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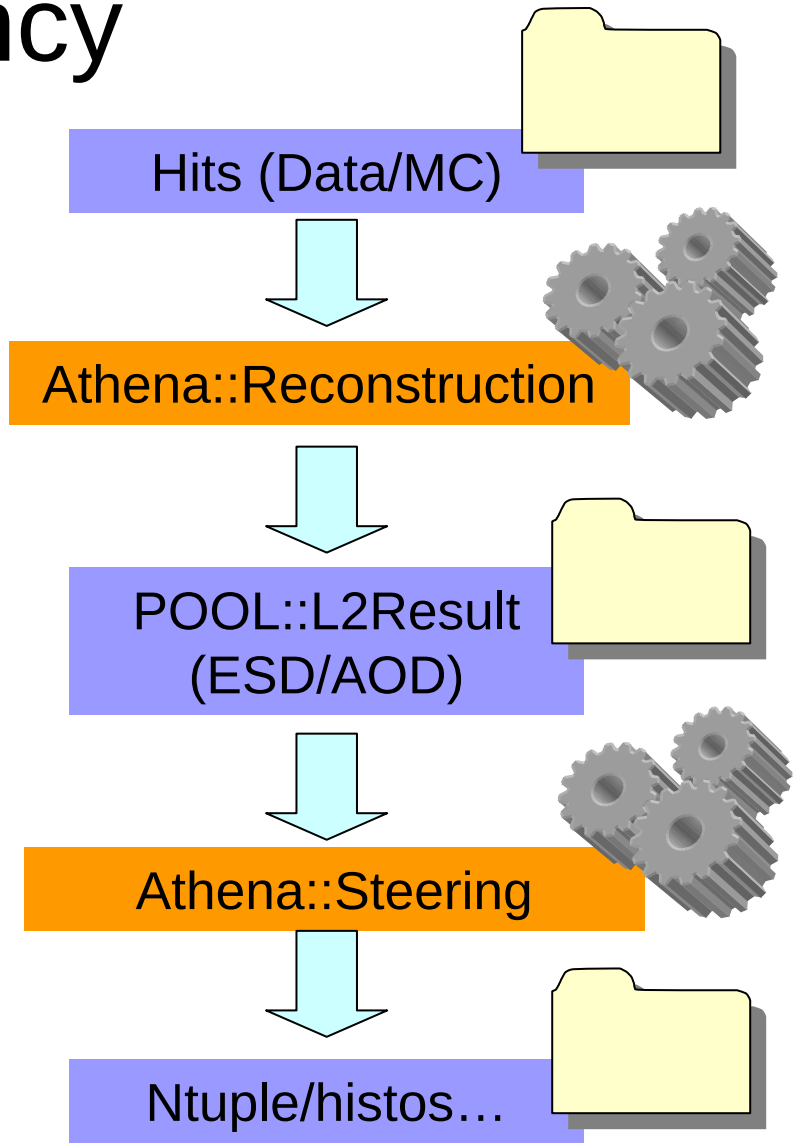
Truth & Persistency…

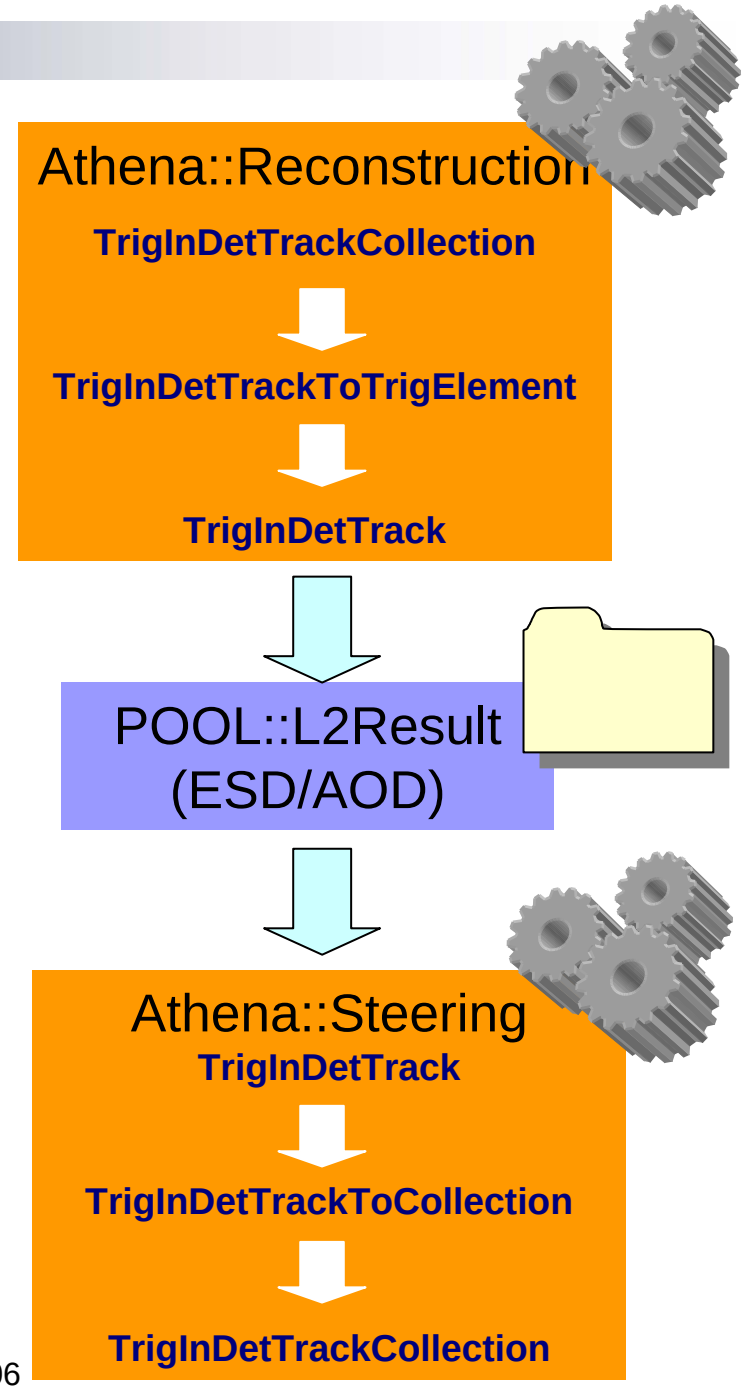
- Level 2 track persistency
- Track-truth association

LVL2 track persistency

- The work is “in a state of flux”…
- **`TrigInDetTrack`** “persistifiable” in POOL and “serializeable” in **`L2Result`**
- This just means that it creates its own dictionary and that the right data members are made transient (i.e. no space points or drift circles are stored for now)
- The working model is that LVL2 tracks should be put into **`L2Result`** to facilitate running the Steering (hypothesis algos only) from ESD/AOD
- This is connected to functionality available in the steering serializer: no serialization of **`std::vector<>`** at the moment => temporary solution now (almost) available



- Must “copy” instances of tracks from existing **`TrigInDetTrackCollection`** and attach them to **`TriggerElement`** so that the Steering finds and serializes them
- This means they must also be de-serialized from the **`L2Result`** in the ESD/AOD and pushed back into new **`TrigInDetTrackCollection`**
- These tasks accomplished by new HLTAlgos **`TrigInDetTrackToTrigElement`** and **`TrigInDetTrackToCollection,`** soon to appear in **`TrigTools/TrigInDetTrackUtils`**.
- **`TrigInDetTrackToTrigElement`** Is a HLTFexAlgo to be run at serialization time
- **`TrigInDetTrackToCollection`** Is a HLTHypoAlgo to be run at de-serialization time
- These classes exist and have been partially tested



Track-truth association

- Two parts to the problem:
  - Classes to code the association
    - To appear soon in **`TrigTruthEvent/TrigInDetTruthEvent`**
  - Algorithm to find the associations and instantiate objects
    - To appear soon in **`TrigAnalysis/TrigInDetTruthAlgs`**
- Need objects which associates each TrigInDetTrack with more than one GenParticle: **`TrigInDetTrackTruth`**
- Need class to define which association object is related to each track (essentially a std::map<track tag, association obj tag>): **`TrigInDetTrackTruthMap`**

TrigInDetTrackTruth

```
class TrigInDetTrackTruth {

 public:
  TrigInDetTrackTruth();
  TrigInDetTrackTruth(const HepMC::GenParticle* p_tru_part,
                      double chi2, int n_hits);
~TrigInDetTrackTruth() { };

  // accessors: to fill object
  void  addMatch(const HepMC::GenParticle* p_tru_part,
                 double chi2, int n_hits);
  // to get quantities
  const HepMC::GenParticle* bestMatchChi2() const;
  const HepMC::GenParticle* bestMatchHits() const;
  const HepMC::GenParticle* truthMatch(unsigned int i) const;
  int    nrMatches()                   const;
  int    nrCommonHits(unsigned int i) const;
  double matchChi2(unsigned int i)    const;

private:
// reference best match quantities
 double best_match_chi2;
  int    best_match_hits;
// vector of HepMC::GenParticle pointers and matching quantities
  std::vector<const HepMC::GenParticle*> m_true_part_vec;
  std::vector<double> m_match_chi2;
  std::vector<int>    m_nr_common_hits;
};
```

- Association figure of merit to be given by number of common hits between GenParticle and TrigInDetTrack and by Chi2 (can this be done? How?)

TrigInDetTrackTruthMap

```
class TrigInDetTrackTruthMap {

 public:
  TrigInDetTrackTruthMap() { };
  ~TrigInDetTrackTruthMap() { };

  /** accessors to fill map */
  void  addMatch(const TrigInDetTrack*      p_trig_trk,
                 const TrigInDetTrackTruth* p_trig_tru)

  /** methods to get truth-match objects */
  // returns true if truth association exists for track
  bool hasTruth(const TrigInDetTrack* p_trig_trk)

  // returns the track truth association object
  const TrigInDetTrackTruth* truth(const TrigInDetTrack* p_trig_trk)

  // to make the map more useful: return the GenParticles which better match this track
  // ...according to chi2
  const HepMC::GenParticle* bestChi2Match(const TrigInDetTrack* p_trig_trk)

 private:
  // code this up as a map for fast lookup
  std::map<const TrigInDetTrack*,const TrigInDetTrackTruth*> m_truth_map;

/*   std::vector<const TrigInDetTrack*>     m_trig_track_vec; */
/*   std::vector<const HepMC::GenParticle*> m_true_part_vec; */
/*   std::vector<bool> m_track_has_truth_vec; */
};
```

```
TrigInDetTrackTruthMaker DEBUG Recording truth map to StoreGate with key
TrigInDetTrackTruthMap
TrigInDetTrackTruthMaker DEBUG GetTruthMaps() : Retrieved PixelSDO_Map
TrigInDetTrackTruthMaker DEBUG GetTruthMaps() : Retrieved SCT_SDO_Map
TrigInDetTrackTruthMaker DEBUG GetTruthMaps() : Retrieved TRT_SDO_Map
TrigInDetTrackTruthMaker DEBUG TrigInDetTrackCollections retrieved
TrigInDetTrackTruthMaker DEBUG Doing TrigInDetTrackCollection 0
TrigInDetTrackTruthMaker DEBUG Doing TrigInDetTrack 0
TrigInDetTrackTruthMaker DEBUG TrackTruth() : TrigInDetTrack has 7 SiSpacePoints
TrigInDetTrackTruthMaker DEBUG TrackTruth() : SCT Space Point3 R: 298.228 phi: 6.27738 z: -3.
TrigInDetTrackTruthMaker DEBUG TrackTruth() : SP-id: InnerDetector SCT barrel layer 0
phi_module 0 eta_module -4 side 0 strip 0
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Doing cluster 0 in SP
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : cluster-id: InnerDetector SCT barrel layer 0
phi_module 0 eta_module -4 side 1 strip 318
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : cluster 0 has 2 RDO identifiers
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Doing RDO nr 0
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : RDO 0 in cluster 0 has 1 deposits
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Doing deposit 0
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Deposit 0: kine 10001, event index0, energy
deposit 25873.2
HepMcParticleLink         INFO cptr: Using TruthEvent as McEventCollection key for this job
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Added particle to vector: 1 matches so far
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Doing RDO nr 1
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : RDO 1 in cluster 0 has 1 deposits
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Doing deposit 0
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Deposit 0: kine 10001, event index0, energy 9608
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Doing cluster 1 in SP
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : cluster-id: InnerDetector SCT barrel layer 0
phi_module 0 eta_module -4 side 0 strip 349
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : cluster 1 has 2 RDO identifiers
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Doing RDO nr 0
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : RDO 0 in cluster 1 has 1 deposits
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Doing deposit 0
TrigInDetTrackTruthMaker DEBUG SCTspTruth() : Deposit 0: kine 10001, event index0, energy 14.9
```

Summary

- TrigInDetTracks can be serialized into the L2Result: tests in progress
- Truth association under development
- My philosophical questions so far:
  - Need to find how to evaluate association Chi2: missing position of HepMC::GenParticle energy deposit
  - Need unique identifier for GenParticles (kine/barcode may or may not be ok)
  - Would be good to have unique identifier also for TrigInDetTracks if the association is to be de-serialized