

The European Strategy and LCs

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European Strategy for Particle Physics - update 2019-20

Relations between the Strategy Process and the European Commission

Information to be prepared for CLIC and ILC



The European Strategy for Particle Physics 2012-13

High-priority large-scale scientific activities

After careful analysis of many possible large-scale scientific activities requiring significant resources, sizeable collaborations and sustained commitment, the following four activities have been identified as carrying the highest priority.

Point 1: Exploit LHC and implement HiLumi. Well underway.

Point 4: Develop a neutrino programme at CERN. Neutrino platform implementation

Point 2: CERN should undertake design studies for accelerator projects in a global context, with emphasis on proton-proton and **electron-positron high-energy frontier machines**. These design studies should be coupled to a vigorous accelerator R&D programme, including high-field magnets and **high-gradient accelerating structures**, in collaboration with national institutes, laboratories and universities worldwide -> **European efforts for CLIC, HE-LHC/FCC**

Point 3: There is a strong scientific case for an electron-positron collider, complementary to the LHC, that can study the properties of the Higgs boson and other particles with unprecedented precision and whose energy can be upgraded. The Technical Design Report of the **International Linear Collider (ILC)** has been completed, with large European participation. The initiative from the Japanese particle physics community to host the ILC in Japan is most welcome, and European groups are eager to participate. Europe looks forward to a proposal from Japan to discuss a possible participation - > **European efforts for ILC**



European Strategy Update 2019-20 (ESU)

Structure:

- The Strategy Secretariat: the Scientific Secretary (Prof. Halina Abramowicz), the SPC Chair, the ECFA Chair, the representative of the European Laboratory Directors meeting
- Physics Prep. Group (in 2012): the four above plus four from ECFA and four from the SPS, plus two from other regions and one person from CERN
- European Strategy Group (in 2012): members nominated by Council from each Member State (MS), Associate MS and Observers, European Comm., Lab directors, etc – a rather large group

These bodies will be defined and the persons identified during the Spring 2018. For the secretariat, the “core”, the names are already known.

Timeline:

- For submission of documents -
- Community meeting(s)
- The ~week long Strategy Meeting forming the Strategy

A detailed timeline will be presented to Council

Official kick-off Spring 2018

Final approval by Council May 2020

The LC community must prepare the input to this process from now and throughout 2018.



MoU CERN-European Commission

Considering (several points, among others):

“The Convention for the Establishment of a European Organization for Nuclear Research dated 1 July 1953, as revised on 18 January 1971, hereinafter referred as "the Convention", and in particular Article II through which the signatories of the Convention have entrusted collaboration among European States in fundamental research in particle physics, as the branch of physics that addresses the fundamental constituents of matter and the forces that act on them, including through international cooperation, to CERN;”

(The two parties) Have decided as follows:

2. The two Sides intend to cooperate, with due regard to their respective competences, in the following up and the implementation of the European Strategy for Particle Physics. For this purpose, they may develop joint activities.
3. With due regard to their respective competences, institutional settings and operational frameworks, the two Sides will as appropriate inform and consult each other on issues of mutual interest, in particular concerning the European Strategy for Particle Physics and related contacts with CERN non-Member States.
4. Subject to its own procedures, the CERN Council will grant the Commission standing entitlement to attend its European Strategy Sessions and take the floor at these sessions.

A work-plan, regularly updated, for implementation of this MoU provides the practical guidelines for the common activities, covering from General Policy issues to specific collaborative areas of action



ESU preparation for CLIC

Accelerator collaboration with ~50 institutes
Detector & Physics collaboration with ~29 institutes



Project timeline

2013 - 2019 Development Phase

Development of a Project Plan for a staged CLIC implementation in line with LHC results; technical developments with industry, performance studies for accelerator parts and systems, detector technology demonstrators

2020 - 2025 Preparation Phase

Finalisation of implementation parameters, preparation for industrial procurement, Drive Beam Facility and other system verifications, Technical Proposal of the experiment, site authorisation

2026 - 2034 Construction Phase

Construction of the first CLIC accelerator stage compatible with implementation of further stages; construction of the experiment; hardware commissioning

2019 - 2020 Decisions

Update of the European Strategy for Particle Physics; decision towards a next CERN project at the energy frontier (e.g. CLIC, FCC)

2025 Construction Start

Ready for construction; start of excavations

2035 First Beams

Getting ready for data taking by the time the LHC programme reaches completion



CLIC documents

Accelerator documents:

An accelerator technical description (around ~150p)

- 380 GeV drive beam, klystron-option, upgrades to 3 TeV and beyond, technical studies, CE and infrastructure, performance studies, cost and power, schedules

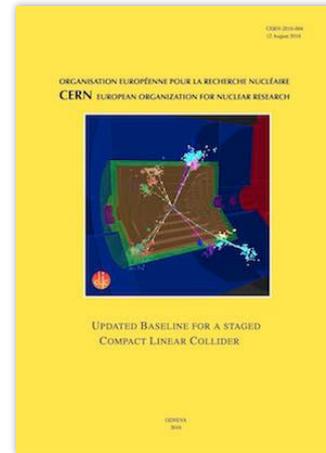
A separate document about the **collaboration's plans for 2020-25** (50p) in the preparation phase including also resource estimates for this period, covering:

- Technical studies and cost/power reduction studies, industrial pre-series where needed
- More detailed site preparation
- Maximising common efforts/collaborative work with outside labs taking Xband in use and other facilities where key components are needed in significant numbers

Documents for next European Strategy

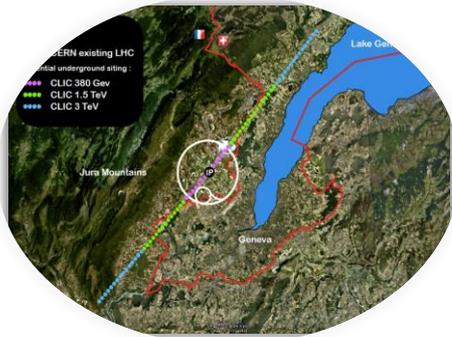
Ingredients for a CLIC summary report

- ✓ Updated baseline for a staged Compact Linear Collider
CERN yellow report CERN-2016-004
- ✓ Higgs Physics at the CLIC Electron-Positron Linear Collider
Eur. Phys. J. C 77, 475 (2017)
- ✓ The New Optimised CLIC detector model CLICdet
CLICdp-Note-2017-001
- 🕒 Performance of CLICdet Detector Model
CLICdp-Note early 2018
- 🕒 An overview of CLIC Top Physics
Complete draft before the end of 2017
- 🕒 Extended BSM studies
Publication planned 2018
- 🕒 CLIC R&D report (main CLIC technology demonstrators)
Summary publications 2018
- 🕒 Plan for period 2019-2025 if CLIC supported by next strategy



A project implementation plan summary for CLIC – acc./detector/physics
Similar to CDR volume 3 and the Re-baselining document

Challenges for 2020-25



The CLIC studies are CERN hosted

MoU annexes or similar (with MS and NMS collaborators)

R&D contracts

Technology Transfer agreements, EU projects.

Place	Activity	Xband RF power	Status
CERN	XBox-1 test stand	50 MW	Operational, connection to CLEAR planned
	Xbox-2 test stand	50 MW	Operational
	XBox-3 test stand	4x6 MW	Operational
Trieste	Linearizer for Fermi	50 MW	Operational
PSI	Linearizer for SwissFEL	50 MW	Operational
	Deflector for SwissFEL	50 MW	Design and procurement
DESY	Deflector for FLASHforward	6 MW	Design and procurement
	Deflector for FLASH2	6 MW	Design and procurement
	Deflector for Sinbad	tbd	Planning
Tsinghua	Deflector for Compton Source	50 MW	Installation and commissioning
	Linearizer for Compton Source	6 MW	Planning
SINAP	Linearizer for Soft X-ray FEL	6 MW	Design and procurement
	Deflectors for Soft X-ray FEL	3x50 MW	Design and procurement

Australia	Test stand	2x6 MW	Proposal submission
Eindhoven	Compact Compton Source, 100 MeV	6 MW	Design and procurement
Valencia	S-band test stand	2x10 MW	Installation and commissioning
KEK	NEXTEF test stand	2x50 MW	Operational
SLAC	NLCTA test stand	2x50 MW	Operational
SLAC/CERN	Design of high-efficiency X-band klystron	30 MW	In progress
Daresbury	Linearizer	6 MW	Design and procurement
	Deflector	tbd	Planning
	Accelerator (CLARA extensions)	tbd	Planning
Frascati	XFEL, plasma accelerator, 1 GeV	4(8)x50 MW	CDR
	Test stand	50 MW	Planning
Gronigen	1.4 GeV XFEL Accelerator, 1.4 GeV	tbd	NL roadmap, CDR

Link the CLIC project development to activities at other facilities, universities and industries. Ideally a ~300 MCHF project will be needed in this period.

ILC since the TDR: Technical focus and changes



Site specific studies

Technical developments for most accelerator systems - high Q improvements for example

E-XFEL at DESY successfully constructed and put into operation – a key technology demonstration

Recent proposal to start with an initial energy of 250 GeV (physics impact report) – key issues:

- Higgs precision depends significantly on HiLumi performance and theory assumptions ([link](#))
- Below $t\bar{t}$ threshold
- Reduced search capabilities

Nevertheless, provides impressive precision, and remains upgradable.

TDR costs of ~ 8 BILCU for 500 GeV (ILCU = 2012 US\$ estimate used in the TDR) can be reduced by up to $\sim 40\%$

ILC Project Phases

2017–2018: Pre-preparation phase

The on-going activities with relevance to the ILC in Europe are reviewed.

2019–2022: Preparation phase

This period needs to be initiated by a positive statement from the Japanese government about hosting the ILC, followed by a European strategy update that ranks European participation in the ILC as a high-priority item. The preparation phase focuses on preparation for construction and agreement on the definition of deliverables and their allocation to regions.

2023 and beyond: Construction phase

The construction phase will start after the ILC laboratory has been established and inter-governmental agreements are in place. At the current stage, only the existing capabilities of the European groups relevant for this phase can be described.



ILC pre-preparation phase in Europe



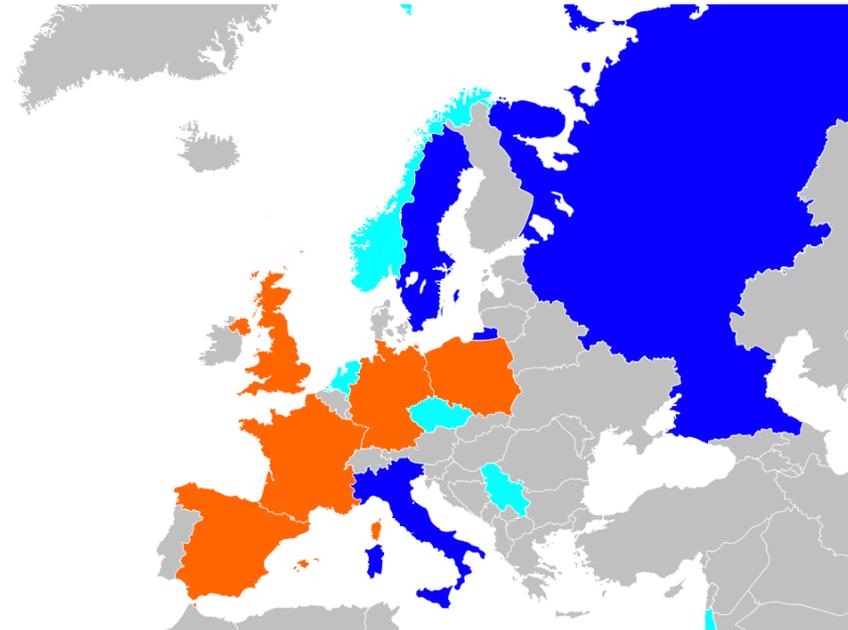
Item/topic	Brief description	CERN	France CEA	Germany DESY	Time line
SCRF	Cavity fabrication including forming and EBW technology,	✓			2017-18
	Cavity surface process: High-Q & -G with N-infusion to be demonstrated with statics, using High-G cavities available (# > 10) and fundamental surface research		✓	✓	2017-18
	Power input-coupler: plug compatible coupler with new ceramic window requiring no-coating	✓			2017-19
	Tuner: Cost-effective tuner w/ lever-arm tuner design	✓	✓		2017-19
	Cavity-string assembly: clean robotic-work for QA/QC.		✓		2017-19
Cryogenics	Design study: optimum layout, emergency/failure mode analysis, He inventory, and cryogenics safety management.	✓			2017-18
HLRF	Klystron: high-efficiency in both RF power and solenoid using HTS	✓			2017- (longer)
CFS	Civil engineering and layout optimization, including Tunnel Optimization Tool (TOT) development, and general safety management.	✓			2017-18
Beam dump	18 MW main beam dump: design study and R&D to seek for an optimum and reliable system including robotic work	✓			2017- (longer)
Positron source	Targetry simulation through undulator driven approach			✓	2017-19
Rad. safety	Radiation safety and control reflected to the tunnel/wall design	✓			2017 – (longer)

Pre-preparation summary:

Europe has played – and continues to play – a central role in development of the ILC project

Large European projects are being implemented where the ILC/SCRF technology is being put to use and is being validated

European Industry is well prepared to construct parts for ILC



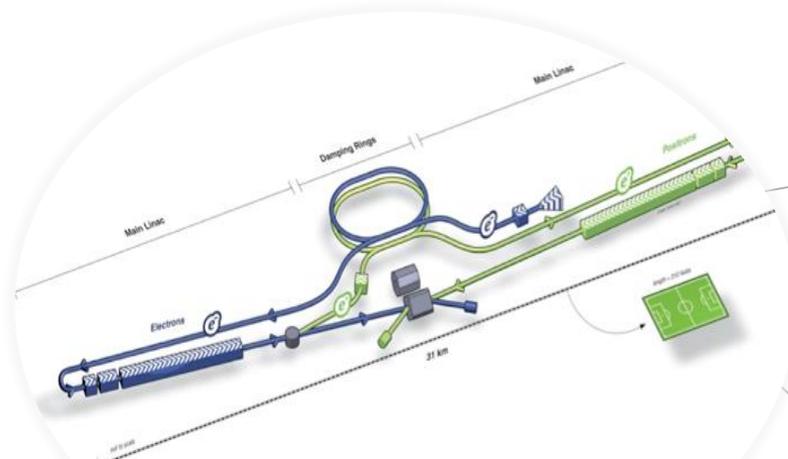
Preparation Phase 2019-22: Key activities in Europe

This period needs to be initiated by a positive statement from the Japanese government about hosting the ILC, followed by a European strategy update that ranks European participation in the ILC as a high-priority item. The preparation phase focuses on preparation for construction and agreement on the definition of deliverables and their allocation to regions.

- The European groups will concentrate on preparation for their deliverables, including European industry.
- Europe and European scientists, as part of an international project team, will also participate in the overall finalization of the design, while in parallel contributing to the work of setting up the overall structure and governance of the ILC project and of the associated laboratory.

Key activities in Europe	More details
SCRF activities	Cavity fabrication and preparation, Power Couplers, Automation of assembly, E-XFEL > ILC
High efficiency klystron R&D	
Cryogenics system	LHC system similar in size to ILC
Accelerator Domain issues	Positron source, Damping Rings, Beam Delivery Systems, Low emittance beam transport, Beam dumps, Positron source
Detector and Physics	Design optimization, MDI, Technical prototypes, TDRs, Physics studies
Documentation system	Experience from E-XFEL
“Regional” Design office	Naturally at CERN, thinking to other European National Labs

Preparation Phase 2019-22: Organization and resources



ILC prep. phase project:
CERN coordination of
European effort

R&D
contracts

MoU annexes or
similar (with MS
and NMS
collaborators)

Techn.
Transfer
agreements,
EU projects.

A European ILC project in the preparation phase 2019-22:

- Resources needed estimated to ~25 MCHF/year (material) and 60 FTE/year (personnel), ramping up from 2019
- Move towards more engineering personnel
- The organisational model above is used for existing studies at CERN, e.g. CLIC/HE-LHC/FCC

Construction phase 2023 and beyond

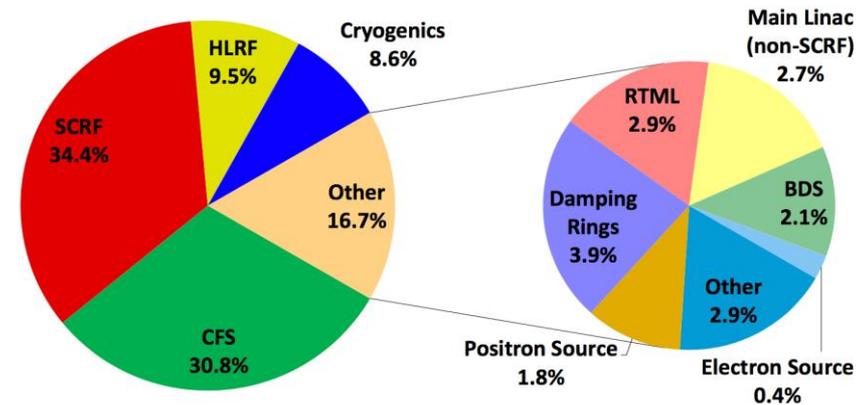
The construction phase will start after the ILC laboratory has been established and inter-governmental agreements are in place. **At the current stage, only the existing capabilities of the European groups relevant for this phase can be described.**

As mentioned above, the detailed contributions will have to be defined during the preparation phase and formalized by inter-governmental agreements. Some contributions from Europe are imperative for the project - most prominently superconducting RF modules.

So premature to plan in detail, however some comments can be made:

- Focus on technical items for ILC (not CE and infrastructure)
- E-XFEL ~7% of a 250 GeV ILC – and more than 10% of the cryo-modules needed
- Detector construction expected to follow LHC detector model
- Spending significantly above the levels mentioned on previous page only by ~2025-26

Any guidance from Japan on contributions would allow us to make firmer European Planning for this period



KEK-ILC Action Plan

KEK-DG Yamauchi set up a WG to develop a [KEK-ILC action plan](#) in May, 2015.

The KEK-ILC Action Plan was released in January 2016. It contains technical preparation tasks and a human resource development plan for the **pre-preparation phase (current efforts)** and the **main-preparation phase (after “green sign” from MEXT)**. It focuses mainly on a development plan for KEK.

“Producing a **EAP (European Action Plan)** for the ILC in timely manner is very important.”

“After having established a discussion group with DOE, discussions with Europe are likely to become the next important topic for MEXT.”

Extracted from slides of Y.Okada, KEK – EJADE meeting 6.9.16

On the European side it was suggested to use the EJADE H2020 MC project to prepare the EAP – the effort was started October 2016

E-JADE

Europe-Japan Accelerator Development Exchange Programme

Programme 2015-2018:

- Three main technical WPs
- Supports extended stays of European Researchers in Japan
- Recently adapted to include detector and physics studies for ILC (new partners)

Technical WPs: WP1: LHC with upgrades/FFC/ SuperKEKb, WP2: ATF2, WP3: ILC/CLIC

Partners: CERN (coord), DESY, CEA, CNRS, CSIC, RHUL, OXF with Uni. Tokyo and KEK -> WG for EAP

New partners: VINCA, AGH-Cracow, Tel Aviv University, Liverpool University, Université de Strasbourg, Université Paris-Sud, Tohoku University and Kyushu University.

Authors of EAP:

For EJADE institutes:

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EJADE WP3 and centrally: T.Schoerner-Sadenius, M. Stanitzki

TDR: B.Foster

Summary

Key messages:

- For the CLIC project the plans and documentation for the European Strategy are defined
- The main challenge will be to mount sufficient resources in next phase -> need to work efficiently and creatively with collaborators and other projects
- Europe is also well set up/prepared (researchers, facilities, industry) for participation in the construction and exploitation of ILC for physics
- A 2018 statement is needed from Japan, including guidance about the resources foreseen. Final sharing of responsibilities and governance to be decided in the preparation phase 2019-2022
- Resources needed – in Europe - are quite modest until ~2025-26, construction spending then picks up
- The European Action Plan document will be concluded now
- An extended and updated document is being prepared for the European Strategy process, taking into account the development in Japan the coming ~year

All summaries prepared by my CLIC and EAP author colleagues

