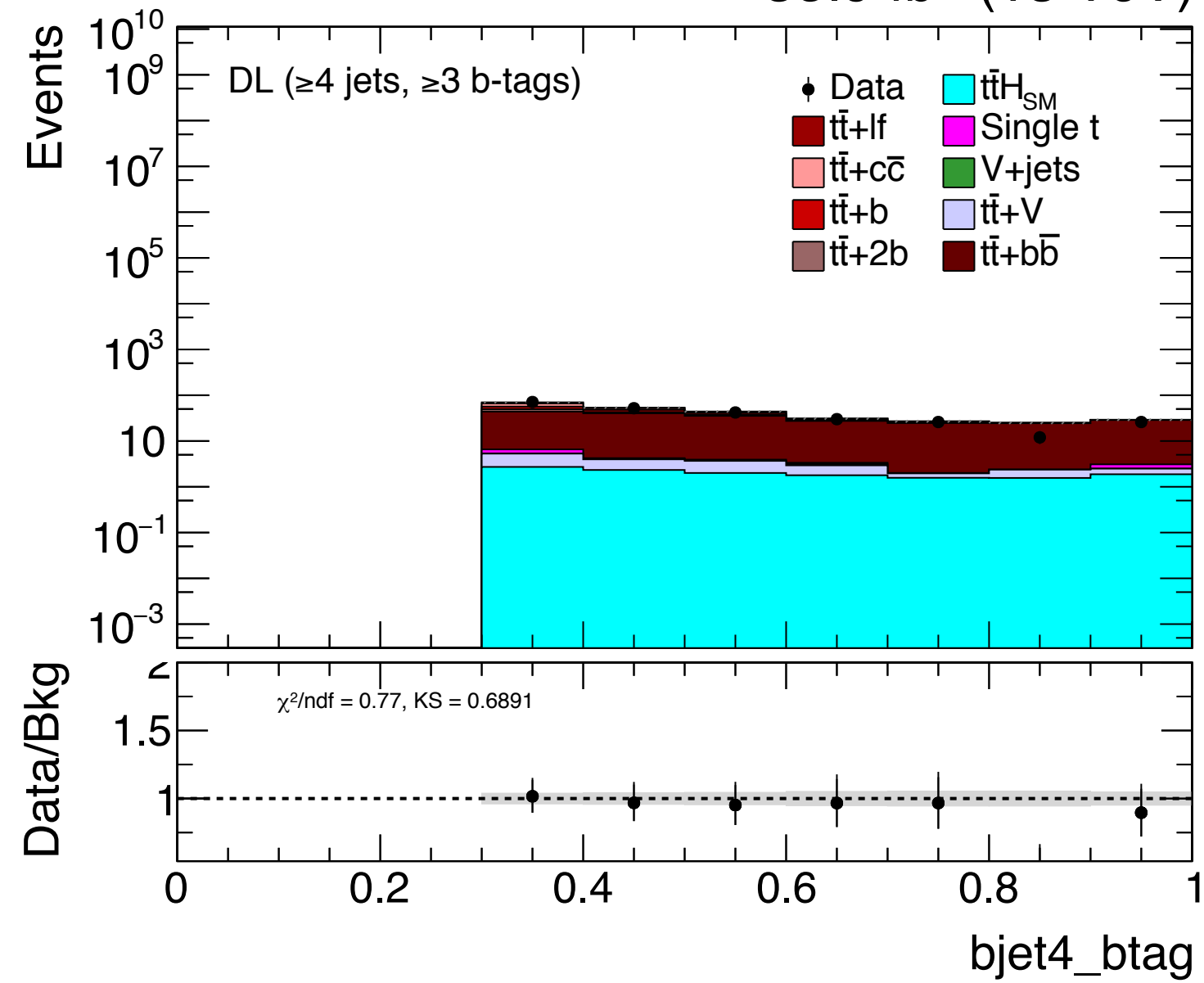
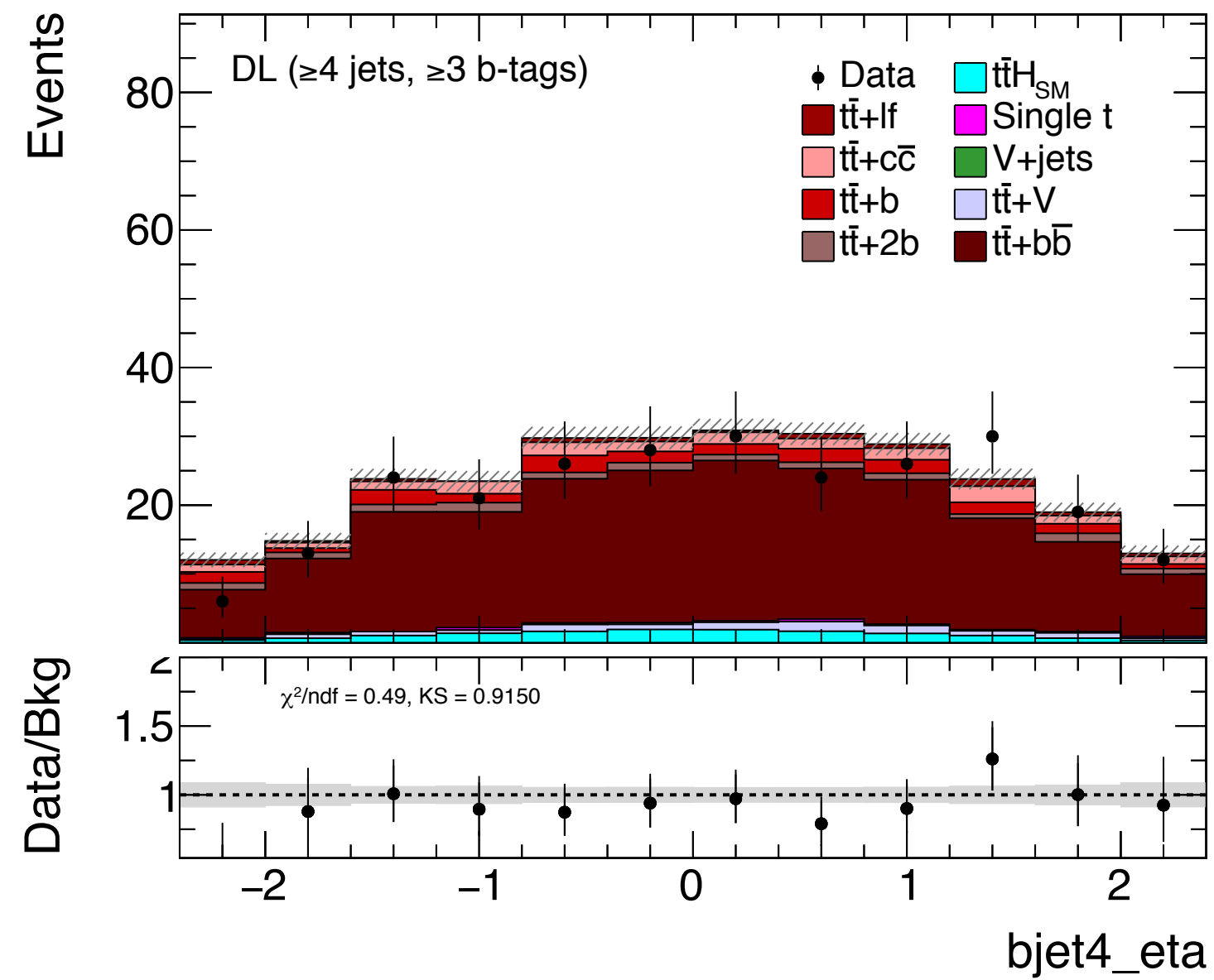
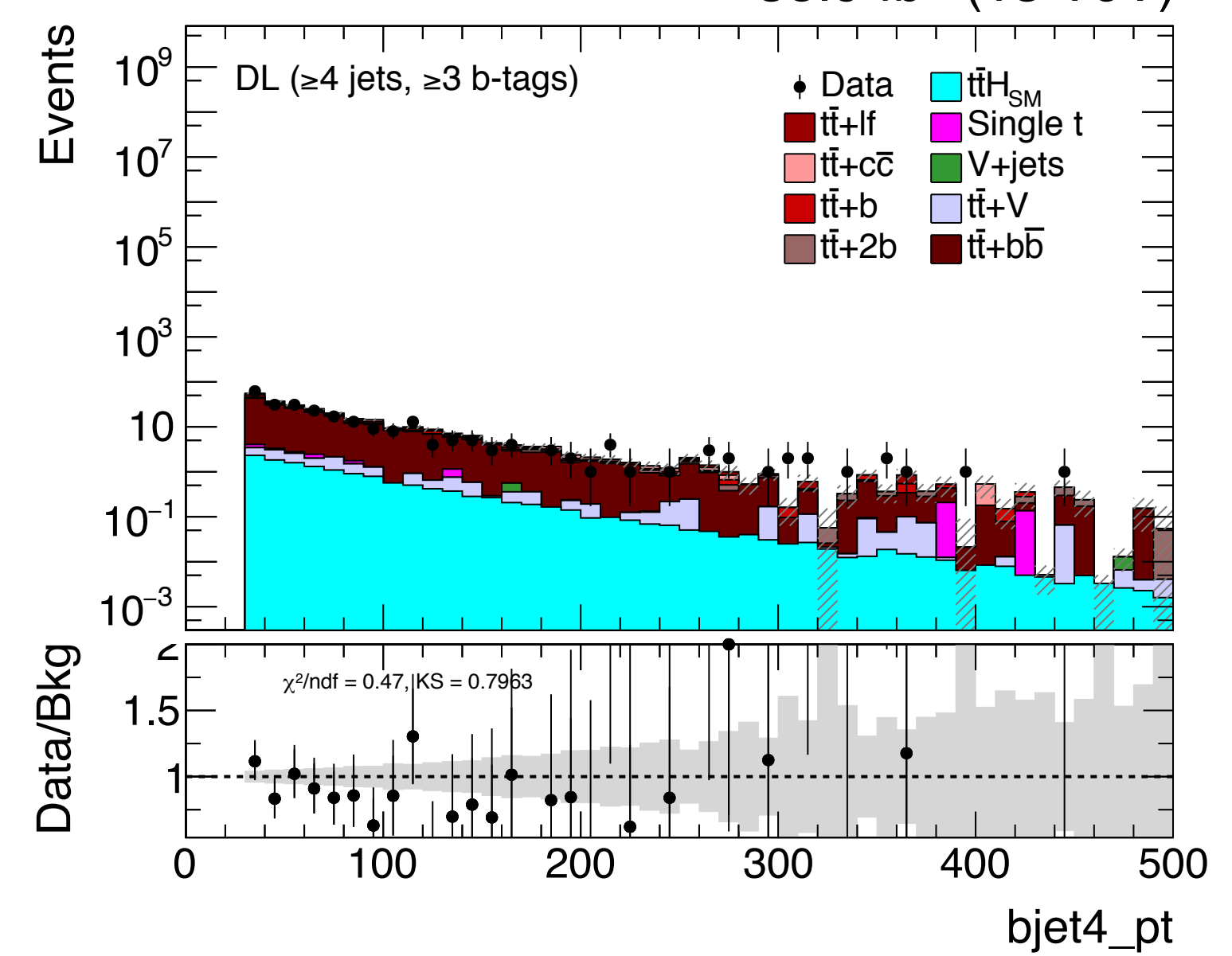
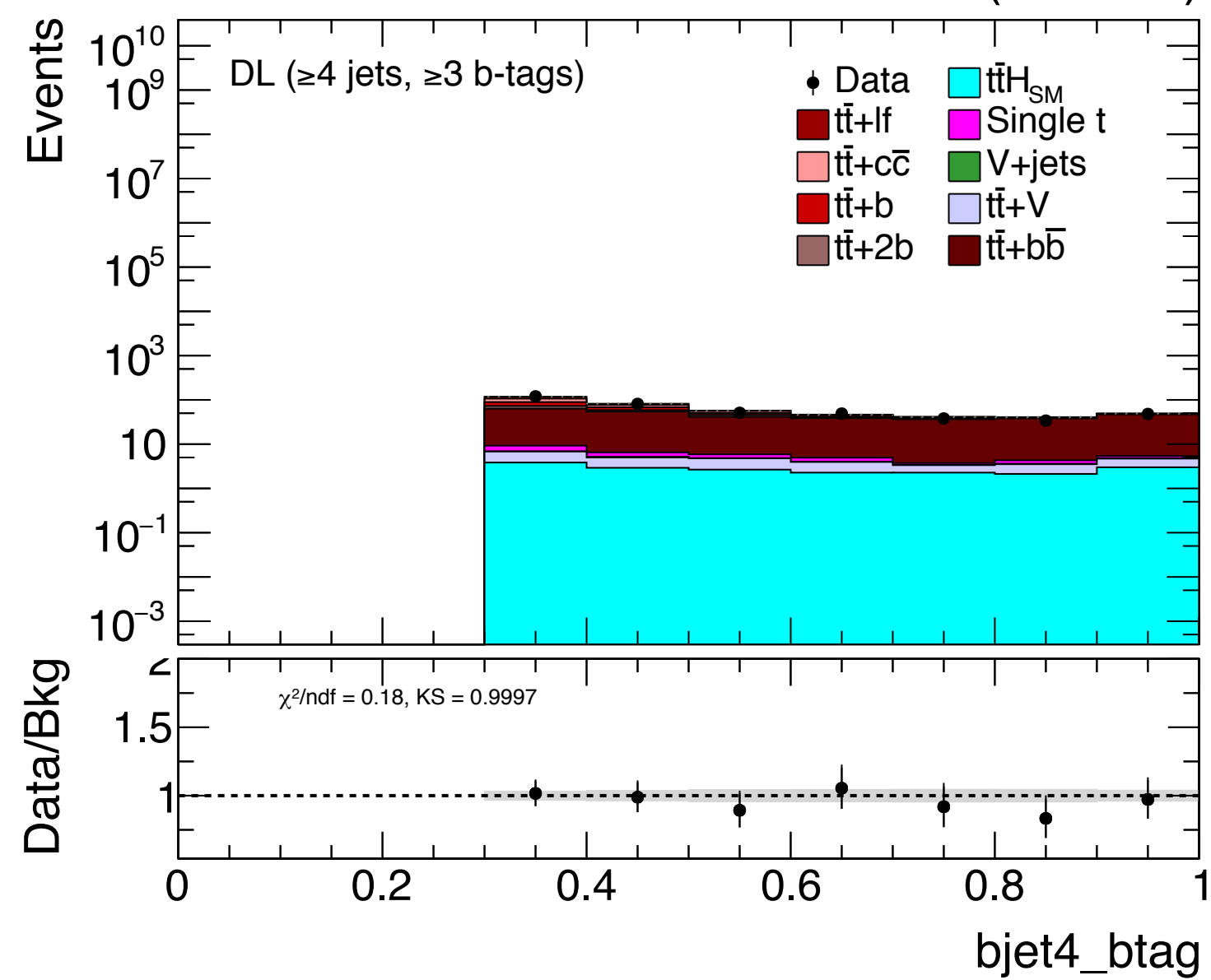
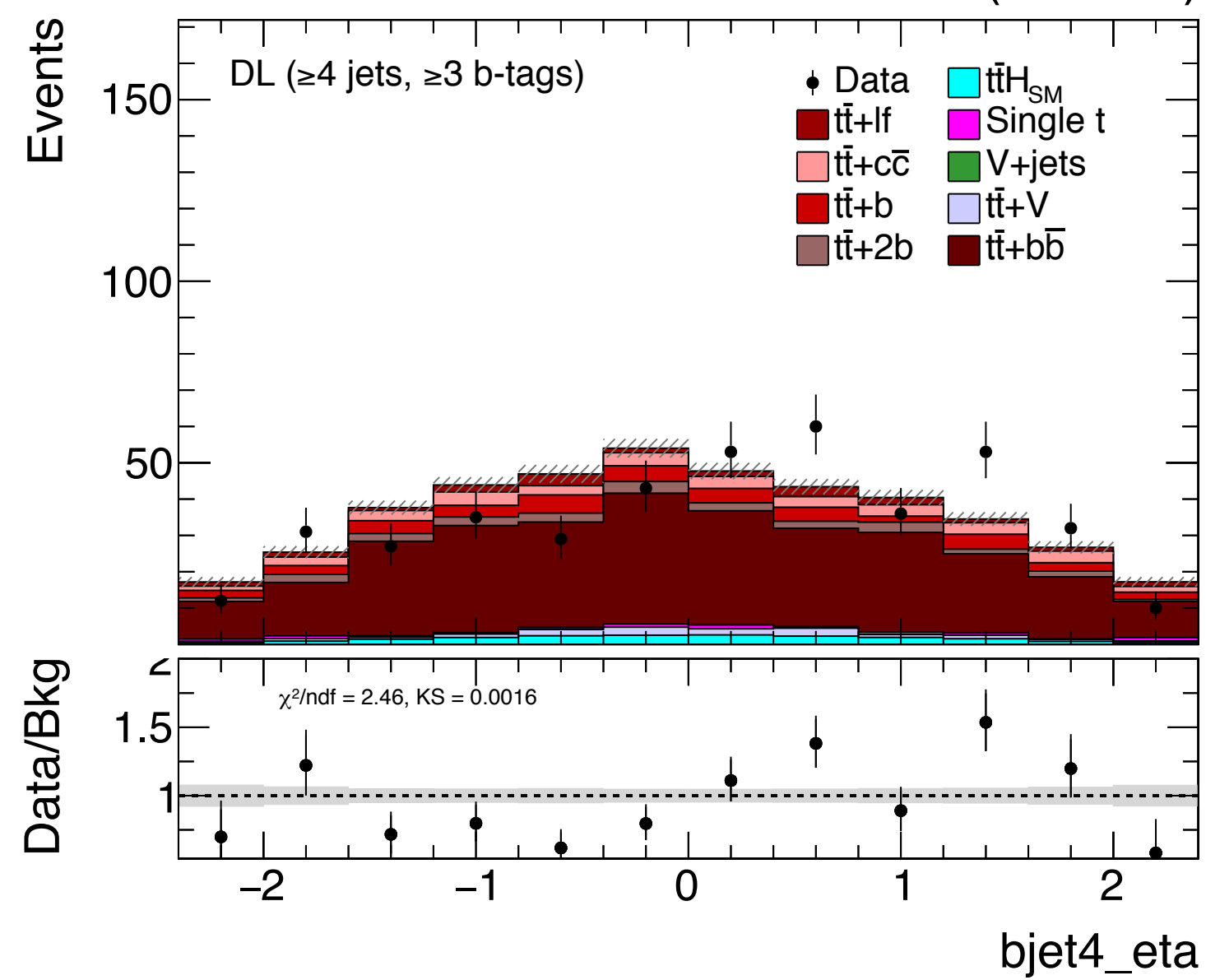
41.5 fb⁻¹ (13 TeV)



41.5 fb⁻¹ (13 TeV)





35.9 fb⁻¹ (13 TeV)35.9 fb⁻¹ (13 TeV)35.9 fb⁻¹ (13 TeV)41.5 fb⁻¹ (13 TeV)41.5 fb⁻¹ (13 TeV)41.5 fb⁻¹ (13 TeV)