Simulation output

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It has been proposed to create a simulation framework that writes directly to ROOT files. What should these files contain?

It would be convenient to write one or both (user selectable) of two trees: One with an entry for each event, the other with an entry for each hit. The former would contain arrays of hit data. In the latter, some event information could be included in each entry.

Tree and branch names should be short, consistent, and self descriptive. They should be easy to use interactively!

For a given hit we might want five general kinds of information, about:

- Detector information about hit (energy deposition and/or digitized signals, detector ID, plane/sector/module ID within detector)
- The hit itself (truth values)
- The event as a whole (e.g. run number, event number, weight)
- The primary interaction (truth values; note that if we merge signal and background hits, they will generally have different primaries.)
- The trajectory from primary to hit (truth values)

The last item requires the simulation to store and output trajectories, which should be available as a user option. As a further option, full trajectory information could be stored to the tree, or just information about the immediate mother.

The detector and plane/sector/module IDs presumably would be encoded in a GEANT volume ID (which could also be written out)

Truth values for the hit could include:
- Average position
- Entry position
- Exit position
- Entry time
- Exit time
- Energy, momentum vector at entry
- Energy, momentum vector at exit
- Sector
- Particle ID
- Track ID
- Mother ID

Given our geometry I would argue positions should be given in cylindrical coordinates and momenta in spherical coordinates. x and y components are rarely useful! The sector (which of the 30 pie slices) is redundant with azimuthal position but is useful to have separately especially for detectors not segmented into sectors.

For the primary and the trajectories:

- Vertex position
- Energy, momentum vector at vertex
- Time
- Particle ID
- Track ID
- Volume ID

- Interaction process
- Mother ID