FCC

Physics, detector and outreach questions

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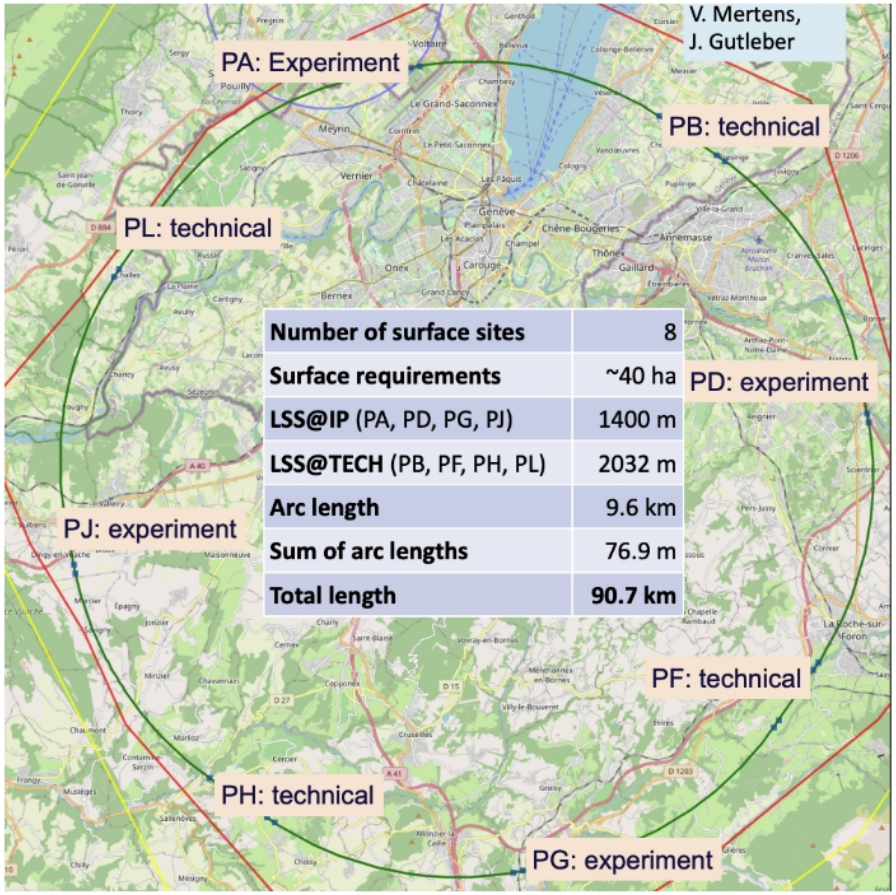
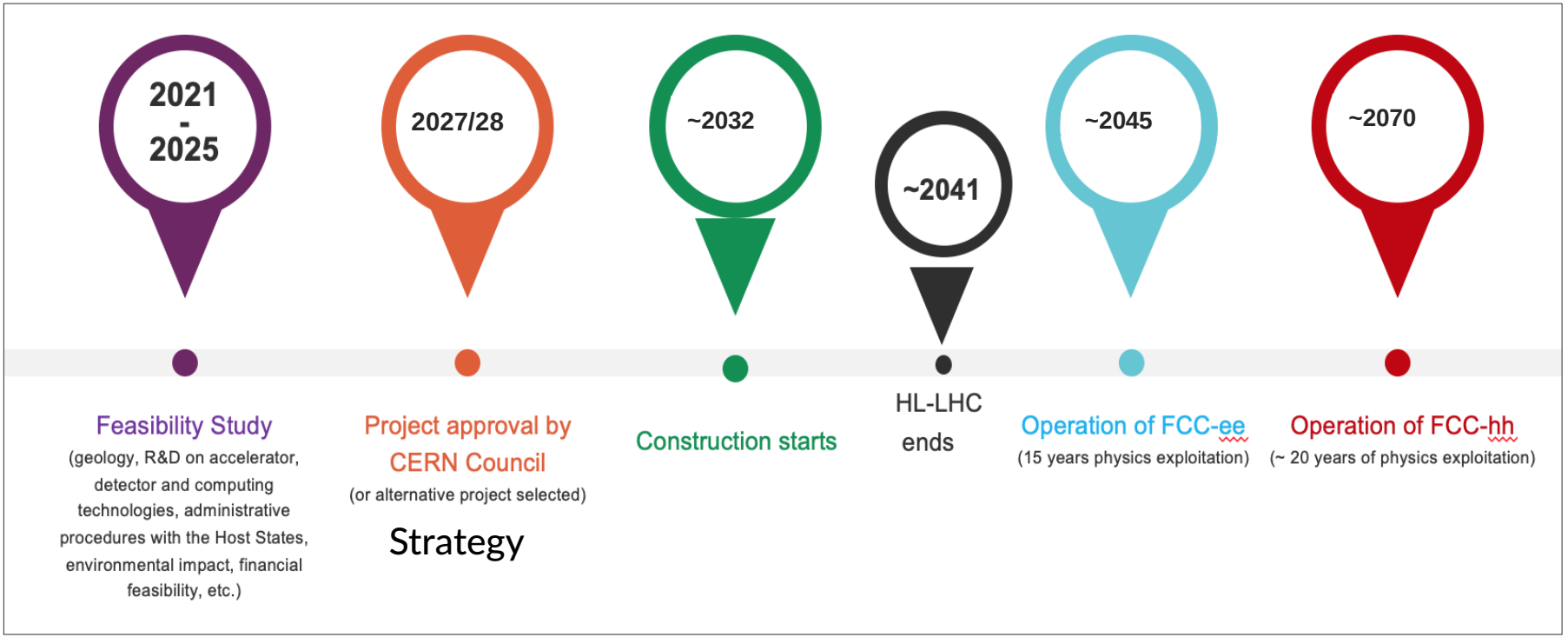
FCC-ee in pills

	Z pole	WW pole	ZH pole	Top pair pole
Beam energy (GeV)	45.6	80	120	182.5
Beam current (mA)	1270	137	26.7	4.9
Number of bunches	11200	1780	440	60
Luminosity (per IP - 10^{34} cm^{-2} s^{-1})	140	20	5	1.25
Integrated luminosity (per IP - ab^{-1}/year)	17	2.4	0.6	0.15
Planned running time (years)	4	2	3	5

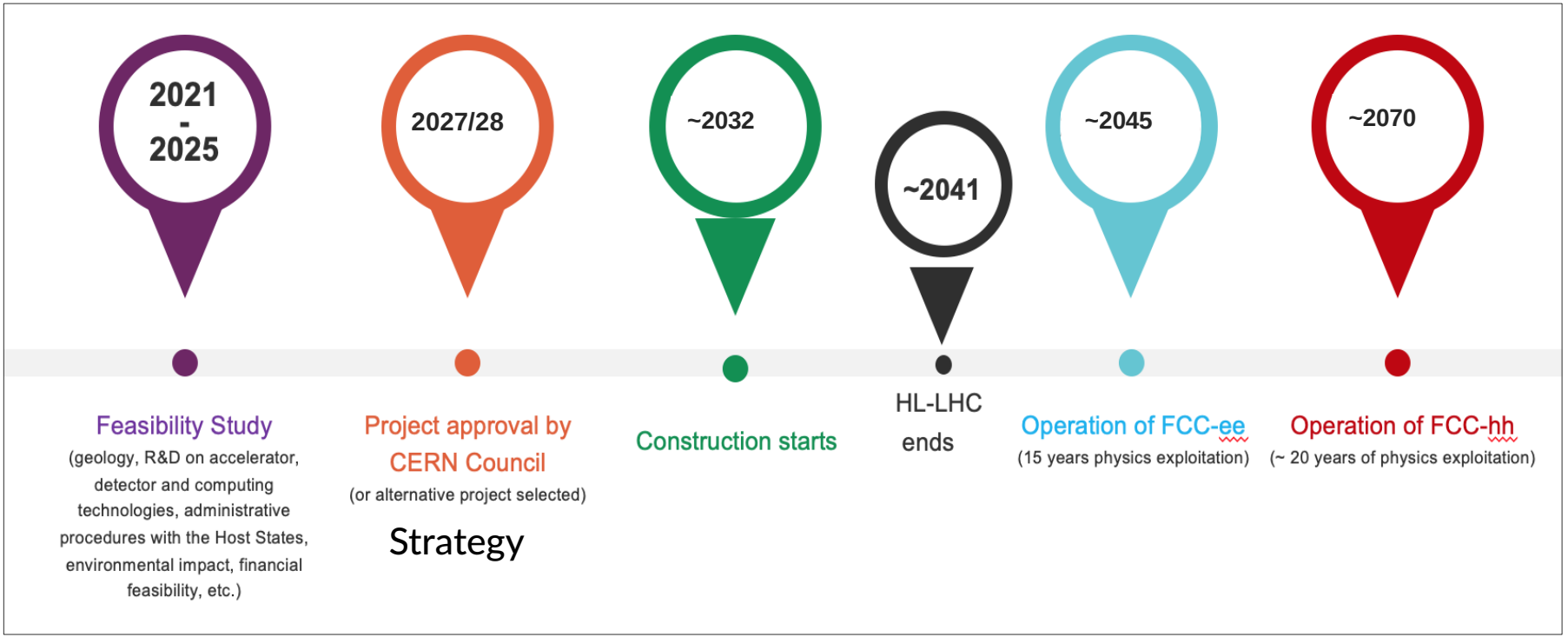
Which translates in

- 5×10^{12} Z (LEP $\times 10^5$)
- $\sim 10^8$ WW (LEP $\times 10^4$)
- 2×10^6 H unprecedented at e^+e^-
- 2×10^6 $t\bar{t}$ unprecedented at e^+e^-





Time scale: short term, transform a conceptual design towards a more technical plan
Expected FCC-ee Data taking by 2045



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HL-LHC will suffice to keep the community at bay?
Need of a “side project”? What’s the role of CEPC proposal (to be approved soon)?

four paths to advance in HEP at colliders:

- Higgs
- new particles
- "Dark" signals
- indirect effects

- at this stage, every single method is of fundamental importance to make progress !
- e+e- colliders can have great opportunities in all sectors (cleanness [→ model independence], accuracy…)
- quite general consensus on e^+e^- Higgs factory as next collider to build !

https://agenda.infn.it/event/39747/contributions/221820/attachments/119165/172652/INFN_Strategia_Mele.pdf

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Which is (if exists) the "no-lose theorem" for FCC-ee?
We all hope that he can find signals of new physics

Which is the interplay with the present generation of detectors and accelerators?
Can we found he solution fror the B-meson anomalies observed at B-factories?

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https://arxiv.org/pdf/2401.07564

Detectors

Physics scenario identifies the best technological solutions

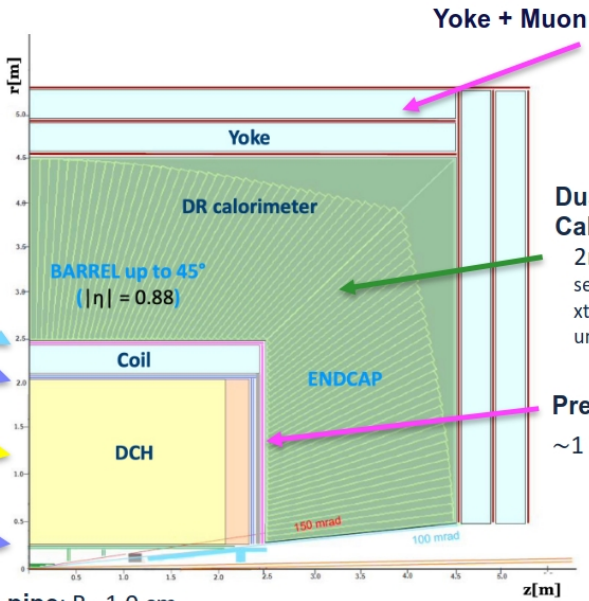
	Critical detector	Requirement	Comments
$ZH \to \ell^+\ell^- X$	Tracker	$\frac{\sigma(p_T)}{p_T^2} \sim \frac{0.1\,\%}{p_T} \oplus 2 \cdot 10^{-5}$	But also precision EW, flavour, BSM
$H \to b\bar{b}, c\bar{c}$	Vertex	$\sigma_{r\phi} \sim 5 \oplus 15(p \sin\theta^{\frac{3}{2}})^{-1}[\mu m]$	Additional case study: B→K*ττ
$H \to gg, q\bar{q}, VV$	ECAL, HCAL	$\frac{\sigma(E_{jet})}{E_{jet}} \sim 4\,\%$ (at $E_{jet} \sim 50$ GeV)	Also BSM and missing energy reconstruction
$H \to \gamma\gamma$	ECAL	$\frac{\sigma(E_\gamma)}{E_\gamma} \sim \frac{10-15\,\%}{\sqrt{E_\gamma}}$	But flavour physics may need better EM energy resolution

Superconducting solenoid coil:
2 T, R ~ 2.1-2.4 m
0.74 X_0, 0.16 λ @ 90°

Outer Silicon wrapper:
Si strips /LGAD options

Drift Chamber: 112 layers
4 m long, R = 35-200 cm

Vertex:
5 MAPS layers
R = 1.37-31.5 cm



Dual-Readout Calorimeter:
2m / 7 λ_{int}
segmented option
xtal+fibres
under study

Preshower:
~1 X_0

Beam pipe: R~1.0 cm

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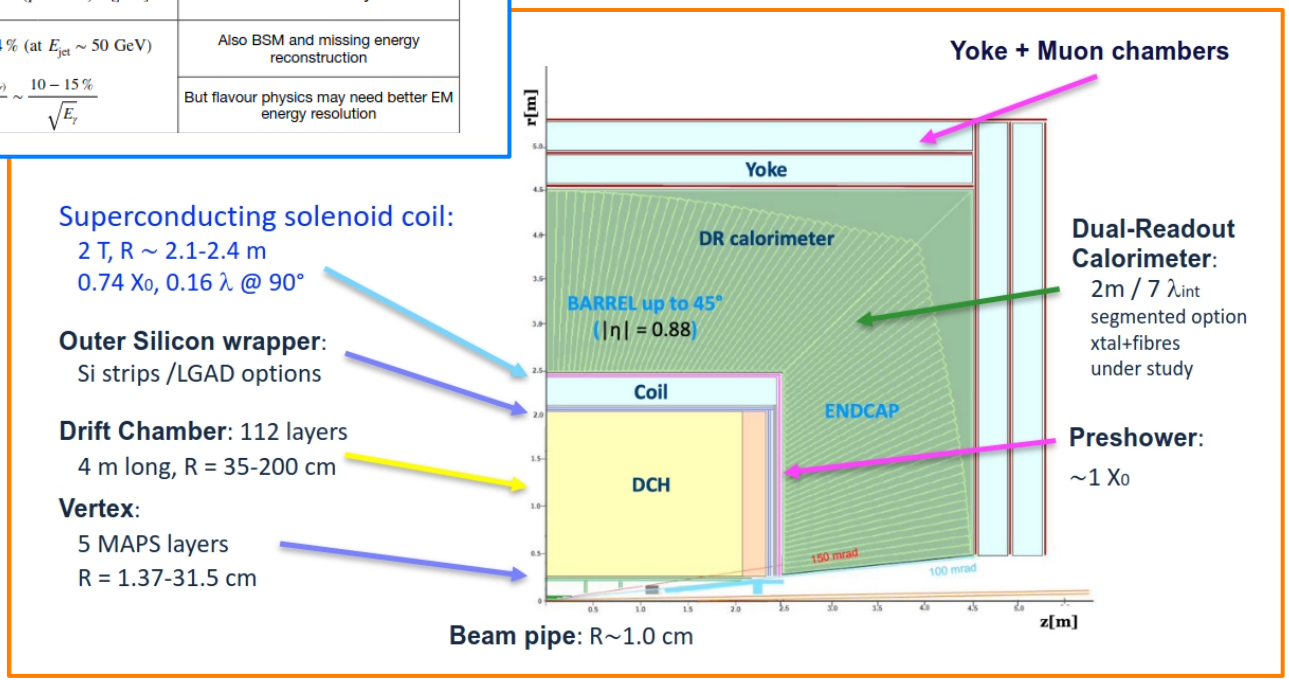
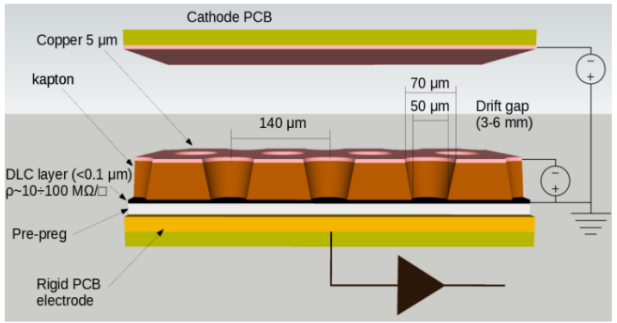
Central role to be played by ECFA DRD to find the optimal solutions

IDEA TDR to be closed by the time of the strategy.
Still many open points/development opportunities

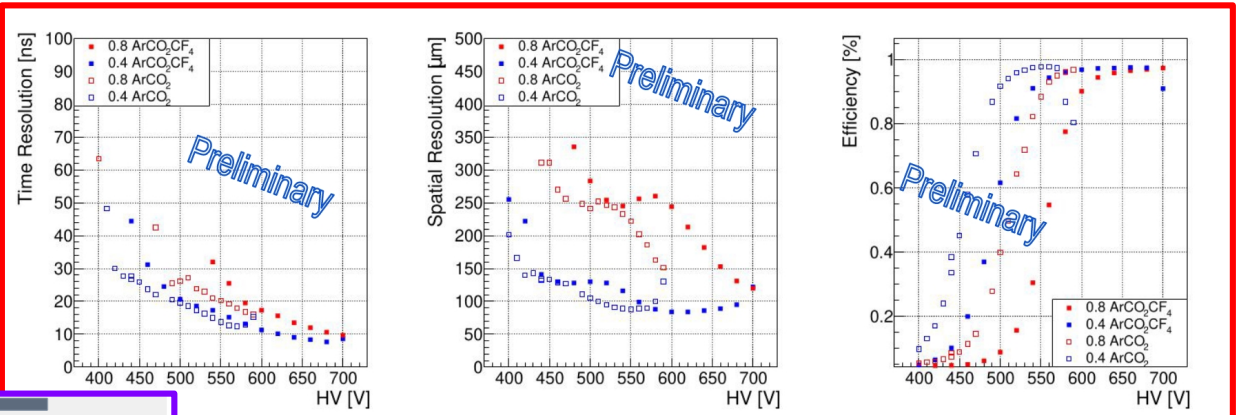


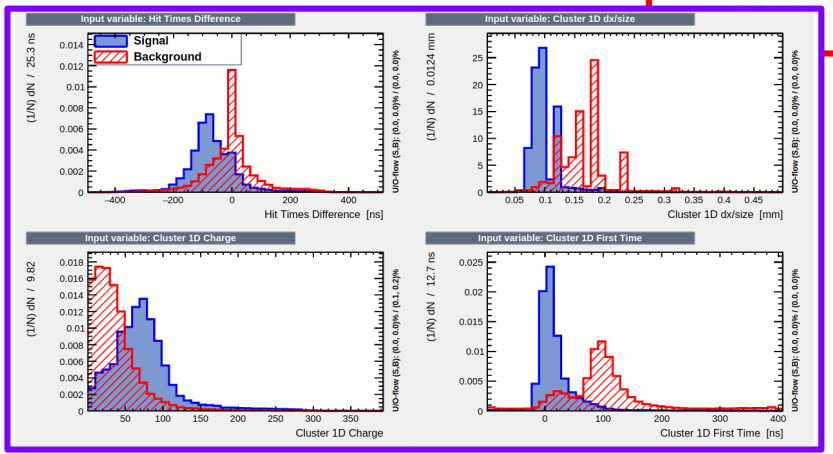
µRWELL @ Fe

µRWELL development for preshower/muon detector for IDEA spectrometer



Test beams





Feasibility study on pattern recognition for signal cluster with Boosted Decision Tree (BDT) technique

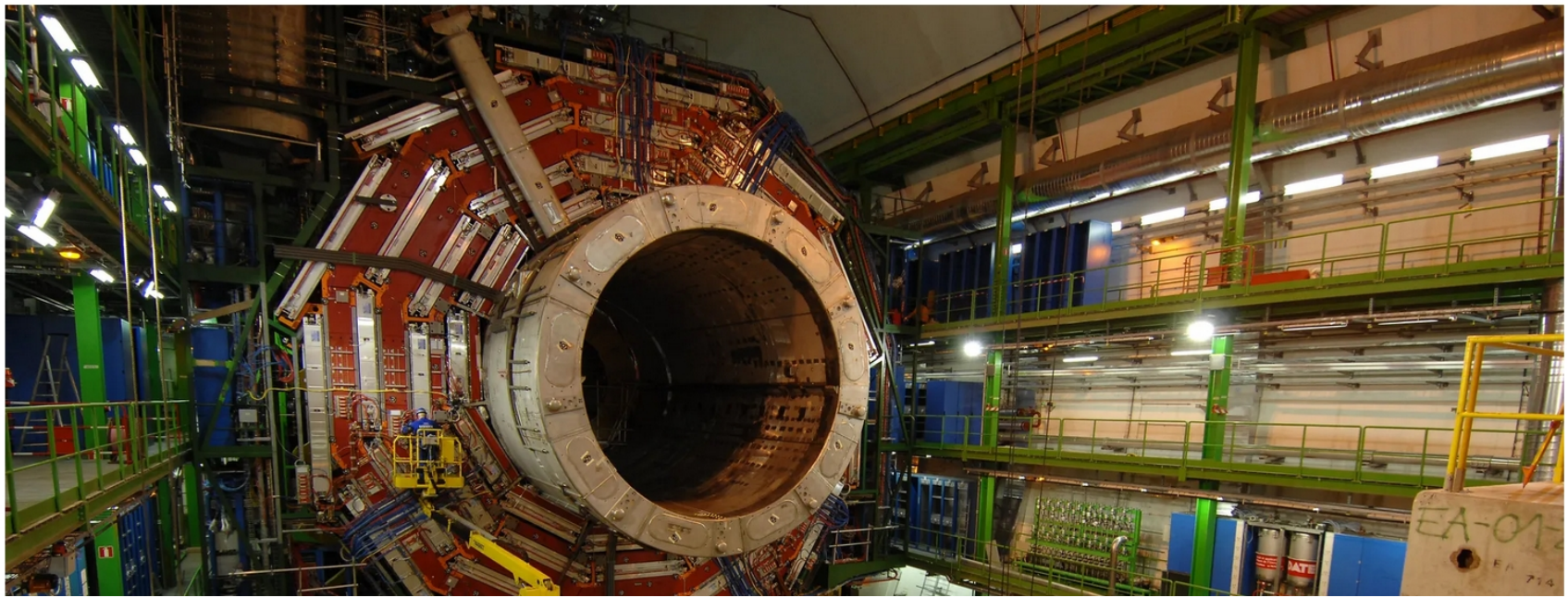
SIMONE VALESINI SCIENZA 10.02.2024

10/02/2024

Al Cern si progetta l'acceleratore di particelle più grande del mondo

Il Future circular collider potrebbe entrare in funzione già nel 2045. Con una potenza finora mai vista sarebbe in grado di portarci più vicini a una teoria del tutto in fisica

https://www.wired.it/article/acceleratore-di-particelle-cern-piu-grande-mondo-future-circular-collider-lhc-fcc/



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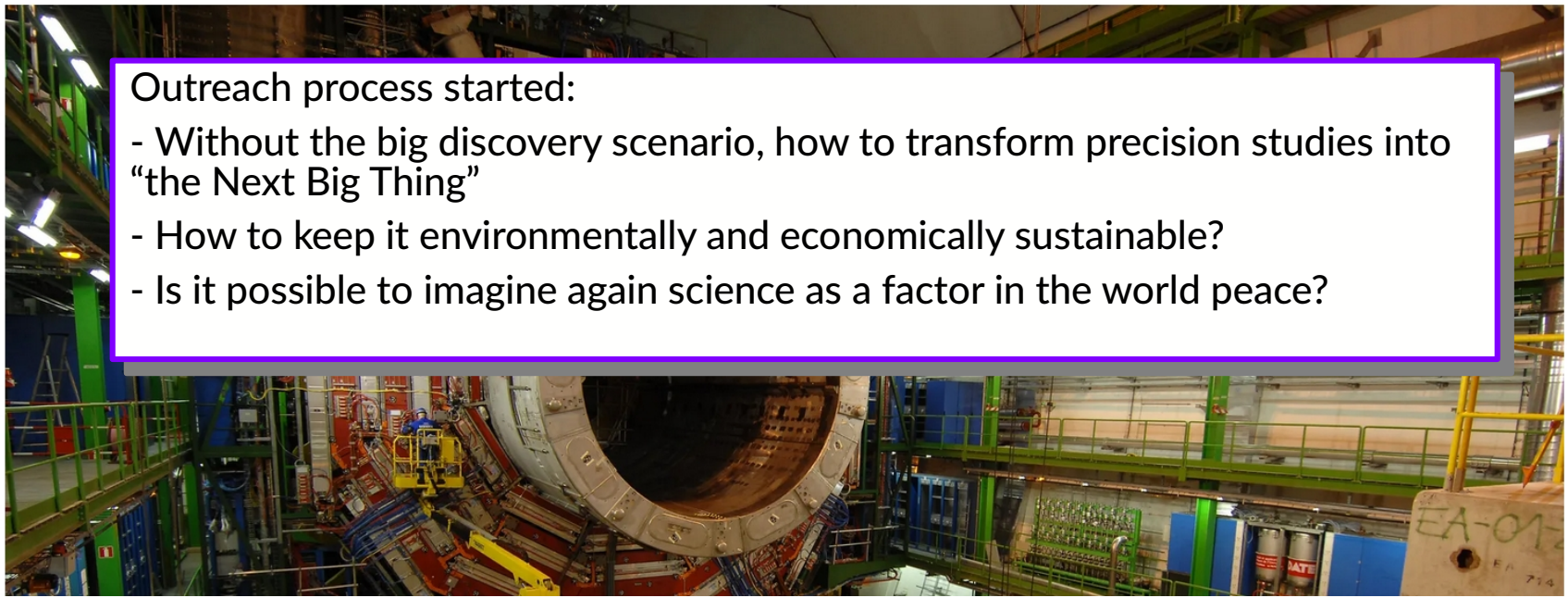

Outreach process started:

- Without the big discovery scenario, how to transform precision studies into “the Next Big Thing”
- How to keep it environmentally and economically sustainable?
- Is it possible to imagine again science as a factor in the world peace?