ALLEGRO MIGRATION TO DDSIM

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 - CERN
- FCC Detector Full Sim Working Meeting
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DDSIM VS. K4SIMGEANT4

DDSim

- Configured with standalone Python steering
- Larger feature set

k4SimGeant4

- Set of Gaudi algorithms
- Event loop controlled by Gaudi
- Ability to be integrated into large Gaudi steerings
- Uses DD4hep to compartmentalize subdetectors

FCC Study Report: One simulation tool to rule them all

• Part of DD4hep (able to compartmentalize subdetectors) • Wrapping around Geant4 — Geant4 controls event loop • Used by multiple experiments (including currently running ones)

SIMULATION DETAILS

DDSim + digitization algorithms from k4SimGeant4

particle gun + k4SimGeant4 Geant4 Gaudi algorithm and digitization

- Default DDSim steering
 - SIM.physicsList = None
 - SIM.physics.list = "FTFP_BERT"
 - SIM.physics.rangecut = 0.7
- Compact files from FCCDetectors
- Number of events:
 - electron @ 50 GeV: 10k
 - pion @ 50 GeV: 10k

VS.

• No changes to the k4SimGeant4 algorithms

```
geantservice.physicslist = "SimG4FtfpBert"
geantservice.g4PreInitCommands += ["/run/setCut 0.1 mm"]
```

ECAL

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ECAL HITS



ECAL HIT CONTRIBUTIONS



ECAL CELLS



ECAL POSITIONED CELLS



ECAL CLUSTER



ECAL CORR. CLUSTER



PION @ 50 GEV ECAL HITS



PION @ 50 GEV ECAL HIT CONTRIBUTIONS



PION @ 50 GEV **ECAL CELLS**

10⁶

10⁶

10³

10

0.8

0.6

0.4

0.2



PION @ 50 GEV ECAL POSITIONED CELLS

PION @ 50 GEV ECAL CLUSTER

PION @ 50 GEV ECAL CORR. CLUSTER

HCAL

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ELECTRON @ 50 GEV HCAL HITS

ELECTRON @ 50 GEV HCAL HIT CONTRIBUTIONS

ELECTRON @ 50 GEV HCAL CELLS

PION @ 50 GEV HCAL HITS

z⁼ 10⁶ Hit energy, e-@ 50 GeV Hit position [x], e- @ 50 GeV ź 10⁶ hit_position_x_k4sg4 hit_energy_k4sg4 Entries 1454989 Entries 1454989 Mean 0.0001181 2865 Mean 10⁵ 121.8 Std Dev 0.0002111 Std Dev 10° ⊨ hit_position_x_dd4hep hit_energy_dd4hep Entries 348285 348285 Entries 10⁴ 10⁴ Mean 0.0005218 9.959 Mean Std Dev 0.001148 0.5358 Std Dev 10³ 10 10² 10 10 10 = 1000 DDSim / k4SimGeant4 DDSim / k4SimGeant4 60 1400 50 1200 DDSi 1000 800 30 600 20 400 200 0 1-----0 0.005 0.01 0.015 0.02 0.025 0.03 0.035 0.04 0.045 0.0 E_{hit} [GeV] $\begin{array}{c} 0 \\ \hline \\ -4000 \\ -3000 \\ -2000 \\ -1000 \\ 0 \\ 1000 \\ 2000 \\ 3000 \\ 40 \\ 40 \\ \end{array}$

PION @ 50 GEV HCAL HIT CONTRIBUTIONS

PION @ 50 GEV HCAL CELLS

Cell energy, e-@ 50 GeV Cell position [x], e- @ 50 GeV z Ž cell_energy_k4sg4 cell_position_x_k4sg4 Entries 349572 Entries 349572 10 Mean 0.02041 Mean Std Dev 0.04462 Std Dev cell_energy_dd4hep cell_position_x_dd4hep 10⁴ Entries 348285 348285 Entries 0.02171 Mean Mean Std Dev 0.04721 Std Dev 0 10 10^{2} DDSim / k4SimGeant4 -----DDSim-/-k4SimGeant4------DDSim-/-k4SimGeant4-----0.8 0.6 0.4 0.2 ┰┿╷╷╽│┿┾ 0 $0 \begin{bmatrix} -1 & -0.8 & -0.6 & -0.4 & -0.2 & 0 & 0.2 & 0.4 & 0.6 & 0.8 \\ -1 & -0.8 & -0.6 & -0.4 & -0.2 & 0 & 0.2 & 0.4 & 0.6 & 0.8 \\ \end{array}$ 1 1.2 1.4 1.6 E_{cell} [GeV] 0.2 0.4 0.6 0.8 0

CONCLUSIONS / OPEN QUESTIONS

• Running DDSim with default settings will get you close

Investigate sensitive actions

• Differences in simulation settings?

• Step length? Filters? Mag. field?

• Effects of hit deduplication?

• Can we drop positioning tools?

