The Si trackers in the LDC concept

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- Scope of the group charge
- Reminder of the Si tracking components in a LDC concept
- Common issues to all the Si tracker components
- Specific issues by component
- Prospects

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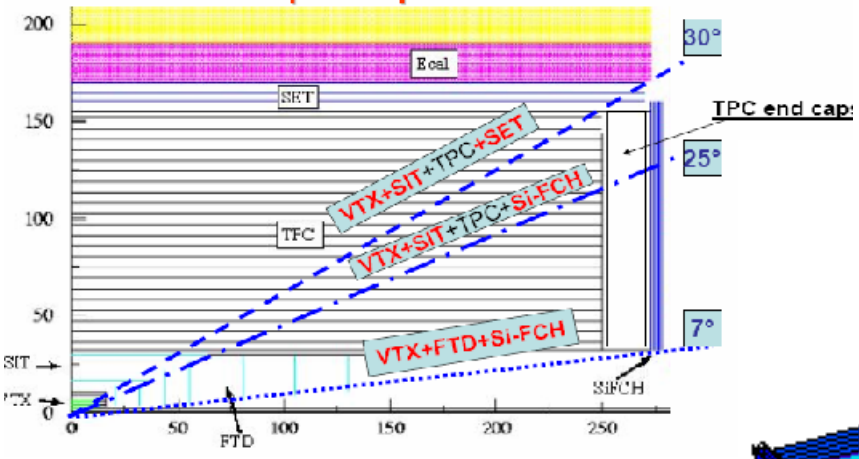
The groupe charge

Study of the role of the Si tracking in LDC

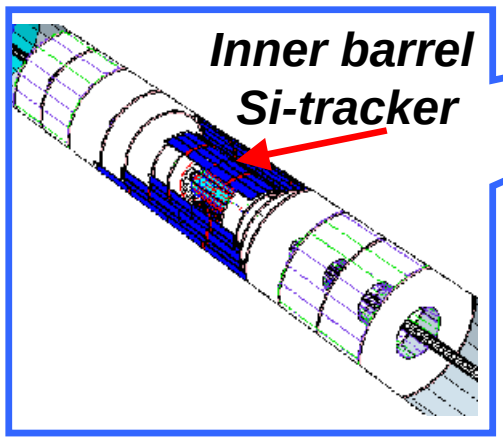
- How important are full Si tracking detectors in addition to the TPC.
- Especially how important is a ‘’complete’’ coverage in addition to the TPC?
- linkers versus trackers is the commonly voiced question

Reminder of the Si components in LDC concept

Crucial Keywords:
- ✓Robustness
- ✓Full coverage
- ✓Improved performances



The 4 Si-components = the Si-Envelope are included in the MOKKA framework (DB description)



Inner barrel Si-tracker

External barrel Si-tracker

TPC

Inner Forward Si-tracker

External Forward Si-tracker

The common issues

- Occupancies
- Alignment
- Time stamping
- Optimisation of number of layers vs material budget
- Length of strips
- Orientation of strips
- Integration issues with other subdetectors (cooling, power switching, mechanical supports, alignment)
- Use of Silicon trackers for handling distorsions, misalignments, calibration, extending tracking coverage
- Linking versus tracking role
- Robustness of the overall tracking system
- Impact on overall detector performances (see performance benchmark for each Si component).

The Silicon Inner tracker in the central barrel

This component must ensure the connection between two different detectors, e.g. Microvertex (2 to 3 µm spatial resolution) with the TPC (60 to 80 µm resolution). Besides it will extend the tracking coverage to 25° wrt beam axis and it improves the momentum resolution.

Specific issues for this component:

- Number of layers: increase to 3 layers?

  At Snowmass discussion with the µvertex group: favours 3 layers

  Physics interests: V0, kinks (intermediate long-life particles)

  R. Van Kooten will study the V0 case.

  Detailed studies on the impact of a 3rd layer on overall momentum performances, wrt increase in material budget just started.

- Length of strips:

  V. Saveliev' occupancies G4 studies tend to support low occupancies, thus 30 cm length looks reasonable. Further studies to extend up to 60cm in the outer layer.

- *Revisiting the occupancy estimate (DID + antisolenoids)*
- Services wrt to µvertex: electronics, cabling, slow controls, cooling, supports, routing of services

  Discussion with µvertex and TPC people:

  - addressing the possibility of a common cooling system and thus include this component as well as the endcap disks with µvertex in an overall common integration system.

  - deciding to follow as much as possible the cable routing of µvertex

  - adressing the minimization of the peak in material profile in the intersection region between barrel and endcap

  - Realistic estimate of Nb of fibers for signals & Nb of channels plus overall power dissipation, is undergoing based on the new FE readout chip produced by LPNHE.

- Integration issues wrt to TPC and the forward inner Si component

The Silicon Inner tracker in the forward region

This component will extend the tracking coverage to 7° wrt beam axis, in a region where there is a reduction in the TPC readout pads and indeed an important region for Physics.

Specific issues for this component:

- Technology choice:
  - First disks technology?

    At Snowmass discussion with the µvertex group: possibility to use the same µvertex pixel techno for the first 3 disks

  - Use different strip techno for the other disks (VELO LHCb R-PHI design) to be studied
- Crucial role in Luminosity measurement, resolution needed for Bhabha cross section?

  Discussion with W. Lohmann and Tel Aviv team: collaborative effort to be pursued
- Occupancies:

  V. Saveliev' occupancies G4 studies will be pursued *to include beam backgrounds (DID+ antisolenoids)*
- Impact on Physics: SUSY signatures, ex sleptons, two photons per se and as physics background, W pair production: *already addressed and will be further studied.*
- Services wrt to µvertex: electronics, cabling, slow controls, cooling, supports, routing of services
  - *Discussion with µvertex and TPC people: address the possibility of a common cooling system and thus include this component as well as the endcap disks with µvertex integration system*
  - *Decision to follow the cable routing of µvertex*
  - Minimization of the peak in material profile in the intersection region between barrel and endcap: to be further studied. *Need further intereactions with Microvertex and TPC as well as beam pipe design.*
  - *Realistic estimate of Nb of digital fibers for signal & total Nb of channels & power dissipation: achievable based on new FE chip produced by LPNHE.*
- Integration issues wrt to TPC and the forward inner Si component: *need further discussions with TPC team*
- Angular optimisation, depending on the beam delivery: *need further discussions with MDI team & Sonya*

A. Savoy-Navarro, LPNHE-Paris

The Silicon outer tracker in the forward region

This component ensures the connection between the central tracking and the e.m. calorimetry. It improves the momentum resolution and the overall tracking, in an region important region for Physics.

Specific issues for this component:

- Technology choice: projective or XUV layers? Number of layers?
- Issues on material budget:

  Evaluate the need to compensate the material budget in this region (all service routing and TPC end plate)
- Occupancies:

  V. Saveliev' occupancies G4 studies *will be pursued.*
- Cluster matching capability, PFA impact?
- Impact on Physics: *same issues as for the inner forward tracker*
- Integration issues wrt to TPC *(extending the level arm of the forward tracking vs shortening the TPC length)*
- Integration issues with the ECAL *(space allocation, mounting)*
- Angular optimisation, extending towards lower radius wrt beam axis this device: *collaborative effort with MDI, W. Lohmann & Co.*

The Silicon outer tracker in the central region

This component ensures the connection between the central tracking and the calorimetry in the barrel. It improves the momentum resolution and possibly other performances (see below).

Specific issues for this component:

- Number of layers? Strip length? *(revisit the SGV study & pursue GEANT based simulation)*
- How much better than a dedicated first layer in the em calorimeter? *(idem as previous point)*
- Issues on material budget: *optimisation with respect to the field cage especially when going away from the 90° region?*
- Occupancies:
  V. Saveliev' occupancies G4 studies *will be pursued.*
- Cluster matching capability, PFA impact? *(SGV & GEANT-based simulations studies)*
- Any need for preshower capability (pi0 separation?): *already studied with SGV, will be further addressed with detailed simulation.*
- Impact on Physics
- Integration issues wrt to TPC (reduction in the TPC radius) *(SGV & GEANT-based simulations studies)*
- Integration issues with the ECAL (space allocation, mounting) *(SGV & GEANT-based simulations studies)*

As an appetizer…

before Vienna

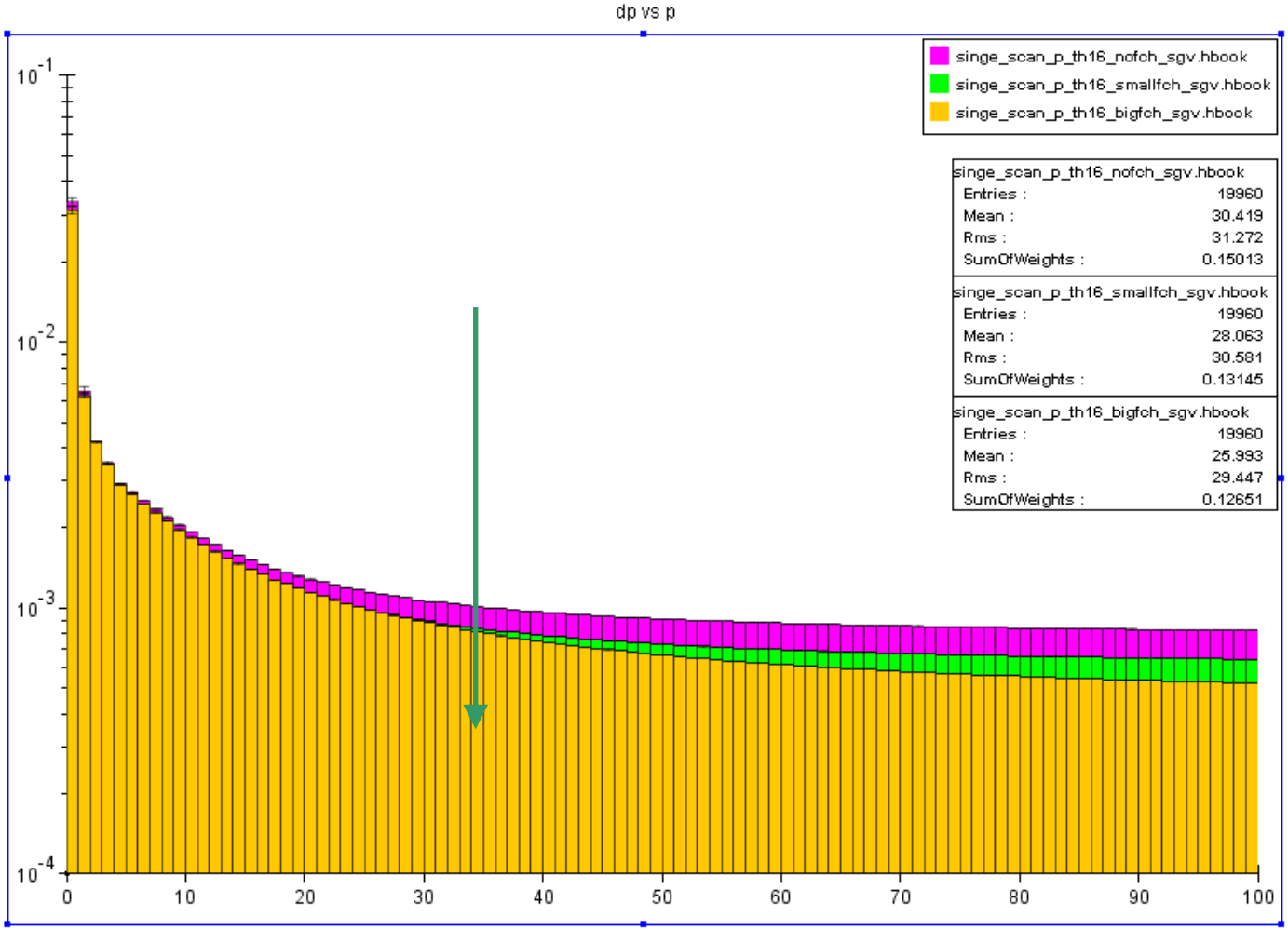
FCH Studies with SGV at Snowmass

Lee Sawyer
Louisiana Tech University
25 Aout 2005
(Or what Lee did during his vacation)

Fast Simulation Studies

- Used SGV to study electron momentum and resolutions
  - Took TPC σ = 60 μm
  - Looked at no FCH, and two extreme cases
    - 2 precision hits, one behind the TCP endplate and the other on the face of the ECAL
    - 10 space hits between TPC and ECAL
- Also generated Z → qq events for PFLOW tests
  - Simple-minded PFA: Match tracks to clusters, add in everything else as neutral energy

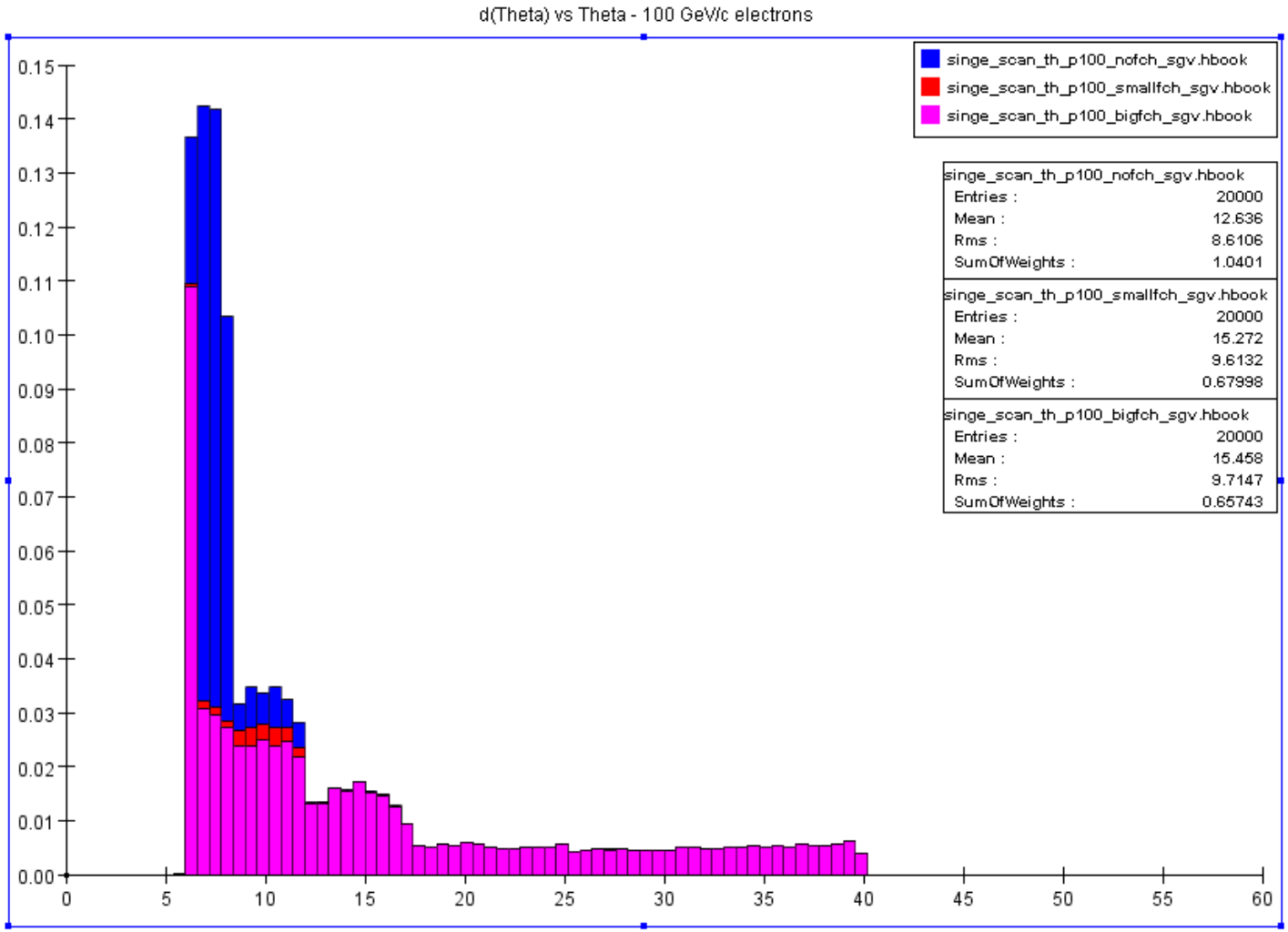
Single Electron Momentum Error



Encouraging…

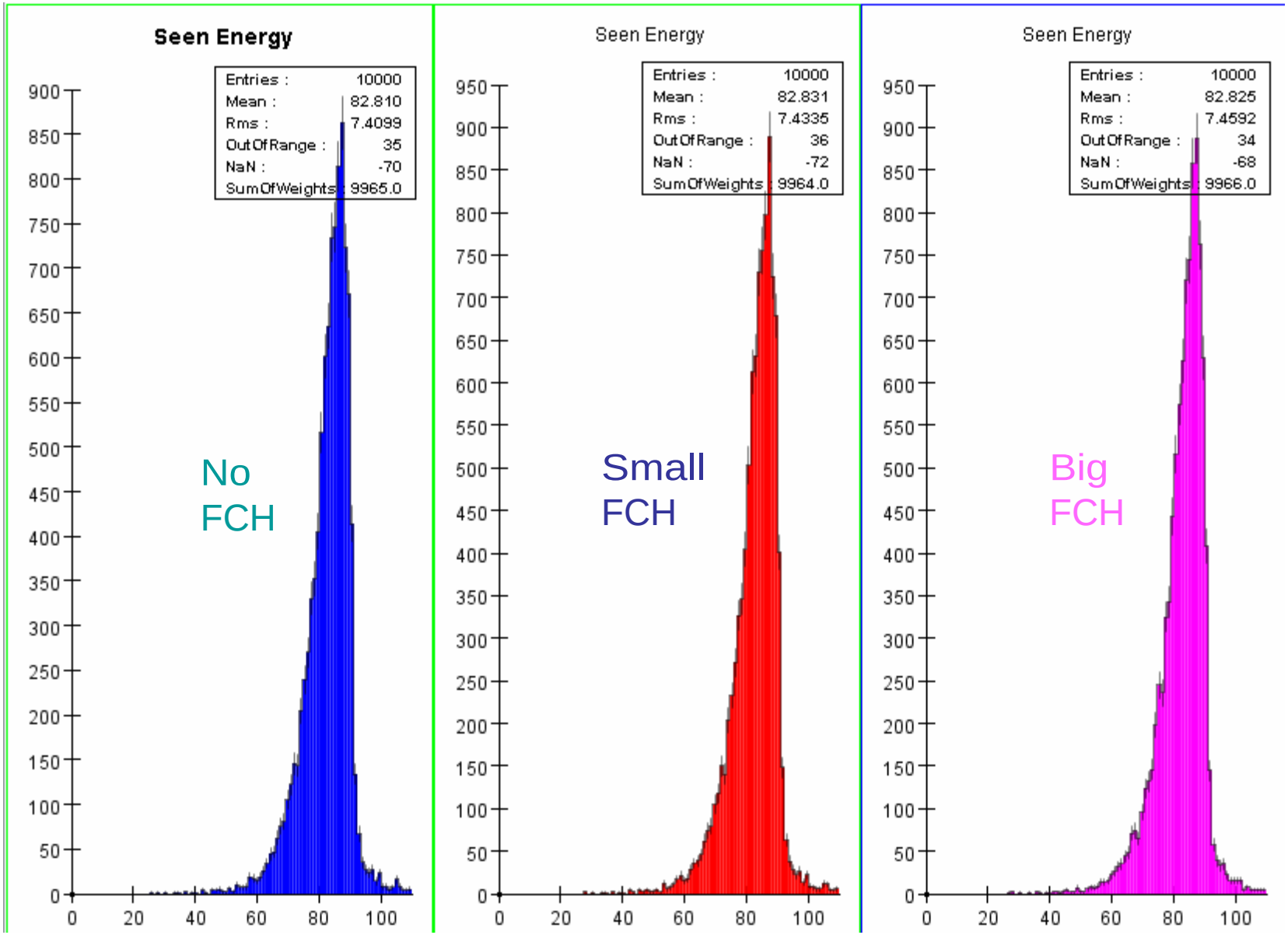
Lee Sawyer, Louisiana Tech U.

Single e Angular Resolution



Encouraging…

First Stab at PFLOW



SGV is not good enough to tackle the PFA studies thus go to GEANT simulation

Lee Sawyer, Louisiana Tech. U.

Concluding remarks

- Snowmass gave the opportunity to set up a task force to fully address the questions about Si tracking in LDC concept
- Contacts have been established with the subdetectors and interesting discussion have occured that will be pursued.
- Some studies have already started
- The tools are at disposal both at the fast simulation level (mainly based on SGV) and at the full GEANT-based simulation level.
- There will be a detailed status report at Vienna Workshop as a result of expected good progress in these two next months.
- The group will pursue its work through regular contacts and will most probably extends.