A US-based future collider initiative for physics prospects and detector R&D

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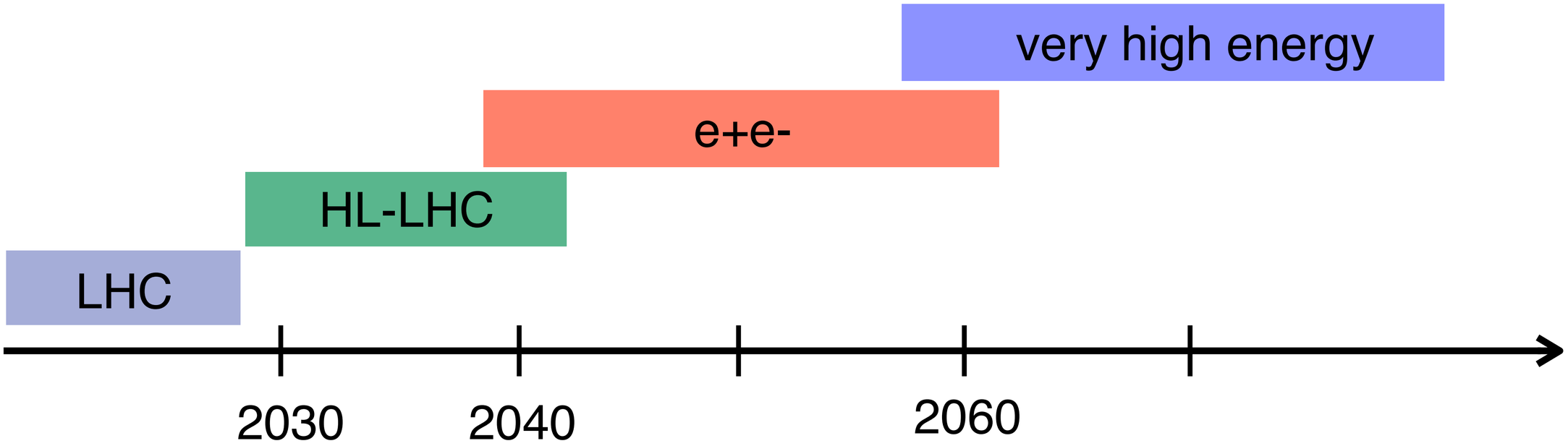
What's next?



Physics goals beyond HL-LHC:

1. Establish Yukawa couplings to light flavor ⟹ precision & lumi
2. Search for invisible/exotic decays and new Higgs ⟹ precision & lumi
3. Establish self-coupling ⟹ high energy

A strong US-based initiative mitigates Global Uncertainty

The Snowmass Energy Frontier discussions have unequivocally highlighted the following theme:

1.7.4 Opportunity for US as a site for a future Energy Frontier Collider

Our vision for the EF can only be realized as a worldwide program, and CERN as host of the LHC has been the focus of EF activities for the past couple of decades. In order for scientists from all over the world to buy into the program, the program has to consider siting future accelerators anywhere in the world. The US community has to continue to work with the international community on detector designs and develop extensive R&D programs, and the funding agencies (DOE and NSF) should vigorously fund such programs (as currently the US is severely lagging behind).

The US community has expressed a renewed ambition to bring back EF collider physics to the US soil, while maintaining its international collaborative partnerships and obligations, for example with CERN. The international community also realizes that a vibrant and concurrent program in the US in EF collider physics is beneficial for the whole field, as it was when Tevatron was operated simultaneously as LEP.

The US EF community proposes to develop plans to site an e^+e^- collider in the US. A Muon Collider remains a highly appealing option for the US, and is complementary to a Higgs factory. For example, some options which are considered as attractive opportunities for building a domestic EF collider program are:

- **A US-sited linear e^+e^- (ILC/CCC) Collider**
- **Hosting a 10 TeV range Muon Collider**
- **Exploring other e^+e^- collider options to fully utilize the Fermilab site**

ArXiv:2211.11084

Proposal Name	Power Consumption	Size	Complexity	Radiation Mitigation
FCC-ee (0.24 TeV)	290	91 km	I	I
CEPC (0.24 TeV)	340	100 km	I	I
ILC (0.25 TeV)	140	20.5 km	I	I
CLIC (0.38 TeV)	110	11.4 km	II	I
CCC (0.25 TeV)	150	3.7 km	I	I
CERC (0.24 TeV)	90	91 km	II	I
ReLiC (0.24 TeV)	315	20 km	II	I
ERLC (0.24 TeV)	250	30 km	II	I
XCC (0.125 TeV)	90	1.4 km	II	I
MC (0.13 TeV)	200	0.3 km	I	II
ILC (3 TeV)	~400	59 km	II	II
CLIC (3 TeV)	~550	50.2 km	III	II
CCC (3 TeV)	~700	26.8 km	II	II
ReLiC (3 TeV)	~780	360 km	III	I
MC (3 TeV)	~230	10-20 km	II	III
LWFA (3 TeV)	~340	1.3 km (linac)	II	I
PWFA (3 TeV)	~230	14 km	II	II
SWFA (3 TeV)	~170	18 km	II	II
MC (14 TeV)	~300	27 km	III	III
LWFA (15 TeV)	~1030	6.6 km	III	I
PWFA (15 TeV)	~620	14 km	III	II
SWFA (15 TeV)	~450	90 km	III	II
FCC-hh (100 TeV)	~560	91 km	II	III
SPPC (125 TeV)	~400	100 km	II	III

ArXiv:2208.06030

A strong US-based initiative mitigates Global Uncertainty

The Snowmass Energy Frontier discussions have unequivocally highlighted the following theme:

- The US community advocates for an active role in planning for future colliders
  - Investigate the possibility of an Higgs factory and the R&D for a future muon collider in the US
  - Given global uncertainties, consideration should be given to the timely realization of a domestic Higgs factory, in case none of the currently proposed options will be realized.
- Future colliders will set unique challenges in detector design to achieve our ambitious physics goals

The investment in detector and collider R&D for lepton facilities in the US should start now

- A parallel effort with the LHC to enable a future e+e– precision electroweak program and a high-energy machine
- **Such a domestic R&D program would grow the US accelerator & detector workforce and strengthen the international community, regardless of where the next big project will be realized**

The opportunity to work on fundamental problems and technological challenges is a key element to motivate students and early career scientists

- A US-based future collider R&D program will give the impetus to make particle physics program attractive to the young and future generations of scientists in the US.