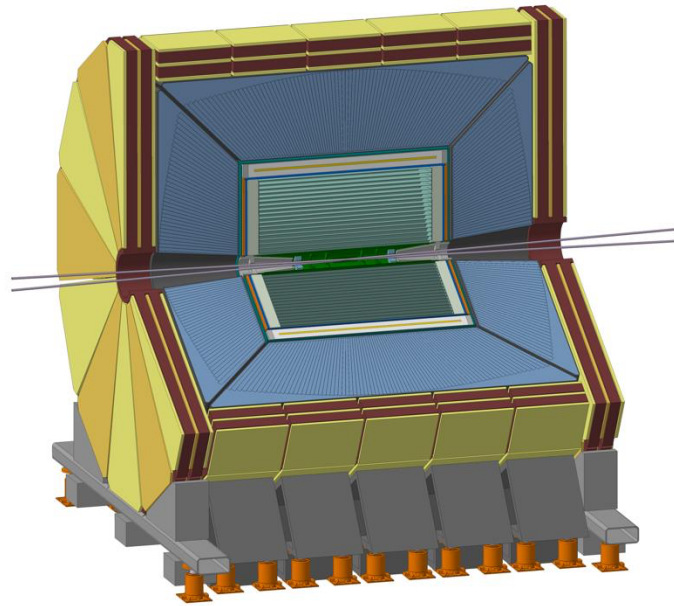
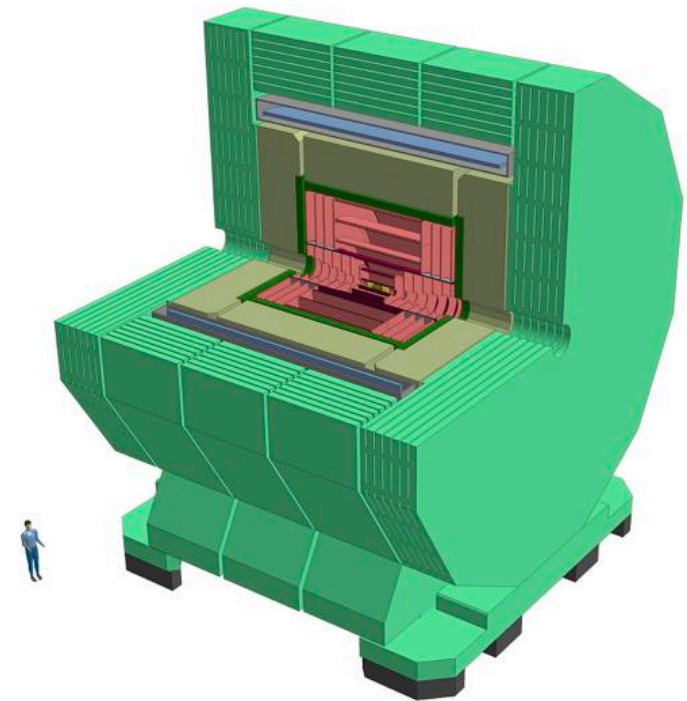


FCC-ee Detector Concepts



Mogens Dam
Niels Bohr Institute

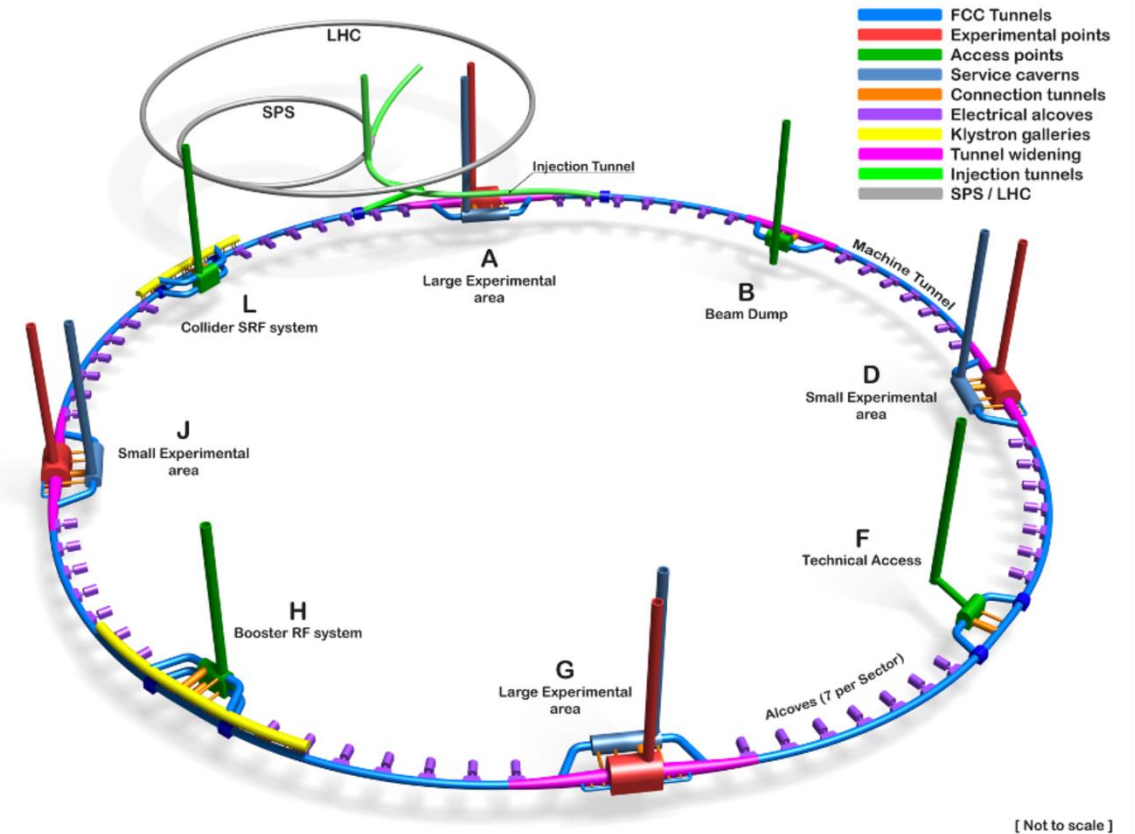
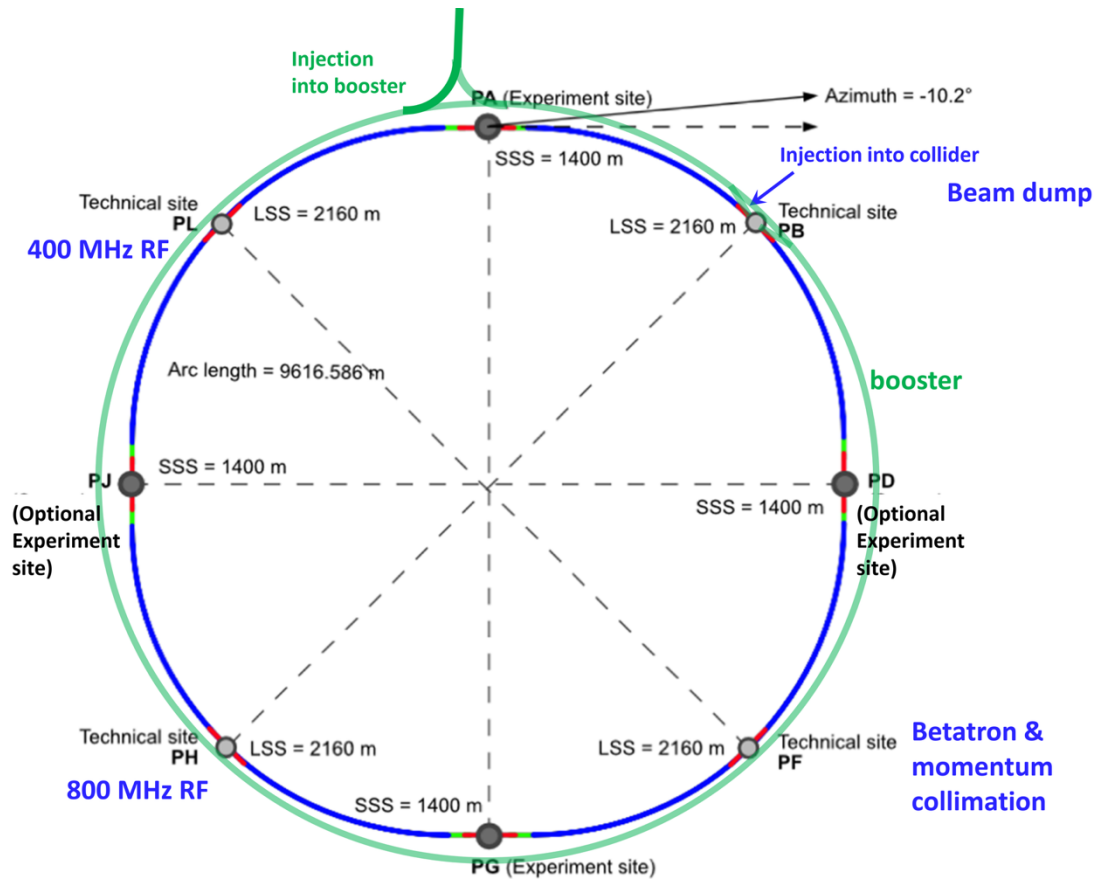
Canadian Association of Physicists
2026 Congress, Ottawa
24 June, 2026



Outline

- ◆ FCC-ee Experimental Conditions
- ◆ Detector Requirements and Challenges
- ◆ Detector Concepts
- ◆ Detector Sub-systems and Technologies
- ◆ Organisational Matters
- ◆ Summary

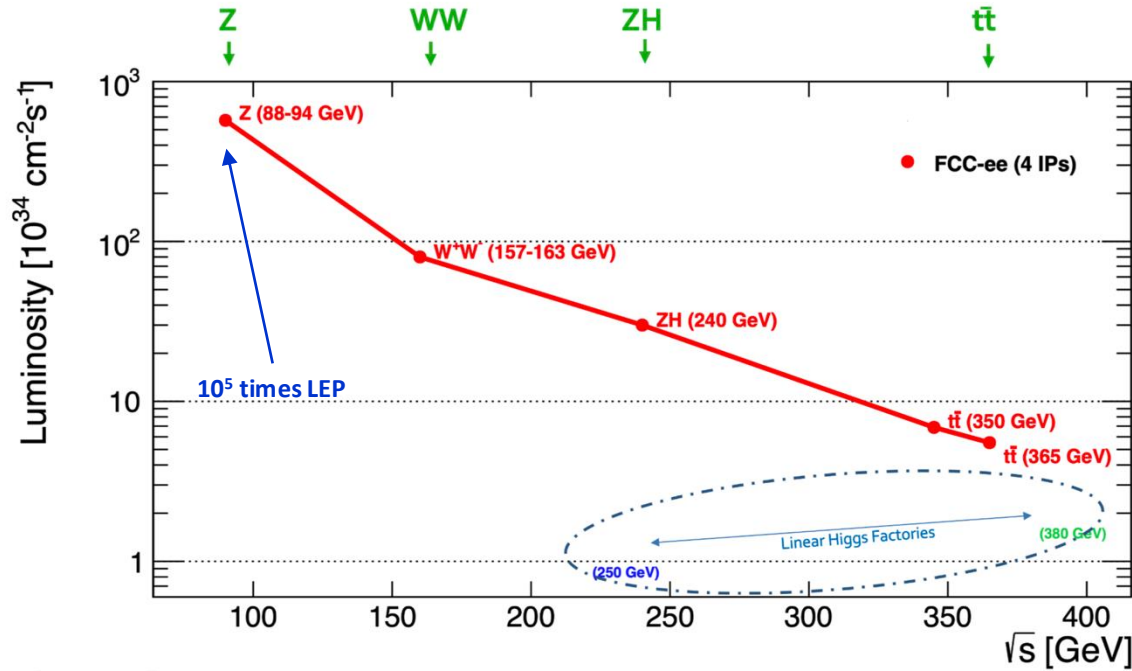
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- ◆ Double ring e^+e^- collider, 91 km
- ◆ Large crossing angle 30 mrad, crab-waist optics
- ◆ Top-up injection from separate booster ring

- ◆ Four experimental areas / experiments
 - Experimental diversity - control of overall systematic uncertainties
 - Higher statistics
 - Sustainability - physics/TWh

FCC-ee Luminosity and Conditions



Z peak	$\sqrt{s} \sim 91 \text{ GeV}$	4 years	6×10^{12}	$e^+e^- \rightarrow Z$
WW threshold	$\sqrt{s} \sim 160 \text{ GeV}$	2 years	2.4×10^8	$e^+e^- \rightarrow W^+W^-$
ZH maximum	$\sqrt{s} \sim 240 \text{ GeV}$	3 years	2.3×10^6	$e^+e^- \rightarrow ZH$
$t\bar{t}$ threshold	$\sqrt{s} \sim 365 \text{ GeV}$	2 years	2×10^6	$e^+e^- \rightarrow t\bar{t}$
[s-channel Higgs	$\sqrt{s} = 125 \text{ GeV}$	5? years	~ 5000	$e^+e^- \rightarrow H_{125}$

FCC-ee parameters		Z	W^+W^-	ZH	$t\bar{t}$
\sqrt{s}	GeV	91.2	160	240	350-365
Luminosity / IP	$10^{34} \text{ cm}^{-2} \text{ s}^{-1}$	140	20	7.5	1.5
Bunch spacing	ns	25	160	680	5000
"Physics" cross section	pb	35,000	10	0.2	0.5
Total cross section	pb	70,000	30	10	8
Event rate	Hz	100,000	6	0.5	0.1
"Pile up" parameter [μ]	10^{-6}	2,500	1	1	1

Experimentally, Z pole is the most challenging

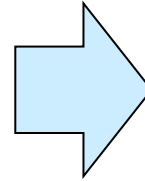
- Extremely large statistics
- Physics event rates of $\sim 100 \text{ kHz}$
- Bunch spacing at 25 ns
 - "Continuous" beams, no bunch trains, no power pulsing
- However, no pileup, no underlying event
 - ...well, pileup of 2.5×10^{-3} at Z pole

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Very Rich Physics Programme → Challenging Detectors

Higgs Factory Programme

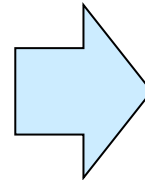
- At $\sqrt{s}=240$ and $\sqrt{s}=365$ GeV collect 2.6M HZ and 150k WW → H events
- Higgs couplings to fermions and bosons
- Higgs self-coupling ($\sim 4 \sigma$) via loop diagrams
- Unique possibility: s-channel $e^+e^- \rightarrow H$ at 125 GeV



- **Momentum resolution $\sigma(p_T)/p_T = \text{few} \times 10^{-3}$ @ $p_T = 50$ GeV**
 - $\sigma(p)/p$ limited by multiple scattering → minimise material
- **Jet $\sigma(E)/E \simeq 3\text{-}4\%$ in multijet events for Z/W/H separation**
- **Superior impact parameter resolution for b, c tagging**
- **Hadron PID for s tagging**

Precision EW and QCD Programme

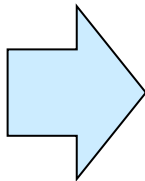
- 6×10^{12} Z and 2×10^8 WW events
- $\times 500$ improvement of statistical precision on EWPO
 $m_Z, \Gamma_Z, \Gamma_{inv}, \sin^2\theta_W, R_b, m_W, \Gamma_W, \dots$
- 2×10^8 tt events: $m_{top}, \Gamma_{top}, \text{EW couplings}$
- Indirect sensitivity to new physics up to tens of TeV



- **Absolute normalisation of luminosity to 10^{-5} - 10^{-4} level**
- **Relative normalisation of channels to $\mathcal{O}(10^{-6})$ [e.g. Γ_{had}/Γ_ℓ]**
 - Acceptance definition (forward) to $\mathcal{O}(10 \mu\text{m})$
- **Track angular resolution < 0.1 mrad**
- **Stability of B field to 10^{-6}**

Heavy Flavour Programme

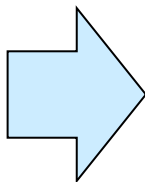
- 10^{12} bb, cc, 2×10^{11} $\tau^+\tau^-$ (clean, boosted): $10 \times$ Belle II stats.
- CKM matrix, CP measurements
- rare decays, CLFV searches, lepton universality



- **Superior impact parameter resolution**
- **Precise identification and measurement of secondary vertices**
- **ECAL resolution at few %/VE; sensitivity to $\mathcal{O}(100 \text{ MeV})$ photons**
- **Excellent π^0/γ separation for τ decay-mode identification**
- **PID: K/ π separation over wide p range → dN/dx, RICH, ToF**

Feebly coupled particles Beyond SM

- Opportunity to directly observe new feebly interacting particles with masses below m_Z
- Axion-like particles, dark photons, Heavy Neutral Leptons
- Long-lifetime LLPs



- **Sensitivity to (significantly) detached vertices (mm → m)**
 - tracking: more layers, "continuous" tracking
 - calorimetry: granularity, tracking capabilities
- **Precise timing, ToF**
- **Hermeticity**

Machine Detector Interface

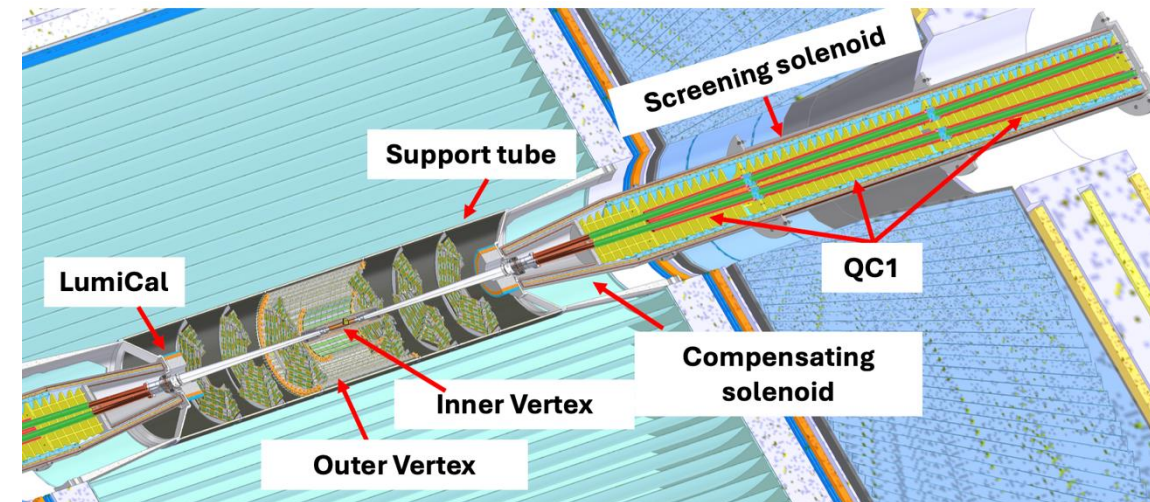
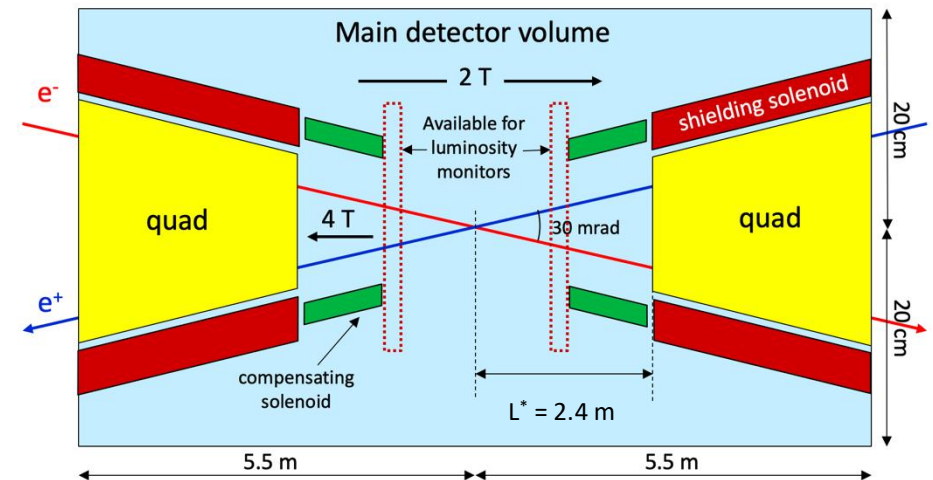
Extreme luminosities reached via

- ◆ Separate electron and positron beam pipes; beams crossing at 30 mrad angle at interaction points (IPs)
- ◆ Top-up injection from separate booster ring
- ◆ Strong focussing and use of crab-waist optics

Implications for MDI (Machine Detector Interface) region

- ◆ Tightly packed MDI region with major components extending deep into detector volume
 - Last quadrupole at $L^* = 2.4\text{m}$; compensating solenoid in front
 - Detector B-field limited to 2 Tesla (@ Z energy) to avoid vertical emittance blow-up (beam Xing B-field at finite angle)
 - ❖ Alternative *local compensation scheme* being adapted; may allow $\lesssim 3\text{T}$

Central part of detector volume – top view



FCC-ee Detectors Overview

Tracking and vertexing

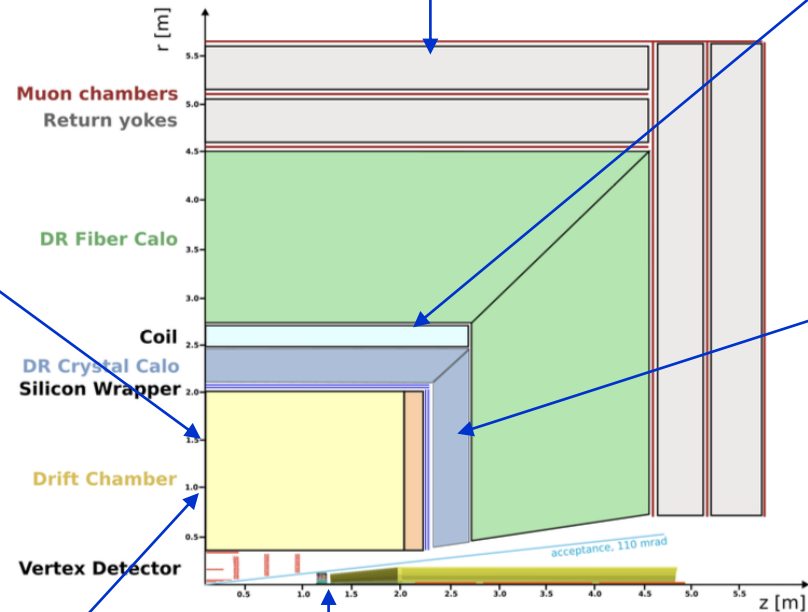
- As lightweight as possible
 - p_T in range 0.1 - 50 GeV; multiple scattering dominated;
 - Strong case for gaseous trackers
- Few micron VXD resolution for flavour tagging and lifetime measurements
 - Thinned MAPS sensors (Monolithic Active Pixel Sensors)
 - Few micron space point resolution
- Moderate radiation environments
- Nanosecond timing for possible BXID (1, possibly 2 layers); picosecond timing only for possible ToF PID

Particle Identification

- $\pi/K/p$ separation for flavour, Higgs, and EW physics
 - Cluster counting in gaseous trackers
 - Compact Cherenkov detector
 - Time-of-flight for $p < \sim 3$ GeV
- π^0/γ separation
 - ECAL granularity

Muon system

- Precise muon identification (tagging);
- 6-8 λ_I HCAL as muon filter



Luminometry and normalisation

- Requirement: $\lesssim 10^{-4}$ absolute; $\lesssim 10^{-5}$ relative
- Compact, extremely precise ($\sim 1 \mu\text{m}$) LumiCal for small angle Bhabha scattering
- Precise acceptance definition ($\sim 10 \mu\text{m}$) for di-foton final state

Coil and B-field

- Field restricted to 2T (3T) to avoid beam emittance blowup
- Coil positioned inside or outside HCAL
- Low temp. super conductivity; R&D for HTS solution

Calorimetry

- Relatively low energy coverage:
 - 20-25 X_0 , 6-8 λ_I suffices
- Jet energy resolution of 3-4 % @ 50 GeV
 - **Particle flow** method: **high granularity**
 - possibly combined with **dual readout**
- **ECAL** resolutions
 - few %/ \sqrt{E} for flavour physics

(T)DAQ

- Require “lossless” system with 10^{-5} normalisation precision between physics channels
- Two basic options: “To TDAQ or to DAQ”
 - i) Trigger system to activate complete detector readout – as at LEP & LHC
 - ii) Streaming out of data from autonomous sub-detectors; off-detector event building based on time-stamping

FCC Detector Expressions of Interest

Input to ESPPU2026, March 2025

- ◆ Build community of institutes interested in development of dedicated sub-detectors
- ◆ Trigger interactions in the community to get (self-) organised around sub-detectors
- ◆ 39 documents received
 - **ESPPU submissions:** <https://indico.cern.ch/event/1530285/>
 - **Individual Eols:** <https://indico.cern.ch/event/1529896/>

Topic	Number of Eols
Detector Concepts	4
Vertex Detector	2
Main Tracker and Envelopes	10
Calorimeters	8
Luminometers	2
Particle ID	1
Coil	1
Muon	5
Trigger/DAQ/Electronics	3
Algorithms, AI	2
Machine Detector Interface	1

Progress since Eol submission:

- ➔ Now, two additional concepts
- ➔ Vertex Detector Workshop, Pisa, Oct. 2025
- ➔ Tracker Workshop, BNL, May 2025
- ➔ DRD6 meetings
- ➔ Workshop at CERN, 27-28 July 2026

- ➔ Workshop in Milan, 2-3 July 2026
- ➔ Workshop to be arranged
- ➔ 1st FCC TDAQ Workshop, CERN, November 2025

- ➔ Series of monthly meetings

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Detector Concepts

Detector concepts form the link between performance requirements and technological capabilities

- ◆ **guide R&D** and give **feedback on performance impact** of technical solutions

Two main ingredients

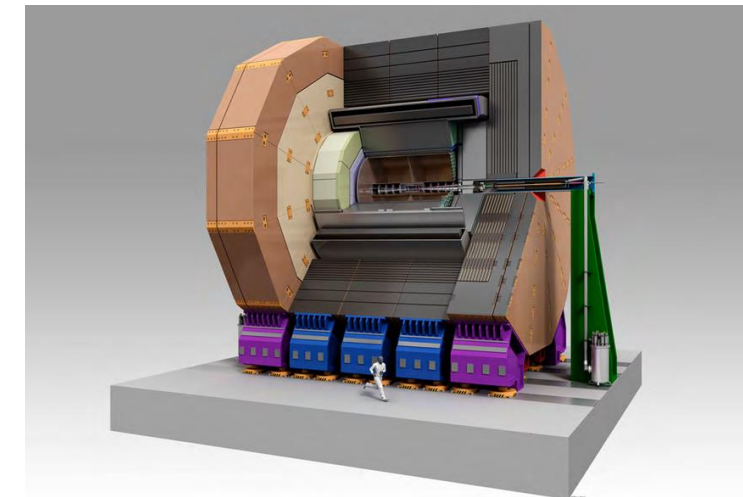
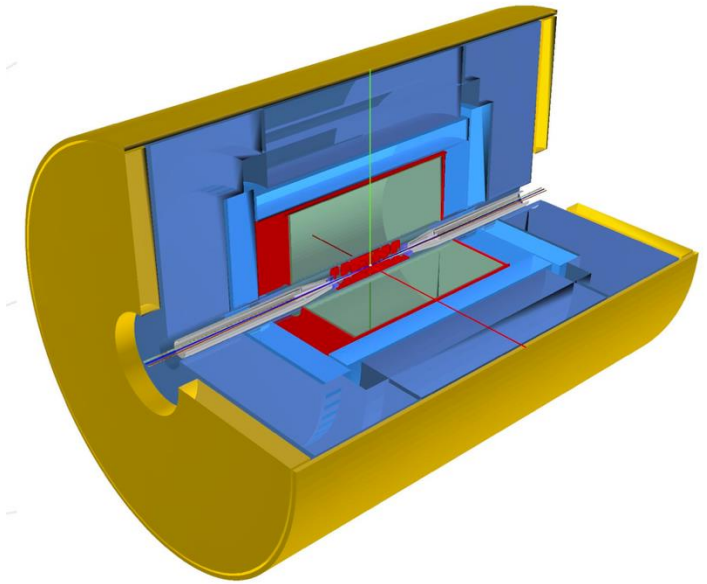
- ◆ **full simulation** model including **digitisation** and **reconstruction**
 - enable validation of single particle performance with prototypes
 - realistic prediction of full-event performance
- ◆ **overall engineering**
 - act and respond to the design of the MDI (Machine Detector Interface)
 - guide the optimisation of the global structure and parameters

Experimental collaborations forming at a later stage

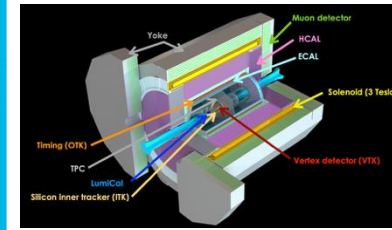
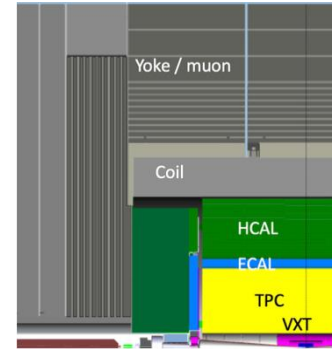
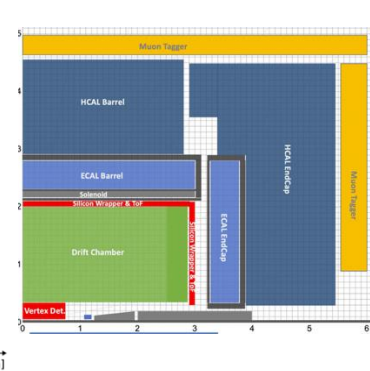
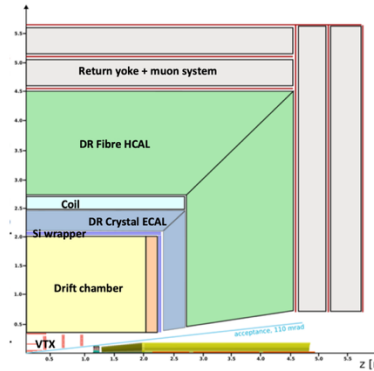
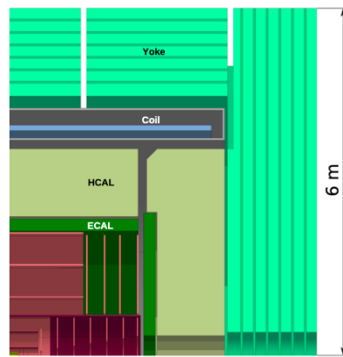
- ◆ maintain freedom to combine technologies, e.g. tracking and calorimetry
 - **“plug & play”** (enabled by **key4hep** software)

Already six concepts under study

- New concepts, ALFA and AGORA, presented for the first time at June 2026 FCC Week
- Healthy situation: exploration of many different sub-system technologies
- Spontaneous merging of ideas towards proposals is certainly a possibility



FCC-ee Proposed Detector Concepts Overview



CLD

IDEA

ALLEGRO

ILD

ALFA
emerging

AGORA
from CEPC, new for FCC-ee

	CLD	IDEA	ALLEGRO	ILD	ALFA emerging	AGORA from CEPC, new for FCC-ee
Vertex	Si	MAPS (ITS-3 like)	MAPS (ITS-3 like)	Si	MAPS (ITS-3 like)	MAPS
Tracker	Full Si	Drift Chamber + Si strp	DCH / Straw / SciFi + Si	TPC + Si strips	All MAPS	TPC + Si strips
ECAL	Si-W highly granular	Crystals w. DR	Noble Liquid (LAr)	Si-W highly granular	Grainita (crystal grains)	Crystals
HCAL	Scint. sampling	Fibre DR	TileCal (steel/scint.)	Scint. or RPC	DR + steel	Glass scint. + steel
Muon	RPC in iron yoke	μ RWELL	TBD	Scint. in iron yoke	TBD	Scint. in yoke
PID	RICH (option)	tracker dN/dx (+ TOF)	tracker dN/dx (+ TOF)	tracker dN/dx (+ TOF)	Cherenkov ARC	tracker dN/dx (+ TOF)
Coil B-field	Outside HCAL 2T	Inside HCAL 2T (3T HTS R&D)	Inside HCAL 2T	Outside HCAL 3.5 T -> 2-3 T	Inside HCAL 3T	Outside HCAL 3T

Outline

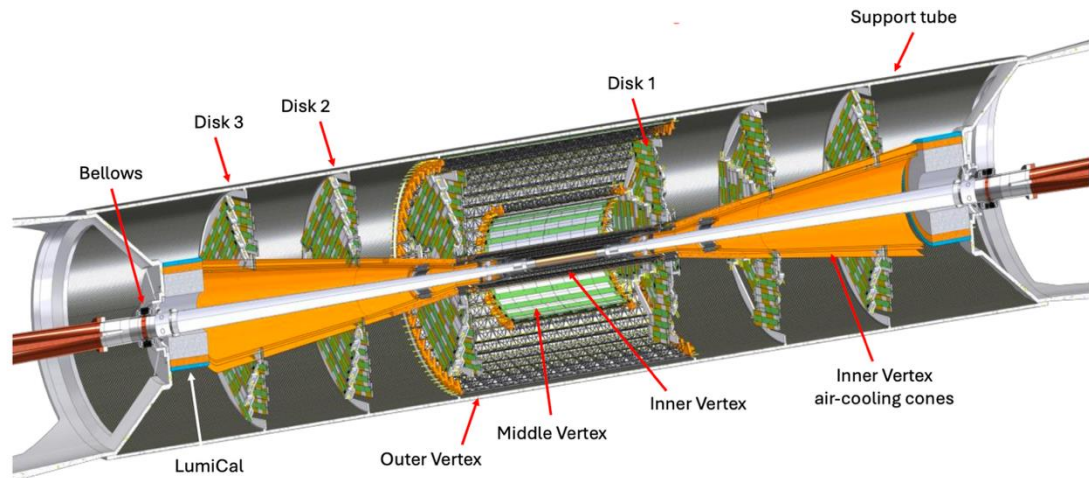
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Vertex detector developments highly inspired by ALICE ITS2 and ITS3 designs

- All based on thinned and stiched MAPS (Monolithic Active Pixel Sensors)

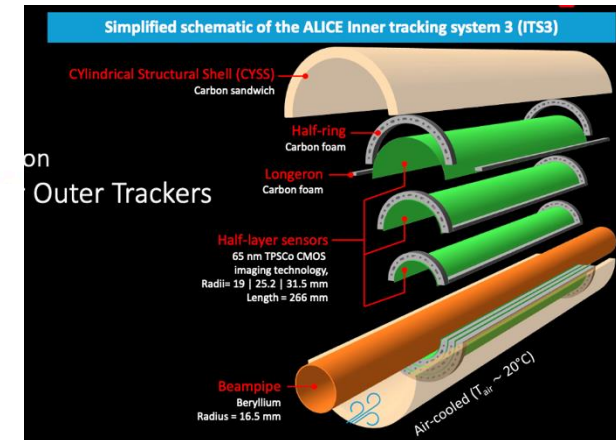
IDEA Vertex Detector design study (INFN Pisa, Frascati)

- Fully integrated in MDI design
- All sensors are 50 μm MAPS (Monolithic Active Pixel Sensors)
- Three inner barrel layers: 25 x 25 μm^2 , 50 mW/cm², air cooling
- Middle + outer barrel layers: 150 x 50 μm^2 , water cooled
- Three disks in each direction: as middle/outer barrel layers
- Hit resolution: $\sim 3 \mu\text{m}$; material: 2.5% X_0 at 90°



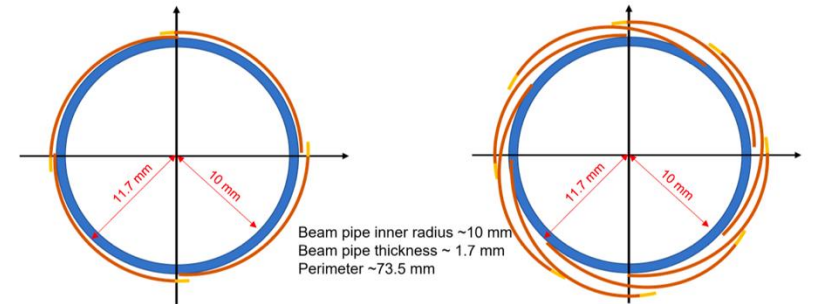
Curved sensors “wrapping” around beam pipe

ALICE ITS3 with air cooling under development



12-mm curvature reached

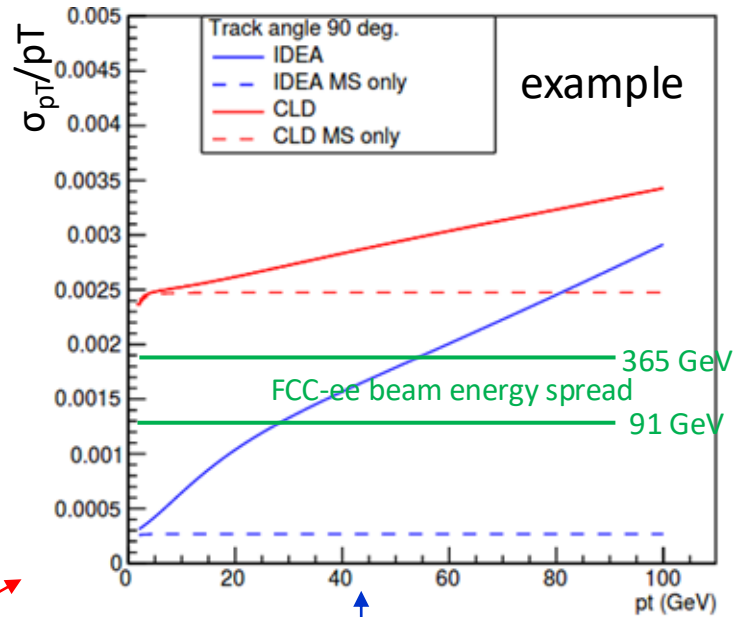
FCC-SEED



For FCC-ee energies, momentum resolution tends to be dominated by multiple scattering

$$\sigma(p_T)/p_T^2 = a \oplus \frac{b}{p \sin \theta}$$

mult.scat
point resolution



Strong case for gaseous trackers

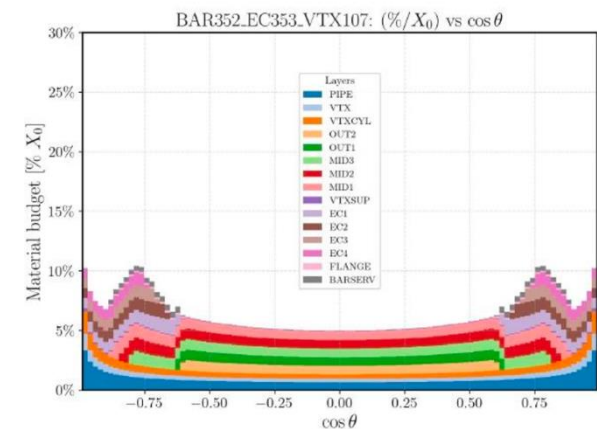
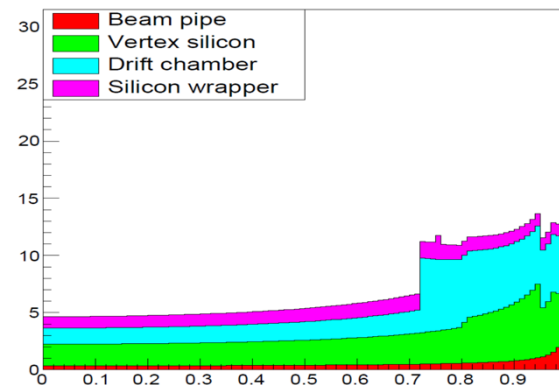
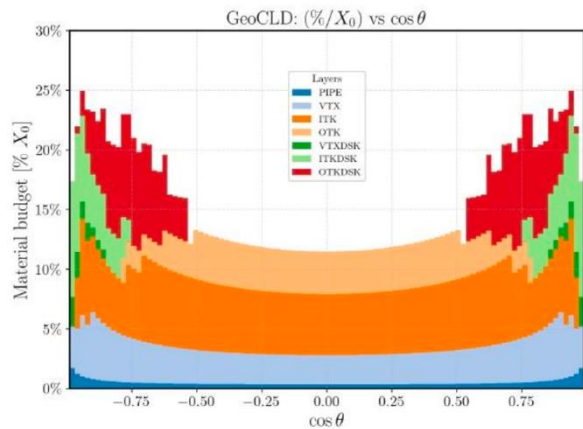
ALFA studies are now developing an all MAPS tracker concept with a very competitive material budget

CLD Si pix + strips

IDEA Drift Chamber + Si

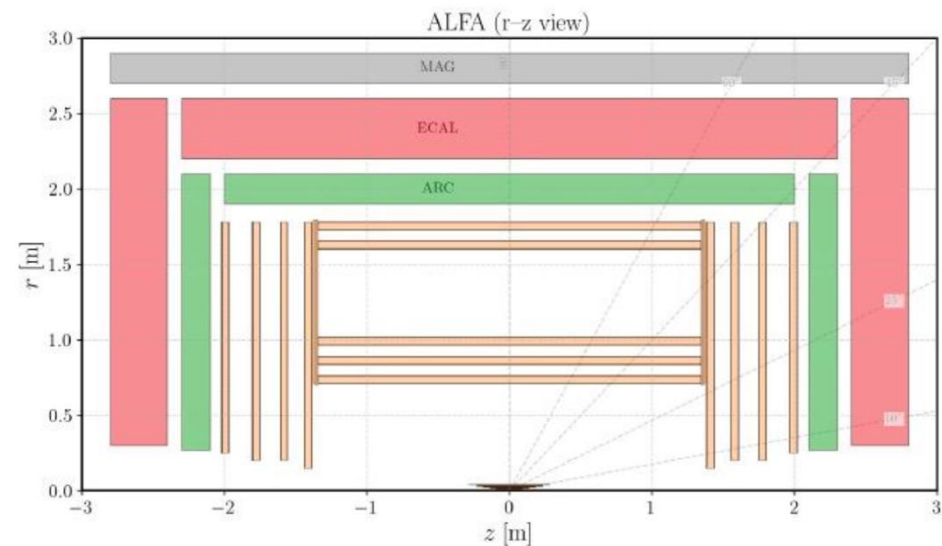
ALFA full Si Maps

ITS2 inspired



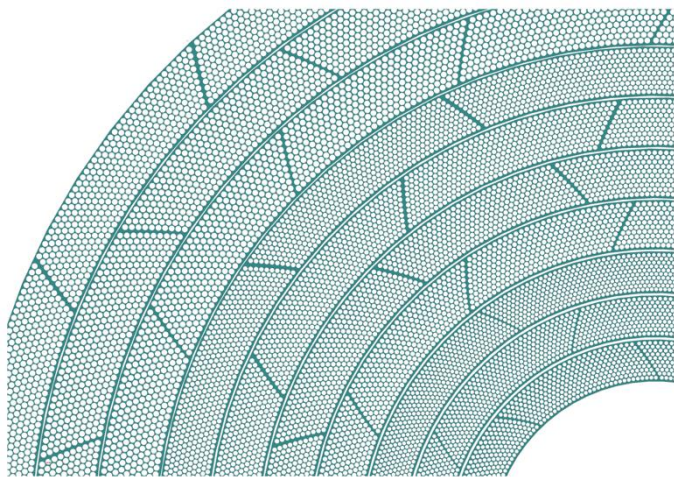
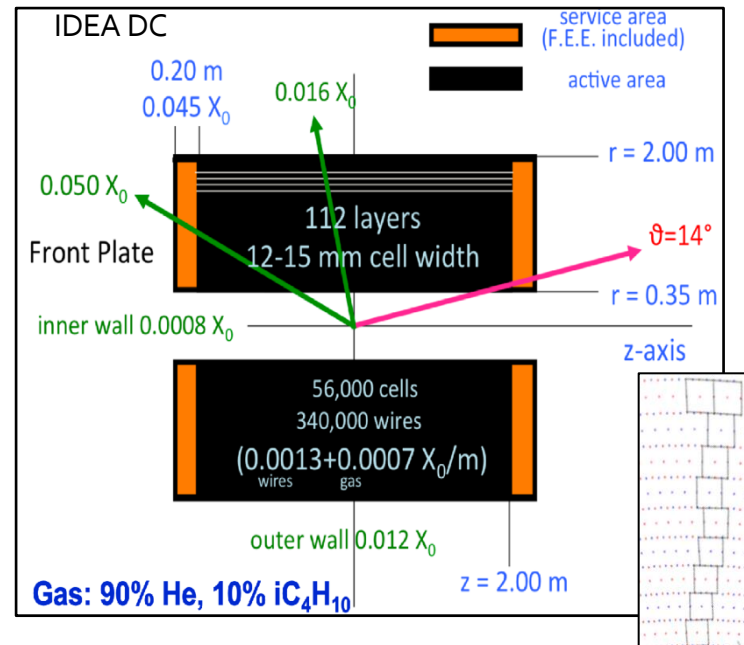
ITS3 inspired

Main Tracker Options under Study



Full silicon
- CLD
- ALFA

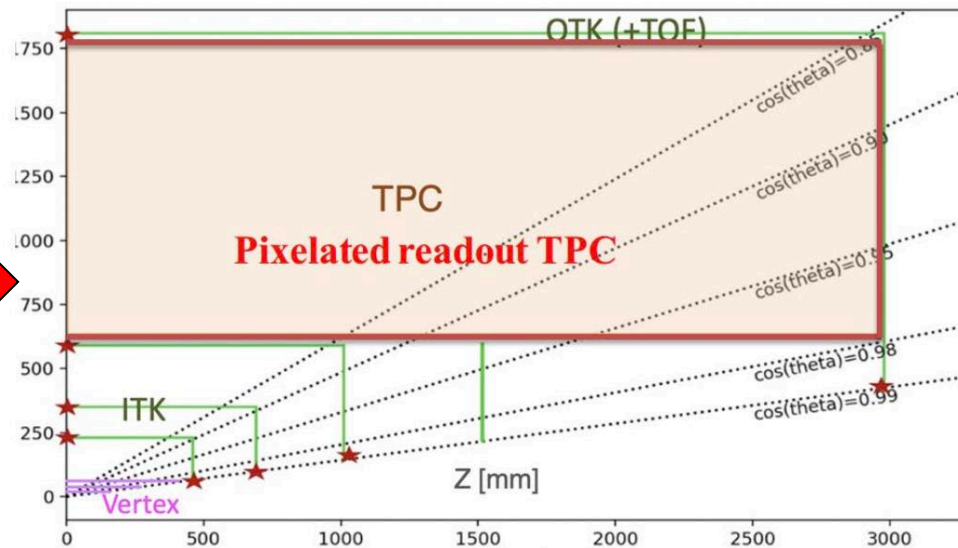
Drift Chamber
- IDEA
- Allergo



Straw Tracker
- More robust than DCH?

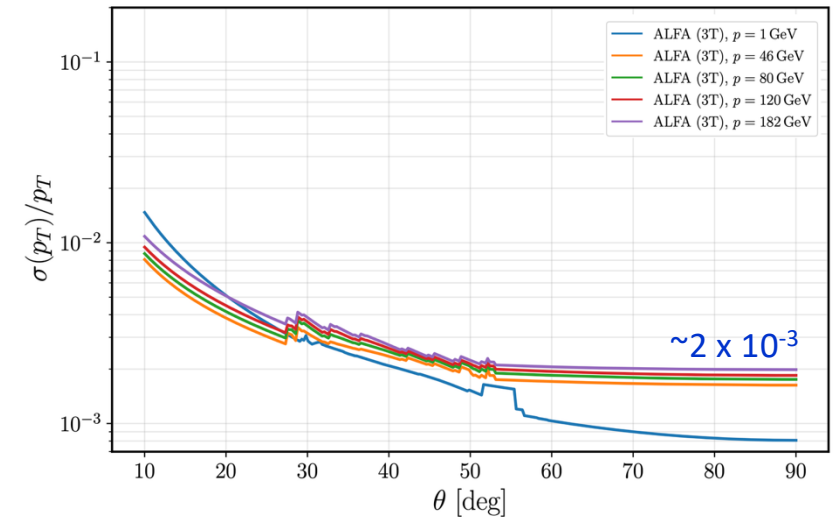
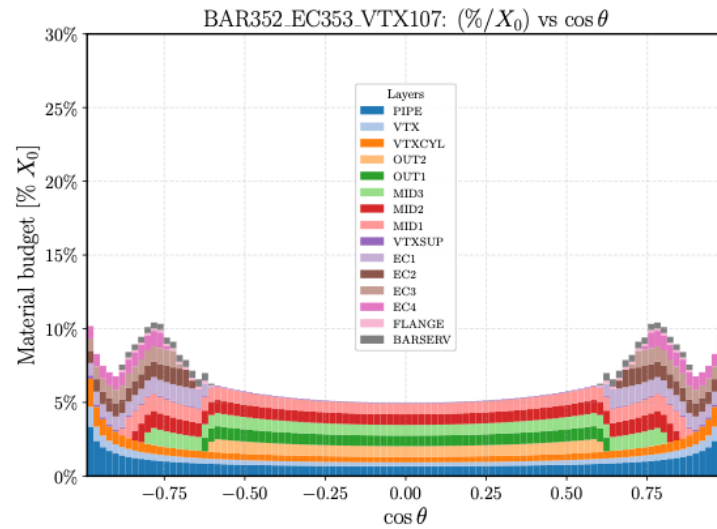
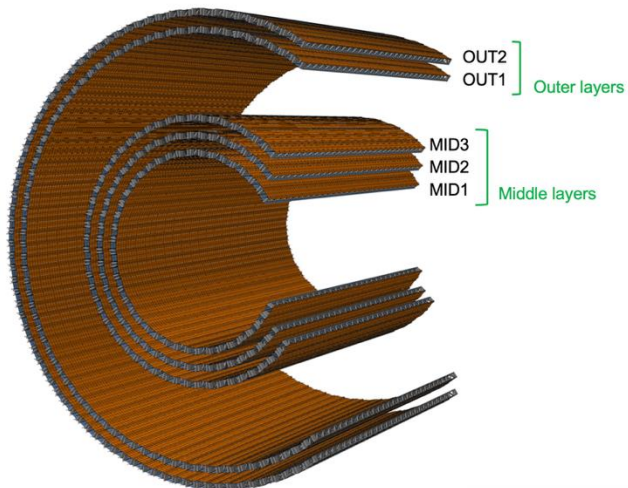
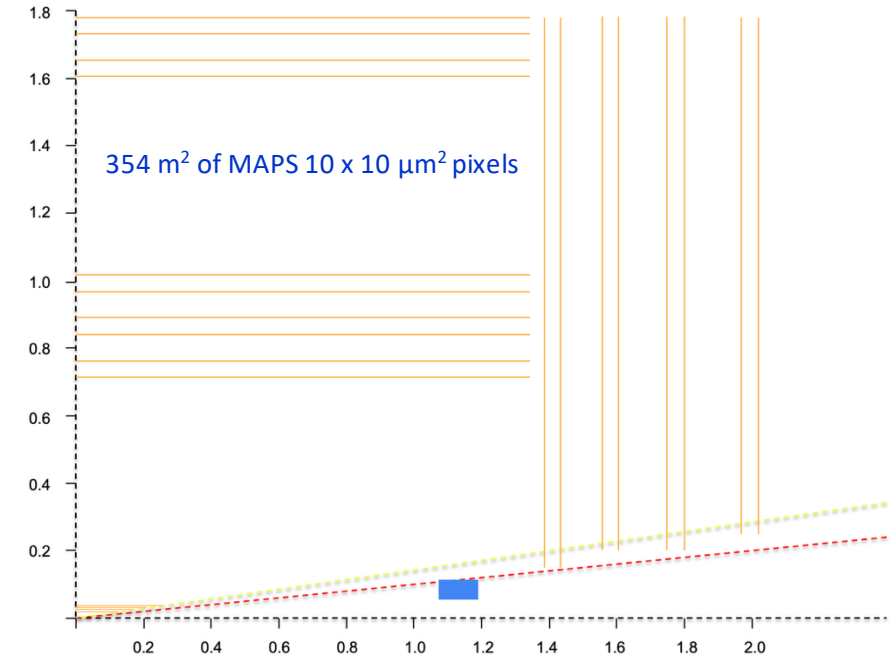
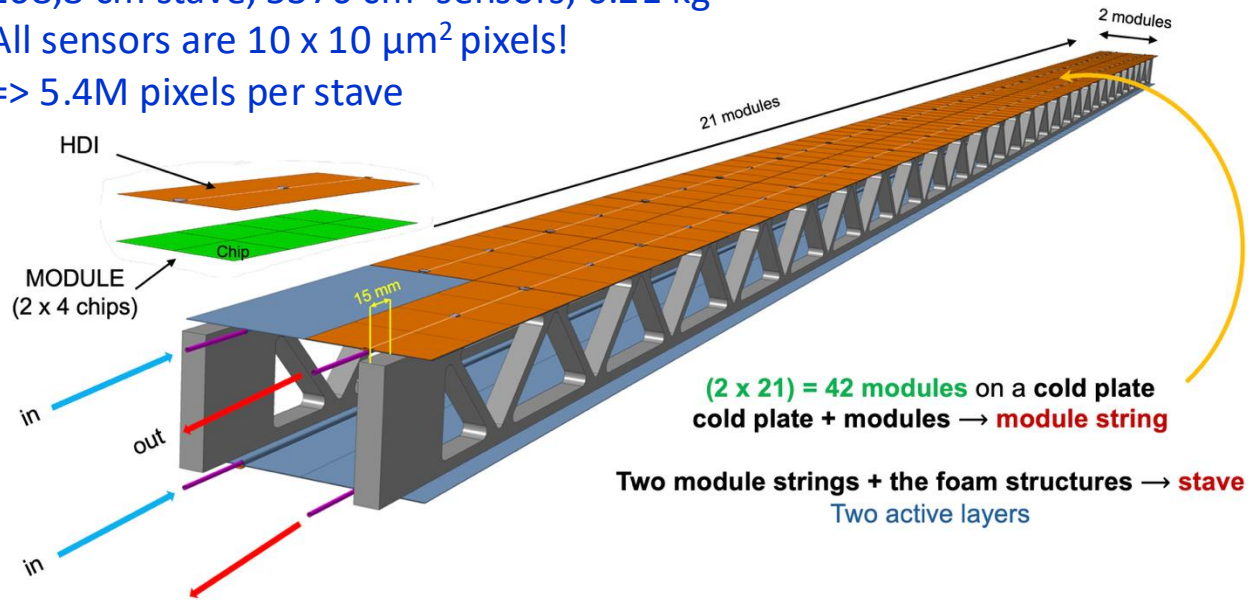
Time Projection Chamber
- ILD and AGORA

Here shown with an inner radius of 60 cm, outside inner Si section [AGORA]



ALFA all-MAPS Tracker

268,8 cm stave, 5376 cm² sensors, 0.21 kg
 All sensors are 10 x 10 μm² pixels!
 => 5.4M pixels per stave



Charged Particle Identification

PID capabilities across a wide momentum range is essential for flavour physics

- ◆ Drift Chamber and Straw Tracker promise $>3\sigma$ π/K separation up to ~ 35 GeV based on **cluster counting, dN/dx** . Similar performance from TPC.

- ionisation cross-over window at 1 GeV, can be alleviated by unchallenging TOF measurement of $\delta T \lesssim 100$ ps

- ◆ **Time of flight (TOF) alone** with δT of ~ 10 ps over 2 m (LGAD,...)

- could provide 3σ π/K separation up to ~ 5 GeV (only)

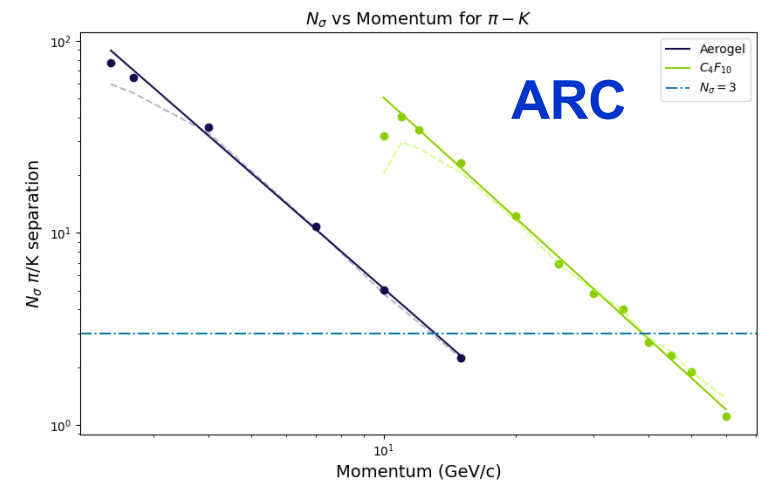
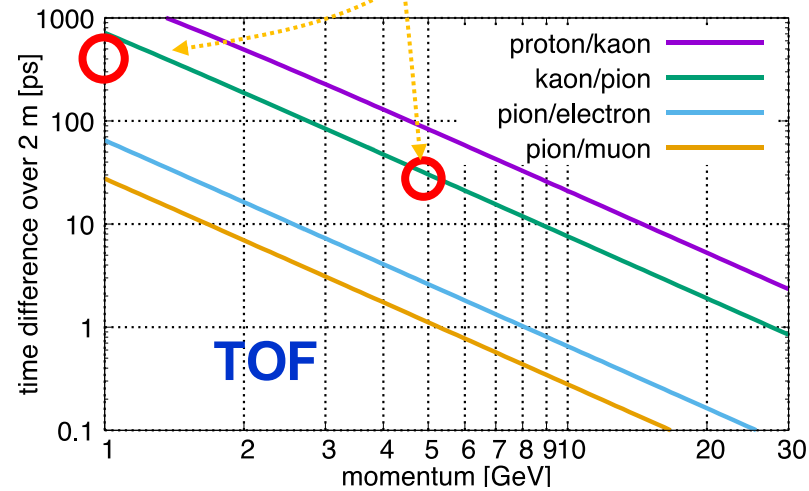
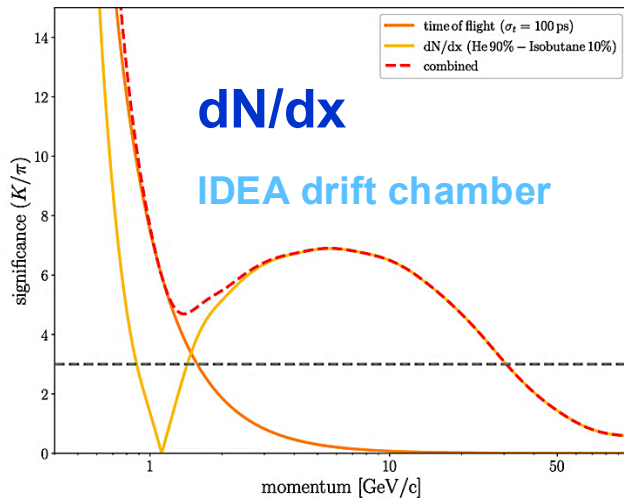
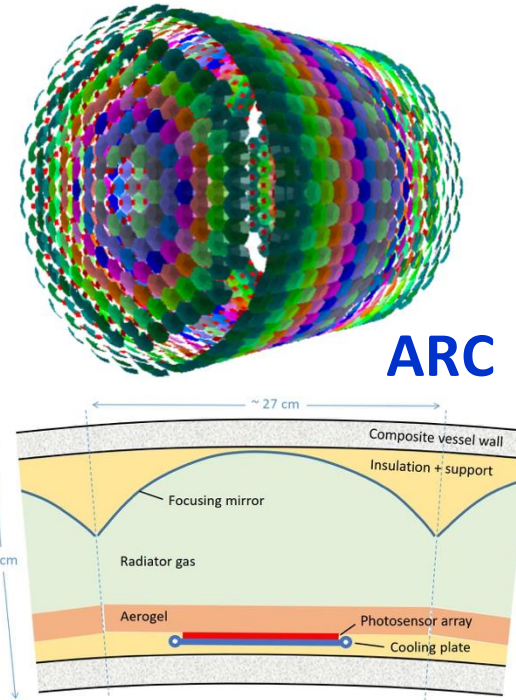
- ◆ **RICH counter** being investigated (for silicon-based trackers): **Array of RICH Cells – ARC**

- Compact geometry (depth: 20 cm, $0.1 X_0$) via use of SiPMs

- Aerogel + Gas (C_4F_{10} or pressurised Xe): 3σ π/K separation in 2.5 - 50 GeV range

- Below 2.5 GeV, no signal from K \Rightarrow veto mode separation

p/K separation



Calorimeter Technologies being pursued

All concepts aim at Particle Flow reconstruction

- with different emphasis on granularity, energy resolution, stability
- R&D activities concentrated within DRD6 (DRDcalo)

Noble Liquid ECAL + Tile HCAL:

- fine longitudinal sampling (w.r.t. ATLAS, 4 → 12 layers)
- Pb+LAr or denser W+LKr; cold (or warm) electronics
- CALICE or ATLAS style scintillating tile HCAL

Fibre-based Dual-Readout :

- copper or steel matrix; Cherenkov and scintillating fibres, SiPMs
- very fine transverse granularity, (some) longitudinal inf. via timing

Segmented crystals with Dual Readout:

- Fine transverse segmentation, two longitudinal layers; SiPMs
- Excellent EM energy resolution of $\sim 3\%/VE$
- Combined with fibre-based DR calorimeter as HCAL

CALICE-style sandwich with embedded front-end electronics:

- Tungsten-silicon ECAL; Extremely fine segmentation: $(0.5 \text{ cm})^3$
- Steel-scintillator HCAL; SiPM-on-Tile; Fine segmentation: $(2.5 \text{ cm})^3$
 - alternatives: scintillator strip ECAL, gaseous (digital) HCAL

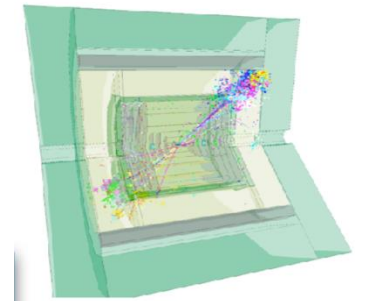
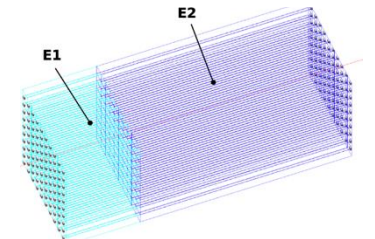
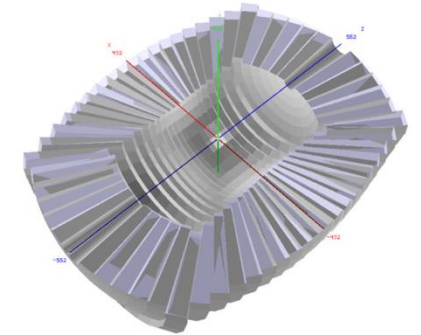
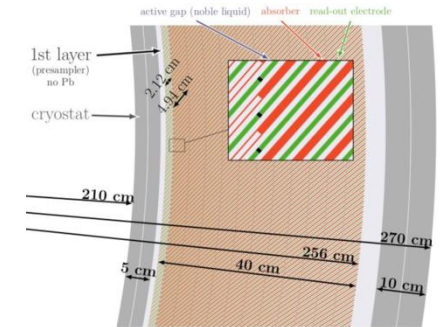
Eur.Phys.J.Plus 136 (2021) 10, 1066,
[arXiv:2109.00391](https://arxiv.org/abs/2109.00391)

EM: $\sigma(E)/E \approx 8\text{-}10\%/\sqrt{E}$
Jet: $\sigma(E)/E \approx 4\% @ 50 \text{ GeV}$

EM: $\sigma(E)/E \approx 11\%/\sqrt{E}$
Jet: $\sigma(E)/E \approx 3\text{-}4\% @ 50 \text{ GeV}$

EM: $\sigma(E)/E \approx 3\%/\sqrt{E}$
Jet: $\sigma(E)/E \approx 3\text{-}4\% @ 50 \text{ GeV}$

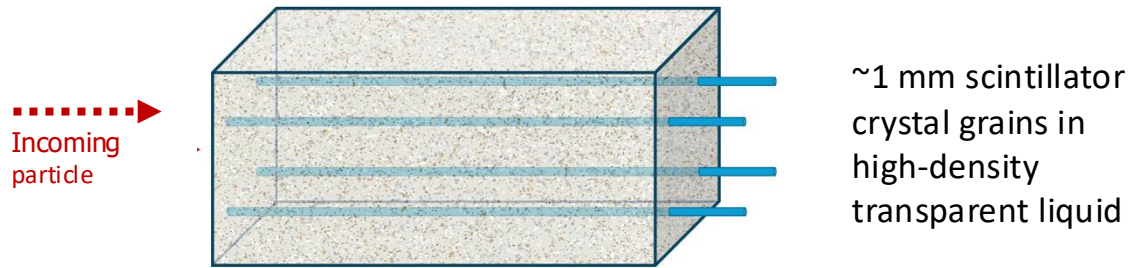
EM: $\sigma(E)/E \approx 16\%/\sqrt{E}$
Jet: $\sigma(E)/E \approx 3\text{-}4\% @ 50 \text{ GeV}$



Calorimetry – New additions

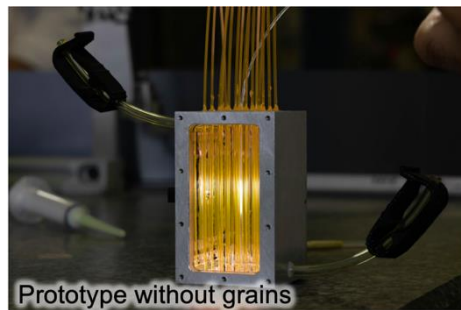
ALFA: Grainita ECAL concept

- Crystal grains (ZnWO_4) immersed in heavy transparent liquid (sodium-tungstate-water solution) or resin
- Light emitted by crystal grains collected by WLS fibres spaced 7 mm

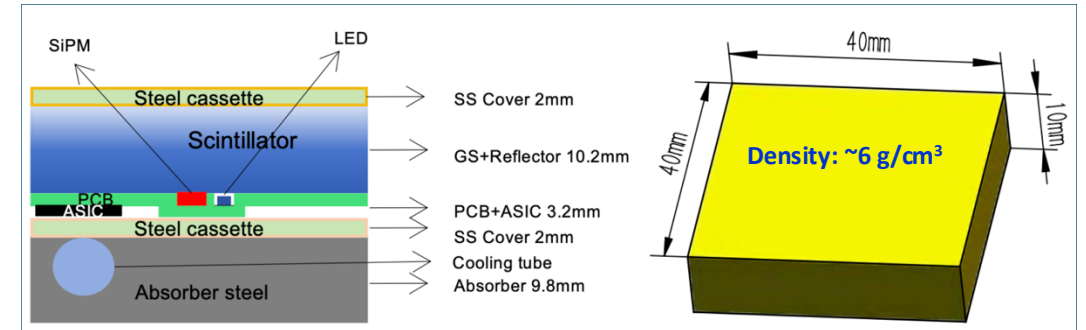


- Excellent energy resolution, high transverse granularity
- Cost-effective grains compared to homogenous crystals

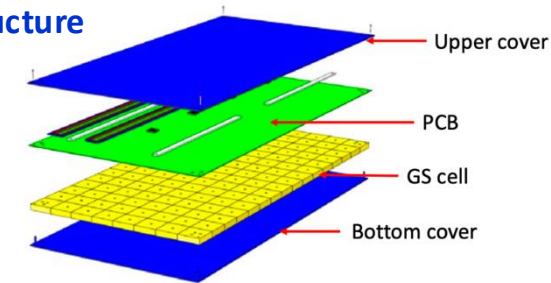
First (small) prototype: 28 x 28 x 55 mm³



AGORA: Glass Scintillator HCAL



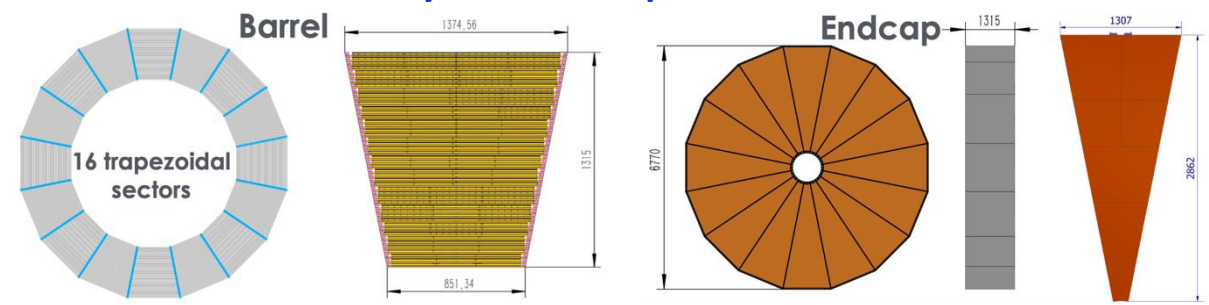
Single layer structure



Total of 85 m³ glass scintillator

- High sampling fraction (~30%)
- Good energy resolution ~30%/VE

48 layers stacked per module

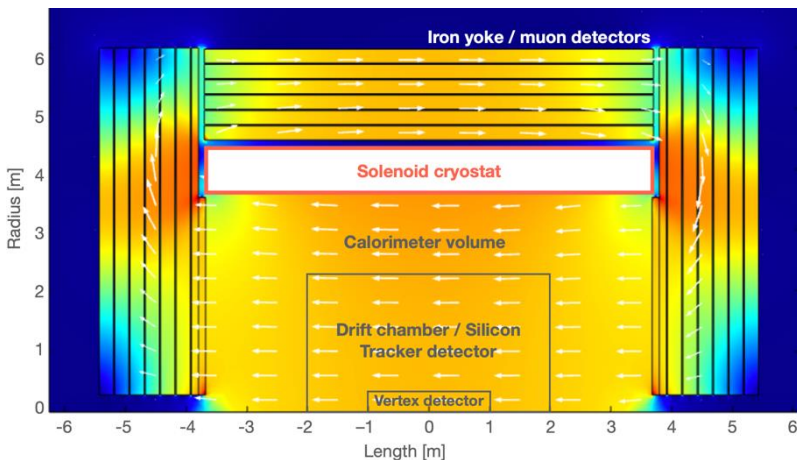


Detector Solenoid

Two placement options being pursued

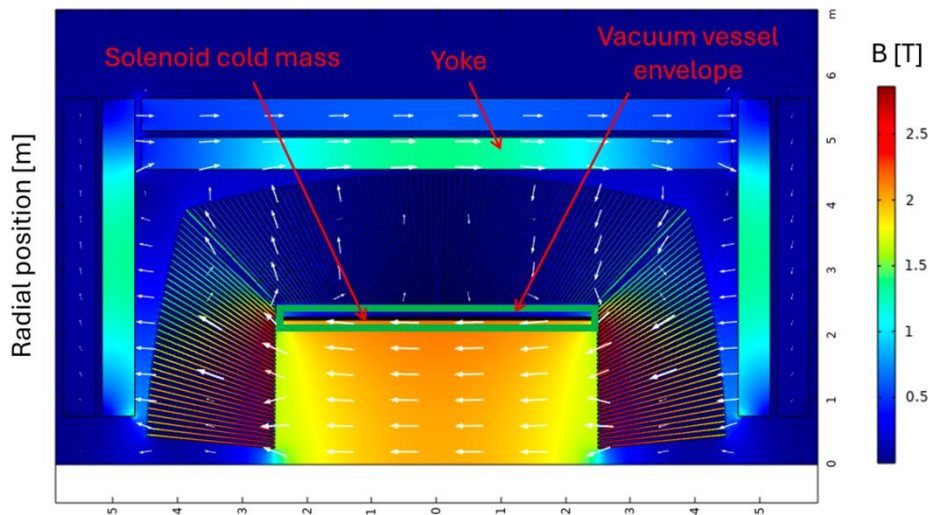
CLD, ILD, AGORA

Coil outside calorimeter system



Coil outside ECAL, inside HCAL

IDEA, ALLEGRO, ALFA



Development efforts

◆ CERN detector magnet group

□ Conceptual design of ultra-light 2 T solenoid

- ◆ Operational temperature: 4 K
- ◆ Radial envelope ~ 30 cm; total material $\sim 0.8 X_0$

◆ EoI (INFN, Uni. Milan, CERN, et al.)

□ 3 Tesla HTS Superconducting Solenoid for IDEA

- ◆ Operational temperature: 20 K
- ◆ Radial envelope ~ 12 cm; total material $1.5 X_0$

◆ CERN magnet group:

“Experience tells that development & construction of large superconducting coil takes \gtrsim a decade”

- Early design needed as input to general detector design
- Need to identify labs with appropriate expertise and strength

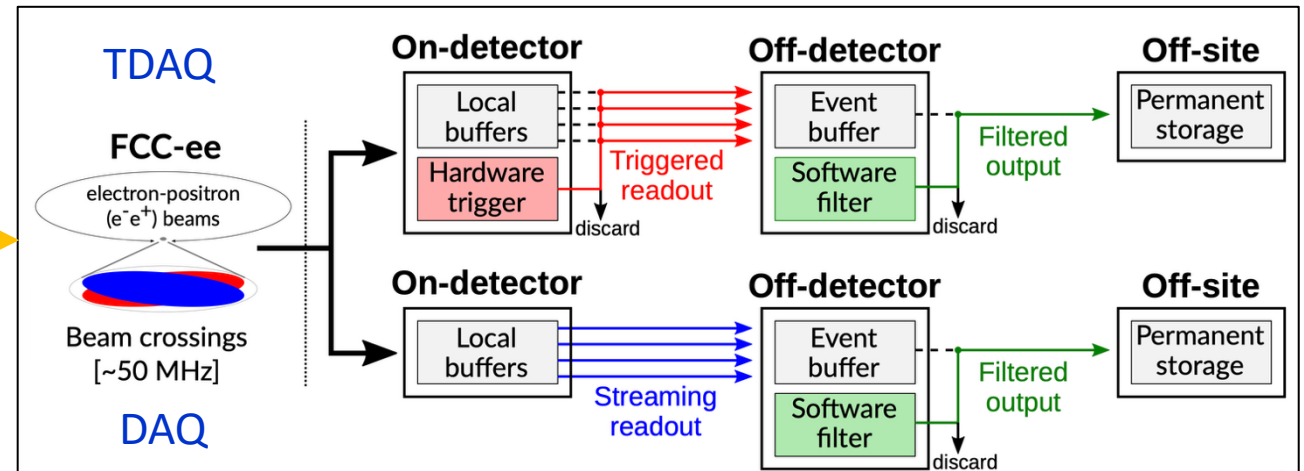
Upcoming FCC-ee Coil Workshop, 2-3 July

FCC-ee Data Acquisition System

DAQ system goal

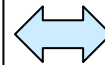
- Full efficiency for all SM annihilation physics events
 - Aiming at $\mathcal{O}(10^{-6} - 10^{-5})$ relative normalisation between channels
- No loss of potential BSM signatures
e.g., heavy (slow) particles decaying late, LLPs

“To TDAQ or to DAQ”
 Does FCC-ee need a trigger system?



Trigger option (as at LEP and LHC)

- Which sub-detectors could trigger decision be based on?
- Need identical deadtime for all detector elements
In particular LumiCal vs. rest
- High BX rate: Need for local **latency buffering** a la LHC?
Material / power / cooling for on-detector buffering?



No Trigger option (as being developed for EPIC @ EIC)

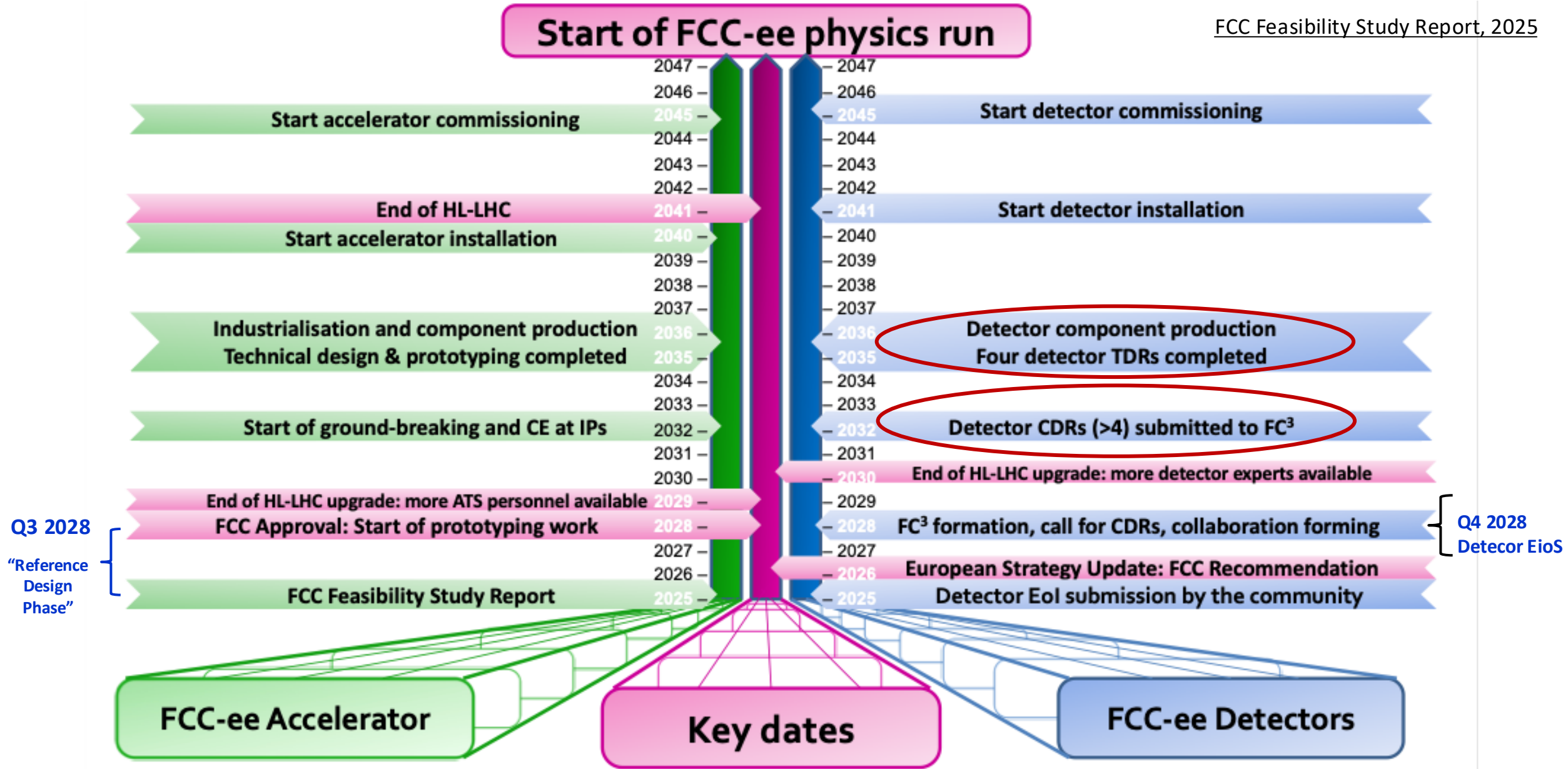
- **Free streaming** of *self-triggered* detector sensors
- Off-detector event building based on time-stamping (BXID) and topological combinations
- Potential enormous data rates out of sub-detectors
Easily Tbit/sec from VXD alone. Technical feasibility? Power needs, ...?

Outline

- ◆ FCC-ee Experimental Conditions
- ◆ Detector Requirements and Challenges
- ◆ Detector Concepts
- ◆ Detector Sub-systems and Technologies
- ◆ **Organisational Matters**
- ◆ Summary

FCC-ee Possible Timeline

FCC Feasibility Study Report, 2025



Evolution of Detector Concepts Work Package

In DRDs:

RnD / technologies

- Gaseous Detectors (DRD1)
- Liquid Detectors (DRD2)
- Semiconductor Detectors (DRD3)
- Photodetectors & PID (DRD4)
- Quantum Sensors (DRD5)
- Calorimetry (DRD6)
- Electronics (DRD7)
- Mechanics (DRD8)

US R&D Collaborations (RDCs) focus on generic (non-targeted), interdisciplinary and blue sky R&D – will collaborate where possible.



In FCC Detector concepts:

a) Generic system-level studies

(create structure as needed or organize workshops)

- Tracker (e.g. Si + straw tracker) & PID
- Calorimetry
- Muons
- TDAQ
- Luminometry
- Magnet

[Full mandate for the Detector Subsystem subgroup](#)

b) Concept-specific studies

(using specific envelopes/support structures, or physics benchmarks)

- ALFA
- Allegro
- CLD
- IDEA
- ILD
- ...

[Full mandate for the Detector Concept Study subgroup](#)

Non-exclusive membership, need to preserve synergies and unity of the community!

How to get involved

Group name	Email	Signup	Indico
Calorimetry	FCC-PED-DetectorConcepts-Calorimetry@cern.ch	click	click
Luminometry	FCC-PED-DetectorConcepts-Luminometry@cern.ch	click	click
Magnet	FCC-PED-DetectorConcepts-Magnet@cern.ch	click	click
Muon	FCC-PED-DetectorConcepts-Muon@cern.ch	click	click
TDAQ	FCC-PED-DetectorConcepts-TDAQ@cern.ch	click	click
Tracker & PID	FCC-PED-DetectorConcepts-Tracker@cern.ch	click	click
ALFA	FCC-PED-DetectorConcepts-ALFA@cern.ch	click	click
ALLEGRO	FCC-PED-DetectorConcepts-ALLEGRO@cern.ch	click	click
CLD	FCC-PED-DetectorConcepts-CLD@cern.ch	click	click
IDEA	FCC-PED-DetectorConcepts-IDEA@cern.ch	click	click
ILD	FCC-PED-DetectorConcepts-ILD@cern.ch	click	click

- As a bonus, signing up to any of the above adds you to "FCC-PED-DetectorConcepts@cern.ch". For free! Not even a click!
- Indico categories for [Detector Subsystems](#) and [Concept Studies](#)
- [FCC-PED homepage](#) with upcoming meetings
- Indico meeting [calendar](#)

Concept Studies

ALFA

ALLEGRO

CLD

IDEA

ILD

Detector Subsystems

Calorimetry

Luminometry

Magnet

Muon

TDAQ

Tracker & PID

Work Ahead

◆ Vertex Detector & MDI Region:

- ❑ Sensor technology exists (MAPS, DRD3); lightweight support structures, low-material power and cooling infrastructure to be developed
- ❑ Continue and strengthen engineering effort on MDI region, support of vertex detectors + LumiCal; develop MDI for all detector concepts

◆ Tracking:

- ❑ Different proposals: Scintillating Fibre, Si tracker (DRD3), gaseous tracker (DRD1): drift chamber, straw tracker, TPC
- ❑ Establish whether (long) drift times are compatible with high-rate Z-pole operation and related backgrounds (synchrotron radiation, beamstrahlung, radiative Bhabha scattering)
- ❑ Minimize material, start engineering of support structures, services, power, cooling, ...

◆ Particle ID:

- ❑ Consolidation of cluster-counting method for DCH and straw
- ❑ Potentially complement Si tracker with ARC Cherenkov detector; need for low GWP gasses
- ❑ ToF detectors (e.g. LGADs)

◆ Calorimetry

- ❑ Continue building prototypes of all proposed calorimeters, testbeams (DRD6)
- ❑ Define needed granularity, performance optimisation
- ❑ Engineering

◆ Muon system:

- ❑ Large area scintillator and gas detector technologies exist; need for low GWP gasses
- ❑ Need to define what is needed for optimal physics reach

◆ Luminometry

- ❑ LumiCals satisfying extreme precision requirements to be developed
- ❑ Consolidation of luminosity measurement via large-angle di-photons

◆ Magnet coils

- ❑ Effort to re-establish availability of reinforced aluminum-stabilized Nb-Ti conductors needed;
- ❑ Investigate novel HTS-based conductors technology

◆ Cryostats

- ❑ Development of low-material carbon-composite cryostats as well as carbon fibre and aluminum honeycomb
- ❑ Construction and test of prototypes

◆ Trigger and DAQ:

- ❑ Is a trigger needed or can all (zero-suppressed) data be streamed out
- ❑ Closely linked to studies of occupancies caused by backgrounds

◆ Software:

- ❑ Full simulation of detector concepts gradually becoming available; important for performance and detector optimisation studies.
- ❑ Detailed digitizers important for quantification of background rates
- ❑ Reconstruction including particle flow appearing

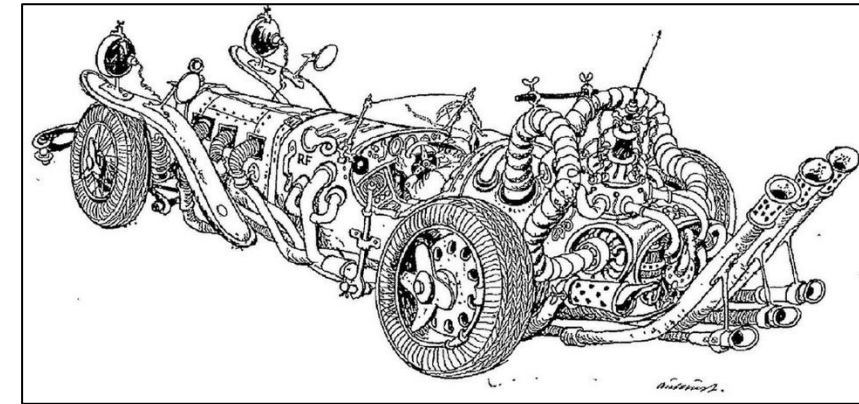
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Summary

- ◆ Extremely rich physics programme ⇒ formidable detector challenge
 - Very high rates; very high precision; advanced detectors called for
- ◆ Aiming for 4 experiments
- ◆ EoI submission to ESPP demonstrated strong community interest in developing detector and sub-detector systems
 - Self-organisation on-going
 - New ideas continue to appear
- ◆ Currently, 4 + 2 concepts are being pursued
 - FCC Software (key4hep based) allows “plug & play”
⇒ Selection of optimal combinations of subdetectors
- ◆ Evolving organisation of Detector Studies effort
 - Detector (sensor) R&D concentrated inside DRD collaborations
 - Detector sub-groups for coordination of sub-detector efforts
 - Detector concept study groups for development of specific concept
- ◆ Ample room for new ideas and technologies
- ◆ Many interesting challenges ahead! Please come and join us!

Il Tempo Gigante.



... from dream to reality ...

