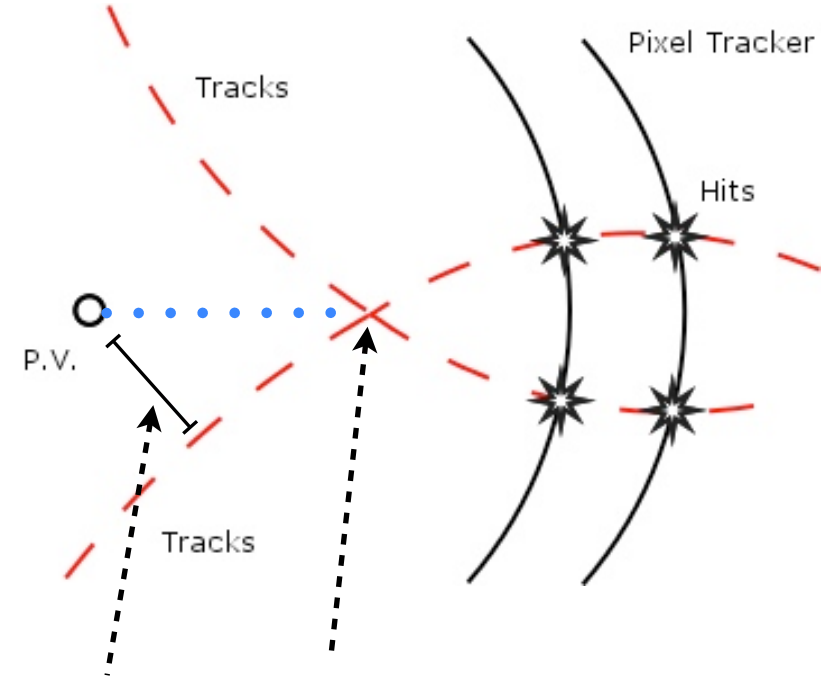
First Look at Flavour Tagging In Stable Beam Collisions

Laurie McClymont
Antonello Miucci
Valerio Dao

UCL ATLAS Weekly
19/06/15

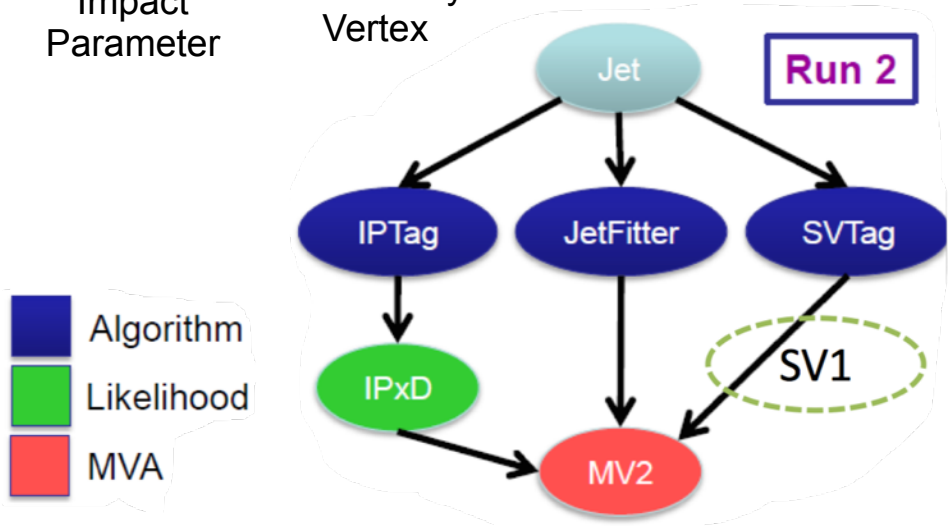
b-Tagging Algorithms



• IP3D
- Look for large track impact parameters.

• SV1
- Reconstruct secondary vertices.
- Look for large flight paths.

• Jet Fitter (JF)
- Reconstruct secondary and tertiary vertices that lie along a common jet flight axis
- These correspond to decays of bottom and charmed hadrons.



• MV2
- Combine basic tagger inputs into a neural network.
- Leads to improved tagging performance.
- MV2c20 is trained on sample containing 20% charm jets.

Aims

- Use dijets to compare data to MC.
- Get an early indication performance of the b-tagging algorithms in Run2 Collisions

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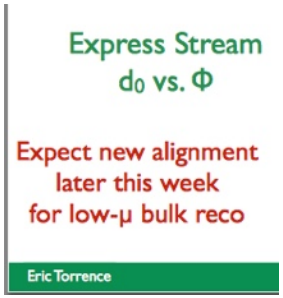
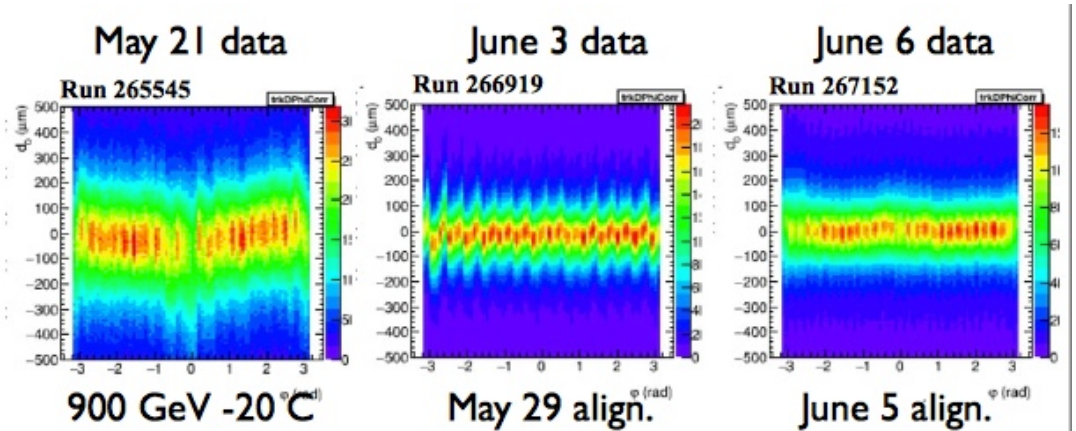
Samples

- *user.vdao.mc15_13TeV.*.Pythia8EvtGen_jetjet_JZ*W.merge.AOD.*.BTAGNTUP_OrigV8full_BTAG STREAM/*
  - JZ1W-JZ6W - No JZ0W
  - ~ 1M Events

- *user.vdao.data15_13TeV. 00267073.physics_Main.merge.AOD.f594_m1435.BTAGNTUP_V9full_BTAGSTREAM.30598468*
  - First stable beam collisions!
  - ~11M Events from Run 267073
  - 29th May Alignment

Beam Spot Quality
- Eric Torrence





Trigger Selections

• L1_RD0_Filled Trigger, P_T > 35 GeV
- Less stringing cuts on data allow us to more data (and MC) points to reduce statistical effects.

Also looked at:
• L1_J50 Trigger with P_T > 175 GeV - In the Backup
- This trigger is used with a large P_T cut such that the trigger is at optimal efficiency

Details/Cuts

• Leading Jet with
- P_T > 35 GeV
- |eta| < 2.5

• Run1MediumBadCuts

• Truth Dijet Test for MC
- (pt_1+pt_2)/2 < 1.4* truth_pt_1, for njet > 1
- (pt_1 < 1.4 * truth_pt_1), for njet =1

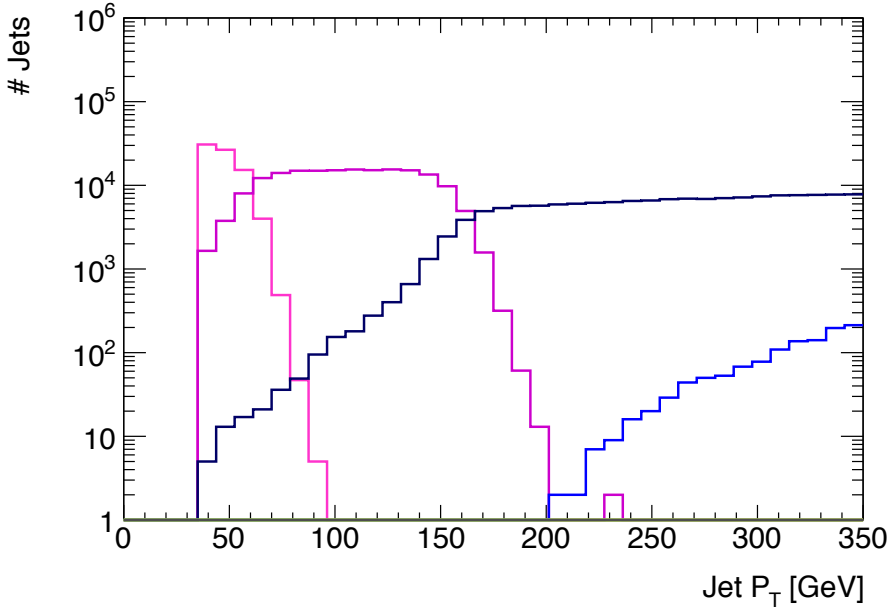
• Then Plot Subleading Jet if it has
- P_T > 25 GeV
- |eta| < 2.5

• Good Run Cut for Data
- Run 267073
- LBN: 368-410, 413-416, 442-466, 471-485 and 491 to 724

•LabDr_HadF truth matching.

• AntiKt4EMTopoJets.

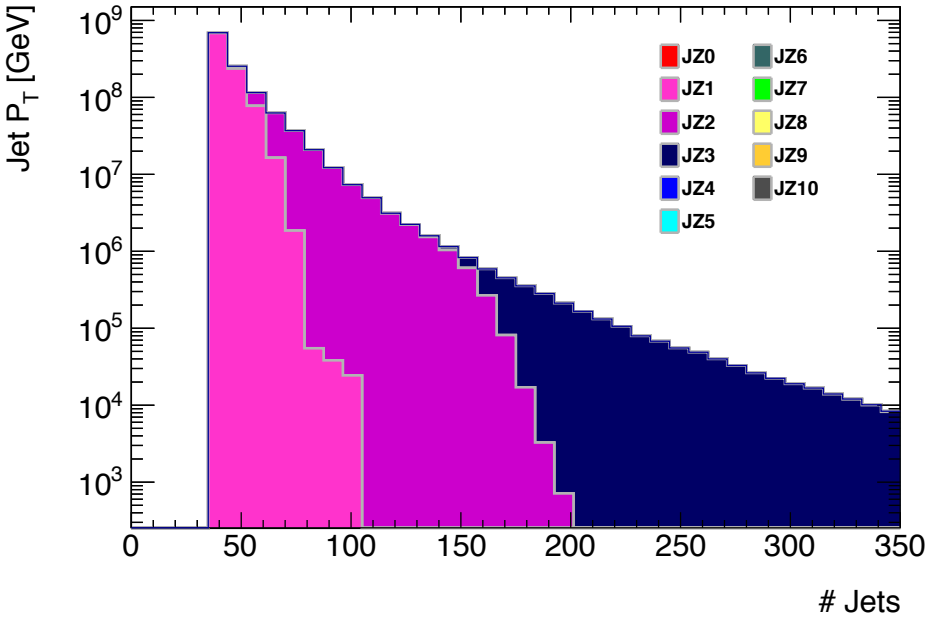
Di-jet sample re-weighting

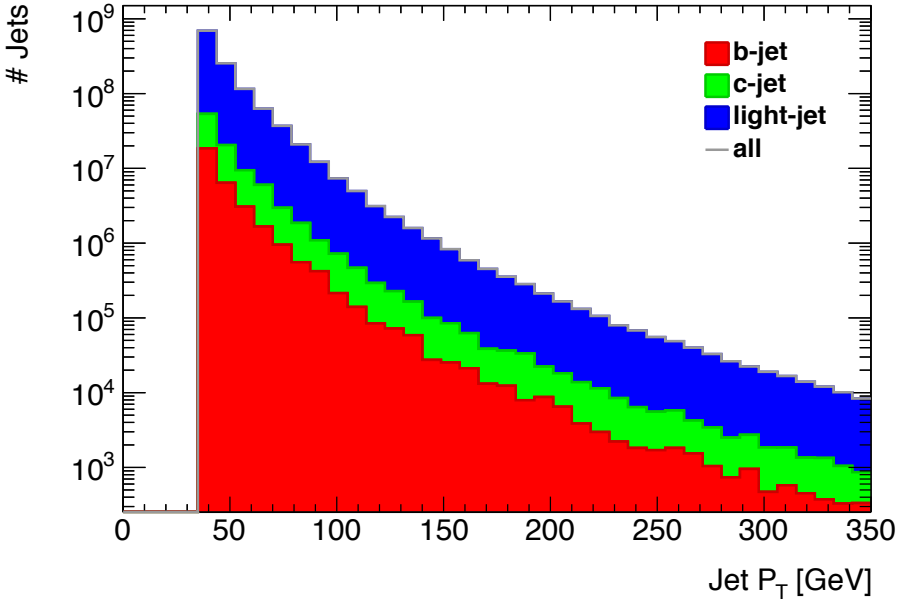


Total Weight	=	mcwg*(Filter Eff.)*(CS[fb])*(Lumi[fb^{-1}]) / (# Events)

I think # events is right but we will do tests.

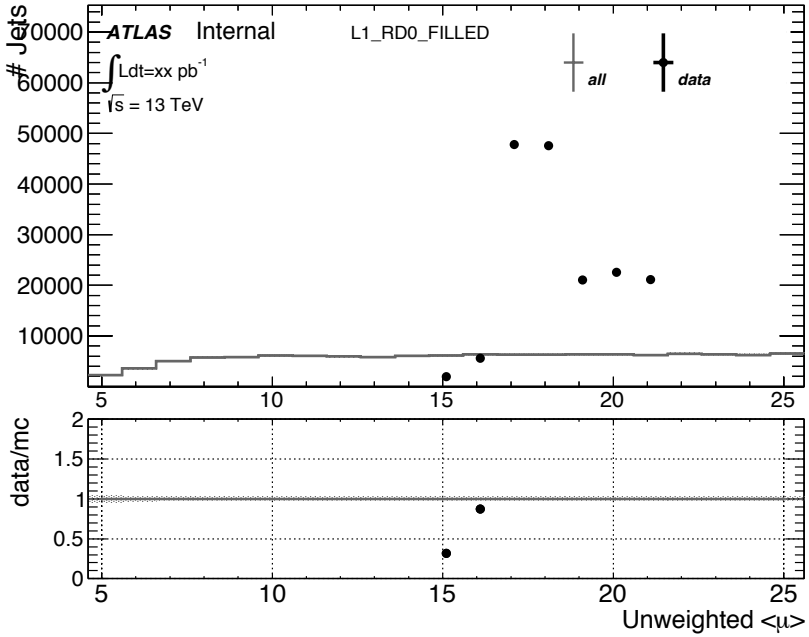
Xs(fb)	Eff.	Slice and Energy
7.8420E+13	6.7198E-04	#JZ1W 20-60 GeV
2.4334E+12	3.3264E-04	#JZ2W 60-160 GeV
2.6454E+10	3.1953E-04	#JZ3W 160-400 GeV
2.5464E+08	5.3009E-04	#JZ4W 400-800 GeV
4.5536E+06	9.2325E-04	#JZ5W 800-1300 GeV
2.5752E+05	9.4016E-04	#JZ6W 1300-1800 GeV

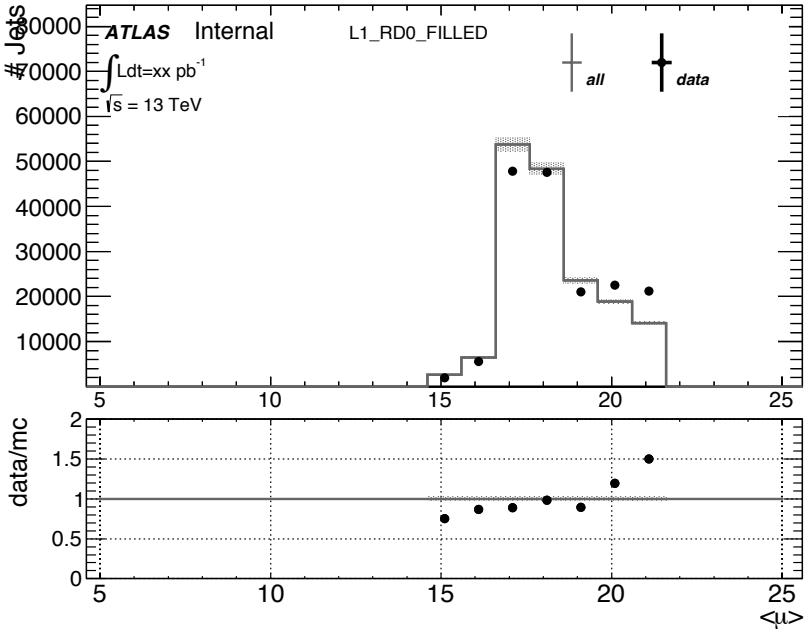


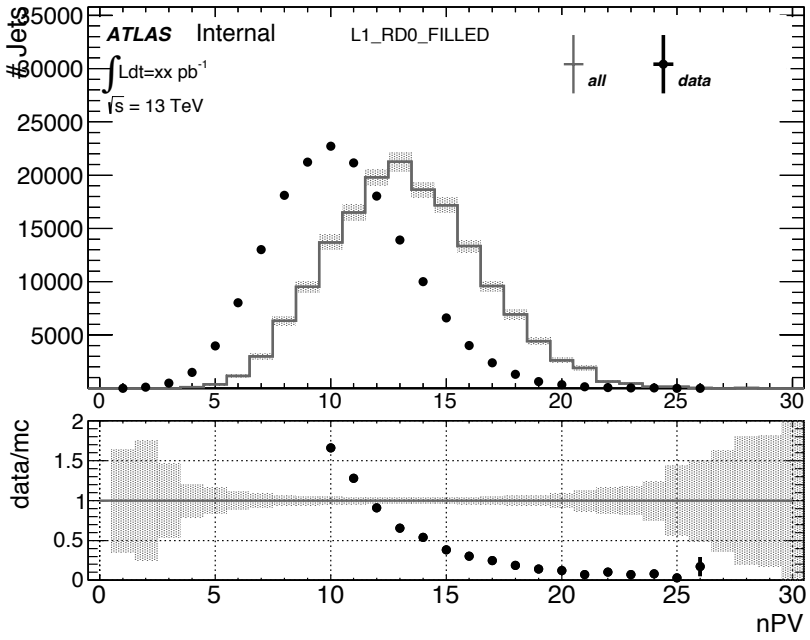


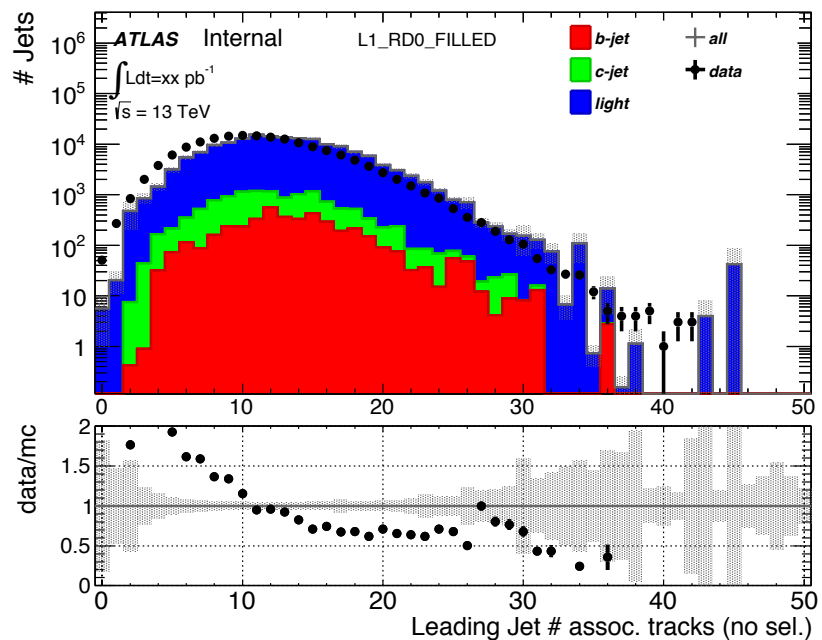
Event/Jet Properties

L1_RD0_Filled



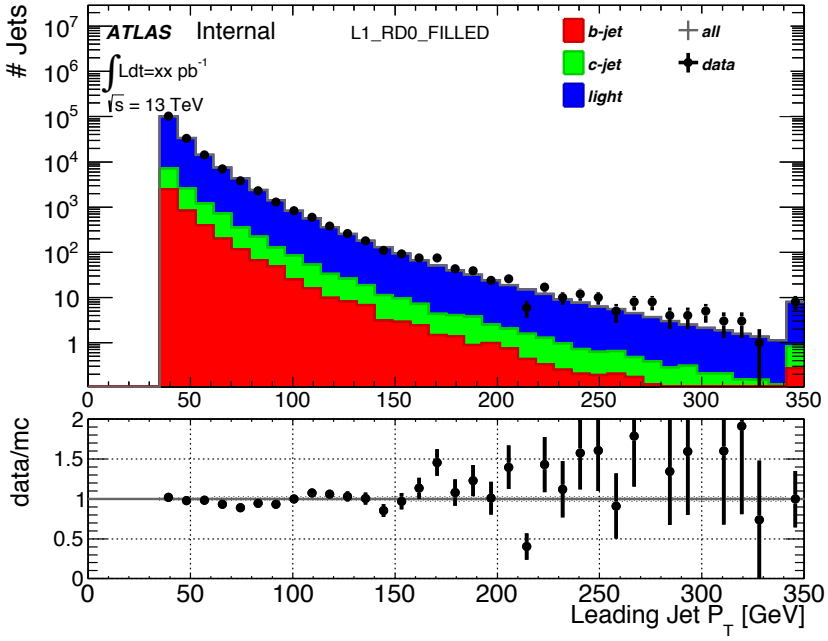


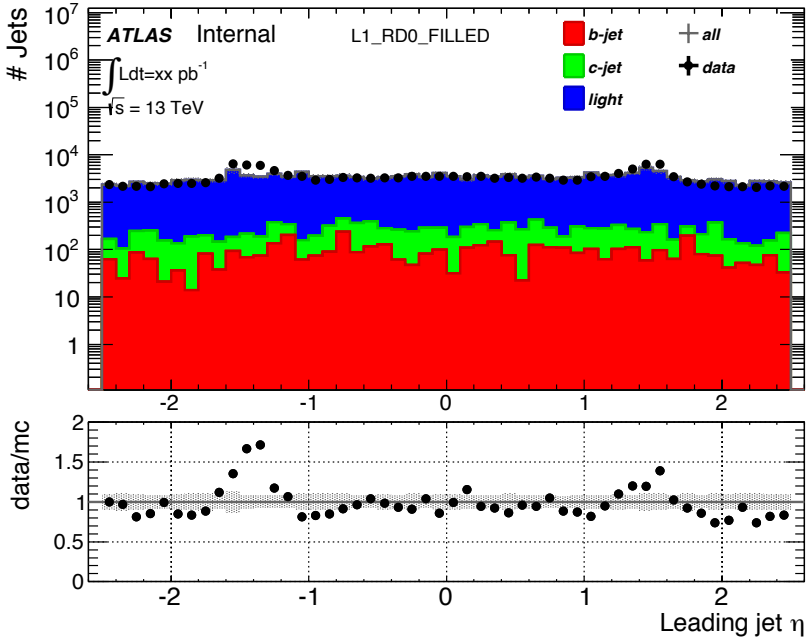


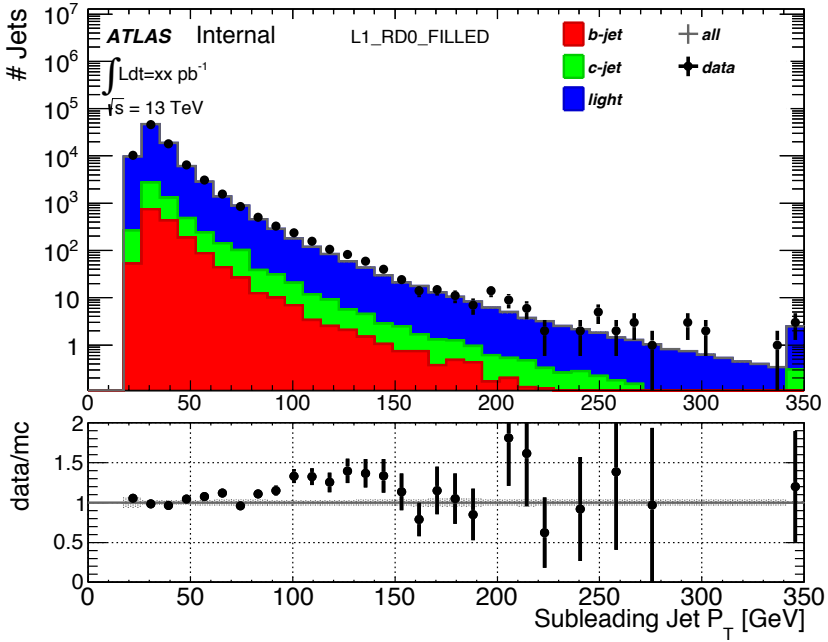


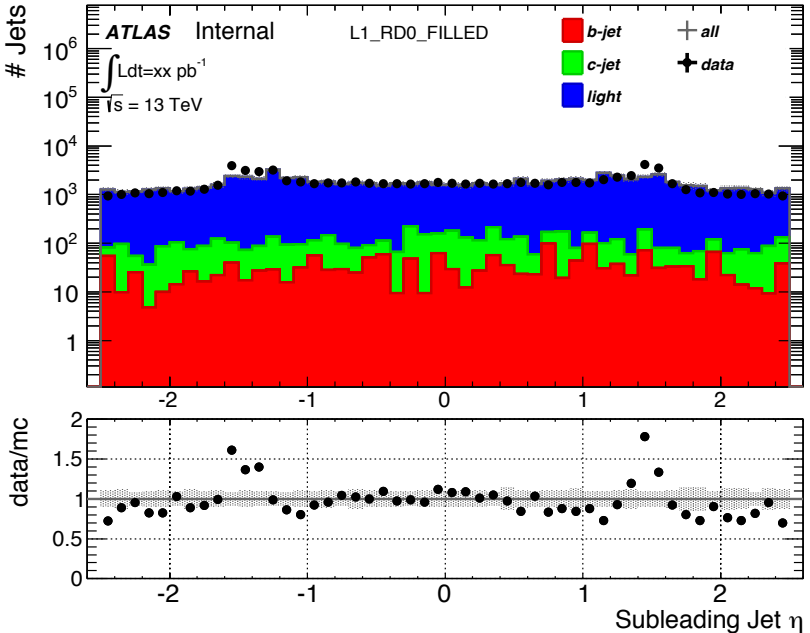
Jet Kinematic Distributions

L1_RD0_Filled



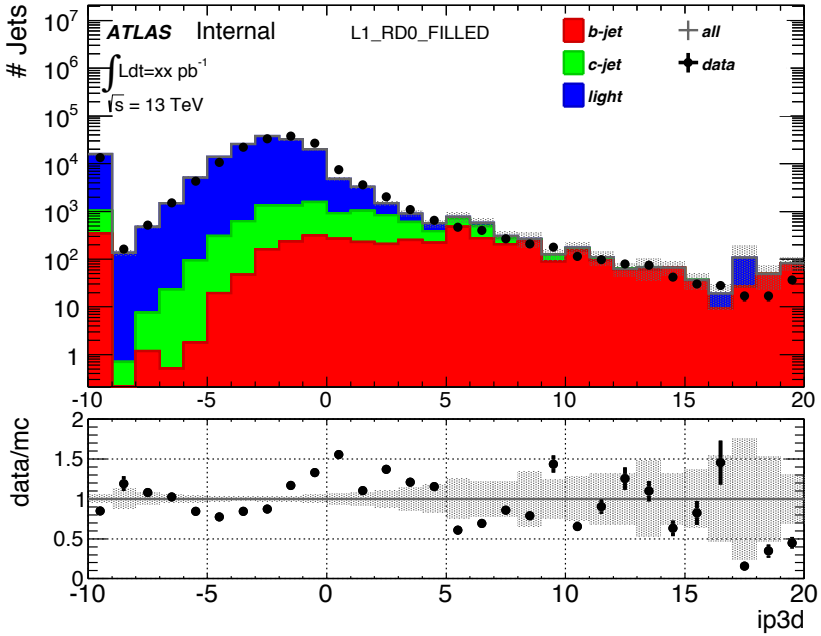


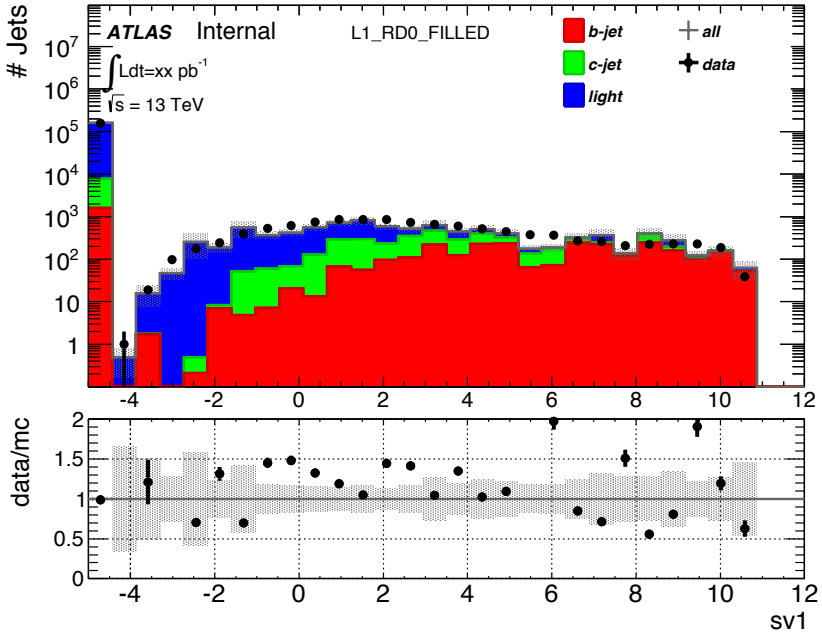


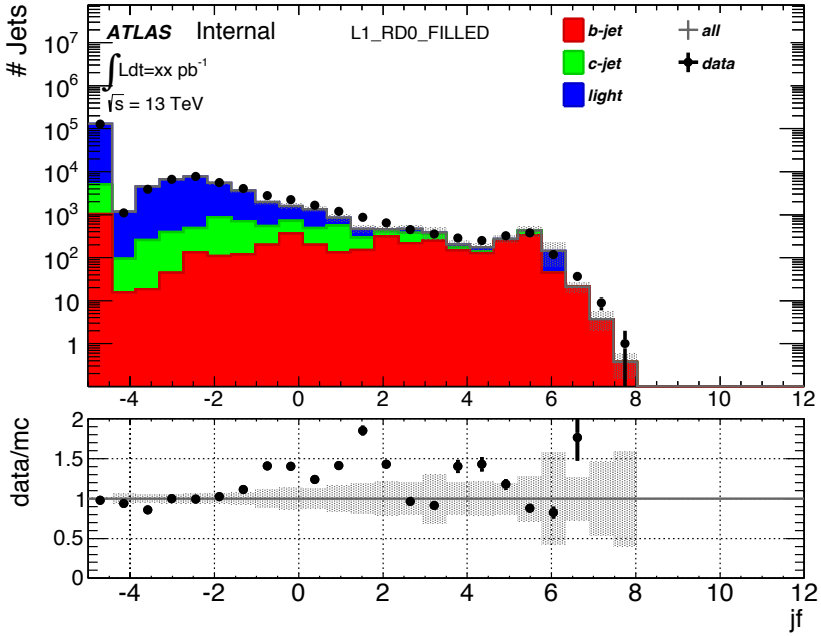


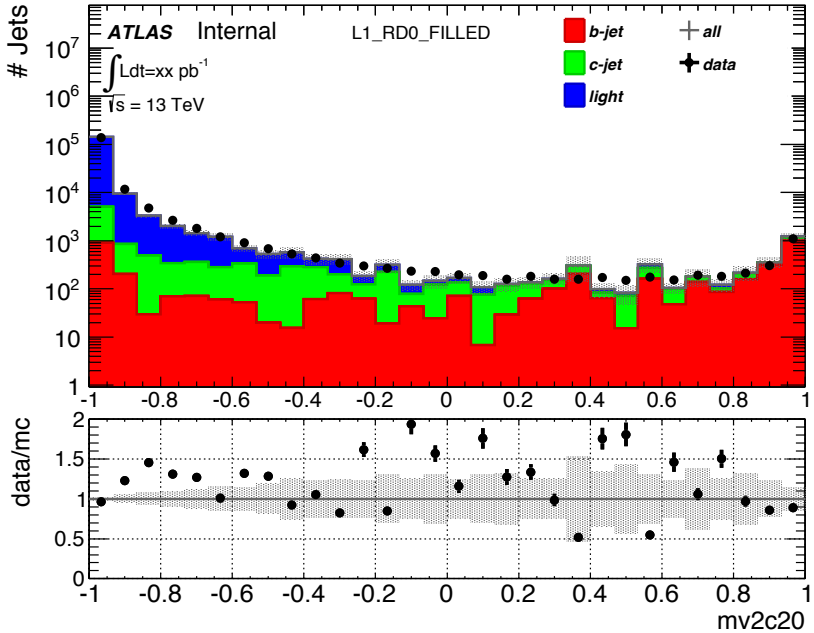
Discriminants

L1_RD0_Filled



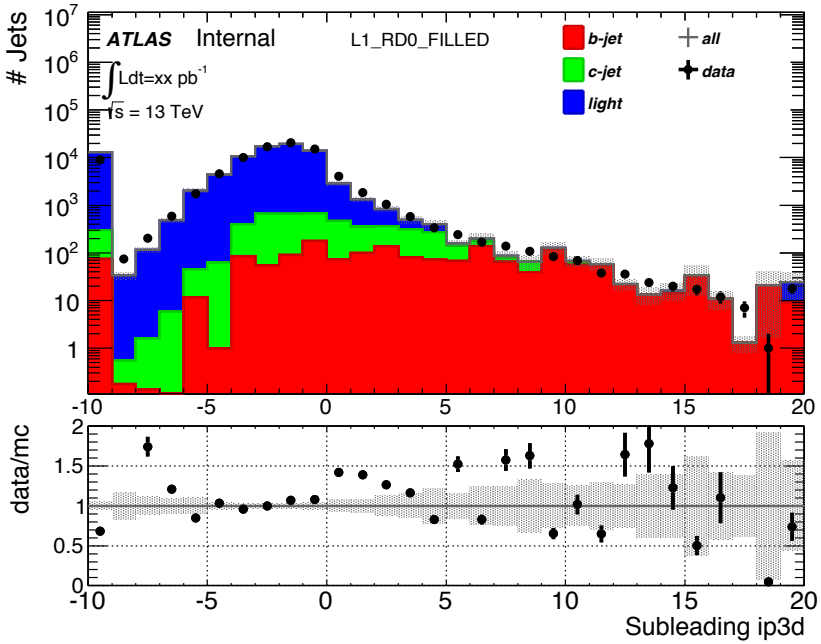


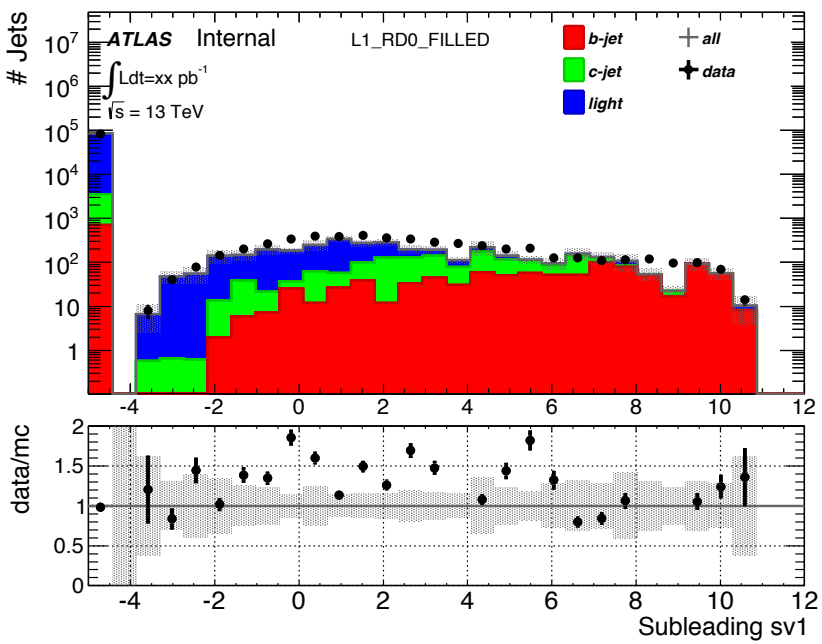


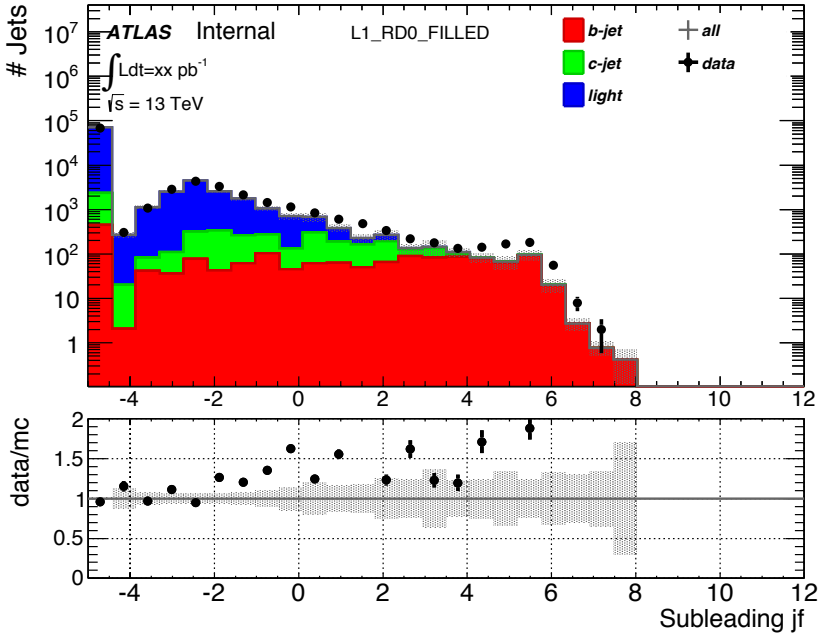


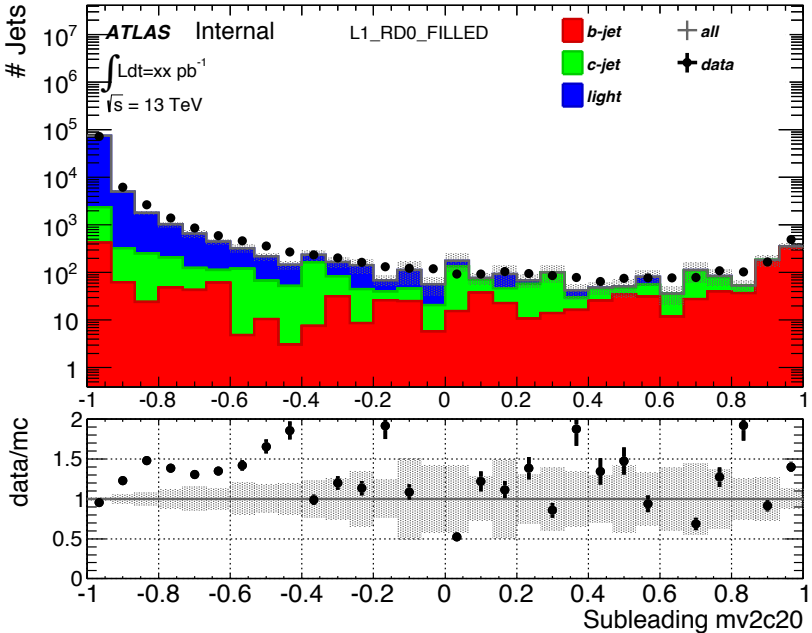
Discriminant - Subleading

L1_RD0_Filled

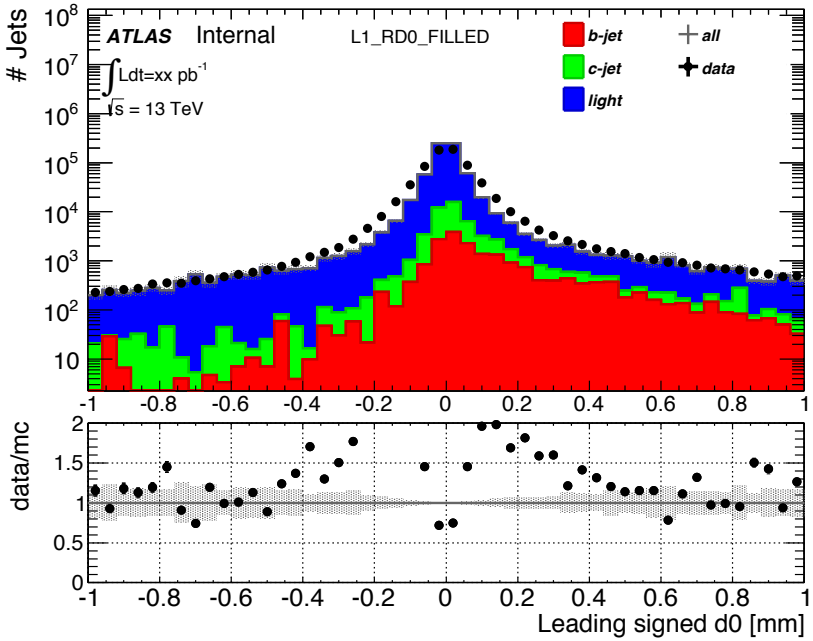


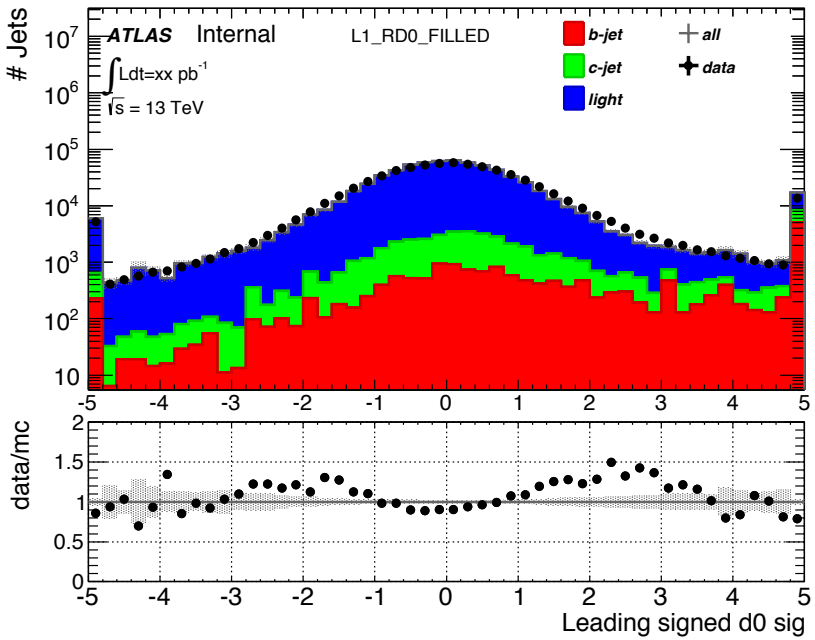


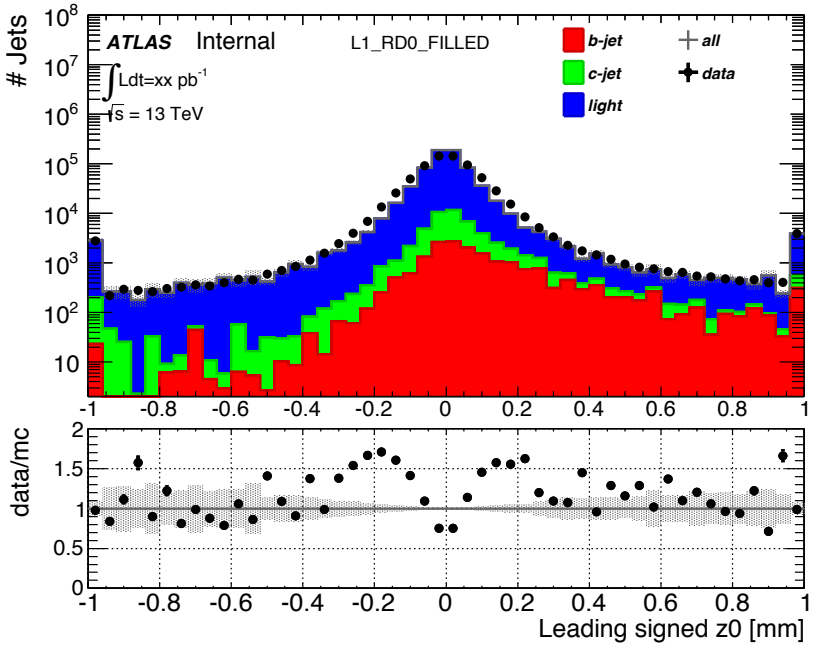


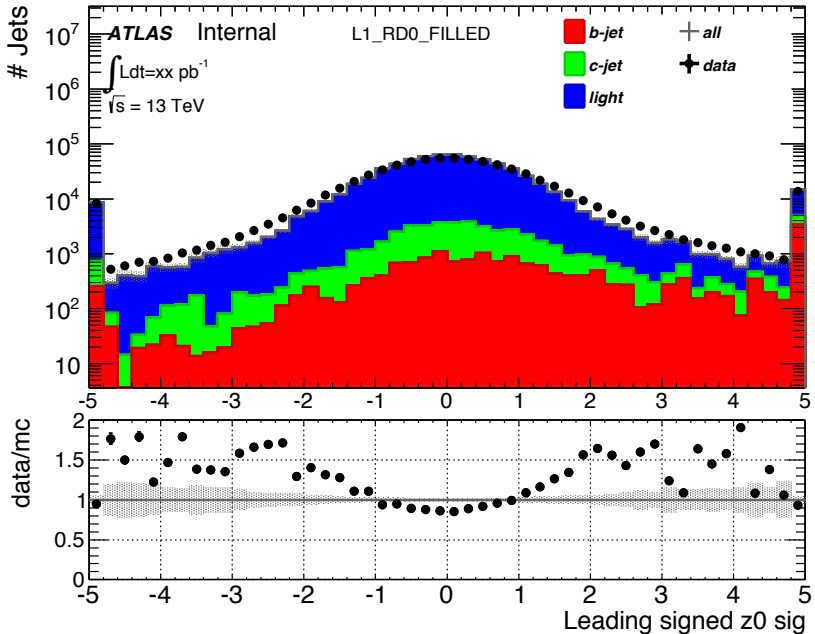


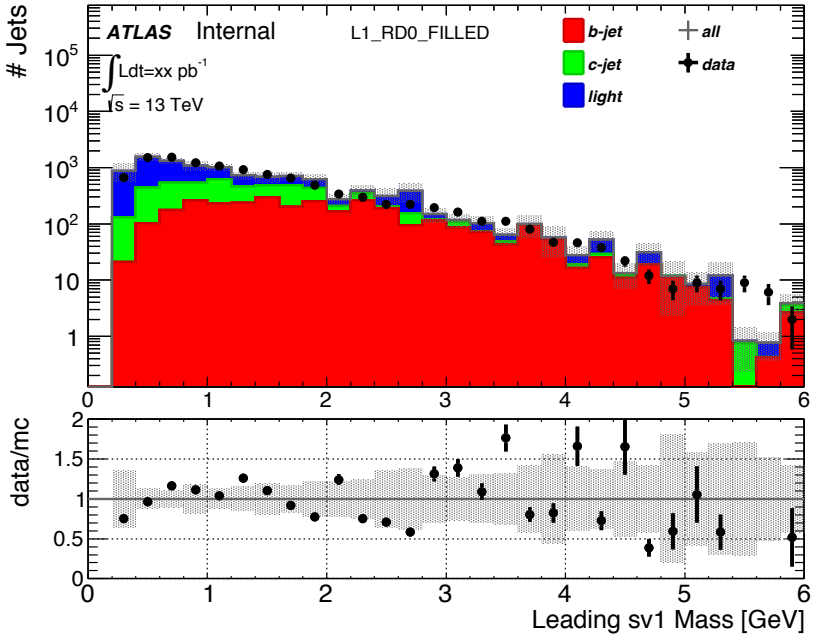
L1_RD0_Filled

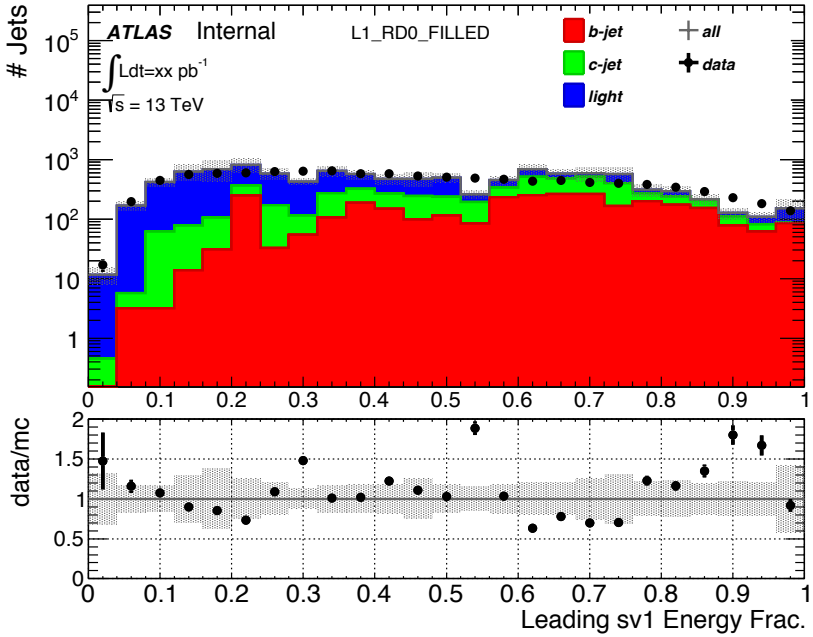


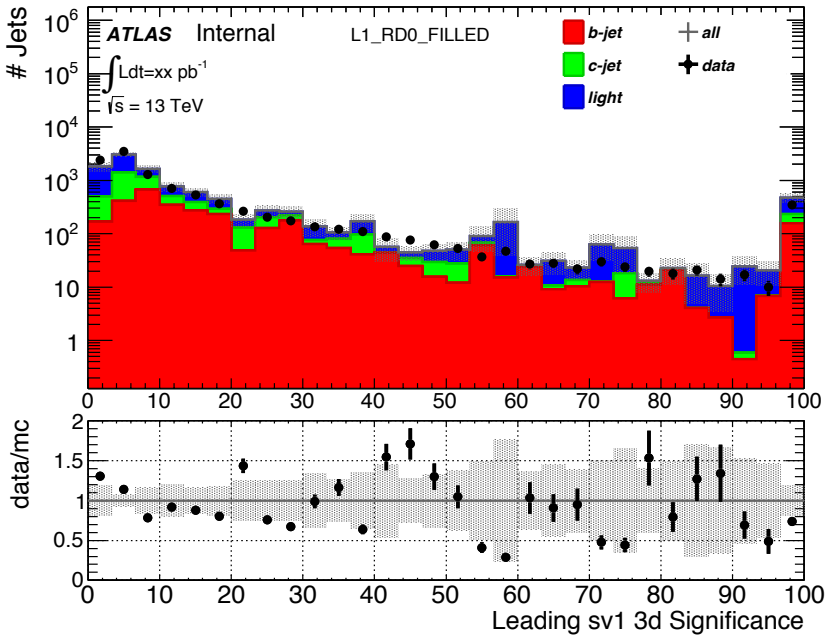


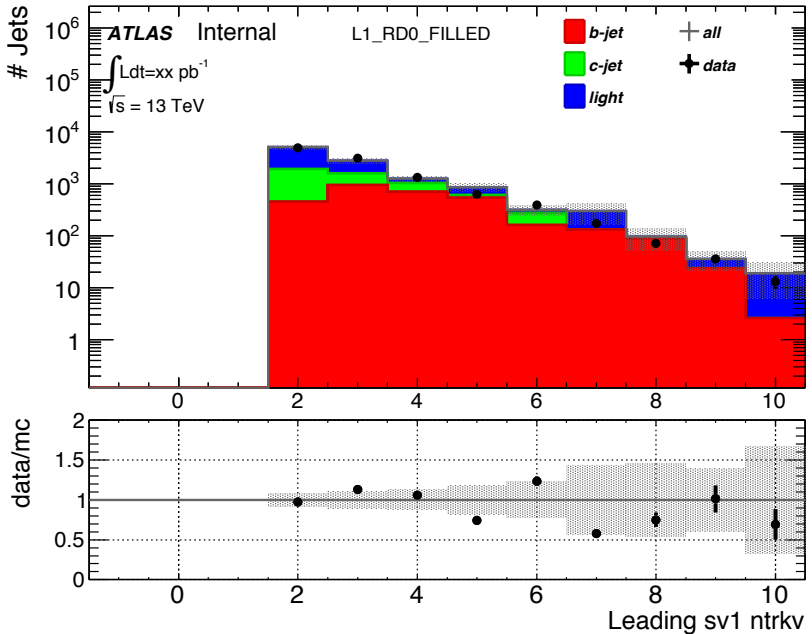




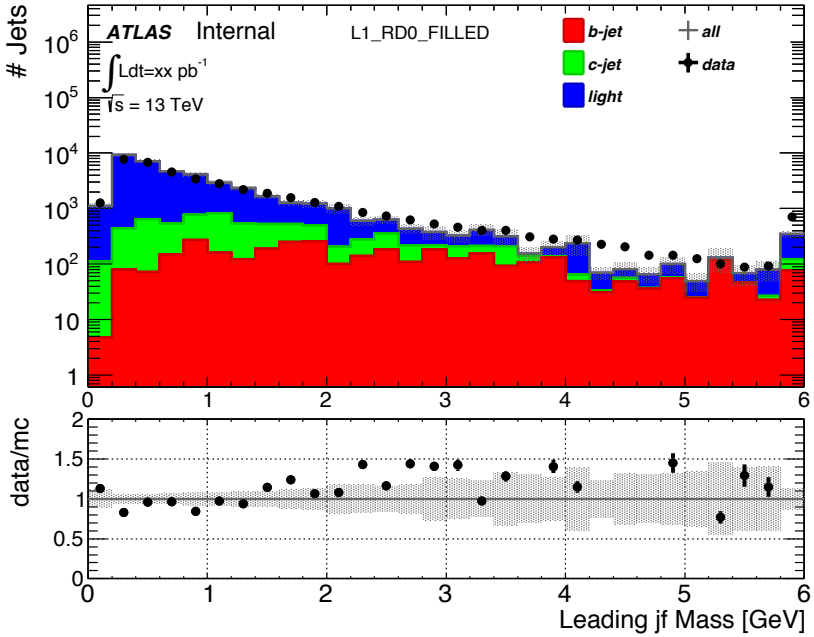

ATLAS Internal
L1_RD0_FILLED
∫Ldt=xx pb-1
√s = 13 TeV
b-jet
c-jet
light
all
data
Jets
data/mc
Leading sv1 Mass [GeV]

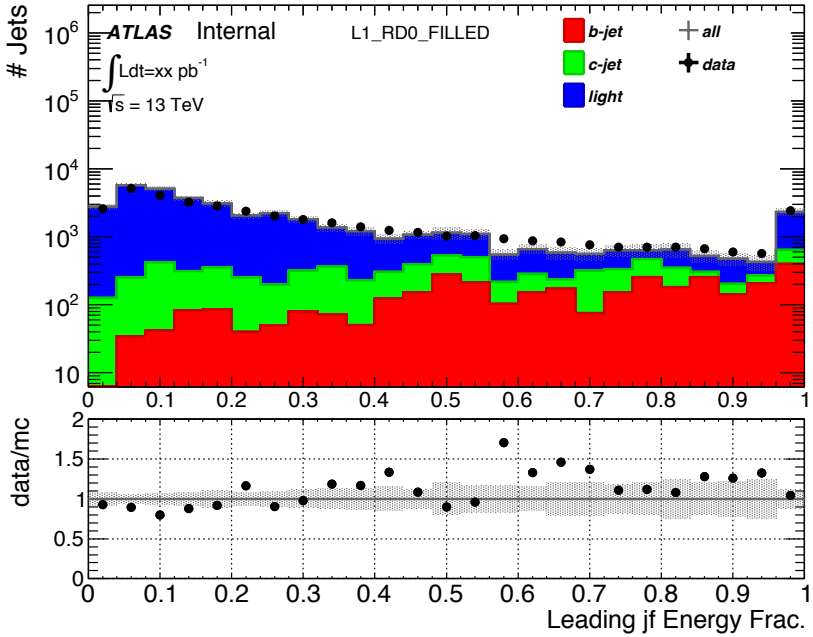

ATLAS Internal
L1_RD0_FILLED
∫Ldt=xx pb-1
√s = 13 TeV
b-jet
c-jet
light
all
data
Jets
data/mc
Leading sv1 Energy Frac.

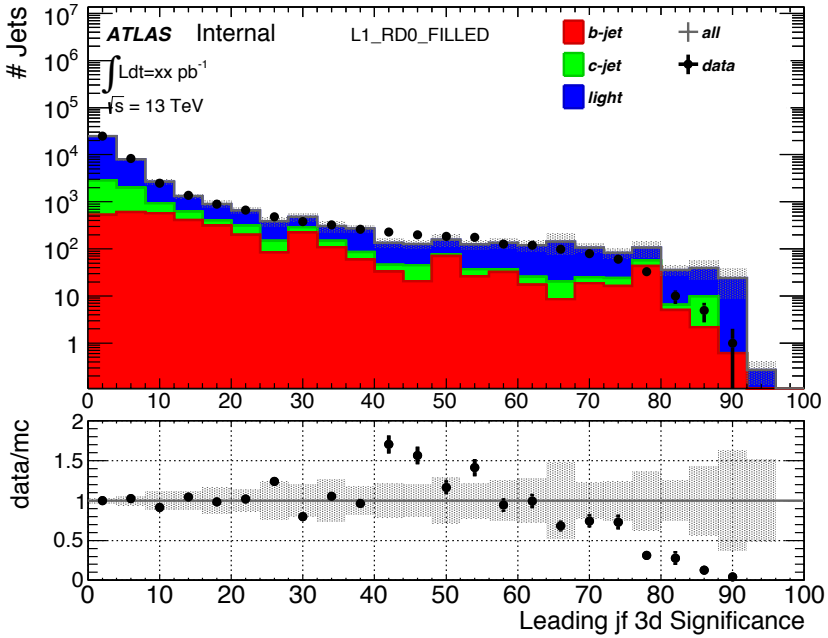

ATLAS Internal
L1_RD0_FILLED
∫Ldt=xx pb-1
√s = 13 TeV
b-jet
c-jet
light
all
data
Jets
data/mc
Leading sv1 3d Significance


ATLAS Internal
L1_RD0_FILLED
∫Ldt=xx pb-1
√s = 13 TeV
b-jet
c-jet
light
all
data
Jets
data/mc
Leading sv1 ntrkv

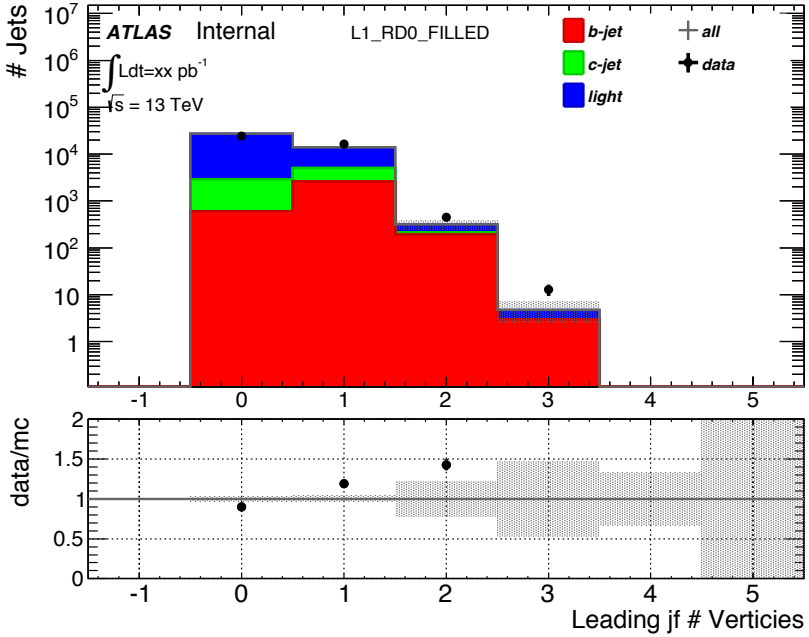
L1_RD0_Filled

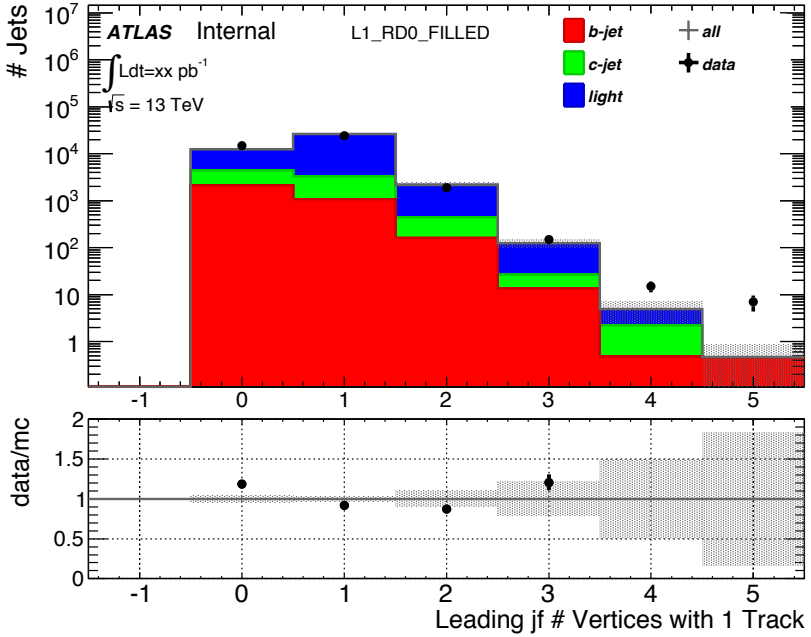


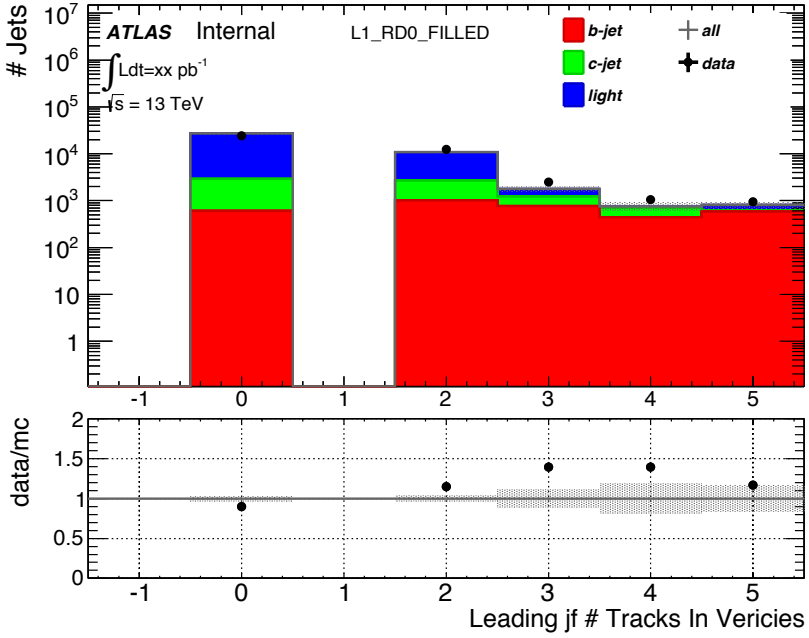




L1_RD0_Filled







Conclusions

• There is beginning to be some agreement here.

• Algorithms are performing reasonably well given some of the caveats (d0 alignment ect.)

To Do

• New Jet Cleaning just around the corner.
- Removal of “ugly jets”.

•Other runs, hopefully some with higher luminosity and new d0 alignments
- d0-Φ and η-Φ

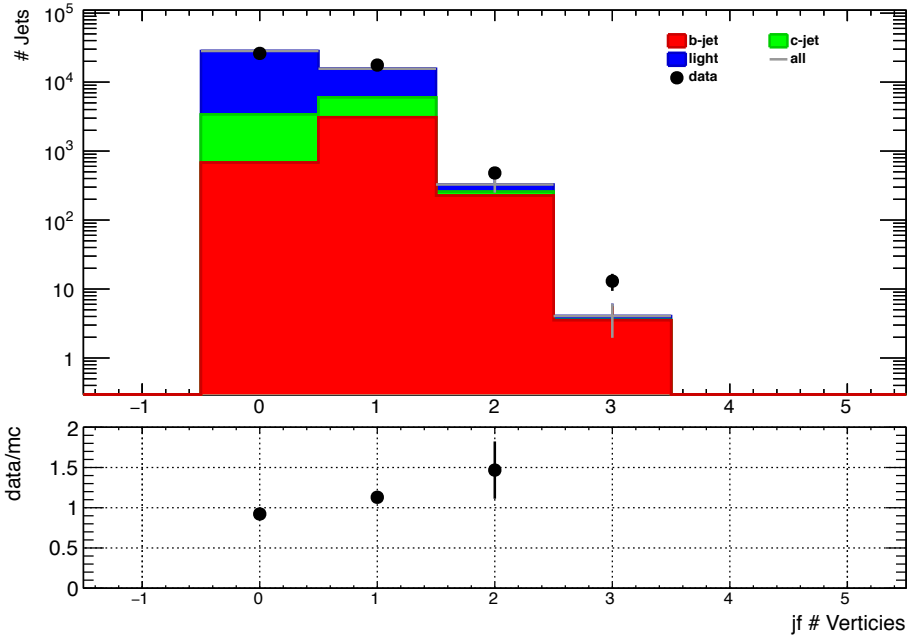
• Add more variables to our studies
- sumtrkV_pt
- Further PV plots.

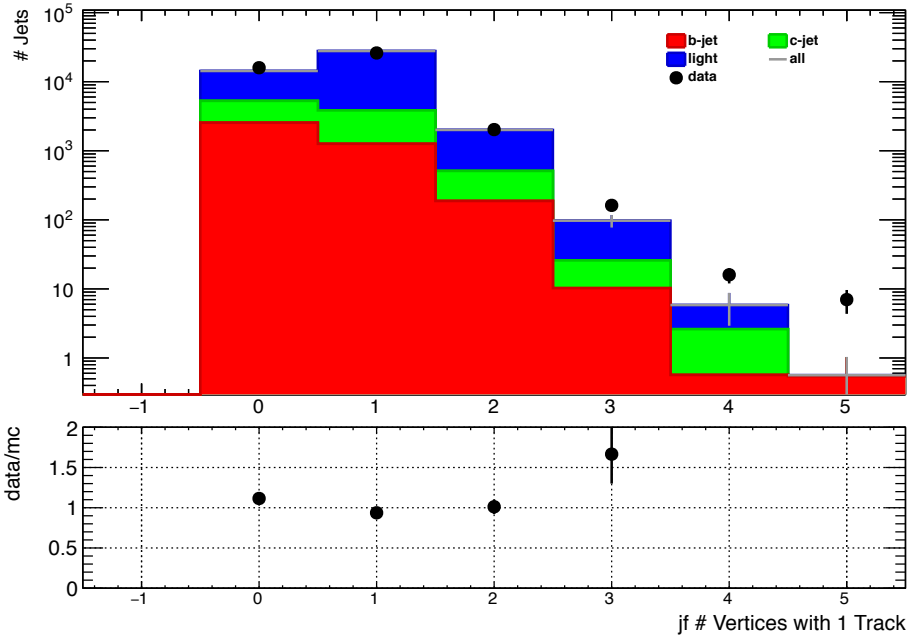
• Couple of tests
- Better understand re-weighting (Look at sum of weights).

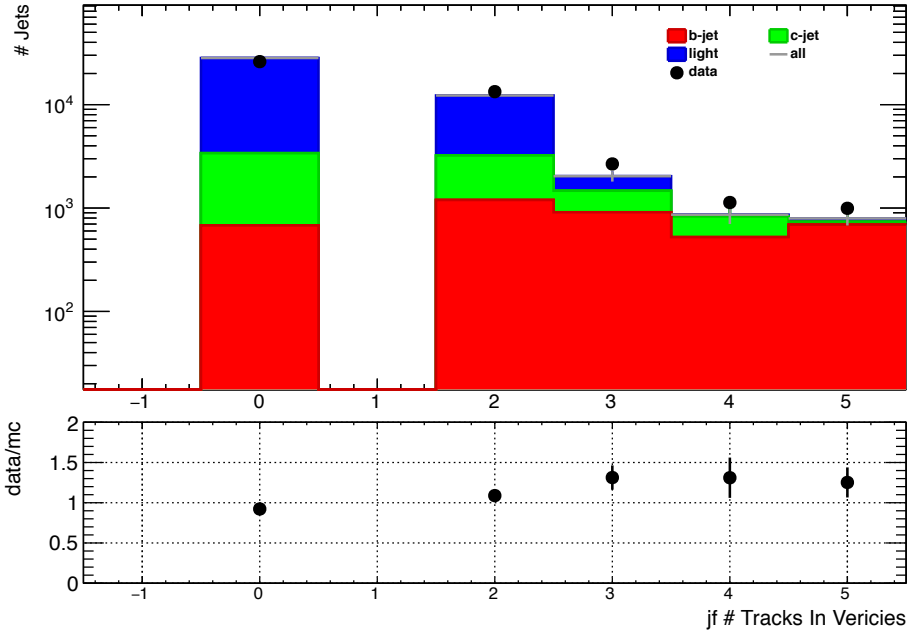
Backup

L1_RD0, Leading Jet, $P_T > 35$ GeV

L1_J50, $P_T > 175$ GeV

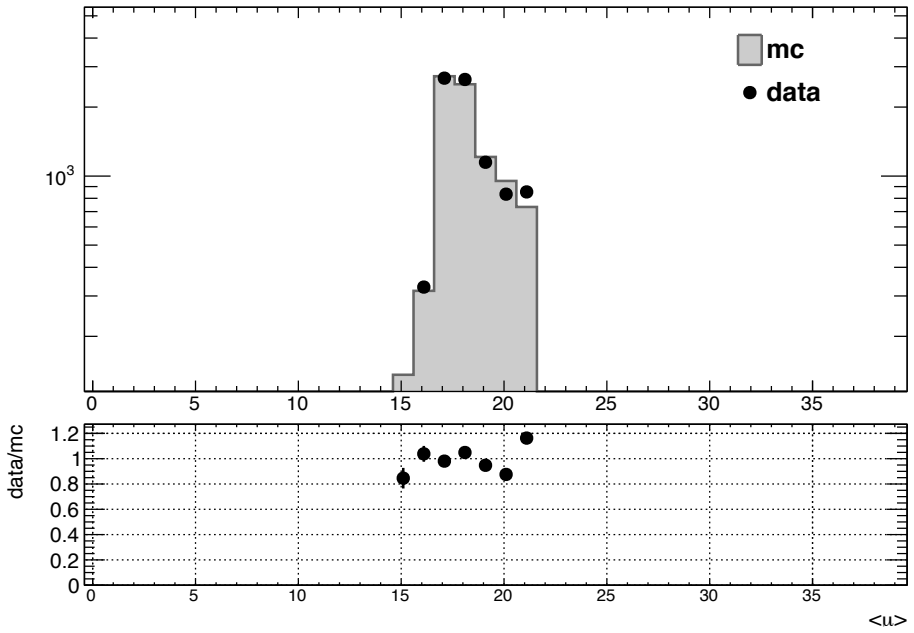

b-jet
c-jet
light
all
data
Jets
data/mc
jf # Verticies

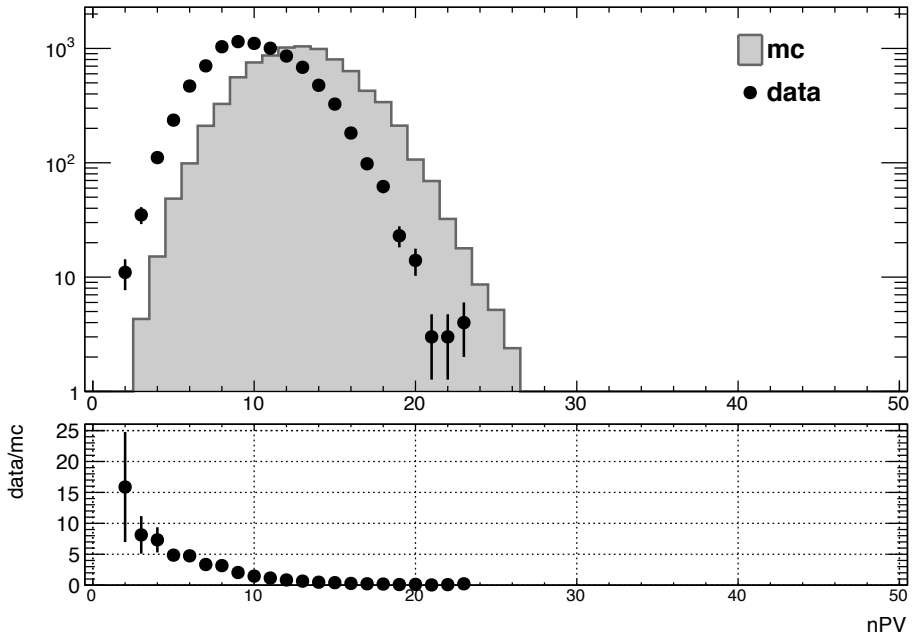

b-jet
c-jet
light
all
data
Jets
data/mc
jf # Vertices with 1 Track

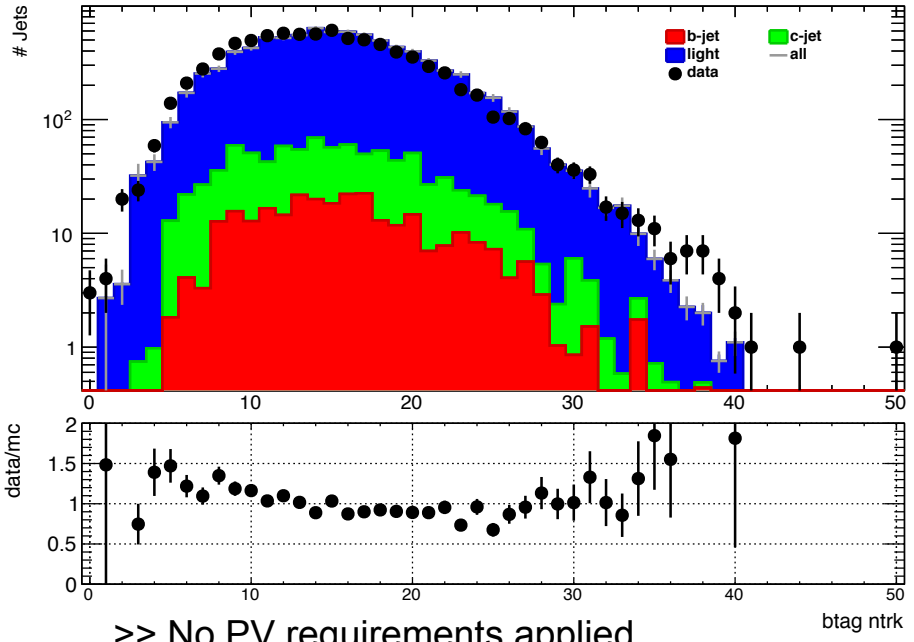

b-jet
c-jet
light
all
data
Jets
data/mc
jf # Tracks In Vericies

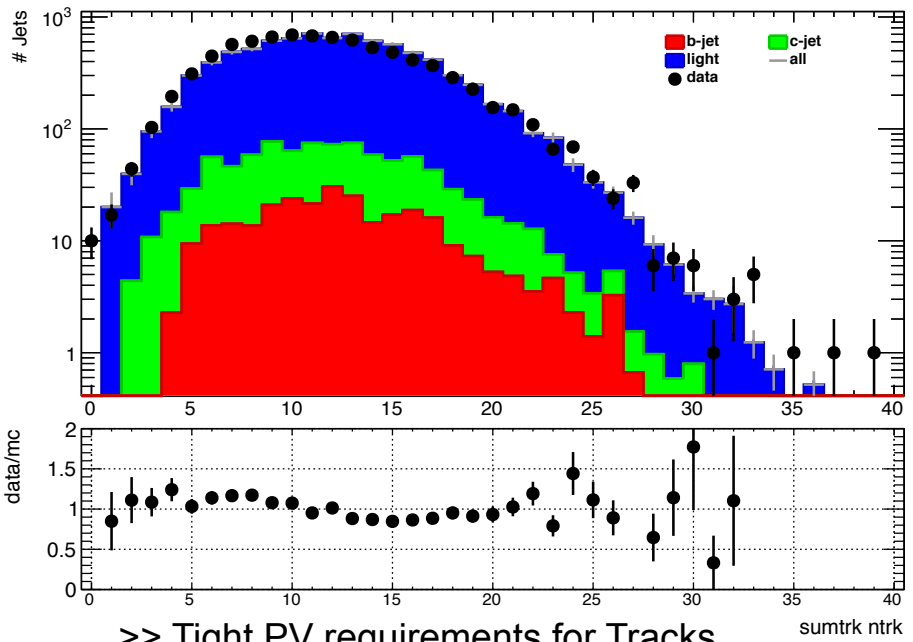
Event/Jet Properties

L1_J50, P_T>175







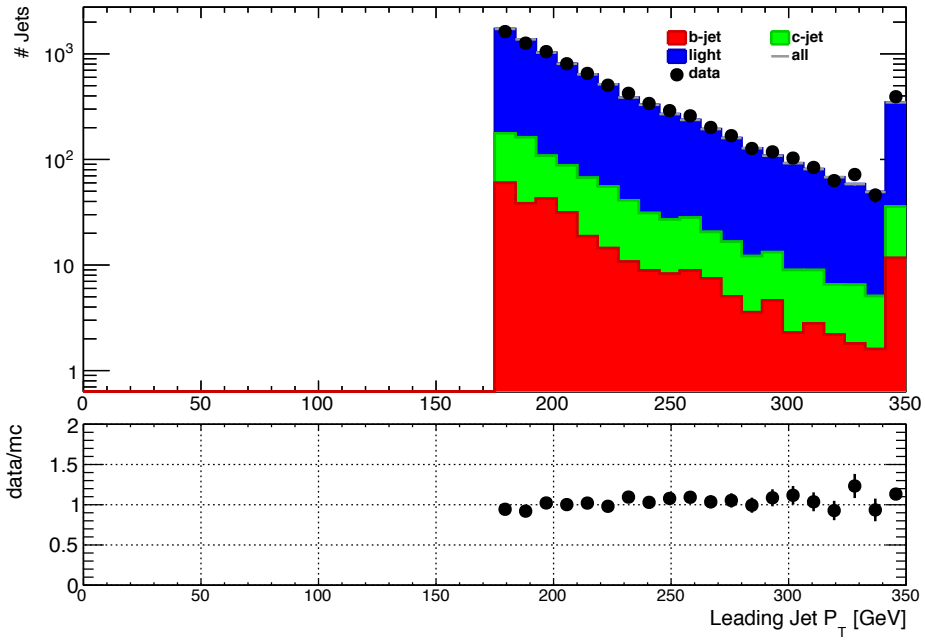


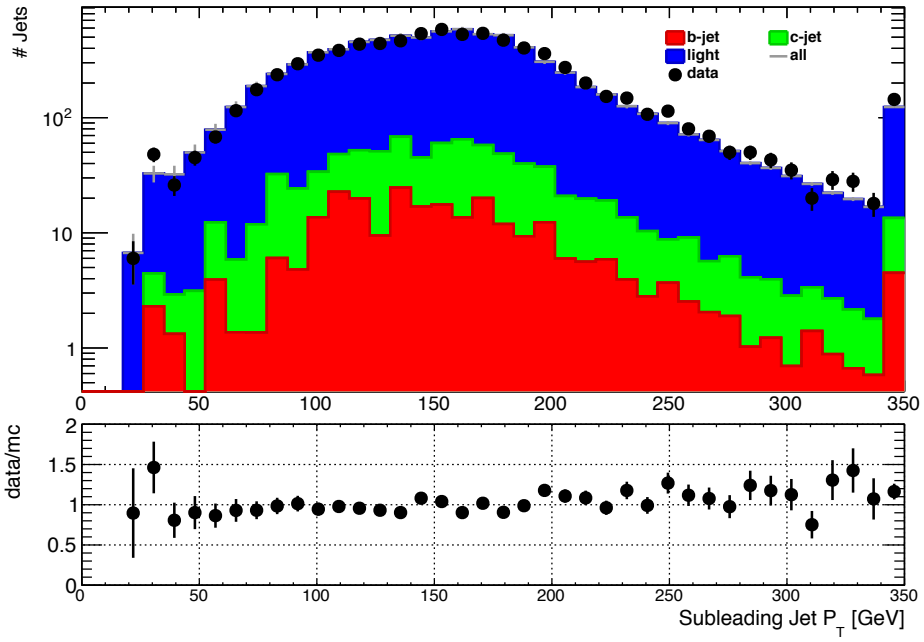
>> No PV requirements applied

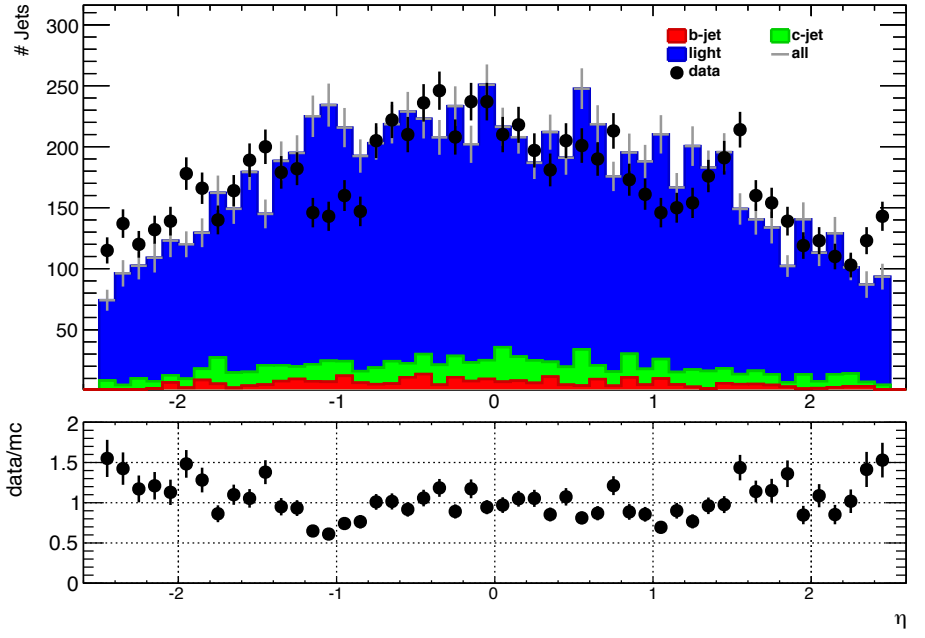
>> Tight PV requirements for Tracks

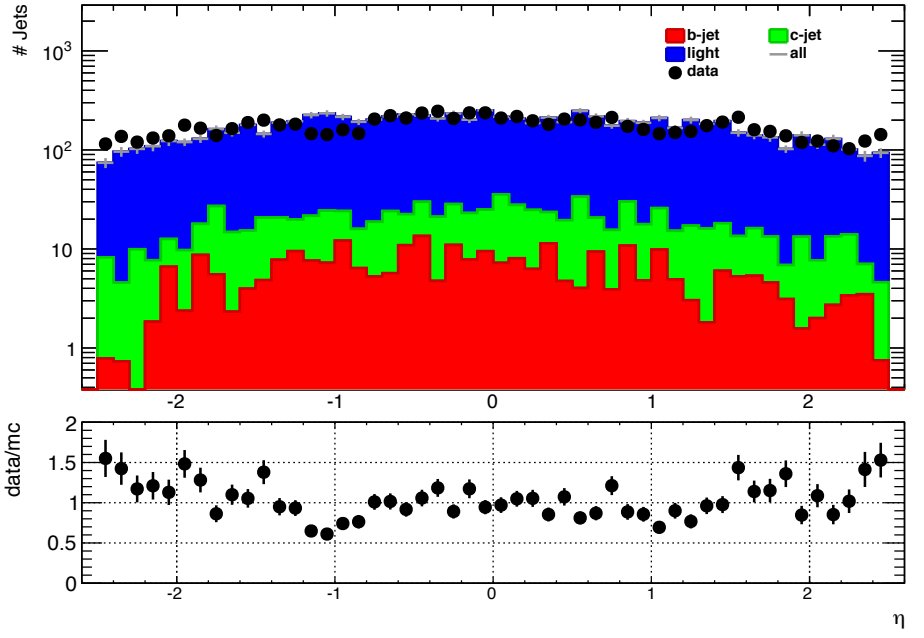
Jet Kinematic Distributions

L1_J50, P_T>175



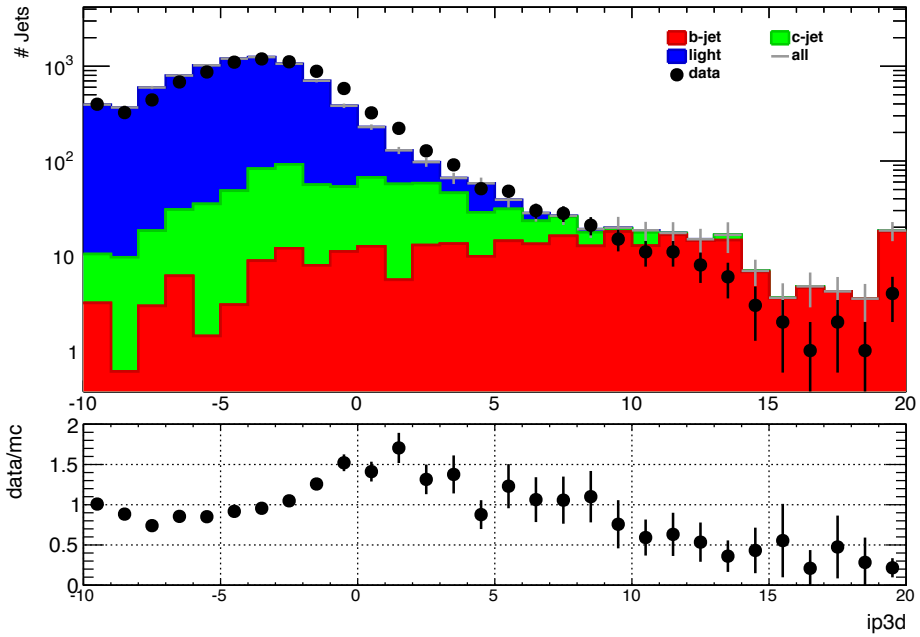


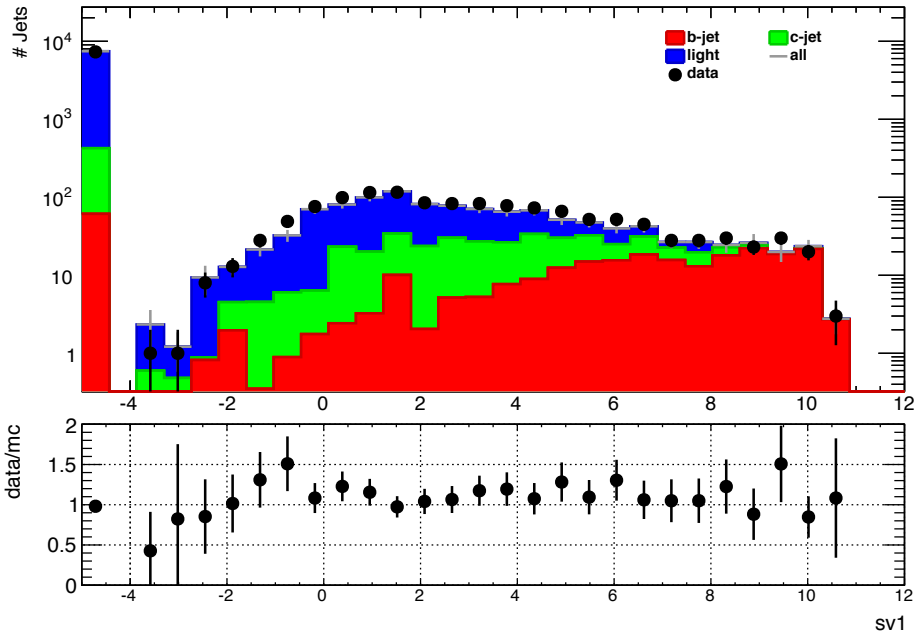


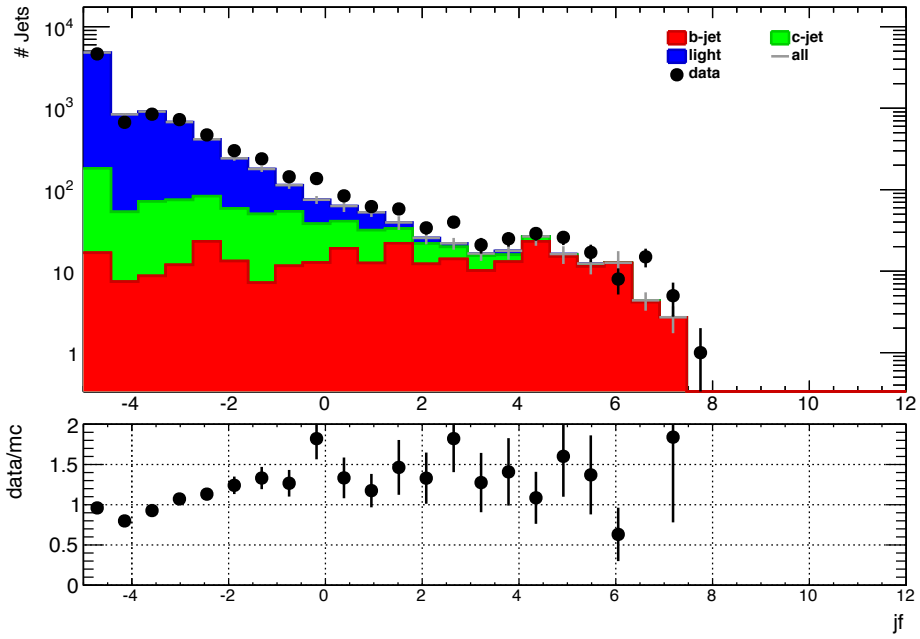


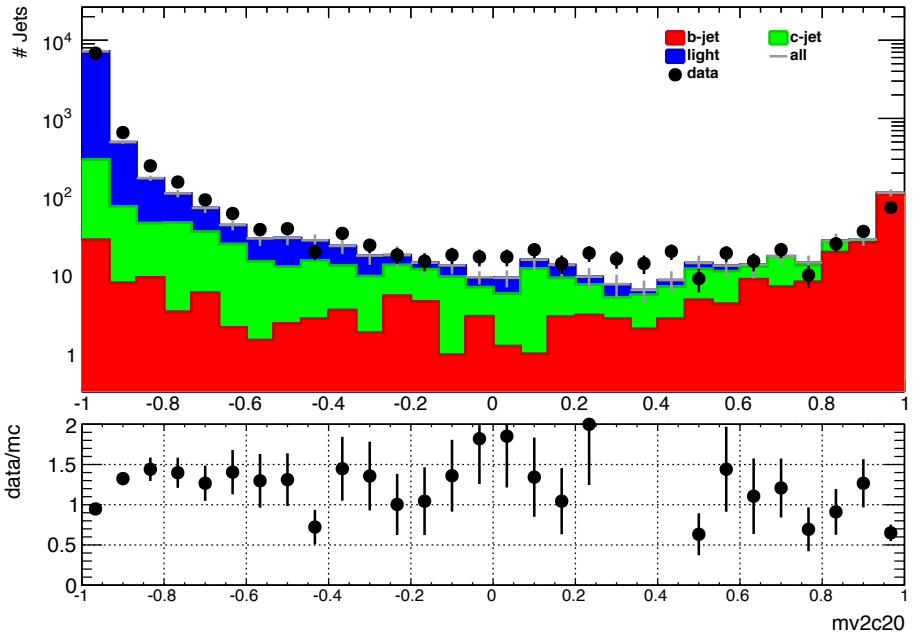
Discriminants

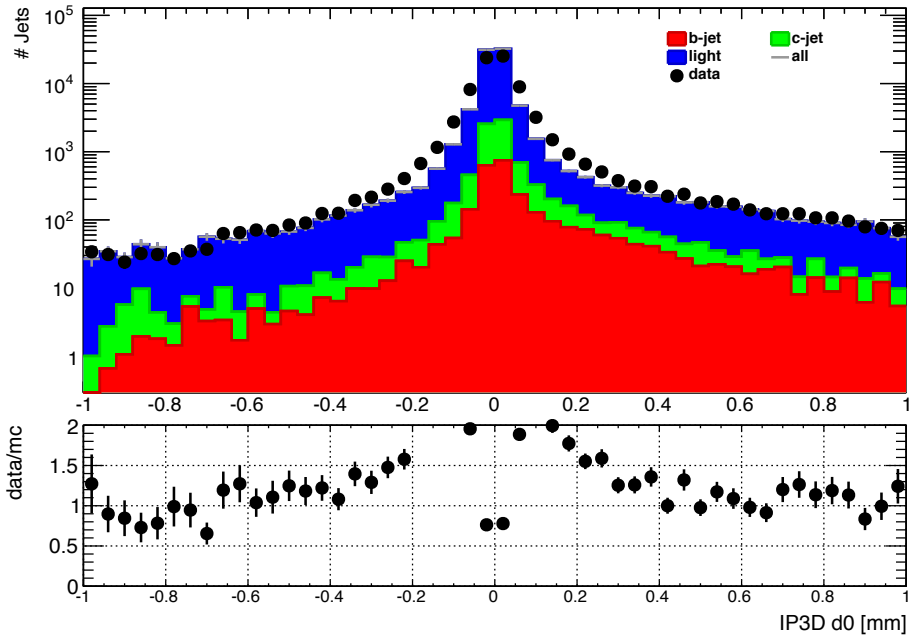
L1_J50, P_T>175







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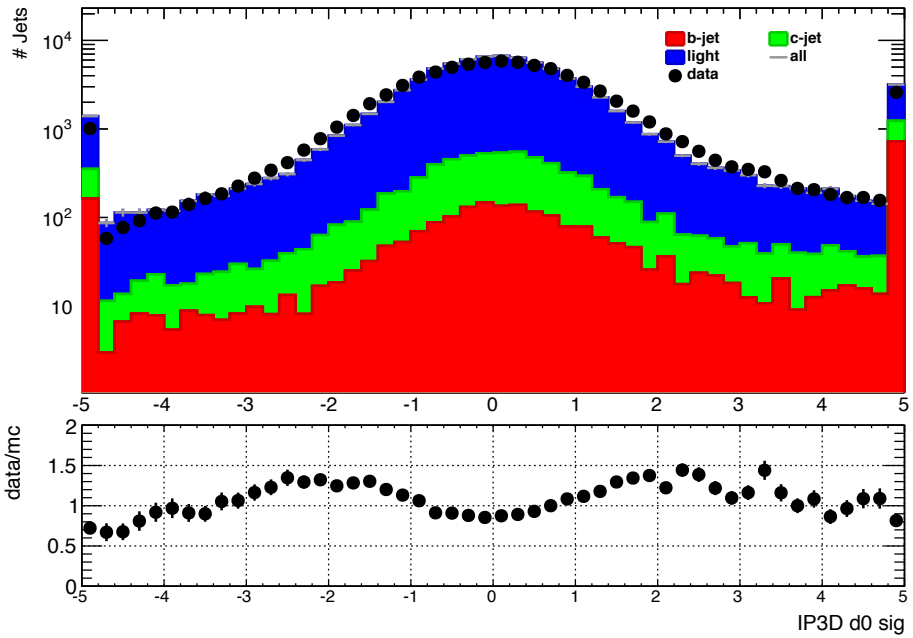
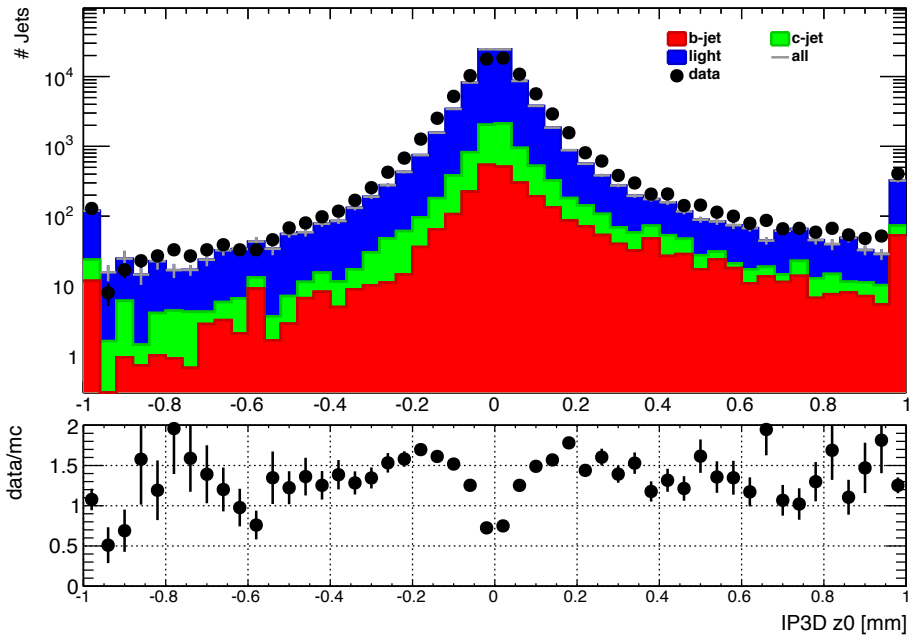
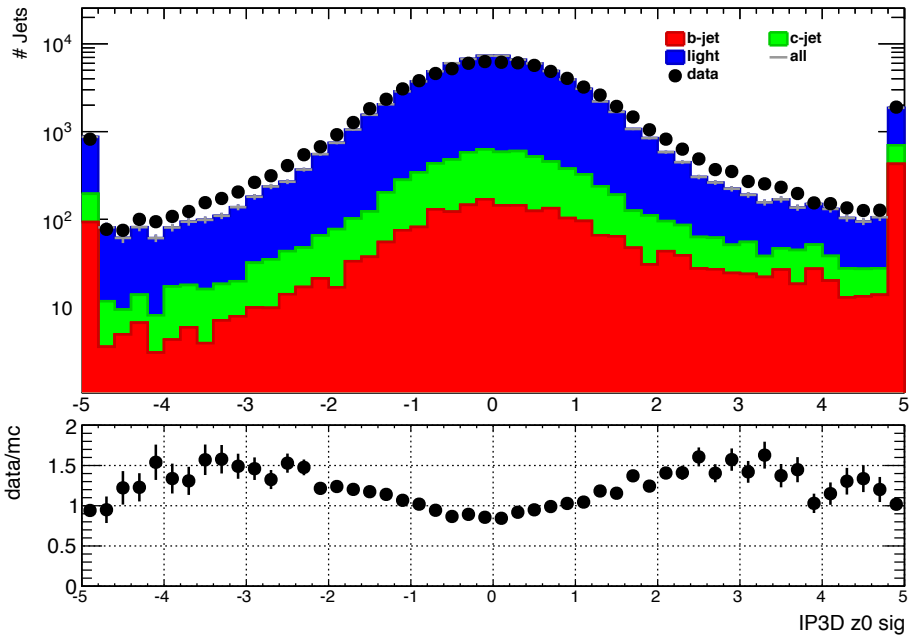
light
data
c-jet
all
Jets
data/mc
IP3D d0 [mm]


b-jet
light
data
c-jet
all
Jets
data/mc
IP3D d0 sig


b-jet
light
data
c-jet
all
Jets
data/mc
IP3D z0 [mm]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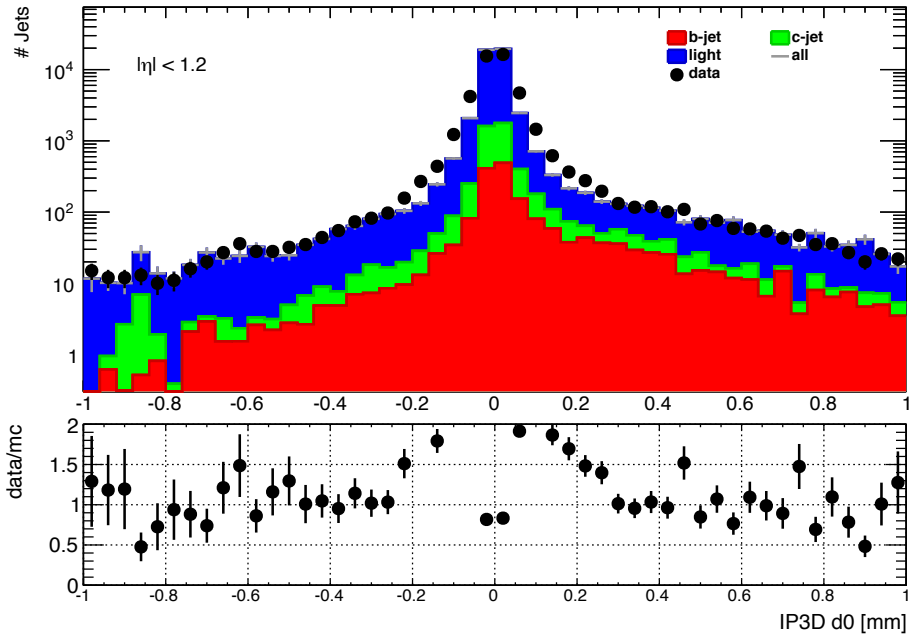
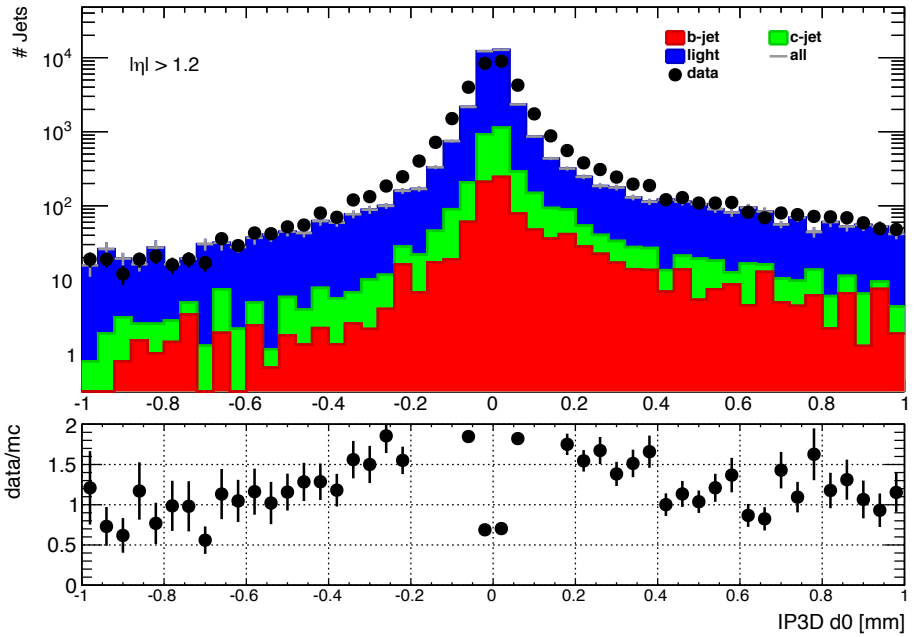
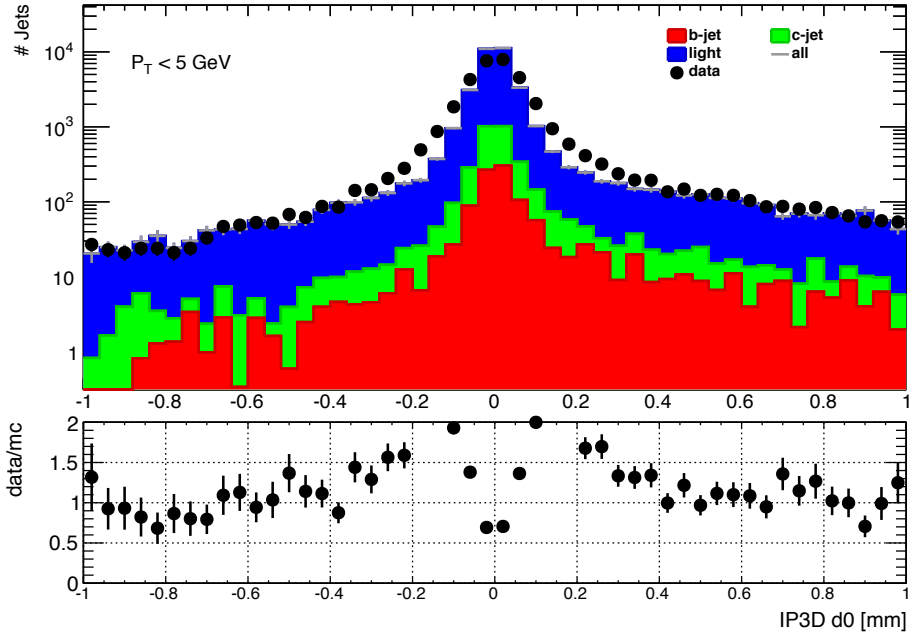
data
c-jet
all
Jets
data/mc
IP3D z0 sig

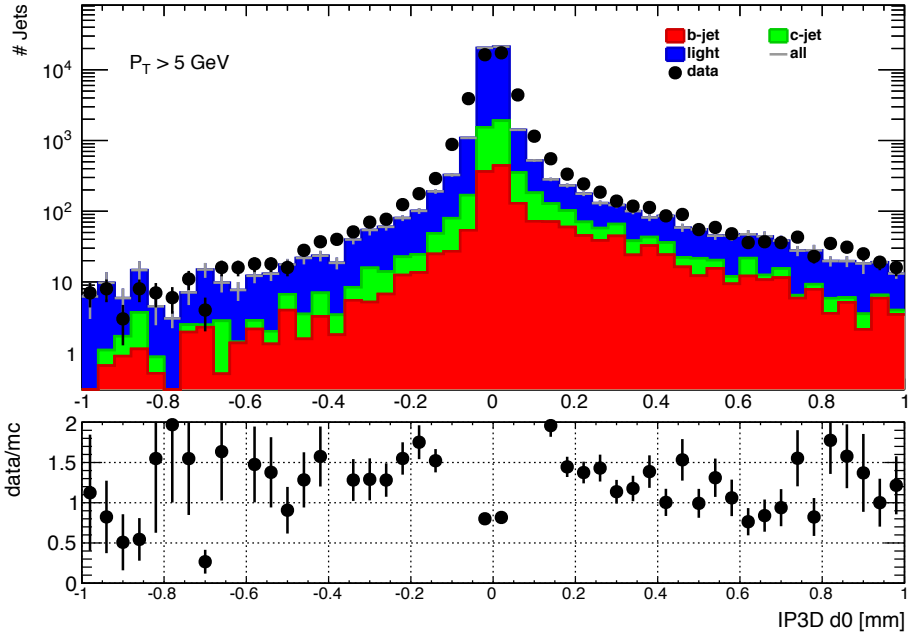
IP3D - d0

L1_J50, P_T>175



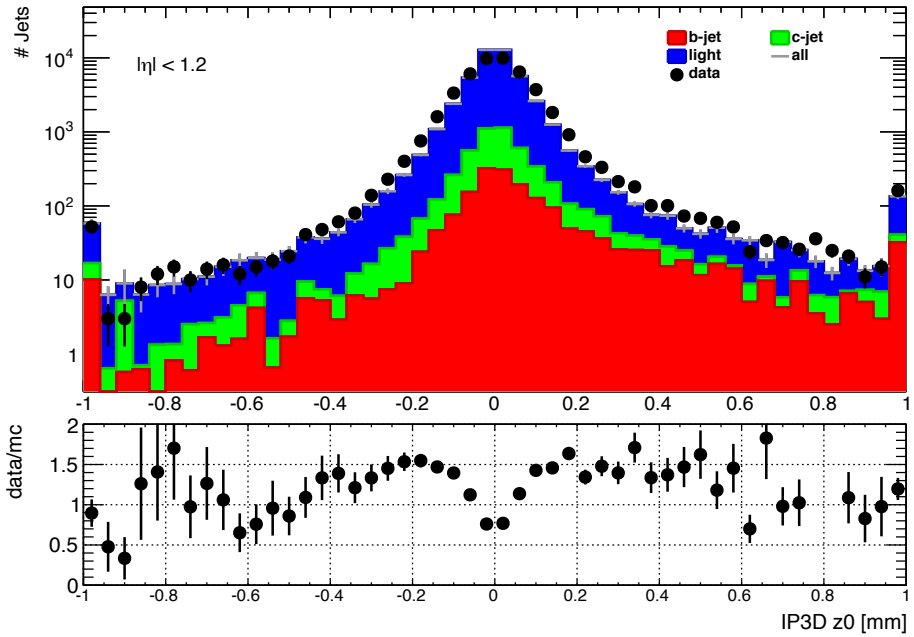


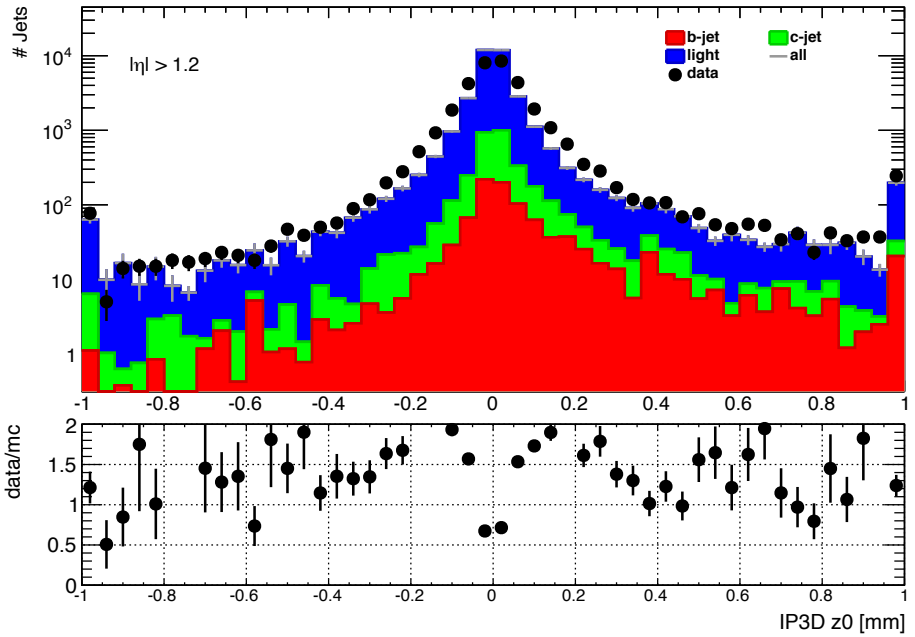


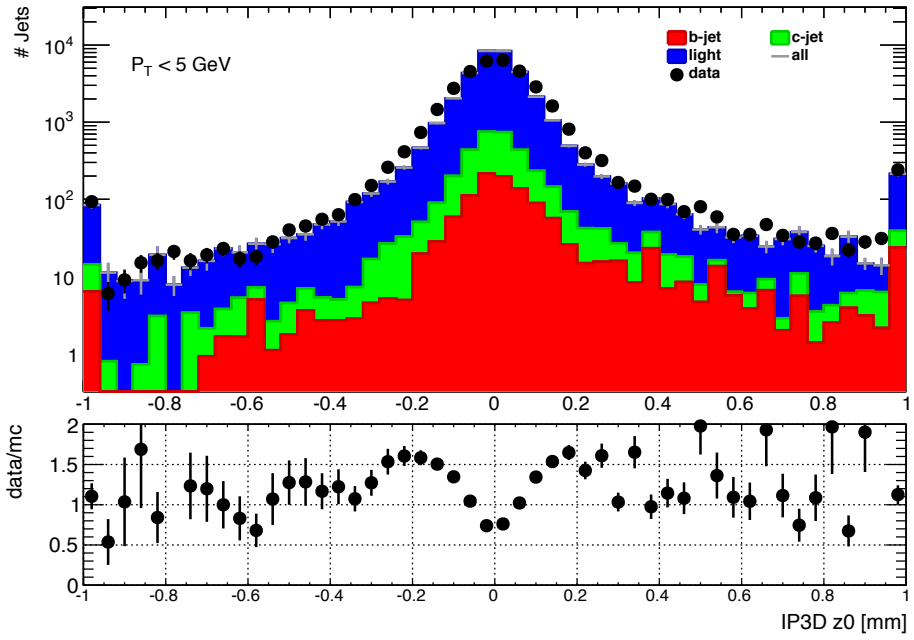


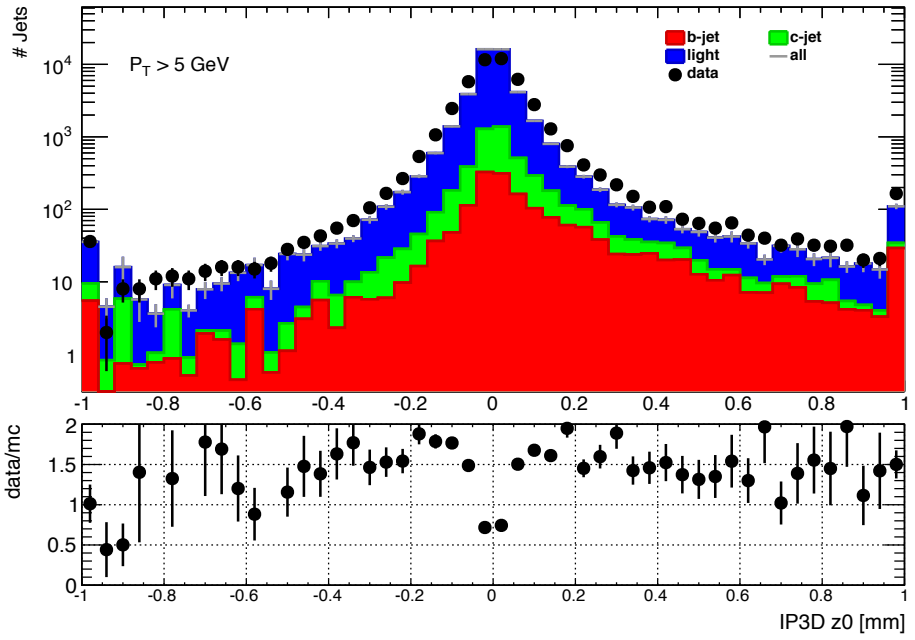
IP3D - z0

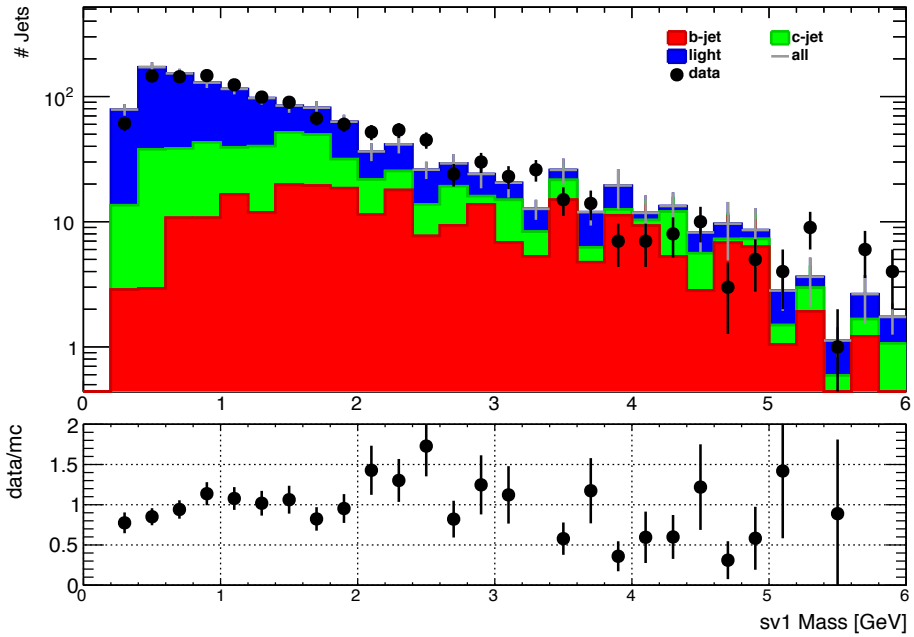
L1_J50, P_T>175

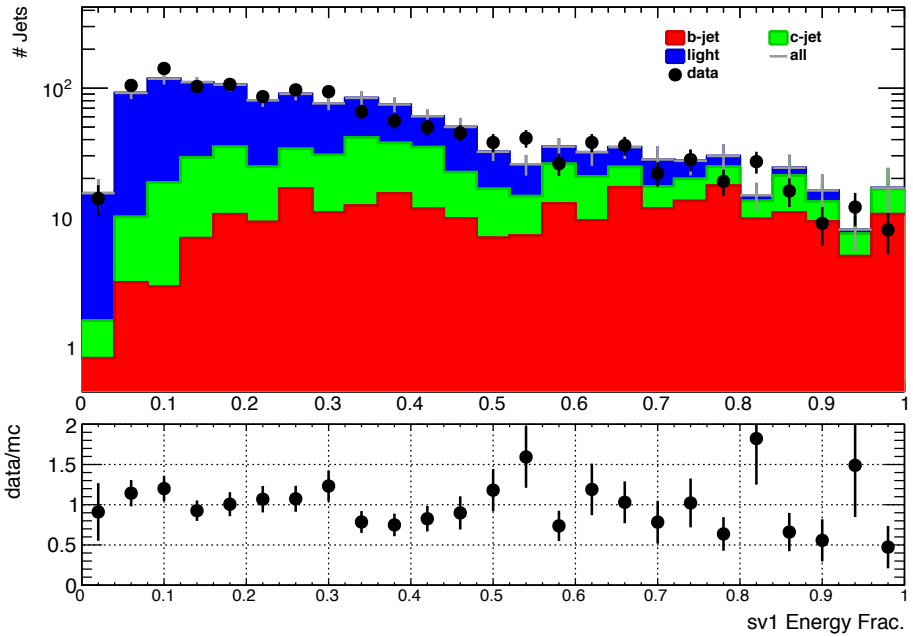


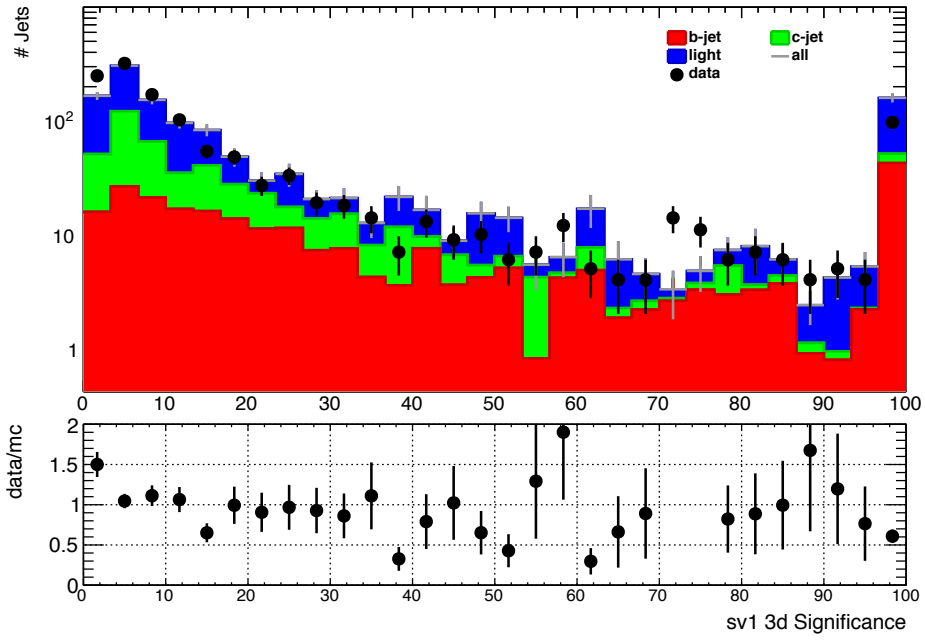


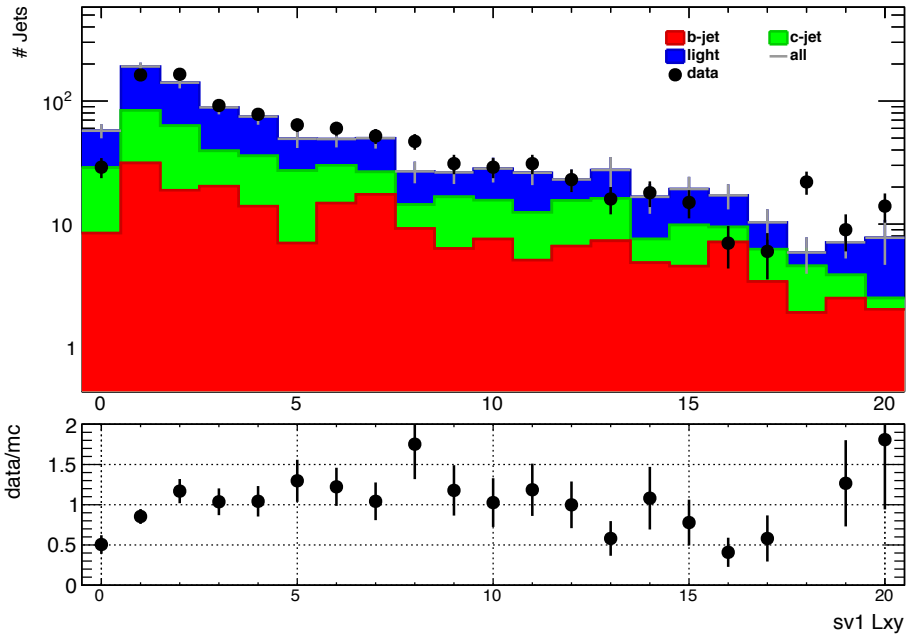




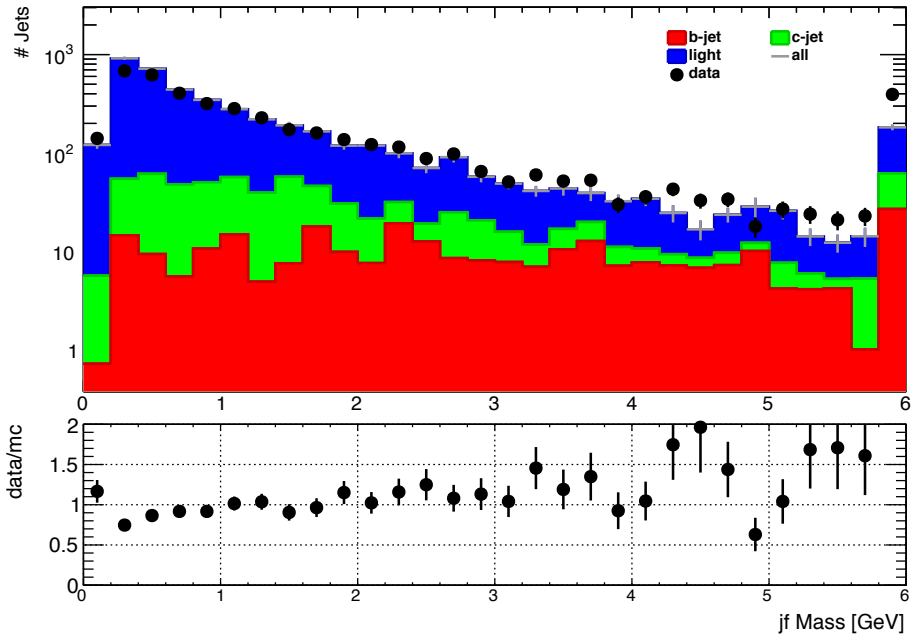

Jets
b-jet
light
data
c-jet
all
data/mc
sv1 Mass [GeV]

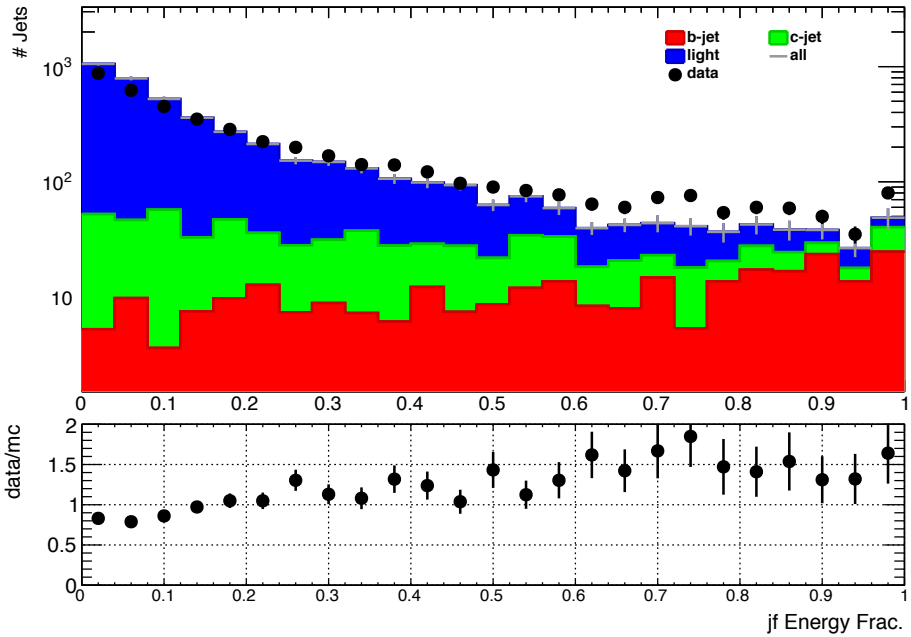

Jets
b-jet
light
data
c-jet
all
data/mc
sv1 Energy Frac.

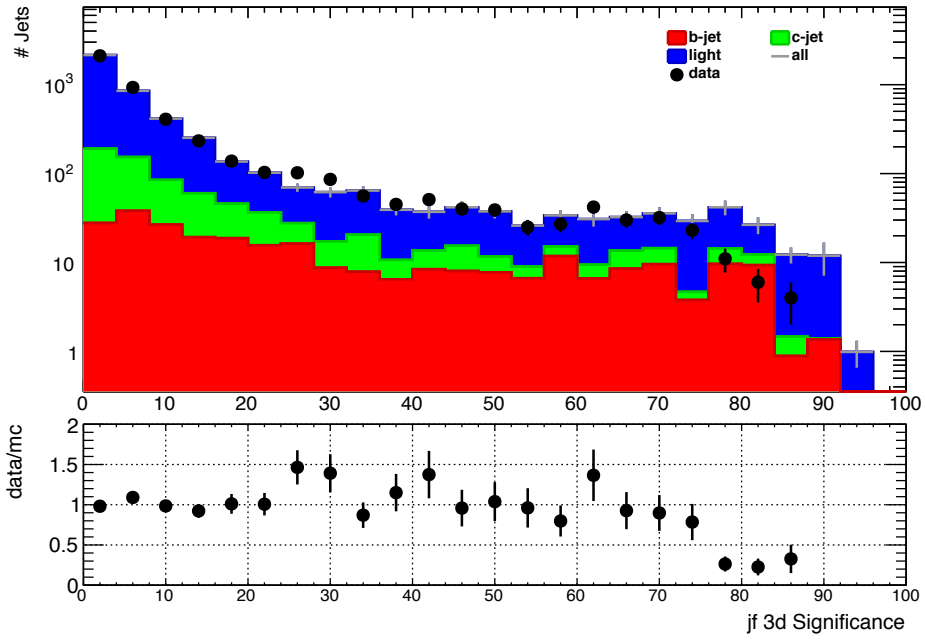

Jets
b-jet
light
data
c-jet
all
data/mc
sv1 3d Significance


Jets
b-jet
light
data
c-jet
all
data/mc
sv1 Lxy

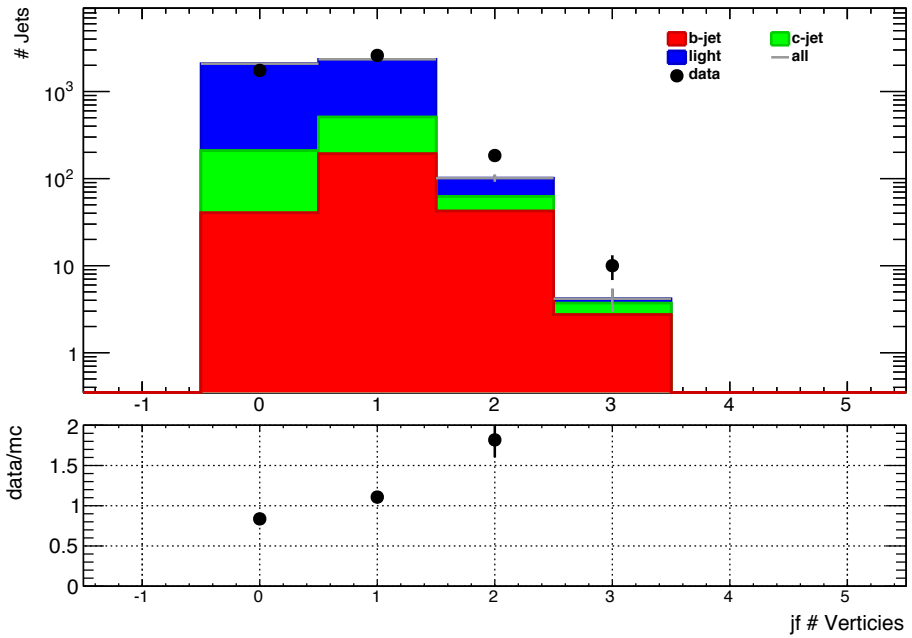
L1_J50, P_T>175

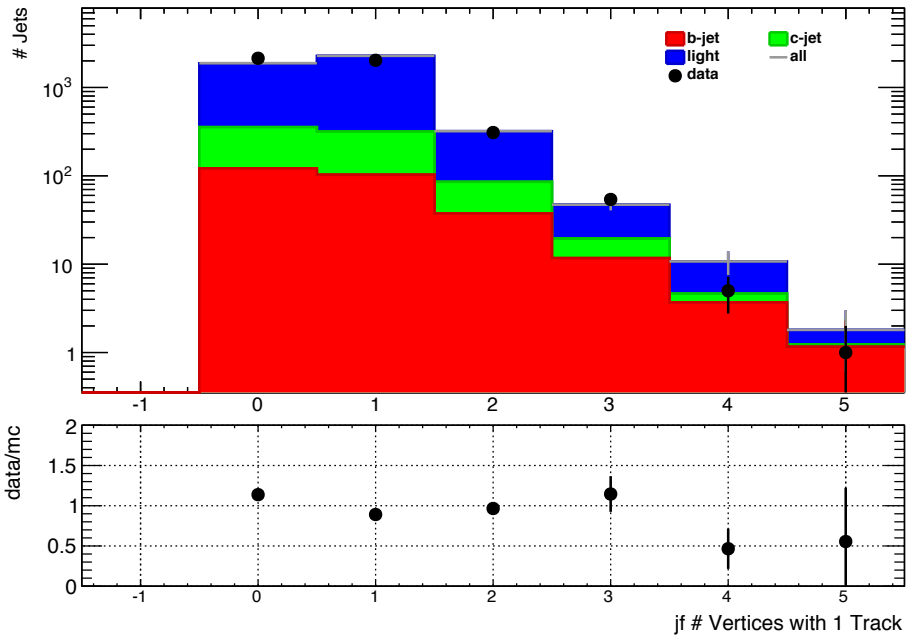

Jets
b-jet
light
data
c-jet
all
data/mc
jf Mass [GeV]

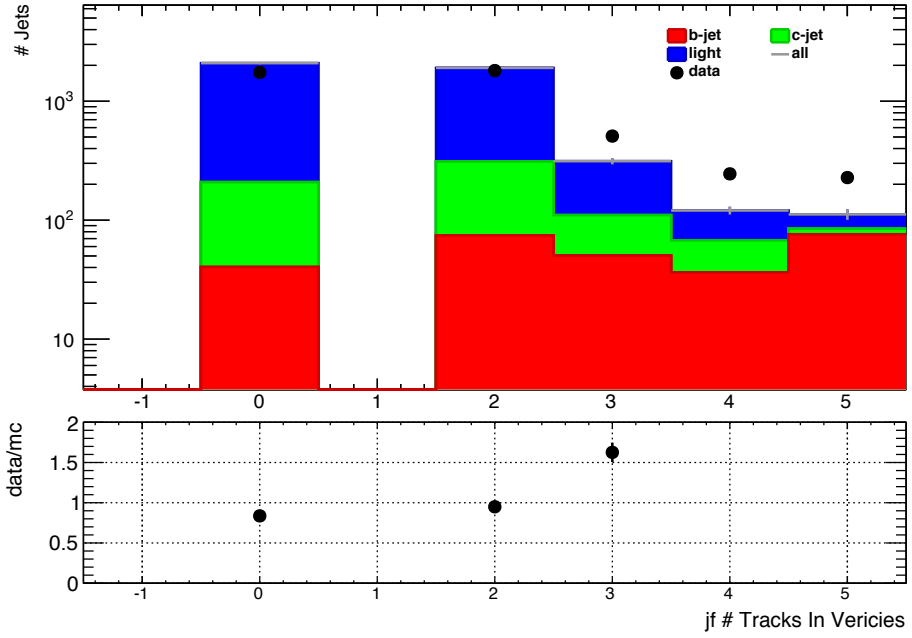

Jets
b-jet
light
data
c-jet
all
data/mc
jf Energy Frac.


Jets
b-jet
light
data
c-jet
all
data/mc
jf 3d Significance

L1_J50, P_T>175


b-jet
light
data
c-jet
all
Jets
data/mc
jf # Verticies


b-jet
light
data
c-jet
all
Jets
data/mc
jf # Vertices with 1 Track


b-jet
light
data
c-jet
all
Jets
data/mc
jf # Tracks In Vericies