TRUTH3

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ATLAS Simulation Tutorial

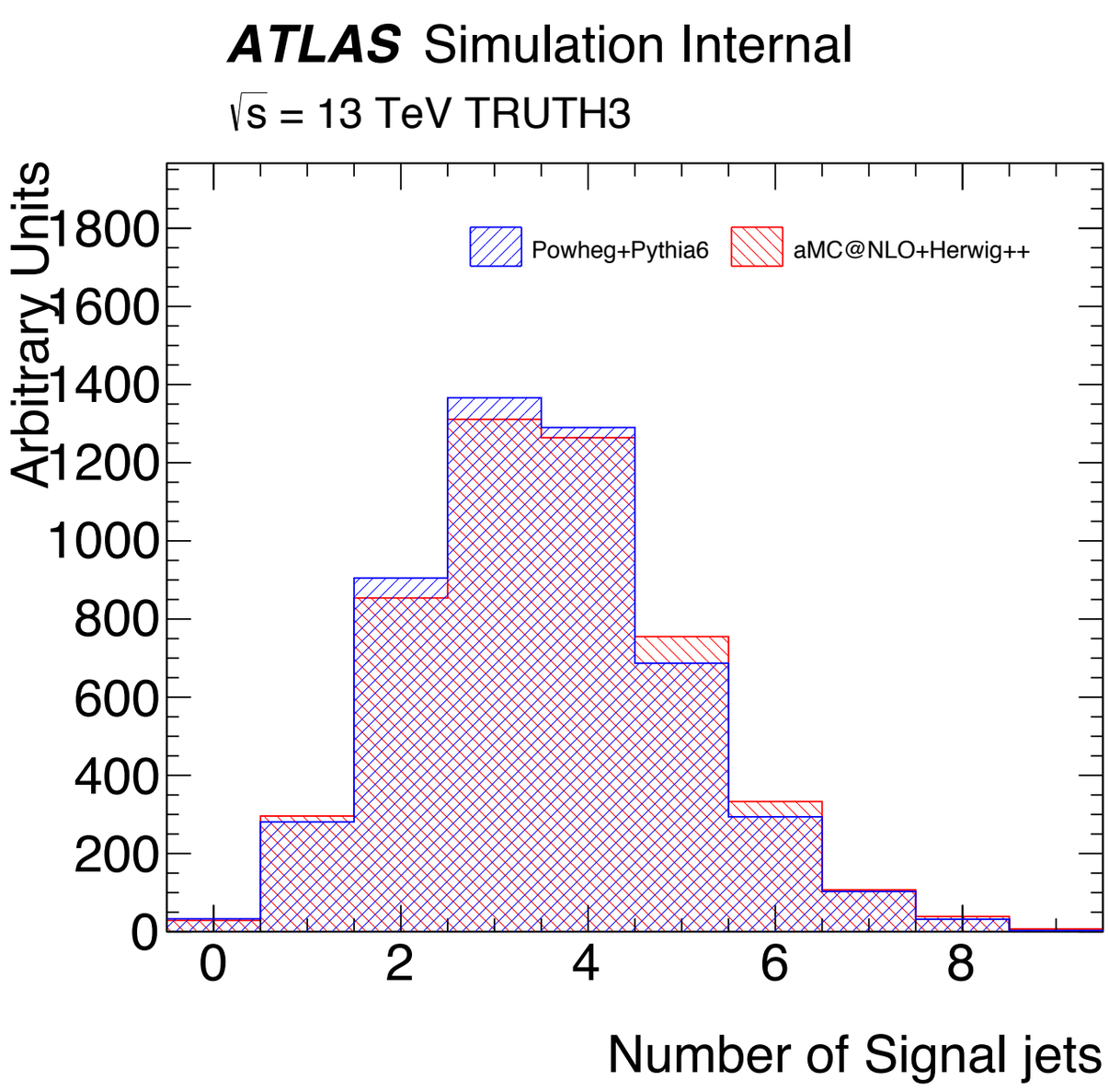
Truth xAODs: what are they good for?

Validation

Making quick plots when testing JOs

Analysis

Many techniques can be tested at truth-level: can generate more events than at detector-level



Uncertainties

Common technique for theoretical uncertainties: generate variations at truth-level and comparing yields

Philosophy ↓	Format	Size/event [kb] ttbar (busy)	Size/event [kb] Gtt (very busy)
Save Everything	**TRUTH0**	25	50
Thin a Little	**TRUTH1**	7.8	24.4
Only What is Needed	**TRUTH3**	1.6	2.3

TRUTH3 is the baseline recommendation for truth DxAOD in ATLAS

In this talk: what you can (and can't) do with TRUTH3

A Minimal Truth DxAOD: TRUTH 3

Philosophy:

- Aim for ~1 kb/event truth record
  depends on the final state
- Should contain everything needed for a truth-based analysis
- Should digest all truth information
  users should not have to look at main MC event record!

How this is achieved:

- Remove the main truth record
  no navigating the truth chain!
- Add special collections of particles which are used in various analysis
  tops, W's, etc.
- For unstable truth particles, keep only the first and last particle in a chain
- Remove / add other unneeded / needed information piece by piece

Jets and E_T^{miss}

R = 0.4 (ant-k_t; not WZ so no muons/neutrinos in these jets)

Selection: p_T > 20 GeV

Atributes saved: 4-vector, GhostC(B)HadronsFinalCount

R = 1.0 (ant-kt, trimmed with kT = 0.2 subjets)

Selection: p_T > 100 GeV

Atributes saved: 4-vector, n-subjettiness

MET: truthNonInt, truthInt, truthIntOut, truthMuons

Save mpx(), mpy(), sumet()

Leptons and Photons

Electrons/Muons

Selection: status == 1

Attributes saved: (un)dressed four-vector 4-vector, et_cone20, pt_cone30, pdgId, barcode, status, MCTruthClassifier Origin/Type/Outcome

Taus

Selection: None (save all of them)

Attributes saved: (un)dressed four-vector 4-vector, pdgId, barcode, status, MCTruthClassifier Origin/Type/Outcome - decay properties

Photons

Selection: status == 1 && $p_T > 20$ GeV

Attributes saved: four-vector 4-vector, pdgId, barcode, status, MCTruthClassifier Origin/Type/Outcome

Other Particle Collections

Selection: first or last in the decay chain with the same pdgId

Attributes saved: 4-vector, pdgId, barcode,
status, motherId, daughterId,
MCTruthClassifier Origin/Type/Outcome

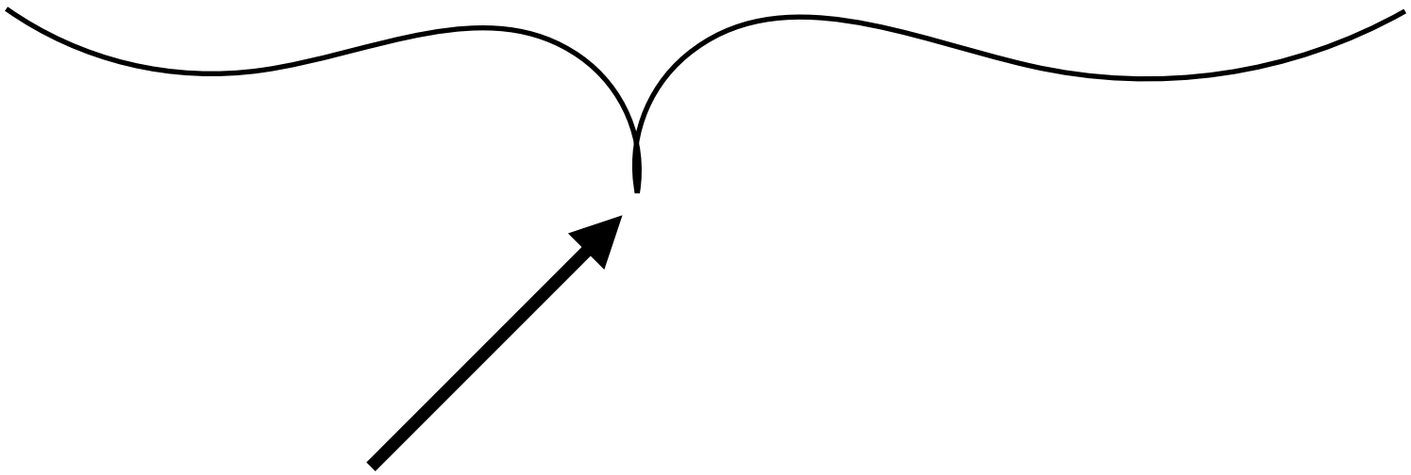
tops **BSM** **Bosons** **Neutrinos**

Coming soon: W/Z bosons from Sherpa

Other Information

The usual metadata:

```
TruthEvents.Q.XF1.XF2.PDGID1.PDGID2.PDFID1.PDFID2.X1.X2.weights.crossSection
```



PDF information

Looking inside TRUTH3

```
================================================================================
         Event data
================================================================================
     Mem Size       Disk Size        Size/Evt      Compression  Items  Container Name (Type)
--------------------------------------------------------------------------------
       2.552 kb        0.437 kb        0.004 kb        5.846      100  TruthElectrons (DataVector<xAOD::TruthParticle_v1>)
      20.604 kb        0.992 kb        0.010 kb       20.766      100  McEventInfo (EventInfo_p4)
      14.431 kb        1.421 kb        0.014 kb       10.156      100  TruthEvents (DataVector<xAOD::TruthEvent_v1>)
      37.779 kb        3.951 kb        0.040 kb        9.562      100  TruthBSM (DataVector<xAOD::TruthParticle_v1>)
      91.870 kb        7.976 kb        0.080 kb       11.519      100  EventInfo (xAOD::EventInfo_v1)
      54.571 kb        8.012 kb        0.080 kb        6.811      100  Truth3Photons (DataVector<xAOD::TruthParticle_v1>)
      37.115 kb        8.110 kb        0.081 kb        4.576      100  TrimmedAntiKt10TruthJets (DataVector<xAOD::Jet_v1>)
      38.754 kb       11.135 kb        0.111 kb        3.480      100  MET_Truth (xAOD::MissingETContainer_v1)
      69.051 kb       11.176 kb        0.112 kb        6.179      100  TruthTop (DataVector<xAOD::TruthParticle_v1>)
      45.955 kb       12.847 kb        0.128 kb        3.577      100  AntiKt4TruthJets (DataVector<xAOD::Jet_v1>)
      75.818 kb       17.129 kb        0.171 kb        4.426      100  TruthNeutrinos (DataVector<xAOD::TruthParticle_v1>)
      78.140 kb       17.483 kb        0.175 kb        4.469      100  TruthMuons (DataVector<xAOD::TruthParticle_v1>)
      98.832 kb       18.421 kb        0.184 kb        5.365      100  TruthBoson (DataVector<xAOD::TruthParticle_v1>)
      79.224 kb       19.344 kb        0.193 kb        4.096      100  MET_TruthRegions (xAOD::MissingETContainer_v1)
      91.040 kb       19.847 kb        0.198 kb        4.587      100  TruthTaus (DataVector<xAOD::TruthParticle_v1>)
--------------------------------------------------------------------------------
     835.735 kb      158.279 kb        1.583 kb        0.000      100  Total
================================================================================
```

Most of the new containers are **xAOD::TruthParticles**; exceptions are **MET** and **jets**.

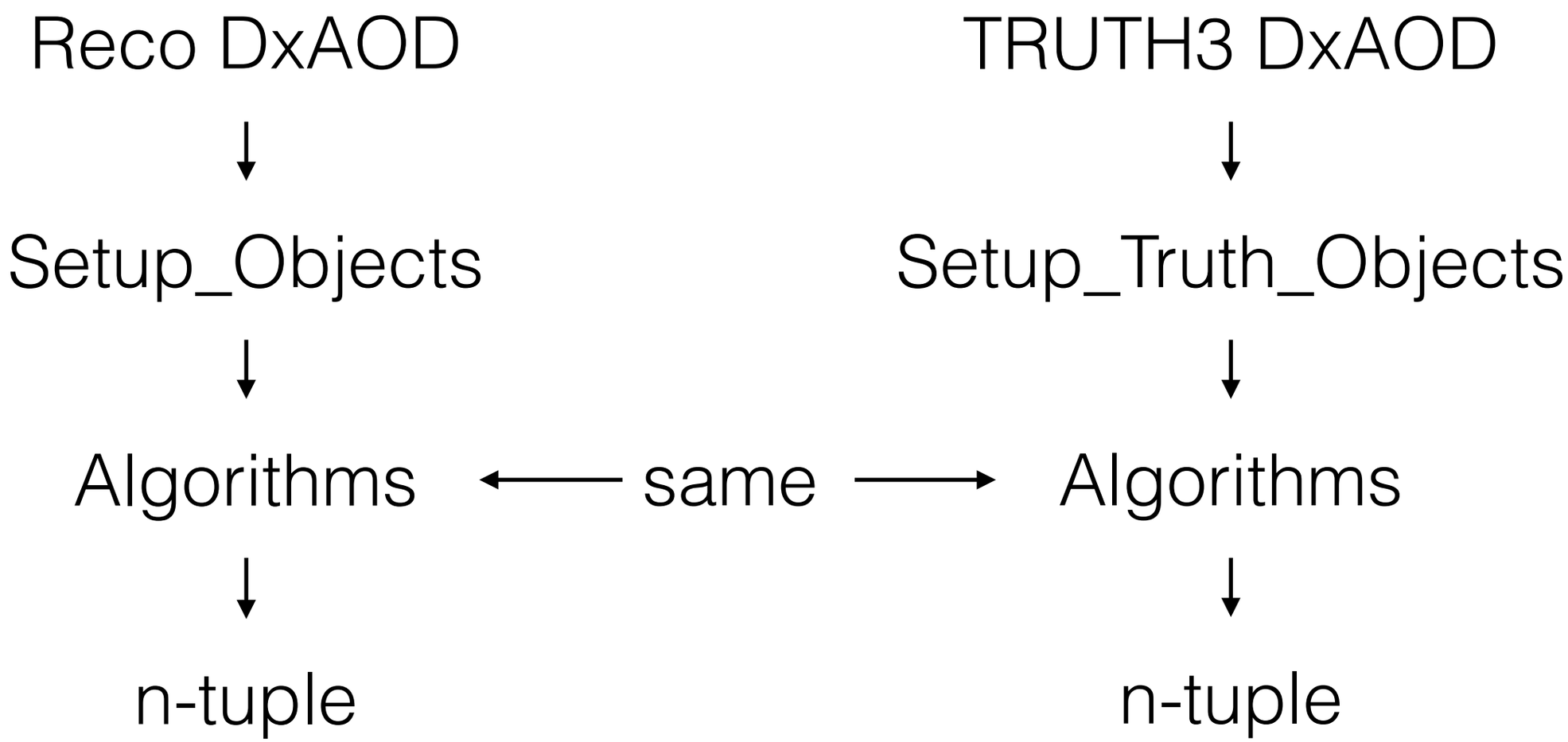
Tutorial *truth_lite*

We have prepared EventLoop analysis code that you can checkout and run out-of-the-box

The first task is to examine the truth objects inside a TRUTH3 file that you make from your own EVNT

Advanced: Integrating TRUTH3 into your xAOD framework

There is an algorithm in truth_lite/Root which can integrate into into a reco derivation setup.



Time for you to try!

Miscellaneous

- Every sample we have in ATLAS has an EVNT file that you can download and test out!

- You can request TRUTH3 in the central production (for instance through your group derivation managers)

- EVNT has not changed from MC12 to MC15 so you can run TRUTHx on any EVNT file

Where can I ask questions / give feedback? **mailing list?**

Useful Links:

Truth DxAOD Tutorial

Truth DxAOD Documentation