Physics Simulation Processing

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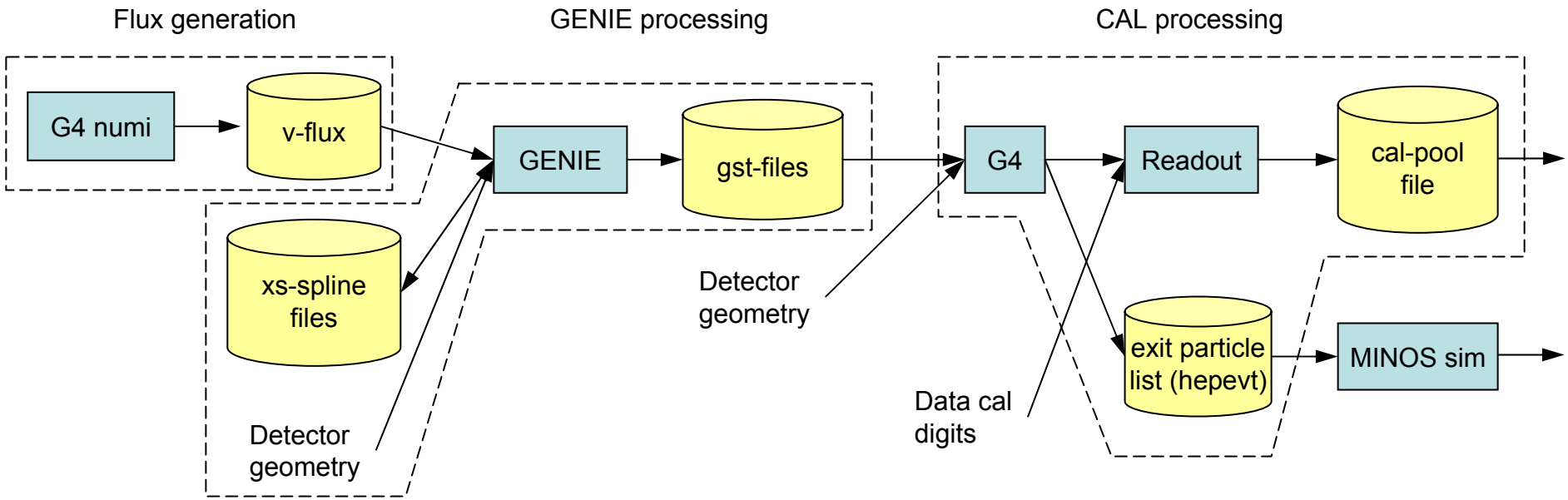
Minerva data management review

Simulation



- G4 numi: G4 NuMI beamline simulation
- GENIE: Neutrino interaction generator (v2.6.2)
- G4 for detector simulation

GENIE Processing

- Cross-section spline file need to be generated first depending on
  - Types of nuclei (~10 nuclei)
  - Version of GENIE
- GENIE processing is much faster compared to cal processing
  - We don't run GENIE processing very often unless we have new version of GENIE or new version of geometry
- We use central value (CV) reweight to apply newer version of flux
  - Don't need to reprocess cal and reco when we update the flux
  - Currently Flux CV calculation is performed at ana processing but in the future, it'll be done directly on flux ntuple files
    - It allows Flux CV calculation in experimental neutral way

Flux files

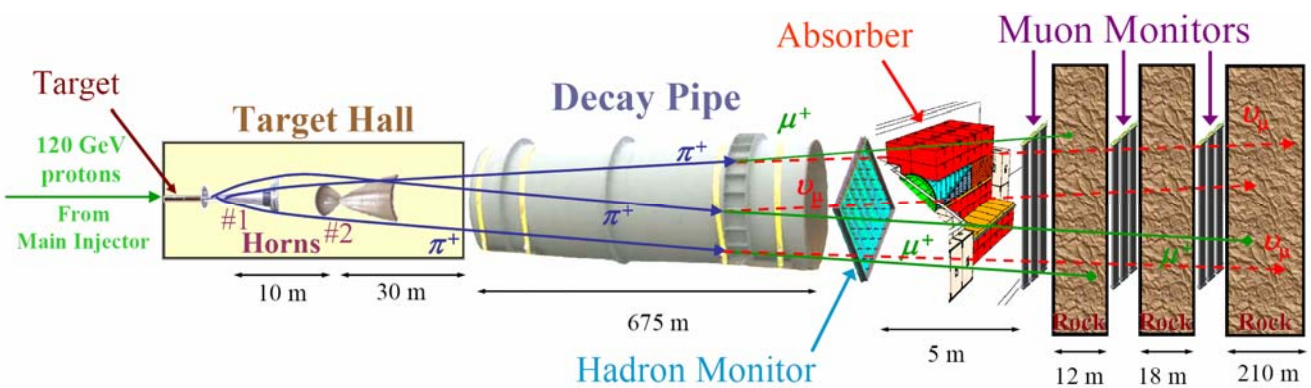
- 500 flux ntuple for each beam configuration
  - Each flux ntuple file: 190MB
  - Each beam configuration: 90 GB in total
  - ~10 beam configurations

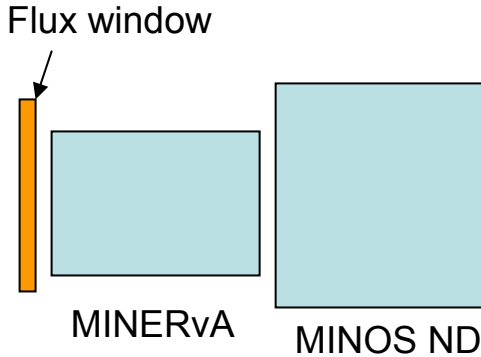
GENIE Output

- Per subrun (file)
  - POT: 1E17
  - ghep root file: 3.3 MB
  - Number of events: ~ 1800

- 7E20
  - POT: 7E20
  - ghep root file: 22 GB

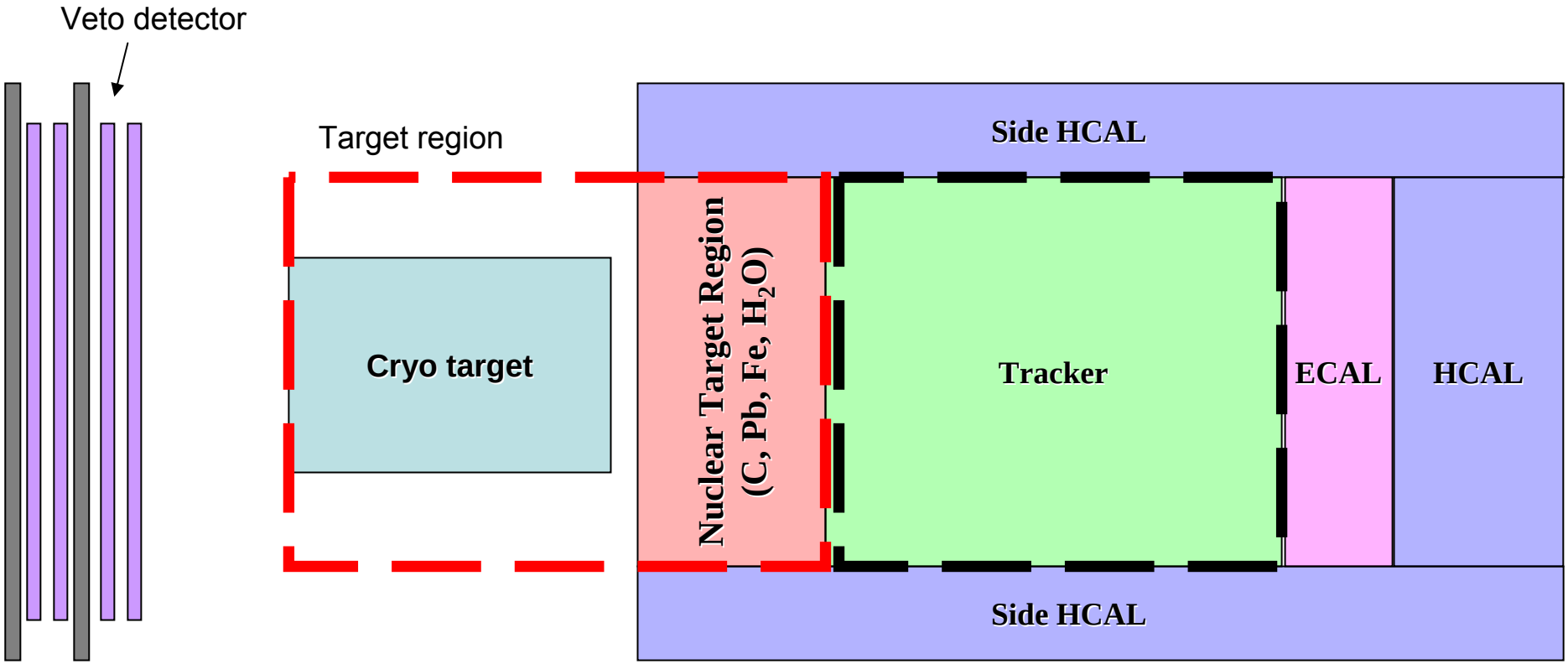
GENIE





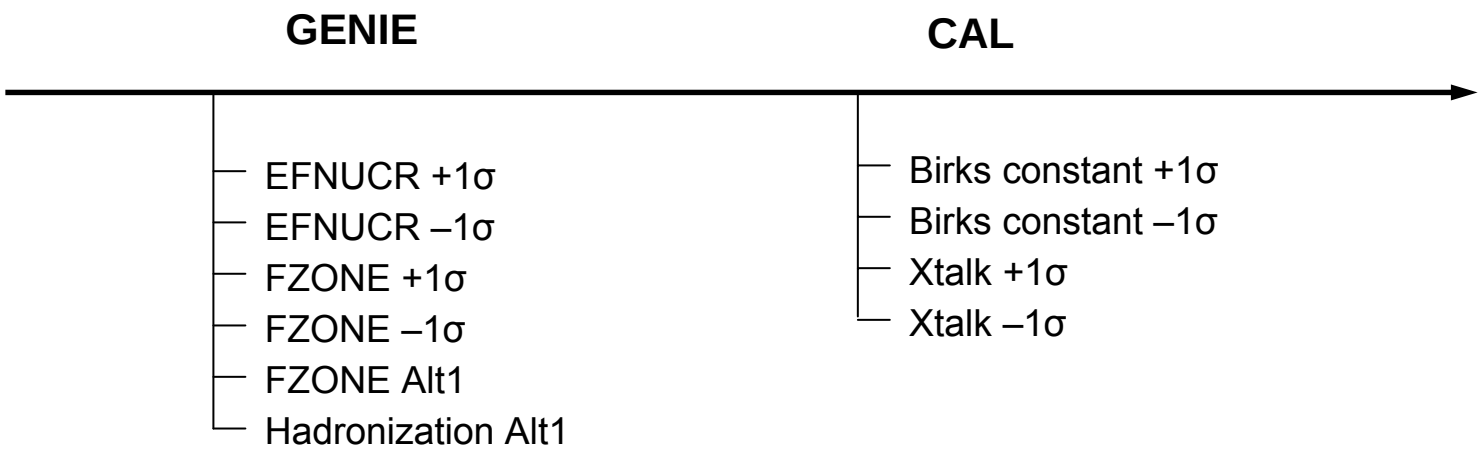
- Flux window is placed in front of minerva detector
  - If neutrino pass through the window, it tries to generate the interaction in the minerva detector
- Run/subrun numbers are used for random number seed in GENIE
  - Run/subrun numbers are uniquely used for each run period (playlist)
  - Playlist can have different beam configuration (or minerva geometry configuration)
- POT per GENIE file is chosen to have reasonable number of events (~2000) per file
- Need to generate separately for each geometry configuration
  - Geometry configuration changes over time

Geometry Configuration



- Interactions in Tracker and Target region are events of interest
- Target region configuration varies over time
  - Water filled or empty
  - Cryoto target filled or empty
- Data-overlay is used to mimic the event overlap and electronics dead time

MC Variation



- MC variation for systematic uncertainty study
- GENIE provides extensive reweight parameters but there are some parameters that are not reweightable
  - Need parallel MC sample for non-reweightable parameter in GENIE

Meta data

- File name
  - Run / subrun number
  - Data tier
  - Tag name (for MC variation or user tag)
- Run number (6 digits)
  - Playlist (beam mode)
  - Geometry
- Subrun number: 1-200