# Design of a drift chamber tracking system for the IDEA experiment at FCC-ee

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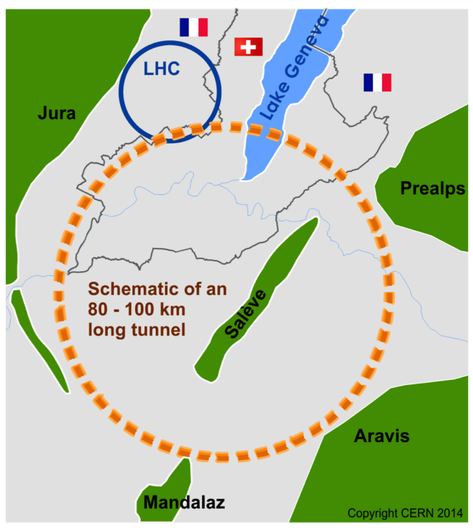
## The Future Circular Collider Experiment (FCC)

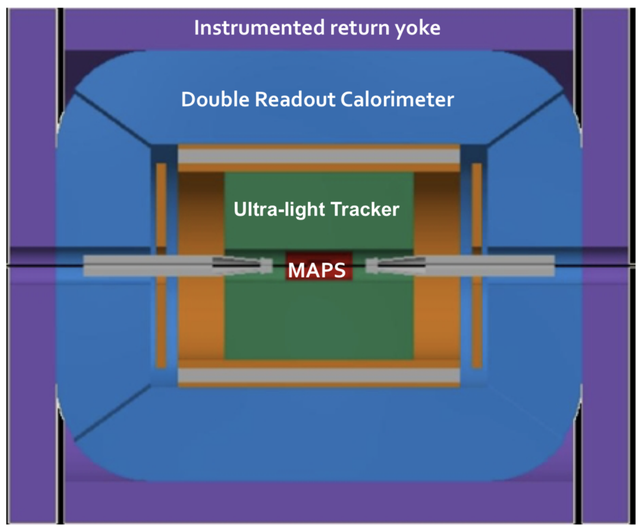
- A future possibility for the post-LHC era
- 3 options of circular colliders
  - FCC-ee: electron - positron collisions
  - FCC-hh: proton - proton collisions
  - FCC-eh: electron - proton collisions
- ∼100 km tunnel in Geneva area
- FCC-ee collider parameters:

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




## The IDEA detector concept for FCC-ee

- The IDEA detector is one of the two detector concepts for the FCC-ee experiment
- 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 ∼ 8 m) for very weakly coupled (long-lived) particles



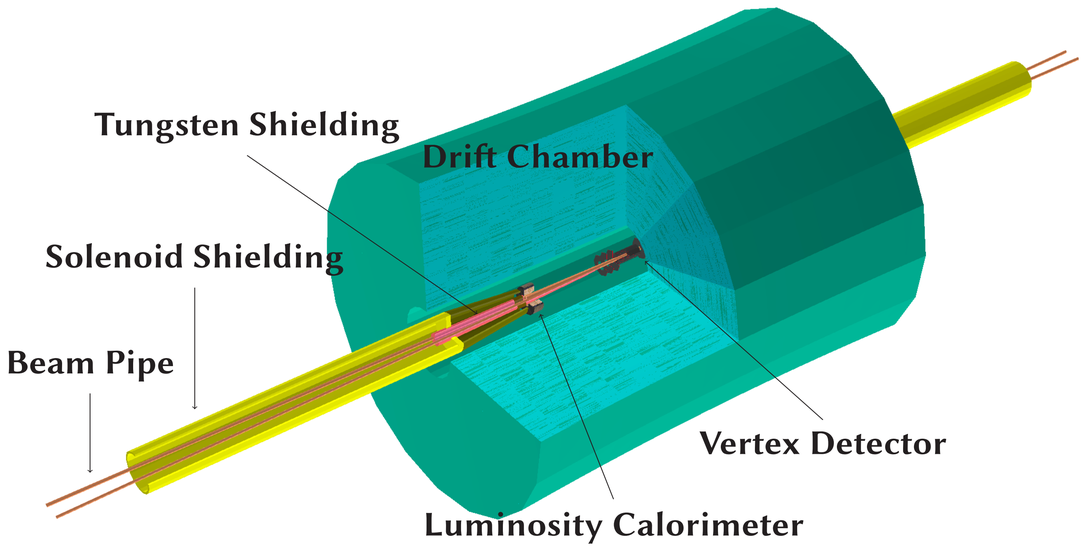

## FCCSW: Physics and Detector simulations with FCCSW

- 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 DDhep → Segmen-tation → Geant4 simulation → Digiti-zation

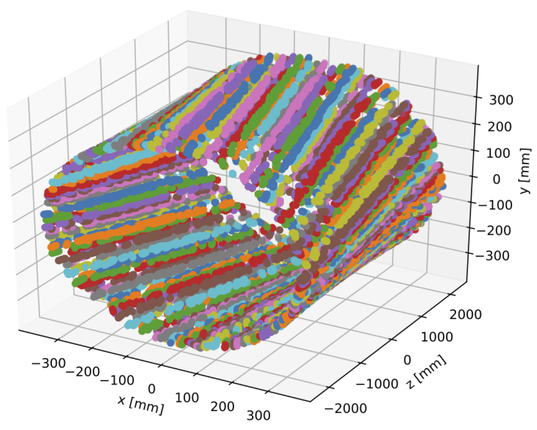
## Simulation of the IDEA drift chamber within FCCSW

- The IDEA detector as simulated with FCCSW

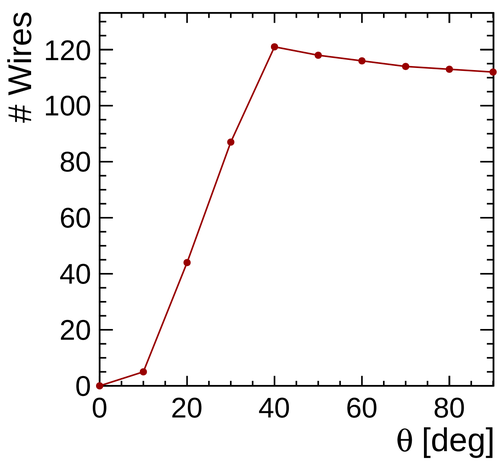



## The simulation of the drift chamber & coverage

- 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

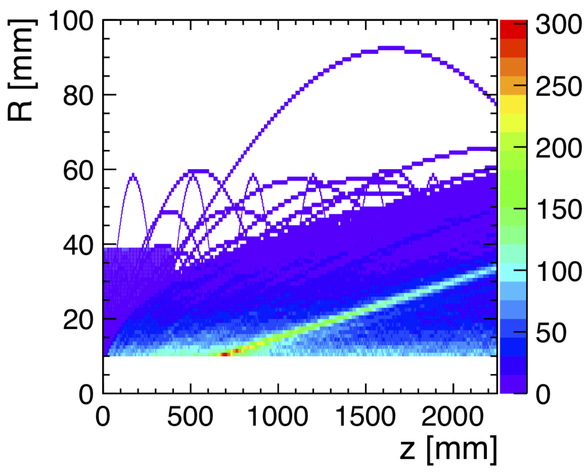



- In the barrel region, the drift chamber has a high coverage of ∼ 112 wires in average.
- In the forward region, silicon disks are foresean to increase the number of layers measuring the tracks.




## Main sources of beam-induced backgrounds

- Three main sources of beam-induced backgrounds
  - Incoherent $e^+e^-$ pairs du to bremstrahlung photons ⇒ highest source of background
  - $\gamma\gamma \rightarrow$ hadrons ⇒ Expected to have a very low impact
  - Synchrotron radiation (SR) ⇒ 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
- The trajectory of the $e^+e$ pairs in a 2 T magnetic field.



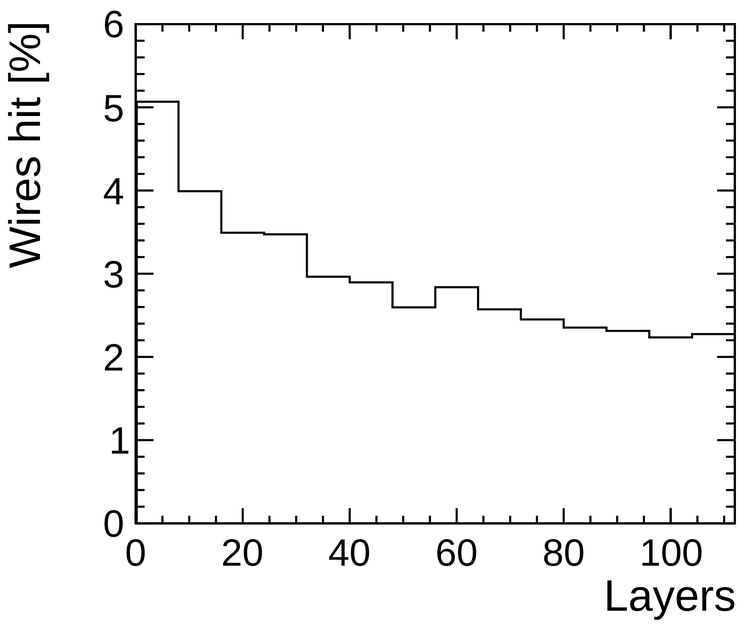

## Summary of beam-induced backgrounds & conclusions

| Background | Average occupancy | |
|---|---|---|
| | $E_{cm}$ = 91.2 GeV | $E_{cm}$ = 365 GeV |
| $e^+e^-$ pair background | 1.1% | 2.9% |
| $\gamma\gamma \rightarrow$ hadrons | 0.001% | 0.035% |
| Synchrotron radiation | - | 0.2% |

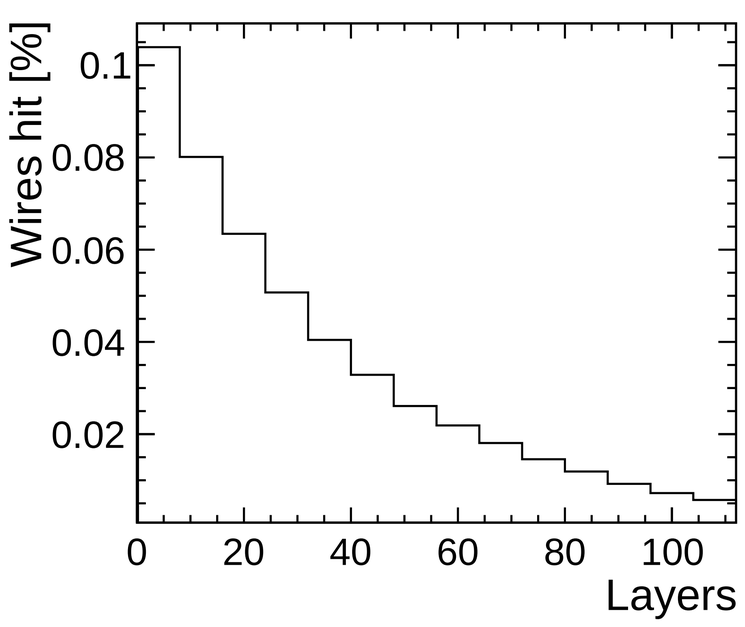
- The overall impact remains low and the results are promising for the track reconstruction with this detector.

## 3 main sources of beam-induced backgrounds at the top stage

- Incoherent $e^+e^-$ pairs




- $\gamma\gamma \rightarrow$ hadrons




- $\gamma\gamma \rightarrow$ hadrons