

European Strategy Granada

With input from
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<https://indico.cern.ch/event/808335>



European Strategy staff meeting June 2019

Peter Kluit (Nikhef)

CERN Council Open Symposium on the Update of

European Strategy for Particle Physics

13-16 May 2019 - Granada, Spain



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Summary from Cern director (Elsen)

[The Granada symposium stimulated much lively discussion on the future of particle physics](https://home.cern/news/opinion/physics/lessons-granada) <https://home.cern/news/opinion/physics/lessons-granada>

Nearly seventy years ago, before the CERN Laboratory was established, two models for European collaboration in fundamental physics were on the table: one envisaged opening up national facilities to researchers from across the continent, the other the creation of a new, international, research centre with world-leading facilities. Discussions were lively, until one delegate pointed out that researchers would go to wherever the best facilities were. From that moment on, CERN became an accelerator laboratory aspiring to be always in the vanguard of technology to enable the best science. It was a wise decision, and one that I was reminded of while listening to the presentations at the European Strategy for Particle Physics Open Symposium in Granada earlier this month. Because among the conclusions of this very lively meeting was the view that providing world-leading accelerator and experimental facilities is precisely the role the community needs CERN to play today. There was huge interest in the Symposium, as witnessed by the [600-plus participants](#), including many from the nuclear and astroparticle physics communities, as well as, of course, particle physicists.

Summary from Cern director (Elsen)

The vibrancy of the field was fully on display, with [future hadron colliders](#) offering the biggest leap in energy reach for direct searches for new physics. Precision electroweak studies at the few per cent level, particularly for the Higgs particle, will obtain sensitivities for similar mass scales. The LHC, and soon the High-Luminosity LHC, will go a long way towards achieving that goal of precision. Indeed, it's remarkable how far the LHC experiments have come in overturning the old adage that hadrons are for discovery and leptons for precision – the LHC has established itself as a precision tool, and this is shaping the debate as to what kind of future we can expect. Nevertheless, however precise proton-proton physics becomes, it will still fall short in some areas. To fully understand the absolute width of the Higgs, for example, [a lepton machine will be needed](#), and no fewer than four implementations were discussed. So, one key conclusion is that if we are to cover all the bases, [no single facility will suffice](#). One way forward was presented by the ACFA Chair, Geoff Taylor, representing the Asian view, who advocated a [lepton machine for Asia, while Europe would focus on advancing the hadron frontier](#). Interest in [muon colliders](#) was rekindled, not least because of some recent reconsiderations in muon cooling. The great and recent progress of [plasma wakefield](#) accelerators, including AWAKE at CERN, calls for further research in this field so as to render the technology usable for particle physics.

Summary from Cern director (Elsen)

Methods of [dark matter searches](#) abound and are an important element of the discussion on physics beyond colliders, using single beams at CERN. The Granada meeting was a town meeting on physics. Yet, it is clear to all that we can't make plans solely on the basis of the available technology and a strong physics case, but must also consider factors such as cost and societal impact in any future strategy for European particle physics. With all the available technology options and open questions in physics, there's no doubt that the future should be bright. The European Strategy Group, however, has a monumental challenge in plotting an affordable course to propose to the CERN Council in March next year. There were calls for [CERN to diversify](#) and lend its expertise to other areas of research, such as [gravitational waves](#): one speaker even likened interferometers to accelerators without beams. In terms of the technologies involved, that statement stands up well to scrutiny, and it is true that technology developed for particle physics at CERN can help the advancement of other fields. CERN already formally collaborates with organisations like ITER and the ESS, sharing our innovation and expertise. However, for me, the strongest message from Granada is that it is CERN's focus on remaining at the forefront of particle physics that has enabled the Organization to contribute to a diverse range of fields. CERN needs to remain true to that founding vision of being a [world-leading centre for accelerator technology](#). That is the starting point. From it, all else follows.

Summary of “objective” observations

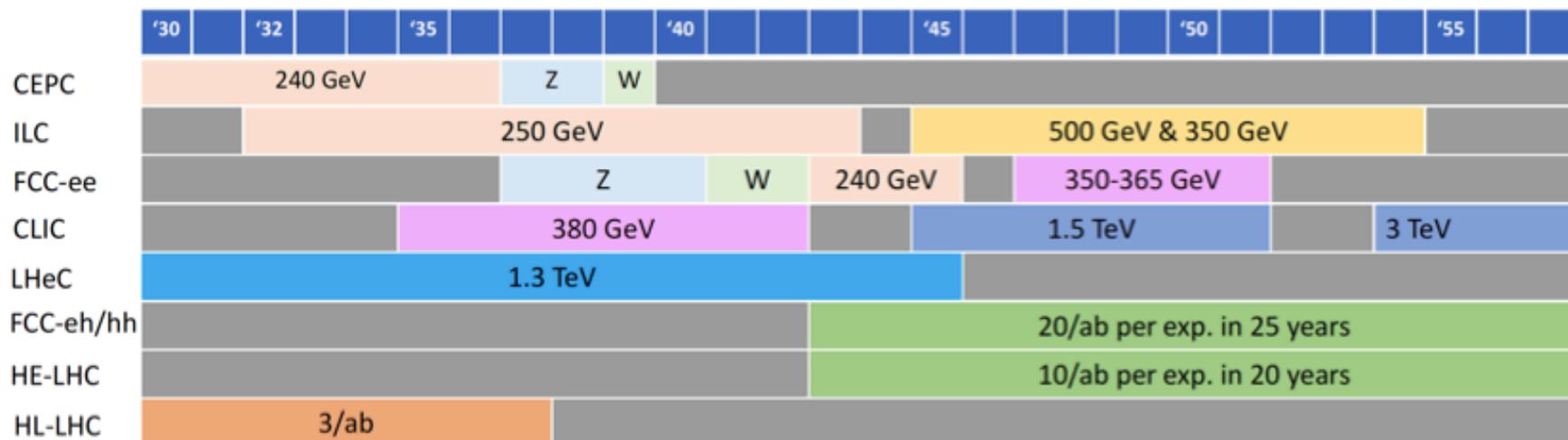
- 1) The scientific discussions at Granada were great; good talks. The strategic/political discussion is becoming somewhat polarized.
- 2) There is large support and a good physics case for an e^+e^- collider at EW scale. The discussion between linear and circular is a discussion on luminosity (circular) vs funding (linear) and pragmatics/politics (CERN vs non-CERN). The "add-on" option of "Tera-Z" was discussed mentioned, but was not really considered sufficient for a physics case on its own.
- 3) There is a worry about the energy frontier pp collider (FCC) since the timescale is very long. In particular the developments for high fields magnets is incredibly difficult.
- 4) There is, however, general support for intensifying R&D for novel accelerator techniques, although in all cases; magnets, wake fields, and muon collider. A 30 TeV muon collider in the LHC is attractive. The time scales are long.

Summary of "objective" observations

5) The elephant in the room is that people feel that CERN **must** have a collider.

Related aspects:

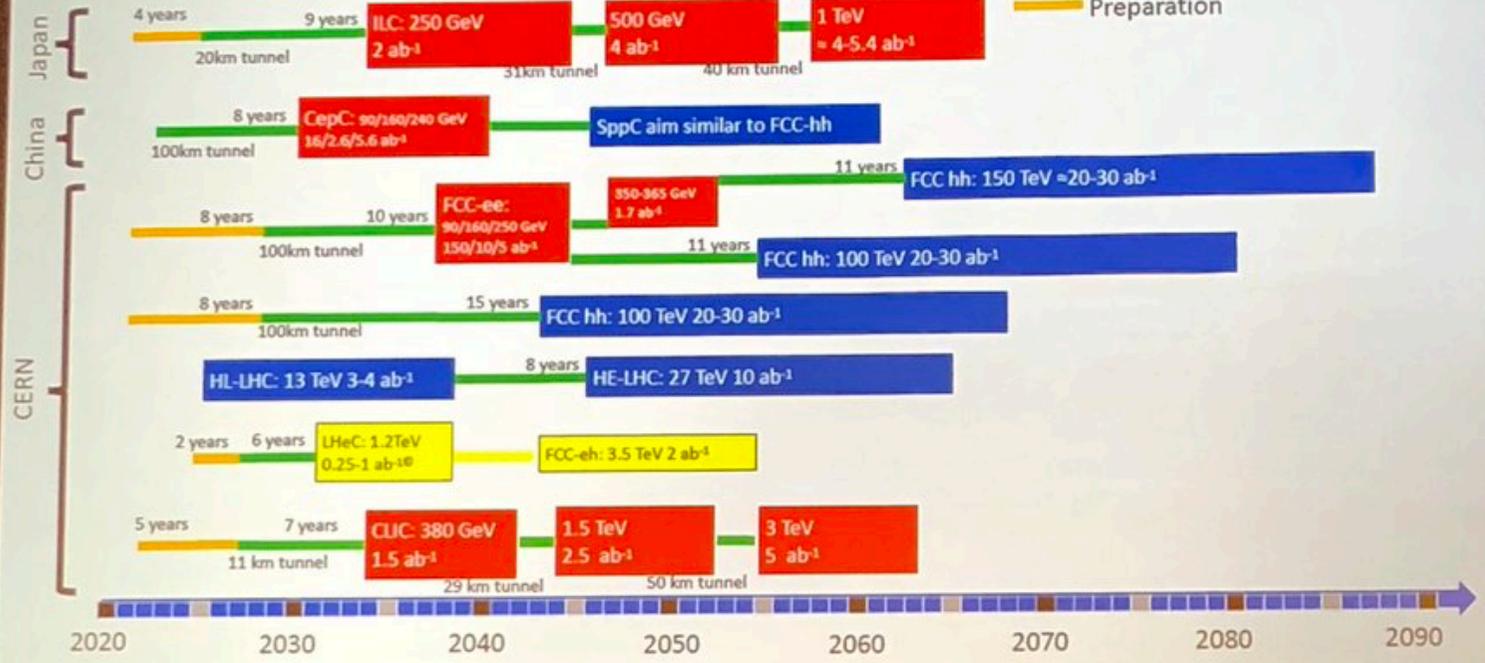
- CERN is facing budget limitations related to HL-LHC.
- There is a tending opinion that a 100 km ring is too expensive
- The options "physics beyond colliders", precision measurements, APP experiments, etc are not considered sufficient for the future of CERN.



Earliest start time in ESU documents

Possible scenarios of future colliders

- Proton collider
- Electron collider
- Electron-Proton collider
- Construction/Transformation
- Preparation



from Tristan



Summary of “objective” observations

Ad 4) (Eric) “The point was strongly made that if CERN *does not have* a large accelerator project the present expertise will dissipate and never come back.”

Ad 5) The options APP experiments, etc are not considered sufficient for the future of CERN.

(Sijbrand) This was not voiced very much, but a large, mostly silent, community is connected to "diverse efforts". In addition, from the comments of Halina, the PPG takes e.g. the Einstein Telescope very seriously (without being precise on now this folds into the European Particle Physics Strategy, or CERN's tasks)

(Eric) Indeed, but scientific diversity is very high on the agenda, especially considering the long time scales of major new projects.

Additional observations (Sijbrand)

- It is becoming more and more clear that magnet development is in an impasse and that the promised time-lines are somewhere in between too optimistic and railing off to infinite. This is important for the following points:
- The FCC-hh now has no physics case other than probing at energies never reached before by colliders. In addition, the technical viability before O(2040) is highly dubious due to the previous point.
- A High Energy LHC has been proposed, but suffers the same technical viability drawback as in the previous point.
- A FCC with 6 T dipoles, delivering a 35-40 TeV (SSC-like !) pp collider has been proposed. (Subjectively: I see not many people taking that serious.)
- The daily confidence rate in the ILC seems declining (again).
- The ESG is in the process of devising scenarios for the energy frontier projects. This will be an interesting project and we will be asked for the Dutch national input at some point.

Summary of circular vs linear options (Peter)

- 1) There was quite a bit of criticism on the FCC package deal: the two accelerators.
 - Is it really wise to start FCC-ee with a Z factory, WW factory and then Higgs? Why not start with the Higgs physics?
 - There will be at least a 10 year gap between FCC-ee and FCC-pp. This is not good for CERN as a hosting lab (Lynn Evans: 15 years)
 - Is it fair to compare a machines without considering time and budget?
 - CLIC 350 5.9 BCHF CLIC 3000 18.3 BCHF
 - FCC-ee 10.5 BCHF (tt +1.1B) FCC-pp +17 BCHF (or 24 BCHF)
 - Is the budget for the FCC tunnel realistic?

In the electroweak session it was therefore quantified what would we know how precise from the Higgs at which time.

- Isn't it wiser to to build an affordable machine like CLIC look at the physics outcome and then upgrade to TeVs or build a muon collider or FCC-pp?
- 2) It was proposed not to built directly FCC-pp (to avoid the gap). But now there is no physics case to motivate this. And the magnets take at least years development.

Summary of “personal” statements (Nicolo)

- 1) The 2020 will (may) be the decade of the neutrinos
- 2) Impressive progress on muon and Wakefield accelerators. Not ready for the big scene yet, but given the 2064 timescale for FCC-hh after FCC-ee, keep an eye on it and support R&D
- 3) Some voices that waiting 10 years for 1-2 T more magnetic field is a very long time
- 4) CLIC looking quite good in potential / prive / timeline plots

Summary of “personal” statements (Marcel)

- 1) To avoid that particle physics research reduces world-wide, we should try to maximize the total amount of funding and hence support new facilities that can receive large local funding.
- 2) We should continue to support HL-LHC with highest priority on the European Strategy.
- 3) CERN should also support this option of an (upgradable) ILC facility in Japan.
 - If the ILC gets green light from Japan, there is no time-pressure to make a decision for the next machine at CERN. CERN should focus on HL-LHC and on new acceleration technology R&D. Sijbrand: there IS time-pressure to decide by 2025-2026 to avoid gap after HL-LHC.
 - If the ILC in Japan does not get green light, the highest priority is to realise an e^+e^- Higgs factory at CERN.
 - The choice for circular (FCC) vs linear (CLIC) is to be made in due time. For me, the realisation of either option is more important than the relative comparison.