



Software for PED studies

# Opportunities in Software & Computing

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FCC Physics Workshop 2023  
Krakow, Poland

January 26, 2023  
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# Context



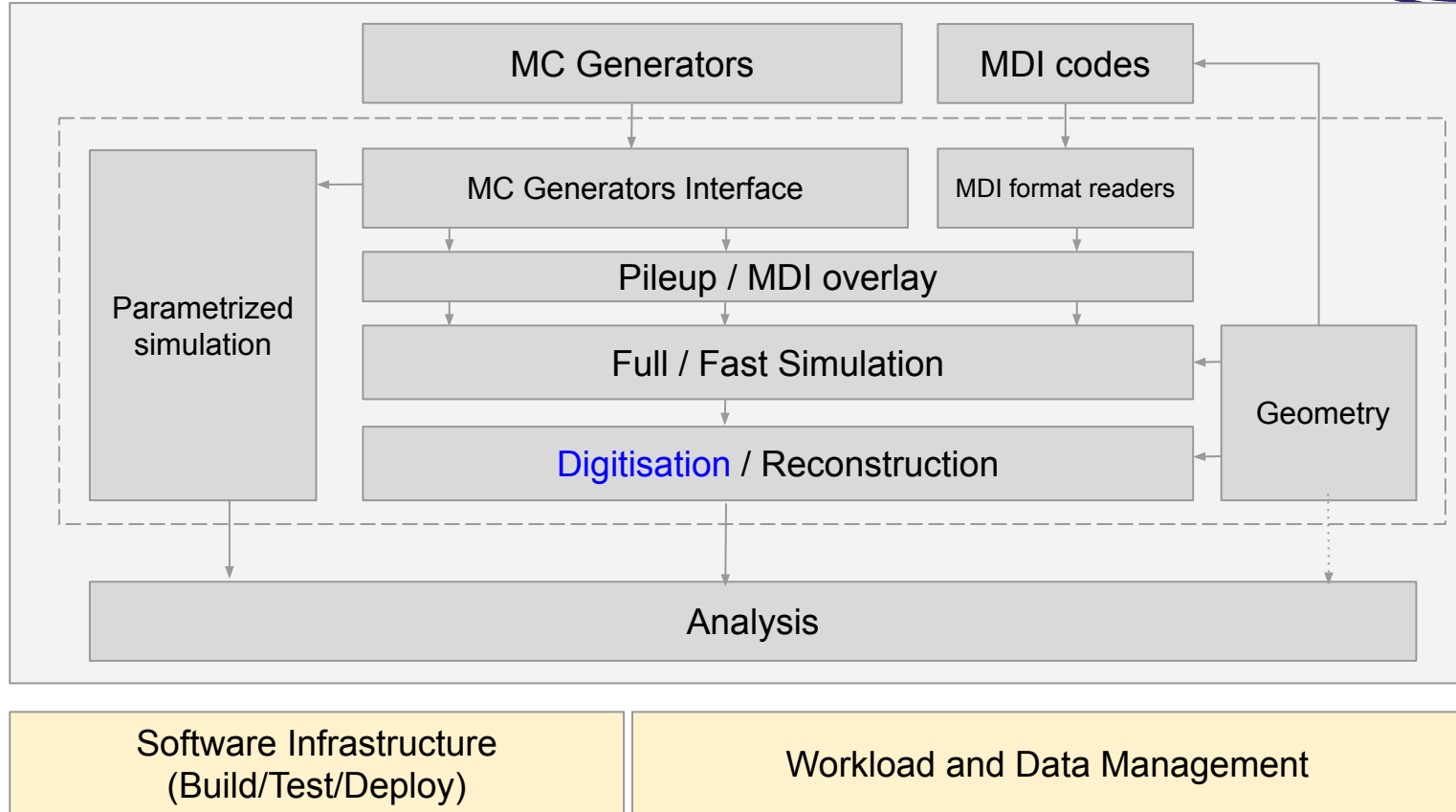
- This is based on the **current status of things and needs** as described on the dedicated sessions of this workshop
- Despite the size of the team being rather small, the **organisational chart** suggested by the reviewed S&C mandate is still considered in here, because it **foresees useful figures that could filled by external institutes**

# Development workforce



- Core team at CERN
  - Bootstrap, lead, and support essential activities
  - As of 1 February 2023
    - 1.5+ FTE staff, 2 FTE fellows, x FTE Tech Stud
      - GG, B François, J Smiesko, A Tolosa Delgado, A Sailer, student
  - Recently 'lost' historical members: C Helsens, V Volkl
- Task force for IDEA tracker (DC + Vertex) to DD4hep
  - DC: L Capriotti, *INFN simifellow* (-> Q1/23) (Q2/23 -> new simifellow?)
  - Vtx: A Ilg, *Univ Zurich*
- Contributions from other WG (Physics Performance, ...)
  - E Perez, M Selvaggi, L Portales, ...

# Reminder: Typical workflows to support

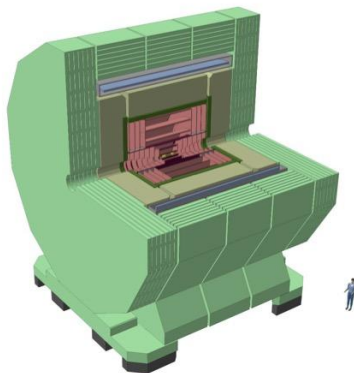


# FCC-ee Detector Concepts

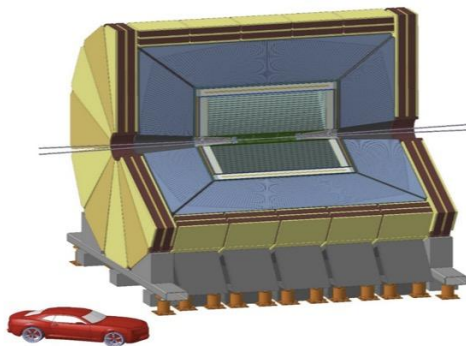


- Two concepts proposed for the FCC-ee CDR: **CLD, IDEA**
- More detectors needed if we have more than 2 IPs
  - New concept based on **High Granularity Noble Liquid calorimeter** under development
- Many different sub-detector technologies on the table!
- Ultimate goal pursued: **full inter-operability of sub-detectors** (eased by DD4Hep plug-and-play approach) and **reconstruction algorithms** (dataformat, more challenging)

CLD



IDEA



Noble Liquid Based



# Technical tasks



## 1. [R] Validate iLCSoft reconstruction algorithms for FCCee

Validate relevant algorithms using k4MarlinWrapper (MarlinTrk, LCFIplus, ... ) to understand possible performance bottlenecks requiring native porting.

Start from CLD and extend to other detector concepts as they become available

## 2. [D] Port/implement IDEA Drift Chamber digitisation in Key4hep

Identify related standalone code and make it running in the common framework to feed reconstruction

## 3. [R] Migrate existing IDEA reconstruction algorithms in Key4hep

Algorithms should be, when possible, generalized to be applicable to other detector configuration

## 4. [R] Pandora integration in Key4hep

Make the k4Pandora algorithm use a DD4hep geometry service and validate it with CLD in preparation for usage with the other detector concepts (IDEA, LAr, ...)

## 5. [R] ACTS integration: CLD and IDEA track reconstruction with ACTS in Key4HEP

Implement ACTS interface in k4ActsTracking and test/validate it with CLD first, and extend to IDEA Drift Chamber

[R] Reconstruction, [G] Generators interfaces, [S] Simulation, [D] Digitisation

## 6. [S] Investigate use of Geant4 fast simulation for FCCee detector concepts

There are several improvements in fast simulation, using classic (parametrization) and modern (ML) techniques which might become interesting for FCCee detector concepts

## 7. [S] Optimise speed-up of full simulation through ddsim and k4SimGeant4

Make sure that all options are used (e.g. multi-thread execution) for an optimal use of the available resources.

## 8. [S] Running simulation of CLD in k4SimGeant4

Understand current limitations and lift them. It should be possible to run ddsim and k4SimGeant4 (k4Gaussino) interchangeably to optimise workflows

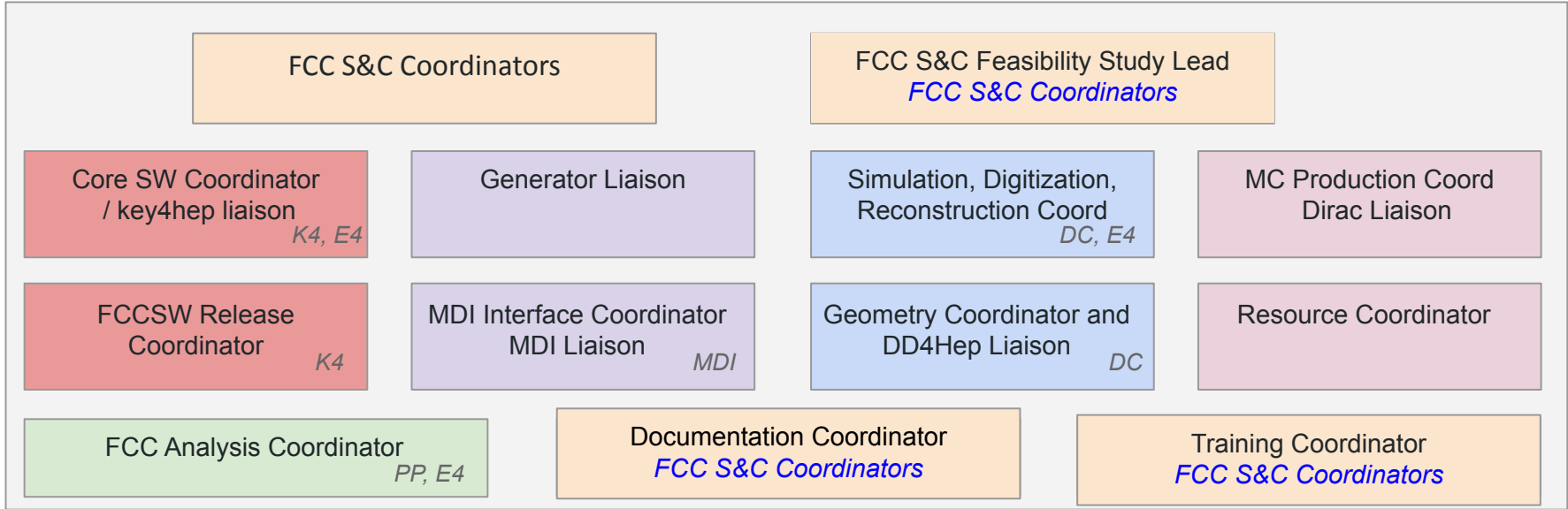
## 9. [G] Consolidation and maintenance of k4Gen

Make sure that tools for crossing angle, energy spread are validated and can be used for generators not implementing the functionality. Make sure that all required readers are available and functional.

Make sure that tools for mixing and overlapping events are available and functional.

[R] Reconstruction, [G] Generators interfaces, [S] Simulation, [D] Digitisation

# FCC S&C revised structure



- Core software group at CERN
- External contributions warmly encouraged
- Connection with other PED groups

PP Physics Performance  
DC Detector Concepts  
MDI Machine Detector Interface  
K4 Key4hep  
E4 EDM4hep



# Coordination opportunities



## 1. Monte Carlo Production coordinator and DIRAC liaison

Coordinate all facets of Monte Carlo production including sample prioritization. Works with generator experts, resource managers, and others to ensure that needed samples are produced in a timely way [...]. Assists users with MC sample availability issues and their interactions with **DIRAC**

## 2. Resource coordinator

Responsible for identifying and coordinating compute and storage resources for `FCC`. Works with resource providers, including CERN, WLCG grid sites involved in `FCC` research, and `HPC` centers to enable `FCC` Monte Carlo production and analysis needs. [...]

## 3. Analysis Tools coordinator

Establish and maintain infrastructure and best practices for user analysis. Assist user community with on-boarding and encourage integration of user-developed features into the infrastructure.

## 4. Generators Liaison

Works with physics group and generator authors to integrate and update generator software needed for **FCC** studies. Fosters use of the agreed exchange formats for passing results between generators and from generators to detector simulation applications. [...]