Overlaying Events

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Overlaying Events

- Will want to be able to study the impact of information recorded in sensitive detector elements which correspond to particles from either previous or future events.

- Process will have to be subdetector-specific, as different detectors have both different sensitivities and different time windows.

- Will need to be able to do this for both simulated and real data.

LCIO Command line tool

- LCIO installation provides a command line tool which allows objects from different events to be combined into common collections, with time offsets.

- SimTrackerHits are added to detector collections with time offsets.

- SimCalorimeterHits are either added to existing readout cells, with time offset, or new cells are created.

- All hits are combined.

lcio Command Line tool

```
> lcio merge
The merge command requires one of the -i or -f options.
usage: LCIO Merge command
merge command
 -i    Set input file list with format:
       [file_name],[n_reads_per_event],[start_time],
       [delta_time],[<reads> poisson]
       This option is not usable with the -f argument.
 -T    Set the starting time (ns).
 -e    Set number of events to merge in from each input
  file per merged event.  (Default is 1)
 -f    Add an input file.
 -h    Print merge usage.
 -n    Set maximum number of output events.
 -o    Set the output file.
 -t    Set delta time (ns).
```

org.lcsim Driver

- lcsim/src/org/lcsim/util/**OverlayDriver.java**
- A Driver which provides much finer control over the merging process.
- Extensively used in CLIC CDR studies where multiple sources of backgrounds need to be accommodated
  - $\gamma\gamma \rightarrow$ hadrons
  - μ from upstream beam interactions
  - coherent e^+e^- pairs from beam-beam interactions

OverlayDriver

- Can apply subdetector-specific merging such as:
    - time-windows
    - time-of-flight corrections
- Can also be custom written for specific application, such as HPS.
    - Need to understand what the needs are.

Handling Time Structure

- Currently, all MC hits occur at one instance of time.

- Digitization code takes delta function and convolutes it with detector response, electronics processing, readout etc.

- TrackerData allows a vector of data to be stored
  - e.g. FADC spectrum for TPC channel

- CalorimeterHit currently does not, but could be associated with LCGenericObject via relation

- Or new LCIO class could be introduced, if needed

Event Overlay Infrastructure

- Infrastructure to handle event overlays, including customized time offsets and windows exists.

- LCIO Tracker raw data class good candidate for HPS data usage

- LCIO CalorimeterHit currently does not natively support a time spectrum for the raw data
  - could do so via LCRelation
  - new class could be developed

- Custom HPS code will need to be developed.

- Looking forward to defining requirements & developing design at next week's software meeting.