TPC Detector Simulators

TPC Fast Simulator &
TPC Response Simulator

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ALICE-STAR Joint Meeting

TPC Simulators

- Simulate response of TPC Detector volume
- Relevant processes
  - Ionization Drift
  - Amplification in Sense Wires
  - Pad Plane Signal Generation
  - Readout Electronics

Current Simulators

- Fast Simulator : **TFS**
  - Fortran based
  - Extensively exercised
  - Fast, but not very detailed
- Slow Simulator : **TRS**
  - **C++ based**
  - **More detailed breakdown of interesting processes**

VERY Fast slide on TFS

- Geant Hit → Signal
- 2 Widths: σ_{prf} & σ_z
  - Intrinsic Pad Response
  - Drift Length
  - Pad Crossing Angle
  - Sense Wire Spacing
  - Diffusion, Trans. & Lon.
  - Electronics Shaping Time & Sampling Frequency

- Geant Hit→Positions
  - Gaussian Smear = f(σ_{prf})
  - Hit Merging = f(σ_{prf} , σ_z)

- TFS Output → Tracking

TRS: Factorization & OO

- Is it possible to factorize the processes occurring in the chamber?
- Study each process individually
  - Each process a different base class
  - Algorithms for a particular process are implemented in derived classes

TRS : Processes

- Charge Transport
- Charge Collection
- Analog Signal Generation
- Electronics Response & Digitization

Charge Transport

- Transport charge (sub-)segments to sense wires. with field cage electrostatics ...
  - ★Field Cage Structure
  - ★E & B Field Maps
  - ★Wire Grid Transparency
- ... and Gas properties
  - ★Drift velocity
  - ★Diffusion & Absorption

Analog Signal

- Induced Charge on Pad
  - Gas Gain Amplification
  - Gas Gain Saturation
  - Cross coupling between adjacent rows
  - Noise generation
- Implementations, e.g. induced charge:
  - "Slow"
    - Image charge integral at the single electron level'
  - "Parameterized"
    - Pad response function

Electronics Response

- Amplification & Gain
  - Analog shaping response & time
    - Gaussian, Asymmetric Gaussian, convolution of shaper response funct. w/ longitudinally diffused cluster.
  - Sampling of signal
  - Distribution of charge into time bins
- Digitization
  - Analog to Digital Conversion
  - Zero Suppression

Status & Summary

- Algorithms being tested, debugged & refined (comparison w/ cosmic ray data)
- Separation of Parameters & Algorithms
  - DB → Geometry, Gas, Calibration parameters
  - Coordinate Transformations
    - Placed DB Utilities area for general use
- Speed up Algorithms (~20 min/Central Hijing)