White paper on generic “Higgs-factory” R&D

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Generic Higgs factor R&D

The output of the European strategy set their next highest priority, after HL-LHC, was a Higgs factory

A. An electron-positron Higgs factory is the highest-priority next collider. For the longer term, the European particle physics community has the ambition to operate a proton-proton collider at the highest achievable energy. Accomplishing these compelling goals will require innovation and cutting-edge technology:

- ***the particle physics community should ramp up its R&D effort focused on advanced accelerator technologies, in particular that for high-field superconducting magnets, including high-temperature superconductors;***

- ***Europe, together with its international partners, should investigate the technical and financial feasibility of a future hadron collider at CERN with a centre-of-mass energy of at least 100 TeV and with an electron-positron Higgs and electroweak factory as a possible first stage. Such a feasibility study of the colliders and related infrastructure should be established as a global endeavour and be completed on the timescale of the next Strategy update.***

The timely realisation of the electron-positron International Linear Collider (ILC) in Japan would be compatible with this strategy and, in that case, the European particle physics community would wish to collaborate.

The P5 process could possibly end up in a similar place. It might not endorse a specific solution, while still making it a high priority (of course other outcomes are possible and even desirable). However, we know other nations are already investing in this future, while there is very little money and a feeling (maybe not deserved) of active discouragement from participation (not clear activity reviews well in DOE/NSF panels deciding funding). The object of this paper is to encourage funded research in generic Higgs factory in the US even if this is the outcome.

White paper on generic R&D

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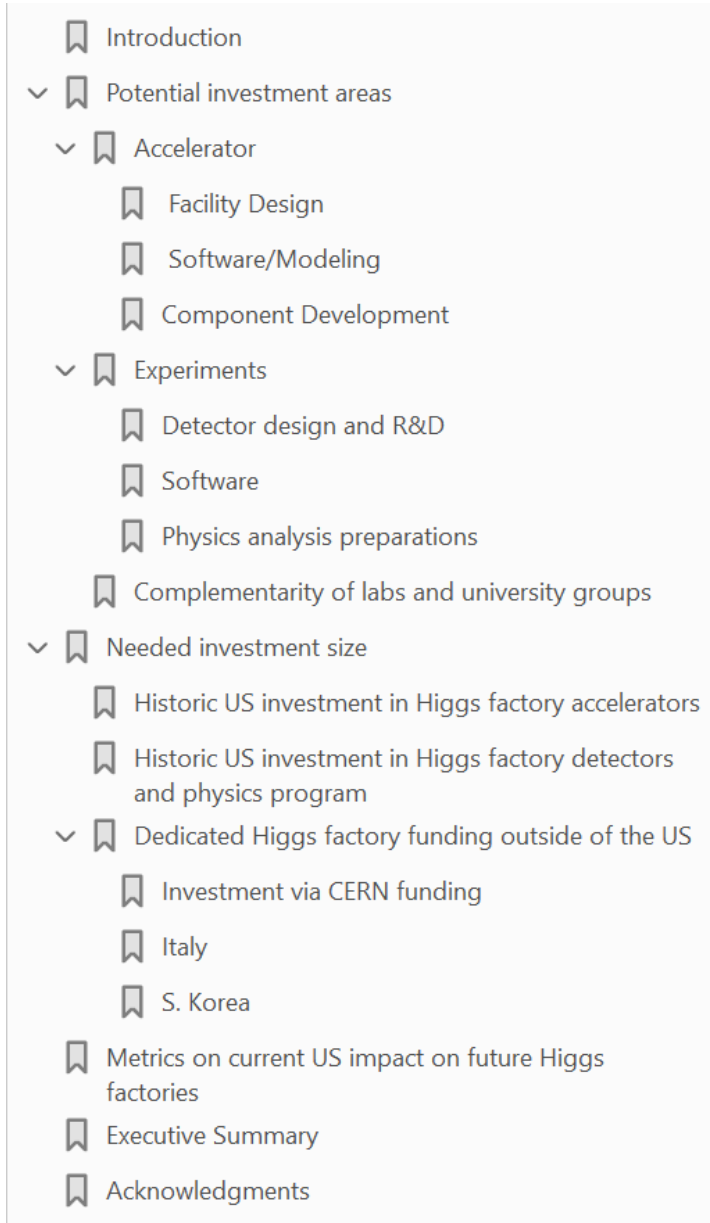
Draft is at:
https://www.overleaf.com/read/mpmymqccnfwy

Rough outline (detailed on right)

- Describe areas where generic R&D can be done
- Document as best we can known world investment in these areas now
- Compare US participation in future accelerator conferences to other areas



abstract

ABSTRACT

Exciting proposals for a new major "Higgs factory" collider, aimed at precision measurements of particles and forces, especially measurement of the Higgs couplings at the loop level, will be evaluated as part of the Snowmass process. Potential facilities include (among others) the ILC, the FCC, CCC, CEPC, and a muon collider, potentially located in Asia, Europe, or the United States. The European Strategy has endorsed a Higgs factory as its highest priority after HL-LHC. Much of the detector, software, and physics preparative studies needed for these machines is in common, and is currently (mainly) being implemented by physicists outside of the United States. In this white paper for the 2022 Snowmass process we look at current world activity on future Higgs factories and detail the investments that could be made in these common areas over the next five years to establish a leadership role for the US in a future Higgs factory, wherever it is built. Funding for this should not be delayed until a decision as to the physical implementation of the Higgs factory is reached.

List of “asks”

Some random text from “potential investment areas” section (most “authors” have not yet read in detail the text, so please only blame me for its stupidity.

single electrons, and a monoenergetic beam is not possible.

- It would be useful if the US would fund detector development projects of the scale and scope of CALICE or RD52 that are not only about ”blue sky” new technologies, but also about improving the practical implementation of great ideas;
- each effort would be more productive if it integrated lab and university components.

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The lab employees should work at least half time on detector R&D.

- An improvement of the test beam facilities in the US would make it easier for US physicists to have an impact in this area.

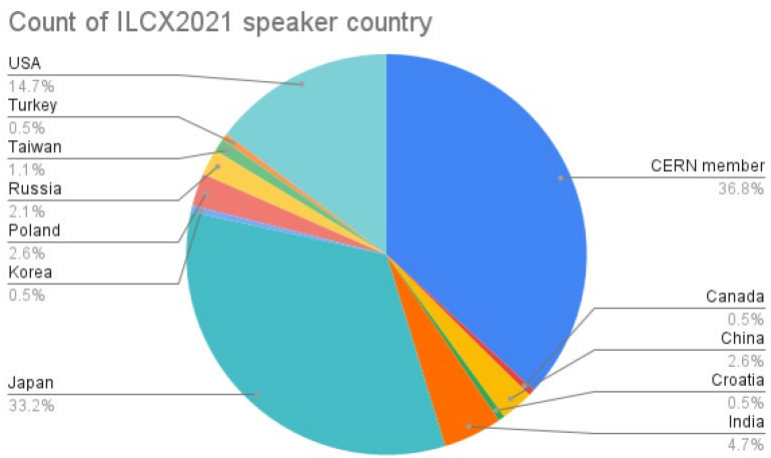
- It would be useful for at least one lab to have a core team of at least three people, working with the dd4hep team at CERN.
- in addition, it would be useful to have at a University at least one dd4hep detector implementation expert (playing the role Sunanda Banerjee plays in CMS) to aid in detector implementation and integration

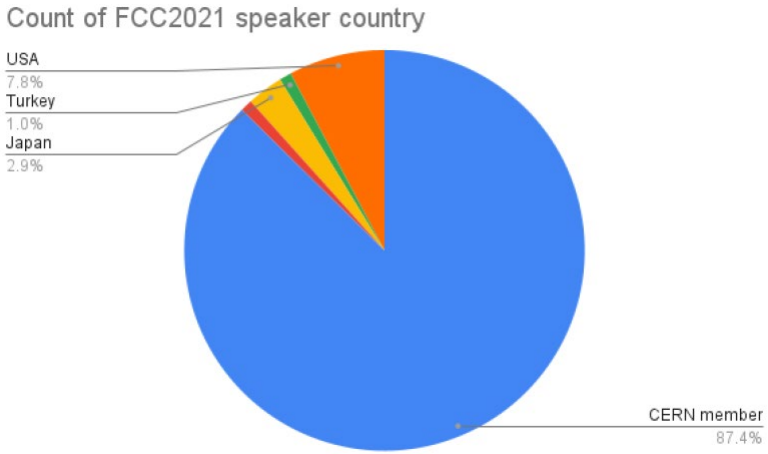
Foreign investment

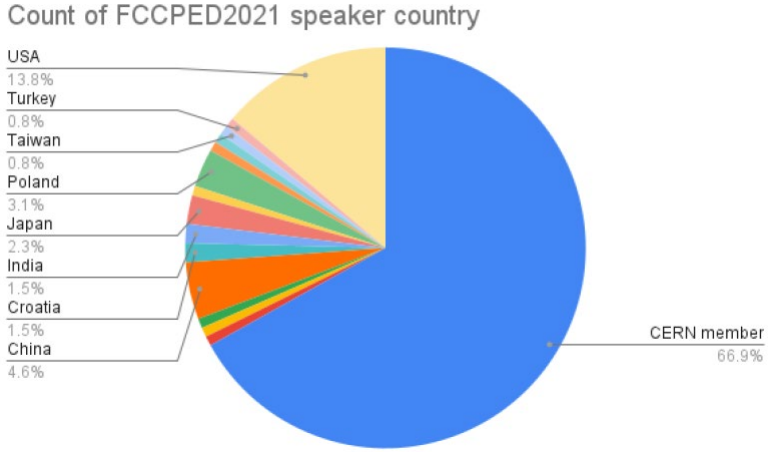
name	personnel (FTE)	personnel (kCHF)	Materials (kCHF)	Total (kCHF)
High-field superconducting accelerator magnets (HFM) R&D				
linear collider	9	2,460	2,610	5,070
FCC	33.8	7,460	12,715	20,175
Muon collider	6.5	1,305	950	2,255

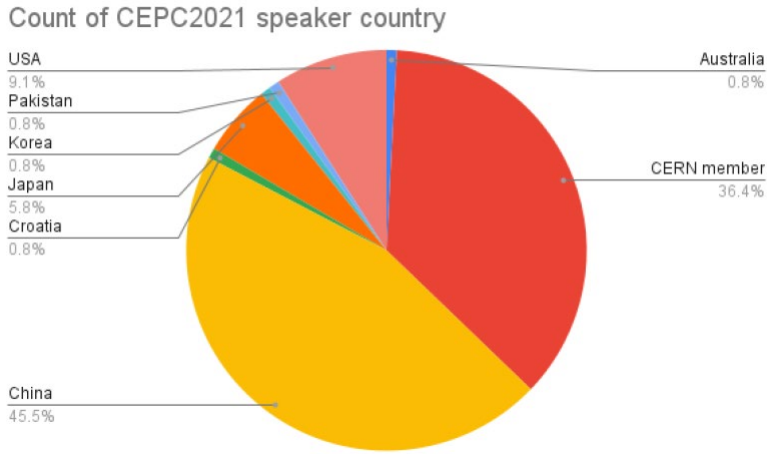
Table 1: Information on CERN MTP funding for 2022

Conference plots









We welcome participation from others who are in agreement with the basic premises of the paper.
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What we need:

- Tales of opportunities missed
- Ideas of work that can be usefully funded that is generic