TruthHelper – Predicates for selecting particles
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The installed library TruthHelper in Generators/GenAnalysisTools/TruthHelper provides a set of predicates that can be used in order to select partilces of certain types. It runs against the HepMC events that are produced either by GeneratorModules or GenzModule and hides the complex status codes from the user.

The available predicates are as follows

- IsGenerator returns true on particles that were part of the event that came from the event generator. Partilces produced by Geant are returned false

- IsGenNonInteracting returns true on neutrinos and other non interacting particles such as those from supersymmetry. It returns a complete list including any geant secondaries. Is has more partilces than results from the combination of IsGenStable and a subseqent selection on the IsGenNonInteracting PDG ID codes.

- IsGenStable returns true on all stable particles. In the case of events from GenzModule these are all the partilces that are passed as input to Geant as either non-interacting or as particles that are subsequently interact and decay in Geant

- IsGenSimulStable returns true on all stable particles during generation and simulation

- IsGenInteractinging is a subset of IsGenStable that excludes non interacting particles. It includes electrons, photons, muons, and hadrons that are considered as imput to geant such as pions, kaons and K_L.

- IsGenType allows a list of PDG ID codes to be specified and returns true on all the partilces in the record (independent of their status codes) that have these the specifed code (or its negative) For example code 11 would return all electrons and positrons including those from Geant showers. Code 24 would find all the W bosons, (including any maked as documentaries which may not be physical)

- IsConversion returns true for the particles that convert into the e^+e^- pair

- isBremsstrahlung returns true for the input particles in the Bremsstrahlung process

An example of the use of these predicates can be found in GeneratorModules/src/TruthDemo.cxx which makes a histogram of all the stables and shows that the total energy of these is the CM energy of the PP collision. The critical code parts are

```
StatusCode TruthDemo::initialize(){
......
  m_tesIO = new GenAccessIO();
```

which provides access to the event

```
StatusCode TruthDemo::execute() {
...
 float totenergy = 0.;
  float pxbalance = 0.;
  float pybalance = 0.;
    // Iterate over MC particles  We are using the IsGenStable predicate from
    IsGenStable ifs;
  vector<const HepMC::GenParticle*> particles;
  StatusCode stat = m_tesIO->getMC(particles, &ifs);
  for (vector<const HepMC::GenParticle*>::iterator pitr = particles.begin();
       pitr != particles.end(); pitr++) {
    pxbalance += (*pitr)->momentum().x();
    pybalance += (*pitr)->momentum().y();
    totenergy += (*pitr)->momentum().e();
```

which is summing up the momentum and energy of all the stables.