Early Career Inputs to the Future Collider Discussion

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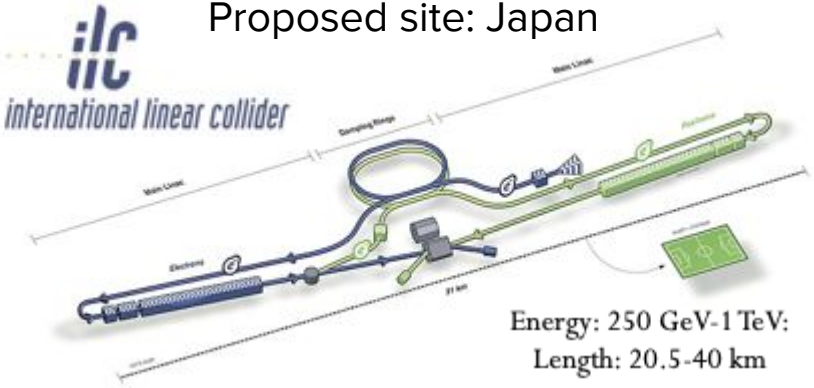
Various Future Collider Concepts that particle physics community is considering..

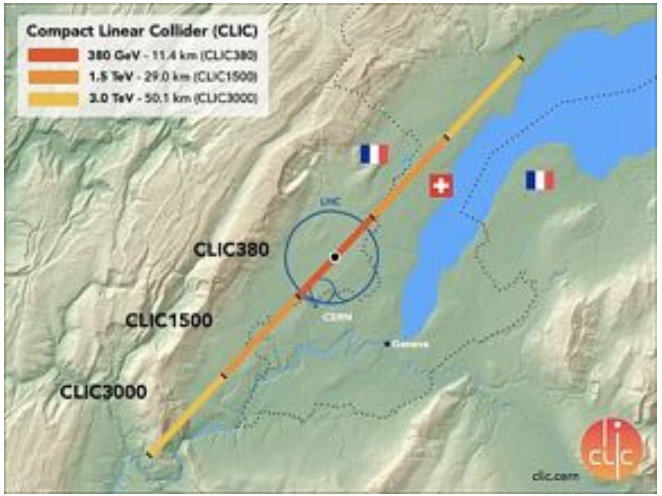
Linear colliders: e+e-

Proposed site: Japan

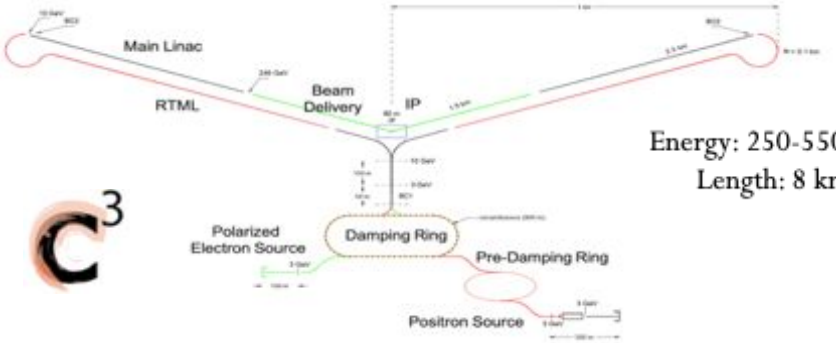


Energy: 250 GeV-1 TeV:
Length: 20.5-40 km

Proposed site: CERN



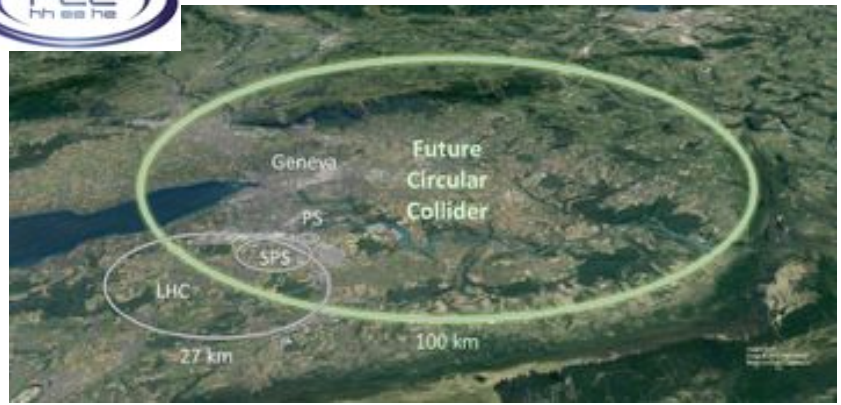
Energy: 380 GeV-3 TeV
Length: 11.4-50 km



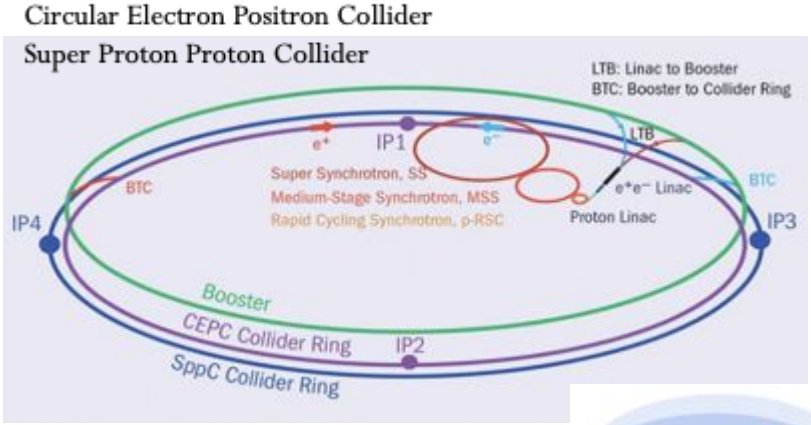
Energy: 250-550 GeV
Length: 8 km

Circular Colliders: e+e- or pp

Proposed site: CERN



Proposed site: China



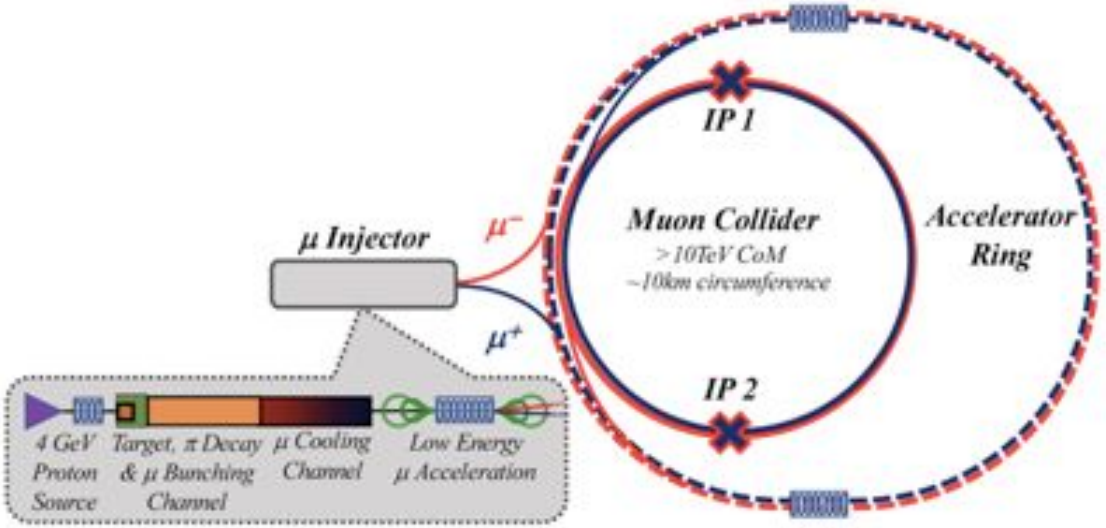
Circumference: 90 – 100 km

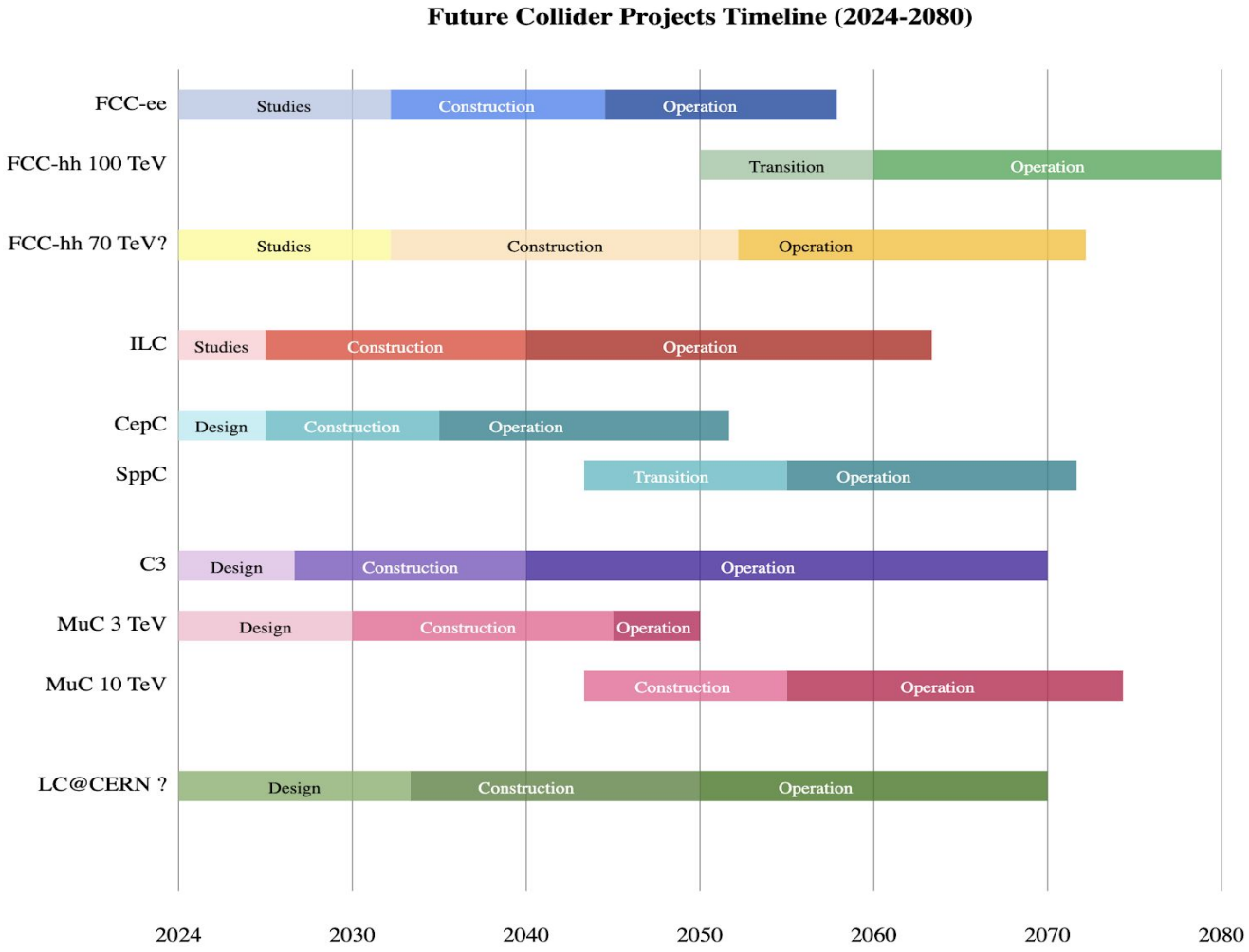
Energy of e+e- stage: ~90-360GeV

Energy of pp stage: ~100 TeV

Muon Collider: New (but no so new) concept

Muons as colliding beam
Fermilab can be a potential site




Future Collider Projects Timeline (2024-2080)
FCC-ee
Studies
Construction
Operation
FCC-hh 100 TeV
Transition
Operation
FCC-hh 70 TeV?
Studies
Construction
Operation
ILC
Studies
Construction
Operation
CepC
Design
Construction
Operation
SppC
Transition
Operation
C3
Design
Construction
Operation
MuC 3 TeV
Design
Construction
Operation
MuC 10 TeV
Construction
Operation
LC@CERN ?
Design
Construction
Operation
2024
2030
2040
2050
2060
2070
2080

Your voice matters!

- Early-career researchers of today are the ones who will be leading the future collider facilities
- Your interests and ideas will influence the priorities and goals of these facilities
- And your active participation in these discussions ensures that the diverse perspectives are considered, reflecting the needs and aspirations of the entire physics community
- We saw this in action during the P5 Town Halls where community input was actively sought
- So please don’t hesitate to share your opinions!

What are the ESG questions?

a) Which is the preferred next major/flagship collider project for CERN?

b) What are the most important elements in the response to (a)?
   - Physics potential; Long-term perspective; Financial and human resources; Requirements and effect on other projects; Timing; Careers and training; Sustainability

c) Should CERN/Europe proceed with the preferred option set out in (a) or should alternative options be considered:
   - if Japan proceeds with the ILC in a timely way?
   - if China proceeds with the CEPC on the announced timescale?
   - if the US proceeds with a muon collider?
   - if there are major new (unexpected) results from the HL-LHC or other HEP experiments?

d) Beyond the preferred option in (a), what other accelerator R&D topics (e.g. high field magnets, RF technology, alternative accelerators/colliders) should be pursued in parallel?

e) What is the prioritized list of alternative options if the preferred option set out in (a) is not feasible (due to cost, timing, international developments, or for other reasons)?

f) What are the most important elements in the response to (e)? (The set of considerations in (b) should be used).

Survey

- We prepared a survey to gather input:
  - https://docs.google.com/forms/d/e/1FAIpQLSeQLD1T9eeHfJVDccCYW_pCK9IT785RFiVzFx0otglowY_aQQ/viewform
  - Aimed at Early Careers but open to everyone
- How are we going to use this input:
  - Gather interest in Level 2 subgroups ⇒ this is useful if we see some subgroups that have lack of person power
  - We can see what matters most to people for the future, and the answers to the questions
    - See trends: Early Career vs more senior colleagues

Questions for Audience!!

- We have built few polls so all of you can participate
- To participate:
  - Open https://pollev.com/rgarg251 on your devices (QR code available on each slide as well)
  - The question on the screen will appear on your devices too
  - Responses are limited to one per person
  - Polls are anonymous so feel free to express your opinions

What Career level you are at?

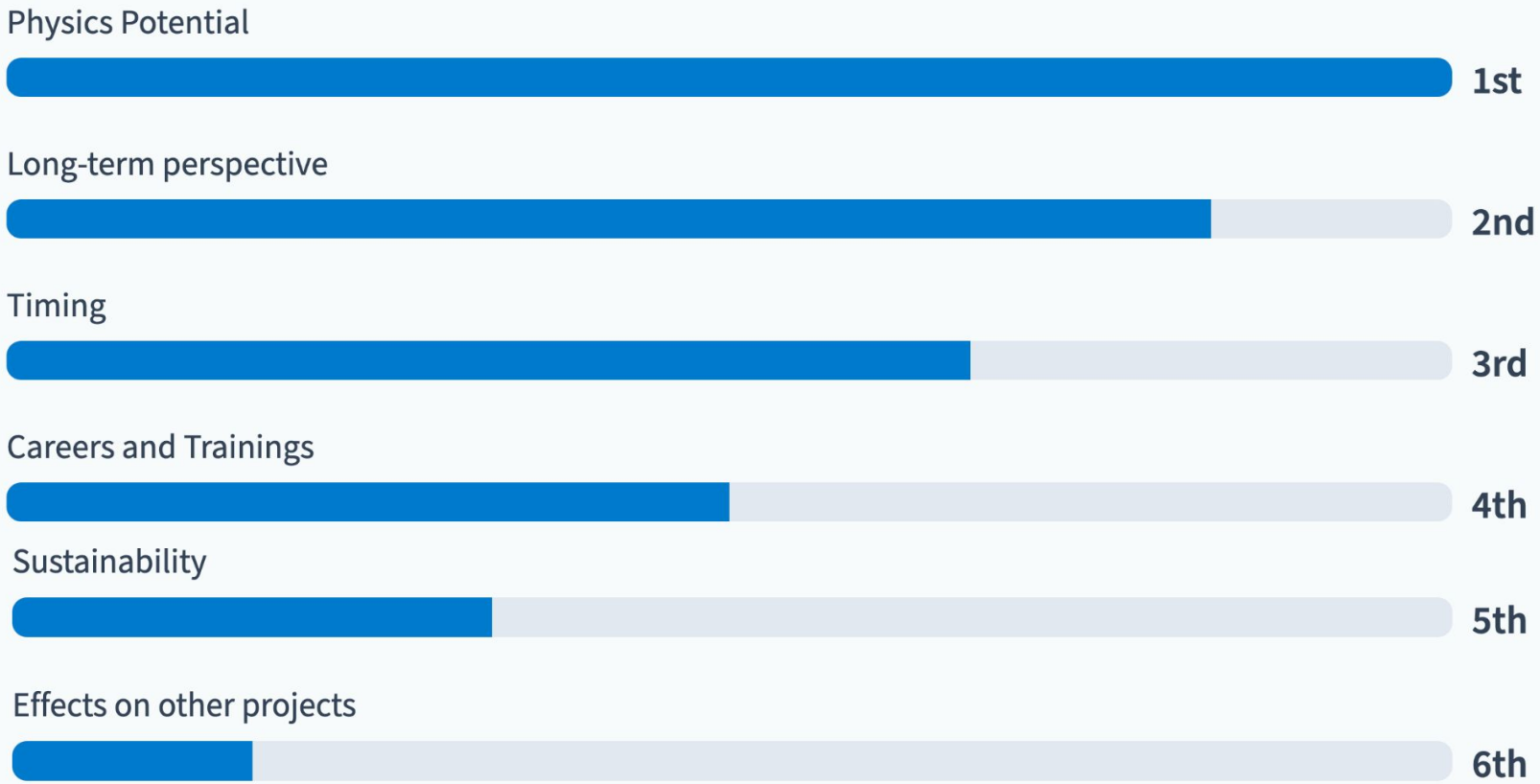
What inspired you to pursue research in high-energy physics?

If you could name the next particle discovered at a future collider, what would you call it?

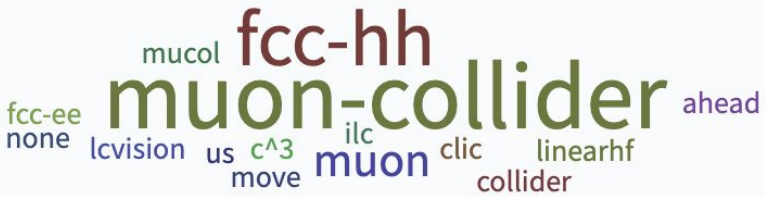
What place do you think is best to have the flagship future collider?

If the decision is taken to build a collider at CERN/in Europe as the next project, what should it be?

What matters most in terms of a future collider facility (You can select more than one option)

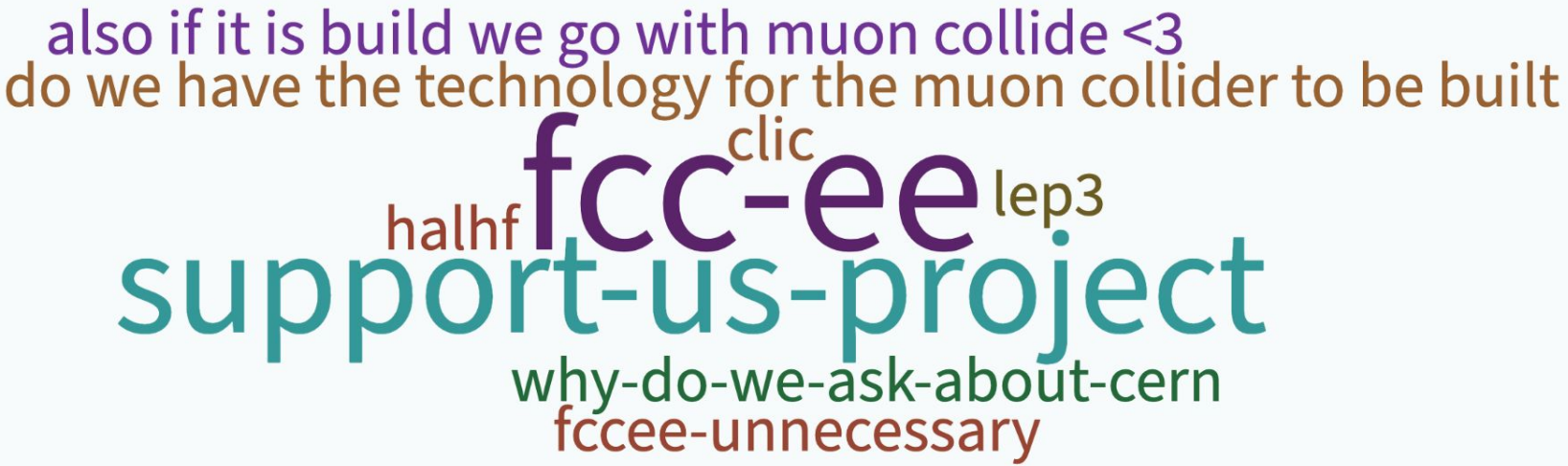


If the project of Circular Electron-Positron Collider (CEPC) is approved in China and could deliver first collisions in 2035-2040, up to 10 years earlier than other projects, what should be the next flagship project in Europe?



If the project of the International Linear Collider (ILC) is approved in Japan and could deliver first collisions in a timely manner, what should be the next flagship project in Europe?

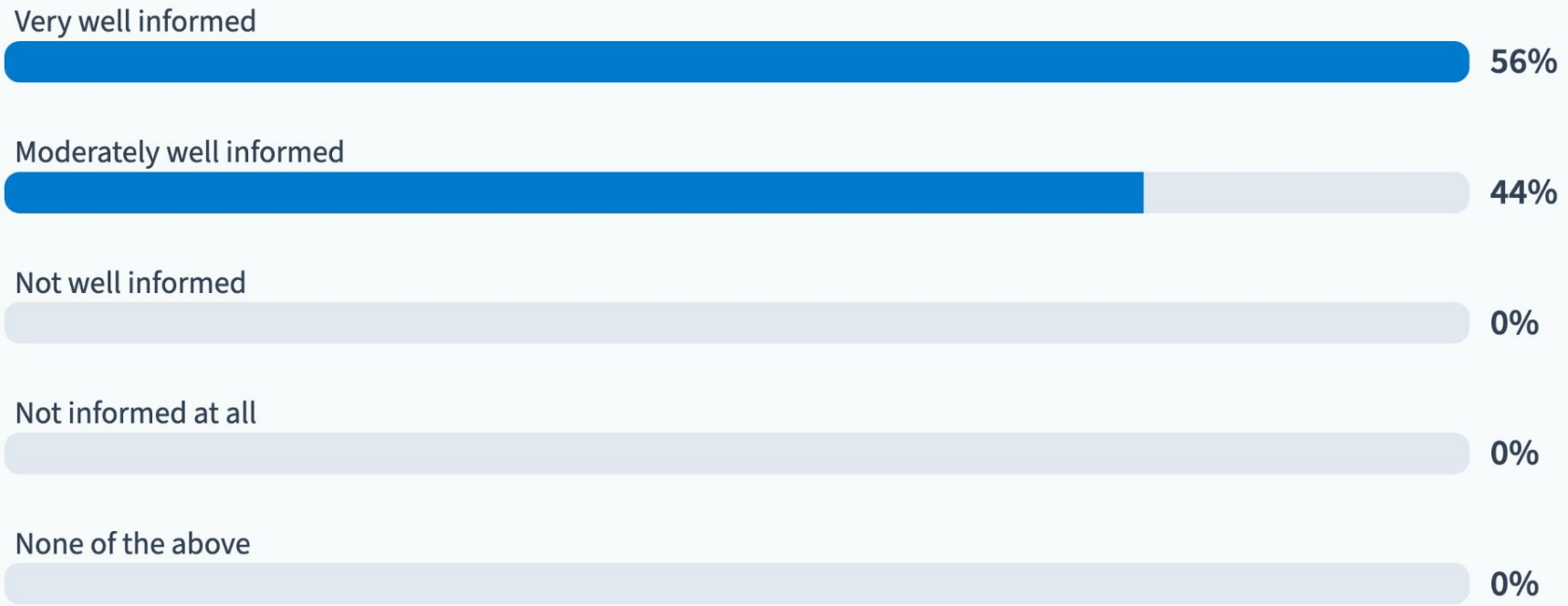
If U.S. plans to go for Muon Collider, what should be the next flagship project in Europe?



If there are some unexpected results/discoveries at HL-LHC or other HEP experiments, what should be the next flagship project in Europe?

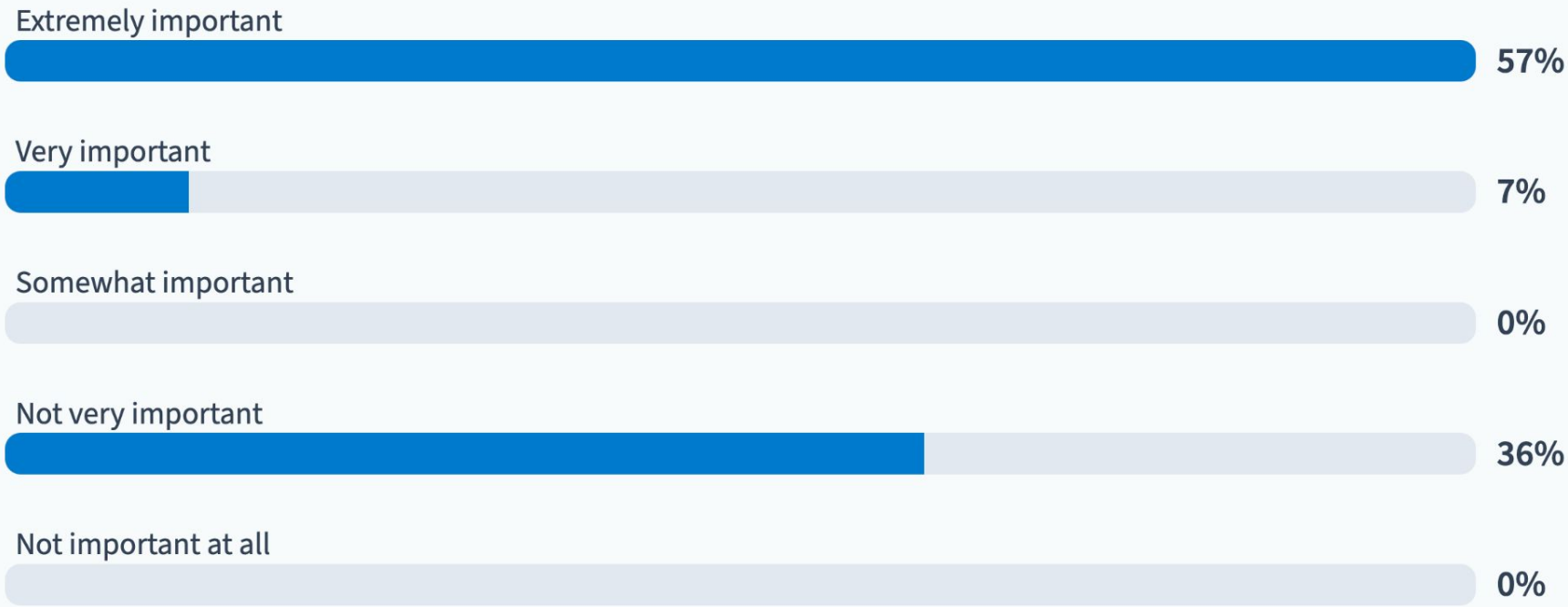
I am willing to support the outcome of the strategy process, even if my favorite future collider option is not chosen as first priority.

How well informed about the future collider options do you feel?



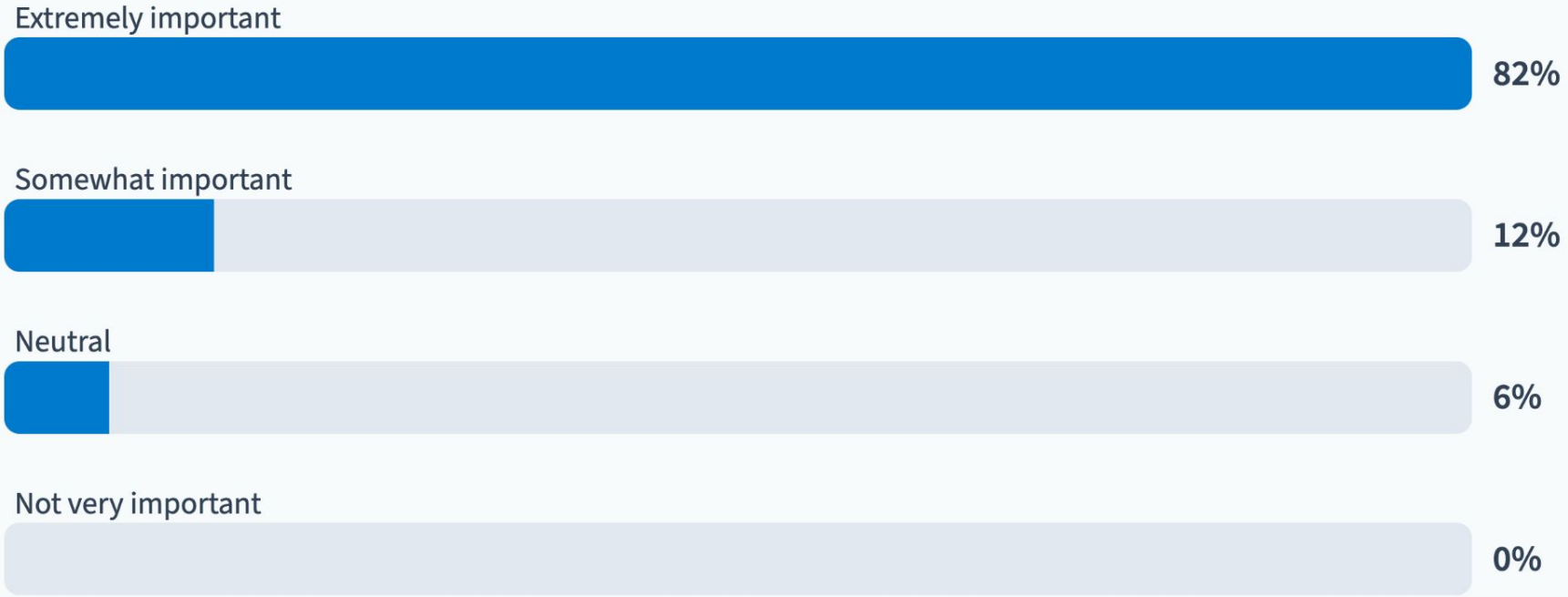
Do you think the global particle physics community should focus on one flagship collider at a time or pursue multiple smaller projects in parallel?

How important is it to consider environmental and economic factors when deciding the location and technology for the next collider?



Would you consider it acceptable to compromise some physics potential (e.g. achieving half the integrated luminosity at ZH energy) for an earlier start of the project by five years?

How important is it to you that the next flagship collider fosters global collaboration, regardless of location?



If you are currently not involved in any future collider project, could you share the reasons for this decision?

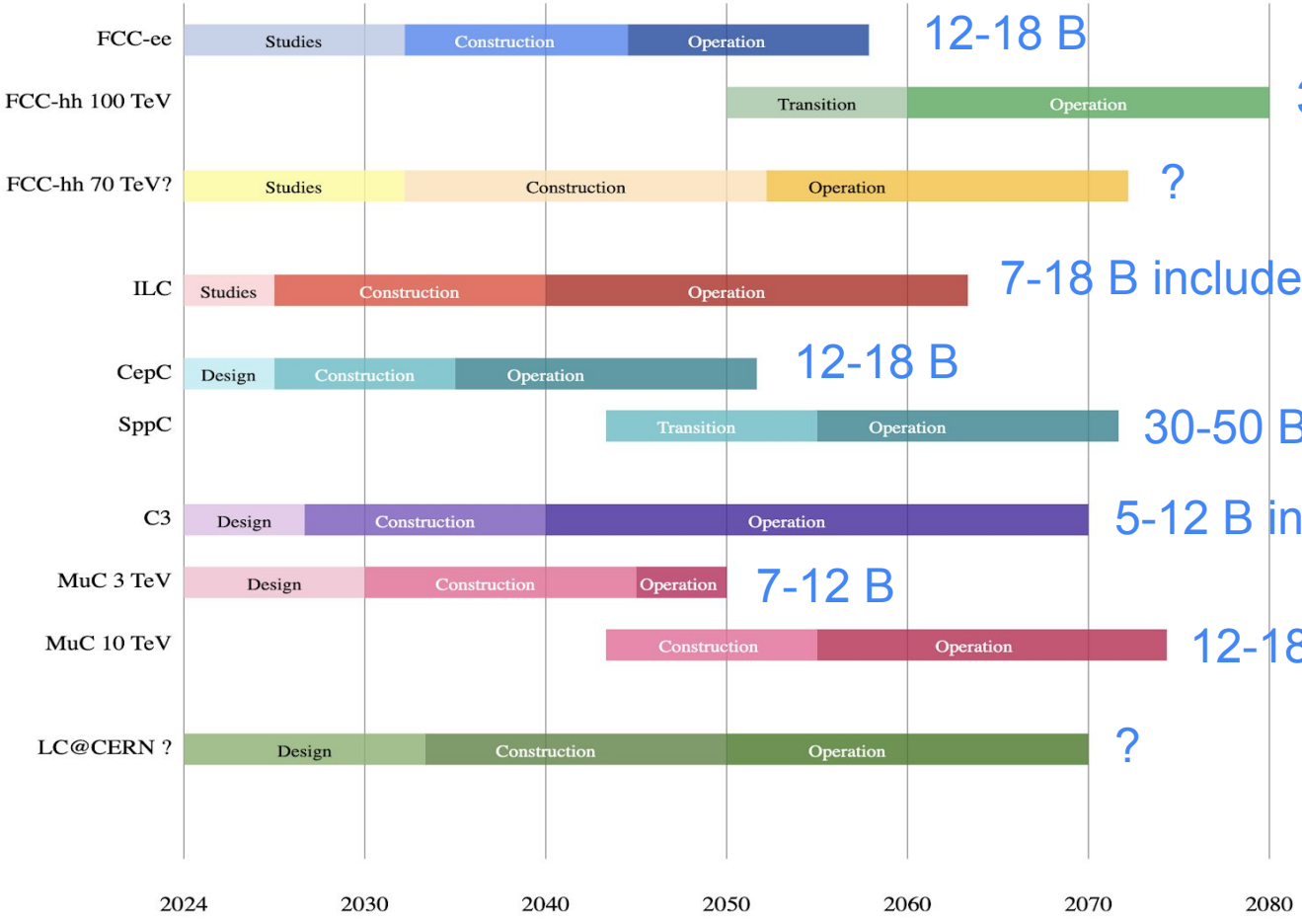
Conclusion

Thank you all for your active participation!!

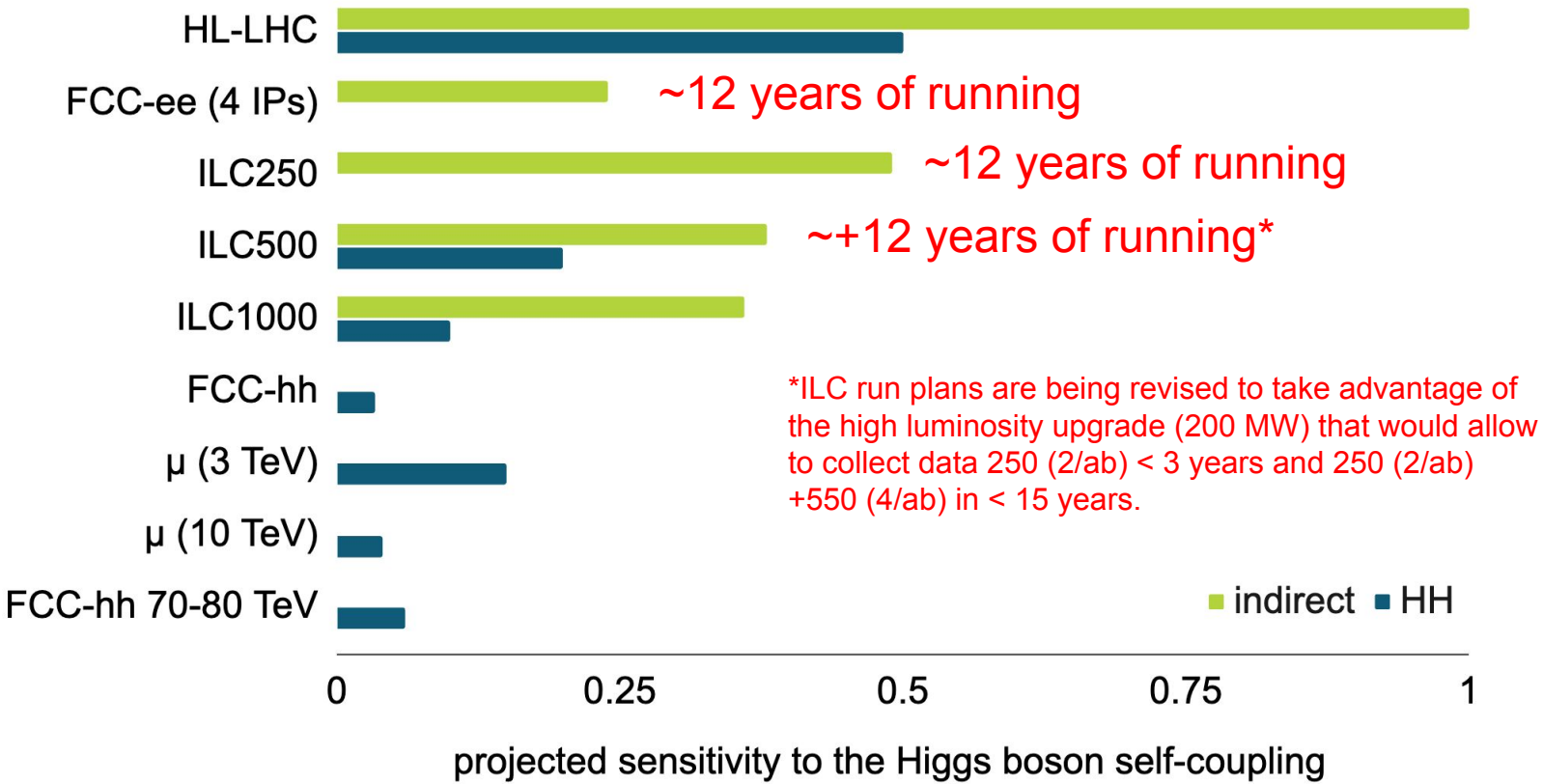
Please don’t forget to fill the survey:
https://docs.google.com/forms/d/e/1FAIpQLSeQLD1T9eeHfJVDccCYW_pCK9IT785RFiVzFx0otglowY_aQQ/viewform

Additional Material

Cost in Billions from EF report



Plot by L.Brost



Reminder: P5 Priorities

- **HL-LHC** **R1a** *under any budget scenario*
  - *Upgrades for Run 4 are on going.*
- **Offshore Higgs Factory** **R2c** *delayed under less favorable scenario*
  - Detector R&D **AR10:** ***To enable targeted R&D before specific collider projects are established in the US, an investment in collider detector R&D funding at the level of $20M (…) per year in 2023 dollars is warranted.***
- **10 TeV Muon (or Wakefield) Collider** **R4a** *R&D supported conditionally*
  - Detector R&D ***For the targeted detector R&D, we suggest initially allocating 70% of the funds for Higgs factory detector R&D, with about 30% reserved for 10 TeV pCM detector R&D.***

More on P5 recommendations

2027?

Recommendation 6: Convene a targeted panel with broad membership across particle physics later this decade that makes decisions on the US accelerator-based program at the time when major decisions concerning an off-shore Higgs factory are expected, and/or significant adjustments within the accelerator- based R&D portfolio are likely to be needed. A plan for the Fermilab accelerator complex consistent with the long-term vision in this report should also be reviewed.

Recommendation 2c: Once a specific project is deemed feasible and well-defined the US should aim for a contribution at funding levels commensurate to that of the US involvement in the LHC and HL-LHC, while maintaining a healthy US on-shore program in particle physics

§8.2 On-shore Higgs factory: (...) If FCC-ee and ILC are judged to be not feasible, a new panel should revisit the possibility of bidding to host a *Higgs factory potentially as a global project and including advanced technology options.*

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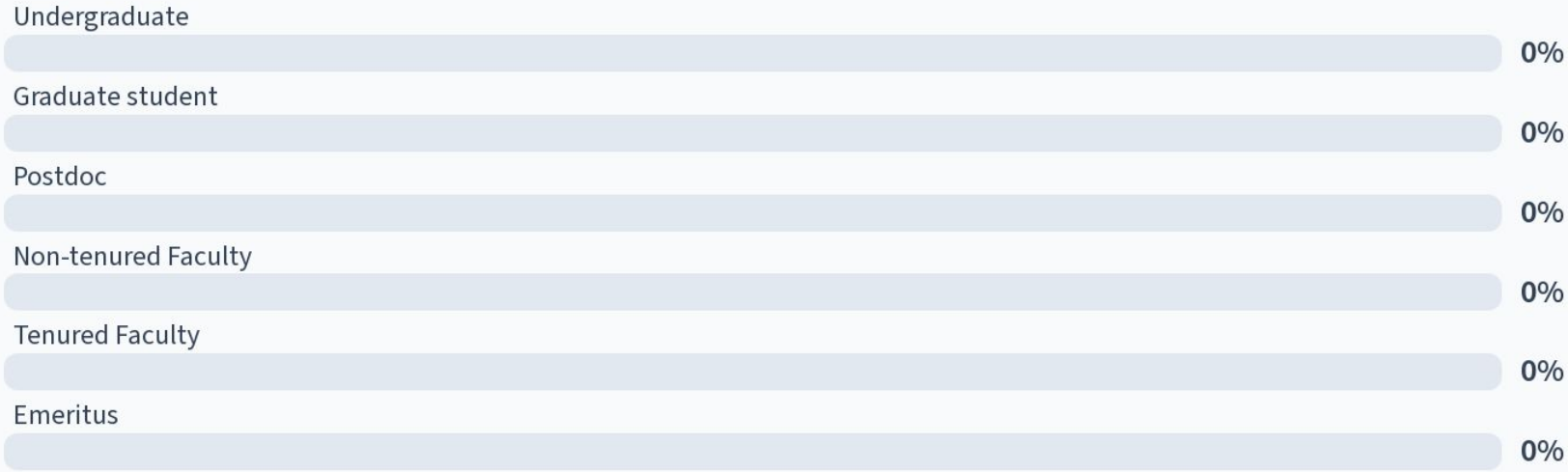

What inspired you to pursue research in high-energy physics?

Nobody has responded yet.

Hang tight! Responses are coming in.

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What matters most in terms of a future collider facility (You can select more than one option)

Physics Potential

Long-term perspective

Effects on other projects

Timing

Sustainability

Careers and Trainings

SEE MORE

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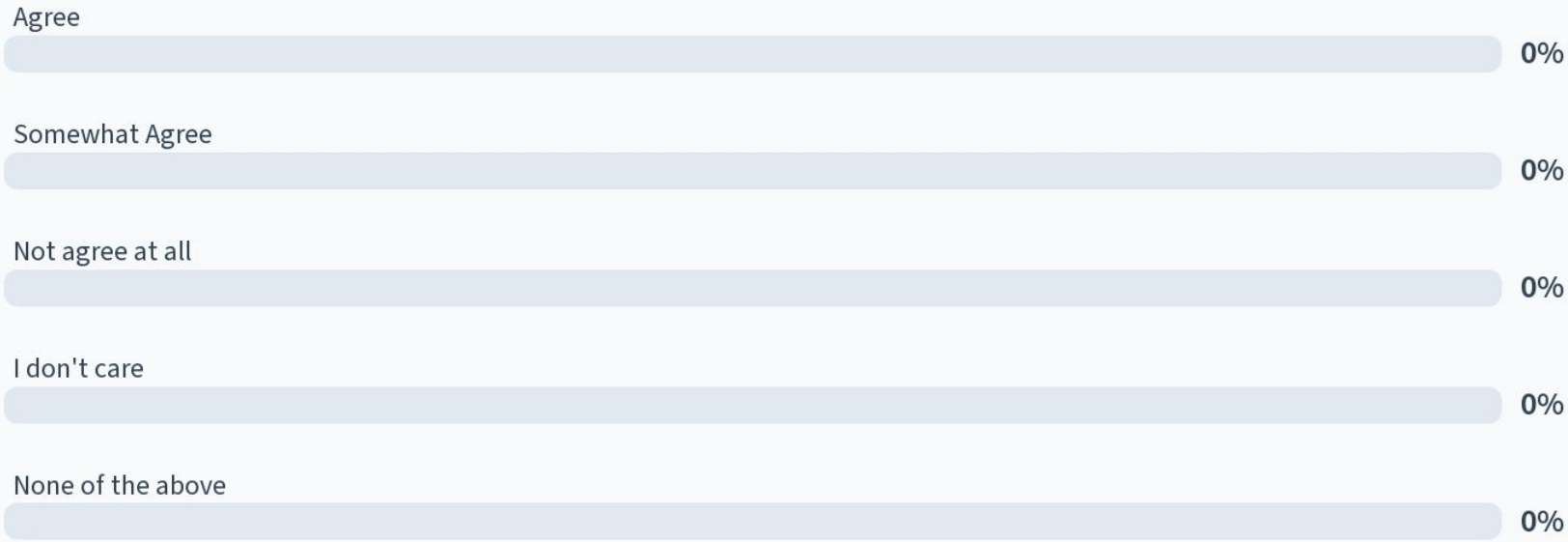

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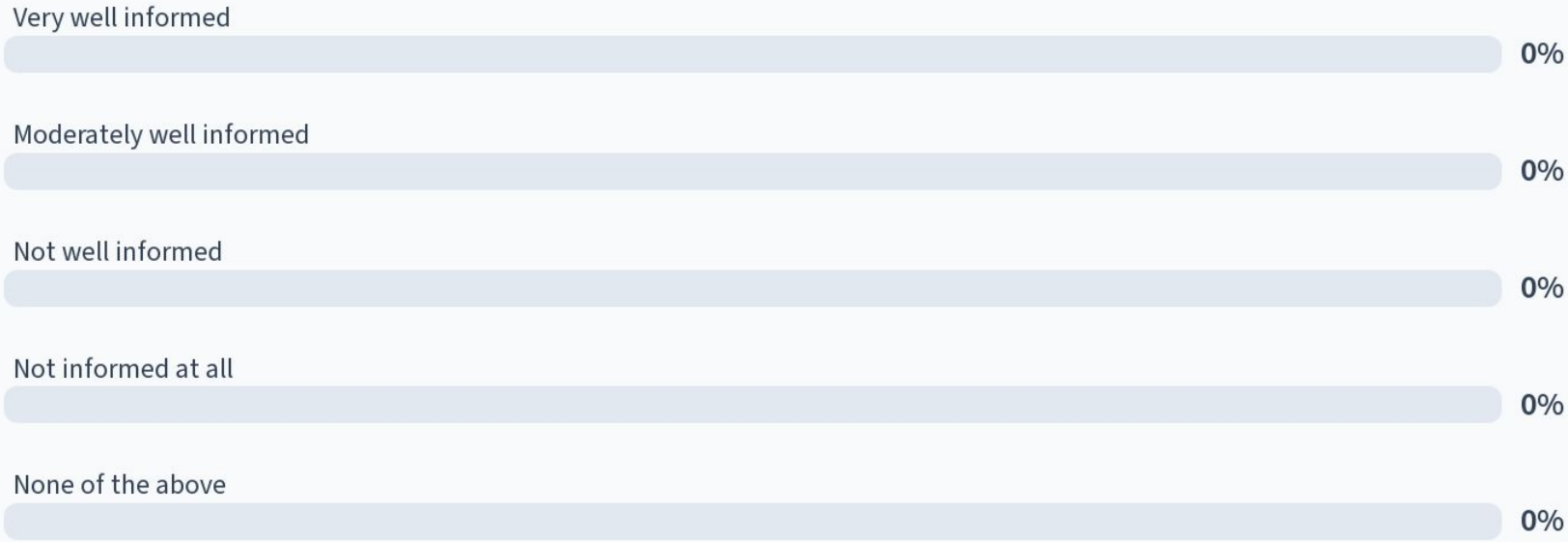


Do you think the global particle physics community should focus on one flagship collider at a time or pursue multiple smaller projects in parallel?

One flagship collider

0%

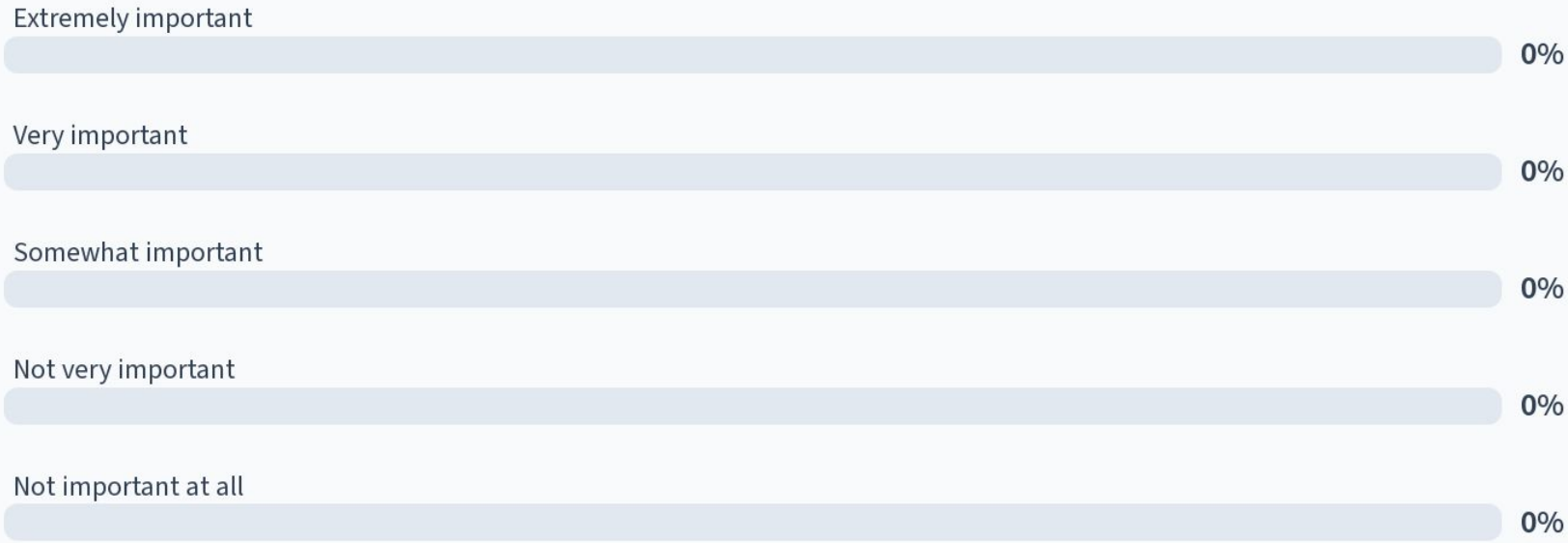
Multiple smaller projects

0%

Combination of both

0%

How important is it to consider environmental and economic factors when deciding the location and technology for the next collider?



Would you consider it acceptable to compromise some physics potential (e.g. achieving half the integrated luminosity at ZH energy) for an earlier start of the project by five years?

Yes 0%

No 0%

I don't care 0%

None of the above 0%

How important is it to you that the next flagship collider fosters global collaboration, regardless of location?

Extremely important 0%

Somewhat important 0%

Neutral 0%

Not very important 0%

If you are currently not involved in any future collider project, could you share the reasons for this decision?

Nobody has responded yet.

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Responses