

# Mokka & DD4hep Development for CEPC

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# Outline

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  - Status of CEPC model
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# Motivation

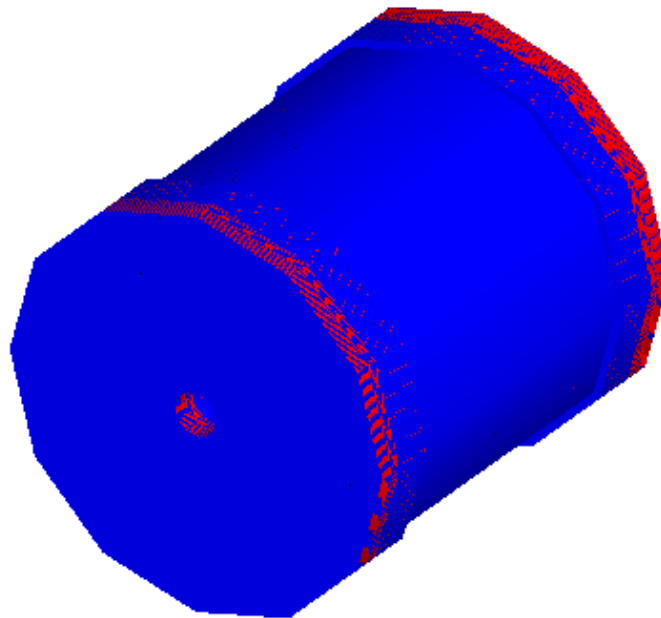
- CEPC-SPPC
- Mokka has been used for ILC, DD4hep is being developed for SiD.
- Mokka can work well for CEPC physical simulation at CDR.
  - Enough? New geometry should be added in future.
- For sub-detectors CDR, more modification of geometry will be needed. Therefore, the simulation tool should be more flexible. Comparing with Mokka, DD4hep is more flexible, and has more function, such as reconstruction, geometry display, etc.

# Status of Mokka

- Using for physical simulation based on CEPC-v1
- New geometries are being built.
- Development based on a new copy, available at </workfs/bes/fucd/Mokka/mokka-08-03>
  - `/Mokka/init/EditGeometry/rmSubDetector` remove sub-detectors from database option
  - `/Mokka/init/EditGeometry/newSubDetector` add the calorimeter not existing in database
  - Unpack the parameters of structure of sub-detector from `globalModelParameter`.
  - New field constructor: `MyField`, build fields at different regions.
  - New generators support: `HepMC`, `slcio`
  - Resize world size (`world_box_hx`, `world_box_hy`, `world_box_hz`) by `globalModelParameter`.

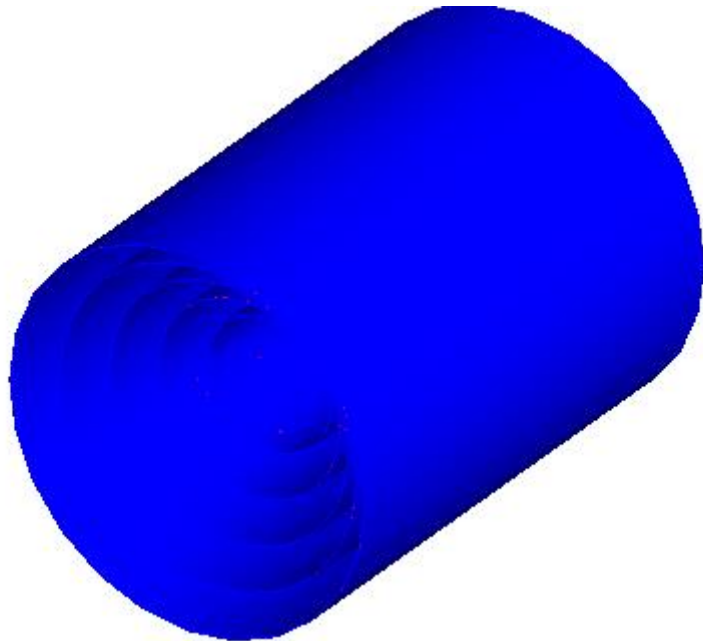
# A simple calorimeter module

- SiCal: cylinder, barrel & endcap, Ecal & Hcal
- Input parameters by `globalModelParameter`, easy to modify the structure of the calorimeter, any size, any layer placement, and any type(?) - predefined.
- First support silicon-based calorimeter, now including:
  - Si, BGO, LGO, Scintillator, THGEM1, THGEM2, RPC1, RPC2
- Output:
  - `SimCalorimeterHit` in slcio file, reconstructed by `Marlin` possibly.

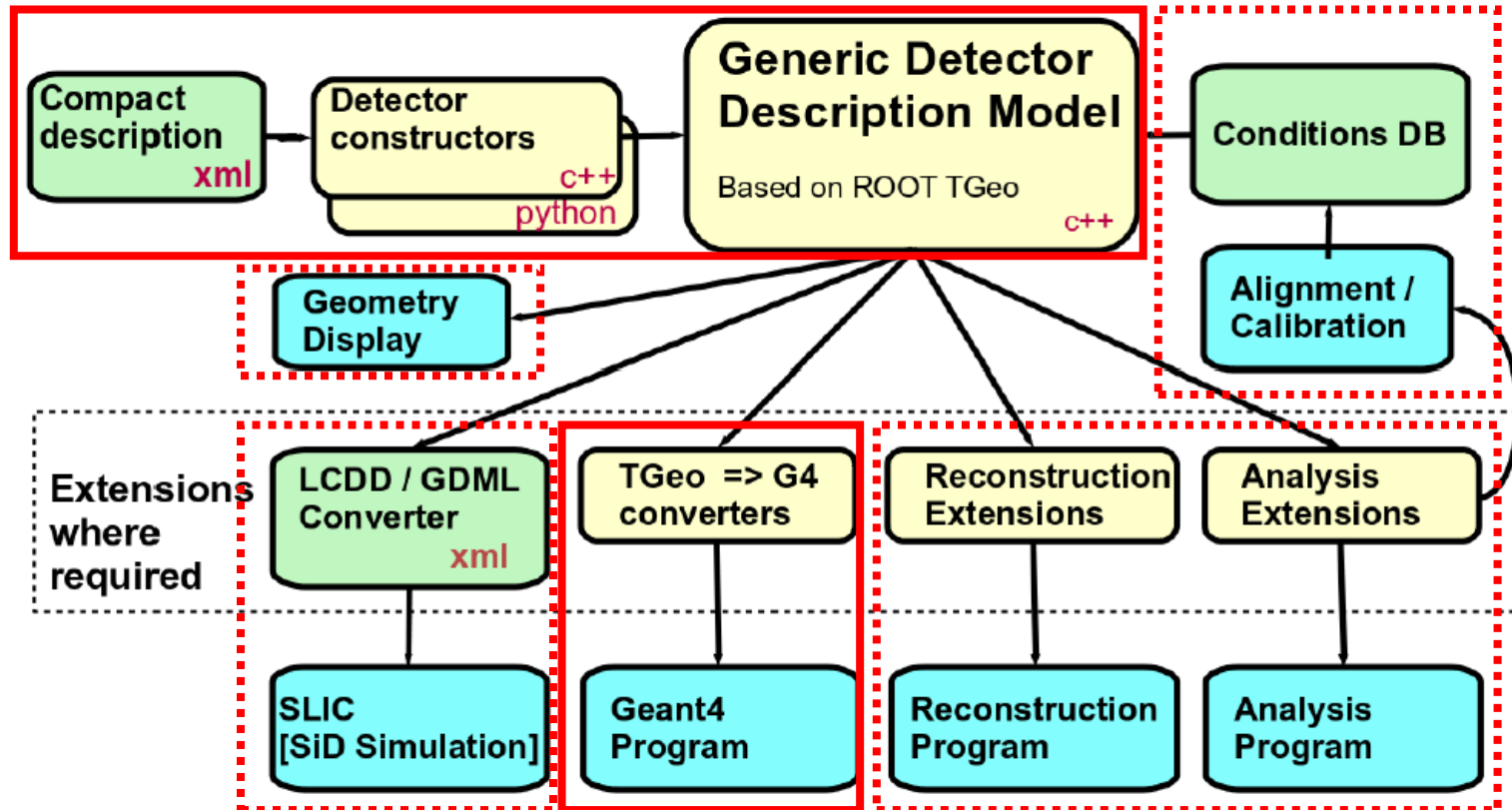


# A simple silicon-tracker module

- SiTracker: cylinder, barrel & endcap
- Input parameters by `globalModelParameter`:
  - Layer position and layer number
  - Layer structure is fixed as SiD's silicon-tracker
- Output:
  - `SimTrackerHit` in slcio file, reconstructed by `Marlin` possibly.



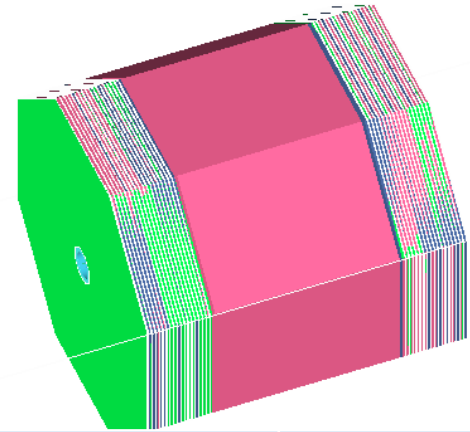
# Introduction of DD4hep



- A Detector description Toolkit for High Energy Physics Experiments, is being developed.
- DDAAlign, DDCond, **DDCore**, **DDDetectors**, **DDEve**, **DDG4**, DDRec, etc.
- Successful to install at lxslc6 based on **Root5.34.07**, </workfs/bes/fucd/DD4hep>

# Test on SiD model

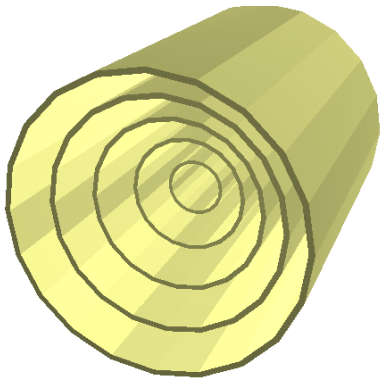
- Found problem
  - Hcal cannot give out hits
  - Overlap found by check tool



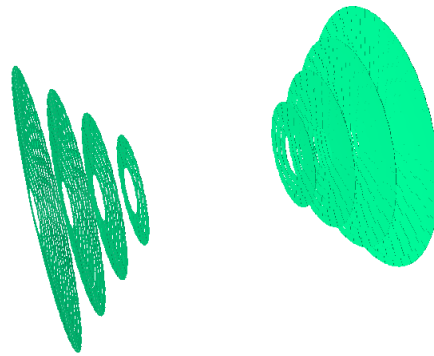
content		test
elements	xml file defined	√
materials	xml file defined, don't need pre-define in code	√
sub-detector	constructor display readout	√ √ X
limits	possible special limit for each sensitive detector	√
physics list	predefined Geant4 physics lists user-defined	√ -
fields	GlobalSolenoid	-
constants	expression supported	√
generator	ParticleGun file input	√ -
output	slcio ROOT	√ -



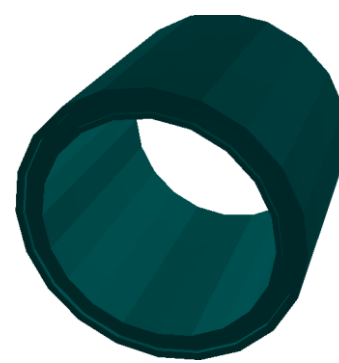
# Standard DD4hep supplied detector palette



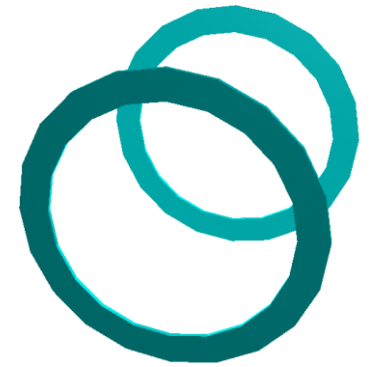
DD4hep\_SiTrackerBarrel



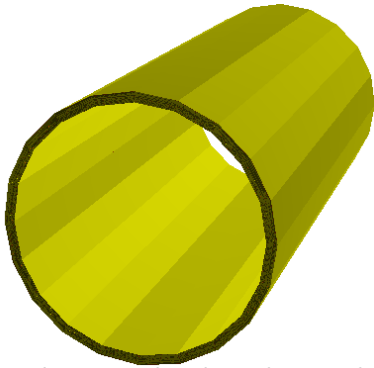
DD4hep\_SiTrackerEndcap2



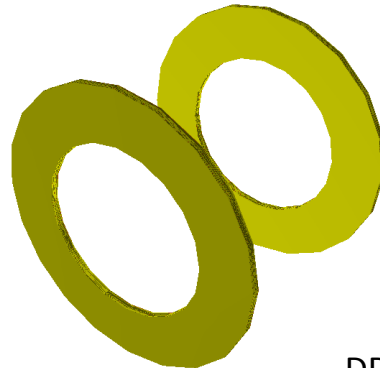
DD4hep\_MultiLayerTracker



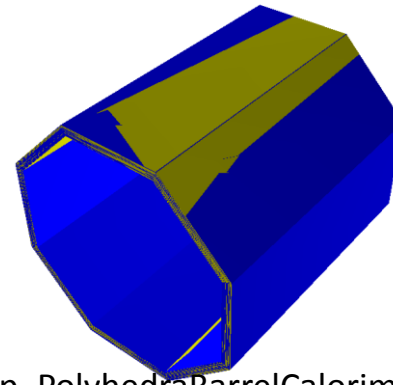
DD4hep\_DiskTracker



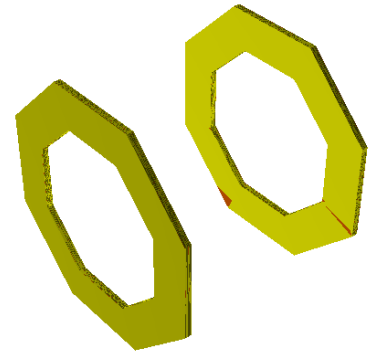
DD4hep\_CylindricalBarrelCalorimeter



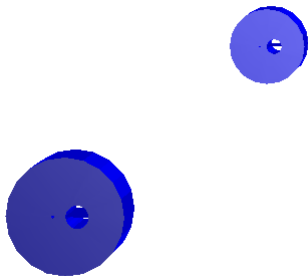
DD4hep\_CylindricalEndcapCalorimeter



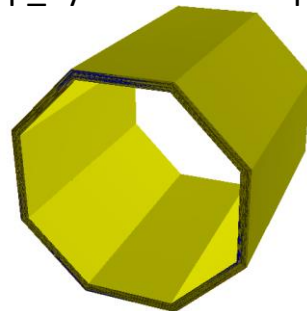
DD4hep\_PolyhedraBarrelCalorimeter2



DD4hep\_PolyhedraEndcapCalorimeter2



DD4hep\_ForwardDetector



DD4hep\_EcalBarrel

# Compact Design for CEPC model

- Ignore support first
- EM calorimeter
  - `DD4hep_PolyhedraBarrelCalorimeter2` + `DD4hep_PolyhedraEndcapCalorimeter2`
- Hadron calorimeter
  - `DD4hep_PolyhedraBarrelCalorimeter2` + `DD4hep_PolyhedraEndcapCalorimeter2`
    - Before bug being found, regarded as EM calorimeter, tagged by layer number
- Muon
  - `DD4hep_PolyhedraBarrelCalorimeter2` + `DD4hep_PolyhedraEndcapCalorimeter2`
- Tracker
  - Silicon: `DD4hep_SiTrackerBarrel` + `DD4hep_SiTrackerEndcap2`
  - TPC:
    - simplified as tube, `DD4hep_SiTrackerBarrel` + `DD4hep_SiTrackerEndcap2`
    - New type of sub-detector
- The CEPC detector can be simplified and built by existing standard DD4hep type of sub-detector.

# Next to do

- Simulate with new geometries by DD4hep
- 2 types of tracker and 4+ types of calorimeters → at least 8 options
  - Silicon-tracker + silicon-calorimeter is coming soon
- The designs of sub-detectors are welcome to build the whole CEPC detector model now!

**Thanks a lot!**