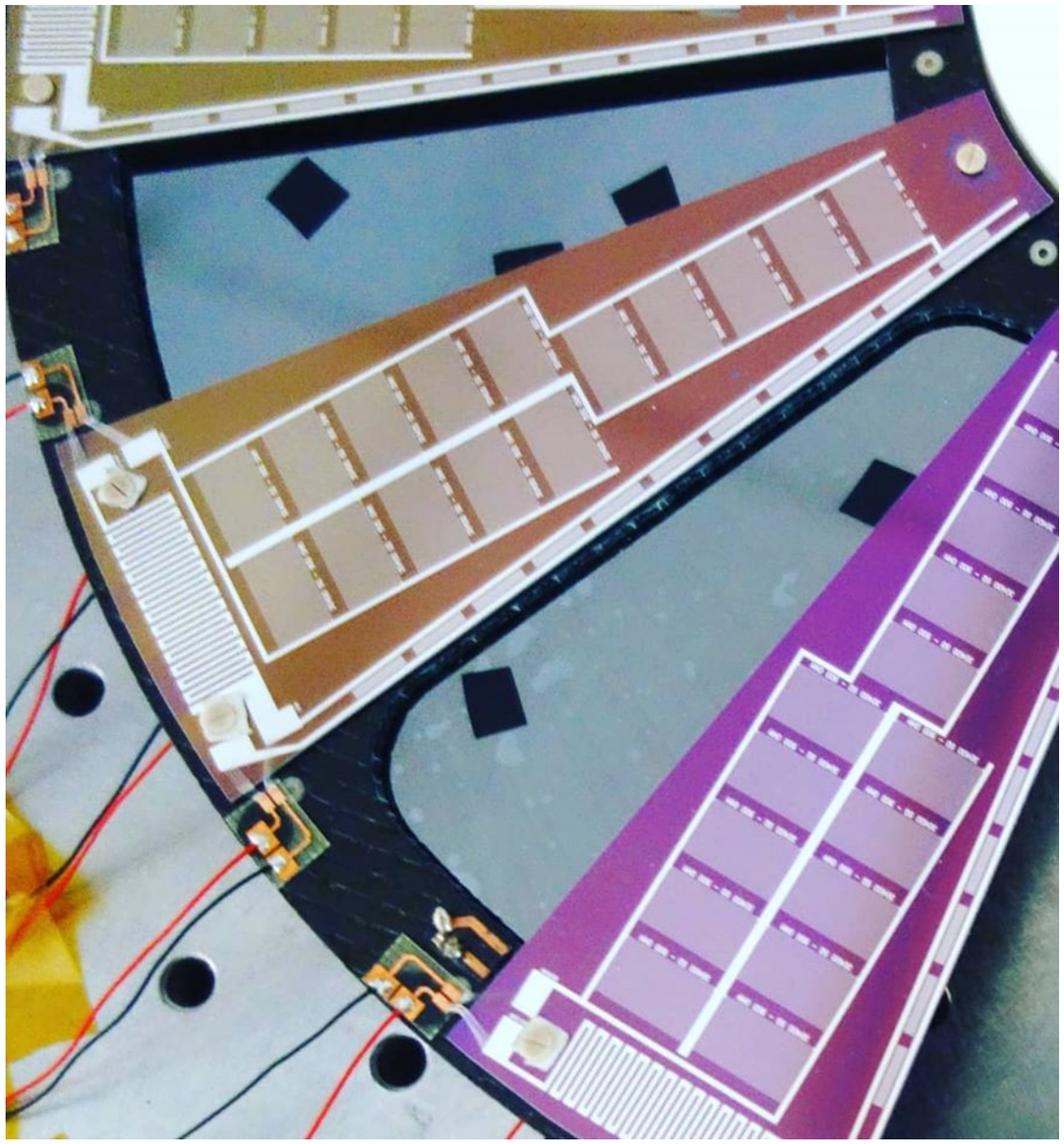
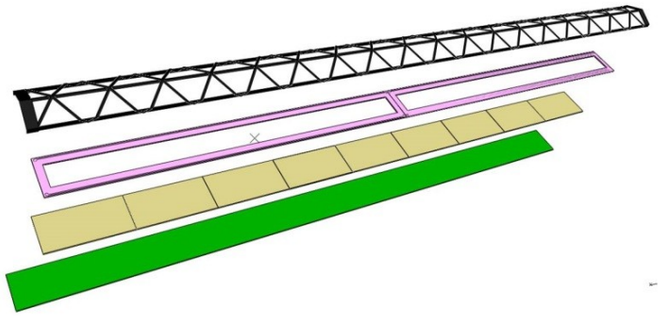
Funded by the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement no. 654168 and

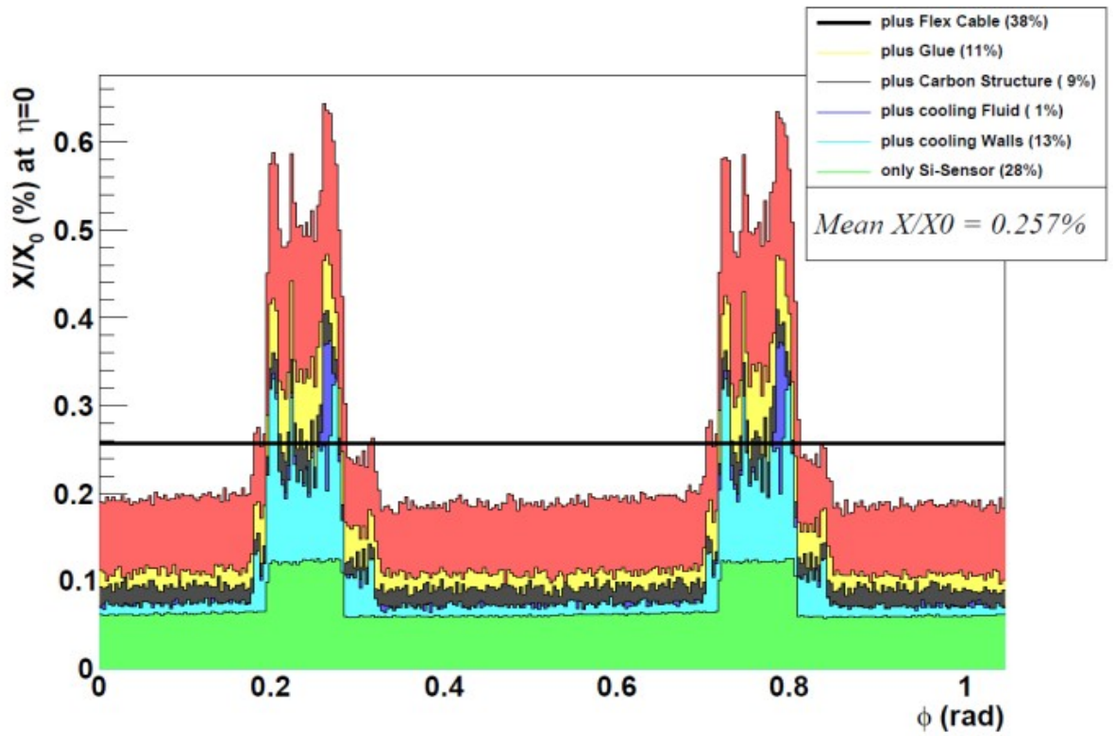


Thermo-mechanical aspects of tracker and vertex detector design

Marcel Vos (IFIC, UV/CSIC, Valencia)

Material budget





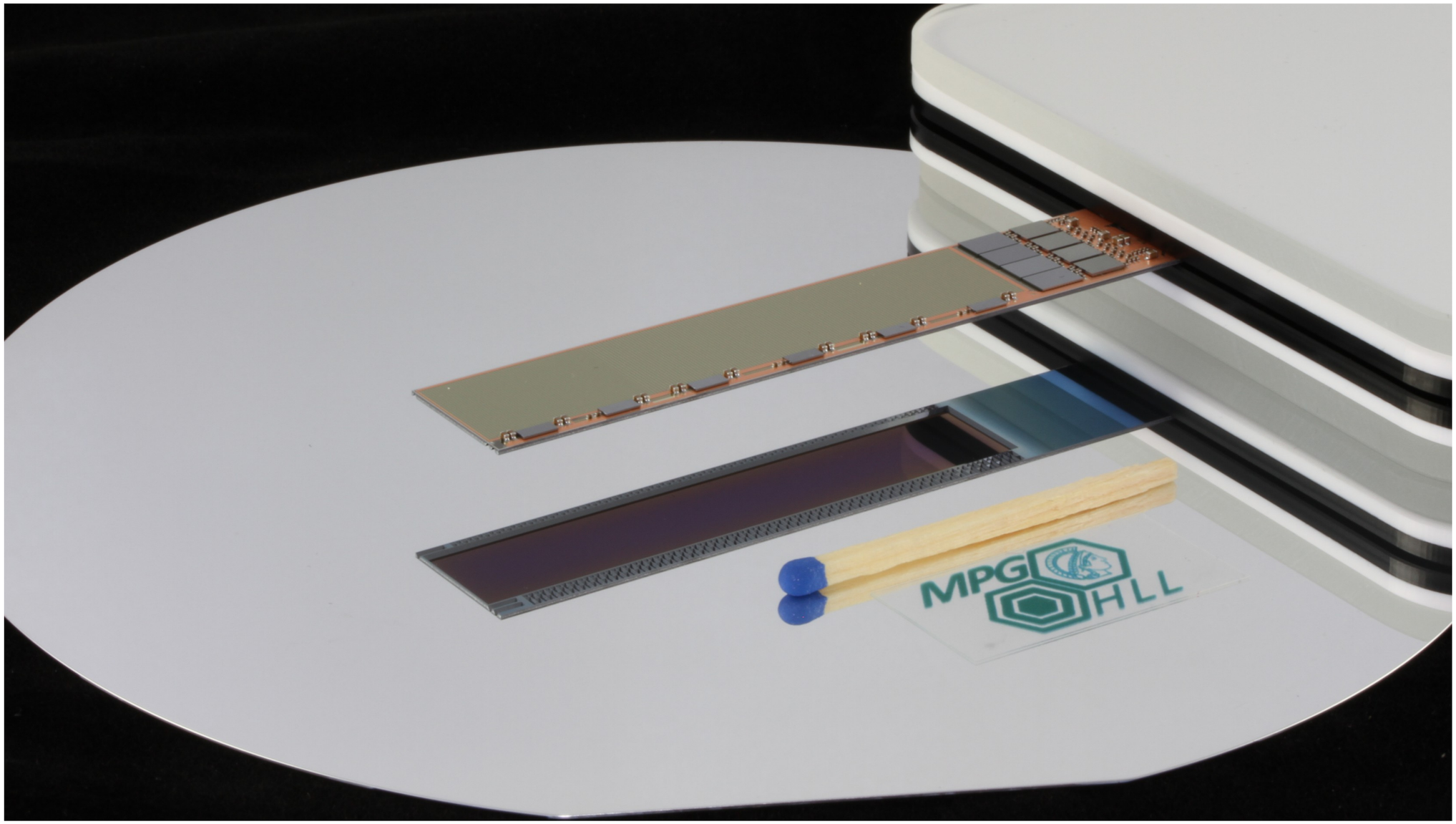
Cooling, support and services dominate material in LHC trackers – by a lot in many cases

Even in ALICE staves only 28% of the budget is for Silicon sensors

Developing thinner sensors is important, of course, but only fully effective if accompanied by a reduction of the material in supports and services

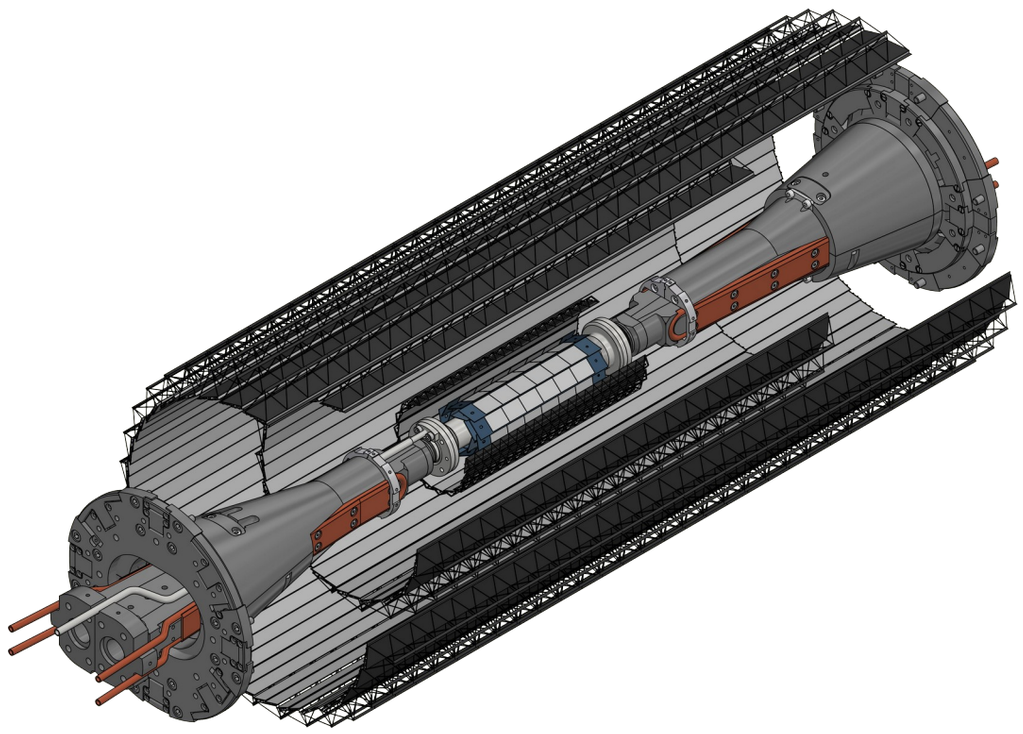
Integrated system

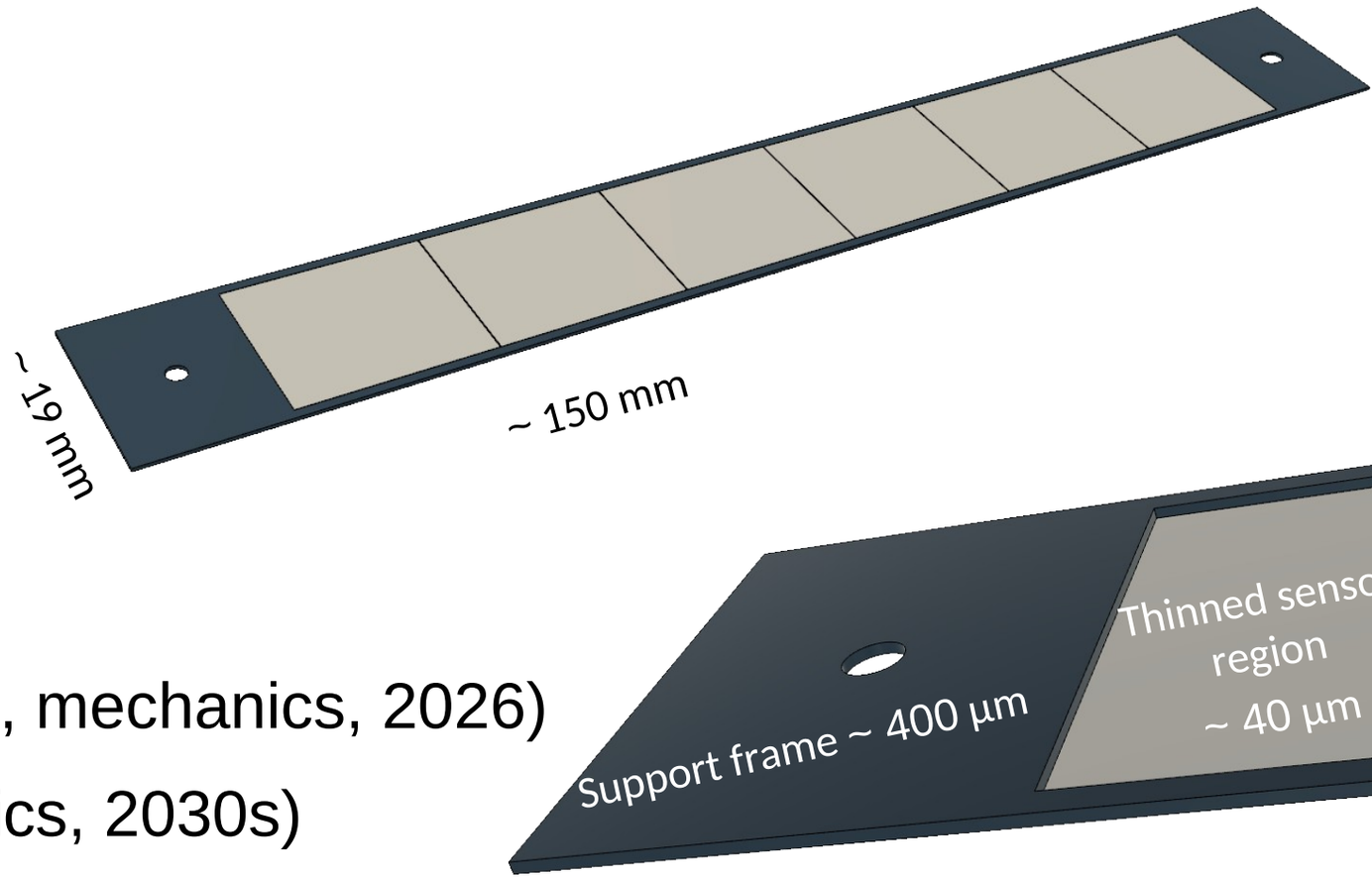
A good example: DEPFET ladders for Belle 2 vertex detector Integrate support, routing and electronics on a thin all-Silicon ladder



L. Andricek et al., Processing of ultra-thin silicon sensors for future e+ e- linear collider experiments, IEEE TNS 51 (2004) 1117-1120

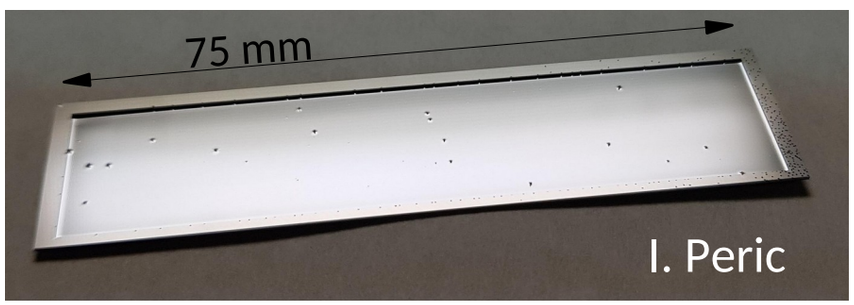
Future e^+e^- colliders





- Belle 2 upgrade (speed, radiation, mechanics, 2026)
- Higgs factory (precision, mechanics, 2030s)
- All-silicon ladders for CMOS sensors
- Start simple, integrate further elements as we go

Promising first steps by I. Peric and IZM on HV35DEMO



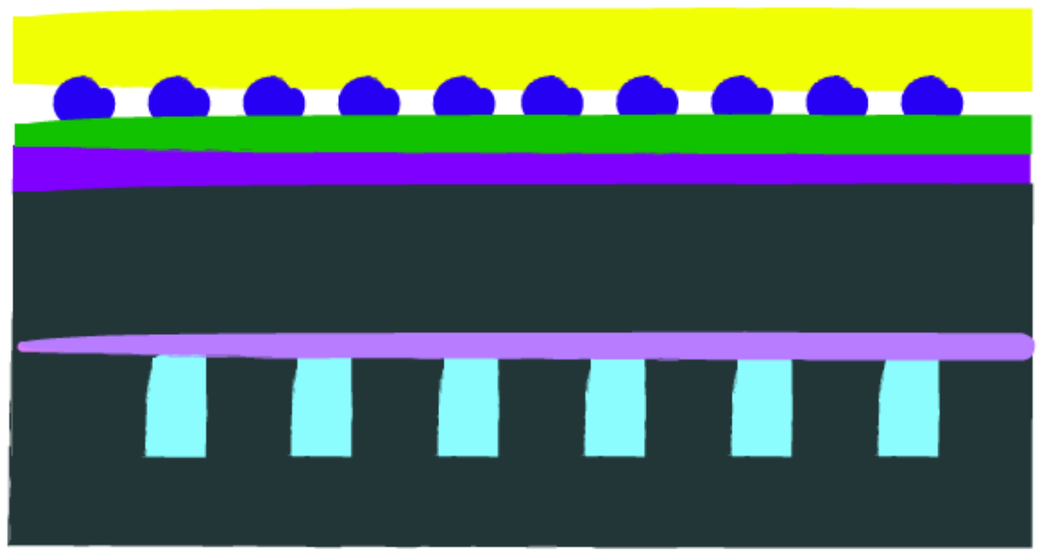
Requirements

- How much material can we remove from the support structure before we get in trouble?
- Precision vertexing and tracking: mechanical stability must be guaranteed to well below the intrinsic resolution (=few-micron level) over sufficiently extended periods of time
- External stimuli: cavern floor movements, earthquakes, stress from other subsystems (magnet ramp), temperature variations, active cooling systems (see Viehhauser, JINST10 (2015) P09001)

Air cooling can meet material budget requirements of e^+e^- experiments. This works in case of linear colliders that benefit from power pulsing, but can it cool away the power in a DC machine like FCCee? Must cool also the beam pipe.

Is fully integrated micro-channel cooling a competitive option?

- can we make it technically feasible and practically accessible?
(post-processing, at reasonable cost → CNM)
- do we even need the better cooling contro or is air cooling sufficient?
(show advantages in REALISTIC conditions → IFIC)



Next steps

- Finish deliverable for AIDAinnova (summer)
- Join DRD8 (WP8.1 and WP8.3)
- Prepare proposal for next EU project

- AIDAinnova annual meeting (Prague, 5-7 May)
- CEPC workshop (Barcelona, 16-19 June)
- LCWS workshop (Valencia, 20-24 October)