Update on PXD Digitizer - SiPxlDigi

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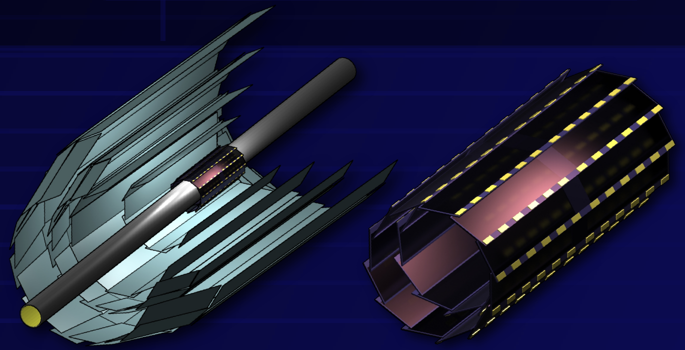


Overview

- **Update on SiPxlDigi (Marlin PXD digitizer):**
  - New proper clustering procedure implemented (code fixes since Depfet meeting in Prague, Jan 2010)
  - MCParticle "weighing" according to deposited energy implemented
  - Correct fluctuations of energy loss in Si implemented (code fixes)
  - Influence of ADC (Analog-To-Digital Converter) implemented, i.e. effects of "digital noise" implemented

Update on SiPxlDigi - New Clustering

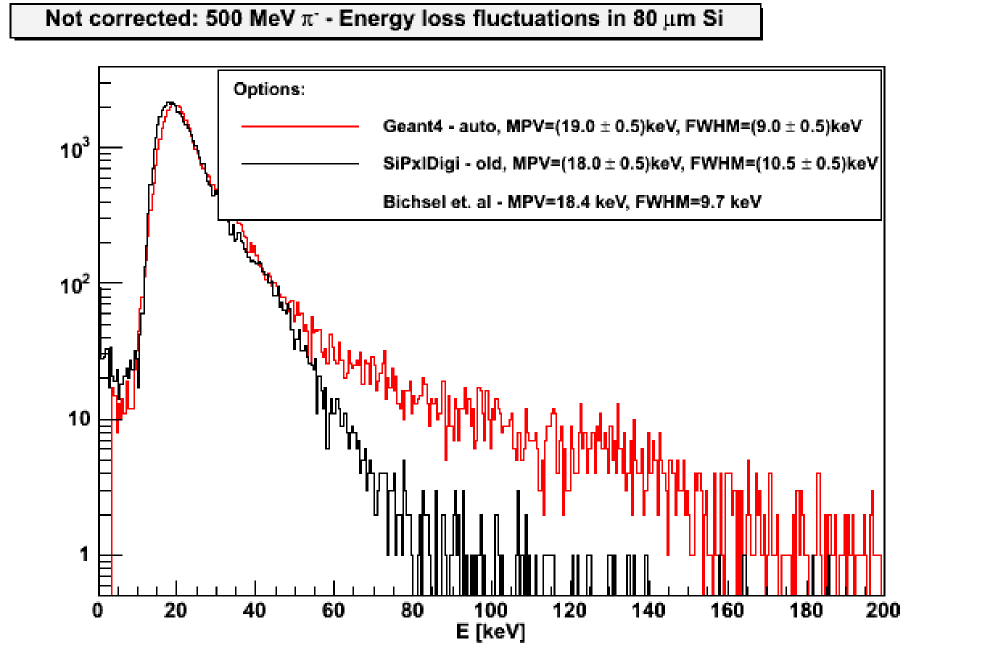
- **New clustering algorithm implemented – each SimTrkHit is not "digitized" step-by-step into TrkHit as before, but ...**
  - All hits are saved in memory
  - Based on S/NAdjacent cut (2 sigma) noise hits are generated (only in sensors, where signal(s) already is(are) – to save CPU time)
  - Cluster seeds based on S/NSeed cut (5 sigma) are found + surroundings is searched → central part of new cluster defined
  - For each cluster other adjacent pixels are found (based on S/NAdjacent cut) and added
  - R-Phi & Z projected positions calculated – 2 algorithms implemented:
    - Cluster size <= 2 → COG (center of gravity – no etha correction)
    - Cluster size > 2 → Analog head-tail algorithm
  - 3D position calculated, MC information + weight on each particle saved
  - TrkHit created

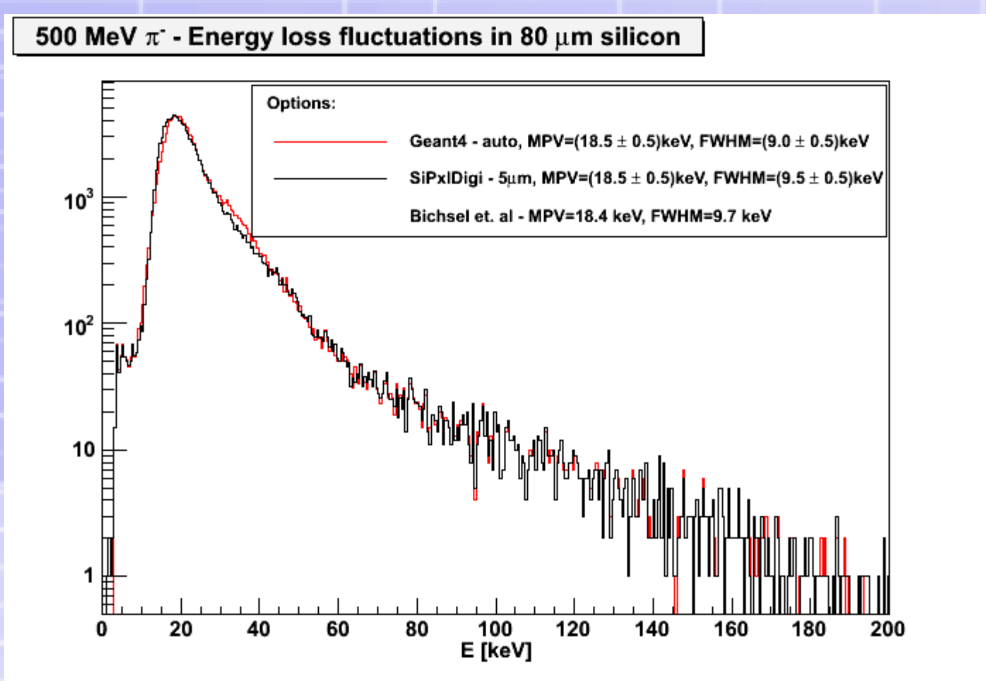
Update on SiPxlDigi – Energy Loss Fluctuations

- **There exist 2 different ways how to incorporate energy loss fluctuations – using Geant4 or <u>direct impl. in the digitizer</u> ...**
  - Geant4 particles in Si lose their energy continuously and/or produce secondary particles (preset product. thresh. cut= 80keV ~ range cut= 50μm)
  - Geant4 total continuous energy loss fluctuates → described by different models, here G4UniversalFluctuations used (simple physics model of atom)
  - SiPxlDigi uses the same phys. model (adapted Geant4 class for SiPxlDigi & Si material) → control of space precision /wo impact on CPU, size of data-files)
    - particles w/ $\beta\gamma >= 2$ – Energy loss fluctuations performed in SiPxlDigi (5μm step-size set)
    - particles w/ $\beta\gamma < 2$ – Energy loss fluctuations performed in Geant4, deposited energy is then distributed uniformly along the path (delta-electrons, ...)
    - <u>Parameters:</u> threshold cut for secondaries = 80 keV (same as in Geant4), dE/dx|min for Si = 305 keV/mm

Update on SiPxlDigi – Corrected Energy Loss Fluctuations in Si

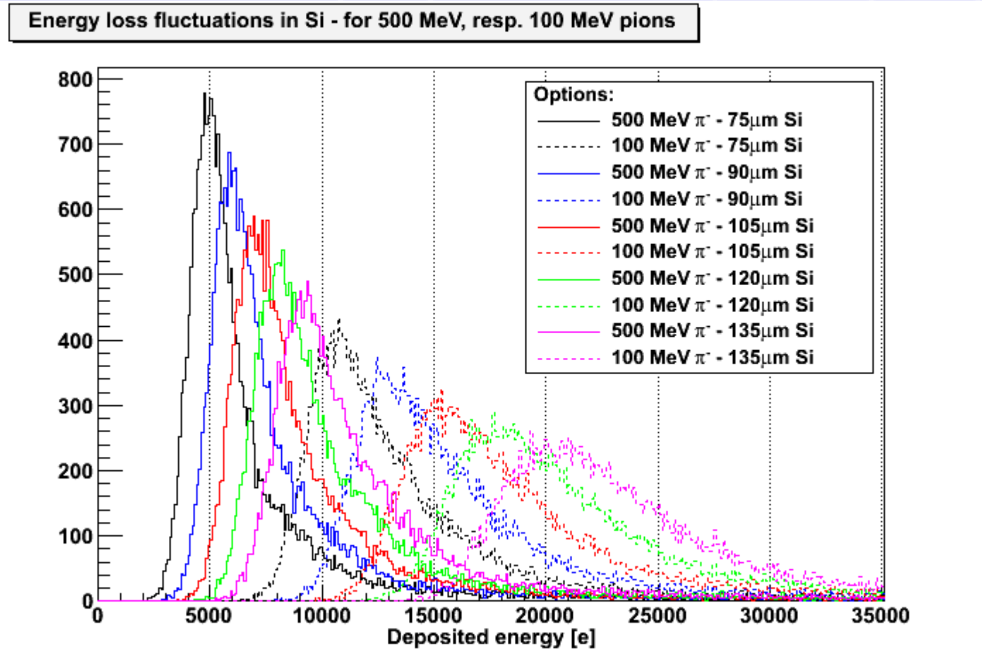
- **Studies of energy loss fluctuations in 80µm silicon - old x new ver.**
  - Geant4: step-size calculated automatically
  - SiPxlDigi: step-size set to 5µm
  - Results compared to straggling functions of Bichsel et. al . (Review of Part. Phys. 2009) → new version in good agreement!





Update on SiPxlDigi – Implementation of ADC & "Digital Noise"

- **ADC implementation …**
  - Parameters:
    - Range: 24 000e (~ 12µA, gq ~ 0.5nA/e → 24 000e), other options ~ 8µA, 16µA
    - ADC bits: 4, 6, 8 bits ADC
    - Noise range: 100e – 400e
  - Each pixel signal is recalculated in ADC units (1ADC ~ 24 000e/2^nBits) → let's do some calculations:
    - 1 ADC for 8 bits ~ 94e
    - 1 ADC for 6 bits ~ 375e
  - Clustering parameters for seeds & adjacent pixels are introduced in ADC units as well → "digital noise" introduced
  - Clustering procedure is then started

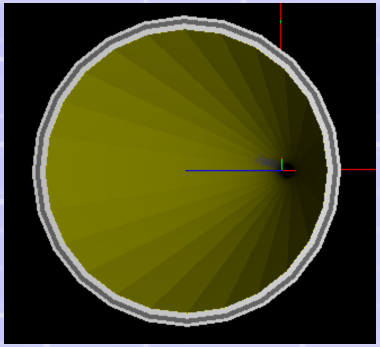


Summary & Plans

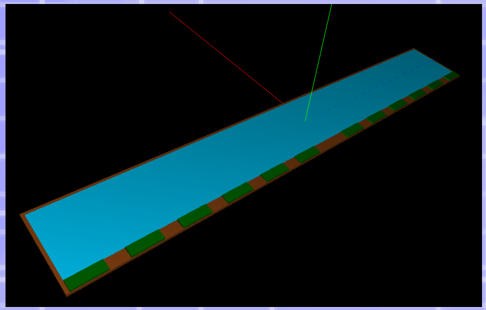
- **SiPxlDigi** → all we wanted is implemented !!! + well-documented !!!
  - Digitization: Landau + Poisson fluct., drift, diffusion, deflection in mag. field
  - Signal process.: random noise, ADC, Lorentz shift correction, clustering
- **Software develop. plans:**
  - Corrections of simulated diffusion process → B. Schwenker is working on that → see his presentation

Backup - Simulation BelleII - Mokka

- **Beam pipe:** cylindrical, "onion-like structure"
  - inner Au layer (10 μm), inner Be layer, paraffin (active cooling), outer Be layer



- **PXD:** 2 layers of DEPFET detectors organized in "wind-mill" structure ("layer" → "ladder" → "sensor + rims")



	R [mm]	# ladders	support
Pxl layer 0	14.00	8	no
Pxl layer 1	22.00	12	yes