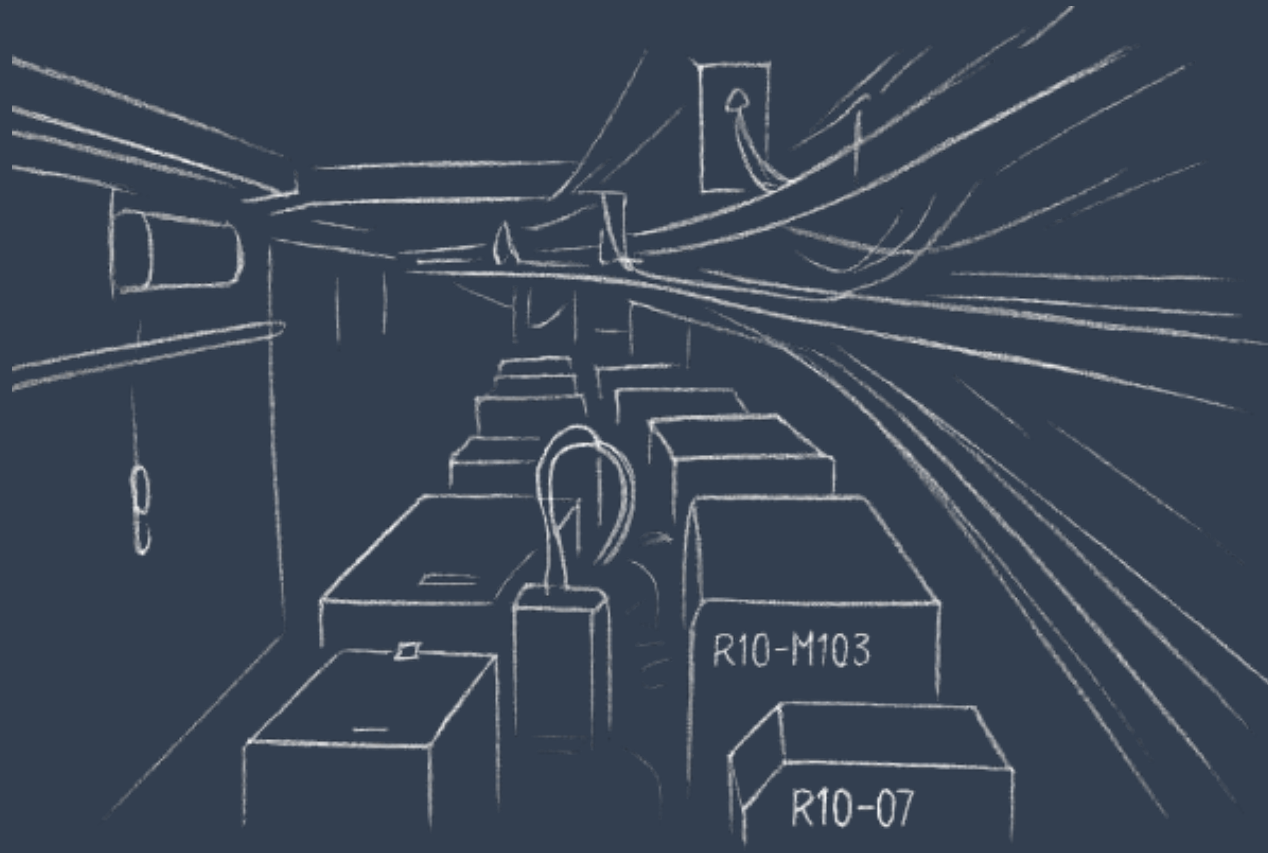
IHEP SUSY Group Meeting

Chengxin Liao

Institute of High Energy Physics
Chinese Academy of Sciences

Jul 23, 2025



C1N2 Status

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- Split run2 and run3 then Update Bkg estimation(Done)
- Update support-note(Ongoing)

  Note: lowerpad for MC modeling label have typo(bkg/MC, it should be bkg/Data)

Fake Factor for Run2 and Run3

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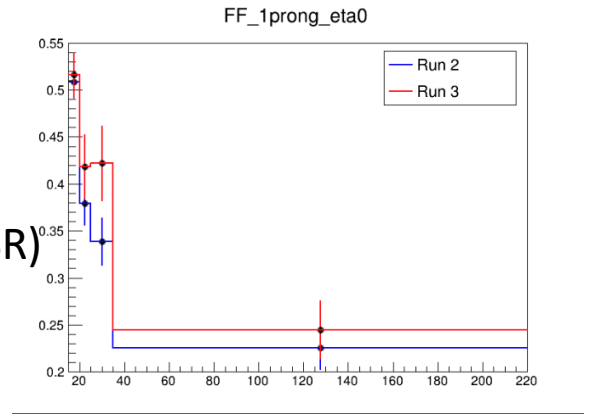
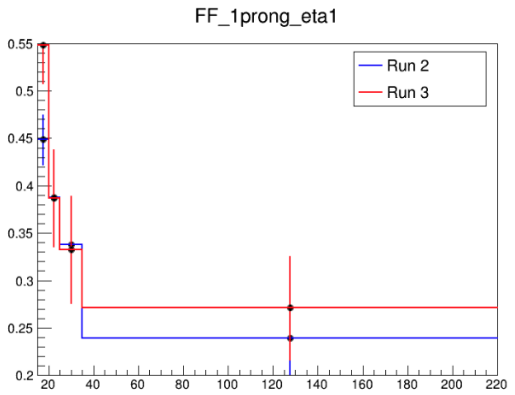
Selection:

nBaseTau == 1
nBaseLep >= 1, SigLep >= 1
MET trigger, MET >= 200
Same-Signal(Orthogonal with SR)
bVeto
ID: nMediumTau == 1
antiID: nMediumTau < 1

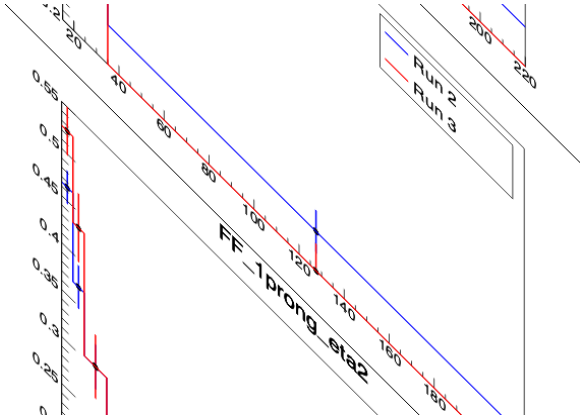
$0 < |\eta| < 1$



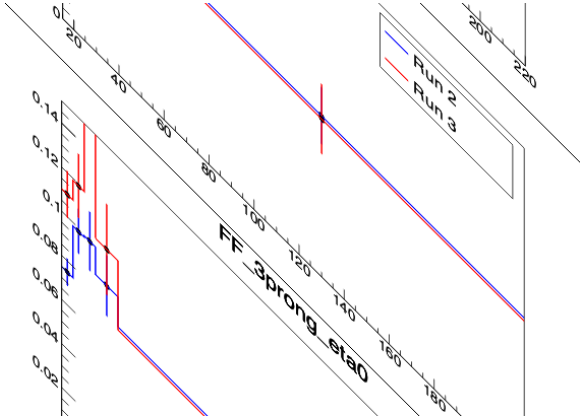
$1 < |\eta| < 1.37$

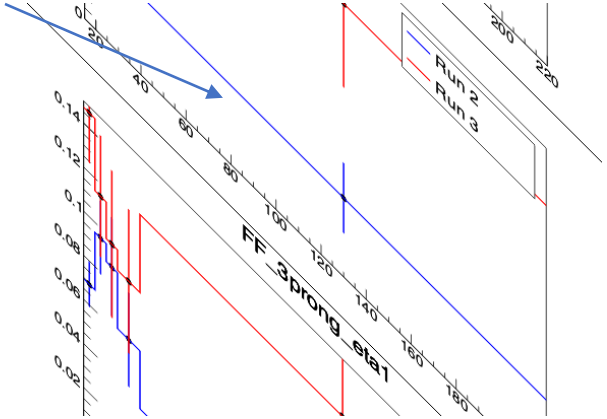


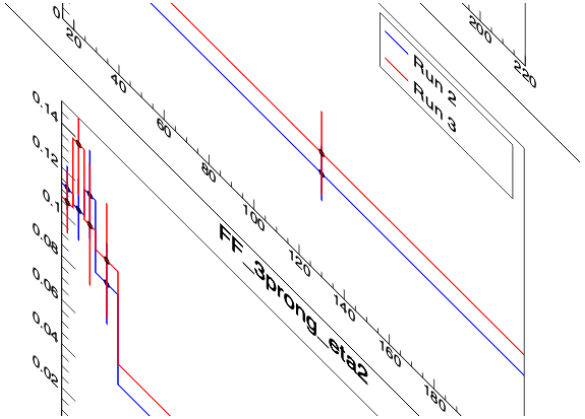
$1.52 < |\eta| < 2.5$



A small bump show in the last bin







Pre-Selection

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HH Pre-selection	LH Pre-selection
>= 2 medium taus	>= 1 medium taus
0 base lepton	1 base lepton, 1 signal lepton
MET ≥ 200; pass MET trigger	MET ≥ 200; pass MET trigger
1≤nJet	1≤nJet
Opposite-sign hadronic-hadronic tau pair	Opposite-sign lepton-hadronic tau pair
bveto	bveto
jet pt>100 GeV	jet pt>100 GeV
Mtt_reco <= 40 GeV || Mtt_reco >= 130GeV	Mtt_reco <= 40 GeV || Mtt_reco >= 130GeV

HH channel: Z bkg estimation(run2)

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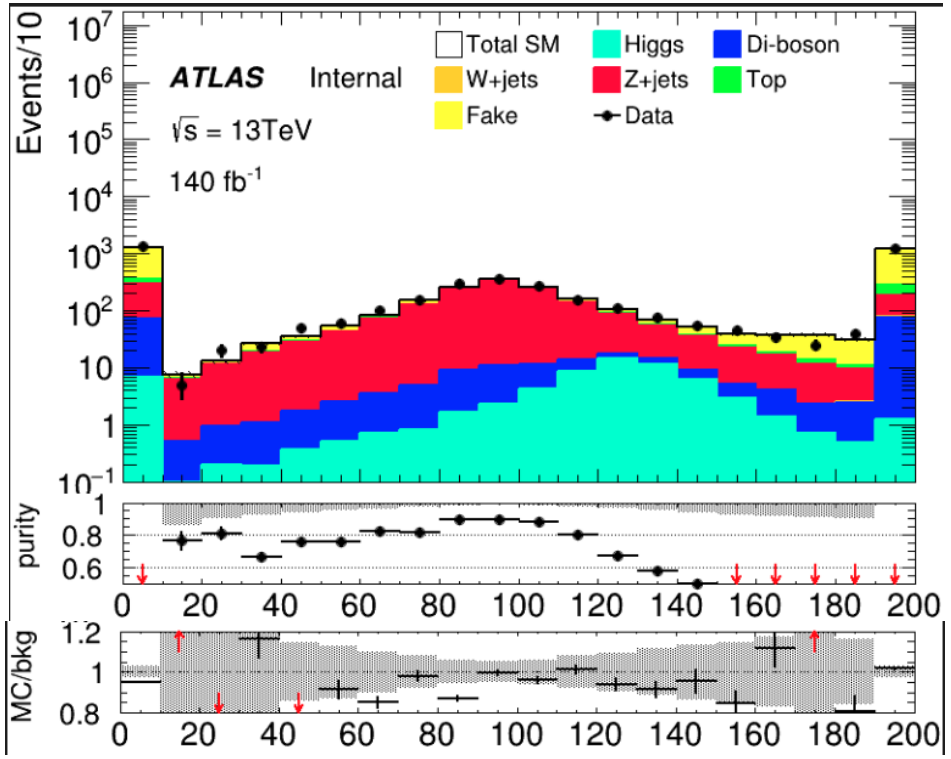
HH pre-selection

CR: $80 < M_{tt}reco < 110$
VR: $40 < M_{tt}reco < 80 \,||\, 110 < M_{tt}reco < 130$

Region	TotalBkg	Zjets	purity	Data	Data/Bkg
CR	1041+-9	915+-4	0.87	1090	1.04
VR1(left)	587+-7	496+-3	0.84	663	1.12
VR2(right)	334+-6	238+-2	0.71	346	1.03



HH channel: Z bkg estimation(run3)

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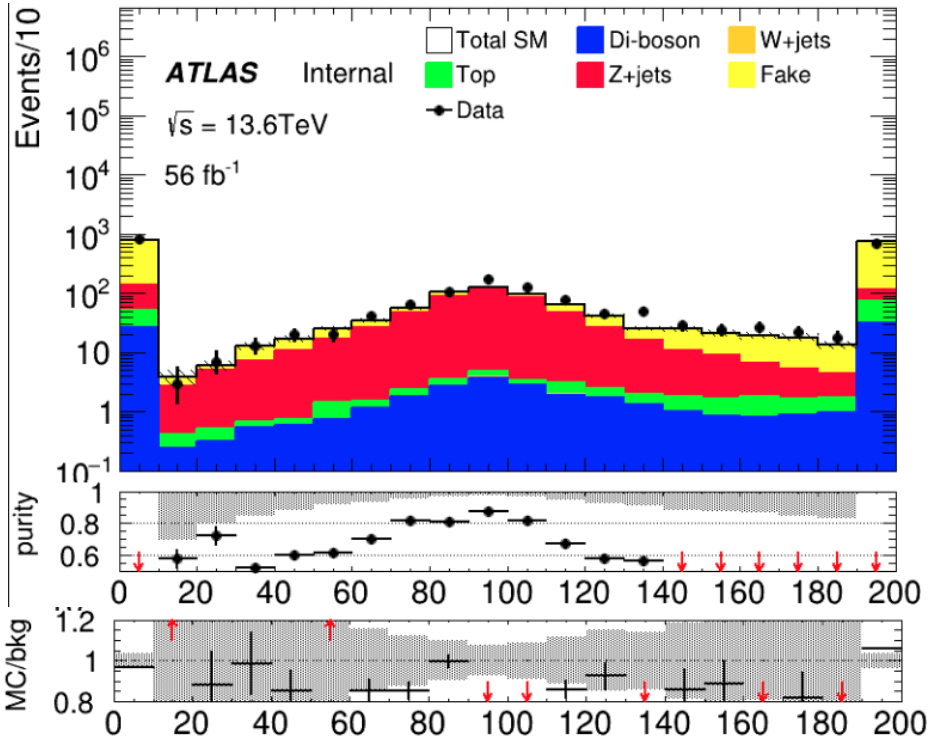
HH pre-selection

CR: $80 < M_{tt}reco < 110$
VR: $40 < M_{tt}reco < 80 \,||\, 110 < M_{tt}reco < 130$

Regionc	TotalBkg	Zjets	purity	Data	Data/Bkg
CR	396+-7	320+-2	0.81	482	1.21
VR1(left)	238+-6	181+-2	0.75	252	1.05
VR2(right)	132+-5	82+-1	0.62	171	1.29



HH channel: Top bkg estimation(run2)

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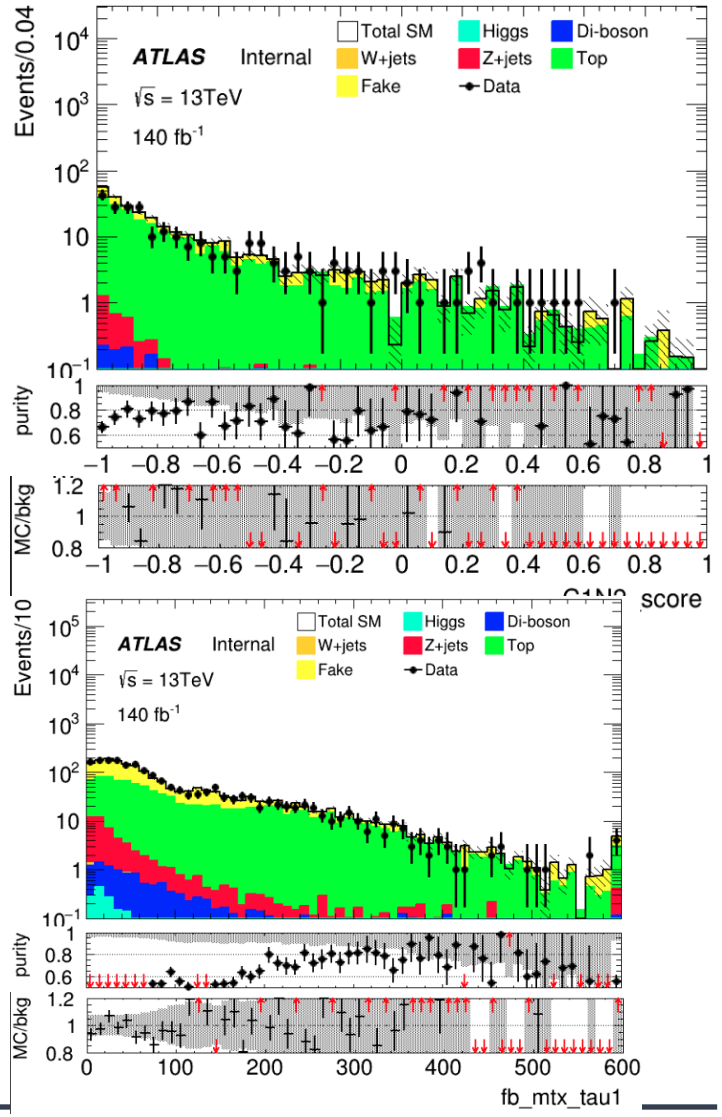
LH pre-selection(remove bVeto and add bJets > 0)

$M_T(tau1, MET) > 200$

CR: C1N2 score < -0.8
VR: -0.8 < C1N2 score < -0.7

Region	TotalBkg	Top	purity	Data	Data/Bkg
CR	168+-6	123+-4	0.73	137	0.81
VR	131+-6	103+-3	0.78	120	0.91



HH channel: Top bkg estimation(run2)

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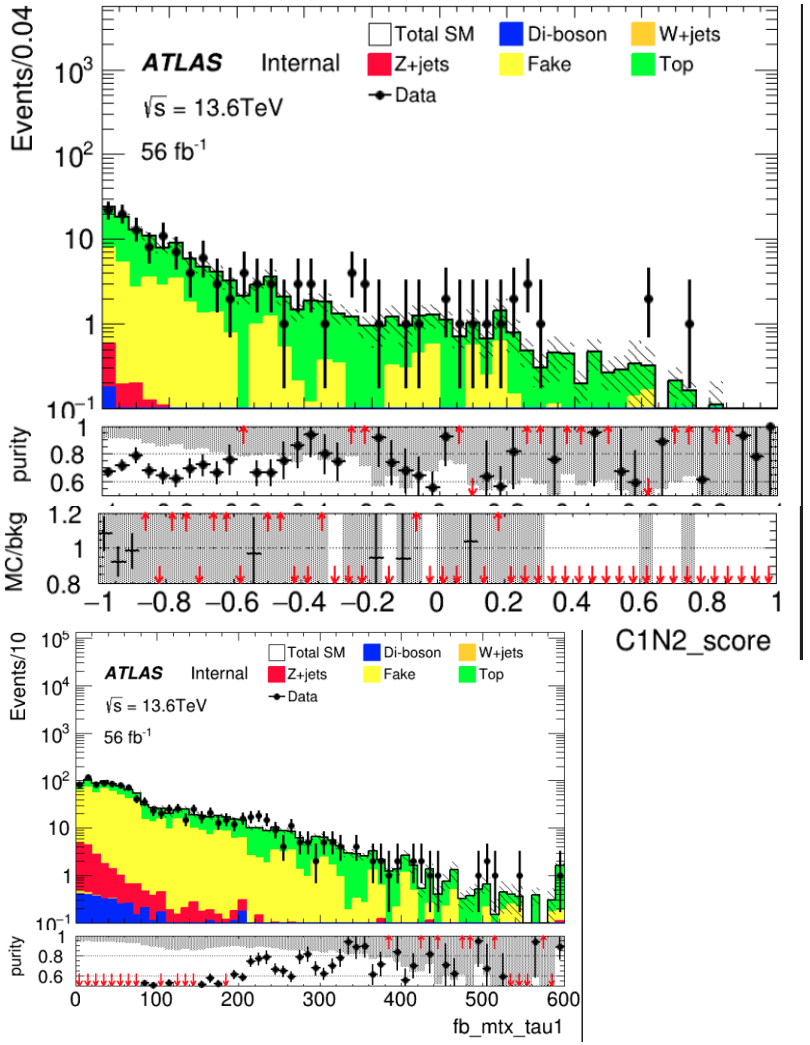
LH pre-selection(remove bVeto and add bJets > 0)

$M_T(tau1, MET) > 200$

CR: C1N2 score < -0.8
VR: -0.8 < C1N2 score < -0.7

Region	TotalBkg	Top	purity	Data	Data/Bkg
CR	73+-3	51+-1	0.70	74	1.01
VR	69+-3	51+-1	0.73	75	1.08



LH channel: Z bkg estimation(run2)

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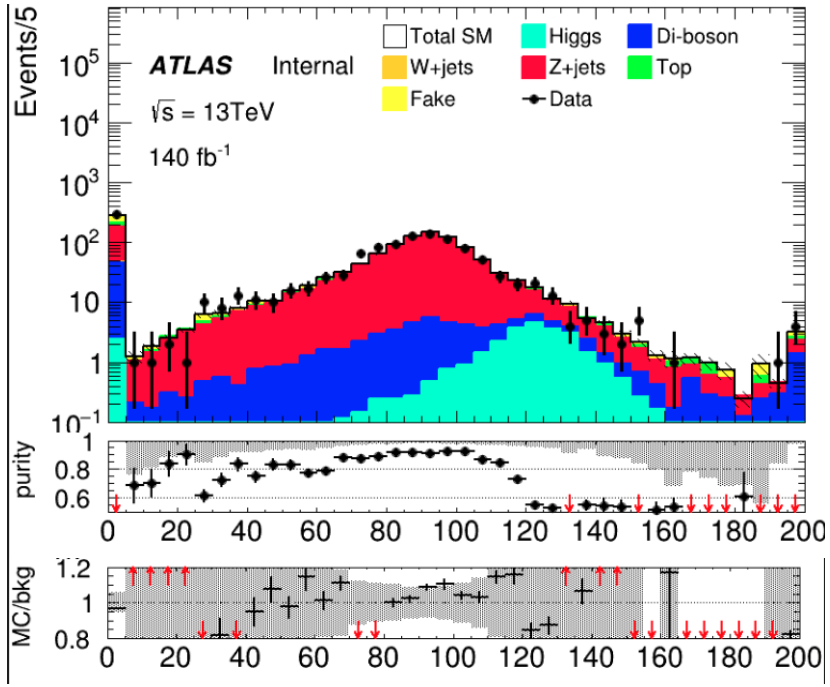
LH pre-selection

dR(tau, lep) < 0.6
CR: $80 < M_{tt}reco < 110$
VR: $40 < M_{tt}reco < 80 \,||\, 110 < M_{tt}reco < 130$

Region	TotalBkg	Zjets	purity	Data	Data/Bkg
CR	660+-6	602+-3	0.91	625	0.94
VR1(left)	316+-4	275+-2	0.87	349	1.10
VR2(right)	92+-2	62+-1	0.67	85	0.92



LH channel: Z bkg estimation(run3)

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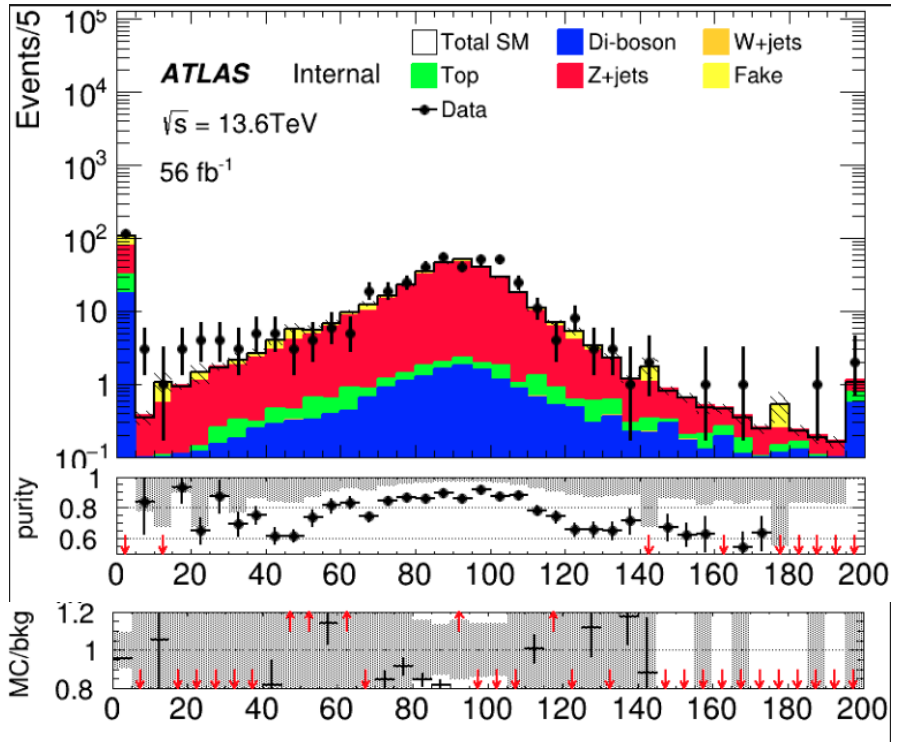
LH pre-selection

dR(tau, lep) < 0.6
C1N2 score < 0.7
CR: $80 < M_{tt}reco < 110$
VR: $40 < M_{tt}reco < 80 \,||\, 110 < M_{tt}reco < 130$

Region	TotalBkg	Zjets	purity	Data	Data/Bkg
CR	230+-3	202+-2	0.87	277	1.20
VR1(left)	118+-3	96+-1	0.81	127	1.07
VR2(right)	29+-1	21+-1	0.72	29	1.00



MttReco

LH channel: Top bkg estimation(run2)

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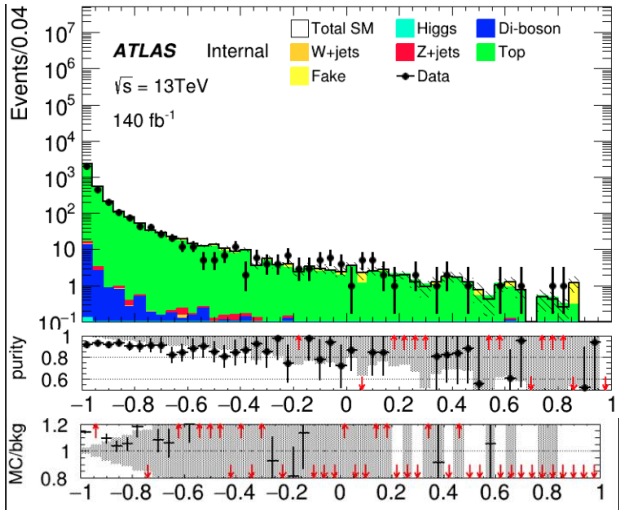
LH pre-selection(remove bVeto and add bJets > 0)

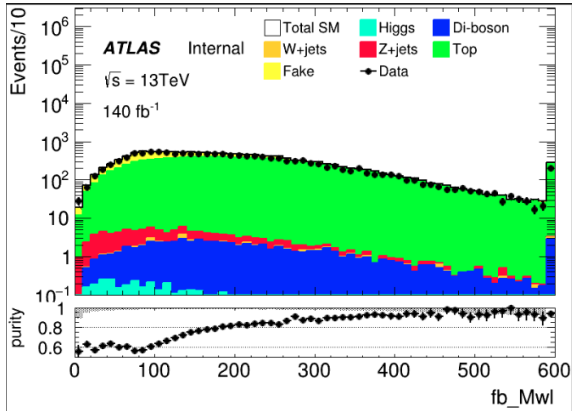
$M_{inv}(lep, MET) > 300$

CR: C1N2 score < -0.9
VR: -0.9 < C1N2 score < -0.7



C1N2 score

After pre-selection



Region	TotalBkg	Top	purity	Data	Data/Bkg
CR	2981+-23	2743+-19	0.92	2593	0.86
VR	619+-10	559+-8	0.90	565	0.91

LH channel: Top bkg estimation(run3)

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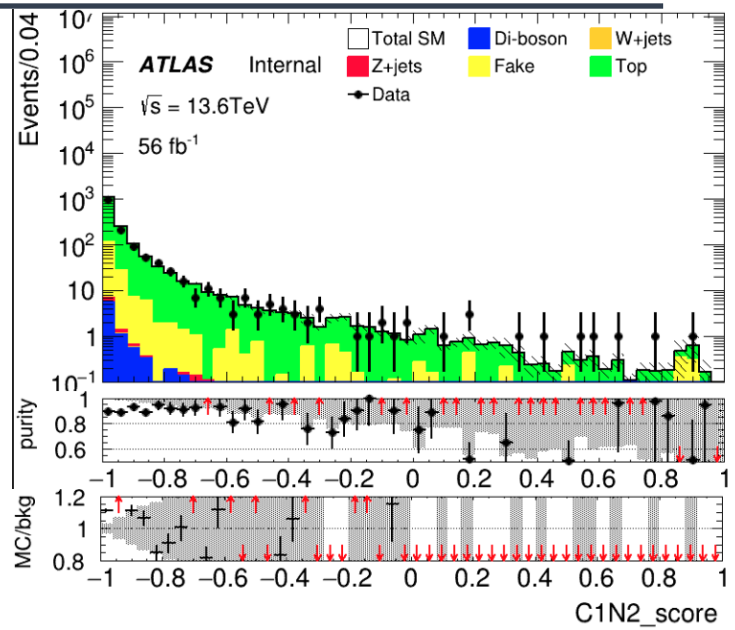
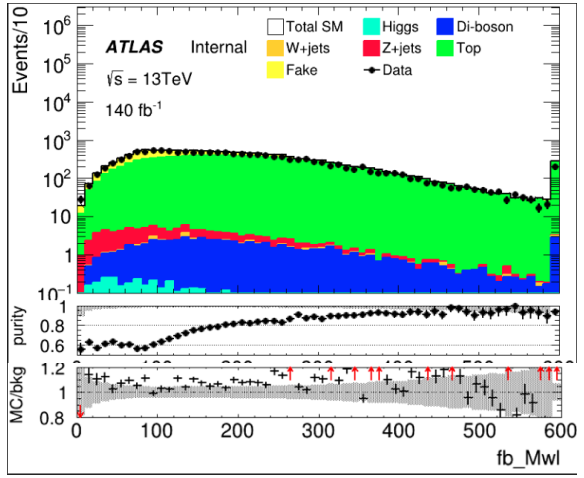
LH pre-selection(remove bVeto and add bJets > 0)

$M_{inv}(lep, MET) > 300$

CR: C1N2 score < -0.9
VR: -0.9 < C1N2 score < -0.7





Region	TotalBkg	Top	purity	Data	Data/Bkg
CR	1446+-11	1295+-7	0.89	1278	0.88
VR	314+-5	288+-3	0.91	298	0.94

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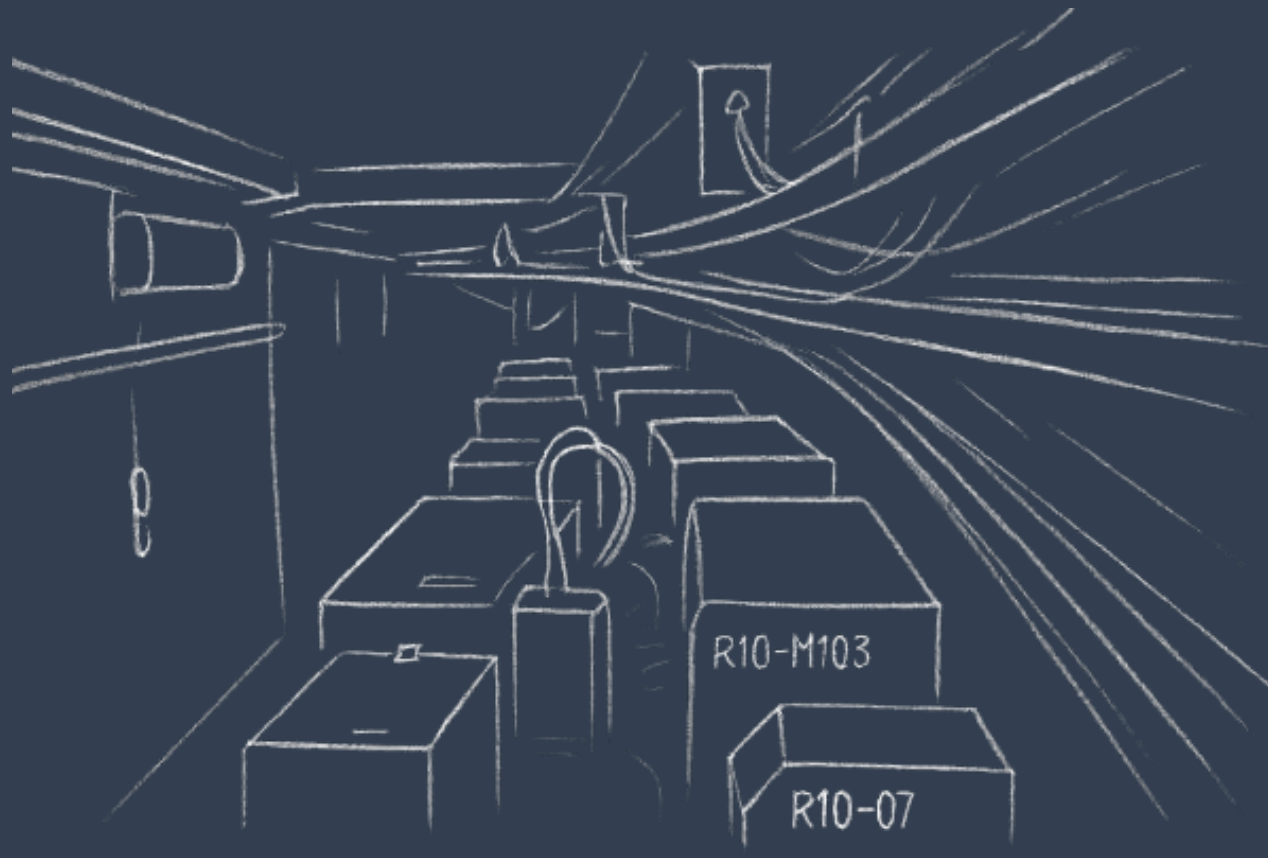
ATLAS EXPERIMENT

Backup



Distribution Check

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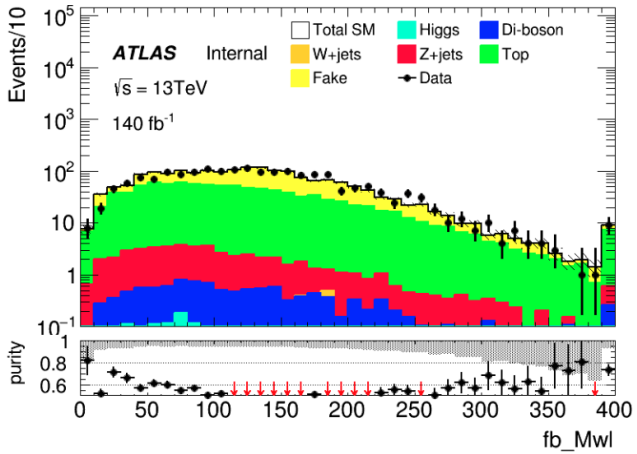
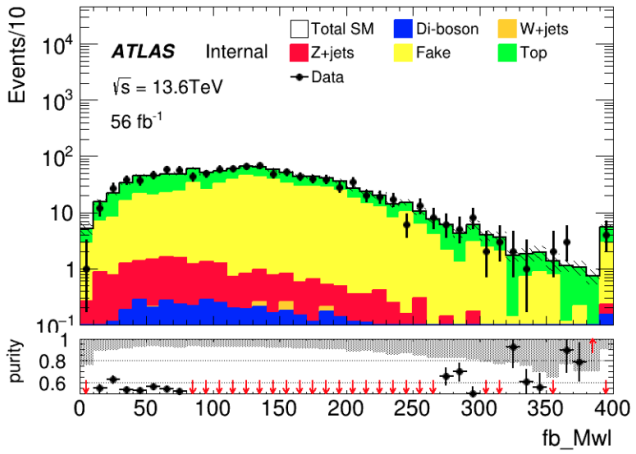
HH TCR run2



HH TCR run3



Cross-Check FF

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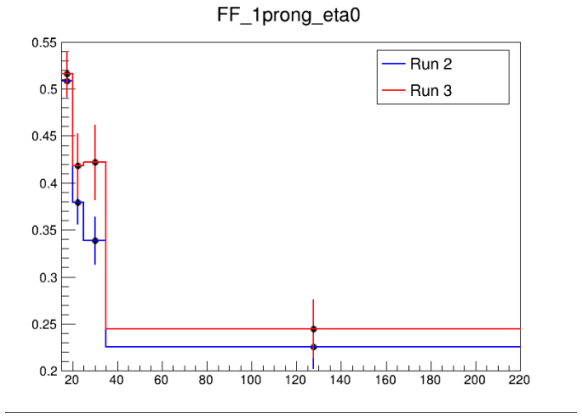
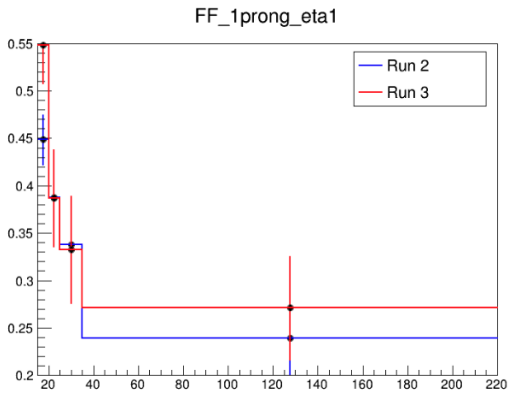
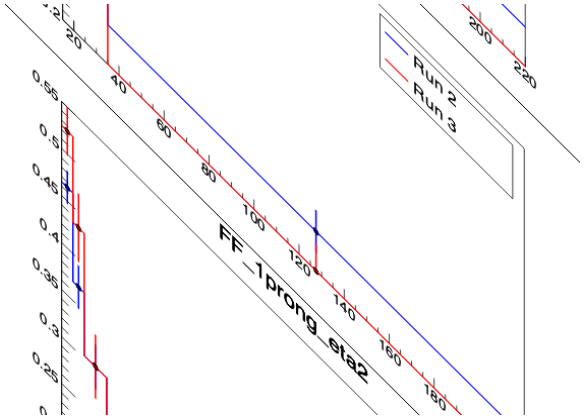
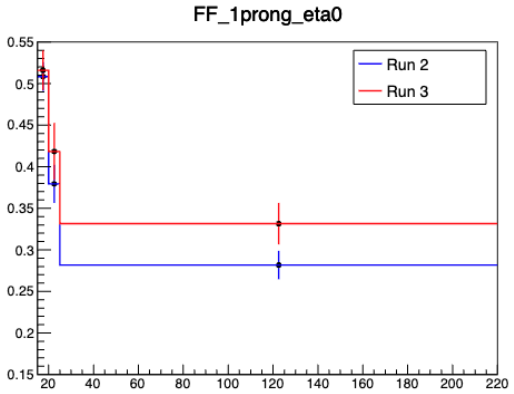
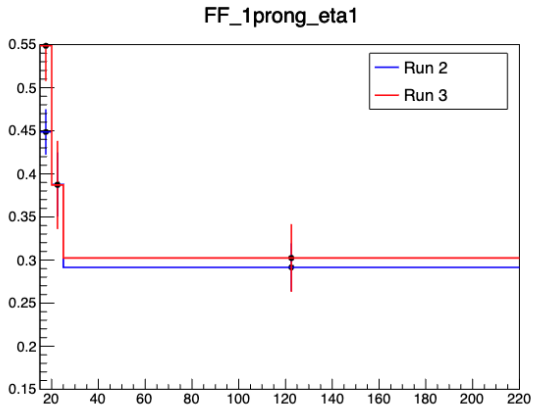
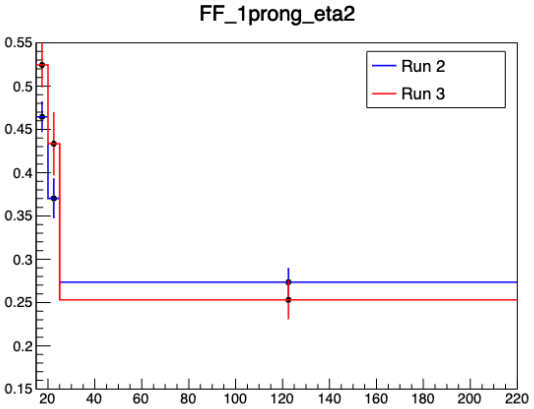
	$0 < \|\eta\| < 1$	$1 < \|\eta\| < 1.37$	$1.52 < \|\eta\| < 2.5$
My result			
Wenyi's result			

Same value for first two bins and different in last bin for different rebin strategy
I check FF with same rebin method in case, it turns out we are the same

Fake Factor for Run2 and Run3

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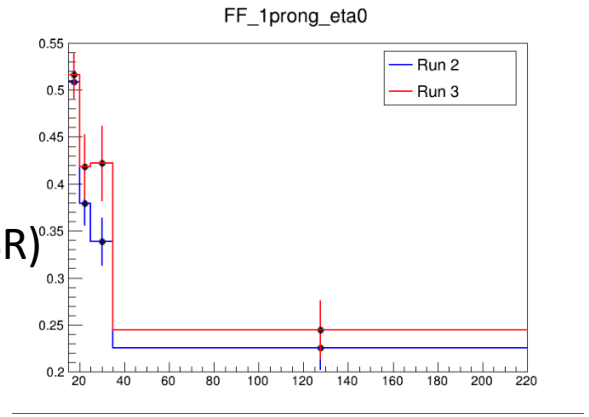
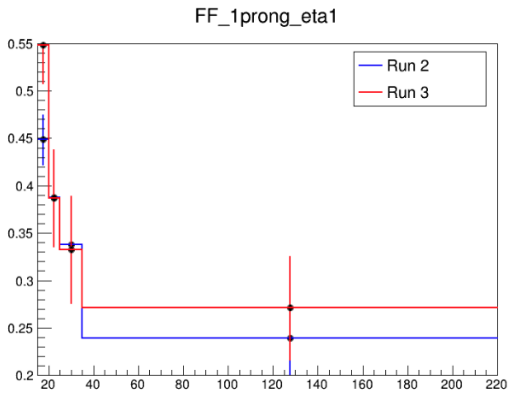
Selection:

nBaseTau == 1
nBaseLep >= 1, SigLep >= 1
MET trigger, MET >= 200
Same-Signal(Orthogonal with SR)
bVeto
ID: nMediumTau == 1
antiID: nMediumTau < 1

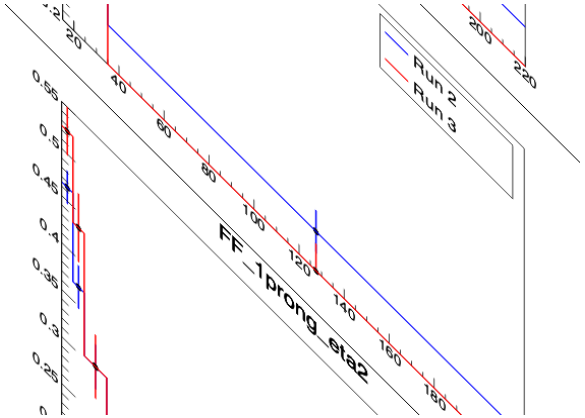
$0 < |\eta| < 1$



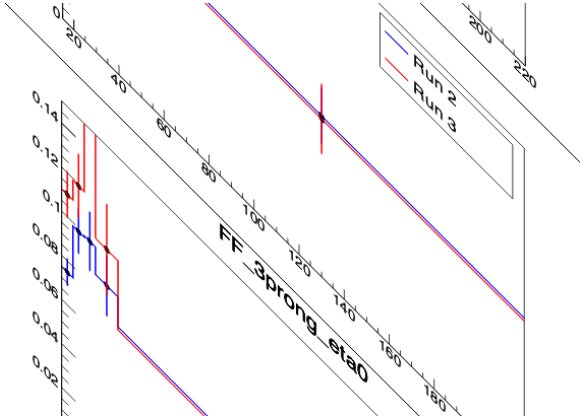
$1 < |\eta| < 1.37$

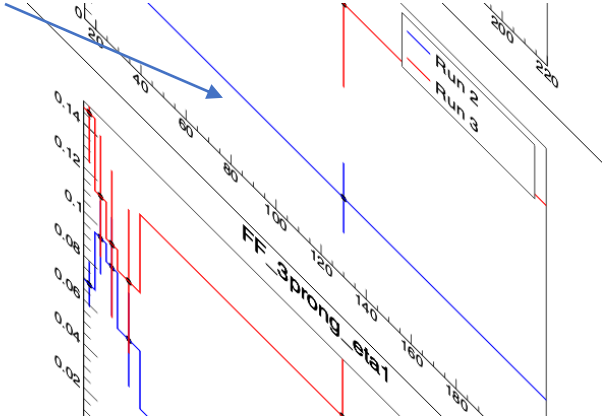


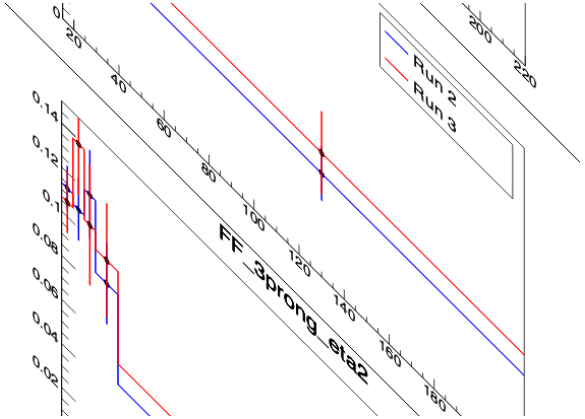
$1.52 < |\eta| < 2.5$



A small bump show in the last bin







MC modeling in Pre-Selection(HH)

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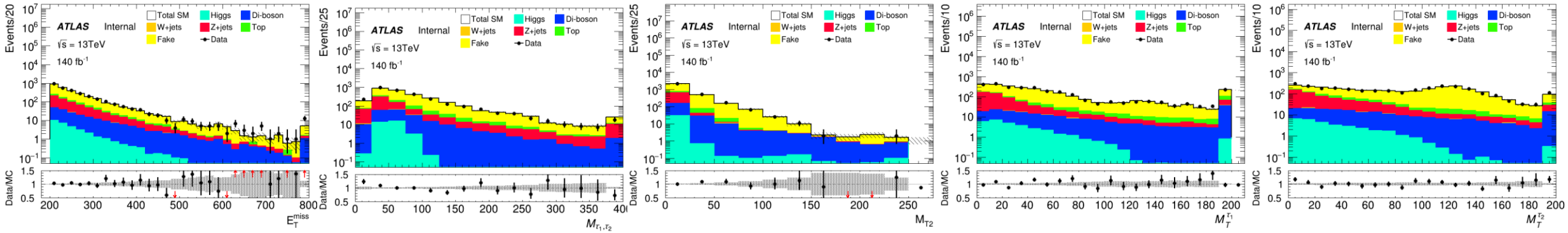
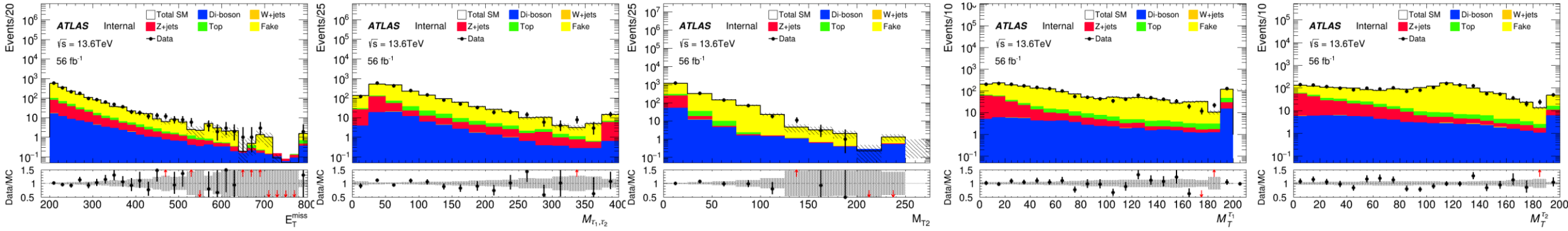
run2



run3



MC modeling in Pre-Selection(HH)

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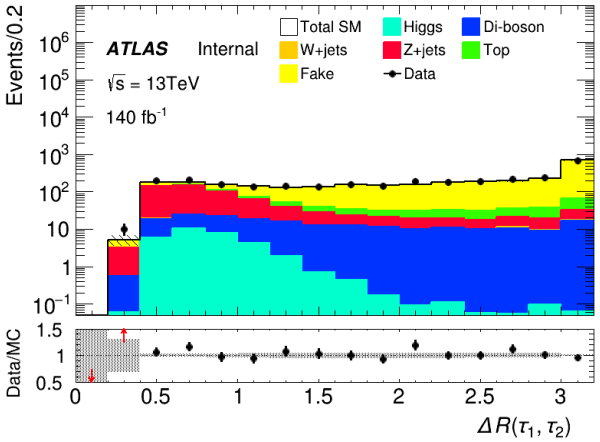
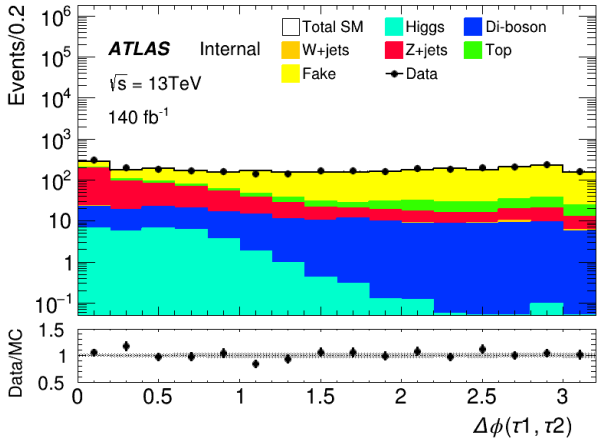
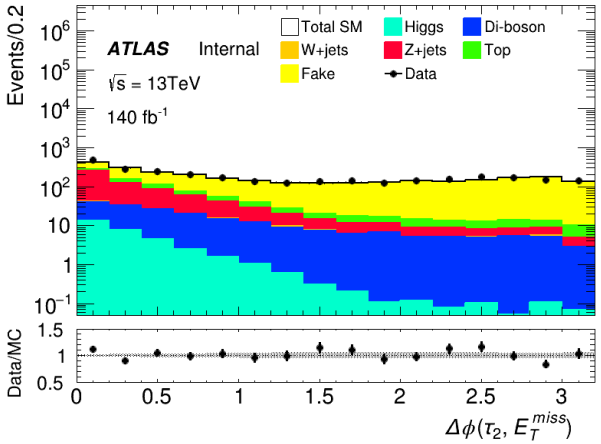
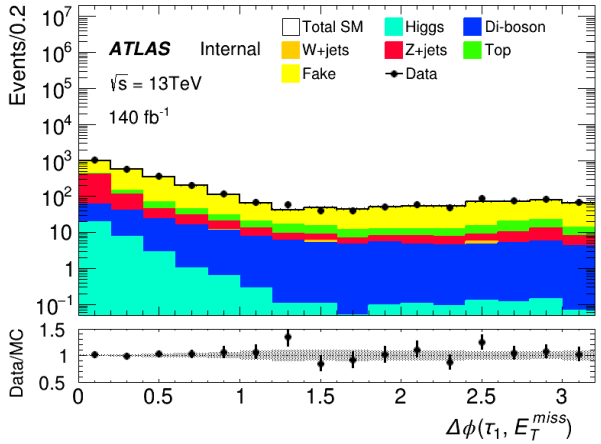
run2

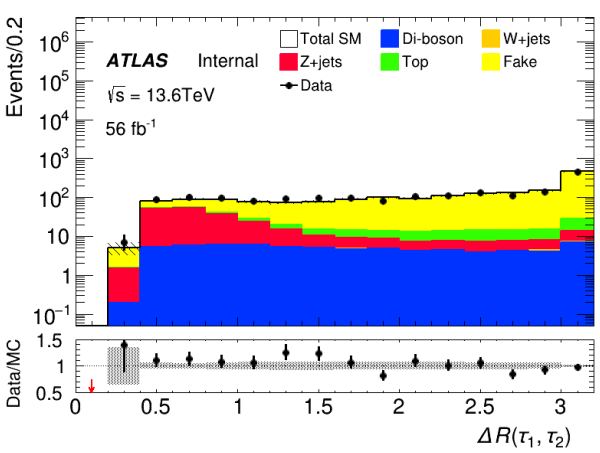


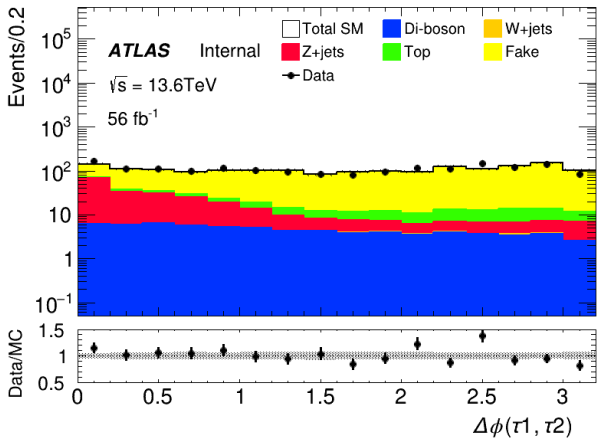


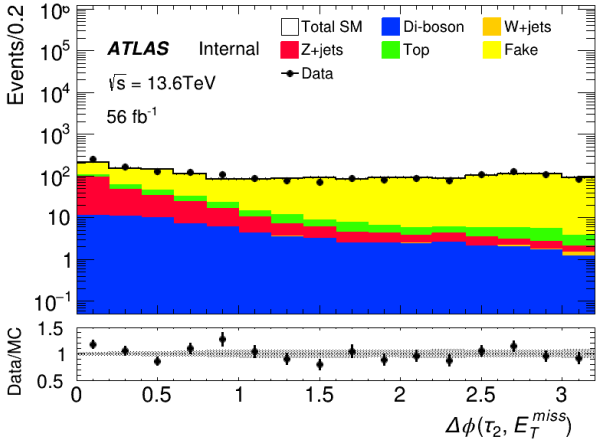


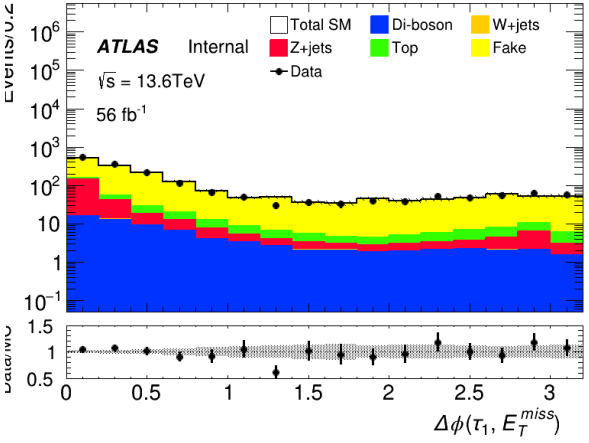


run3









MC modeling in Pre-Selection(HH)

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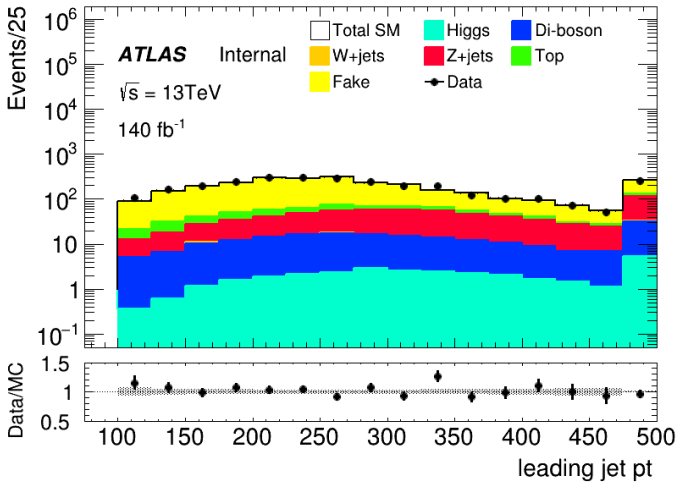
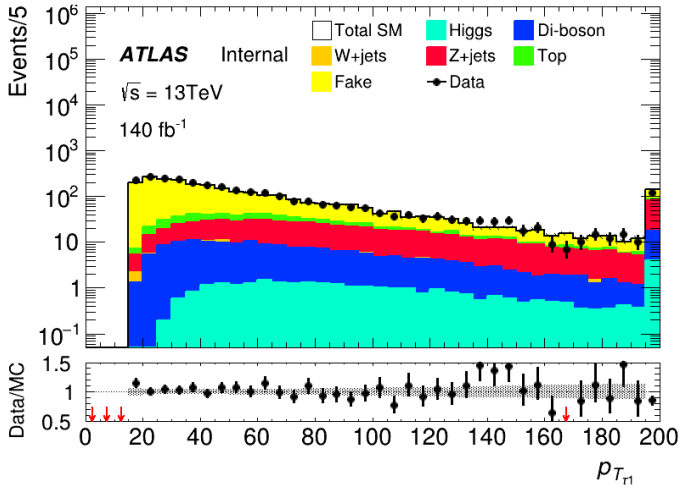
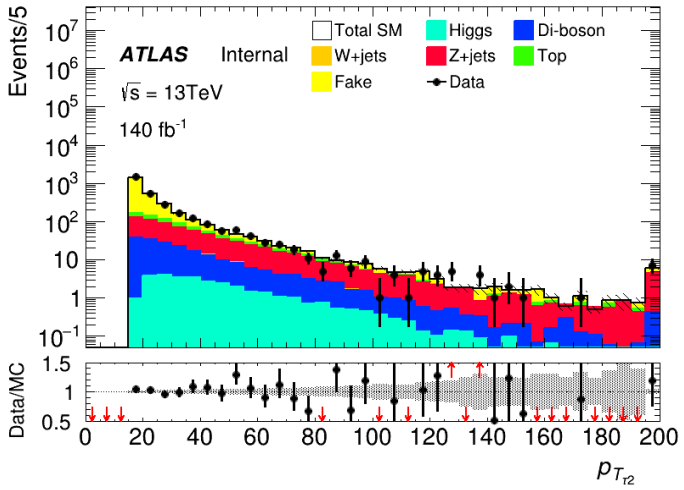
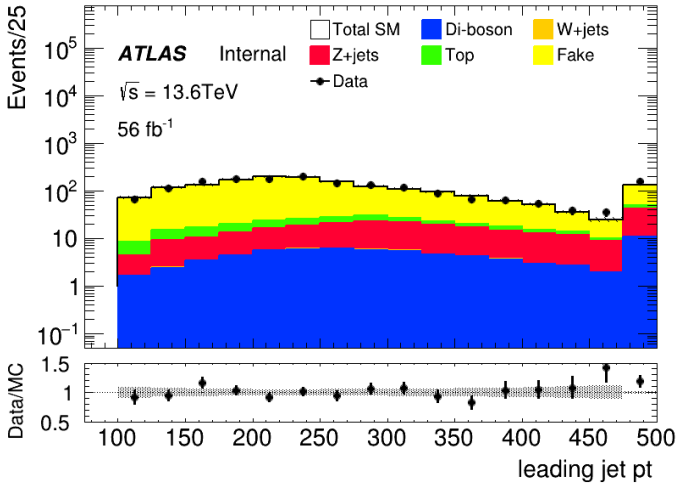
run2

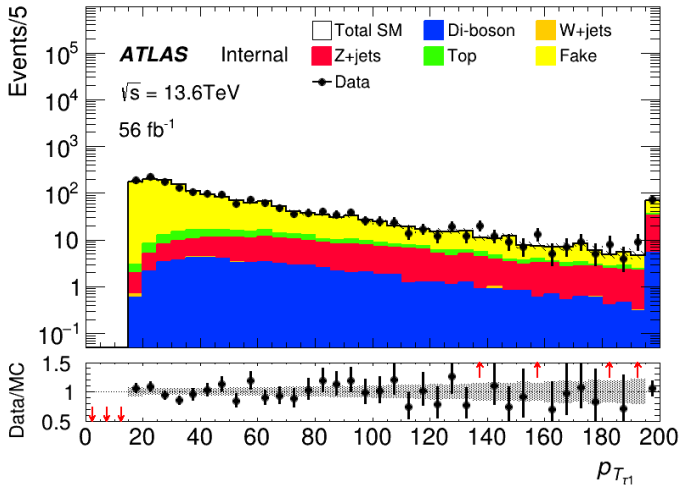


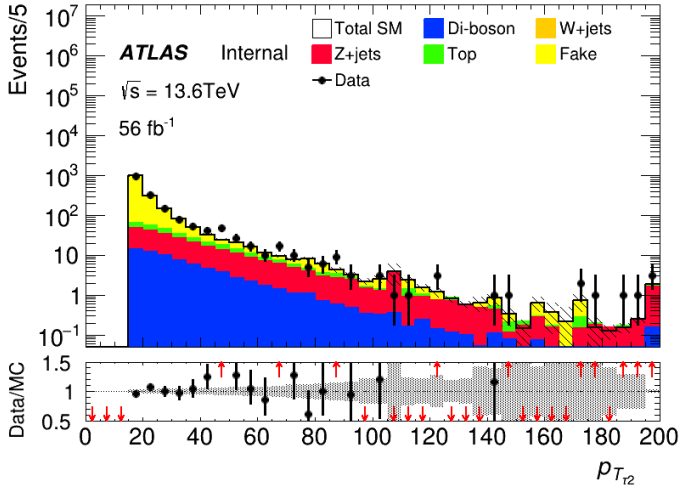




run3







MC modeling in Pre-Selection(LH)

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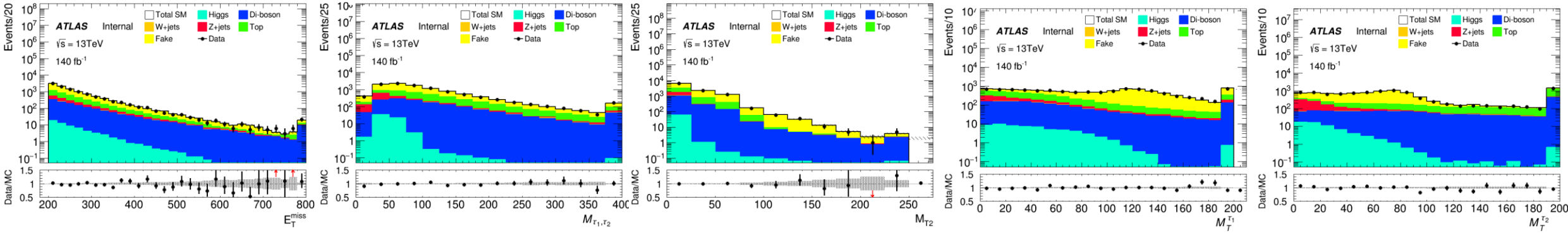
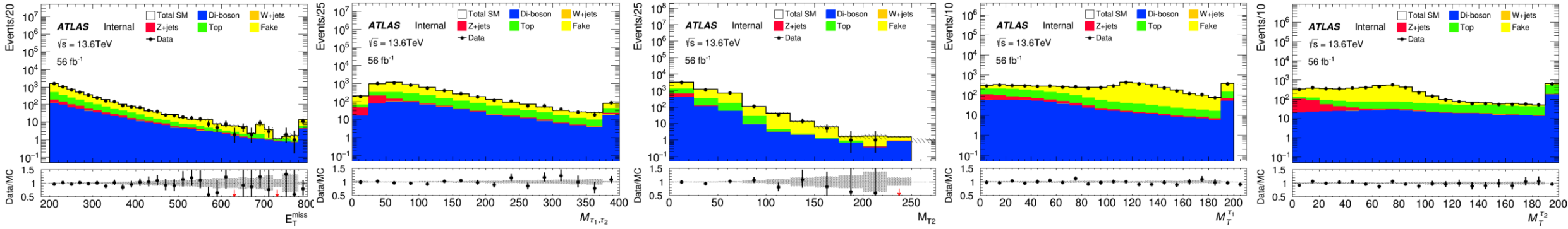
run2



run3



MC modeling in Pre-Selection(LH)

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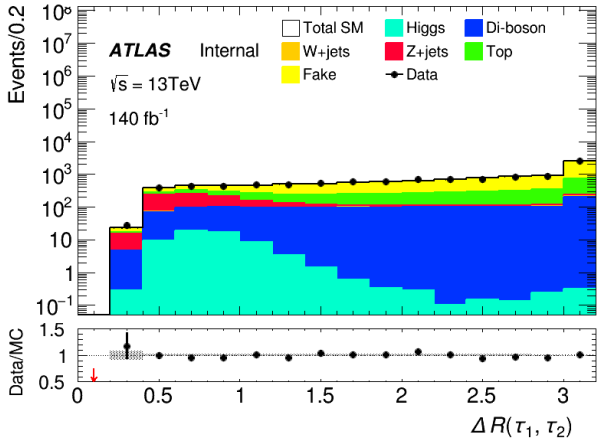
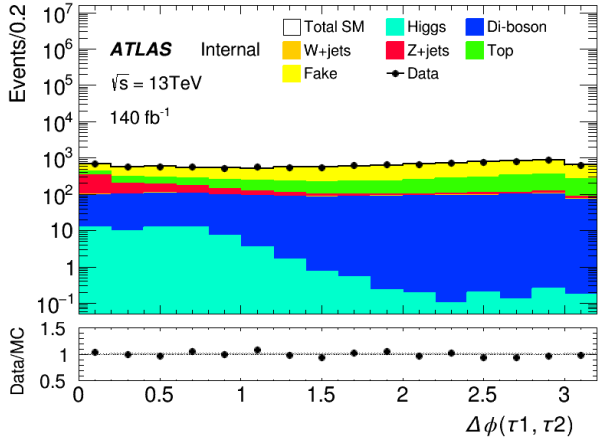
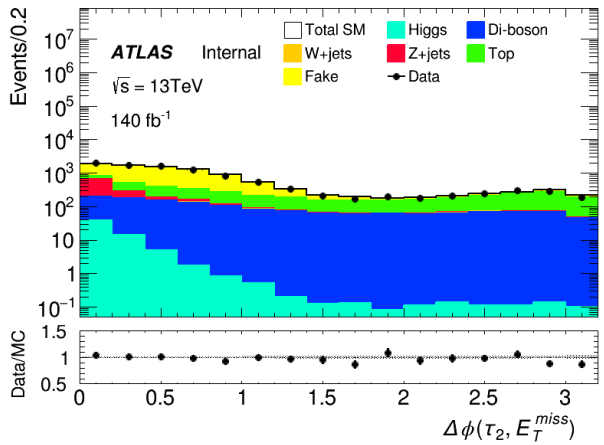
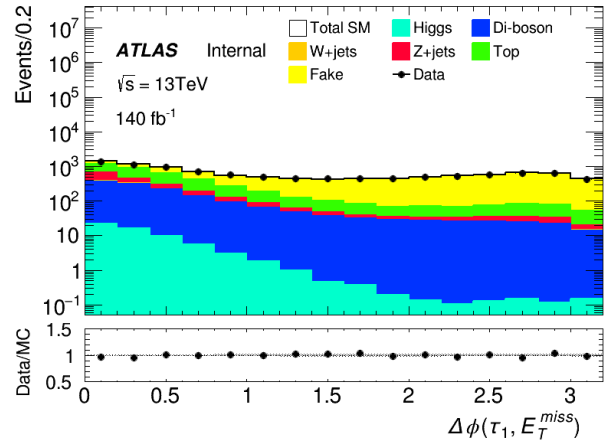
run2

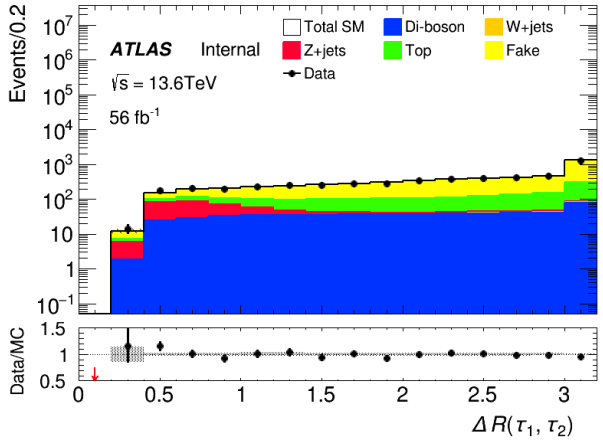


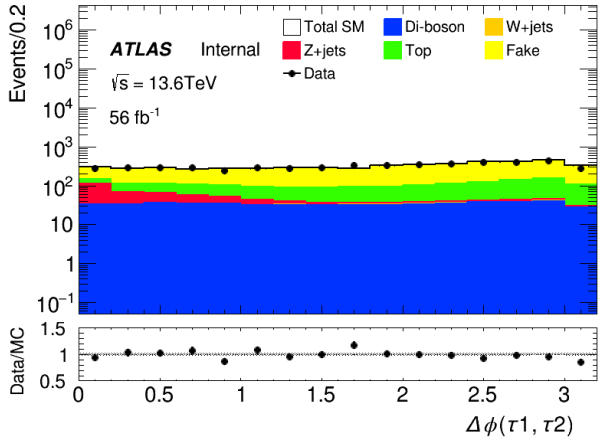


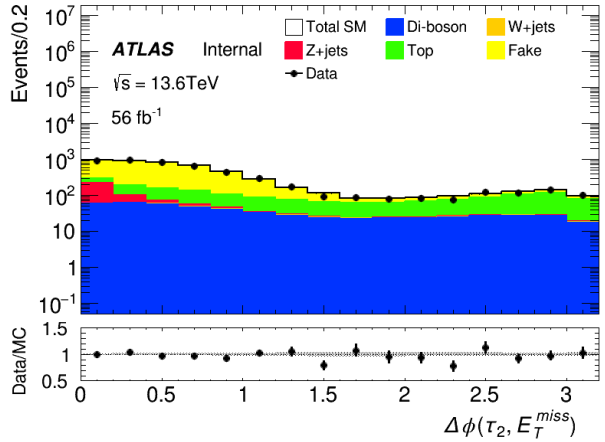


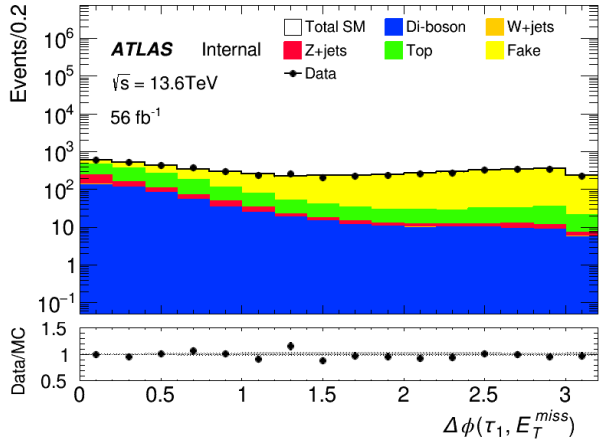


run3









MC modeling in Pre-Selection(LH)

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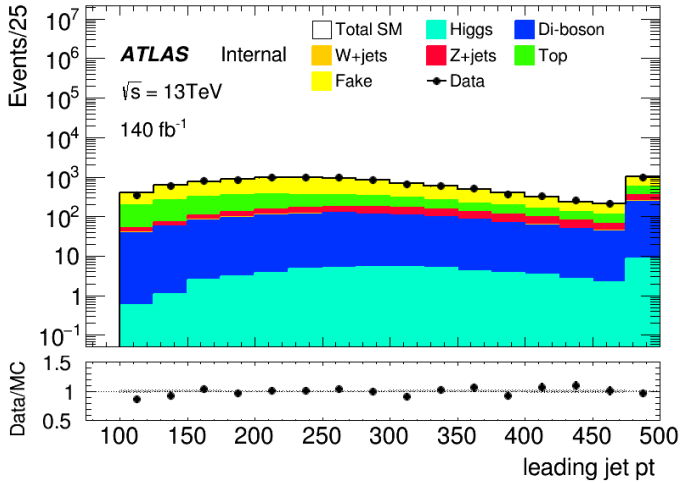
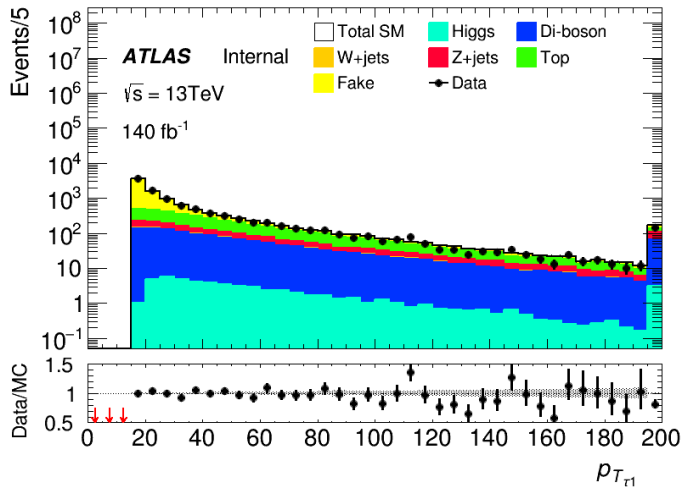
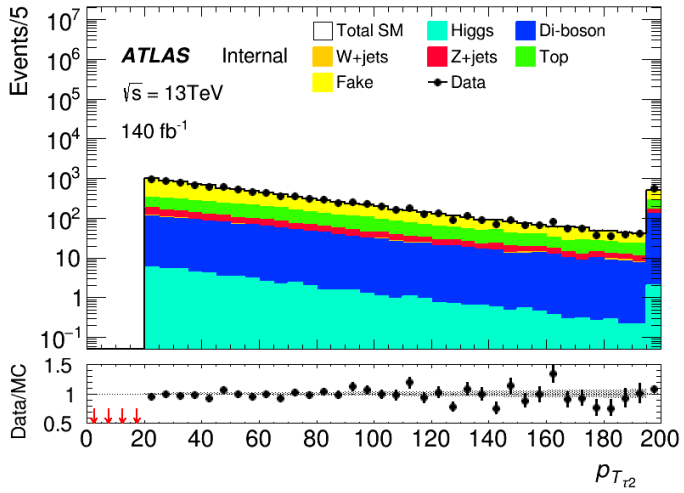
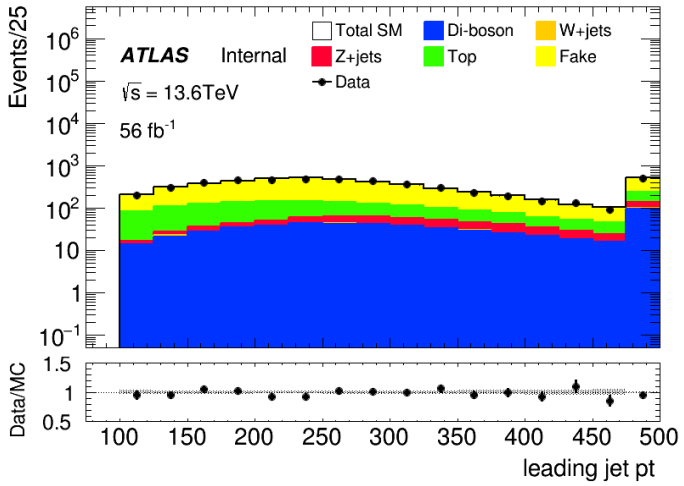
run2

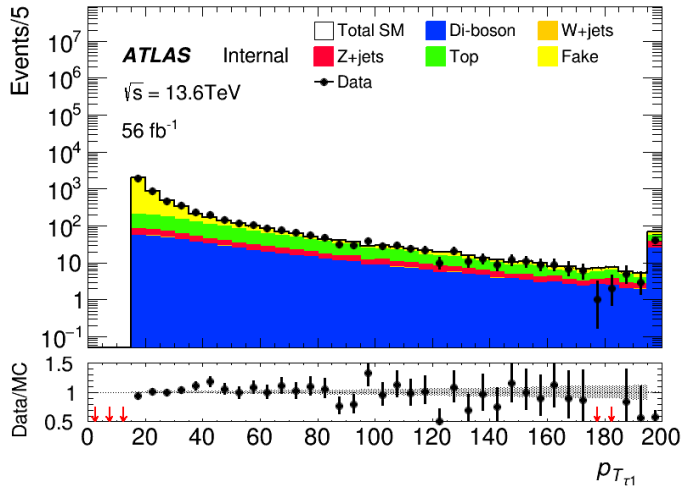


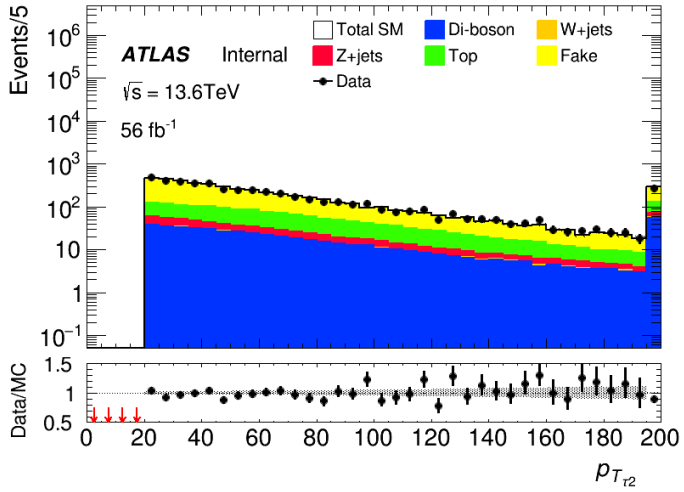




run3







C1N2 SR(HH and LH)

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Input sample:

bkg: run2 bkg sample passed pre-selection(HH/LH)
sig: 100_70, 120_90, 140_90(only run2)

Hyperparameters:

HH: Ntrees = 300, MaxDepth = 6, MinNodeSize = 1%, Learning rate = 0.05
LH: Ntrees = 200, MaxDepth = 6, MinNodeSize = 1%, Learning rate = 0.05

Weight choose: abs(physics weight)

Split strategy: Separate entries by using mod 5, for Fake bkg, if separate follow sequence, all weighted entry will split into first fold

BDT distribution for LH and HH

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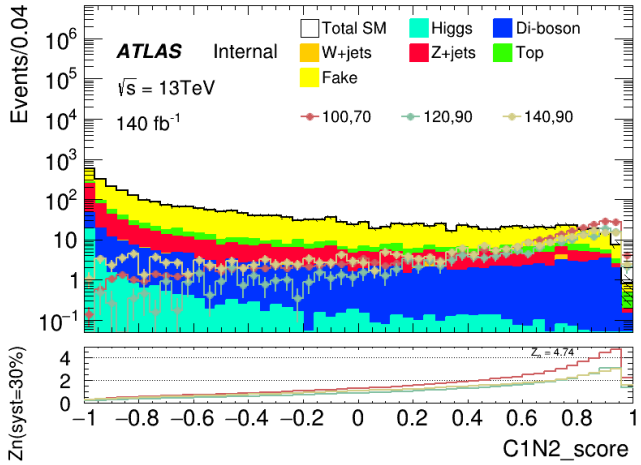
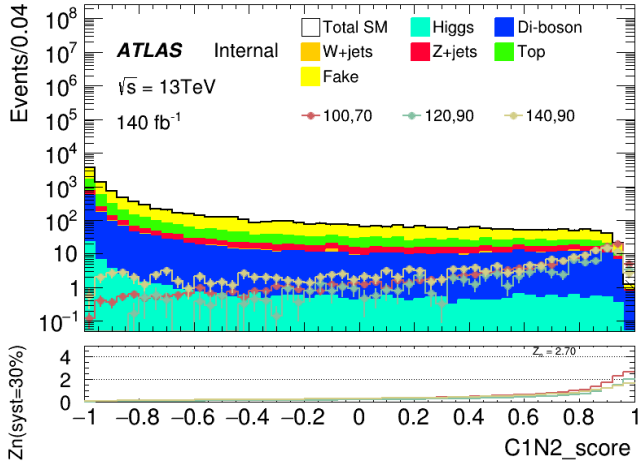
HH

LH

run2





run3