Flavour Tagging Commissioning with Data

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Flavour Tagging Group

Flav. Tag WG
11/08/16

Aims

- Comparing data to MC in dijet events to test our understanding of flavour tagging.

- This was done in 2015 data - We saw some discrepancies

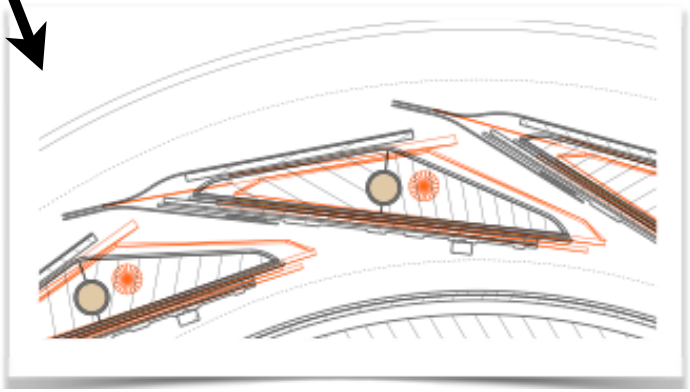
- Tracking group has an updated geometry (see next slide)

- Here we study the impact of using the updated geometry

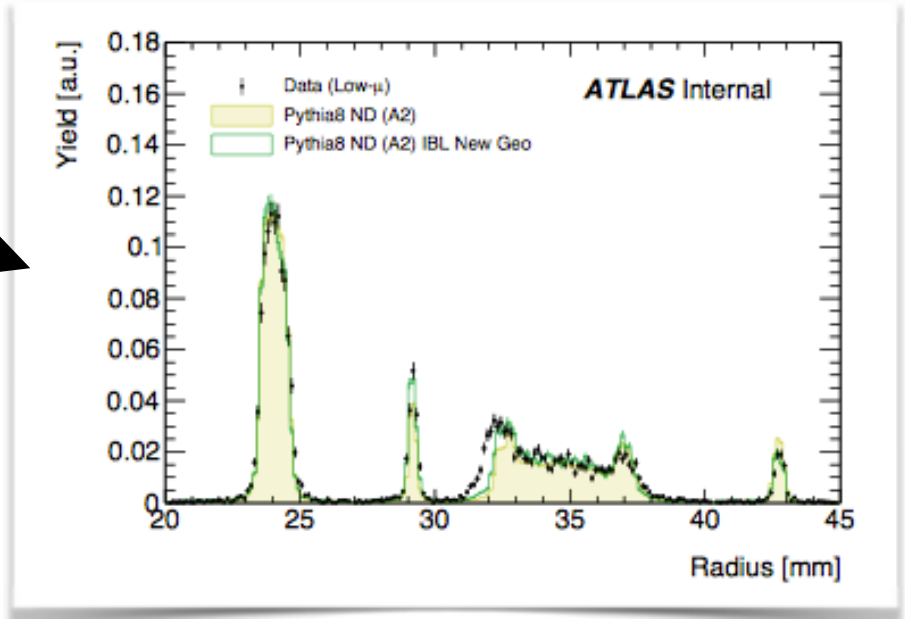
Changes in Geometry

- Geometry tag missing 23% IBL material
  - New Geo. Tag Produced
  - In validation.

- Angle of overlap issue for IBL
  - Unlikely to be a large effect.



GEO Model
IBL



- These issues affect the error estimation and hence the d0/z0 significance distribution

- Also the d0 and z0 resolution is also effected

Simone Pagan Griso, Heather Gray

https://indico.cern.ch/event/433839/contribution/6/attachments/1128840/1612854/PC_20jul.pdf

Samples

- **MC Sample (New Geo):**

- Full AODs,, 50ns dijet Pythia8 QCD ~4M Events
- Geometry = **"ATLAS-R2-2015-03-15-00_VALIDATION"**

mc15_13TeV.361021.Pythia8EvtGen_A14NNPDF23LO_jetjet_JZ1W.merge.AOD.e3569_s2781_r8122_r7676_tid08750161_00
mc15_13TeV.361022.Pythia8EvtGen_A14NNPDF23LO_jetjet_JZ2W.merge.AOD.e3668_s2781_r8122_r7676_tid08750166_00
mc15_13TeV.361024.Pythia8EvtGen_A14NNPDF23LO_jetjet_JZ4W.merge.AOD.e3668_s2781_r8122_r7676_tid08750174_00
mc15_13TeV.361023.Pythia8EvtGen_A14NNPDF23LO_jetjet_JZ3W.merge.AOD.e3668_s2781_r8122_r7676_tid08750170_00

- **MC Sample (Old Geo):**

- Full xAOD, 50ns dijet MC sample, ~ 4M Events.
- Geometry = "**ATLAS-R2-2015-03-01-00_VALIDATION**"

"mc15_13TeV.361021.Pythia8EvtGen_A14NNPDF23LO_jetjet_JZ1W.merge.AOD.e3569_s2576_s2132_r6630_r6264/"
"mc15_13TeV.361022.Pythia8EvtGen_A14NNPDF23LO_jetjet_JZ2W.merge.AOD.e3668_s2576_s2132_r6630_r6264/"
"mc15_13TeV.361023.Pythia8EvtGen_A14NNPDF23LO_jetjet_JZ3W.merge.AOD.e3668_s2576_s2132_r6630_r6264/"
"mc15_13TeV.361024.Pythia8EvtGen_A14NNPDF23LO_jetjet_JZ4W.merge.AOD.e3668_s2576_s2132_r6630_r6264/"

- **Data Sample:**

- 50ns data from stable beam collisions.
- **FTAG** derivation
- ~4M Events from 6 Runs: 270806, 270953, 271048, 271421, 271516 and 271595

"data15_13TeV.00270806.physics_Main.merge.DAOD_FTAG1.f611_m1463_p2375/"
"data15_13TeV.00270953.physics_Main.merge.DAOD_FTAG1.f611_m1463_p2375/"
"data15_13TeV.00271048physics_Main.merge.DAOD_FTAG1.f611_m1463_p2375/"
"data15_13TeV.00271421.physics_Main.merge.DAOD_FTAG1.f611_m1463_p2375/"
"data15_13TeV.00271516.physics_Main.merge.DAOD_FTAG1.f611_m1463_p2375/"
"data15_13TeV.00271595.physics_Main.merge.DAOD_FTAG1.f611_m1463_p2375/"

- We are using NTuples created using Run2BTagOptimisationFramework

Details and Cuts

- 20.1.5.3 with all tags recommended by CP group
- Running xAOD fix on full xAOD

- **HLT_j60 Trigger for MC and Data with Leading Jet P_T > 70 GeV.**

- AntiKt4EMTopoJets
- Run1LooseBadCuts and "ugly" jet removal.
- Jet Calibration:

```
- calibfile  ="JES_MC15Prerecommendation_April2015.config"
- calSeg     ="JetArea_Residual_Origin_EtaJES_GSC" (_Insitu for data)
```

- GRL = *"data15_13TeV.periodAllYear_DetStatus-v63-pro18-01_DQDefects-00-01-02_PHYS_StandardGRL_All_Good.xml"*

Select event if:

- njets ≥ 2 with P_T > 35 GeV, |η| < 2.4 and JVT > 0.641 if P_T < 50 GeV

- Leading jet, P_T > 70 GeV, |η| < 2.4 *(and JVT > 0.641 if P_T < 50 GeV)*

Then plot subleading if subleading jet has:

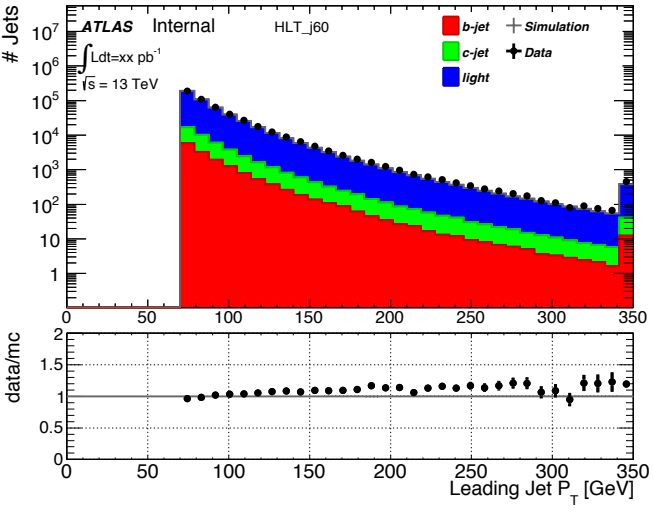
- P_T > 35 GeV
- |η| < 2.5
- JVT > 0.641 if P_T < 50 GeV

Monte Carlo Cuts

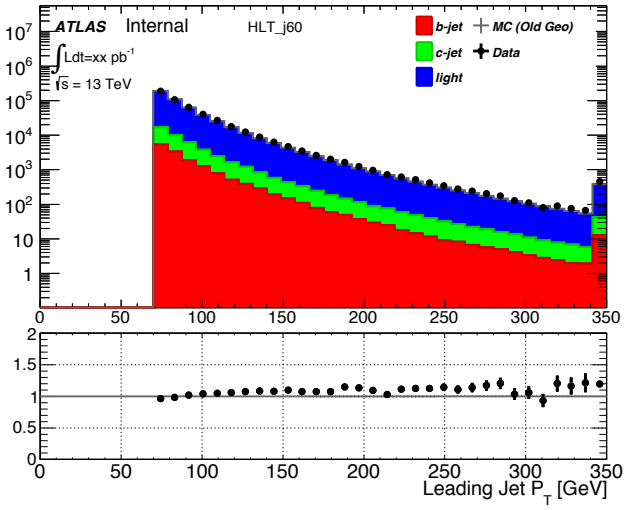
Truth Dijet Test applied to MC to clean sample
- (Lead P_T +Sublead P_T)/2 < 1.4* Truth Lead P_T

- LabDr_HadF truth matching.

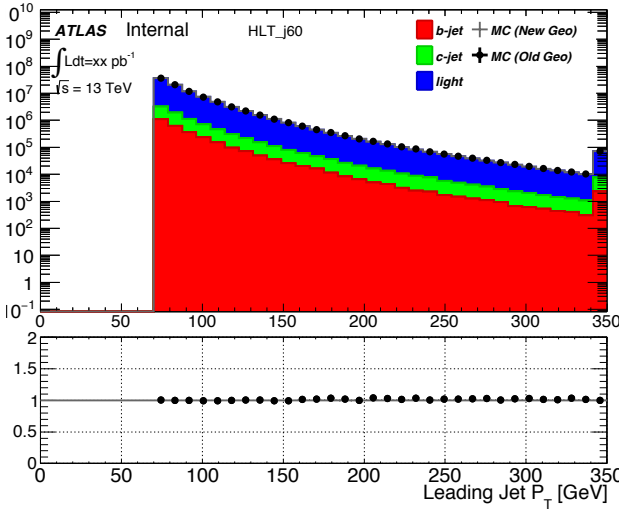
Jet pT



Data / New Geo MC

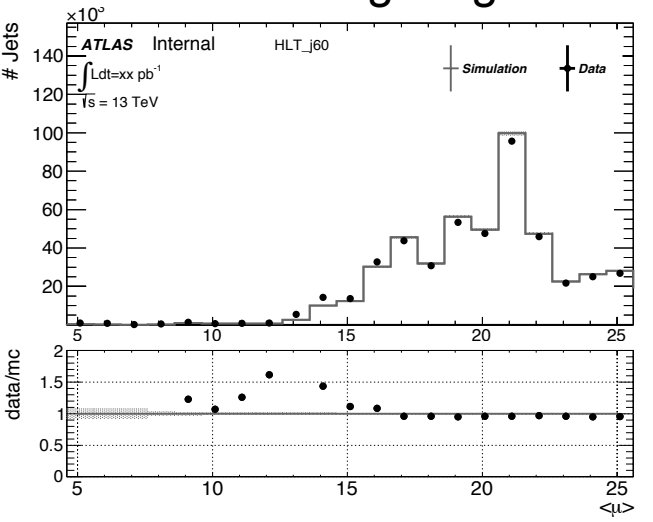


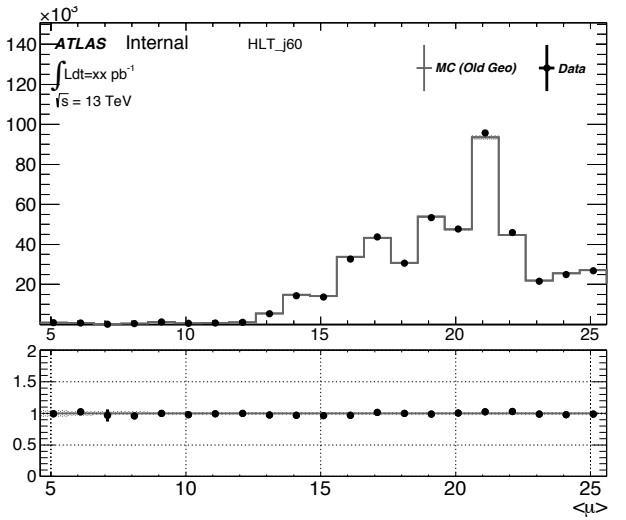
Data / Old Geo MC

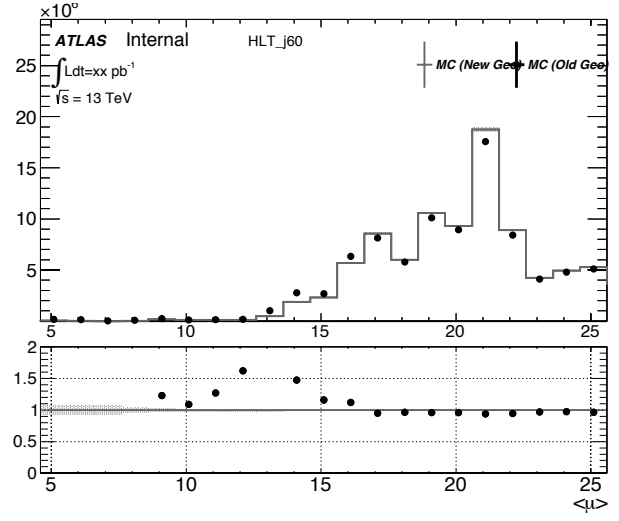


Old Geo MC / New Geo MC

Mu After Reweighting

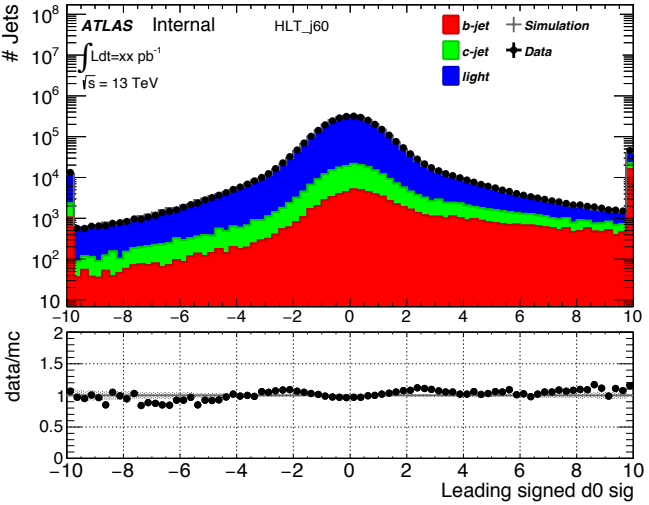






Signed d0/z0 Significance

d0 Significance:



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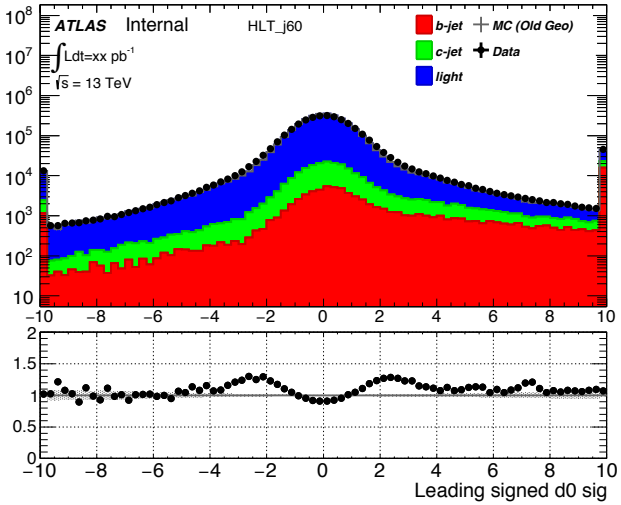
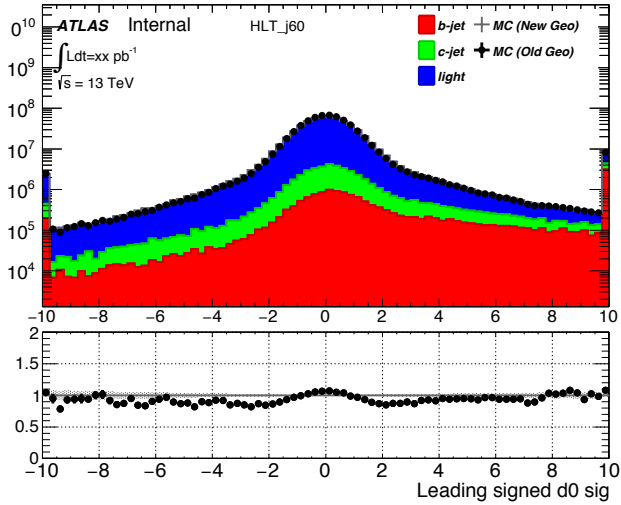
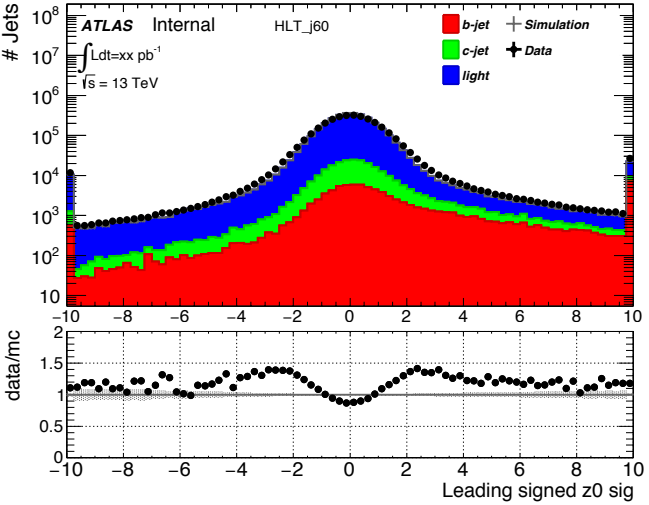


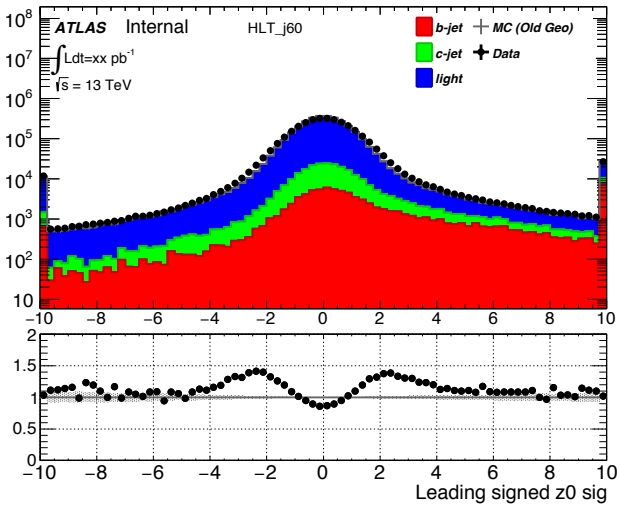
Data / Old Geo MC

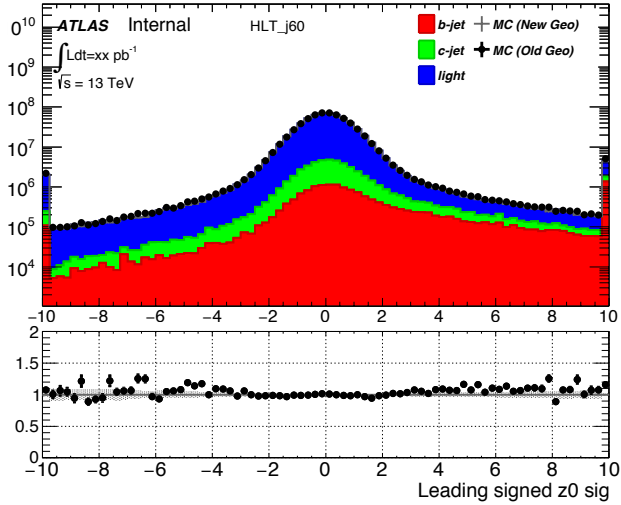


Old Geo MC / New Geo MC

z0 Significance:

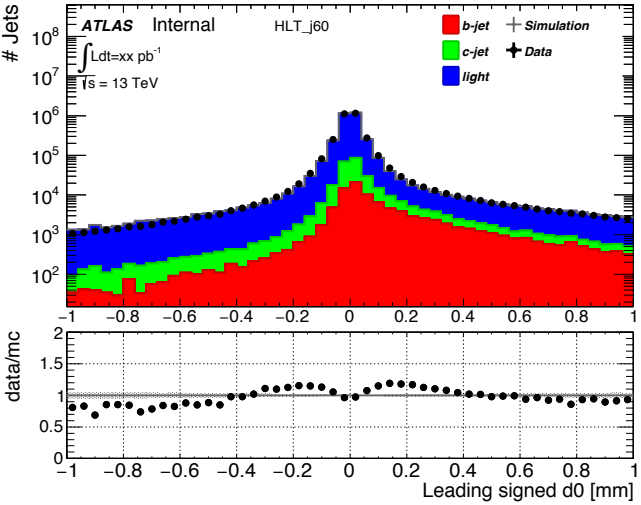




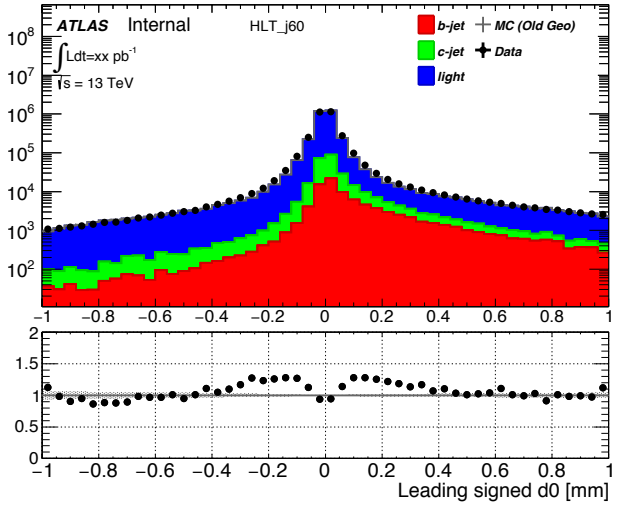


Signed d0/z0

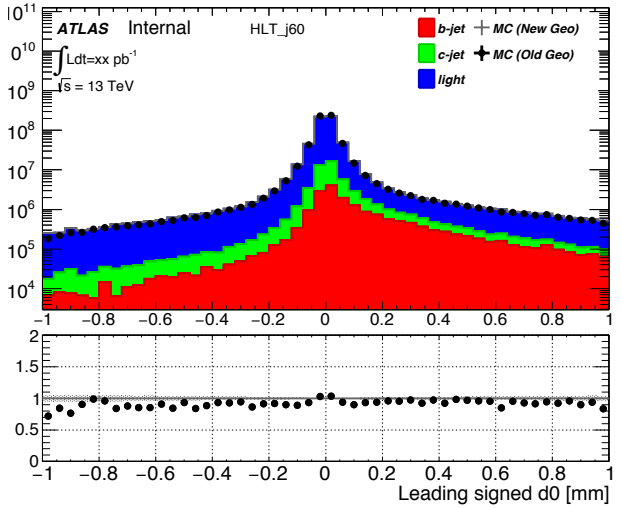
d0:



Data / New Geo MC

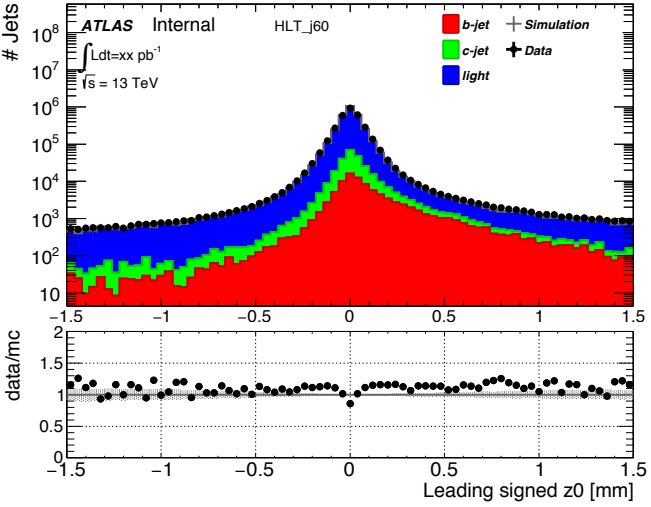


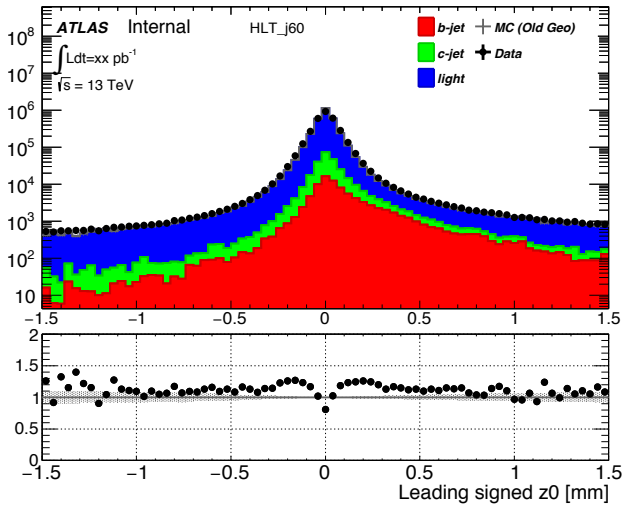
Data / Old Geo MC

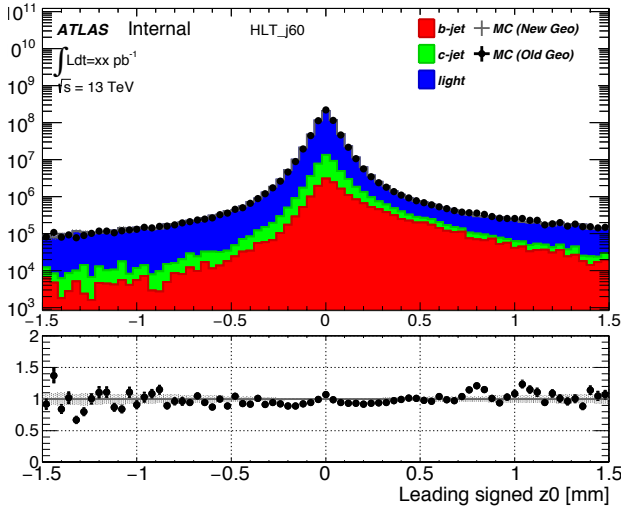


Old Geo MC / New Geo MC

z0:

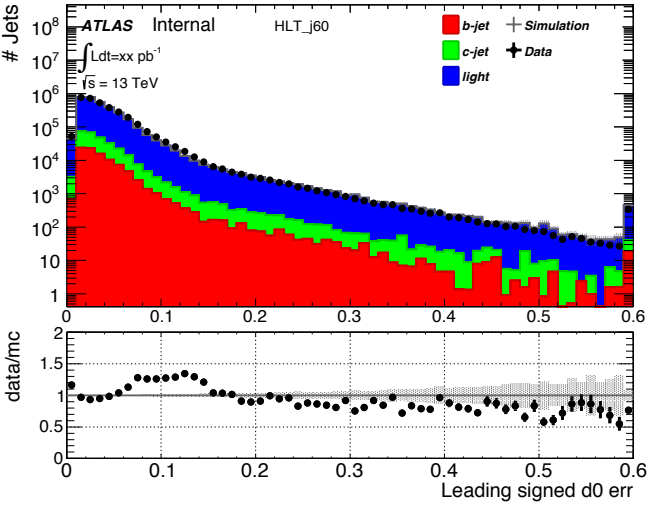




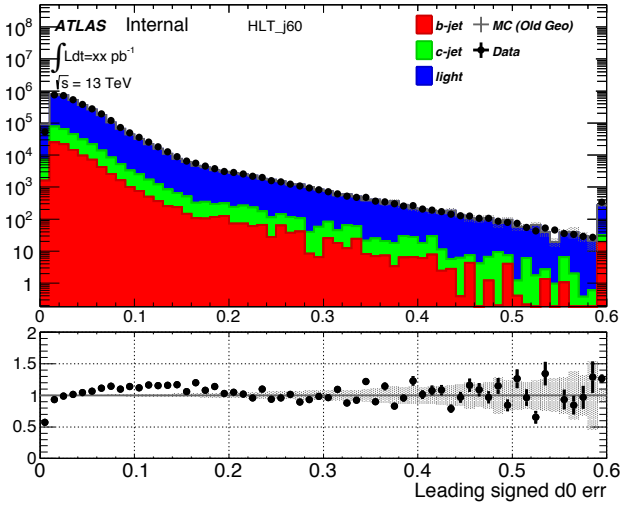


Signed d0/z0 Error

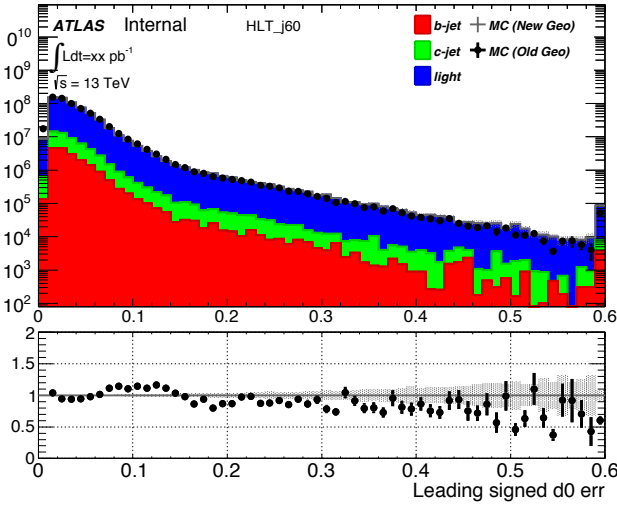
d0 Error:



Data / New Geo MC

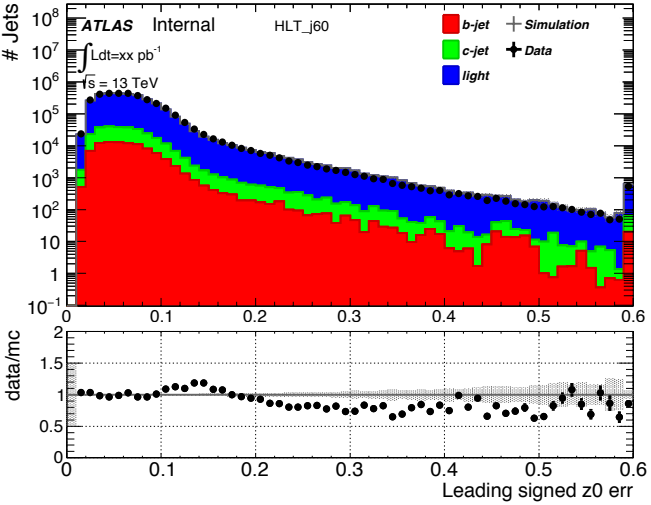


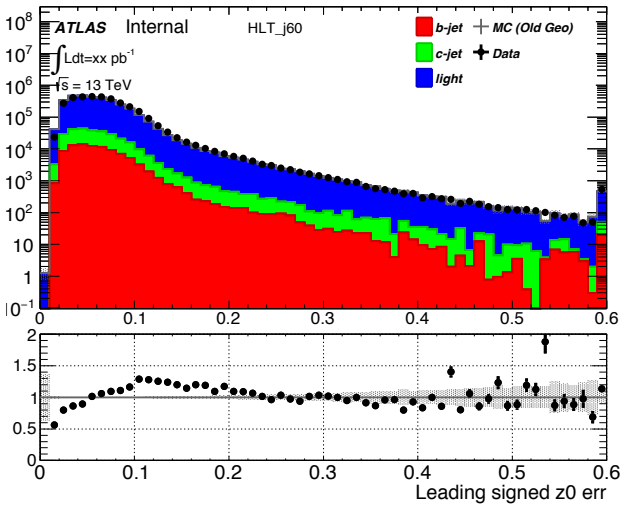
Data / Old Geo MC

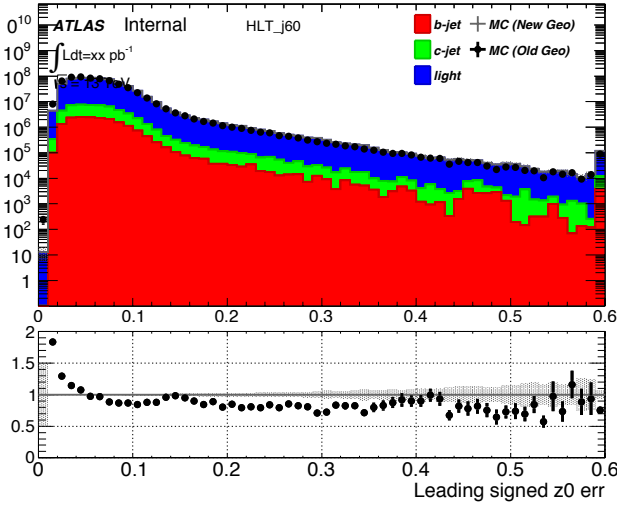


Old Geo MC / New Geo MC

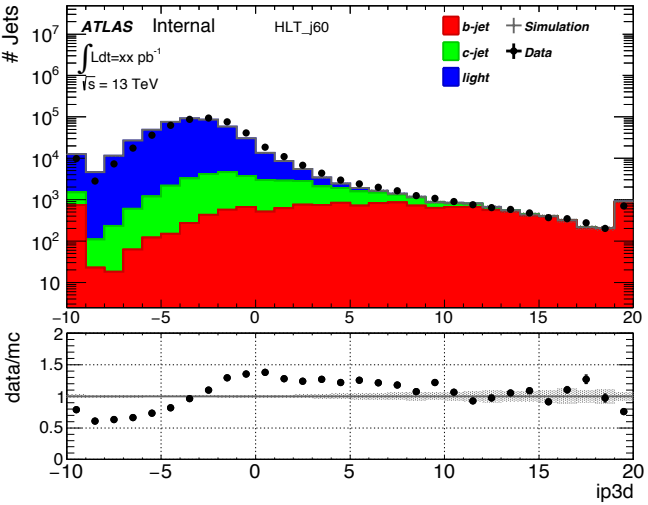
z0 Error:







IP3D



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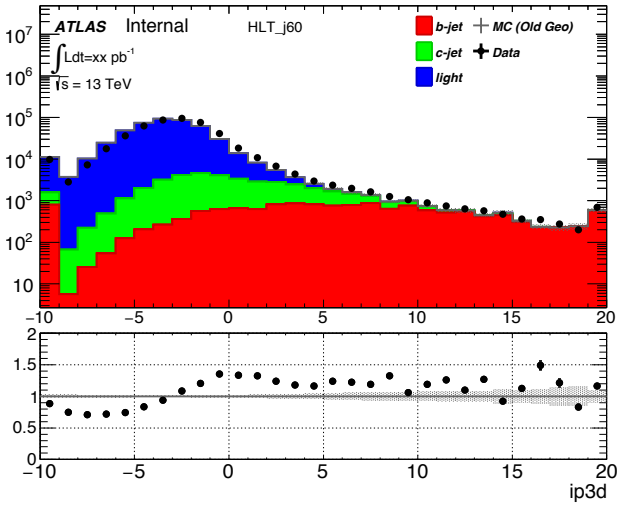
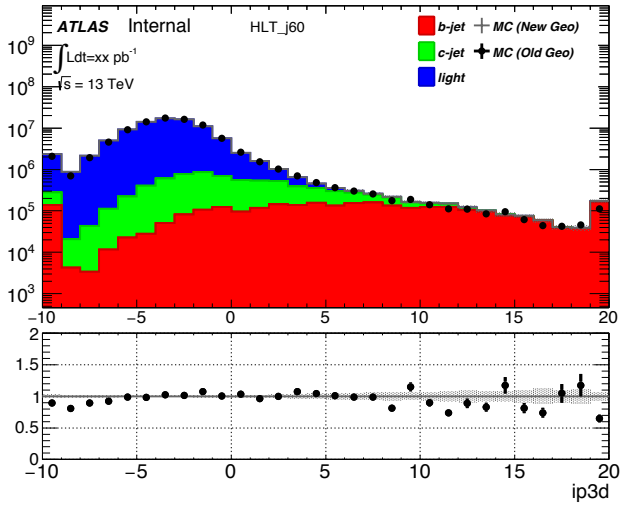
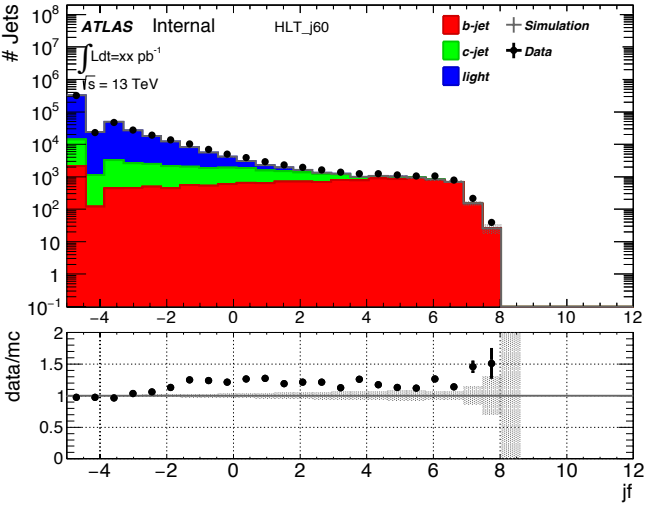


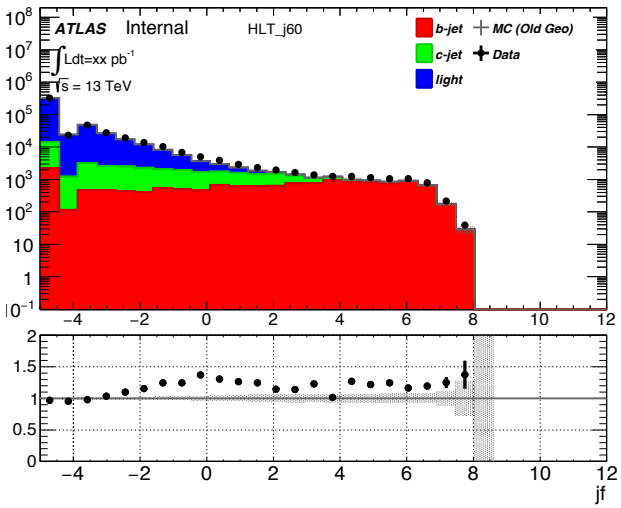
Data / Old Geo MC

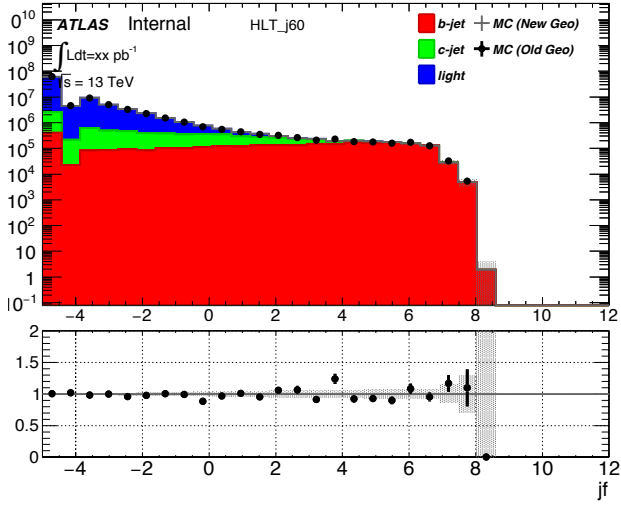


Old Geo MC / New Geo MC

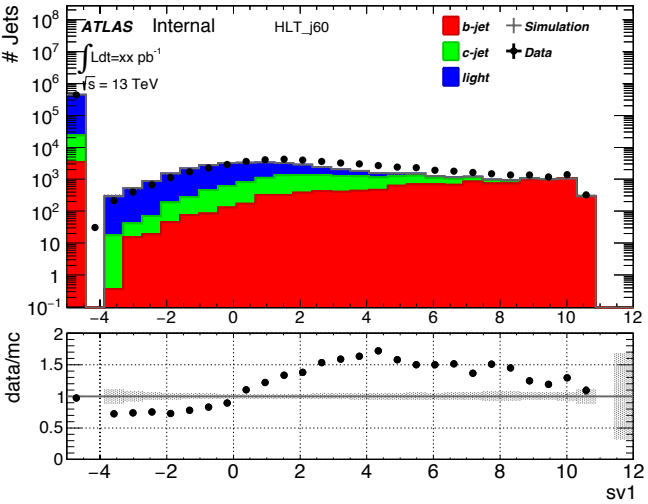
JF



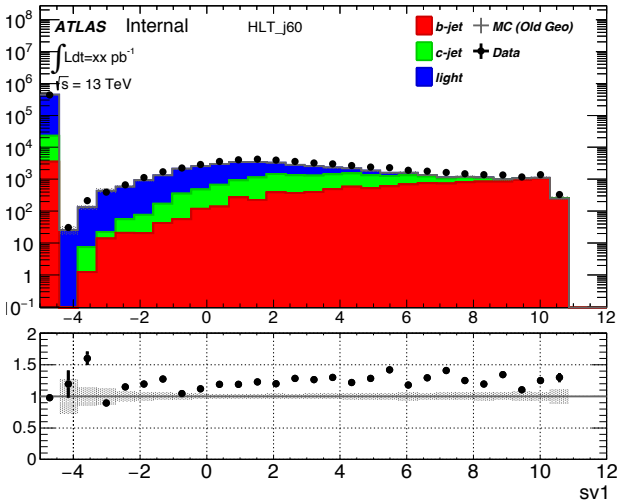




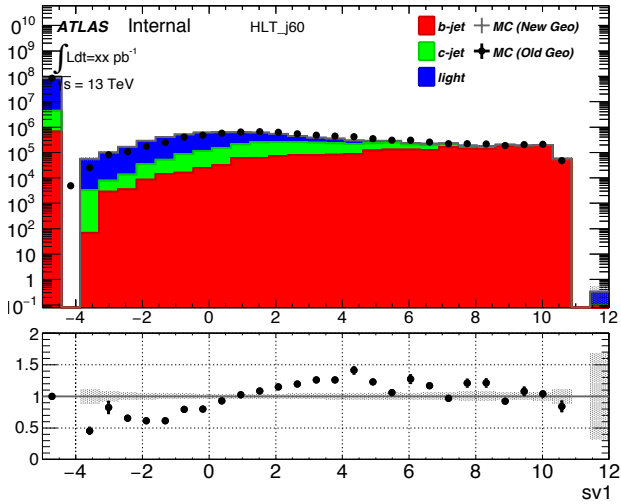
SV1



Data / New Geo MC

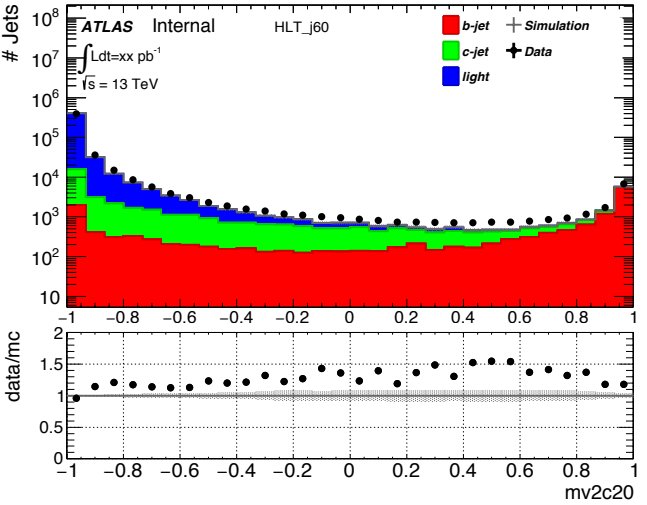


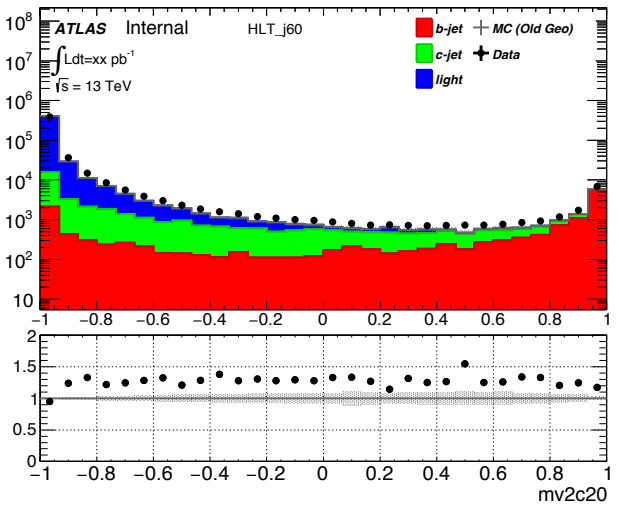
Data / Old Geo MC

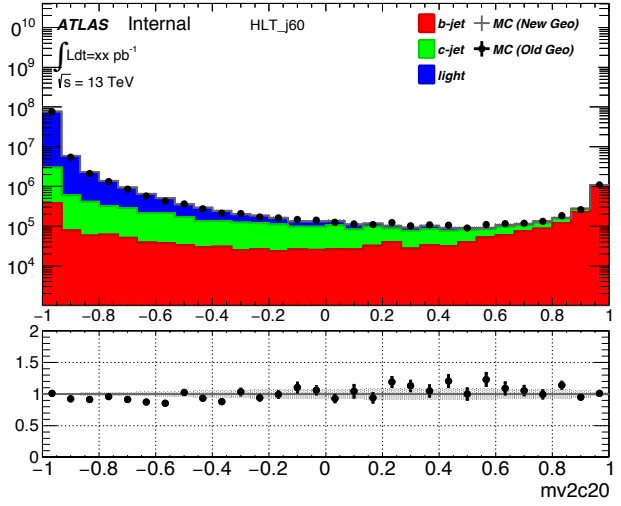


Old Geo MC / New Geo MC

MV2c20

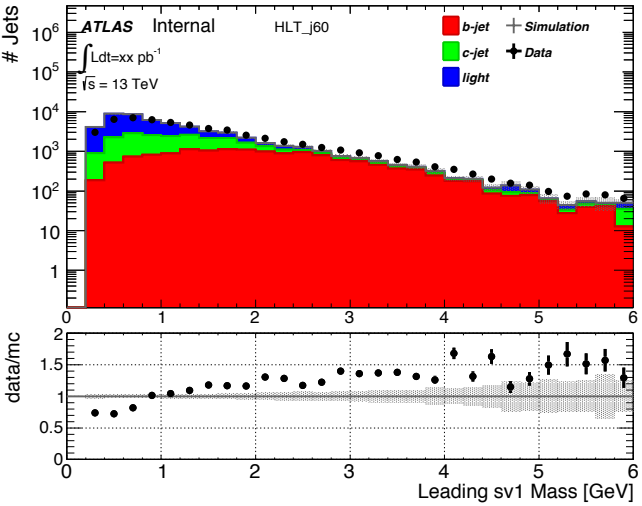




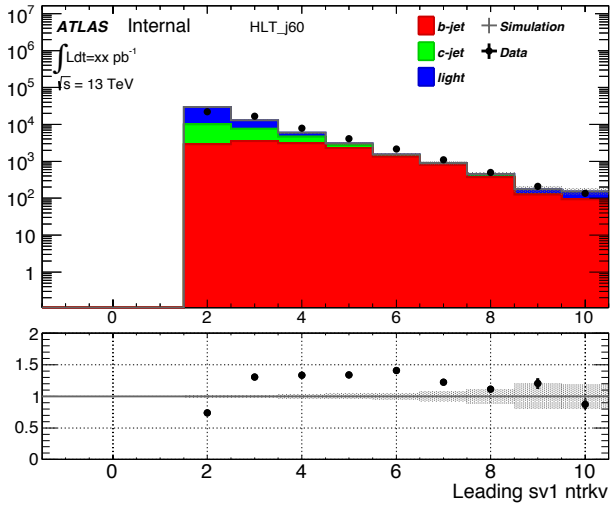


Further Look at SV1 Variables

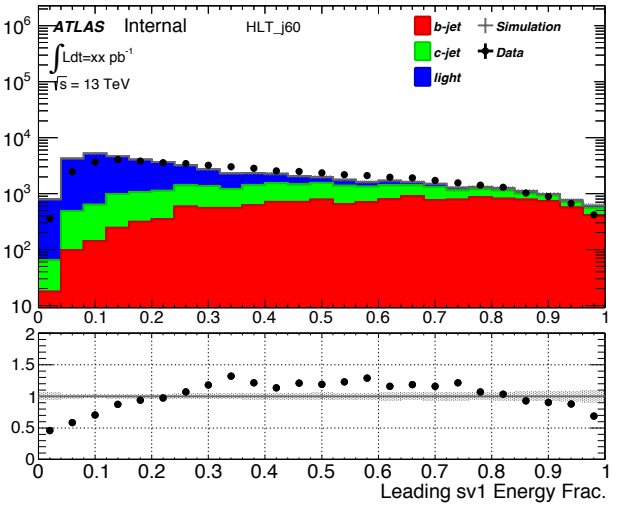
Data / New Geo MC



SV1 m

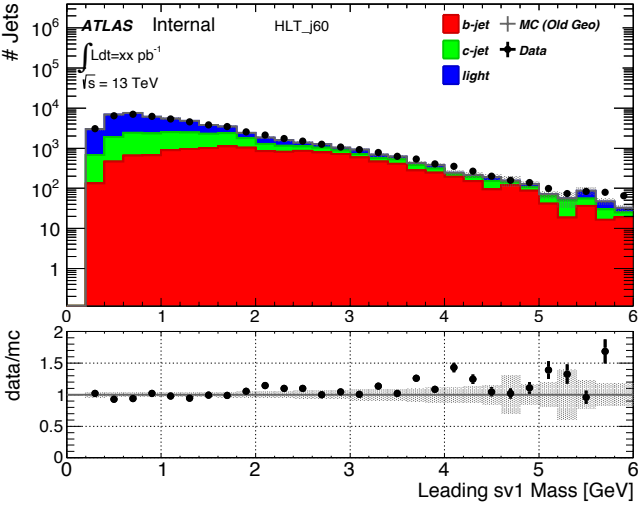


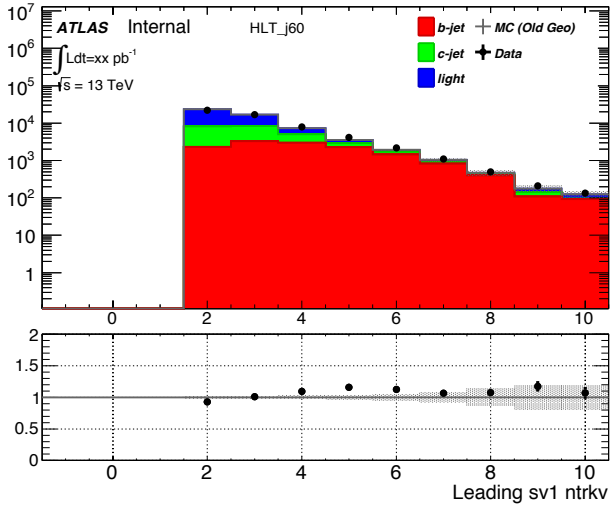
SV1 # tracks at vertex

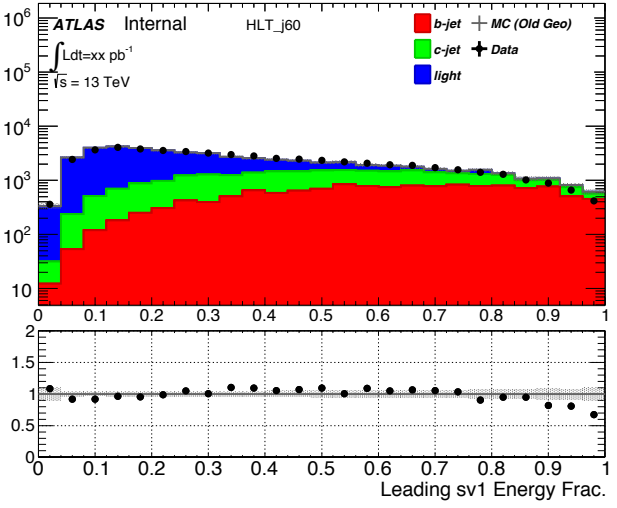


SV1 Energy Fraction

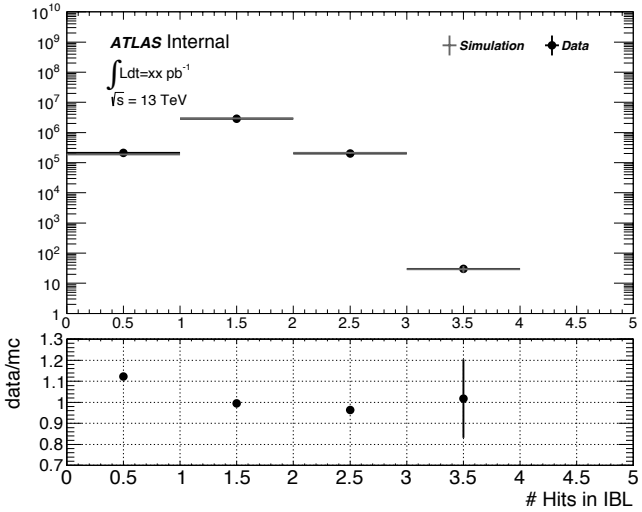
Data / Old Geo MC

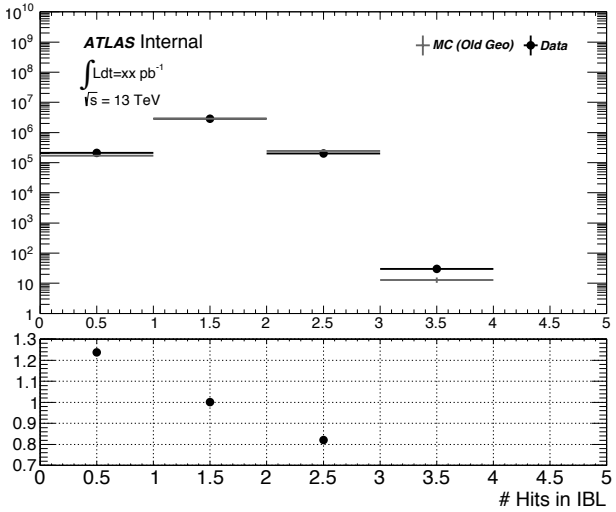


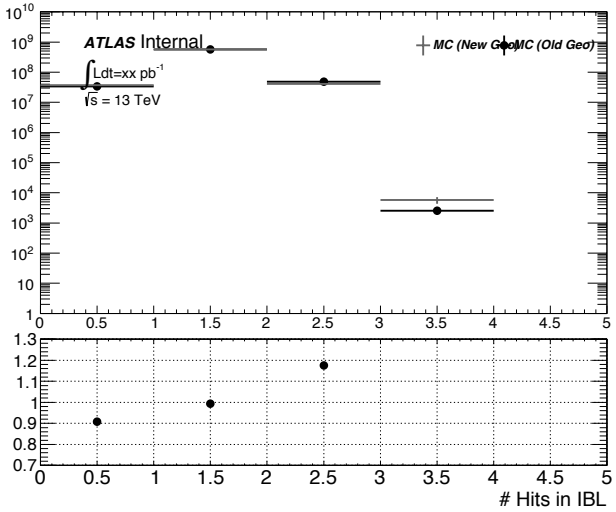




IBL Hits





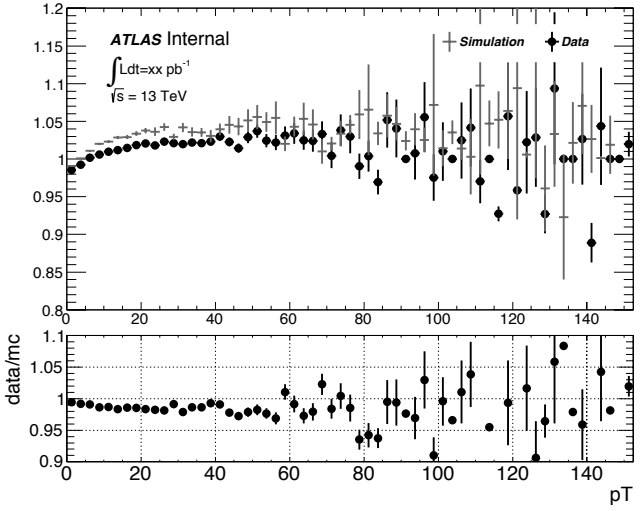


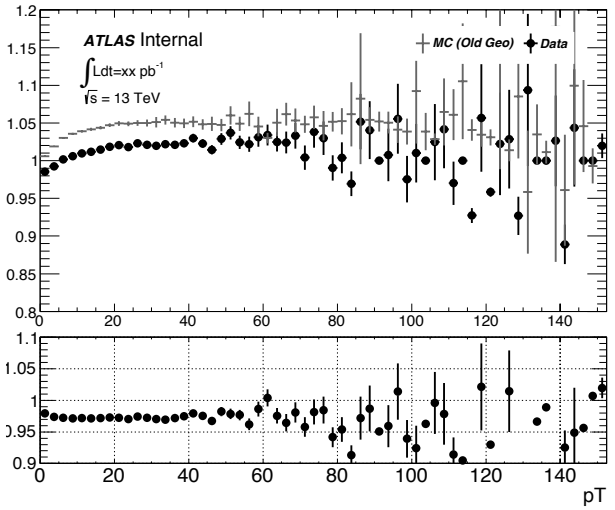
Data / New Geo MC

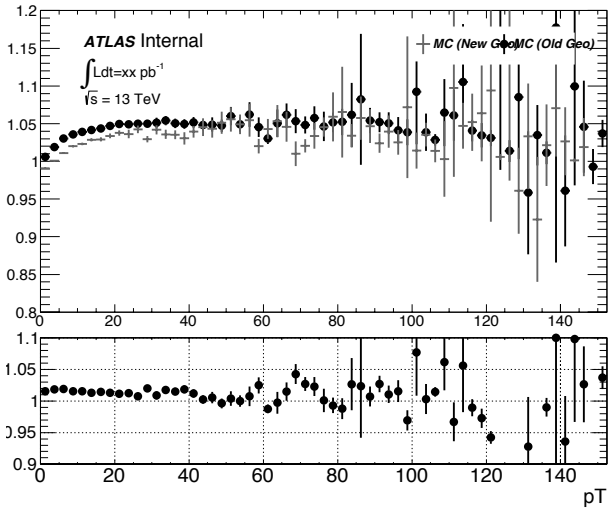
Data / Old Geo MC

Old Geo MC / New Geo MC

IBL hits vs track pT







Conclusions

Changes comparing new geometry to old geometry…

Improvements!

- d0 significance modelling is much better
- # IBL hits better modelled (overlap of IBL issue)

No real change

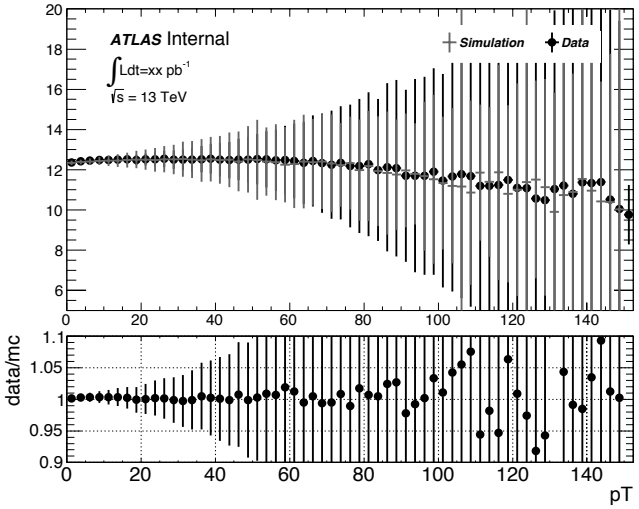
- z0sig is still mismodelled
- IP3D - no great change - surprising given improvements in d0 sig
- JF shows no real change
- mv2c20 still showing mismodelling

Deteriorations

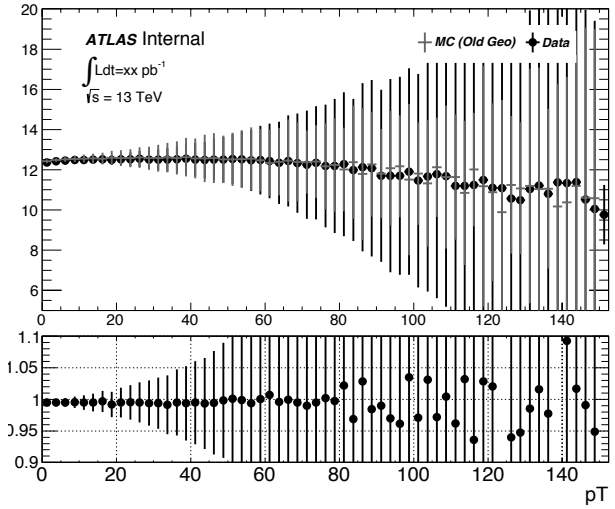
- sv1 - This is now modelling has notably worsened
    - Appears to be driven by sv_m, sv_ef and sv_nvtx

Backup

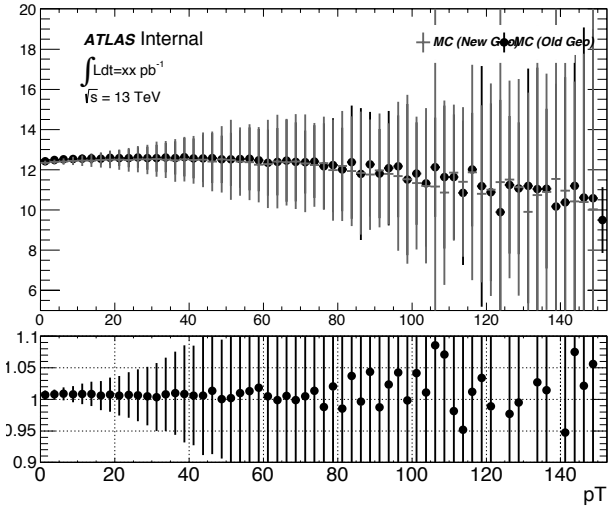
Si hits vs track pT



Data / New Geo MC

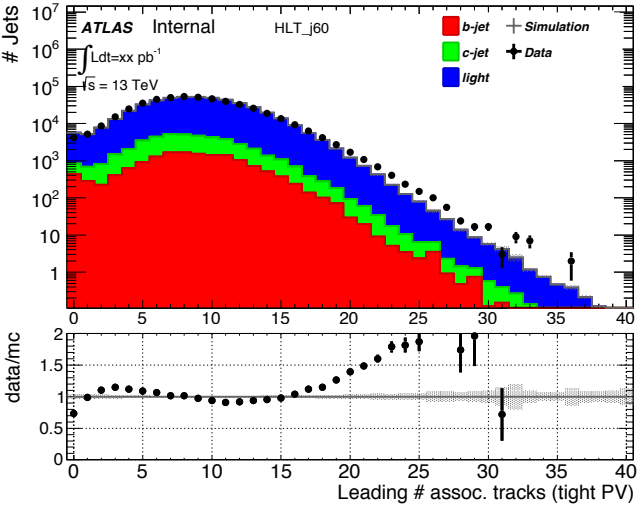


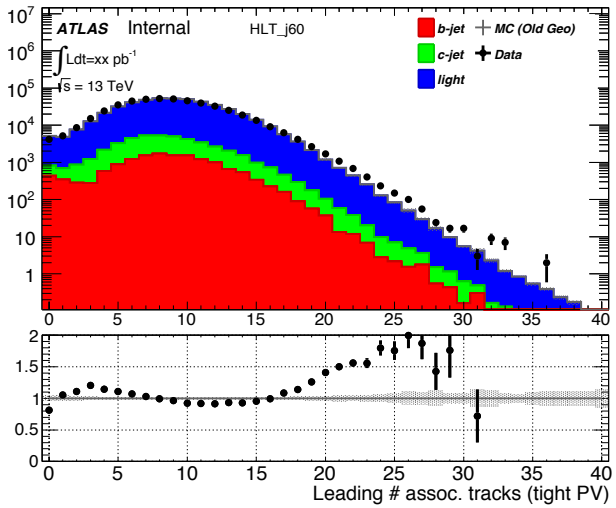
Data / Old Geo MC

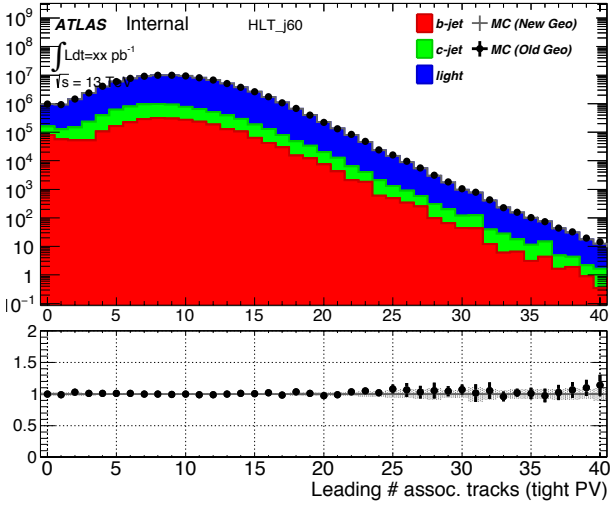


Old Geo MC / New Geo MC

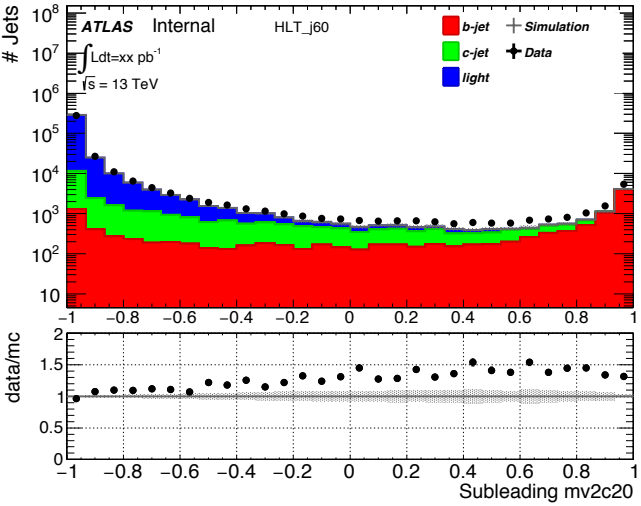
Tracks



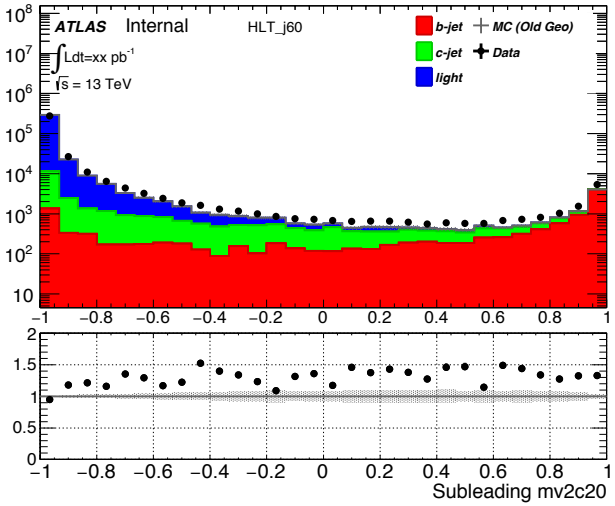




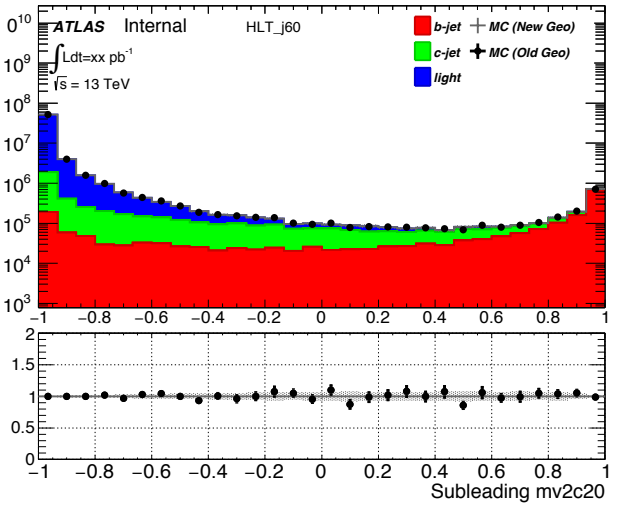
Subleading mv2c20



Data / New Geo MC

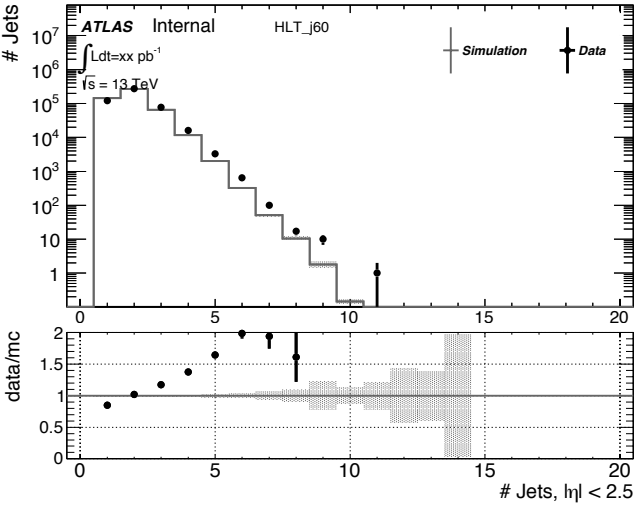


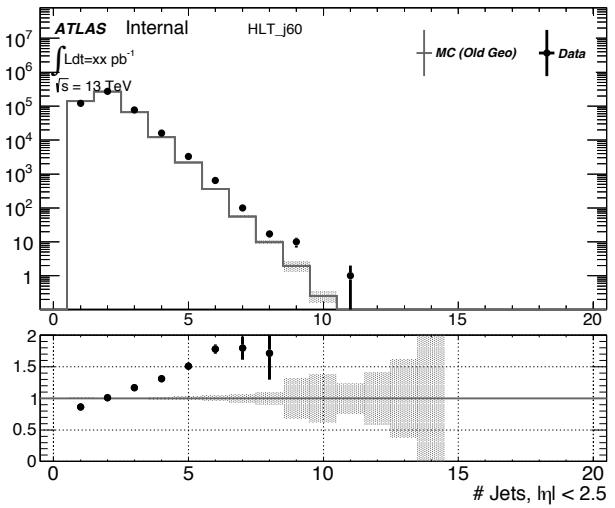
Data / Old Geo MC

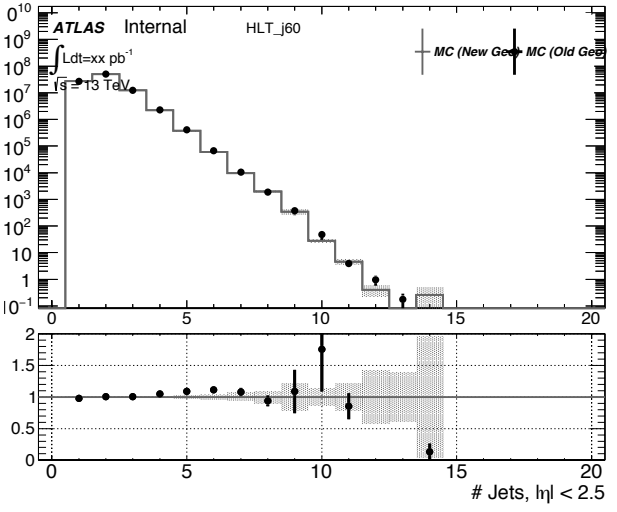


Old Geo MC / New Geo MC

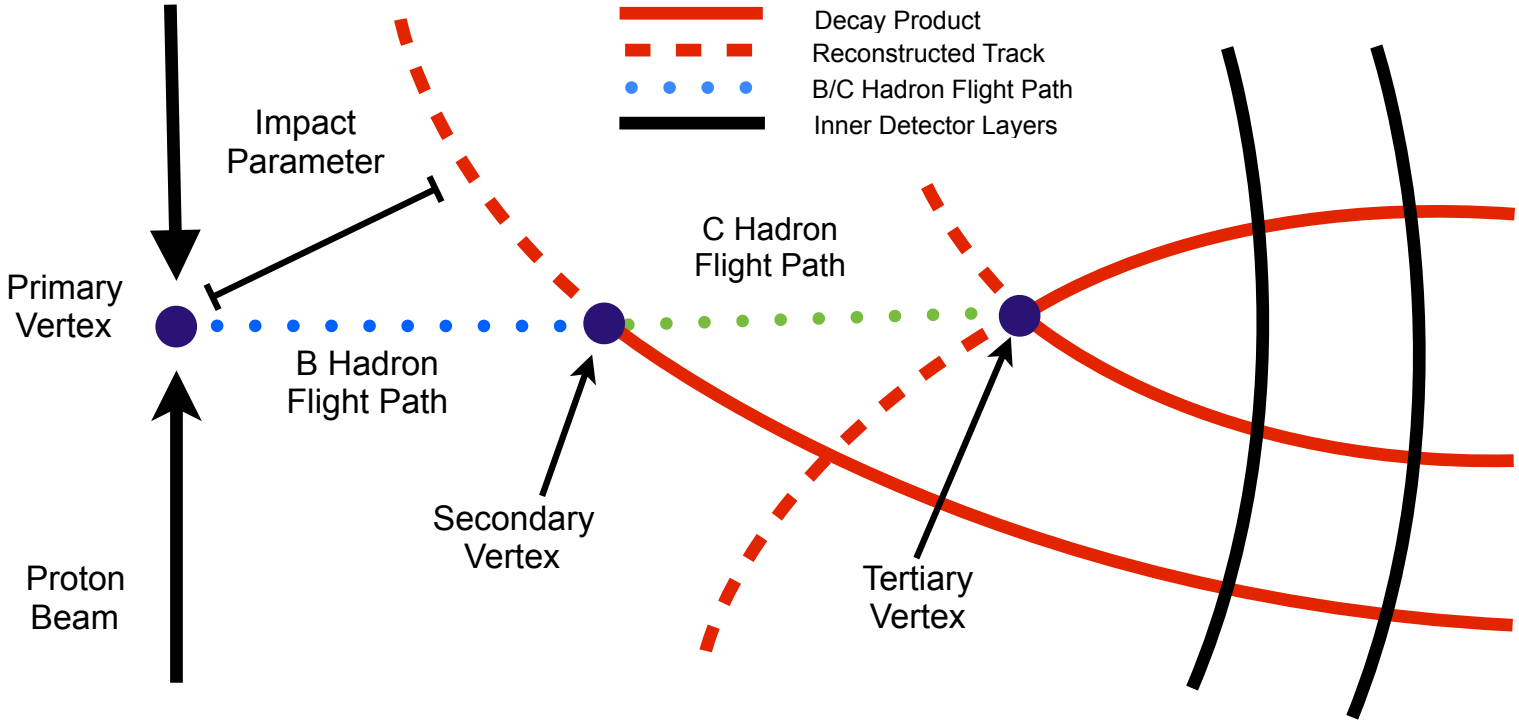
Jet Multiplicity - *Code for data and MC on slightly different versions, maybe causing this.*







Flavour Tagging Algorithms



- IP2D and IP3D: Use impact parameter distributions to discriminate between flavours
- SV1: Search for Secondary Vertex from crossing of tracks
- Jet Fitter: Reconstructs full decay chain by searching for many vertices along a shared jet flight axis

- MV2c20: Base algorithms are combined in a BDT to give optimal performance.