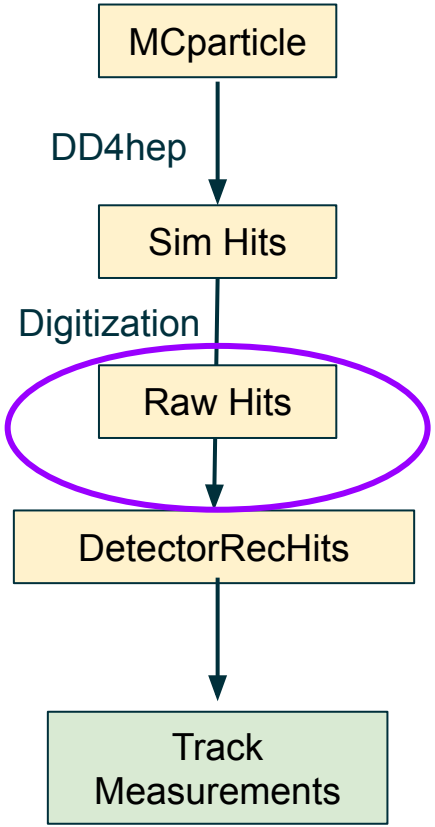
How to insert random noise hits to simulation



- **Approach 1:**
  - Based on DD4hep segmentation of pixels
  - Randomly generate cell ID → position on surface
  - **Challenges:**
    - Need to know a valid cell ID range
      1. Pre-define the range by inspecting the cell ID distribution (as Mito presented)
         - Issue: not scalable
      2. Generate cell ID, then use dd4hep volume manager to check if it's valid
         - eicrecon/si_noise_hits (PR 1643)
         - Issue:
           slow (64 bit phase space)
           Valid cell id != valid hit on surface

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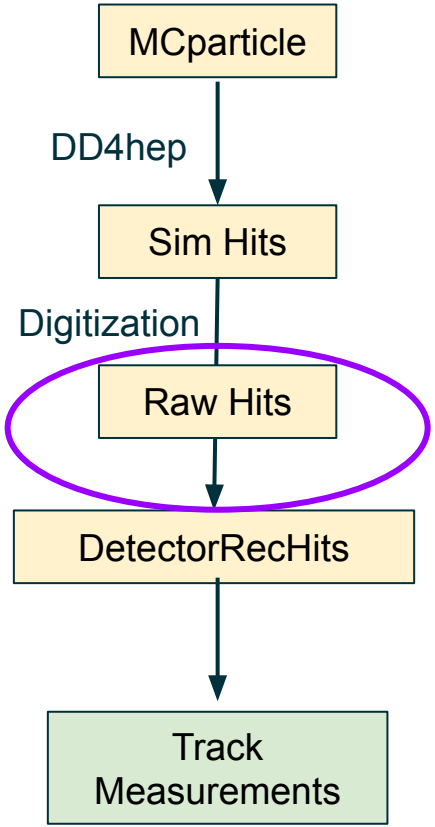

- **Approach 2:**
  - Suggestions from DD4hep experts: https://github.com/AIDASoft/DD4hep/issues/1335
  - Access volume/surface boundary, calculate the valid position range → pick a point and convert to cell ID. Expected to work for simple geometry
  - See more discussions on ePIC mattermost/eicrecon
  - **Challenges:**
    - Dedicated development and test needed
    - Not sure if it can handle tiles and inactive areas

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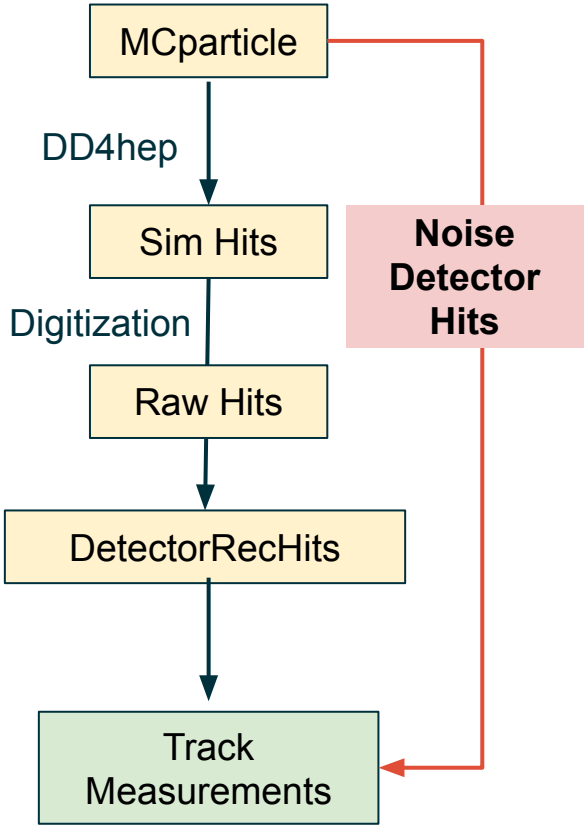

Alternative approach

- Generate random event sample with dd4hep
  - Effectively randomized (Q: how to uniform in R and Z)
  - DD4hep takes care of surface check and validation
  - Extract hits per detector

- In EICrecon:
  - For every event:
    - For each detector,
      - Randomly decide a starting index i
      - Pick i to i+N hits from the noise sample
      - Save it in measurements as e.g. VertexTrackerNoiseRecHits

Pros and Cons:

- Minimal software development.
- Need pre-generated noise sample.
- Only fit for dedicated study (like the background study). Won't change the default simulation campaign results.