eRD6 Tracking Simulation Tools

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Tracking Simulation Needs

Simulation Needs

1. Various types of digitization schemes supported by the track fitting code
   - TPC
   - U-V (planar trackers, i.e. GEMs)
   - Z-ϕ (cylindrical trackers, e.g. cylindrical $MPGD$)
2. Track fitting code should available and usable
   - No hard coded detector lists or sensitive volumes
   - Automatic geometry match along the simulation -> digitization -> reconstruction chain
3. Symmetric access to simulated (truth) and reconstructed quantities
   - e.g. track parameterizations at various locations
4. Material scans
5. Easy to use vertexing
6. Suite should be modular so swapping detectors in and out does not require a lot of effort such as making changes in multiple places and needing to constantly recompile.
7. Continent way to implement background related to beam intensities and interaction rates.

Tracking Detector Geometries

- Simulation geometry and digitization parameters should avoid being hard coded such as drift length, pitch, U-V angle, etc.
  - Geometry and digitization parameter values listed represent nominal values.
- Tracking Endcap Detectors
  - **GEM Trackers**
    - Several planar layers placed at the endcaps
      - EIC Common GEMs are based on trapezoidal shape (dimensions should be adjustable, i.e. lower/higher width, opening angle, etc.)
        - ➢ Nominal values: 30.1° opening angle, Length = 904 mm, small width = 43 mm, large width = 529 mm
      - 12 trapezoids can be arranged to form GEM wheel/disk
    - Digitization: U-V readout strips with adjustable resolutions
  - **GEM-TRD**
    - Will sit between RHIC and colorimeters to provide seeding for RHIC ring and additional dE/dx to discriminate between e/π
    - Triple-GEM detector operating in mini-drift (μTPC)
    - Drift gap uses XeCO2 and is about 3 cm (this should be adjusted by the user)
    - dE/dX used to discriminate between e/π
    - Digitization: u-v readout strips
      - Several hit points within the gas gap. How many?
        - ➢ Hit points and resolution vary with track angle entering the detector. How to implement?
        - ➢ Can these hit points be fit and form tracklets and obtain a track pointing vector?

Tracking Detector Geometries

- Tracking Central Detectors
  - **TPC (central region)**
    - Similar parameters as sPHENIX TPC
    - Need to assess dE/dX performance – **critical** for PID at EIC
  - **Cylindrical MPGD ($\mu RWELL$) for fast timing operating in mini-drift (μTPC) mode**
    - Surround TPC
    - Allow for variable detector radius, length, and gas gap thickness
      - Nominal Values: radius = 80 cm, length = 2 m, gas gap = 3 cm
    - 2 digitization schemes to study
      - 1st Digitization scheme: Readout will be a Z-ϕ strips placed on the outside of the MPGD cylinder
        - Z and ϕ resolutions should be adjustable
          - Nominal resolutions: 100 μm
      - 2nd Digitization scheme: Readout will be a U-V strips placed on the outside of the MPGD cylinder
        - U and V strips have pitches of 400 μm, and angle between them is 90° (oriented 45° wrt detector sides) (should be easily adjustable)
        - U strip width = 80 μm, V strip width = 340 μm (should be easily adjustable)
          - Nominal resolutions: 100 μm
    - **Mini-drift** mode:
      - Cylindrical MPGD will operate as a mini-TPC with drift gap around 1-5 cm. This should be adjustable.
      - Several hit points within the gas gap. How many?
        - Hit points and resolution vary with track angle entering the detector. How to implement?
        - Can these hit points be fit and form tracklets and obtain a track pointing vector?
      - Will provide directional information for DIRC