

Design of a drift chamber tracking system for the Research



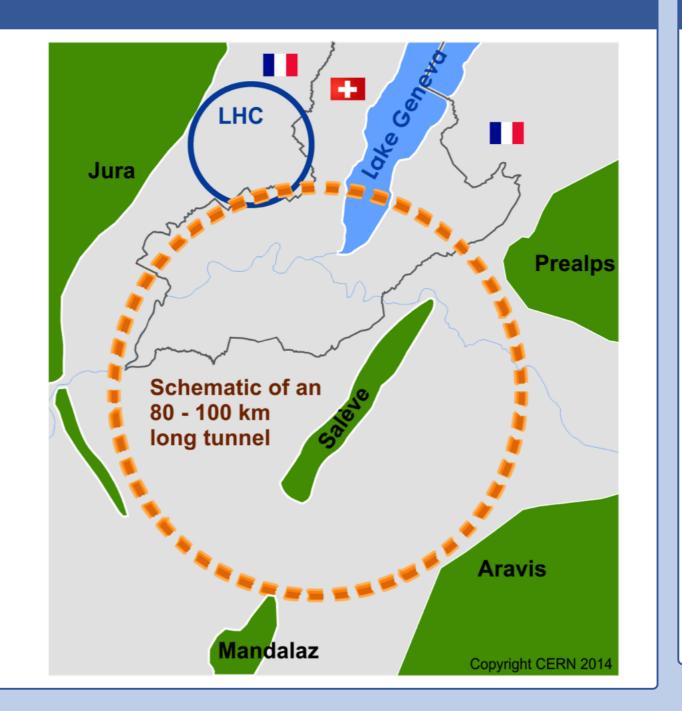
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2018 IEEE Nuclear Science Symposium and Medical Imaging Conference, Sydney, Australia

The Future Circular Collider Experiment (FCC)

- A future possibility for the post-LHC era
- 3 options of circular colliders
 - FCC-ee: electron positron collisions
- FCC-hh: proton proton collisions
- FCC-eh: electron proton collisions
- \sim 100 km tunnel in Geneva area
- FCC-ee collider parameters:

Stages	Z	WW	H (ZH)	tīt
Beam energy [GeV]	45.6	80	120	182.5
Average bunch spacing [ns]	19.6	163	994	3396



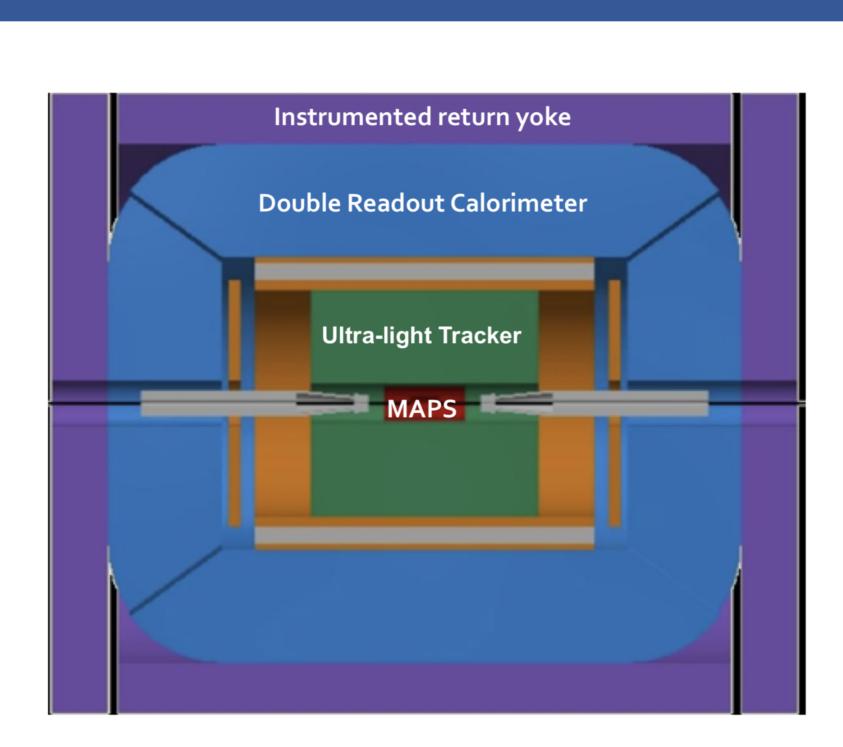
FCCSW: Physics and Detector simulations with FCCSW

- Common software for all FCC experiments (ee, hh & eh)
- Detector and physics studies
 - Fast & full simulations
 - One software stack from event generation to physics analysis
- Collaborative approach with other CERN experiments
 - Gaudi from LHC
 - DD4hep from CLIC & LHCb
 - New solutions where needed

Geometry	Segmen-	Geant4	Digiti-
DDhep	tation	simulation	zation

The IDEA detector concept for FCC-ee

- The IDEA detector is one of the two detector concepts for the FCC-ee
- Ultimate goal for the IDEA detector concept
 - Vertex detector: MAPS
 - Ultra-light drift chamber with particle identification
 - Double readout calorimetry
 - Aditional silicon disk layers placed in the space between the drift chamber and the dual readout calorimeter to increase the forward coverage
 - 2 T solenoidal magnetic field
 - Instrumented return yoke
 - Large tracking volume (R \sim 8 m) for very weakly coupled (long-lived) particles



 The IDEA detector as simulated with FCCSW **Tungsten Shielding Drift Chamber** Solenoid Shielding **Beam Pipe Vertex Detector Luminosity Calorimeter**

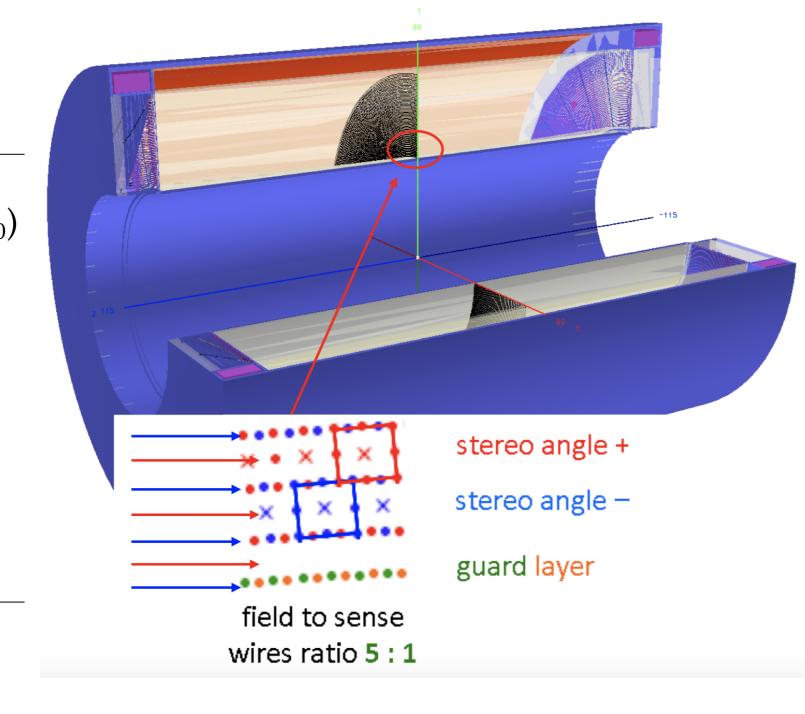
The drift chamber

The parameters of the drift chamber

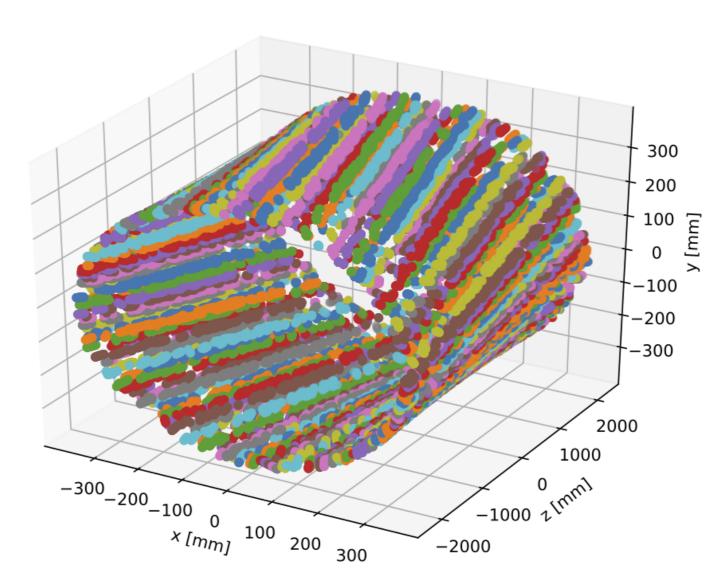
Gas 90 % Helium & 10 % isobutane (C_4H_{10}) 4500 mm Length Inner radius 345 mm Outer radius 2000 mm

Nb. layer 112 Cell size 12 mm - 14.7 mm

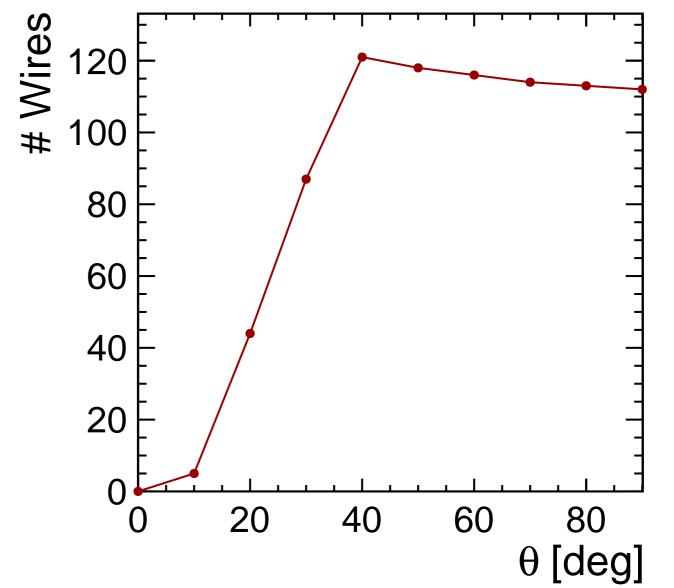
Number of sensitive wires 56448 Single cell resolution 0.1 mm Longitudinal resolution 1 mm



- The first layer of the drift chamber
- Wires are illustrated using different colors
- The wires are rotated by a stereo angle to increase the hit resolution



- In the barrel region, the drift chamber has a high coverage of \sim 112 wires in average.
- In the forward region, silicon disks are foresean to increase the number of layers measuring the tracks.



Main sources of beam-induced backgrounds at the FCC-ee and the impact on the IDEA drift chamber

2 T magnetic field.

- Three main sources of beam-induced
- Incoherent e^+e^- pairs du to bremstrahlung photons \Rightarrow highest source of backgrand $\gamma\gamma \rightarrow backgrand$
- $\gamma\gamma \rightarrow$ hadrons \Rightarrow Expected to have a very low impact
- Synchrotron radiation (SR) \Rightarrow Dictates the design of the interaction region (IR) • Defines the beampipe radius, the design of the
- shielding (in Tungesten) Mostly stopped by the shielding, few SR photons can hit the detector
- 250 200 60 150 100 20 50 1500 2000 z [mm]

• The trajectory of the e^+e pairs in a

• Incoherent e^+e^- pairs [%] hit — Top Stage Wires ─ Z Stage

Layers

- Background Average occupancy $E_{cm} = 91.2 \text{ GeV } E_{cm} = 365 \text{ GeV}$ e^+e^- pair background 2.9% 1.1% $\gamma\gamma \to \mathsf{hadrons}$ 0.001% 0.035% Synchrotron radiation 0.2%
- The overall impact remains low and the results are promising for the track reconstruction with this detector.