

ECR Workshop on EPPSU informal discussion

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European Strategy for Particle Physics

- The European Strategy for Particle Physics defines the long-term future of the field.
- In March 2024, the CERN Council launched the process for the update of the Strategy.
- The update process is expected to converge in **January 2026** and the community is asked to provide input by **March 2025**.
- Early Career Researchers (ECR) are welcome to contribute!

Why are we here?

- We want to provide input to EPPSU as **young researchers**:
 - non-permanent or <10 years after PhD
 - studying or employed in ECFA member states or CERN
- “we” = ECFA ECR panel + **anyone** interested in joining the activities
- **General spirit**: today’s students => tomorrow’s leaders
- Trying to answer the question how to keep (make?) our field efficient and livable

Organisation

- 5 working groups (WGs) established:
 - WG1: Communicating the importance of particle physics
 - WG2: Future colliders
 - WG3: Future particle physics experiments beyond colliders
 - WG4: Interplay with neighbouring fields
 - WG5: Career prospects and ECR leadership
- Communication via [Mattermost](#) and regular online meetings: **everyone** is invited!

Higgs factory as the future project

- EPPSU is focused on long-term planning => large-scale projects are of the main interest
- The 2020 Update of the Strategy stated:

An electron-positron Higgs factory is the highest-priority next collider.

- How do we want this issue to be addressed in the 2026 Update?

Physics case for an e^+e^- collider

Higgs physics

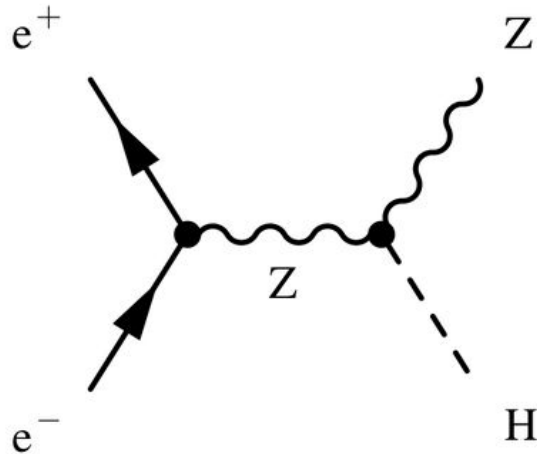
top physics

EW
measurements

direct searches

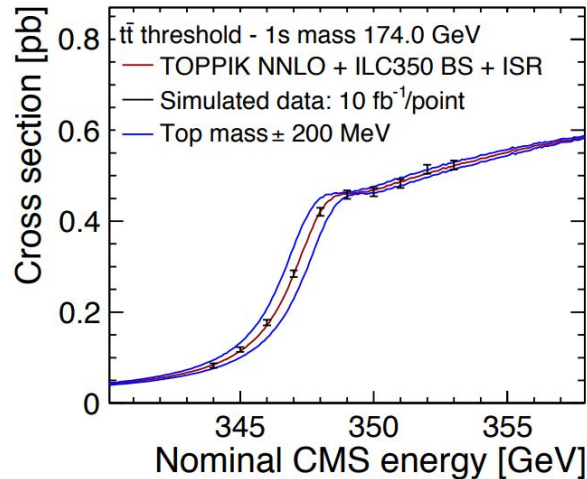
Higgs physics

- Numerous Higgs bosons produced in the *Higgstrahlung* process: $e^+e^- \rightarrow ZH$
- Higgs mass, width, CP properties, couplings to the SM particles, self-coupling, ...
still to be **measured**



top physics

- A dedicated threshold scan to measure the top mass, width and Yukawa coupling
- Further tests of the Standard Model: forward-backward asymmetry, beam polarisation asymmetry, polarisation of the top in decays, etc.

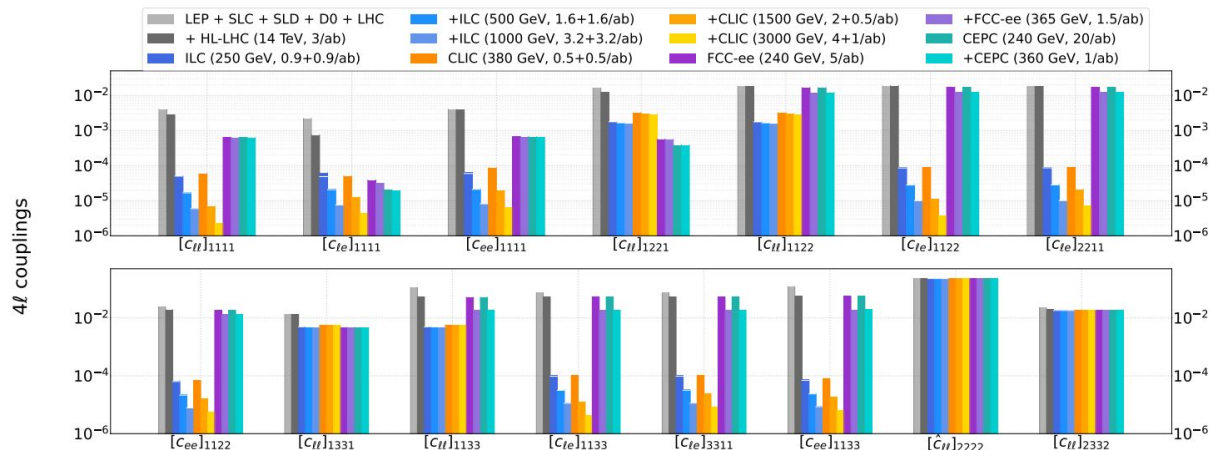


[\[1306.6352\]](#)

EW measurements

Possible improvements in many fields:

- parameters of the SM, e.g. electroweak couplings
- new Vector-Boson Scattering processes
- many Effective Field Theory operators to be constrained
- ...



[2206.08326]

Direct searches

Many BSM scenarios remain to be probed:

- SUSY
- exotic scalars
- extra gauge bosons
- extra dimensions
- compositeness
- heavy neutrinos
- axions
- dark matter
- ...

In many cases scenarios excluded up to the kinematic limit!

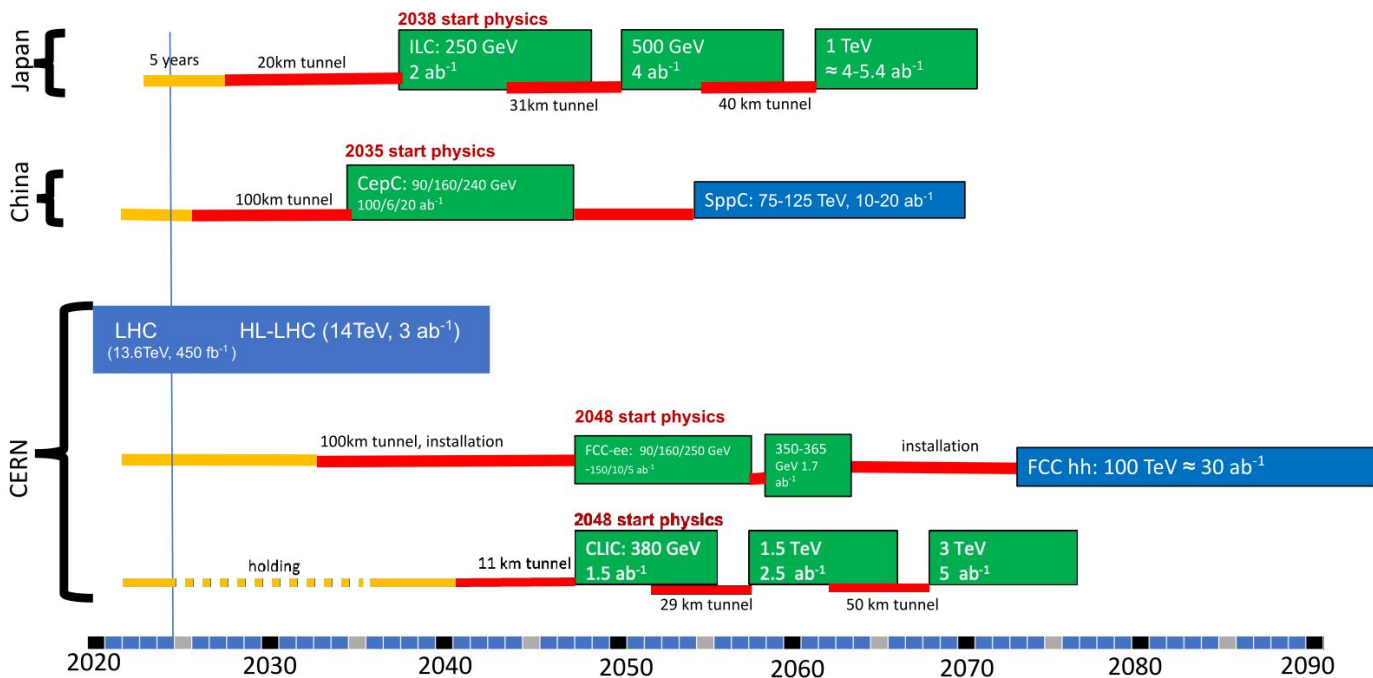


https://www.esa.int/ESA_Multimedia/Images/2007/07/The_Bullet_Cluster2

Collider proposals – timeline

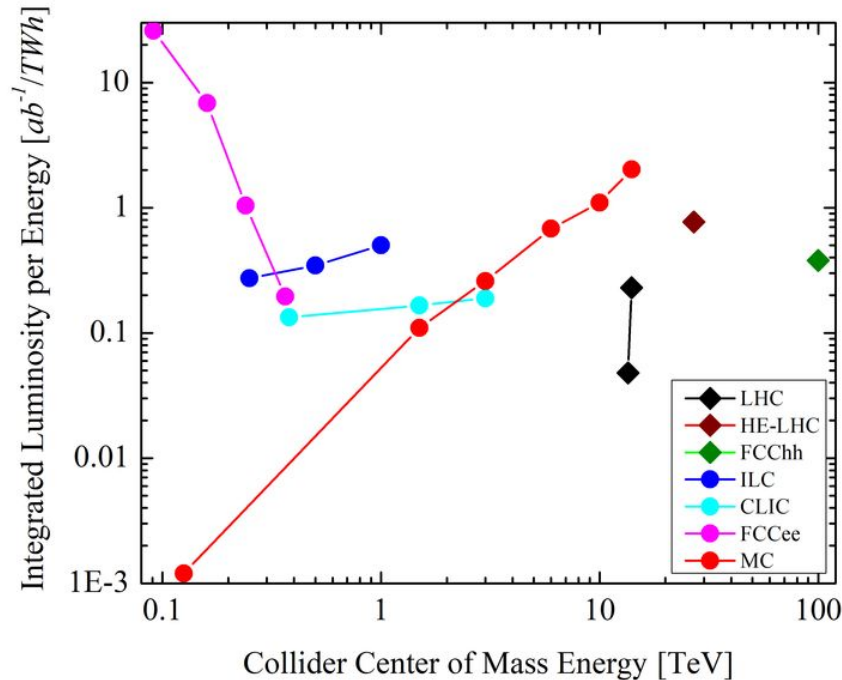
Original from ESG 2020 by UB
Updated July 25, 2022 by MN

- Proton collider
- Electron collider
- Muon collider
- Construction/Transformation
- Preparation / R&D



Scenarios considered in the previous EPPSU

Collider proposals – energy and luminosity



[DOI:10.22323/1.390.0039](https://doi.org/10.22323/1.390.0039)

Collider proposals – other aspects

- Physics reach: energy and polarisation or luminosity?
- Extendibility: higher energies with leptons or hadrons?
- Location: in Europe or anywhere else?
- Collaboration: international or global project?
- Cost: what can we sacrifice for a cheaper collider?
- Sustainability: what does it mean in this context?
- ...

Today's WG reports

- **WG1:** communication skills are important to stay visible in the society, even though we have not been trained in this direction; different levels of communication needed (colleagues vs. general public)
- **WG2:** emphasize the importance of a future collider; demand transparency; highlight criteria useful for the decision-making process
- **WG3:** smaller experiments are complementary to collider searches; how to position them in the big-collider era?
- **WG4:** exchange of methods, tools, knowledge, people is crucial and unavoidable - how to facilitate it?
- **WG5:** our future depends on the choice of the next collider - please, include us in the process

Open Plenary ECFA

- The ECFA member country, CERN, and the ECFA ECR panel have representatives in Plenary ECFA (PECFA).
- The November meetings are at CERN, with most of the meeting open to anyone!

FRIDAY 15 NOVEMBER

09:00 – 10:55 HETP

09:00	ESPP preparation	Speaker: Karl Jakobs (University of Freiburg (DE))	15m
09:20	ECFA HET Factory study: Overall status and report planning	Speaker: Christophe Leondopoulos (The University of Liverpool (UK))	15m
09:35	ECFA HET Factory study: WG1 Higgs, top & electroweak physics and global fits	Speaker: Marcel Vos (EPJ, Valencia (ES))	15m
09:50	ECFA HET Factory study: WG1 Searches and flavour	Speaker: Roberto Franceschini (Boson S.r.l.)	15m
10:10	ECFA HET Factory study: WG2 Physics Analysis Tools	Speaker: Patricia Azziz (CERN, Geneva (CH))	15m
10:30	ECFA HET Factory study: WG3 Detector Technologies	Speaker: Mary-Chloe Tsou (Georgia Institute of Technology (US))	15m

10:55 – 11:15 Coffee break 20m

11:15 – 12:35 LHC experiments upgrades and plans

11:15	ALICE upgrades and plans	Speaker: Felix Dath (CERN)	15m
11:35	ATLAS upgrades and plans	Speaker: Craig Sawyer (Council and Technological Facilities Board (UK))	15m
11:50	CMS upgrades and plans	Speaker: Katja Klein (Deutscher Forschungszentrum Jülich (DE))	15m
12:10	LHCb upgrades and plans	Speaker: Vava Dilortova (Centre National de la Recherche Scientifique (FR))	15m

13:35 – 16:00 Lunch Break 1h 20m

14:00 – 16:00 Accelerator R&D areas

14:00	Update on LDO	Speaker: Prof. Dave Newbold (CERN, European Laboratory for Particle Physics (CH))	10m
14:15	High Field Magnets	Speaker: Dr. Edzo Tolboom (CERN)	15m
14:30	Radiofrequency Structures	Speaker: Igor Byratchev (CERN)	15m
14:50	Energy Recovery Linacs	Speaker: Jorgien D'Hondt (Vrije Universiteit Brussel (BE))	15m
15:15	Muon colliders	Speaker: Daniel Schulte (CERN)	15m
15:30	Plasma Accelerators and the HALIF concept	Speaker: Erik Adli (University of Bonn)	15m

16:00 – 16:20 Coffee break 20m

16:20 – 17:20 JENA and others

16:20	Report from the LDC Sustainability WG	Speaker: Caterina Boller (EPJ, European Laboratory for Particle Physics (CH)), Caterina Boller (Laboratoire National de Physique (FR)), Dr. Maksym Tsyry (EPJ, CERN, Université Paris Saclay (FR))	15m
16:40	Nuclear Physics at the LHC	Speaker: Alexander Philipp Kalweit (CERN)	15m
17:00	AI/ML for Particle Physics: Building an Infrastructure with EuCAF and Beyond	Speaker: Santha Caron (Deutscher Forschungszentrum für Subnukleare Physik (DE))	15m

Discussion session

- What aspects are the most important for us? What is irrelevant?
- What are our expectations? Hopes? Concerns?
- How can we contribute as young researchers? What is our responsibility?
- How to make sure we are heard? Do we feel part of the community?
- ...