



CMS Simulation Update

February 15, 2024
Geant4 Technical Forum

Sunanda Banerjee
Vladimir Ivantchenko



Geant4 in Run2 and Run-3

- For Run-2 legacy MC production
 - Geant4 10.4.p03 + private patches is used
 - VecGeom was used for the first time
- For Run-3 in 2022-2023
 - The production platform slc7_amd64_gcc10
 - Geant4 10.7.2 + private patches
 - VecGeom 1.1.17
 - DD4hep 1.19
 - CLHEP 2.4.5.1
- For Run-3 2024
 - The production platform el8_amd64_gcc12
 - Geant4 11.1.2 and enabled features:
 - G4GammaGeneralProcess
 - Extra cut on photo-effect is enabled
 - G4TransportationWithMsc
 - LTO method to build executable
 - DD4hep 1.27.2
 - VecGeom 1.2.7
 - CLHEP 2.4.7.1
- Currently on validation
 - Geant4 11.2
 - The 1st patch to 11.2 will be tested promptly

CPU performance of CMS production

Ratio of Run3/Run2 CPU per event for different WFs	QCD	Z- \rightarrow e+e-	ttbar	T1tttt
2022-2023 GEN-SIM production	0.70	0.75	0.79	0.83
2024 GEN-SIM production	0.62	0.71	0.71	0.74

- T1tttt is pp \rightarrow gluino + gluino, gluino \rightarrow ttbar + lightest neutralino
- Significant speed-up came from
 - Geant4 version
 - Computing platform
 - LTO method

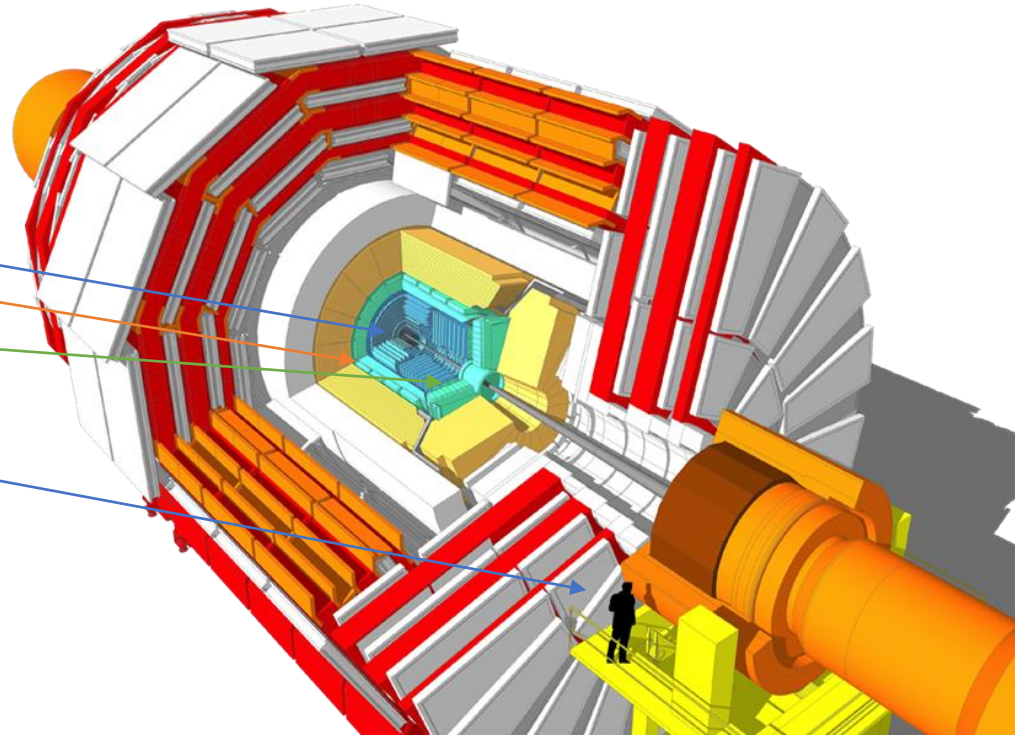
Phase-2 simulation preparations (1/2)

- New detectors

- Tracker
- MTD precise timing
- HGCal endcap calorimeter
- Extra muon chambers
- PPS and beam monitors

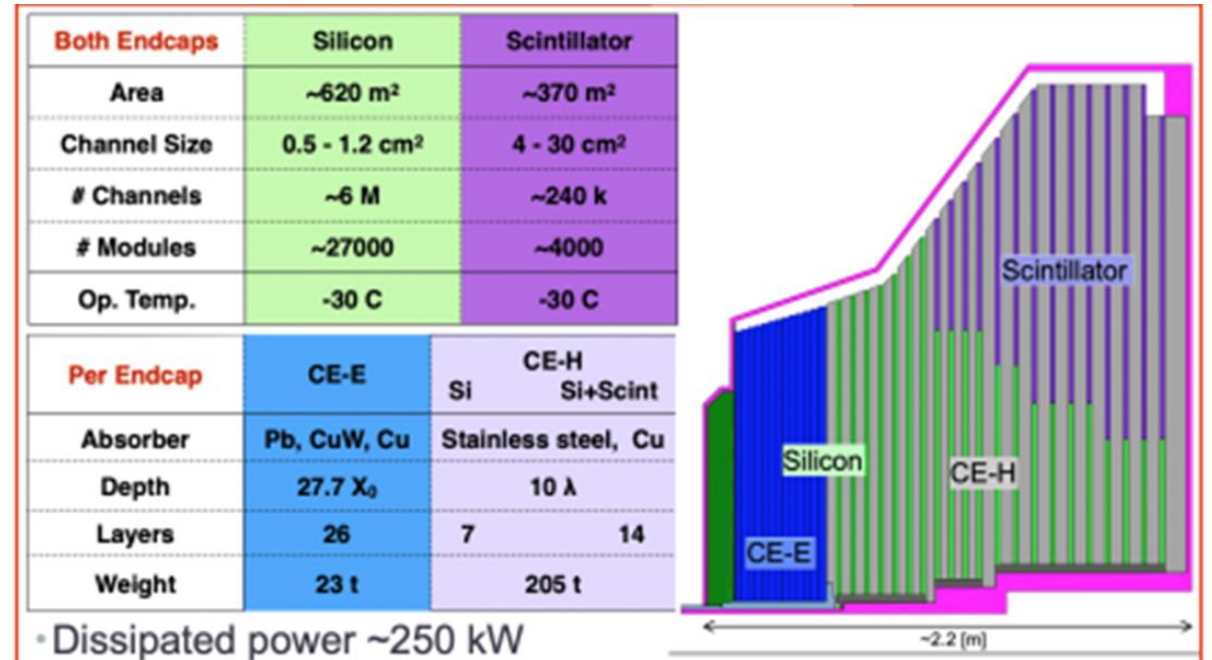
- Geometry description is in progress

- GDML file for the current variant of geometry D98 is available



Phase-2 simulation preparations (2/2)

- Geant4 configuration nearly the same as for Run-3
 - Physics List FTFP_BERT_EMM is used
 - Slow down of Phase-2 versus Run-3 about factor 2
 - Mainly due to the HGCal calorimeter
- R&D is in progress
 - G4HepEM external library is integrated into CMSSW
 - May be enabled via alternative Physics List
 - Celeritas external library is integrated into CMSSW
 - Not yet possible to enable



We would like to thanks Geant4 team for effective resolution of problems connected both with Run-3 simulation and R&D efforts

Thank you