

Print Generator level particle decay scheme from NanoAOD MC simulation files

Set up CMS NanoAOD toolkit

NanoAOD postprocessing tool:

https://twiki.cern.ch/twiki/bin/view/CMSPublic/WorkBookNanoAOD#Quickly_make_plots_with_Nano_AN1

```
cmsrel CMSSW_9_4_11_cand1
cd CMSSW_9_4_11_cand1/src
cmsenv
git cms-init #not really needed unless you later want to add some other cmssw
stuff
git clone https://github.com/cms-nanoAOD/nanoAOD-tools.git
PhysicsTools/NanoAODTools
scram b
voms-proxy-init -voms cms

cd PhysicsTools/NanoAODTools/python/postprocessing/examples/
python exampleAnalysis.py
```

Get list of NanoAOD files to process:

Lets say we want to analyze list of selected events stored in file
/home/ssawant/hhAnalysis/2016/20210129_hh_2lss_0tau_2016_Datacards_wUpdatedZveto_3/
cfgs/hh_2lss/Tight_SS/W4JetsToLNu/central/analyze_W*JetsToLNu_Tight_SS_central_1_cfg.py
for W4JetsToLNu sample from 2016.

1. Name of the miniAOD file of the sample:

Search for “W4JetsToLNu” in https://raw.githubusercontent.com/HEP-KBFI/tth-htt/master/python/samples/tthAnalyzeSamples_2016_base.py

```
samples_2016["W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/RunIISummer16MiniAODv3-PUMoriond17_94X_mcRun2_asymptotic_v3-v2/MINIAODSIM"] = OD([
    ("type", "mc"),
    ("sample_category", "EWK"),
    ("process_name_specific", "W4JetsToLNu"),
    ...
])
```

MiniAOD file name:

/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/RunIISummer16MiniAODv3-PUMoriond17_94X_mcRun2_asymptotic_v3-v2/MINIAODSIM

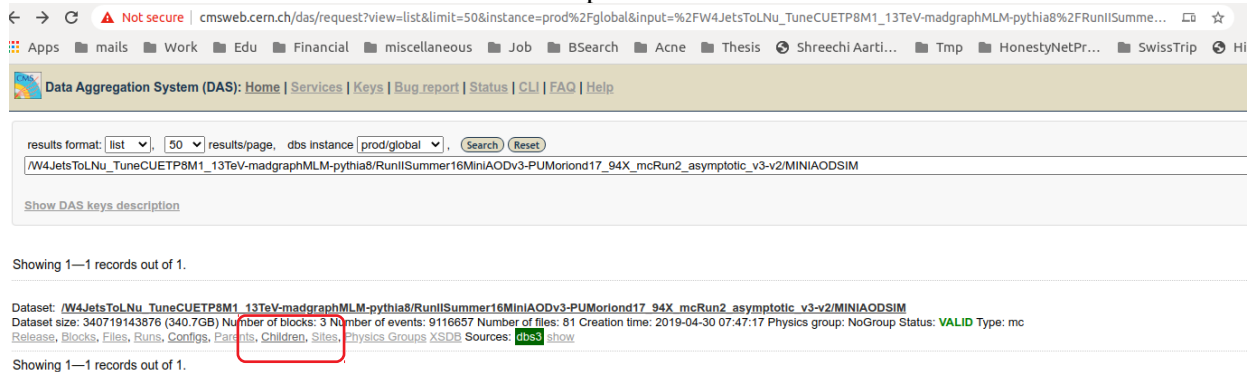
2. Get NanoAOD file:

1. Search for the miniAOD file in DAS:

https://cmsweb.cern.ch/das/request?view=list&limit=50&instance=prod%2Fglobal&input=%2FW4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-

[pythia8%2FRunIISummer16MiniAODv3-PUMoriond17_94X_mcRun2_asymptotic_v3-v2%2FMINIAODSIM](https://cmsweb.cern.ch/das/request?view=list&limit=50&instance=prod%2Fglobal&input=%2FW4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8%2FRunIISummer16MiniAODv3-PUMoriond17_94X_mcRun2_asymptotic_v3-v2%2FMINIAODSIM)

2. Click on “Children” link of the sample:

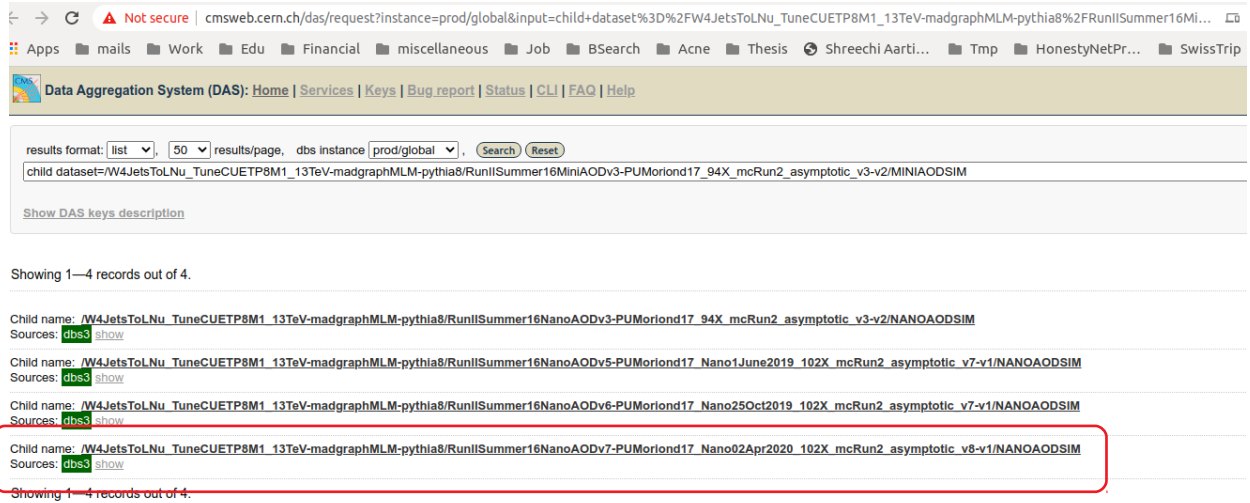


The screenshot shows the DAS interface with the search bar containing the dataset name. Below the search bar, it says "Showing 1—1 records out of 1." and displays a table with one record. The record details include the dataset name, size, number of blocks, events, files, creation time, physics group, status, and type. A red box highlights the "Children" link in the "Sources" section.

Dataset: [/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/RunIISummer16MiniAODv3-PUMoriond17_94X_mcRun2_asymptotic_v3-v2/MINIAODSIM](#)
Dataset size: 340719143876 (340.7GB) Number of blocks: 3 Number of events: 9116657 Number of files: 81 Creation time: 2019-04-30 07:47:17 Physics group: NoGroup Status: **VALID** Type: mc
[Release](#), [Blocks](#), [Files](#), [Runs](#), [Configs](#), [Parents](#), [Children](#), [Sites](#), [Physics Groups](#) XSDR Sources: [dbs3](#) [show](#)

3. This opens list of NanoAOD samples processed from that miniAOD sample. Choose NanoAOD-v7 sample:

https://cmsweb.cern.ch/das/request?instance=prod/global&input=child+dataset%3D%2FW4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8%2FRunIISummer16MiniAODv3-PUMoriond17_94X_mcRun2_asymptotic_v3-v2%2FMINIAODSIM



The screenshot shows the DAS interface with the search bar containing the child dataset name. Below the search bar, it says "Showing 1—4 records out of 4." and displays a table with four records. The records list child names and sources. A red box highlights the third record, which is the NanoAOD v7 sample.

Showing 1—4 records out of 4.


Child name: /W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/RunIISummer16NanoAODv3-PUMoriond17_94X_mcRun2_asymptotic_v3-v2/NANOAOBSIM Sources: dbs3 show
Child name: /W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/RunIISummer16NanoAODv5-PUMoriond17_Nano1June2019_102X_mcRun2_asymptotic_v7-v1/NANOAOBSIM Sources: dbs3 show
Child name: /W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/RunIISummer16NanoAODv6-PUMoriond17_Nano25Oct2019_102X_mcRun2_asymptotic_v7-v1/NANOAOBSIM Sources: dbs3 show
Child name: /W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/RunIISummer16NanoAODv7-PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/NANOAOBSIM Sources: dbs3 show

4. Open NanoAOD v7 sample and click on “Files” tab of the nanoAOD sample:

https://cmsweb.cern.ch/das/request?input=dataset%3D%2FW4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8%2FRunIISummer16NanoAODv7-PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1%2FNANOAOBSIM&instance=prod/global

← → ↻ Not secure cmsweb.cern.ch/das/request?input=dataset%3D%2FW4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8%2FRunIISummer16NanoAODv7-PUMoriond17_Na...

Apps mails Work Edu Financial miscellaneous Job BSearch Acne Thesis Shreechi Aarti... Tmp HonestyNetPr... SwissT

 Data Aggregation System (DAS): Home | Services | Keys | Bug report | Status | CLI | FAQ | Help

results format: 50 results/page, dbs instance: Search Reset

dataset=W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/RunIISummer16NanoAODv7-PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/NANOAOBSIM

Show DAS keys description

Showing 1—1 records out of 1.


Dataset: [W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/RunIISummer16NanoAODv7-PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/NANOAOBSIM](#)
 Creation time: 2020-03-10 10:09:57 Physics group: NoGroup Status: **VALID** Type: mc Dataset size: 15676683143 (15.7GB) Number of blocks: 3 Number of events: 9116657 Number of files: 9
[Release](#), [Blocks](#), [Files](#), [Runs](#) [Configs](#), [Parents](#), [Children](#), [Sites](#), [Physics Groups](#) [XSDB](#) Sources: [dbs3](#) [show](#)

Showing 1—1 records out of 1.

- This open the list of NanoAOD files: https://cmsweb.cern.ch/das/request?instance=prod/global&input=file+dataset%3D%2FW4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8%2FRunIISummer16NanoAODv7-PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1%2FNANOAOBSIM

← → ↻ Not secure cmsweb.cern.ch/das/request?instance=prod/global&input=file+dataset%3D%2FW4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8%2FRunIISummer16Nano...

Apps mails Work Edu Financial miscellaneous Job BSearch Acne Thesis Shreechi Aarti... Tmp HonestyNetPr... SwissTrip HighLevelTrig... Sennheiser

 Data Aggregation System (DAS): Home | Services | Keys | Bug report | Status | CLI | FAQ | Help

results format: 50 results/page, dbs instance: Search Reset

file dataset=W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/RunIISummer16NanoAODv7-PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/NANOAOBSIM

Show DAS keys description

Showing 1—9 records out of 9.

File name: [/store/mc/RunIISummer16NanoAODv7/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/NANOAOBSIM/PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/70000/C55BAED5-28EB-8749-9835-9FB6D8558EC8.root](#)
 File size: 194557861e+08 (194.9MB) File size: 194557861 (194.9MB) File type: EDM Number of events: 111789
[Dataset](#), [Block](#), [Sites](#), [Runs](#), [Parents](#), [Children](#), [Lumis](#) Sources: [dbs3](#) [huc3](#) [show](#)

File name: [/store/mc/RunIISummer16NanoAODv7/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/NANOAOBSIM/PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/70000/01E5AB94-A9D4-214E-8BE7-03BE75E43986.root](#)
 File size: 2223302916e+09 (2.2GB) File size: 2223302916 (2.2GB) File type: EDM Number of events: 1294728
[Dataset](#), [Block](#), [Sites](#), [Runs](#), [Parents](#), [Children](#), [Lumis](#) Sources: [dbs3](#) [huc3](#) [show](#)

File name: [/store/mc/RunIISummer16NanoAODv7/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/NANOAOBSIM/PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/70000/14A380E9-DEBA-7B40-91CC-C36FF2395459.root](#)
 File size: 1857626177e+09 (1.9GB) File size: 1857626177 (1.9GB) File type: EDM Number of events: 1078955
[Dataset](#), [Block](#), [Sites](#), [Runs](#), [Parents](#), [Children](#), [Lumis](#) Sources: [dbs3](#) [huc3](#) [show](#)

File name: [/store/mc/RunIISummer16NanoAODv7/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/NANOAOBSIM/PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/70000/5595476A-1D42-304C-BB99-D4A7FD26A0EF.root](#)
 File size: 1854948285e+09 (1.9GB) File size: 1854948285 (1.9GB) File type: EDM Number of events: 1078660
[Dataset](#), [Block](#), [Sites](#), [Runs](#), [Parents](#), [Children](#), [Lumis](#) Sources: [dbs3](#) [huc3](#) [show](#)

File name: [/store/mc/RunIISummer16NanoAODv7/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/NANOAOBSIM/PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/70000/B0B776BF-1CC8-5E4B-A223-863201ABFE31.root](#)
 File size: 2844280773e+09 (2.8GB) File size: 2844280773 (2.8GB) File type: EDM Number of events: 1654599
[Dataset](#), [Block](#), [Sites](#), [Runs](#), [Parents](#), [Children](#), [Lumis](#) Sources: [dbs3](#) [huc3](#) [show](#)

File name: [/store/mc/RunIISummer16NanoAODv7/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/NANOAOBSIM/PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/70000/B6279900-F858-A24F-A903-C53E6D35D2CE.root](#)
 File size: 1485869772e+09 (1.5GB) File size: 1485869772 (1.5GB) File type: EDM Number of events: 862999
[Dataset](#), [Block](#), [Sites](#), [Runs](#), [Parents](#), [Children](#), [Lumis](#) Sources: [dbs3](#) [huc3](#) [show](#)

File name: [/store/mc/RunIISummer16NanoAODv7/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/NANOAOBSIM/PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/70000/D49BC128-FA77-5C4F-839F-BEB99D761F4E.root](#)
 File size: 742407825e+08 (742.4MB) File size: 742407825 (742.4MB) File type: EDM Number of events: 430896
[Dataset](#), [Block](#), [Sites](#), [Runs](#), [Parents](#), [Children](#), [Lumis](#) Sources: [dbs3](#) [huc3](#) [show](#)

File name: [/store/mc/RunIISummer16NanoAODv7/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/NANOAOBSIM/PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/70000/E9282D94-FF18-064B-AC23-2225B48F29D0.root](#)
 File size: 2840971607e+09 (2.8GB) File size: 2840971607 (2.8GB) File type: EDM Number of events: 1653614
[Dataset](#), [Block](#), [Sites](#), [Runs](#), [Parents](#), [Children](#), [Lumis](#) Sources: [dbs3](#) [huc3](#) [show](#)

File name: [/store/mc/RunIISummer16NanoAODv7/W4JetsToLNu_TuneCUETP8M1_13TeV-madgraphMLM-pythia8/NANOAOBSIM/PUMoriond17_Nano02Apr2020_102X_mcRun2_asymptotic_v8-v1/70000/F14D56F3-727C-1640-AFFB-2B2E7F1D693E.root](#)
 File size: 1632437927e+09 (1.6GB) File size: 1632437927 (1.6GB) File type: EDM Number of events: 950455
[Dataset](#), [Block](#), [Sites](#), [Runs](#), [Parents](#), [Children](#), [Lumis](#) Sources: [dbs3](#) [huc3](#) [show](#)

Showing 1—9 records out of 9.

Run printGenEventFromNanoAOD macro

- A code that print generator level particle decay chain in a form of family tree is at <https://github.com/siddhesh86/myCodes/blob/d4d30c2f26f24c8756fda62bec3bb81b6a530f75/python/CMSNanoAOD/printGenEventsFromNanoAOD/anaGenEventsFromNanoAOD.py>
- It takes input from https://github.com/siddhesh86/myCodes/blob/d4d30c2f26f24c8756fda62bec3bb81b6a530f75/python/CMSNanoAOD/printGenEventsFromNanoAOD/anaGenEventsFromNanoAOD_inputs_cfg.json json file.

Put all of the NanoAOD files as list into the json file under "NanoAOD_PostProc" variable.
Prepend "root://cms-xrd-global.cern.ch:1094/" to the NanoAOD file path that needs to include in the "NanoAOD_PostProc" list.
Provide path+name of the file, containing run:lumi:event number of the events which needs to run from the NanoAOD file, to "runOnSelectedEventsList" variable in the json file.

3. Run anaGenEventsFromNanoAOD.py with command:

```
python anaGenEventsFromNanoAOD.py anaGenEventsFromNanoAOD_inputs_cfg.json
```

4. Example of the output is given at

https://github.com/siddhesh86/myCodes/blob/d4d30c2f26f24c8756fda62bec3bb81b6a530f75/python/CMSNanoAOD/printGenEventsFromNanoAOD/anaGenEventsFromNanoAOD_W4JetsToLNu.log

5. Generator level particle decay chain is printed in the following format:

printFamilyTree:

```
0 (21) [0, 23168.00, 0.000]
  2 (24) [47, -2.70, -2.672]
    7 (24) [56, -2.54, -3.109]
      8 (24) [55, -2.53, -3.102]
        10 (24) [55, -2.53, -3.102]
          11 (24) [55, -2.53, -3.102]
            12 (24) [55, -2.53, -3.109]
              13 (24) [56, -2.53, -3.109]
                15 (24) [56, -2.52, -3.102]
                  17 (-13) [32, -1.71, 1.523]
                  18 (14) [66, -2.08, -2.602]
3 (21) [142, 1.60, -0.427]
  9 (21) [162, 1.45, -0.446]
    19 (-5) [131, 1.50, -0.578]
    20 (511) [121, 1.50, -0.578]
      35 (14) [25, 1.50, -0.551]
      36 (-13) [72, 1.50, -0.576]
      37 (-411) [24, 1.46, -0.613]
        40 (11) [0, 0.87, -2.961]
        41 (-12) [2, 1.41, -0.531]
    22 (5) [18, 0.83, 0.264]
    23 (-533) [17, 0.87, 0.242]
      39 (-531) [16, 0.86, 0.243]
      44 (-431) [11, 0.84, 0.093]
4 (21) [62, -0.23, -2.859]
  16 (21) [0, -0.25, -0.547]
  27 (21) [1, -0.79, -2.703]
  28 (21) [5, -0.30, -2.930]
  29 (21) [1, -0.15, 2.898]
  30 (21) [15, -0.17, -2.805]
  31 (21) [30, -0.13, -2.844]
  32 (21) [5, -0.19, -2.984]
  33 (21) [3, -0.77, -2.797]
5 (21) [19, 1.16, 2.328]
  14 (21) [14, 1.34, 2.344]
  26 (21) [2, 0.25, 1.996]
6 (3) [85, -0.32, 1.754]
  24 (3) [40, -0.24, 1.707]
  25 (21) [17, -0.20, 1.715]
```

24(W+) -> -13(μ^-) 14(ν_μ)

Each particle is printed in the following format:

<particle index in GenParticleCollection> (<pdgID>) [<pt>, <eta>, <phi>]

for e.g. 2 (24) [47, -2.70, -2.672] : 2 is particle index in GenParticleCollection, 24 is pdgID of W^+ , and 47, -2.70, -2.672 are pT, eta and phi of W^+ .

Particle decay chain is shown in the following order:

- Column represents generation of the particle family
- Rows in a given column represents 'sibling particles' in a family.

Particle pdgID can be found at <https://pdg.lbl.gov/2007/reviews/montecarlohpp.pdf>