Discussion

We will go through the main questions about the next facility in HEP one by one.

I have “example” statements on the slides, that we can adapt during the meeting.

Let’s go through in order, trying to stick to subject.

There will be time to raise further questions at the end.

Mary Cruz and I will take notes. We will prepare a draft statement after the meeting, and circulate it to the participants for approval/feedback.

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LHC + HL-LHC

The HL-LHC is not a “future” collider like the Higgs factory; it’s approved and under construction

The Spanish input should probably start with a statement on the commitment to the LHC + HL-LHC program (prepared by LHC network)

As always, there is pressure to finish the progam early, to free up funding for the next facility.

Do we insist that the HL-LHC reaches its target of 3000/ifb?

The Spanish community involved in the LHC program is committed to:
- the operation of the experiments and the development of computing, data analysis and theory to maximize the scientific return of this unique facility
- the detector upgrades for the high-luminosity phase and operation of the HL-LHC up to the target integrated luminosity of 3000/fb

Detector design & Instrumentation

A detailed detector R&D road map exists and is being implemented in DRDs

The Spanish input should emphasize the important work in detector R&D of the Spanish community (to be prepared by instrumentation network)

The Spanish input should indicate the priorities of specific detector R&D and experiment design towards the Higgs factory in Spain (discuss today)

Which are our key strengths?
Should we stick to ILD? Can we reinforce our role there?
What special roles do we foresee for CNM, ITA and Spanish industry?

The Spanish community involved in detector R&D is committed to:
- experimental design for a future Higgs factory (circular or linear) in ILD
- development of detectors in these areas…(Silicon? CMOS? Granular calorimeters?)

Spanish technological centres, such as CNM and ITAINNOVA
- can offer important important in-house capacities for …

The Spanish science industry, represented by INEUSTAR, …
- can offer...

Theory

SM calculations must match precision of the e+e- measurement program
(theory+exp $m_b(m_H)$, PRL128, m_t , PLB804)

BSM + SMEFT developments specific to the Higgs factory
(S. Heinemeyer, J. De Blas + M.A. Sanchis + IFIT/C team)

Theory interest in muon collider (A. Wulzer, …)

Which contributions can we expect from the Spanish theory community?

The Spanish particle physics theory groups are currently contributing to:
- phenomenology of quark masses and BSM + SMEFT interpretations of

Accelerator technology

A detailed accelerator R&D road map exists and is being implemented

The Spanish input should emphasize the important work in accelerator R&D of the Spanish community, its key strengths and future plans and directions (this network)

Plan for ILC contributions has been worked out, but needs updating
Plan for CLIC has overlaps, but more opportunities in PETS/cavities
Plan for FCCee may exist in the minds of those present here...

The Spanish community involved in accelerator R&D is committed to:
- the development of high-field magnets and high-gradient cavities, beam line instrumentation, beam dumps?, damping rings?

The Spanish science industry, represented by INEUSTAR, …
- here, I think we're in good shape, but we need a concrete

The Higgs factory

There is a broad consensus that the next large-scale facility in high-energy physics should be an electron-positron “Higgs factory”
(EU strategy https://europeanstrategy.cern/european-strategy-for-particle-physics)
(P5 report: https://www.usparticlephysics.org/2023-p5-report/).

The view of the Spanish high-energy physics community:
- is aligned with the European strategy: the highest priority of global high energy physics is an electron-positron collider that can study the Higgs boson and the top quark

The Spanish HEP community:
- has not reached consensus on the optimal implementation of the Higgs factory program; the community preference is divided between a circular and a linear collider design.

Scenarios

Scenario A:

CERN approves a Higgs factory project!

- which Spanish contributions to the project can we expect?
  - -- contributions to accelerator?
  - -- experiment design and focused R&D?
  - -- phenomenology studies and calculations?
- which (young) researchers are willing to devote time?
- which funding is available in Spain to pursue all this?
- what are the overall priorities of the Spanish HEP community?
- what are Spain's strongest in-kind contributions to the machine?

Should a Higgs factory project be approved by CERN, the Spanish HEP community:
- will lend its full support to the project, actively contributing to accelerator and detector R&D, the experiment design and Standard Model calculations, and to studies of the scientific case (condition: make sure it's not an empty statement)

Scenarios

Scenario B:

Others (Asia?) build a Higgs factory before CERN can

Scenario C:

FCC feasibility study finds a show-stopper (funding?)

- should we reconsider the plan?

- should we build a linear Higgs factory? Linear/circular complementarity

- should we go straight for a hadron collider? ee/hh complementarity

Should China approve construction of CEPC, or should the FCC not be feasible for another reason, the Spanish HEP community:
- favours the construction of a linear electron-positron collider at CERN
- ….

Can China really beat us?

NEWS | 17 June 2024 | Correction 18 June 2024

China could start building world's biggest particle collider in 2027

The US$5 billion facility would be cheaper, bigger and faster to build than a similar one proposed by European scientists.

By Gemma Conroy

Numbers and statements from a recent Nature article:
https://www.nature.com/articles/d41586-024-02005-4

Check out their TDR:
https://arxiv.org/abs/2312.14363

Total cost of the facility:
5.2 billion $ (vs. 17 billion $ in Europe)
Possible start of construction:
2027 (vs. 2030s in Europe)

Yifang Wang (IHEP, head of the project):
"We are now confident this is a real machine that we can build"
Frank Zimmerman (CERN, chair of TDR review):
"IHEP might now have more expertise in this area than does CERN"
Andy Cohen (Hong Kong, Int'l advisory panel:
"The TDR demonstrates that China is capable of building the CEPC's accelerator with little assistance from international researchers"

Note: Experiments (not in the TDR) would be international, according to Yifang Wang

What's up with the Germans?

Identification of funding beyon CERN budget is an intrinsic part of the mandate for the feasibility study

No explicit cost sharing model in mid-term report, but…

FCC cost (of approx. 17 billion $) to be shared by
- host states (FR and CH have greater return)
- member states, following the usual weight-by-PIB
- agreements with non-member states (i.e. US)
- private donors (sizable?)

NEWS | 06 June 2024

CERN's $17-billion supercollider in question as top funder criticizes cost

Germany has raised doubts about the affordability of the Large Hadron Collider's planned successor.

By Davide Castelvecchi

Based on a recent Nature article:
https://www.nature.com/articles/d41586-024-01671-8

Germany, which already contributes €267 million (US$290 million) annually to CERN — some 20% of the lab's budget — cannot afford to spend more, said Eckart Lilienthal of the country's Federal Ministry of Education and Research (BMBF) on 23 May, at a workshop for particle physicists in Bonn, Germany. (see slides)

Longer term: exploration of the energy frontier

After the Higgs factory, the European strategy envisages exploration of the energy frontier
(EU strategy https://europeanstrategy.cern/european-strategy-for-particle-physics)

- which is the most effective and sustainable accelerator technology?
- should we (Spain) push proton colliders and high-field magnets?
- should we (Spain) invest in next-gen. Ideas (muon collider, wakefield)?

For the longer term, beyond the Higgs factory, the Spanish HEP community:
- agrees with the European strategy: CERN should aim for exploration of the energy frontier, building a collider facility that can explore collisions with $\sqrt{s}$ =10 TeV and beyond

The Spanish HEP community:
- has not reached consensus on the optimal implementation of the energy-frontier program; the community is interested in FCChh, the muon collider, ...