



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



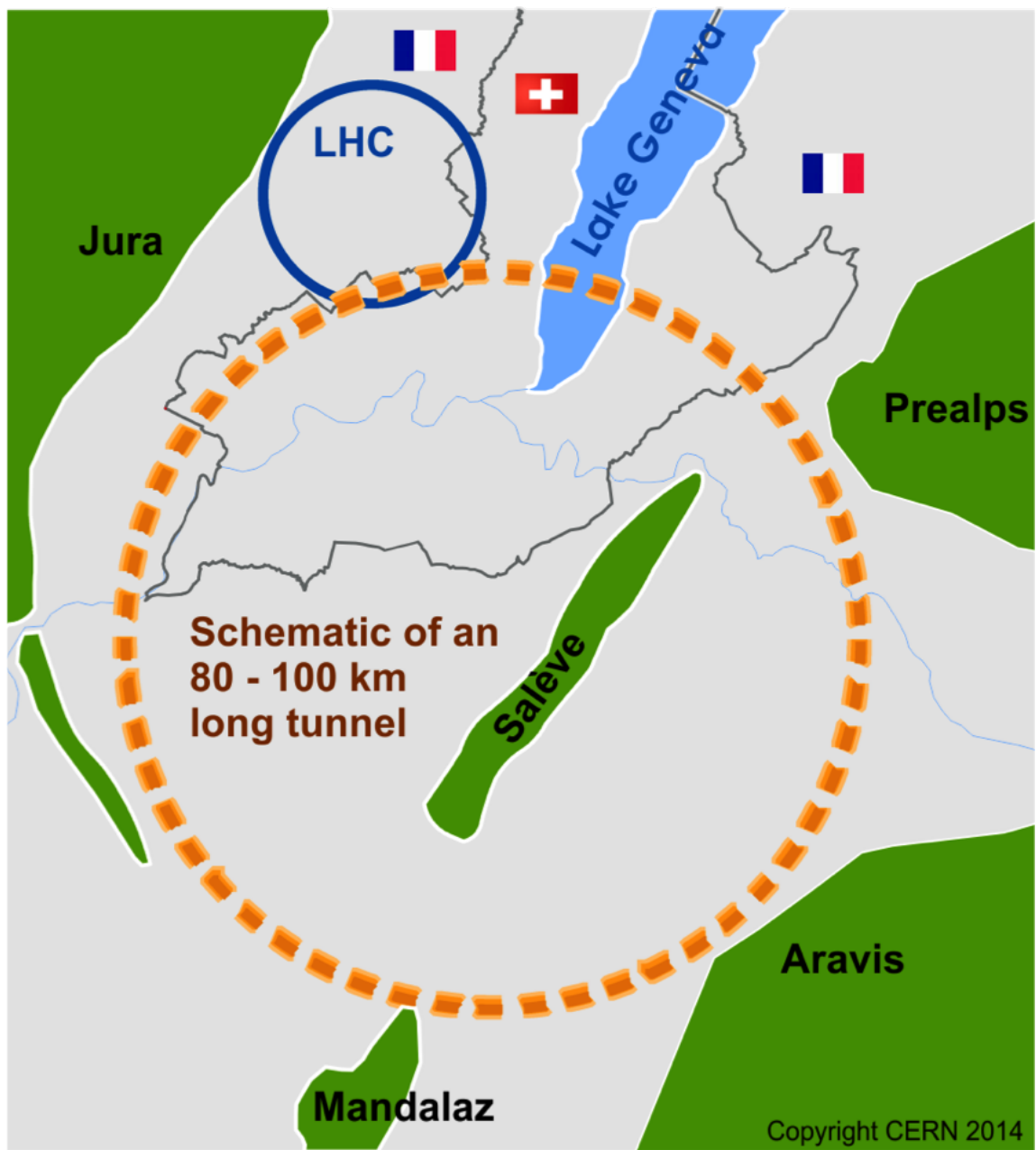
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The Future Circular Collider Experiment (FCC)

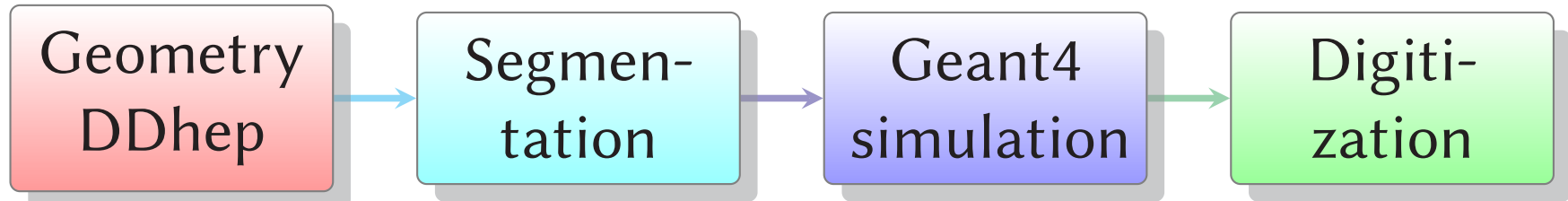
- A future possibility for the post-LHC era
- 3 options of circular colliders
 - FCC-ee: electron - positron collisions
 - FCC-hh: proton - proton collisions
 - FCC-eh: electron - proton collisions
- ~100 km tunnel in Geneva area
- FCC-ee collider parameters:

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



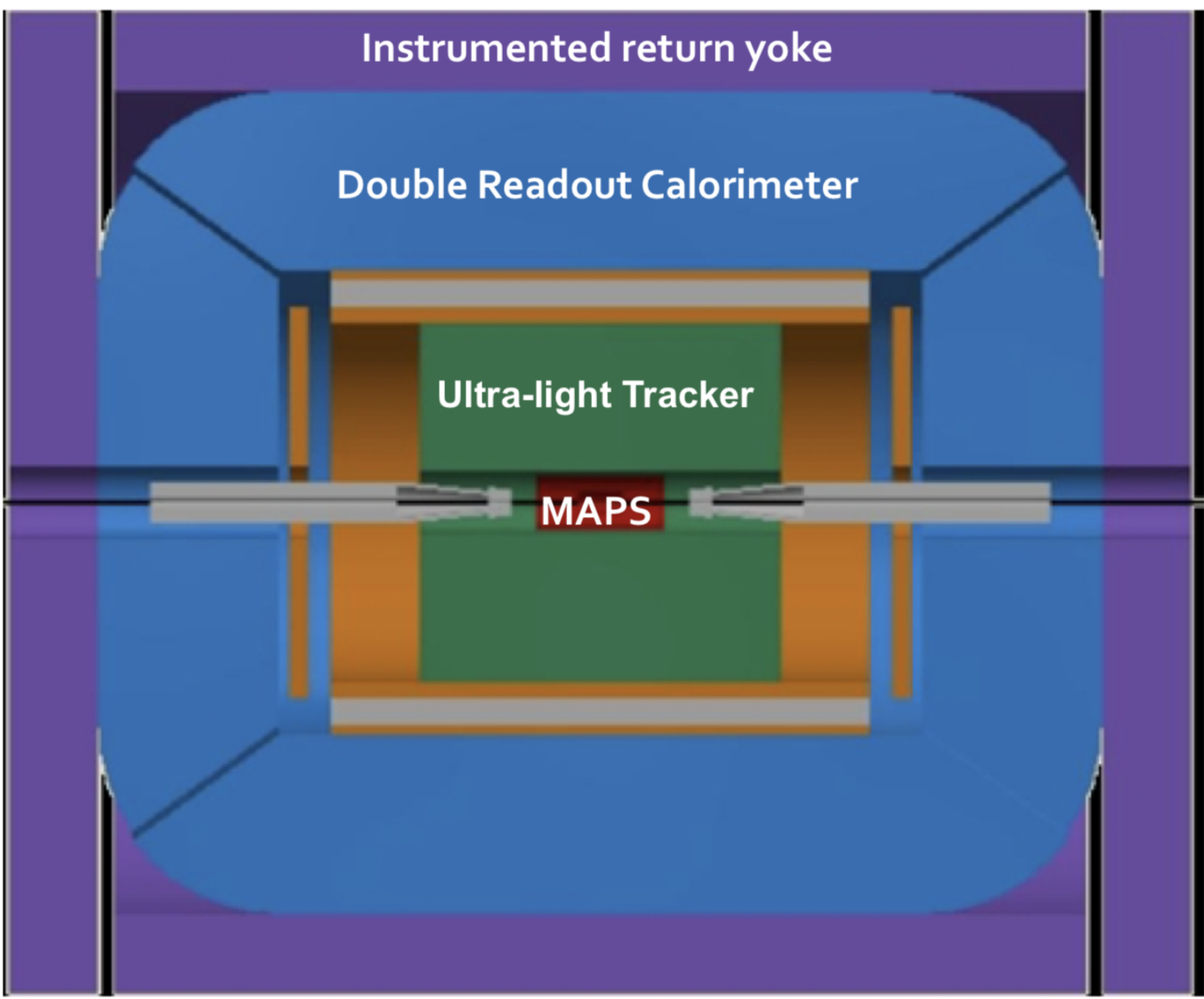
FCCSW: Physics and Detector simulations with FCCSW

- 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

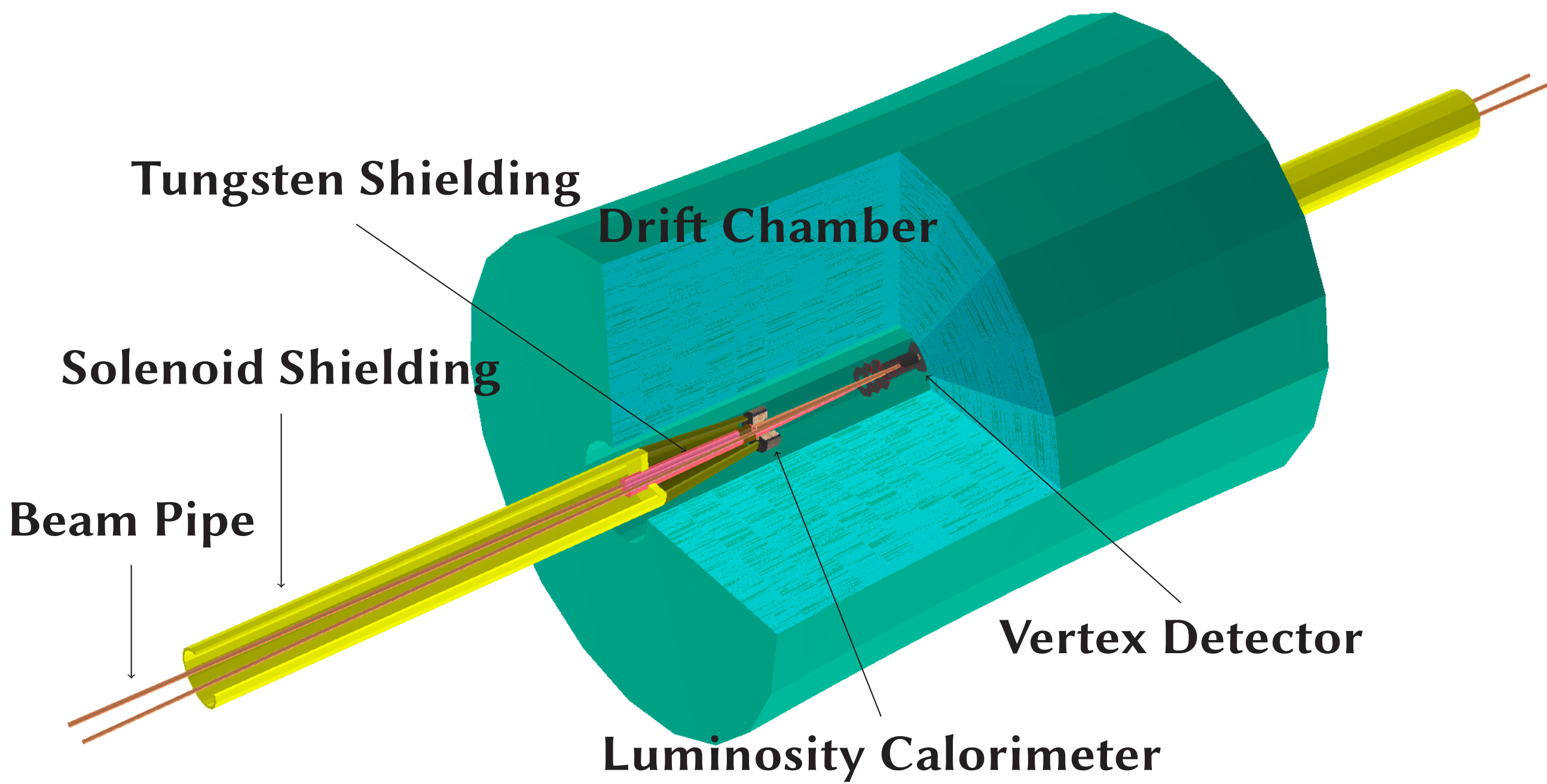


The IDEA detector concept for FCC-ee

- 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
 - Additional 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



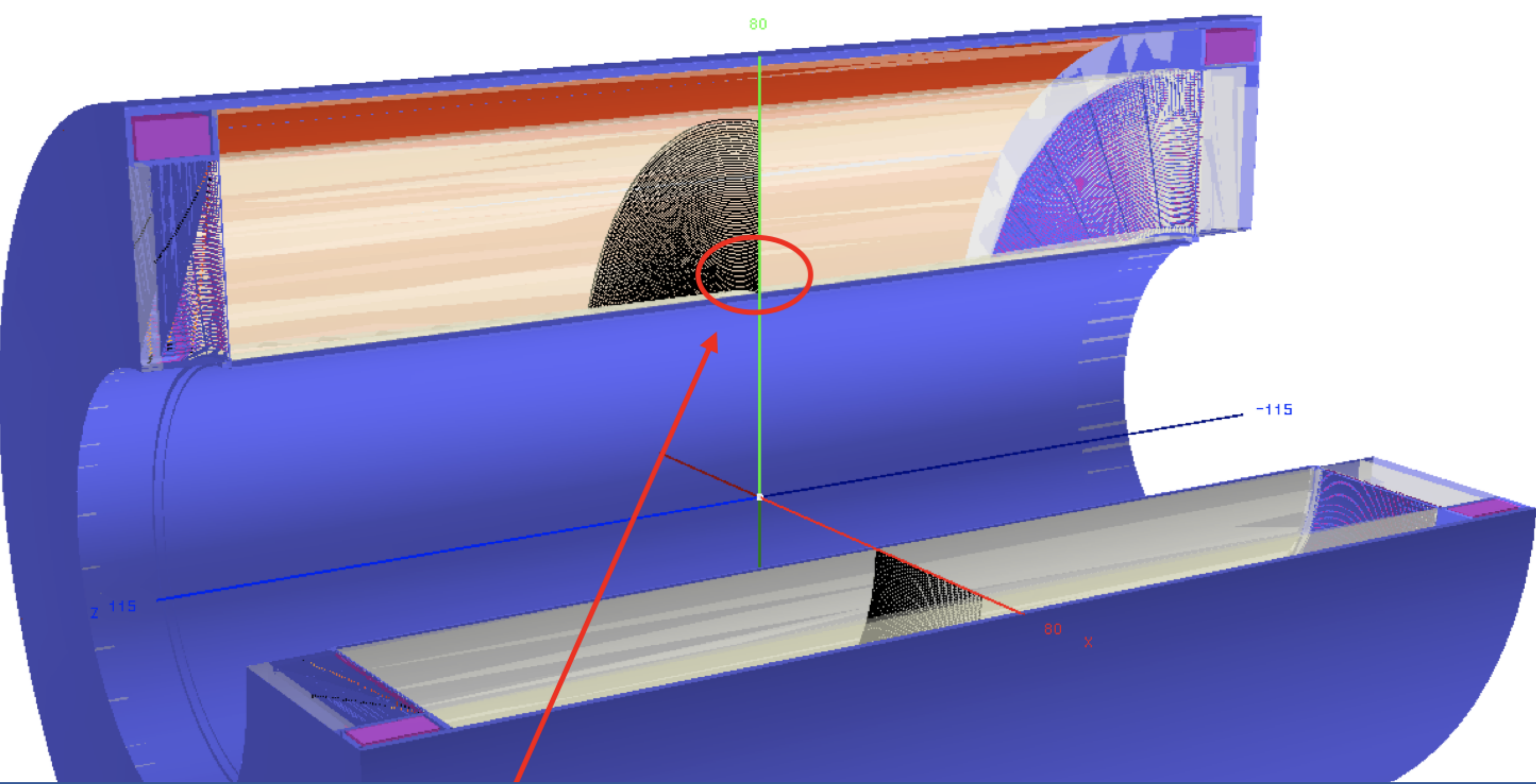
- The IDEA detector as simulated with FCCSW



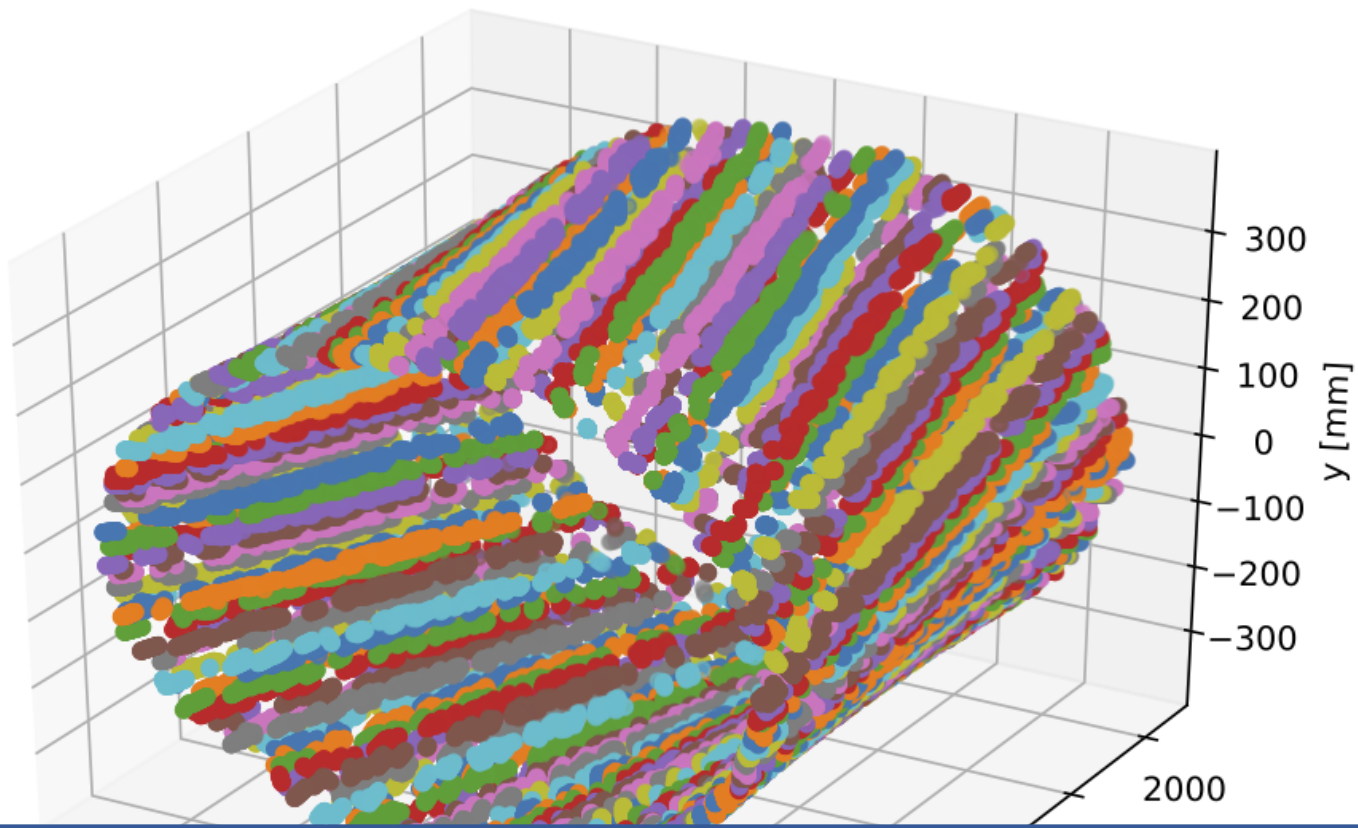
The drift chamber

- The parameters of the drift chamber
 - The gas volume is divided into a set of hyperboloid shells.
 - The wires are rotated with a stereo angle of 0.1 radians to improve the longitudinal resolution along them.

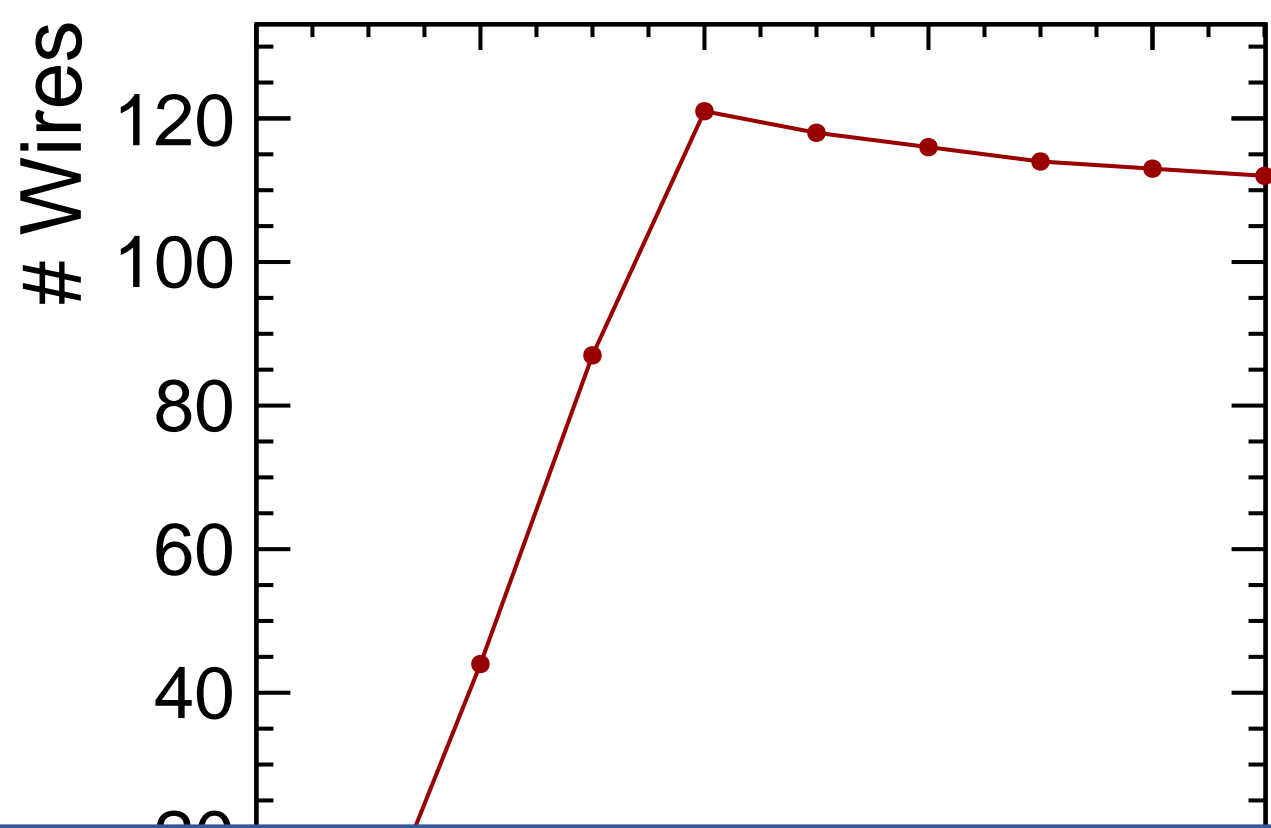
Gas	90 % Helium & 10 % isobutane (C ₄ H ₁₀)
Length	4500 mm
Inner radius	345 mm
Outer radius	2000 mm
Nb. layer	112
Cell size	12 mm - 14.7 mm
Number of sensitive wires	56448
Single cell resolution	0.1 mm
Longitudinal resolution	1 mm



- 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



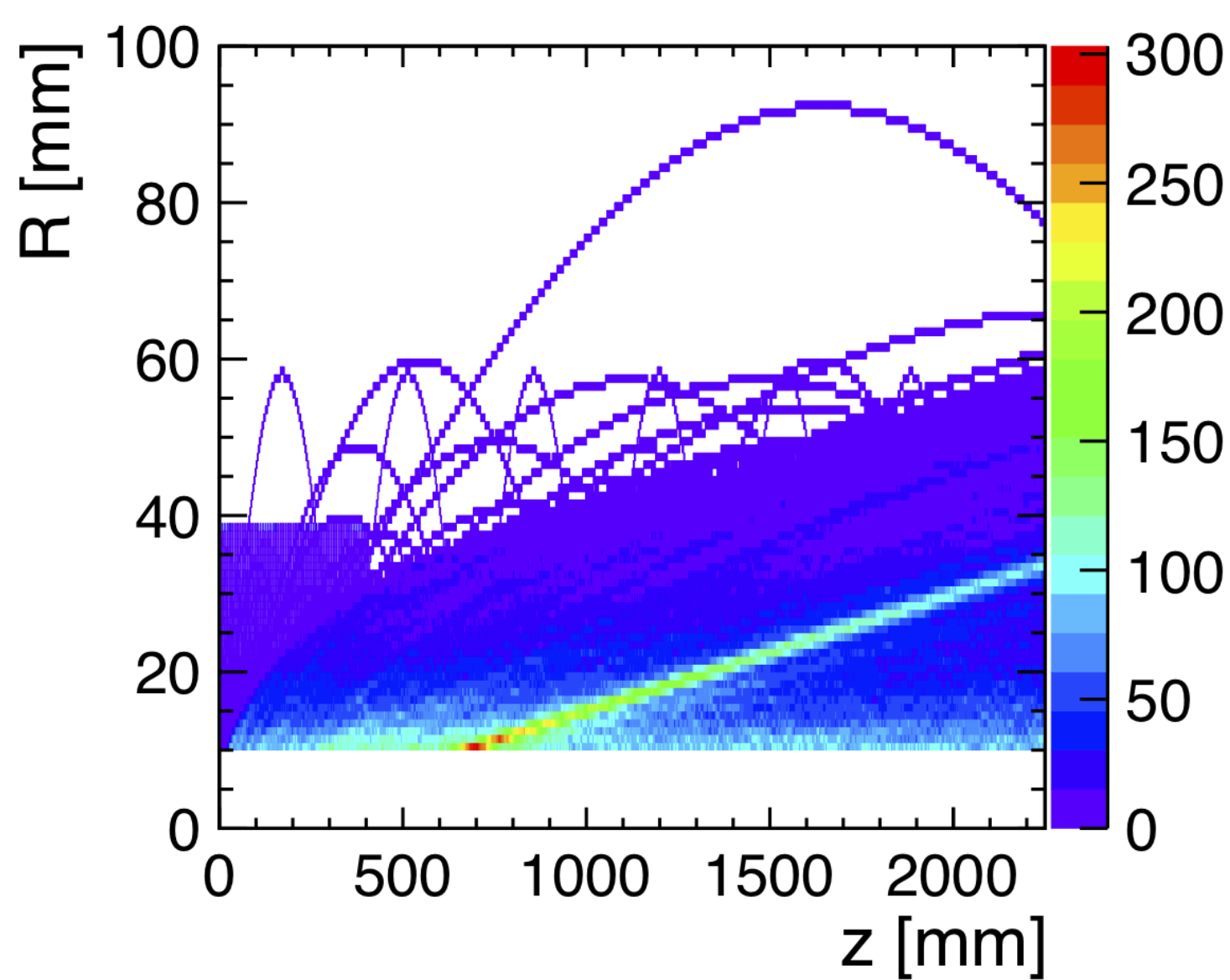
- In the barrel region, the drift chamber has a high coverage of ~ 112 wires in average.
- In the forward region, silicon disks are foreseen to increase the number of layers measuring the tracks.



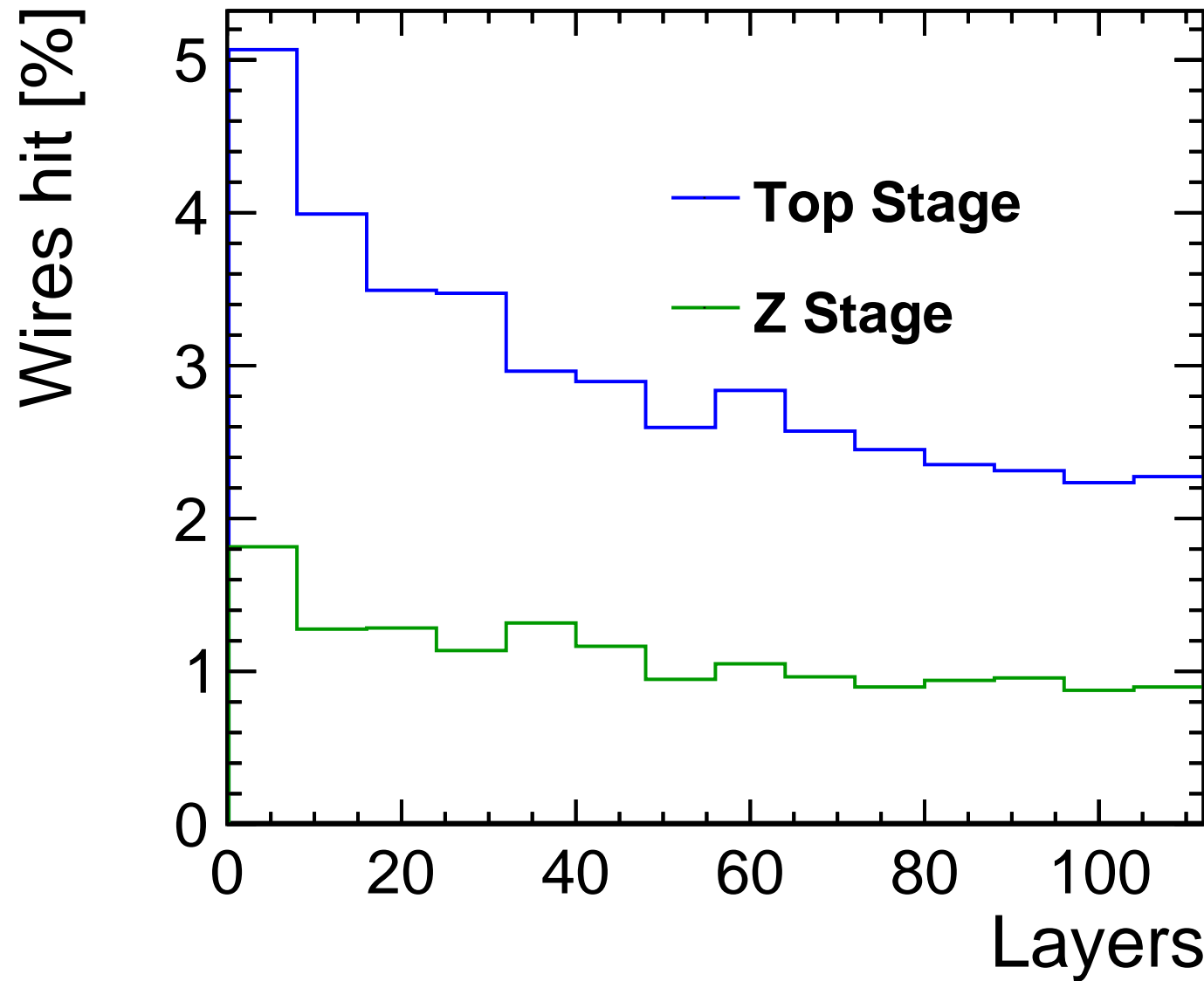
Main sources of beam-induced backgrounds at the FCC-ee and the impact on the IDEA drift chamber

- Three main sources of beam-induced backgrounds
 - Incoherent e^+e^- pairs du to bremsstrahlung photons \Rightarrow highest source of background
 - $\gamma\gamma \rightarrow$ 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 Tungsten)
 - 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.



- Incoherent e^+e^- pairs



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.