



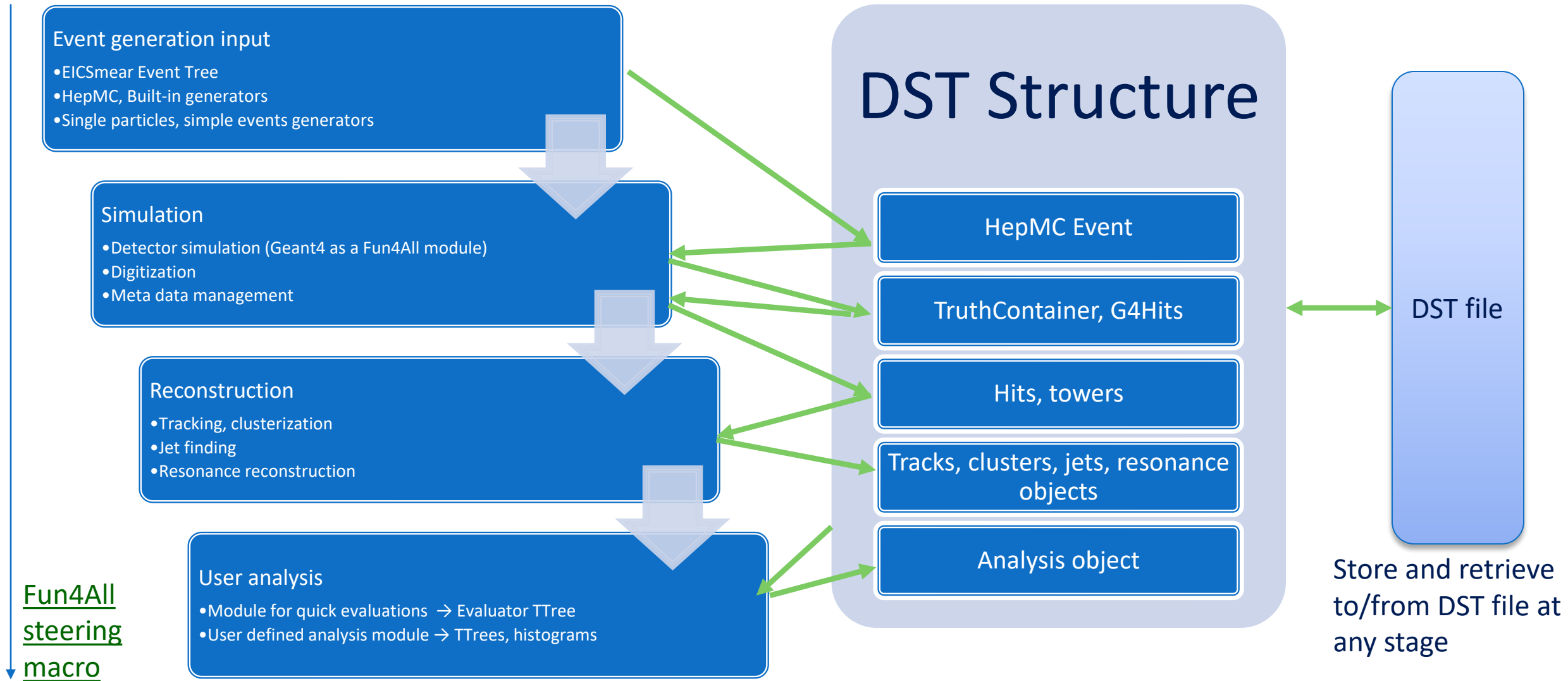
Structure/content of Eval trees and DST files

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B -hadron
or photon

Sim+reco data flow in Fun4All framework



Sim+reco data flow in Fun4All framework

DST structure printout at start of any Fun4All process

```
List of Nodes in Fun4AllServer:
Node Tree under TopNode TOP
TOP (PHCompositeNode)/
  DST (PHCompositeNode)/
    G4HIT_EGEM_0 (IO,PHG4HitContainer)
    G4HIT_EGEM_1 (IO,PHG4HitContainer)
    G4HIT_EGEM_2 (IO,PHG4HitContainer)
    G4HIT_EGEM_3 (IO,PHG4HitContainer)
    G4HIT_FGEM_2 (IO,PHG4HitContainer)
    G4HIT_FGEM_3 (IO,PHG4HitContainer)
    G4HIT_FGEM_4 (IO,PHG4HitContainer)
    G4HIT_FST_0 (IO,PHG4HitContainer)
    G4HIT_FST_1 (IO,PHG4HitContainer)
    G4HIT_FST_2 (IO,PHG4HitContainer)
    G4HIT_FST_3 (IO,PHG4HitContainer)
    G4HIT_FST_4 (IO,PHG4HitContainer)
    G4HIT_DIRC (IO,PHG4HitContainer)
    G4HIT_RICH (IO,PHG4HitContainer)
    PHG4INEVENT (PHDataNode)
    G4HIT_ZDC (IO,PHG4HitContainer)
    G4HIT_offMomTruth_0_0 (IO,PHG4HitContainer)
    G4HIT_offMomTruth_1_0 (IO,PHG4HitContainer)
    G4HIT_rpTruth_0_0 (IO,PHG4HitContainer)
    G4HIT_rpTruth_1_0 (IO,PHG4HitContainer)
    G4HIT_b0Truth_0_0 (IO,PHG4HitContainer)
    G4HIT_b0Truth_1_0 (IO,PHG4HitContainer)
    G4HIT_b0Truth_2_0 (IO,PHG4HitContainer)
    G4HIT_b0Truth_3_0 (IO,PHG4HitContainer)
    MVTX (PHCompositeNode)/
      G4HIT_MVTX (IO,PHG4HitContainer)
    TPC (PHCompositeNode)/
      G4HIT_TPC (IO,PHG4HitContainer)
    CEMC (PHCompositeNode)/
      G4HIT_CEMC (IO,PHG4HitContainer)
      G4CELL_CEMC (IO,PHG4CellContainer)
      TOWER_SIM_CEMC (IO,RawTowerContainer)
      TOWER_RAW_CEMC (IO,RawTowerContainer)
      TOWER_CALIB_CEMC (IO,RawTowerContainer)
      CLUSTER_CEMC (IO,RawClusterContainer)
    HCALIN (PHCompositeNode)/
      G4HIT_HCALIN (IO,PHG4HitContainer)
      G4CELL_HCALIN (IO,PHG4CellContainer)
      TOWER_SIM_HCALIN (IO,RawTowerContainer)
      TOWER_RAW_HCALIN (IO,RawTowerContainer)
      TOWER_CALIB_HCALIN (IO,RawTowerContainer)
      CLUSTER_HCALIN (IO,RawClusterContainer)
    HCALOUT (PHCompositeNode)/
      G4HIT_HCALOUT (IO,PHG4HitContainer)
      G4CELL_HCALOUT (IO,PHG4CellContainer)
      TOWER_SIM_HCALOUT (IO,RawTowerContainer)
```

```
G4GEOPARAM_b0Truth_2_0 (IO,PdbParameterMapContainer)
CYLINDERGEOM_b0Truth_2_0 (IO,PHG4CylinderGeomContainer)
G4GEOPARAM_b0Truth_3_0 (IO,PdbParameterMapContainer)
CYLINDERGEOM_b0Truth_3_0 (IO,PHG4CylinderGeomContainer)
MVTX (PHCompositeNode)/
  G4GEOPARAM_MVTX (IO,PdbParameterMapContainer)
  FIELD_CAGE (PHCompositeNode)/
    G4GEOPARAM_FIELD_CAGE (IO,PdbParameterMapContainer)
  TPC (PHCompositeNode)/
    G4GEOPARAM_TPC (IO,PdbParameterMapContainer)
    CYLINDERGEOM_TPC (IO,PHG4CylinderGeomContainer)
  ABSORBER_CEMC (PHCompositeNode)/
    G4GEOPARAM_ABSORBER_CEMC (IO,PdbParameterMapContainer)
  CEMC (PHCompositeNode)/
    G4GEOPARAM_CEMC (IO,PdbParameterMapContainer)
    CYLINDERGEOM_CEMC (IO,PHG4CylinderGeomContainer)
    G4CELLPARAM_CEMC (IO,PdbParameterMapContainer)
    TOWERGEOM_CEMC (IO,RawTowerGeomContainer_cylinderv1)
  G4GEOPARAM_CEMC_ELECTRONICS_0 (IO,PdbParameterMapContainer)
  HCALIN (PHCompositeNode)/
    G4GEOPARAM_HCALIN (IO,PdbParameterMapContainer)
    G4CELLPARAM_HCALIN (IO,PdbParameterMap)
    TOWERPARAM_HCALIN (IO,PdbParameterMap)
    TOWERGEOM_HCALIN (IO,RawTowerGeomContainer_cylinderv1)
  HCALIN_SPT (PHCompositeNode)/
    G4GEOPARAM_HCALIN_SPT (IO,PdbParameterMapContainer)
  MAGNET (PHCompositeNode)/
    G4GEOPARAM_MAGNET (IO,PdbParameterMapContainer)
  HCALOUT (PHCompositeNode)/
    G4GEOPARAM_HCALOUT (IO,PdbParameterMapContainer)
    G4CELLPARAM_HCALOUT (IO,PdbParameterMap)
    TOWERPARAM_HCALOUT (IO,PdbParameterMap)
    TOWERGEOM_HCALOUT (IO,RawTowerGeomContainer_cylinderv1)
  FEMC (PHCompositeNode)/
    G4GEOPARAM_FEMC (IO,PdbParameterMapContainer)
  FHCAL (PHCompositeNode)/
    G4GEOPARAM_FHCAL (IO,PdbParameterMapContainer)
  EEMC (PHCompositeNode)/
    G4GEOPARAM_EEMC (IO,PdbParameterMapContainer)
  DIRC (PHCompositeNode)/
    G4GEOPARAM_DIRC (IO,PdbParameterMapContainer)
  FLUXRET_ETA_MINUS (PHCompositeNode)/
    G4GEOPARAM_FLUXRET_ETA_MINUS (IO,PdbParameterMapContainer)
  G4GEOPARAM_BH_1 (IO,PdbParameterMapContainer)
  CYLINDERGEOM_BH_1 (IO,PHG4CylinderGeomContainer)
  BH_FORWARD_PLUS (PHCompositeNode)/
    G4GEOPARAM_BH_FORWARD_PLUS (IO,PdbParameterMapContainer)
    CYLINDERGEOM_BH_FORWARD_PLUS (IO,PHG4CylinderGeomContainer)
  BH_FORWARD_NEG (PHCompositeNode)/
    G4GEOPARAM_BH_FORWARD_NEG (IO,PdbParameterMapContainer)
    CYLINDERGEOM_BH_FORWARD_NEG (IO,PHG4CylinderGeomContainer)
  CYLINDERGEOM_MVTX (IO,PHG4CylinderGeomContainer)
  GEOMETRY_IO (IO,PHGeomIOGeo)
  CYLINDERCELLGEOM_CEMC (IO,PHG4CylinderCellGeomContainer)
  TOWERGEOM_FEMC (IO,RawTowerGeomContainerv1)
  TOWERGEOM_FHCAL (IO,RawTowerGeomContainerv1)
  TOWERGEOM_EEMC (IO,RawTowerGeomContainerv1)
  PHG4TrackFastSim_Parameter (IO,PdbParameterMap)
```

DST Structure

HepMC Event

TruthContainer, G4Hits

Hits, towers

Tracks, clusters, jets, resonance
objects

Analysis object

DST file

Store and retrieve
to/from DST file at
any stage

Focus of this talk

User analysis

- Module for quick evaluations → Evaluator TTree
 - User defined analysis module → TTrees, histograms
-
- ▶ Quick evaluation TTree outputs.
 - ▶ DST structure that is mostly commonly used in user analysis

```
G4EICDetector_eventtree.root  
G4EICDetector_g4cemc_eval.root  
G4EICDetector_g4hcalin_eval.root  
G4EICDetector_g4hcalout_eval.root  
G4EICDetector_g4femc_eval.root  
G4EICDetector_g4fhcal_eval.root  
G4EICDetector_g4eemc_eval.root  
G4EICDetector_g4jet_eval.root  
g4fwdjets_track_05_eval.root  
g4fwdjets_full_05_eval.root  
g4fwdjets_tower_05_eval.root  
g4fwdjets_tower_07_eval.root  
g4fwdjets_tower_10_eval.root  
g4fwdjets_cluster_05_eval.root  
g4fwdjets_cluster_07_eval.root  
g4fwdjets_cluster_10_eval.root  
g4fwdjets_TowerFwd_05_eval.root  
g4fwdjets_TowerFwd_07_eval.root  
g4fwdjets_TowerFwd_10_eval.root  
g4fwdjets_ClusterFwd_05_eval.root  
g4fwdjets_ClusterFwd_07_eval.root  
g4fwdjets_ClusterFwd_10_eval.root  
G4EICDetector_g4tracking_eval.root
```



Evaluator TTree structure



- Enabled by default running our default macro: <https://github.com/ECCE-EIC/macros>
- Aimed for quick evaluation without need of writing analysis module
- Deep evaluation tool chain match reco with truth objects
- Specialized analysis require analysis module (next talk) reading DST directly (2nd section of this talk)

Tracking eval



- ▶ Truth and matched reco track / vertex
- ▶ Typically named G4EICDetector_g4tracking_eval.root
- ▶ Produced by PHG4TrackFastSimEval::fill track tree

```
[2]: gFile->ls()

TFile**      G4EICDetector_g4tracking_eval.root
TFile*       G4EICDetector_g4tracking_eval.root
KEY: TTree   tracks;1      FastSim Eval => tracks
KEY: TTree   vertex;1      FastSim Eval => vertices
KEY: TH2D    DeltaMomVsTruthEta;1  #frac{#Delta p}{#Delta p}
KEY: TH2D    DeltaMomVsTruthMom;1  #frac{#Delta p}{#Delta p}
```

g* is shorthand
for Geant4
truth

Matched reco
track

```
tracks->Show(0)

=====> EVENT:0
event          = 1
gtrackID       = 1
gflavor        = -211
gpx            = 1.2328
gpy            = 7.82863
gpz            = -56.2354
gvx            = 0
gvy            = 0
gvz            = 3.64197
gvt            = 0
trackID        = 0
charge         = -1
nhits          = 0
px             = 0.872744
py             = 5.46897
pz             = -39.3583
pcax           = 0.00277378
pcay           = -0.00133881
pcaz           = 3.63195
dca2d          = 6.57687e-05
```

Number of hit
in each tracker

```
nHit_G4HIT_EGEM_0 = 0
nHit_G4HIT_EGEM_1 = 1
nHit_G4HIT_EGEM_2 = 1
nHit_G4HIT_EGEM_3 = 1
nHit_G4HIT_FGEM_2 = 0
nHit_G4HIT_FGEM_3 = 0
nHit_G4HIT_FGEM_4 = 0
nHit_G4HIT_FST_0 = 0
nHit_G4HIT_FST_1 = 0
nHit_G4HIT_FST_2 = 0
nHit_G4HIT_FST_3 = 0
nHit_G4HIT_FST_4 = 0
nHit_G4HIT_MVTX = 0
nHit_G4HIT_TPC = 0
```

Calorimeter evaluator



- ▶ Truth and matched calorimeter showers
- ▶ Typically named G4EICDetector_g4<calo-name>_eval.root
- ▶ Produced by CaloEvaluator::fillOutputNtuples()

```
gFile->ls()
TFile**      G4EICDetector_g4cemc_eval.root
TFile*       G4EICDetector_g4cemc_eval.root
KEY: Tntuple  ntp_gpoint;1    primary vertex => best (first) vertex
KEY: Tntuple  ntp_gshower;1   truth shower => best cluster
KEY: Tntuple  ntp_tower;1     tower => max truth primary
KEY: TTree    tower_debug;1   tower => max truth primary
KEY: Tntuple  ntp_cluster;1   cluster => max truth primary
```

g* is shorthand
for Geant4
truth

Matched reco
cluster

```
=====> EVENT:2
event          = 0
gparticleID    = 3
gflavor        = -211
gnhits         = 0
geta           = 0.471559
gphi           = -2.16036
ge             = 1.79279
gpt            = 1.60551
gvx            = 0
gvy            = 0
gvz            = 3.64197
gembed         = 1
gedep          = 0.0943061
clusterID      = 436
ntowers        = 3
eta            = 0.457651
x              = -42.2263
y              = -85.3743
z              = 48.7691
phi            = -2.03012
e              = 0.767885
efromtruth     = 0.0267012
```

jet evaluator



- ▶ Truth and matched calorimeter showers
- ▶ Typically named g4fwdjets_<tower/track/cluster>_<R*10>_eval.root
- ▶ Produced by JetEvaluator::fillOutputNtuples()

```
gFile->ls()
```

```
TFile**      g4fwdjets_tower_10_eval.root
TFile*       g4fwdjets_tower_10_eval.root
KEY: TTuple  ntp_recojet;1 reco jet => max truth jet
KEY: TTuple  ntp_truthjet;1 truth jet => best reco jet
```

g* is shorthand
for Geant4
truth

Matched reco
jet

```
ntp_truthjet->Show(2)
```

```
=====> EVENT:2
```

```
event      = 0
gid        = 2
gncomp     = 1
geta       = -1.44483
gphi       = -3.13949
ge         = 10.9744
gpt        = 4.90226
id         = 11
ncomp      = 176
eta        = -1.11833
phi        = 3.141
e          = 7.02573
pt         = 3.84213
efromtruth = 0.11846
```


Event TTree evaluator



- ▶ Recently introduced to sum above object-based evaluator ntuple into event-based TTree to facilitate analysis based on evaluator
- ▶ See also next (Ralf's) talk and [talk by Friederike Bock in first workshop](#)
- ▶ Produced by [EventEvaluator::fillOutputNtuples\(\)](#)

Array of tracks

```
=====> EVENT:0
nHits      = 0
nTracks    = 5
tracks_ID  = 0,
           1, 2, 3, 4
tracks_px   = 0.872744,
           0.522337, -0.892324, 2.61175, -5.02921
tracks_py   = 5.46897,
           13.7141, -1.33293, 0.663873, -0.0118706
tracks_pz   = -39.3583,
           -59.0867, 0.784418, 3.46976, -10.0691
tracks_trueID = 1,
           2, 3, 4, 5
nProjections = 0
tower_FHCAL_N = 1
tower_FHCAL_E = 0.120629
tower_FHCAL_iEta = 43
tower_FHCAL_iPhi = 42
tower_FHCAL_trueID = 4
cluster_FHCAL_N = 1
cluster_FHCAL_E = 0.120629
cluster_FHCAL_Eta = -10000
cluster_FHCAL_Phi = 0.753151
cluster_FHCAL_NTower = 1
cluster_FHCAL_trueID = 4
```

Array of calo
cluster

Truth particle history

```
nMCPart      = 511
mcpart_ID    = -69126,
           -69125, -69124, -69123, -69122, -69121,
           -69120, -69119, -69118, -69117, -69116,
           -69115, -69114, -69113, -69112, -69111,
           -69110, -69109, -69108, -69106
mcpart_ID_parent = 5,
           5, 5, 5, 5, 5,
           5, -69116, -69116, -69116, 5,
           -69114, 5, 5, 5, 5,
           5, 5, 5, -69104
mcpart_PDG    = 11,
           11, 11, 11, 11, 11,
           11, 11, 11, 11, 11,
           11, 11, 11, 11, 11,
           11, 11, 11, 11
mcpart_E      = 0.000957295,
           0.000512798, 0.000517208, 0.000517958, 0.000512139, 0.000513288,
           0.000512109, 0.000512333, 0.000512548, 0.000514088, 0.000574473,
           0.000512766, 0.000517922, 0.000512001, 0.000512566, 0.000512286,
           0.000512245, 0.000512885, 0.000513813, 0.000513676
mcpart_px     = -0.00079231,
           1.64712e-05, -5.05921e-05, 7.22584e-05, -1.8018e-05, -3.42674e-05,
           8.94382e-06, 2.84778e-05, -3.60339e-05, -4.73742e-05, -2.34221e-05,
           2.92805e-05, 3.75538e-05, 1.03576e-05, 1.50216e-05, 7.77634e-06,
           -2.74842e-05, 3.72734e-05, -4.23575e-05, -1.85439e-06
```

```
List of Nodes in Fun4AllServer:
Node Tree under TopNode TOP
TOP (PHCompositeNode)/
  DST (PHCompositeNode)/
    G4HIT_EGEM_0 (IO,PHG4HitContainer)
    G4HIT_EGEM_1 (IO,PHG4HitContainer)
    G4HIT_EGEM_2 (IO,PHG4HitContainer)
    G4HIT_EGEM_3 (IO,PHG4HitContainer)
    G4HIT_FGEM_2 (IO,PHG4HitContainer)
    G4HIT_FGEM_3 (IO,PHG4HitContainer)
    G4HIT_FGEM_4 (IO,PHG4HitContainer)
    G4HIT_FST_0 (IO,PHG4HitContainer)
    G4HIT_FST_1 (IO,PHG4HitContainer)
    G4HIT_FST_2 (IO,PHG4HitContainer)
    G4HIT_FST_3 (IO,PHG4HitContainer)
    G4HIT_FST_4 (IO,PHG4HitContainer)
    G4HIT_DIRC (IO,PHG4HitContainer)
    G4HIT_RICH (IO,PHG4HitContainer)
    PHG4INEVENT (PHDataNode)
    G4HIT_ZDC (IO,PHG4HitContainer)
    G4HIT_offMomTruth_0_0 (IO,PHG4HitContainer)
    G4HIT_offMomTruth_1_0 (IO,PHG4HitContainer)
    G4HIT_rpTruth_0_0 (IO,PHG4HitContainer)
    G4HIT_rpTruth_1_0 (IO,PHG4HitContainer)
    G4HIT_b0Truth_0_0 (IO,PHG4HitContainer)
    G4HIT_b0Truth_1_0 (IO,PHG4HitContainer)
    G4HIT_b0Truth_2_0 (IO,PHG4HitContainer)
    G4HIT_b0Truth_3_0 (IO,PHG4HitContainer)
    MVTX (PHCompositeNode)/
      G4HIT_MVTX (IO,PHG4HitContainer)
    TPC (PHCompositeNode)/
      G4HIT_TPC (IO,PHG4HitContainer)
    CEMC (PHCompositeNode)/
      G4HIT_CEMC (IO,PHG4HitContainer)
      G4CELL_CEMC (IO,PHG4CellContainer)
      TOWER_SIM_CEMC (IO,RawTowerContainer)
      TOWER_RAW_CEMC (IO,RawTowerContainer)
      TOWER_CALIB_CEMC (IO,RawTowerContainer)
      CLUSTER_CEMC (IO,RawClusterContainer)
    HCALIN (PHCompositeNode)/
      G4HIT_HCALIN (IO,PHG4HitContainer)
      G4CELL_HCALIN (IO,PHG4CellContainer)
      TOWER_SIM_HCALIN (IO,RawTowerContainer)
      TOWER_RAW_HCALIN (IO,RawTowerContainer)
      TOWER_CALIB_HCALIN (IO,RawTowerContainer)
      CLUSTER_HCALIN (IO,RawClusterContainer)
    HCALOUT (PHCompositeNode)/
      G4HIT_HCALOUT (IO,PHG4HitContainer)
      G4CELL_HCALOUT (IO,PHG4CellContainer)
      TOWER_SIM_HCALOUT (IO,RawTowerContainer)
```



DST Structure

- Carries full information of sim and reco
- Accessed via analysis modules
- Searchable on [Doxygen](#), e.g.

```
DST (PHCompositeNode)/
  G4HIT_EGEM_0 (IO,PHG4HitContainer)
  G4HIT_EGEM_1 (IO,PHG4HitContainer)
  G4HIT_EGEM_2 (IO,PHG4HitContainer)
  G4HIT_EGEM_3 (IO,PHG4HitContainer)
```



PHHepMCGenEvent

- ▶ PHHepMCGenEvent contains input HepMC event if using Event generator inputs
- ▶ Also stores the truth vertex and LorentzRotation translating between event generator frame and lab fram
- ▶ Embedding and pile up: HepMC events in PHHepMCGenEventMap

Code snippet to read hepMC events:

https://ecce-eic.github.io/doxygen/df/d2f/DumpPHHepMCGenEventMap_8cc_source.html#I00025

```
int DumpPHHepMCGenEventMap::process_Node(PHNode *myNode)
{
    PHHepMCGenEventMap *phhepmcgeneventmap = nullptr;
    MyNode_t *thisNode = static_cast<MyNode_t *>(myNode);
    if (thisNode)
    {
        phhepmcgeneventmap = thisNode->getData();
    }
    if (phhepmcgeneventmap)
    {
        PHHepMCGenEventMap::ConstIter iter_beg = phhepmcgeneventmap->begin();
        PHHepMCGenEventMap::ConstIter iter_end = phhepmcgeneventmap->end();
        *fout << "size: " << phhepmcgeneventmap->size() << endl;
        for (PHHepMCGenEventMap::ConstIter iter = iter_beg; iter != iter_end; ++iter)
        {
            *fout << "map entry: " << iter->first << endl;
            PHHepMCGenEvent *genevt = iter->second;
            HepMC::GenEvent *evt = genevt->getEvent();
            *fout << "Embedding id " << genevt->get_embedding_id() << endl;
            *fout << "is simulated " << genevt->is_simulated() << endl;
            *fout << "Collision vertex x: " << genevt->get_collision_vertex().x() << endl;
            *fout << "Collision vertex y: " << genevt->get_collision_vertex().y() << endl;
            *fout << "Collision vertex z: " << genevt->get_collision_vertex().z() << endl;
            *fout << "Collision vertex t: " << genevt->get_collision_vertex().t() << endl;
            evt->print(*fout);
        }
    }
    return 0;
}
```

Truth container and G4 hits

- ▶ **PHG4TruthInfoContainer** records Geant4 truth **PHG4Particle/PHG4VtxPoint** history
- ▶ **PHG4Hit** records interaction of particle with detector volumes, saved in **PHG4HitContainer**
- ▶ You can enable DSTReader (Enable::DSTREADER) to dump them in a TTree for a quick look [[tutorial](#)]. Note file will be large, not for analysis purpose

PHG4Particle ()	
virtual	~PHG4Particle ()
virtual bool	islon () const
virtual int	get_pid () const
virtual std::string	get_name () const
virtual double	get_px () const
virtual double	get_py () const
virtual double	get_pz () const
virtual double	get_e () const
virtual int	get_track_id () const
virtual int	get_vtx_id () const
virtual int	get_parent_id () const
virtual int	get_primary_id () const
virtual int	get_barcode () const
virtual int	get_A () const
virtual int	get_Z () const
virtual double	get_IonCharge () const
virtual double	get_ExcitEnergy () const

PHG4Hit ()	
virtual	~PHG4Hit ()
virtual void	identify (std::ostream &os=std::cout) const
virtual void	CopyFrom (const PHObject *phobj)
virtual void	Reset ()
	Clear Event.
virtual float	get_x (const int i) const
virtual float	get_y (const int i) const
virtual float	get_z (const int i) const
virtual float	get_px (const int i) const
virtual float	get_py (const int i) const
virtual float	get_pz (const int i) const
virtual float	get_local_x (const int i) const
virtual float	get_local_y (const int i) const
virtual float	get_local_z (const int i) const
virtual float	get_t (const int i) const
virtual float	get_edep () const
virtual float	get_eion () const
virtual float	get_light_yield () const
virtual float	get_path_length () const
virtual unsigned int	get_layer () const
virtual PHG4HitDefs::keytype	get_hit_id () const
virtual int	get_detid () const
virtual int	get_shower_id () const
virtual int	get_scint_id () const
virtual int	get_row () const
virtual int	get_trkid () const
virtual int	get_strip_z_index () const
virtual int	get_strip_y_index () const
virtual int	get_ladder_z_index () const
virtual int	get_ladder_phi_index () const
virtual int	get_index_i () const
virtual int	get_index_j () const
virtual int	get_index_k () const
virtual int	get_index_l () const
virtual int	get_hit_type () const

Cluster / jets

- ▶ RawCluster store reconstructed calo clusters placed in RawClusterContainer
- ▶ Jet are placed in JetMap
- ▶ See also Joe's talk

virtual	~RawCluster ()
virtual void	Reset () Clear Event .
virtual PHObject *	CloneMe () const Virtual copy constructor.
virtual int	isValid () const isValid returns non zero if object contains valid data
virtual void	identify (std::ostream &os=std::cout) const
virtual RawClusterDefs::keytype	get_id () const cluster ID
virtual float	get_energy () const total energy
virtual size_t	getNTowers () const Tower operations.
virtual TowerConstRange	get_towers () const
virtual const TowerMap &	get_towermap () const return tower map for c++11 range-based for-loop
virtual CLHEP::Hep3Vector	get_position () const
virtual float	get_phi () const access to intrinsic cylindrical coordinate system
virtual float	get_r () const
virtual float	get_z () const
virtual float	get_x () const access Cartesian coordinate system
virtual float	get_y () const
virtual float	get_ecore () const
virtual float	get_chi2 () const reduced chi2 for EM shower
virtual float	get_prob () const cluster template probability for EM shower
virtual float	get_et_iso () const isolation ET default
virtual float	get_et_iso (const int radiusx10, bool subtracted, bool c isolation ET the radius and heuristic can be specified

Jin Huang <jhuang@bnl.gov>

	Jet ()
virtual	~Jet ()
virtual void	identify (std::ostream &os=std::cout) const
virtual void	Reset () Clear Event .
virtual int	isValid () const isValid returns non zero if object contains valid data
virtual PHObject *	CloneMe () const Virtual copy constructor.
virtual unsigned int	get_id () const
virtual void	set_id (unsigned int id)
virtual float	get_px () const
virtual void	set_px (float px)
virtual float	get_py () const
virtual void	set_py (float py)
virtual float	get_pz () const
virtual void	set_pz (float pz)
virtual float	get_e () const
virtual void	set_e (float e)
virtual float	get_p () const
virtual float	get_pt () const
virtual float	get_et () const
virtual float	get_eta () const
virtual float	get_phi () const
virtual float	get_mass () const
virtual float	get_mass2 () const

Track and vertex

- ▶ SvtxTrack_FastSim placed in SvtxTrackMap
- ▶ SvtxVertex placed in SvtxVertexMap
- ▶ See also Joe's talk

Public Member Functions inherited from SvtxTrack_v1

```

SvtxTrack_v1 ()
SvtxTrack_v1 (const SvtxTrack &)
SvtxTrack_v1 (const SvtxTrack_v1 &track)
SvtxTrack_v1 & operator= (const SvtxTrack_v1 &track)
virtual ~SvtxTrack_v1 ()
void identify (std::ostream &os=std::cout) const
void Reset ()
    Clear Event.
int isValid () const
    isValid returns non zero if object contains valid data
PHObject * CloneMe () const
    Virtual copy constructor.
unsigned int get_id () const
void set_id (unsigned int id)
unsigned int get_vertex_id () const
void set_vertex_id (unsigned int id)
bool get_positive_charge () const
void set_positive_charge (bool ispos)
int get_charge () const
void set_charge (int charge)
float get_chisq () const
void set_chisq (float chisq)
unsigned int get_ndf () const
void set_ndf (int ndf)
float get_quality () const
float get_dca () const
void set_dca (float dca)
float get_dca_error () const
void set_dca_error (float dca_error)
float get_dca2d () const
void set_dca2d (float dca2d)
float get_dca2d_error () const
void set_dca2d_error (float error)
float get_dca3d_xy () const
void set_dca3d_xy (float dca3d_xy)
float get_dca3d_xy_error () const
    
```

```

virtual ~SvtxVertex ()
virtual void identify (std::ostream &os=std::cout) const
virtual void Reset ()
    Clear Event.
virtual int isValid () const
    isValid returns non zero if object contains valid data
virtual PHObject * CloneMe () const
    Virtual copy constructor.
virtual unsigned int get_id () const
virtual void set_id (unsigned int id)
virtual float get_t0 () const
virtual void set_t0 (float t0)
virtual float get_x () const
virtual void set_x (float x)
virtual float get_y () const
virtual void set_y (float y)
virtual float get_z () const
virtual void set_z (float z)
virtual float get_chisq () const
virtual void set_chisq (float chisq)
virtual unsigned int get_ndof () const
virtual void set_ndof (unsigned int ndof)
virtual float get_position (unsigned int coord) const
virtual void set_position (unsigned int coord, float xi)
virtual float get_error (unsigned int i, unsigned int j) const
virtual void set_error (unsigned int i, unsigned int j, float value)
virtual void clear_tracks ()
virtual bool empty_tracks ()
virtual size_t size_tracks () const
virtual void insert_track (unsigned int trackid)
virtual size_t erase_track (unsigned int trackid)
    
```

Useful resources

- ▶ Recommendation:
 - Event TTree evaluator for quick analysis [Ralf's talk]
 - User analysis module accessing DST for full access and more complex analysis [Joe's talk]
- ▶ Search any class/function/key words <https://ecce-eic.github.io/doxygen/>
- ▶ <https://ecce-eic.github.io/>
- ▶ <https://github.com/ECCE-EIC/tutorials>
- ▶ ECCE Fun4all chats: <https://chat.sdcc.bnl.gov/ecce/channels/fun4all-ecce>
- ▶ ECCE simulation office hour: <https://indico.bnl.gov/category/346/>
- ▶ ECCE simulation workshops <https://indico.bnl.gov/category/344/>