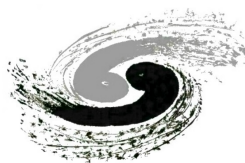


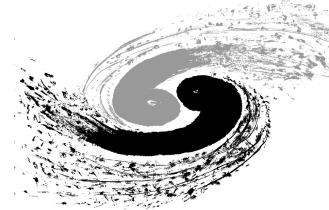
# Learn CEPCSW



中國科學院高能物理研究所  
*Institute of High Energy Physics*  
*Chinese Academy of Sciences*

WU Kewei

2021/02/26



# Quick Start

➤ Source code: <https://github.com/cepc/CEPCSW>

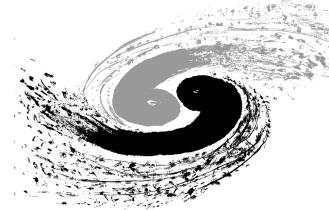
➤ Installation:

➤ tip: clean up your personal environment variables before installation.

SSH to lxslc7 (CentOS 7).

Before run following commands, please make sure you setup the CVMFS:

```
$ git clone git@github.com:cepc/CEPCSW.git
$ cd CEPCSW
$ git checkout master # branch name
$ source setup.sh
$ ./build.sh
$ ./run.sh Examples/options/helloalg.py
```



# Tutorials

- Web: <https://cepc.github.io/CEPCSW/tutorial.html>
- Indico: <https://indico.ihep.ac.cn/event/12341/>

## New CEPCSW Tutorial and detector study

17-18 September 2020  
New Building  
Asia/Shanghai timezone

### Overview

Scientific Programme

Timetable

Contribution List

Author List

My Conference

After the CDR was released in 2018, the CEPC is moving towards its technical design steadily. A new software framework is under developing and various new detector concepts were proposed, which need validation, intensive and sophisticated simulation study, and optimization. The new CEPCSW is designed to meet all these requirements.

This workshop is going to focus on the new CEPCSW. The new software is based on a more generic framework and modern event data model and within very broad international collaboration, which could provide all aspects support for the CEPC to perform R&D and physics study.

This workshop is going to introduce the new software to new comers and help them get involve detector and physics study more smoothly, which is going to cover detector geometry and mater implementation, simulation, reconstruction, and a little bit analysis.



Starts Sep 17, 2020 08:00  
Ends Sep 18, 2020 18:00  
Asia/Shanghai



New Building  
124  
IHEP

Kewei IHEP

09:10 **CEPC physics requirements 50'**

Speaker: LI Gang ( EPC.IHEP )

Material: [Slides](#)

### Detector Simulation

14:00 **Introduction to CEPCSW 1h0'**

Speaker: Dr. Jiaheng Zou (高能所)

Material: [Slides](#) [Examples](#)

15:00 **DD4HEP: detector description 1h0'**

Speaker: Chengdong FU (IHEP)

Material: [Slides](#) [Build Geometry](#)

### Detector simulation

17:05 **Simulation of a simple detector in CEPCSW 1h0'**

Speaker: Dr. Tao LIN (高能所)

Material: [Slides](#) [Quick Start](#)

09:40 **Tracking reconstruction 40'**

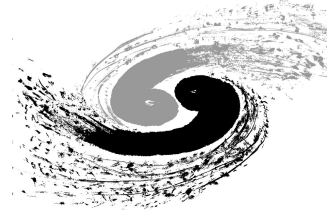
Speaker: Ms. Yao Zhang (Institute of high energy physics)

Material: [Slides](#) [\(Gas\) Tracking](#)

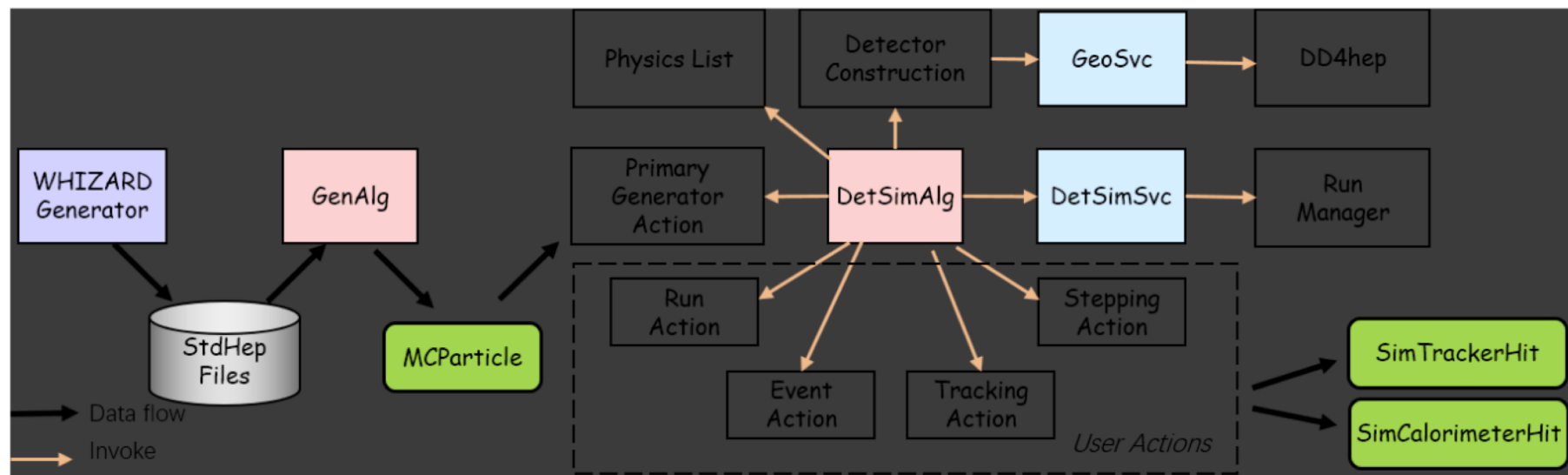
11:20 **Calorimeter reconstruction 40'**

Speaker: 文兴 方 (高能所)

Material: [Slides](#) [\(CAL\) Tracking](#)

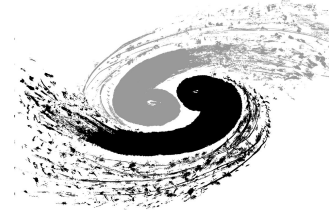


# Simulation Framework



- The simulation chain is driven by Gaudi.
- Detector description is from DD4hep.
- Event Data Model is in EDM4hep format.
- Detector response is done by Geant4.

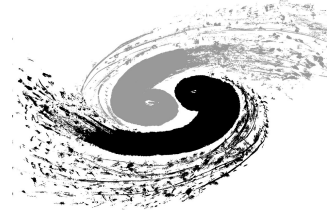
from Lin Tao



# Source Code Framework

- Detector description: See /Detector
- Event generator interface: See /Generator
- Detector simulation: See /Simulation
  - DetSimInterface: Gaudi Tool interface
  - DetSimCore: integrate Gaudi and Geant4
  - DetSimGeom: integrate with DD4hep
  - DetSimAna: collect data from Geant4
  - DetSimSD: detector response
- Job options: See /Examples/options

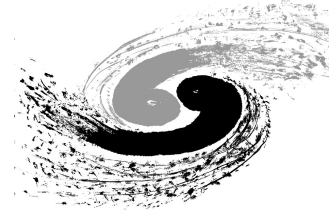
from Lin Tao



# Job Option

- Command: `$ ./run.sh Examples/options/tut_detsim.py`
- Services  
([https://github.com/cepc/CEPCSW/blob/master/Examples/options/tut\\_detsim.py](https://github.com/cepc/CEPCSW/blob/master/Examples/options/tut_detsim.py)) :
  - Random Number Service
  - Event Data Service and PODIO writer
  - Geometry Service (geometry\_option = "CepC\_v4-onlyVXD.xml")
  - Physics generator algorithm
  - Detector simulation algorithm
  - Save detector response into ROOT file
  - Control how many events to be simulated
- Visualization: `detsimalg.VisMacs = ["$PATH/vis.mac"]`  
(<https://geant4-userdoc.web.cern.ch/UsersGuides/ForApplicationDeveloper/html/Visualization/visualization.html>)

from Lin Tao



# Detector description

➤ Tracker([https://github.com/cepc/CEPCSW/blob/master/Detector/DetCEPCv4/src/tracker/VXD04\\_geo.c](https://github.com/cepc/CEPCSW/blob/master/Detector/DetCEPCv4/src/tracker/VXD04_geo.c)  
[pp](#))

➤ DD4hep construction:

- Compact file (xml) to input geometry parameters
- Object prepare
- Parameters input
- Volume placement
- Sensitive detector
  - <readouts>
  - <readout name="TPCCollection">
  - <id>system:5,side:2,layer:9,module:8,sensor:8</id>
  - </readouts>
- Extension output

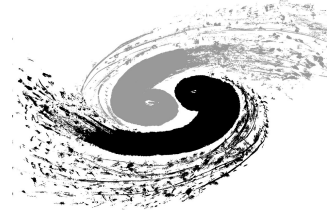
## Solids

| dd4hep                      | ROOT                    | Geant4              |
|-----------------------------|-------------------------|---------------------|
| Box                         | TGeoBBox                | G4Box               |
| Tube                        | TGeoTube, TGeoTubeSeg   | G4Tubs              |
| CutTube                     | TGeoCtub                | G4CutTubs           |
| EllipticalTube              | TGeoElltu               | G4EllipticalTube    |
| TwistedTube                 | TwistedTubeObject       | G4TwistedTubs       |
| Trd1, Trd2                  | TGeoTrd1, TGeoTrd2      | G4Trd               |
| Hyperboloid                 | TGeoHype                | G4Hype              |
| EightPointSolid             | TGeoArb8, G4GenericTrap | G4GenericTrap       |
| ExtrudedPolygon             | TGeoXtru                | G4ExtrudedSolid     |
| PolyhedraRegular, Polyhedra | TGeoPgon                | G4Polyhedra         |
| Polycone                    | TGeoPcon                | G4Polycone          |
| Cone, ConeSegment           | TGeoCone, TGeoConeSeg   | G4Cons              |
| Paraboloid                  | TGeoParaboloid          | G4Paraboloid        |
| Sphere                      | TGeoSphere              | G4Sphere            |
| Torus                       | TGeoTorus               | G4Torus             |
| Trap                        | TGeoTrap                | G4Trap              |
| TessellatedSolid            | TGeoTessellated         | G4TriangularFacet   |
|                             |                         | G4QuadrangularFacet |
|                             |                         | G4ReflectedSolid    |
|                             |                         | G4Ellipsoid         |
| PseudoTrap                  | TGeoScaledShape         |                     |
| TruncatedTube               | TGeoCompositeShape      |                     |
| SubtractionSolid            |                         | G4SubtractionSolid  |
| UnionSolid                  |                         | G4UnionSolid        |
| IntersectionSolid           |                         | G4IntersectionSolid |

For special solid XXX, beside class XXX, class TGeoXXX and class G4XXX, convertShape<TGeoXXX>(shape) also needed in Geant4Converter::handleSolid(...), not recommended

from Fu Chengdong

# Build Detector by DD4hep



Main compact file  
(xml)

```
<lcdd ...>
  <info ...>
    <comment> ... </comment>
  </info>
  <includes>
    <gdmlFile ref="elements.xml"/>
    <gdmlFile ref="materials.xml"/>
  </includes>
  <define>
    ...
  </define>
  <limits> ... </limits>
  <include ref="XXX_v01_01.xml"/>
  ...
  <plugins>
    <plugin name="DD4hepVolumeManager"/>
    <plugin name="InstallSurfaceManager"/>
  </plugins>
  <include ref="field.xml"/>
</lcdd>
```

```
<materials>
  <element Z="89" formula="Ac" name="Ac" >
    <atom type="A" unit="g/mol" value="227.028" />
  </element>
  <material formula="Ac" name="Actinium" state="solid" >
    <RL type="X0" unit="cm" value="0.601558" />
    <NIL type="lambda" unit="cm" value="21.2048" />
    <D type="density" unit="g/cm3" value="10.07" />
    <composite n="1" ref="Ac" />
  </material>
  ...
</materials>
```

```
<materials>
  <material name="Air">
    <D type="density" unit="g/cm3" value="0.0012"/>
    <fraction n="0.754" ref="N"/>
    <fraction n="0.234" ref="O"/>
    <fraction n="0.012" ref="Ar"/>
  </material>
  ...
</materials>
```

parameters transmit

construct files  
(cpp)

```
static Ref_t create_detector(Detector& theDetector, xml_h element, SensitiveDetector sens){
  ...
}
DECLARE_DETELEMENT(DD4hep_XXX_v01, create_detector)
```

```
static Ref_t create_detector(Detector& theDetector, xml_h element, SensitiveDetector sens){
  ...
}
DECLARE_DETELEMENT(DD4hep_YYY_v01, create_detector)
```

from Fu Chengdong



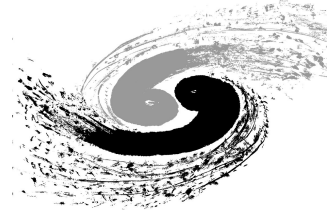
# Thanks for your listening!



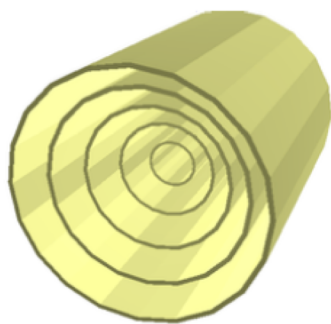
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WU Kewei

2021/02/19



# Basic Sub-detector in DD4hep



DD4hep\_SiTrackerBarrel



DD4hep\_SiTrackerEndcap2



DD4hep\_MultiLayerTracker



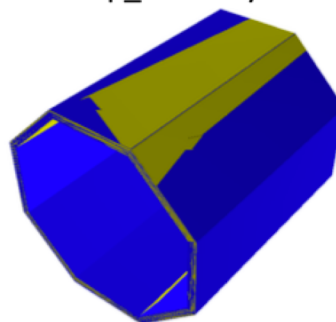
DD4hep\_DiskTracker



DD4hep\_CylindricalBarrelCalorimeter



DD4hep\_CylindricalEndcapCalorimeter



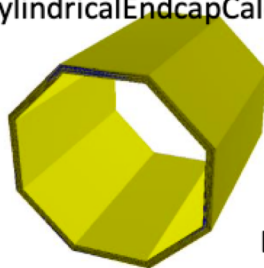
DD4hep\_PolyhedraBarrelCalorimeter2



DD4hep\_PolyhedraEndcapCalorimeter2



DD4hep\_ForwardDetector



DD4hep\_EcalBarrel

- lgeo package also has built ILC sub-detector type, help us to move from MokkaC to DD4hep quickly.

from Fu Chengdong