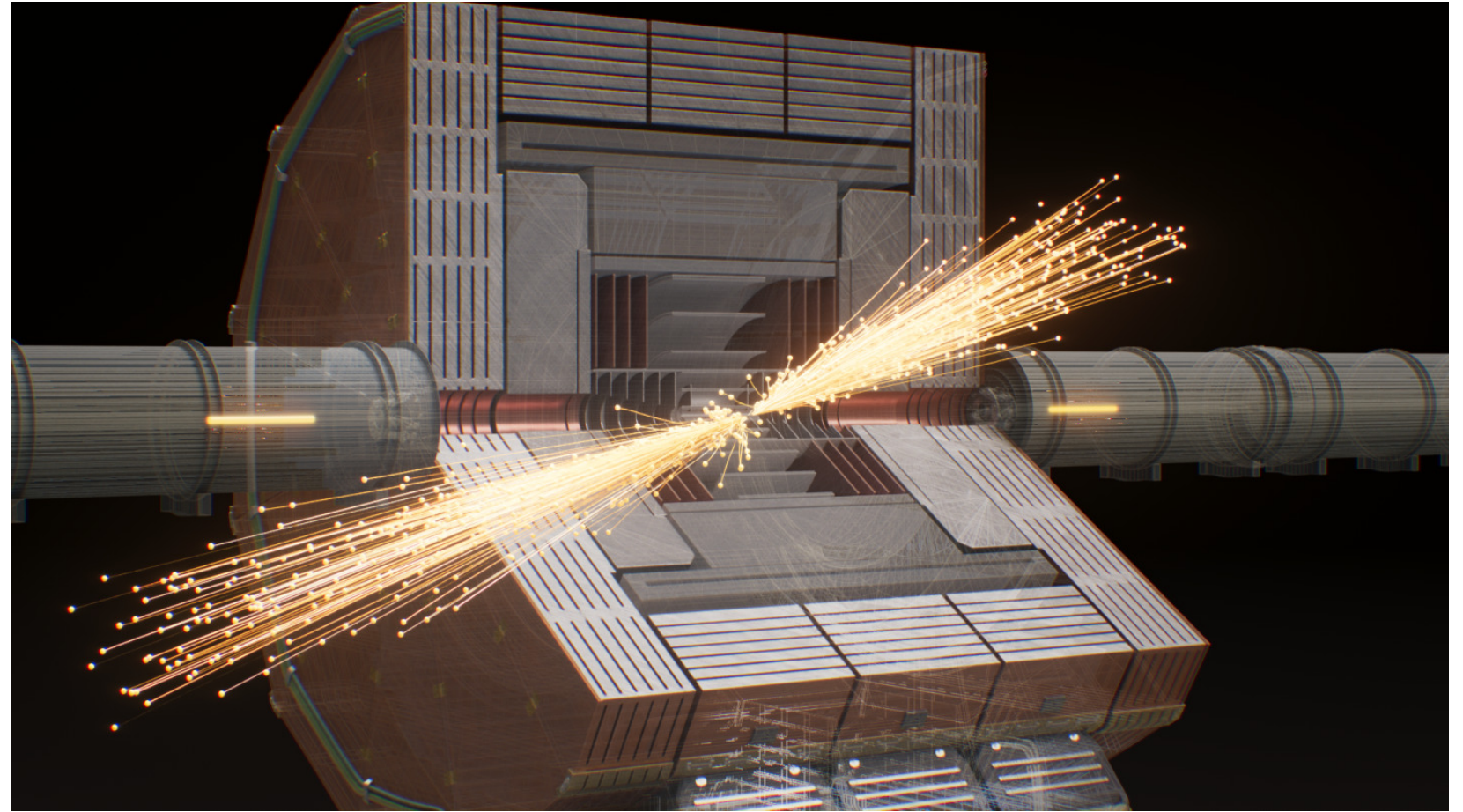


Future Collider Experiments



MU-FPF POF5 Retreat
June 20, 2025

Felix Sefkow
DESY



Strategic Considerations

In 10 Minutes

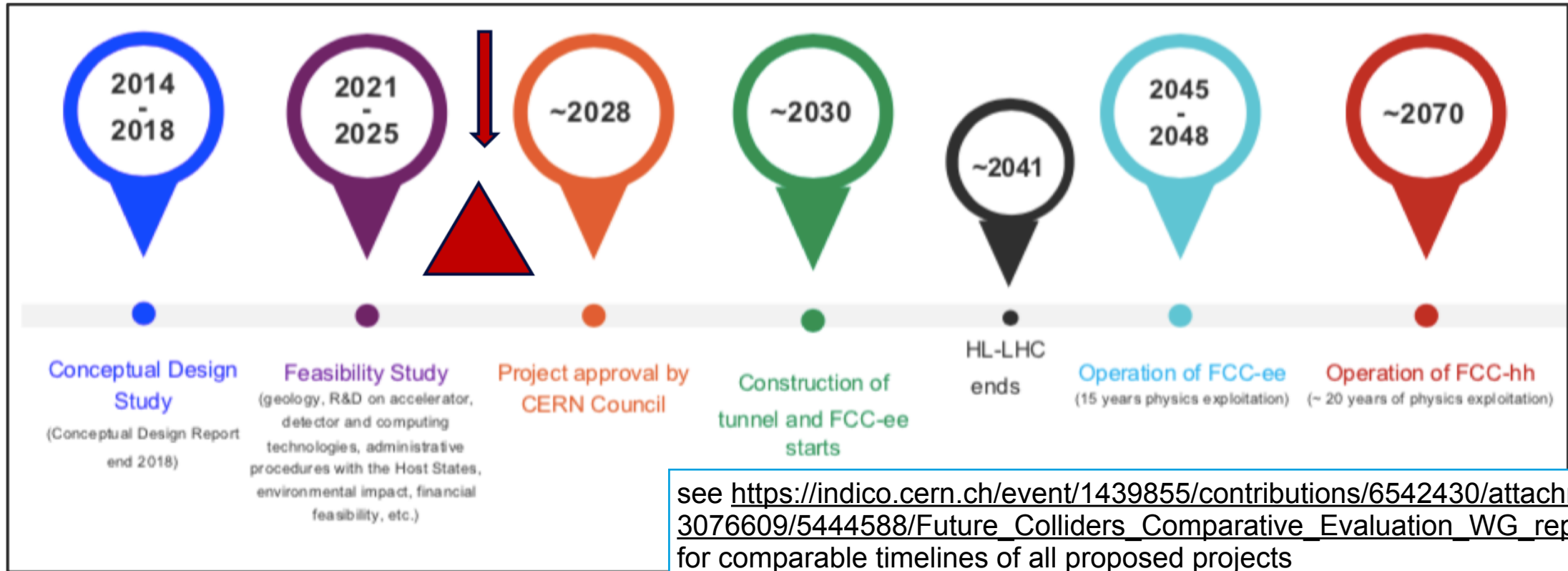
Timelines

German Community

DESY Competences

Punchline

FCC Timeline as an Example



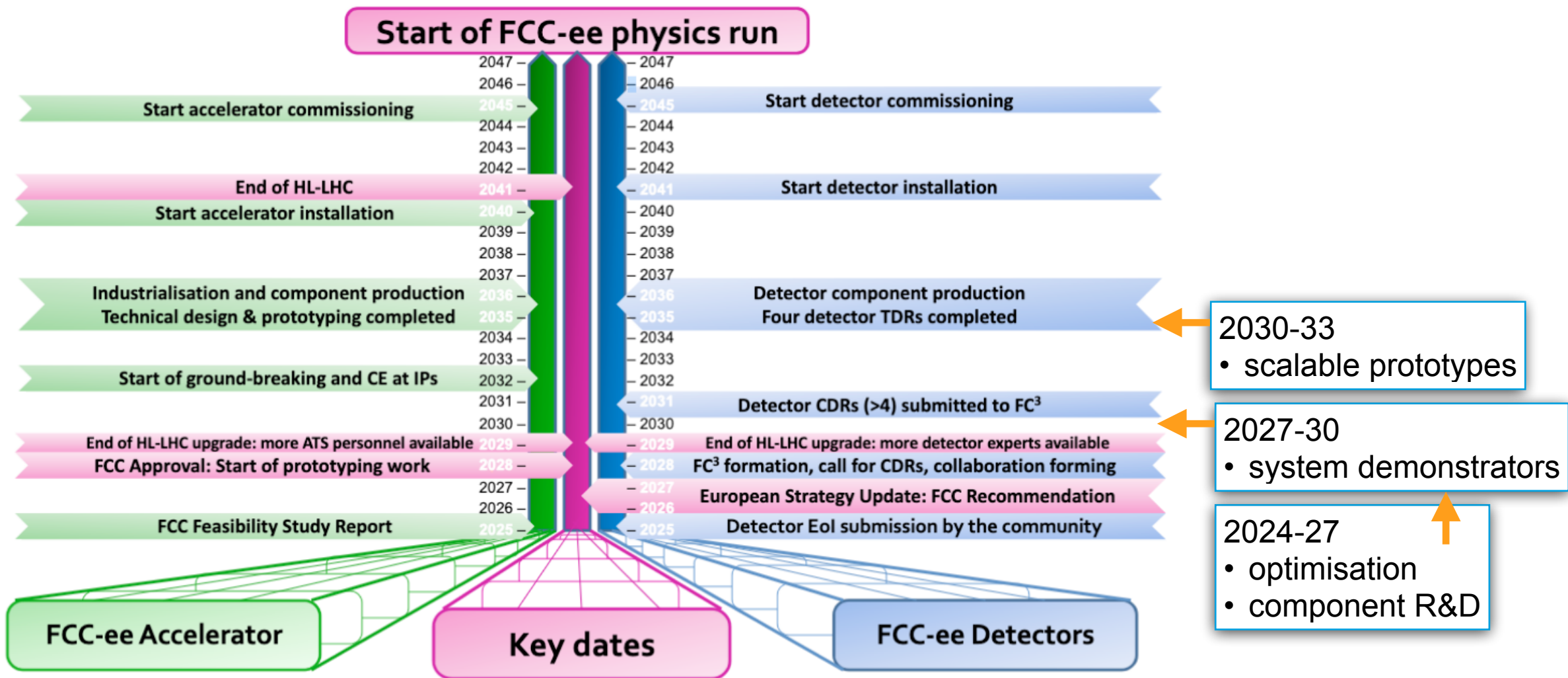
20 years to develop, prototype, build and install detectors

- not all in the last moment
- LHC experience teaches us: time to start
- next phase already includes CERN contribution to detector concepts

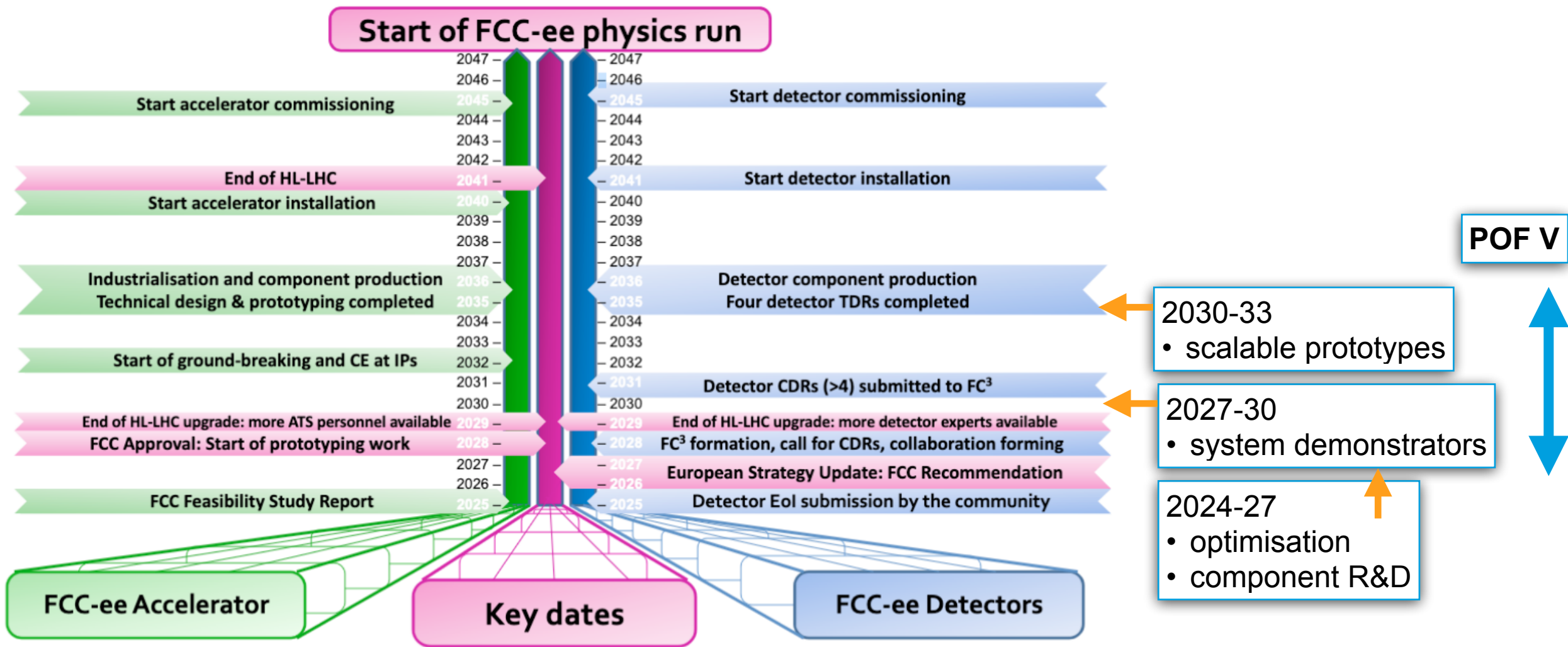
Timelines are uncertain and tend to slip

- earlier milestones and decisions less affected than end dates

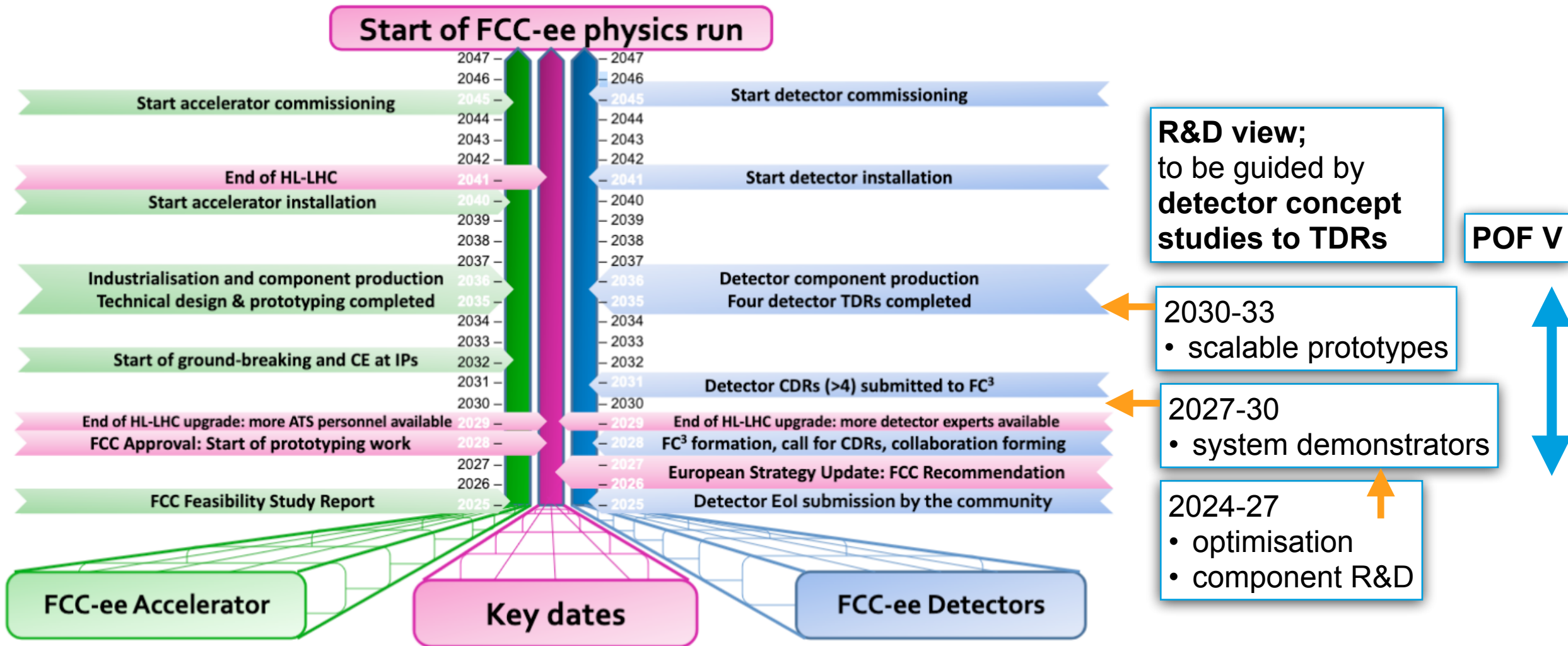
Timeline for the FCCee



Timeline for the FCCee

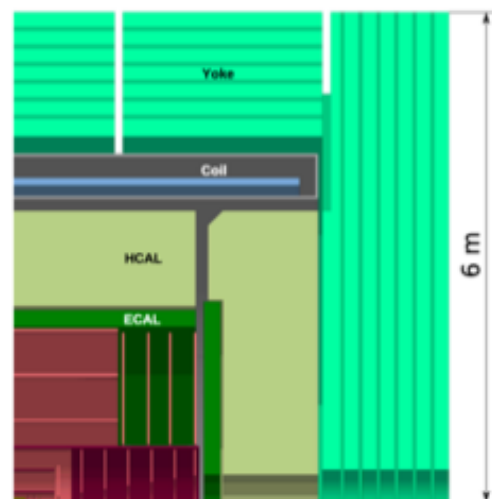


Timeline for the FCCee



FCC-ee Detector Concepts

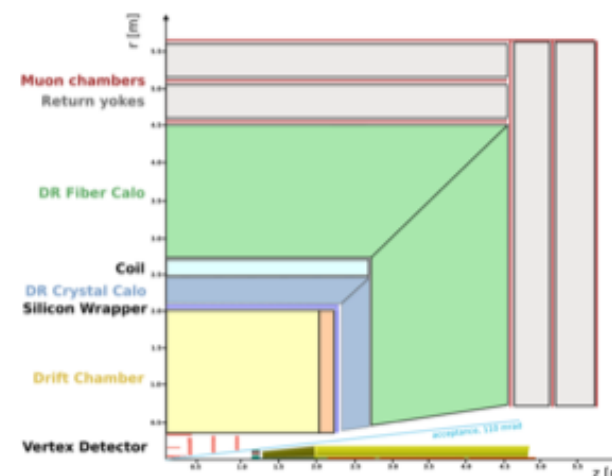
CLD



- Well established design
 - ILC → CLIC detector → CLD
- Full Si VXD + tracker
- CALICE-like calorimetry – very high granularity
- Coil outside calorimetry, muon system
- Possible detector optimizations
 - Improved σ_p/p , σ_E/E
 - PID: precise timing and RICH

[arXiv:1911.12230](https://arxiv.org/abs/1911.12230)

IDEA



- Design developed specifically for FCC-ee and CEPC
- Si VXD; ultra-light drift chamber with powerful PID
- Crystal ECAL w. dual readout
- Compact, light coil;
- Dual readout fibre calorimeter
- Muon system

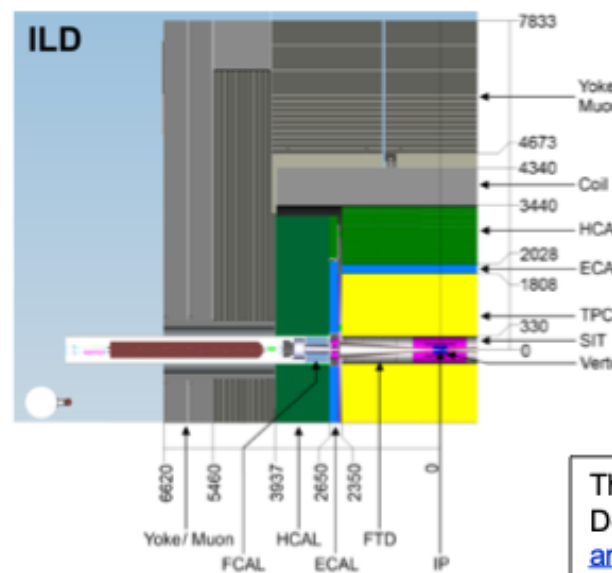
<https://doi.org/10.48550/arXiv.2502.21223>

Allegro



- Still in early design phase
- Design centred around High granularity **Noble Liquid ECAL**
 - Pb+LAr (or denser W+LKr)
- Si VXD
- Tracker: Drift chamber, straws, or Si
- Steel-scintillator HCAL
- Coil outside ECAL in same cryostat
- Muon system

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

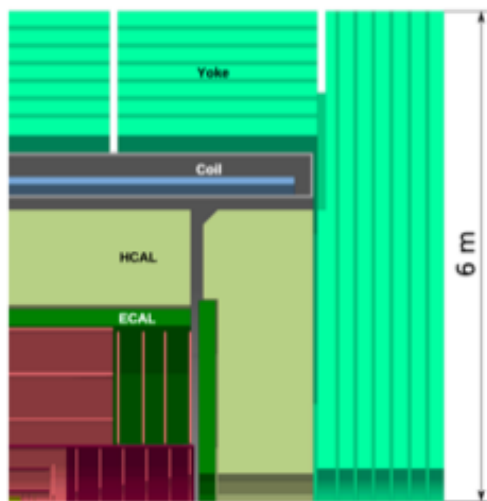


- Designed originally for operation at the ILC
- Together with SiD, ancestor of CLD.
- Main difference and signature element:
 - Large-volume time projection chamber (TPC)

The International Linear Collider Technical Design Report - Volume 4: Detectors
[arXiv:1306.6329](https://arxiv.org/abs/1306.6329)

Any Future Higgs Factory Detector Concepts

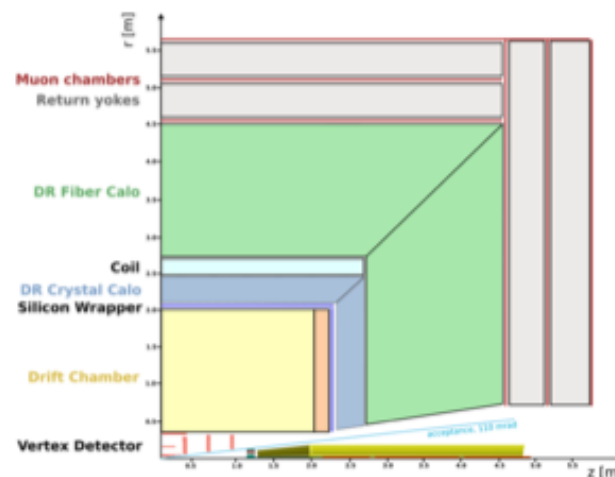
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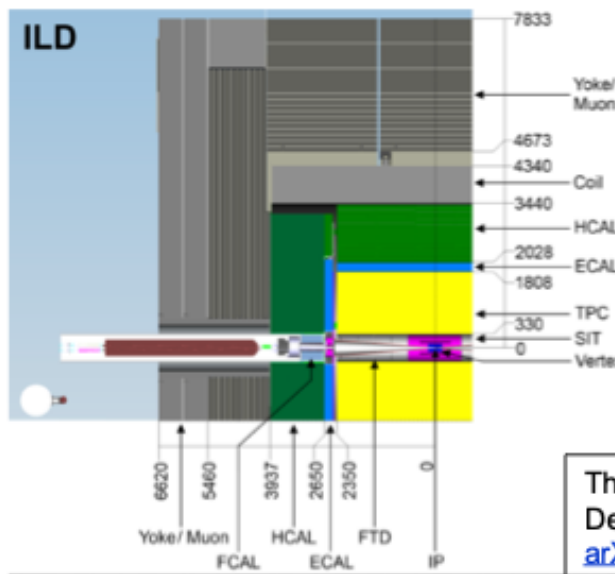
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German Community and DESY

Survey in 2024

Main interest in silicon detectors (vertex and large area) and calorimetry

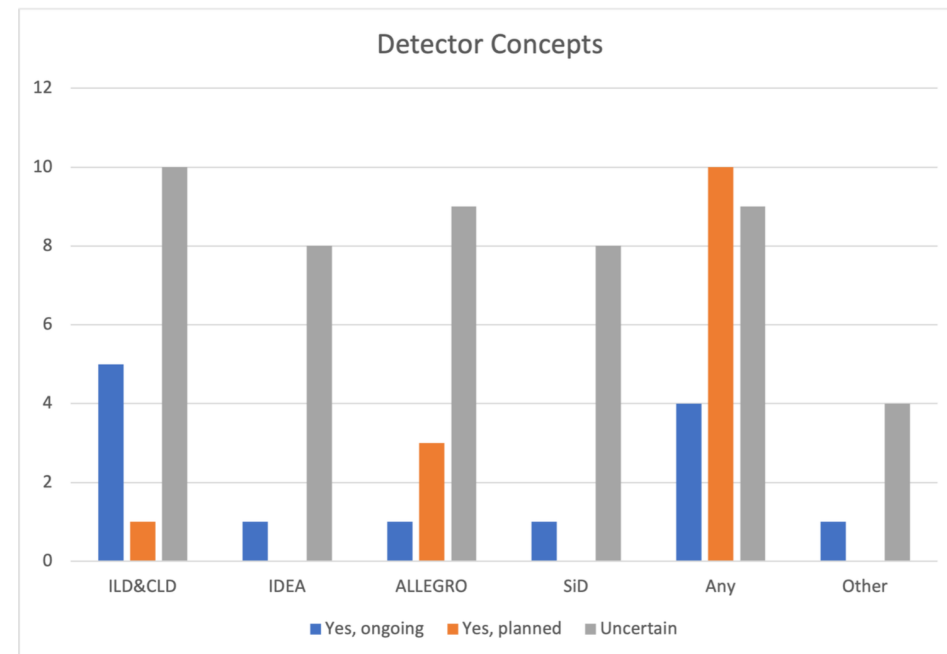
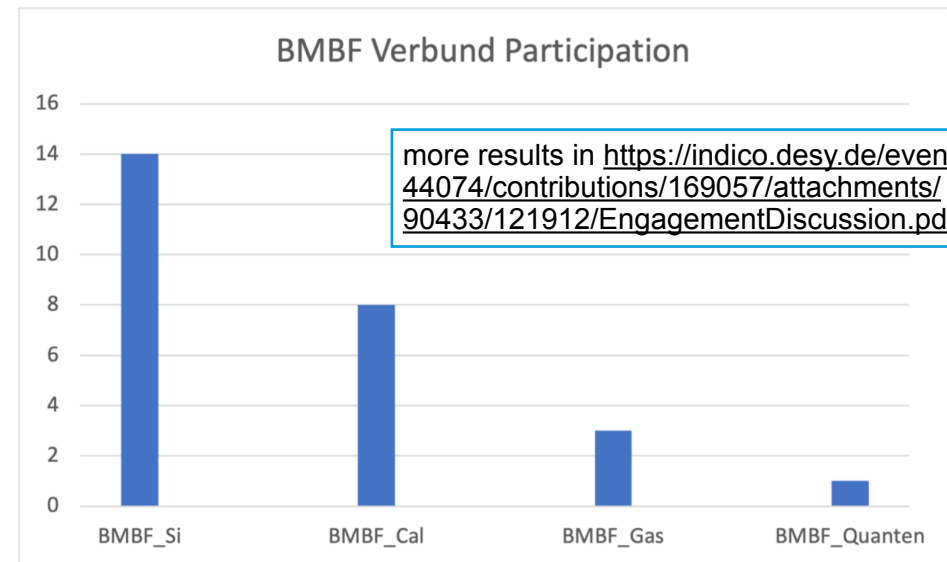
- best way to position oneself in future projects is success in ongoing ones
- DESY and German universities well aligned
- DESY technology focus also includes advanced electronics & mechanics
 - see detector platform view

Interest in several detector concepts

- CLD/ILD, ALLEGRO

See also submitted **Expressions of Interest** (concepts and sub-detectors)

<https://indico.cern.ch/event/1529896/>



DESY Key Competences in Detector Concepts

25 years of experience in leading and supporting physics and detector efforts worldwide

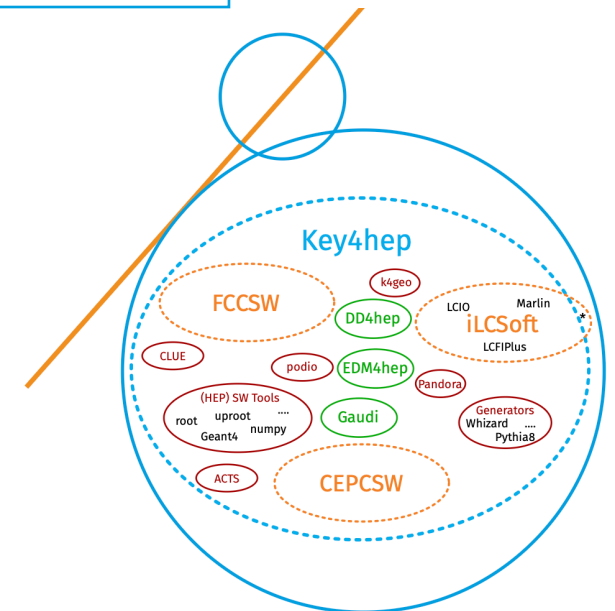
DESY strengths

- strong links with **theory**; phenomenology and generator competences
- **physics** case studies as key to strategic contributions
- physics driven detector **optimisation**
- **software** frameworks, sub-detector s/w integration and high-level reconstruction; **Machine Learning** in simulation & reconstruction
 - key to community integration
 - see computing platform view
- detector integration including **MDI**
- detector **engineering** and test beam **support**

Lifetime competences

- detector understanding → methods development → physics leadership

Jenny's talk



Key4hep contains the experiment specific software components of all major Higgs factory proposals

Punchline

Maintain and evolve DESY's position as a German hub for future collider activities

- in sync with momentum growth in the community

Capitalise on DESY strengths in

- **physics** and link to **theory**
- overall **detector concepts** and optimisation
- **software** frameworks and **integration**
- **detector technology** competences and **infrastructure**

Develop leading role of DESY and German institutes in CERN's future flagship project