



Future Collider@CERN - Introduction for Discussion

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(on behalf of KET)
KET Jahrestagung
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Why yet another Future Collider Discussion?

- Last EPPSU: Higgs Factory = “highest-priority next collider”
 - up to now no approved project
 - hopes on Japan are vanishing
 - China could approve CEPC in 2026 - international participation?
- Next EPPSU expected for 2026/27 (input by end of 2025)
 - Centre of particle physics is CERN, future must be shaped at and with CERN
 - whatever the outcome of the next EPPSU might be, the European HEP-Community needs to support it
 - but *before* we should participate actively in the discussions and contribute to shaping the outcome
- How do we (HEP-Community in Germany) prepare us?
 - last time Germany was excellently prepared with agreed statement following a series of workshops
- What is needed to
 - make the community enthusiastic about a Higgs Factory and to engage?
 - convince funding agencies / peers from other areas of science?

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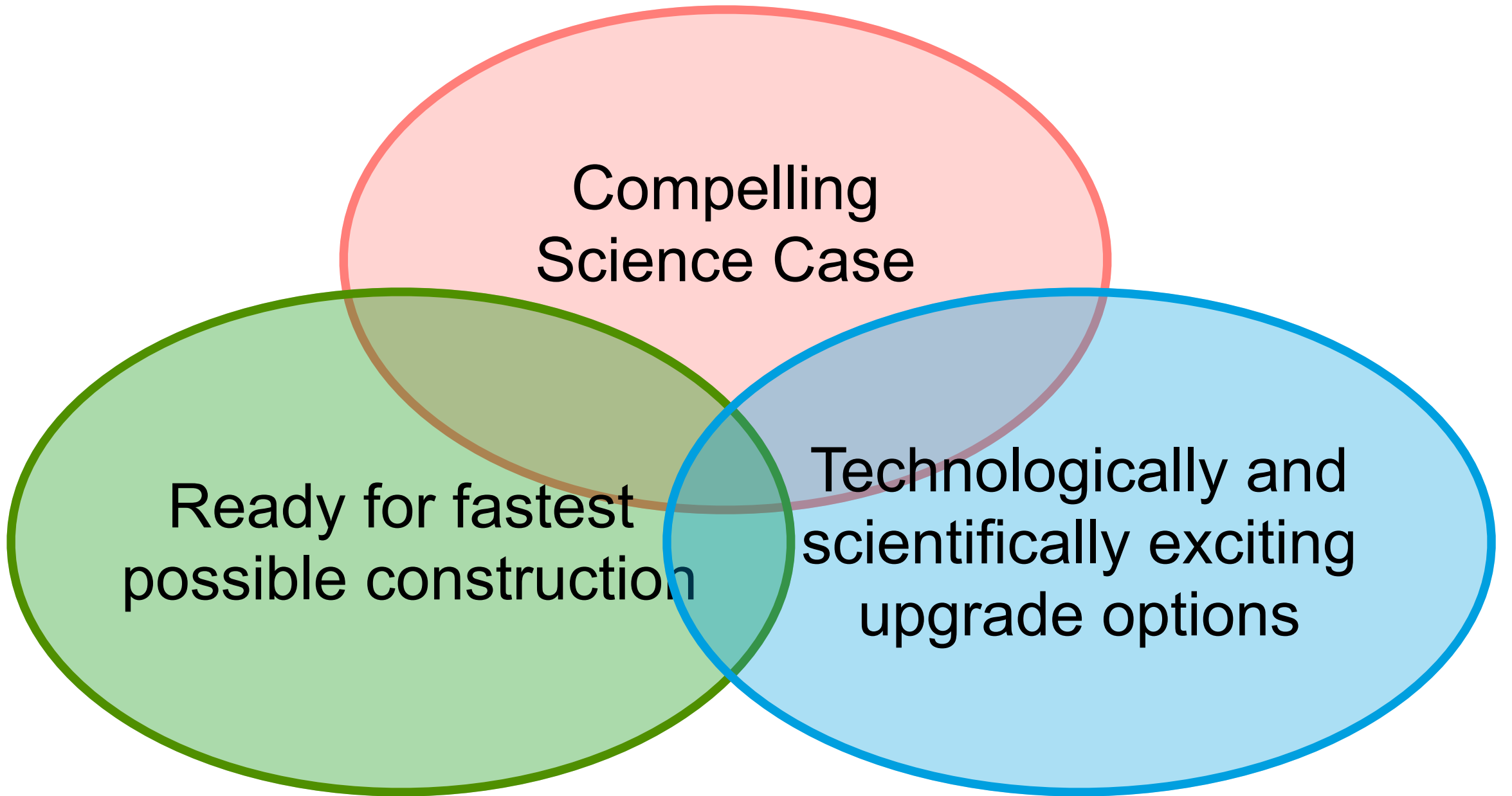
Discuss only FC@CERN

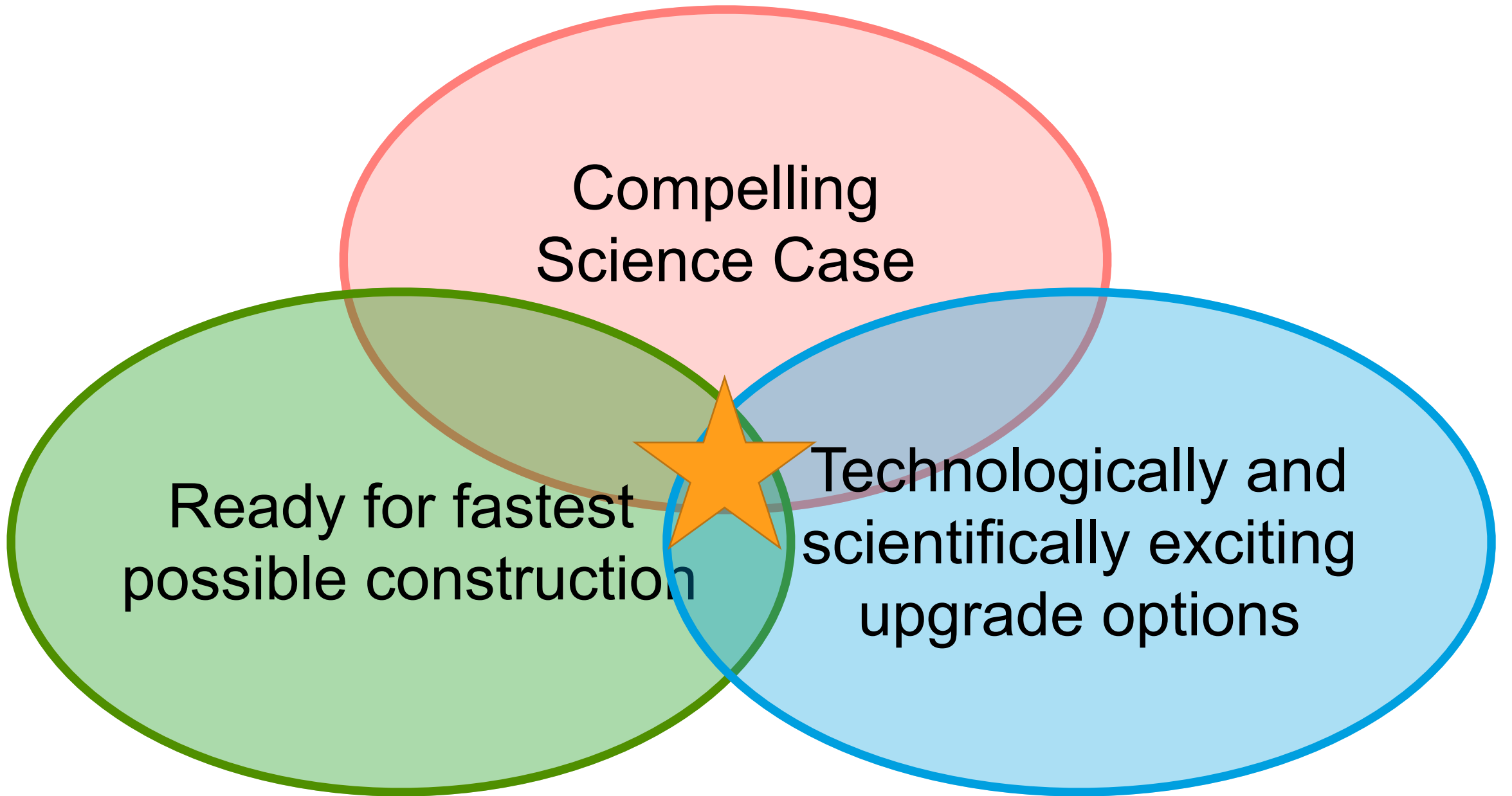


Compelling Science Case

Compelling
Science Case

Ready for fastest
possible construction



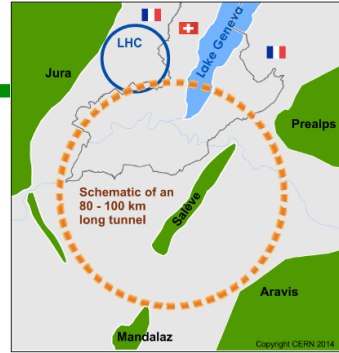


Two possible approaches

Each with its advantages

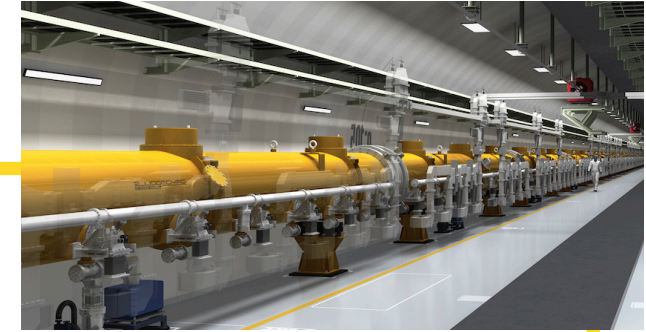
Circular e+e- Colliders

- FCCee, CEPC
- length 250 GeV: 90...100km
- high luminosity & power efficiency at **low energies**
- **unique precision Z pole programme**
- multiple interaction regions => many users
- very clean: little beamstrahlung etc



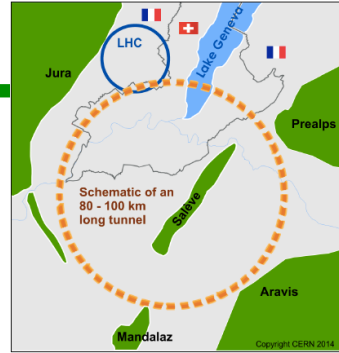
Linear Colliders

- ILC, CLIC, C³, ...
- length 250 GeV: 4...11...20 km
- high luminosity & power efficiency at **high energies**
- **full tt, ttH, HH and BSM program**
- more room for scientific diversity?
- **longitudinally spin-polarised beam(s)**



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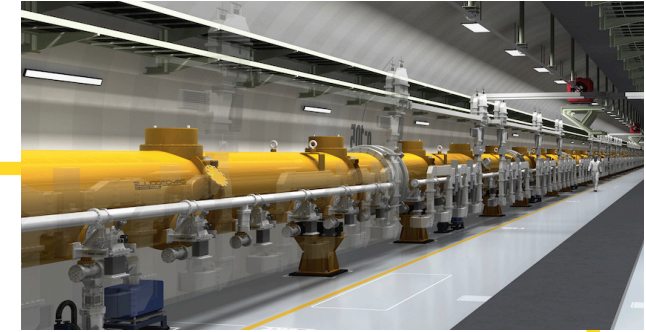
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Long-term vision: re-use of tunnel for pp collider

- technical and financial feasibility of required magnets still a challenge

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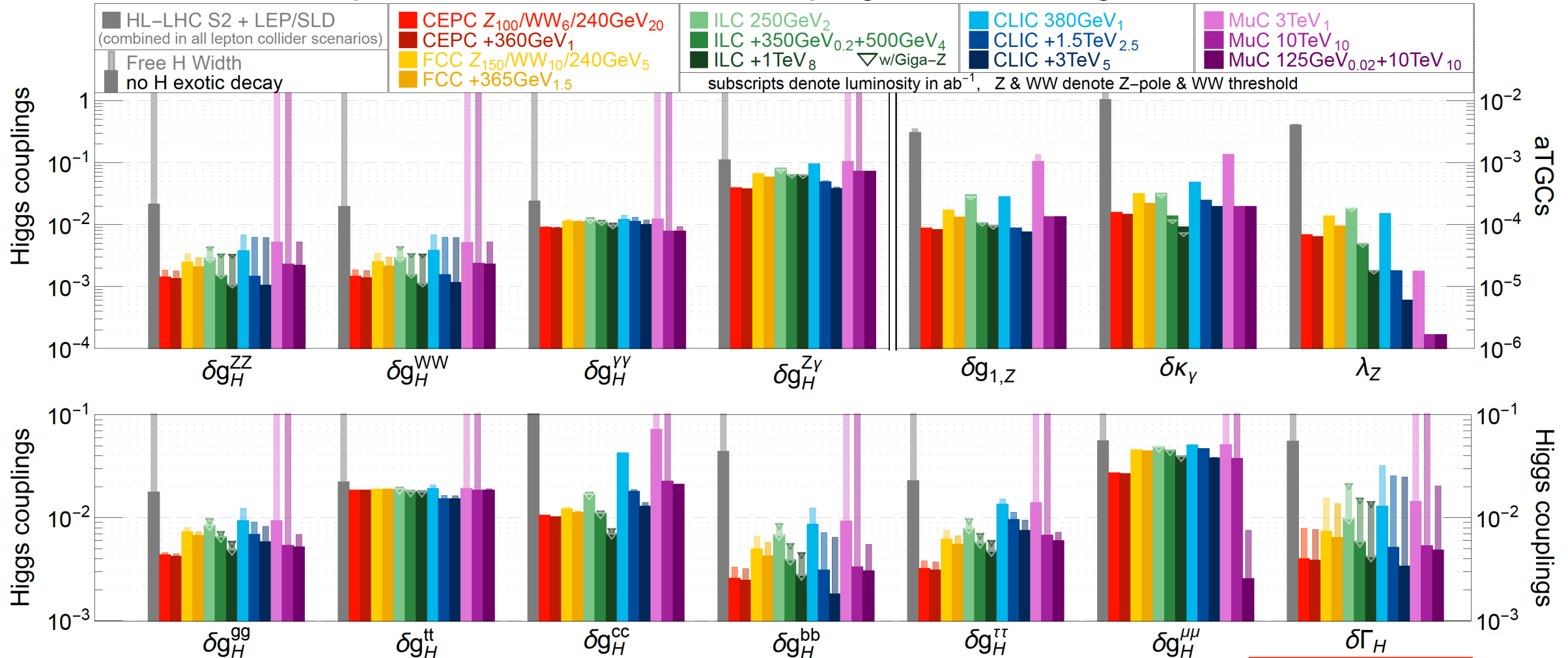
Long-term upgrades: energy extendability

- same technology: by increasing length
- **or by replacing accelerating structures with advanced technologies**
 - RF cavities with high gradient
 - plasma acceleration ?

All projects deliver core 240/250 GeV Higgs Factory programme

Example: Snowmass SMEFT fit

precision reach on effective couplings from SMEFT global fit

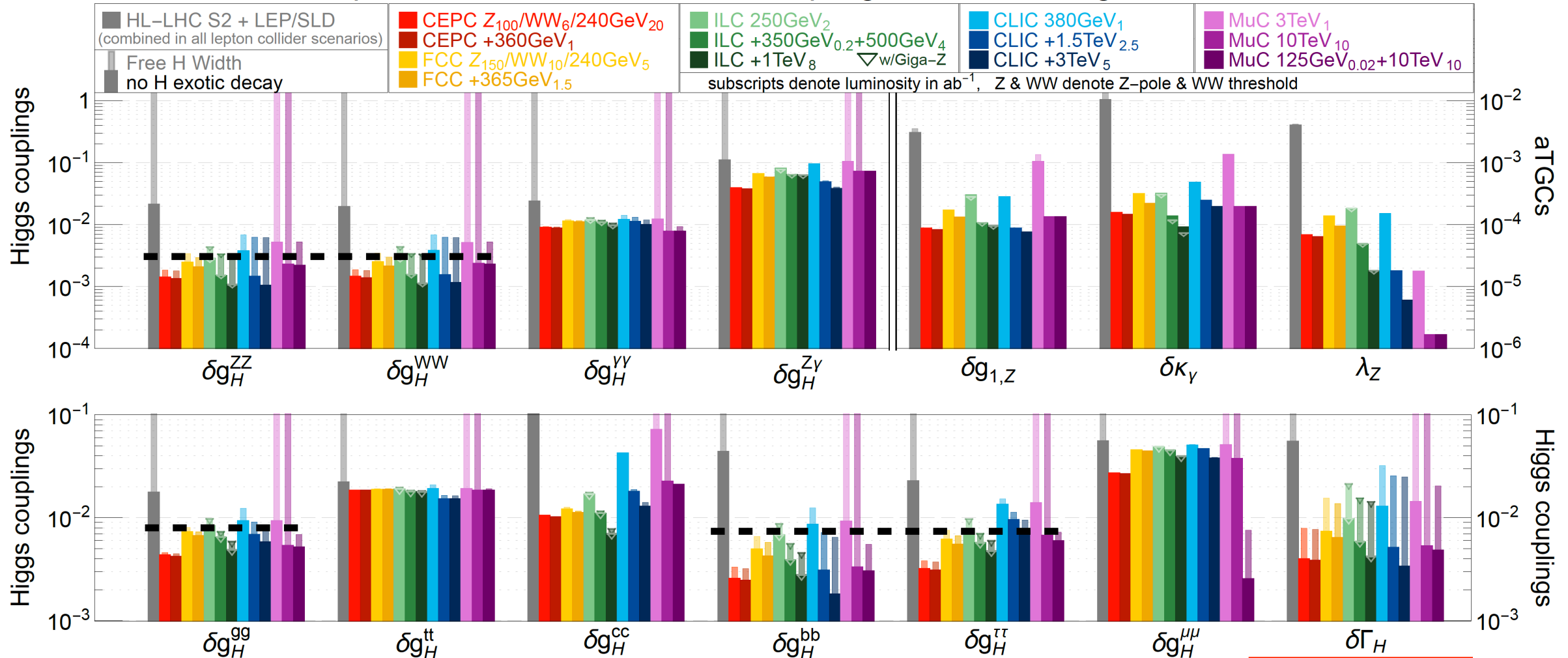


arXiv:2206.08326

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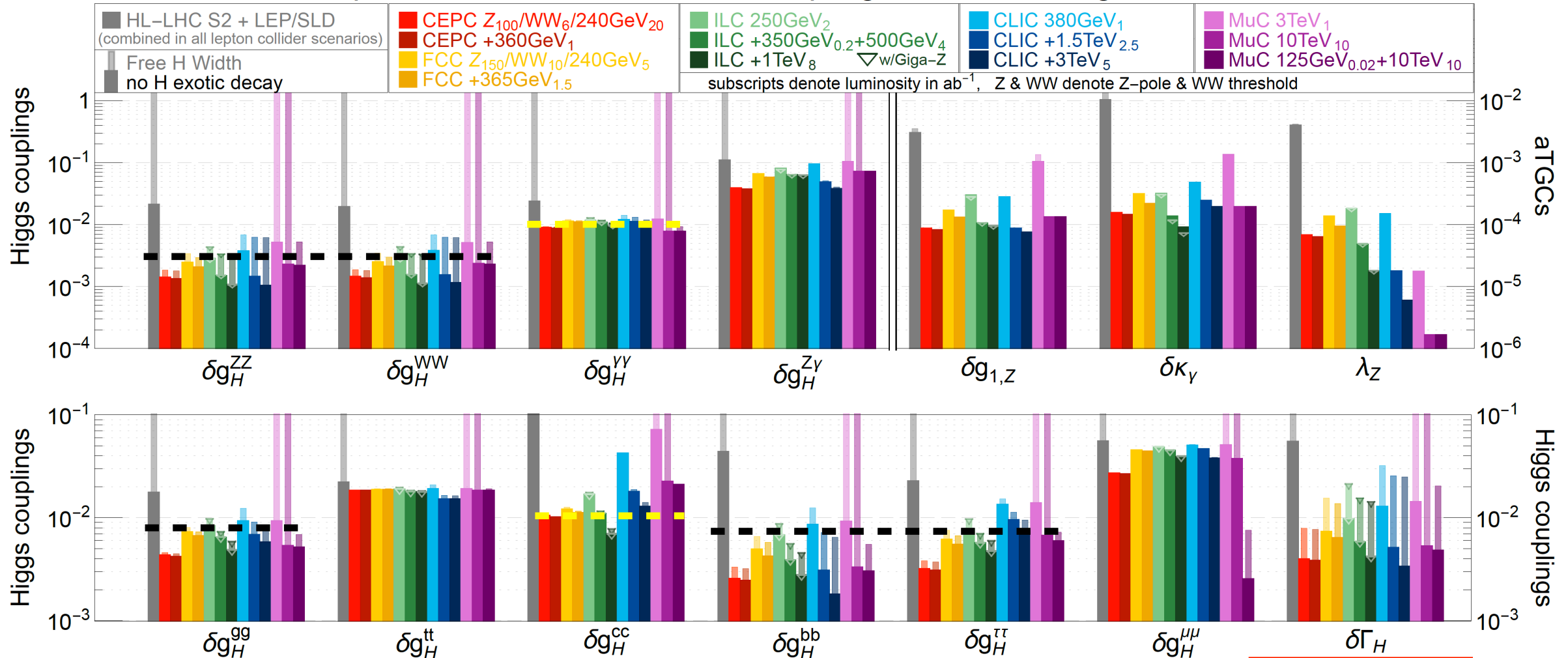


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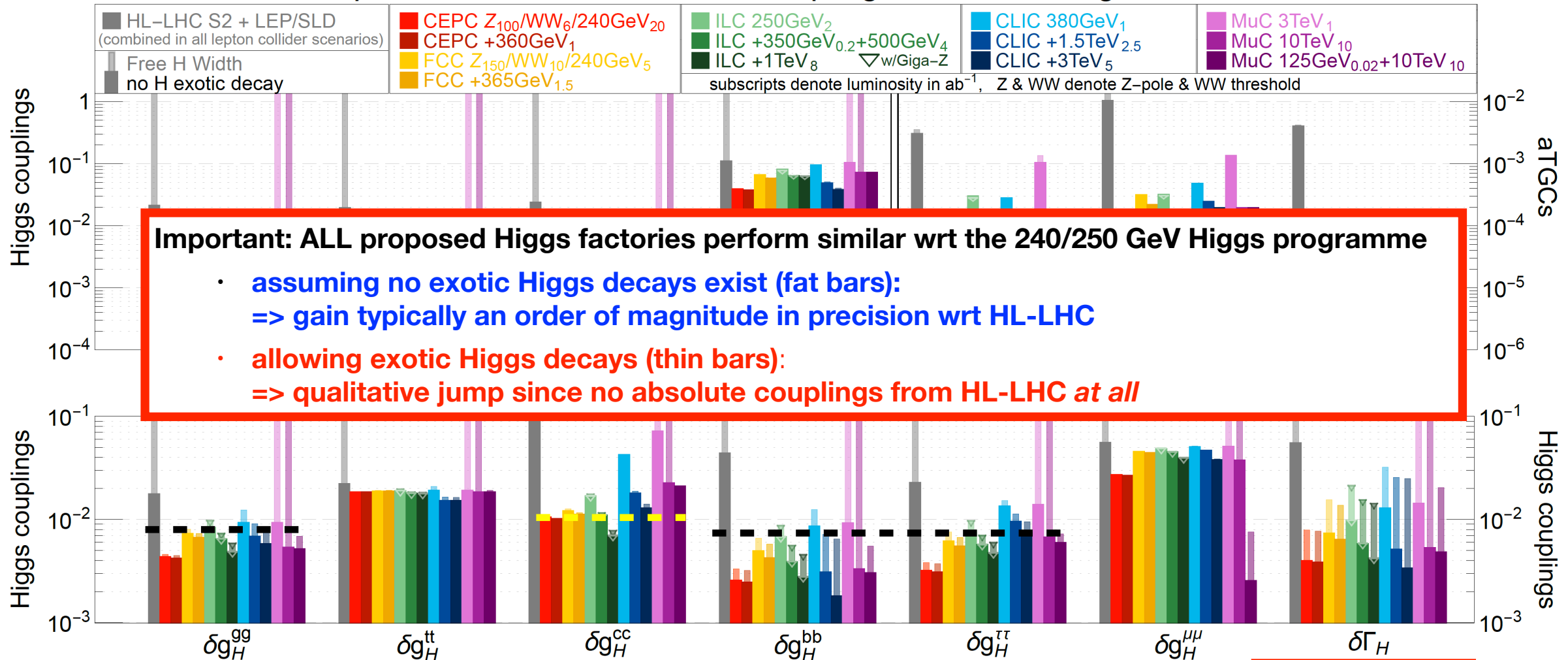


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The Perspective of the German HEP Community Last Time

What changed?

- Last EPPSU: Input from German community clearly favoured Higgs Factory upgradable to 500 GeV(++) - and was criticised for it => revision needed?
- Reminder: Why was 500GeV++ so important to us?
 - tree-level sensitivity to Higgs self-coupling from di-Higgs production
 - complete analysis of the electroweak couplings of the top quark
 - complete CP-Analysis of the ttH coupling
 - BSM sensitivity from $ee \rightarrow f\bar{f}$ at high energies
 - direct BSM searches complementary to LHC - and in places where HL-LHC still could discover something
- Is this still true?
 - did we so far underestimate the HL-LHC's potential?
 - Are ultra-precise ew measurements and flavour physics at the Z pole as well as the search for light exotic particles with very weak couplings more important than we thought in 2017/2018?
 - Did it become clear by now that it will be sufficient to measure di-Higgs production only in $pp@100\text{TeV}$?

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No physics discussion today, please!

Further important aspects for Big Projects

beyond the pure scientific programme

- Sustainability
- Impact on “Scientific Diversity” / availability of resources for smaller projects
- Technological developments with “lighthouse character” beyond HEP
 - Accelerators, detectors, computing, sustainability, international cooperation ... ?
- In case funding will be needed beyond the CERN-budget:
 - How will this be incorporated in national roadmap processes?
 - How do we convince the non-HEP community?
- This concerns the future of current ECRs / students
=> they need to be enabled to form their opinion and to engage!

Proposal KET

Higgs Factory Community Workshop: 2-3 days in 2nd quarter 2024 in central place in Germany

- **An e+e- Higgs Factory at CERN is our highest priority**
 - new results / projections on Higgs properties (LHC, HL-LHC, Future Collider)
 - importance of Higgs mechanism for open questions
 - discuss and sharpen science case and its communication
- **CERN is our European particle physics lab and shall continue to be so**
 - results of FCC mid-term review
 - status of alternative options for CERN
 - sustainability and technology transfer
- **Support of R&D Activities**
 - overview on potential german contributions from universities, HGF and MPI to accelerators, detectors, methods, computing, analysis
 - ECFA roadmap and start of the new German consortia for detector R&D
 - LGD roadmap and German activities -> KfB
- **Preparation of German participation in EPSSU**
 - EPSSU process will start in 2024 (secretary ...)
 - Preference of / decision for linear or circular will only be discussed then, not in 2024
 - Town-hall meeting or so to prepare German input to EPSSU

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Will you all come, and encourage your ECRs?