

Key4hep Migration and Software Validation Status

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CEPC Detector and Physics Plenary Meeting

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Migration to the newest Key4hep (1)

- ❖ Key4hep migration & AI-agent integration
 - During the Ref-detector TDR preparation, a fixed Key4hep version was used to avoid disruptions from ongoing Key4hep upgrades.
 - At the CEPC Workshop (Lisbon), it was proposed to integrate AI Agents/Agentic AI into the CEPSCSW development flow.
 - Now the migration to the newest Key4hep serves as the first AI-agent use case.
- ❖ Concrete progress has been made
 - Three meetings on 22 June, 29 June, and 6 July were organized to discuss the migration.
 - The meeting minutes are available at:
<https://jupyter.ihep.ac.cn/faX6jrBATtGiKBfVbkLH5Q>

Migration to the newest Key4hep (2)

❖ Migration strategy: Core software -> Simulation -> Reconstruction -> Analysis

❖ Upgrade of core software (**completed**)

- External library deployment

Key4hep stack 109.0.0 has been successfully deployed in the new environment.

- EDM compatibility handling

Missing EDM components are temporarily bypassed using `#if/#else` preprocessing guards.

- CEPCSW compilation status

All CEPCSW packages compile cleanly under the updated Key4hep stack.

❖ Upgrade of detector simulation software (**completed**)

	TDR / LCG 105	New / LCG 109
Compiler	GCC 11.3.0	GCC 13.1.0
CMake	3.26.2	3.30.6
Python	3.9.12	3.13.11
Gaudi	v37r2	v40r2
ROOT	6.30.2	6.38.0
Geant4	11.2.0	11.4.0
DD4hep	01.27.02	01.35
EDM4hep	00.10	1.0
podio	00.17.01	01.07
k4FWCore	8 th Oct 2023	01.06

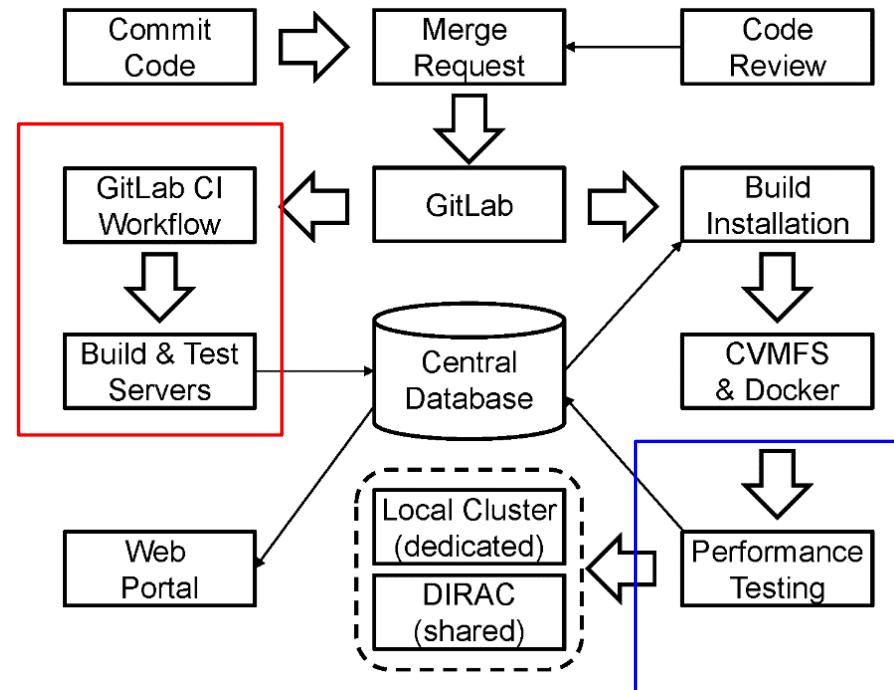
Migration to the newest Key4hep (3)

- ❖ Upgrade of digitization, reconstruction, analysis, and related software packages
 - Reconstruction
 - RecSiTracking / RecTrkGlobal / RecAssociationMaker — Chengdong ([in progress](#))
 - RecActsTracking — Yizhou, ZZU ([done](#), [validation in progress](#))
 - RecPFACyber (3D) — Zhang Yang etc. ([done](#), [validation in progress](#))
 - ParticleID — Zhao Guang etc. ([done](#), [validation in progress](#))
 - Muon software— Fudan University ([contact person is needed](#))
 - Analysis
 - RDAAnalysis — Shandong University ([in progress](#))
 - Event Display — Sun Yat-sen University ([in progress](#))
 - Data Model
 - RecTof — Zhao Guang and Wenxing ([done](#))
 - Integration of FCC background simulation data ([request for permission](#))
 - Provides support for adding FCC background events during event mixing — Tao
- ❖ The validation will begin once the new release is completed.

Software validation

❖ In the Reference TDR, the validation workflow mainly consists of two stages.

1. The first stage (in the red box) includes fast unit and integration tests on each commit or merge request.
2. The second stage (in the blue box) is release validation, where large-scale production is launched and key physics quantities are compared against reference samples.



❖ Status and plan

- The test units for most algorithms are not yet standardized. Going forward, AI will continue to be used to complete this work.
- The release-validation framework has been developed, but the algorithms for producing the physics-performance plots are still missing. We will work with the physics group to add the existing performance-filling algorithms into the framework.

Other issues: software-name proposal

❖ Naming convention

Level	Name	Usage
Full name	Agora Software	Official name
Short name	AgoraSoft	Talks, slides, papers
Technical abbreviation	ASW	Code, repos, namespaces

❖ AgoraSoft is not just a rename of CEPCSW

- evolves into a dual-experiment software platform built on Key4hep
- supports both CEPC and FCC-ee through configuration layers
- distinguishes CEPC-specific and FCC-ee components from shared plugins using a clear namespace hierarchy
 - asw::core, asw::sim, asw::reco, asw::validation, asw::exp::cepc, asw::exp::fccee

Other issues: ACTS collaboration

- ❖ Paul Gessinger-Befurt (CERN) informed us of the establishment of a lightweight organizational structure for the ACTS project.
 - **The Experiment Liaison Group (ELG):** The ELG serves as a bidirectional communication channel and identifies cross-experiment issues. Each experiment using or assessing ACTS designates a liaison.
 - **The Project Contact (PC):** the entry point for the project, chairing the ELG and initiating discussions when required.

- ❖ After discussion, Tao Lin was nominated as the Agora liaison and is expected to
 - attend the quarterly video meetings, along with the additional session at the ACTS annual workshop.

Thank You !