The European Strategy for Particle Physics: Impressions and Impact on ILC / ILD

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ILD General Meeting, June 30, 2020

2020 European Strategy Update for Particle Physics

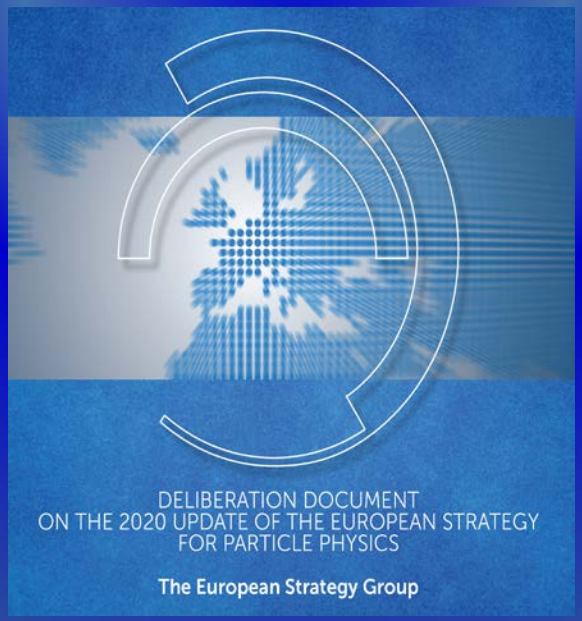
On June 19, the CERN Council has ***updated*** the European Strategy of Particle Physics intended to guide the future of the domain within the global landscape

- ✓ 2020 Update of the European Strategy for Particle Physics:
  https://cds.cern.ch/record/2721370/files/CERN-ESU-015-2020%20Update%20European%20Strategy.pdf

- ✓ Deliberation Document on the 2020 Update of the European Strategy for Particle Physics:
  https://cds.cern.ch/record/2721371/files/CERN-ESU-016 2020%20Deliberation%20Document%20European%20Strategy.pdf

- ✓ Halina Abramowicz presentation (ESG Secretary), CERN Council Session, Open Meeting, June 19th, 2020:
  https://indico.cern.ch/event/924500/contributions/3884837/subcontributions/308162/attachments/2060472/3456104/Strategy-Statements-Open-Session.pdf

- ✓ CERN Press Release on the 2020 Update of the European Strategy for Particle Physics
  https://home.cern/news/news/physics/particle-physicists-update-strategy-future-field-europe



- European Strategy Update: main document (accompanied by CERN Council resolution)

- Deliberation Document, prepared by the Strategy Secretariat, provides background information underpinning the Strategy statements. (Recommendations made by ESG WGs for possible modifications to certain organisational matters are given).

Major Developments from 2013 & *General Considerations* for 2020 Update

✓ 2 Statements in the 2020 European Strategy on ***Major Developments since 2013 Strategy***
(2013 Strategy identified 4 high-priority, large-scale scientific activities; ILC was among them)

LHC → upgrade to high luminosity (HL-LHC):The successful completion of the high-luminosity upgrade of the machine and detectors should remain the focal point of European particle physics, together with continued innovation in experimental techniques. The full physics potential of the LHC and the HL-LHC, including the study of flavour physics and the quark-gluon plasma, should be exploited.

2020 Strategy Statement

Neutrino Physics: Europe, and CERN through the Neutrino Platform, should continue to support long baseline experiments in Japan and the United States (LBNF/DUNE)

✓ ***2013 European Strategy Update for Particle Physics:*** *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*

2020 Deliberation Document

✓ ***Major Developments from 2013 (2020 Deliberation document:*** *No such proposal has since been received,* ***although interest in the ILC hosted in Japan remains high within the particle physics community****. This is reflected in the recommendation made in Section 3 of this Strategy.*

✓ ***General Considerations for the 2020 Strategy:***

Science & Technology: This Strategy update should be implemented to ensure Europe's continued scientific and technological leadership
Global Nature of Particle Physics: This Strategy takes into account the rich and complementary physics programmes being undertaken by Europe's partners across the globe and of scientific and technological developments in neighbouring fields. The implementation of the Strategy should proceed in strong collaboration with global partners and neighbouring fields

2020 Strategy Statement

2020 EPPSU: High - Priority Future Initiatives

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.

2020 Strategy Statement

- ✓ *Two possible energy-frontier colliders have been studied for implementation at CERN, namely CLIC and FCC.CLIC has the potential to reach 3 TeV in the centre of mass, while FCC could reach 100 TeV or beyond.*
- ✓ *The design, technology, and implementation aspects of CLIC indicate that the first stage (a Higgs factory) could be realised on a timescale of 15 years and could be extended to higher energies subsequently. However, the dramatic increase in energy possible with a future hadron collider compared to the 13 TeV of the LHC leads to this technology being considered as the most promising for a future facility at the EF.*
- ✓ *If the large circular tunnel for such a collider can be built, then it would also provide the infrastructure needed for an electron-positron Higgs factory as a possible first step, of the type that has been studied as FCC-ee.*
- ✓ *In addition to the high field magnets the accelerator R&D roadmap could contain: the R&D for an effective breakthrough in plasma acceleration schemes (with laser and/or driving beams), as a fundamental step toward future linear colliders; an international design study for a muon collider, as it represents a unique opportunity to achieve a multi-TeV energy domain beyond the reach of e+e– colliders,*
- ✓ *Reduction in energy consumption is an important consideration in accelerator design.*

2020 Deliberation Document

2020 EPPSU: Organizational Issues

✓ **Support for high impact, financially implementable, experimental initiatives world-wide**

An ambitious next-generation collider project will require global collaboration and a long-term commitment to construction and operations by all parties. *CERN should initiate discussions with potential major partners as part of the feasibility study for such a project being hosted at CERN. In the case of a global facility outside Europe in which CERN participates, CERN should act as the European regional hub, providing strategic coordination and technical support.* ***Individual Member States could provide resources to the new global facility either through additional contributions made via CERN or directly through bilateral and multilateral arrangements with the host organisation****.*

2020 Strategy Statement

- ✓ *The issues to be addressed for the governance of global projects relate to governance and funding around either CERN hosting a next-generation collider as a globally funded project or a European contribution to a next-generation collider constructed outside Europe, and specifically the role that CERN would play.*
- ✓ *The governance model for a new global facility hosted by CERN must be compatible with the provisions of the CERN Convention, amendment of which is not desirable. The discussion should recognise the need to provide a link between the level of participation and the level of influence on the project.*

2020 Deliberation Document

- ✓ *For the case of a European contribution to a new global facility outside Europe, CERN should, if so decided by the CERN Council, provide strategic coordination and technical support for European contributions. The modalities of European participation remain to be decided, as and when the need occurs.*

The particle physics community and the European Commission have a strong record of collaboration. *The relationship between the particle physics community and the European Commission should be further strengthened, exploring funding-mechanism opportunities for the realisation of infrastructure projects and R&D programmes in cooperation with other fields of science and industry.*

2020 Strategy Statement

- ✓ *The European particle physics community should work with the European Commission to shape and establish the funding instruments that are required for the realisation of common R&D projects, e.g. in the Horizon Europe programme.*

2020 Deliberation Document

2020 EPPSU: Environmental Impact & Other Essential Scientific Activities

✓ ***Enviromental Impact*** → *e.g. further studies in the context of the « Green ILC » concept*

The energy efficiency of present and future accelerators, and of computing facilities, is and should remain an area requiring constant attention. Travel also represents an environmental challenge, due to the international nature of the field. The environmental impact of particle physics activities should continue to be carefully studied and minimised. A detailed plan for the minimisation of environmental impact and for the saving and re-use of energy should be part of the approval process for any major project.

2020 Strategy Statement

The next generation of high-energy particle colliders foresees power consumptions in the hundreds of megawatts of grid power, as compared to about 100 MW for the HL-LHC. Many ways of improving the energy efficiency of particle physics accelerator complexes exist, such as waste-heat recovery, optimisation of cryo-cooling plants and beam-energy recovery, to name but a few. Investments in dedicated R&D for energy efficiency techniques will pay off already in the medium term, with a significant impact on the operating costs of accelerators.

2020 Deliberation Document

✓ ***Other Essential Scientific Activities*** → *e.g. developments of detectors concepts for the ILC*

The success of particle physics experiments relies on innovative instrumentation and state-of-the-art infrastructures. To prepare and realise future experimental research programmes, the community must maintain a strong focus on instrumentation. Detector R&D programmes and associated infrastructures should be supported at CERN, national institutes, laboratories and universities. Synergies between the needs of different scientific fields and industry should be identified and exploited to boost efficiency in the development process and increase opportunities for more technology transfer benefiting society at large. Collaborative platforms and consortia must be adequately supported to provide coherence in these R&D activities. The community should define a global detector R&D roadmap that should be used to support proposals at the European and national levels.

2020 Strategy Statement

2020 European Strategy Update for Particle Physics

- The European Particle Physics Strategy Update (EPSSU) represents a scientific vision of the particle physics community in Europe and, as such, does not constitute a funding decision;
- CERN is going to set up dedicated strategic R&D accelerator roadmap (e.g. high-field magnets, etc …);
- A further update of the Strategy should be foreseen in the second half of this decade when the results of the feasibility study for the future hadron collider are available/ready for decision;

Many European newpapers pick-up a « hot topic » of the future 100 km collider:

- ✓ Physics World: https://physicsworld.com/a/cern-approves-further-work-on-future-circular-collider-but-delays-final-decision/?fbclid=IwAR274ksjufqh44BVAo-uKXt6AjKtRh81F4fisMCEf-0e4btWOhGwqhtFsI8
- ✓ Nature News: https://www.nature.com/articles/d41586-020-01866-9?fbclid=IwAR1GiBS-Wfwkg7N4bjieXZLcGoyCLs2zweYTxTu0JNkVTPU_d5Xo0Y57QvA

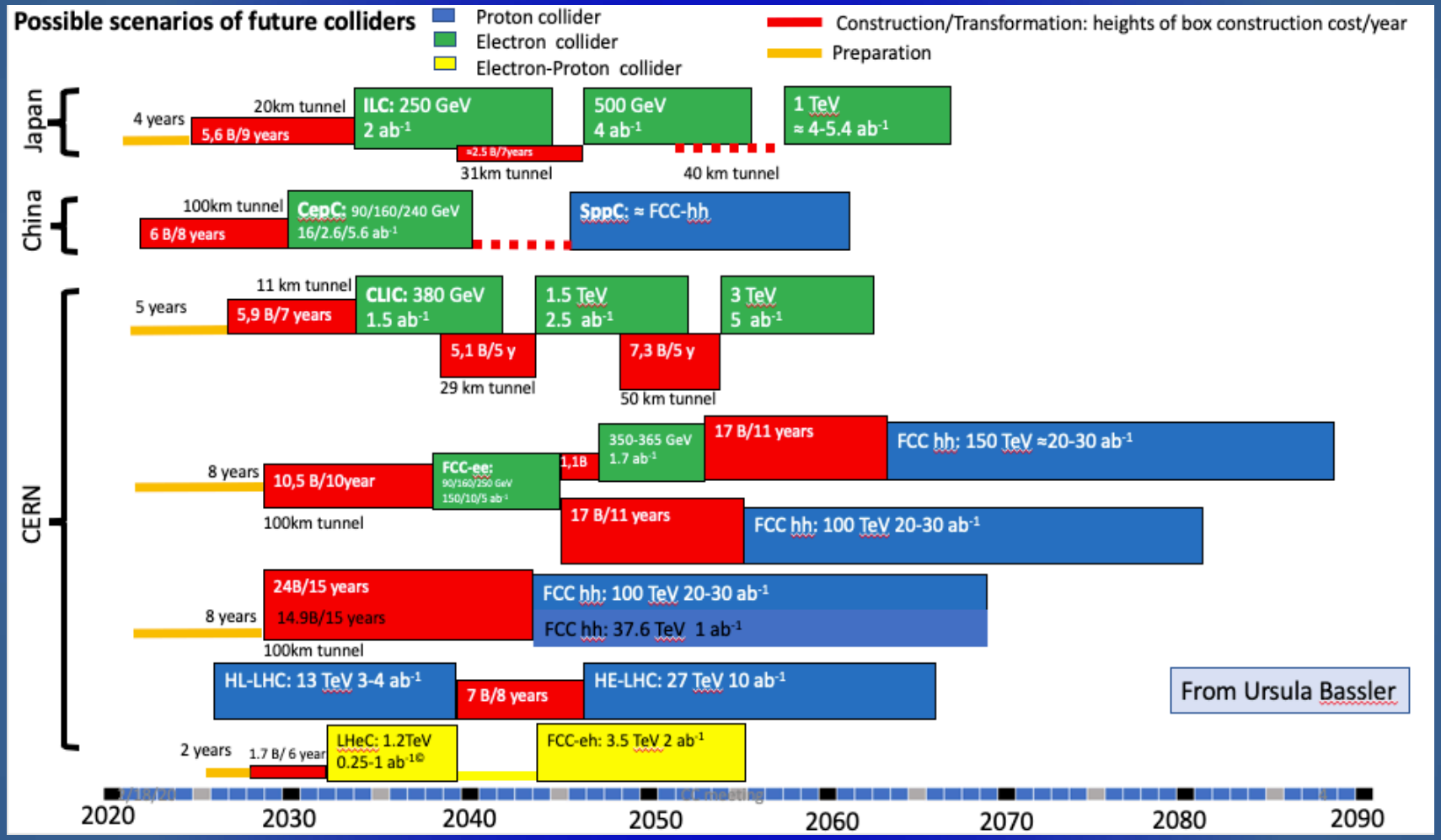
Some reactions in Japanese media:

K. Kawagoe, T. Tanabe, T. Yoshioka

- ✓ June 19 The Sankei News (newspaper, central): https://www.sankei.com/life/news/200619/lif2006190087-n1.html
  "European Research Institute supports the construction of the next generation accelerator, ILC, in Japan"
- ✓ June 20 Iwate Nippo (newspaper, local): https://www.iwate-np.co.jp/article/2020/6/20/80107
  «Europe hopeful for ILC in next strategy for particle physics, "wish to collaborate" for Japan's bid for the ILC»
- ✓ June 20 Nippon TV: NEWS24 (Iwate): https://www.fnn.jp/articles/-/54676
  "International Linear Collider (ILC): European researchers' organization announces their cooperation"
- ✓ June 24 Iwate Nippo (newspaper, local), on MEXT minister's com.: https://www.iwate-np.co.jp/article/2020/6/24/80383
  "MEXT intends to continue discussions with the U.S. and Europe following the European Strategy for PP»

Long-Term Options for Large Facilities

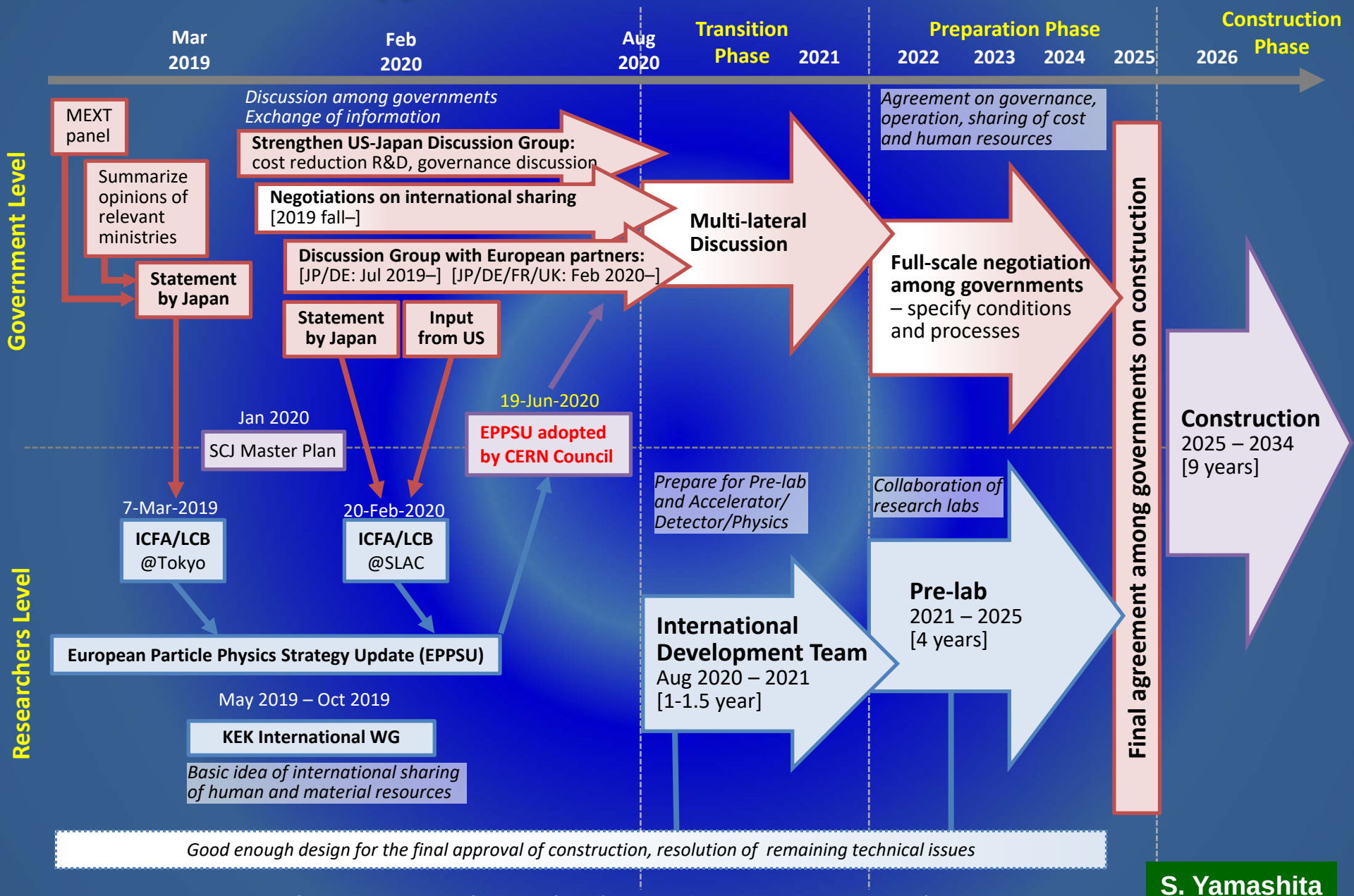
Approximate ***technically limited timelines*** of future large-scale collider facilities for the next five decades, based on the presentations by their proponents given at the European Strategy Symposium in Granada (May 2019),



ICFA Statement on ILC, Feb. 2020: https://icfa.fnal.gov/wp-content/uploads/ICFA_Statement_22Feb2020.pdf

→ ICFA advocates establishment of an international development team to facilitate transition into the preparatory phase.

Processes and Approximate Timelines Towards Realization of ILC



S. Yamashita

* ICFA: international organization of researchers consisting of directors of world's major accelerator labs and representatives of researchers
* ILC pre-lab: International research organization for the preparation of ILC based on agreements among world's major accelerator labs such as KEK, CERN, FNAL, DESY, etc.

ILC International Development Team

- **The main goal of the ILC-IDT, succeeding LCB/LCC, is setting-up the ILC Pre-lab in a short timescale (one to two years), for the construction of the ILC in Japan.**

- **The ILC-IDT will be based on the Executive Group and three Working Groups under: WG1 (Pre-lab setup), WG2 (Accelerator), WG3 (Physics and Detector)**

  *LCC Physics and Detector Executive Board plans to continue regular bi-weekly meeting until August

- **The first step will be the ICFA approval for establishing the Executive Group, possibly in early August**

European information and discussion meeting about the ILC development phase (and beyond), June 12, 2020: https://indico.cern.ch/event/928782/

S. Stapnes

European equivalents/activities – II

Accelerator:

Two main focuses the next year or two:
- Build on ongoing and focus on near term technical work (slide(s) Benno)
- Planning for next phases: European capabilities and possible deliverables - for Prep. Phase and Construction studied in EJADE report (covered to some extend also detectors)
  - The EJADE report is linked to at the INDICO page

Next (as a proposal) for the Accelerator:
Revive "EJADE" accelerator working group, extend/adapt it, adapt also mailing list(s), meet every ~4-8 weeks
Cover:
- Participate in technical design where we can find effort
- Establish and refine possible deliverables list for Europe
- Initiate carefully contacts with FAs/Labs management related to "deliverable planning"
- Explore funding mechanisms for prep phase (need ~40 MEURO/year according to EJADE report)
  - CERN support for prep. phase premature to discuss
  - EU level (slides(s) Titov, Winter)
  - National Level (example: Fuster, Spain – slide(s))

European equivalents/activities – III

Detector and Physics:

Initial considerations:
- It seems to me that the experiment studies (concept groups) and physics studies for ILC are truly international.
- The R&D likewise, but there are specific important European initiatives, for example the various AIDA programmes.
- The LCC physics and detector work is also truly international. Its scope will evolve, composition too, how ? (for later).

- Will the concepts move towards TDRs, or will there be an LoI process ? Do we have a preference ? Significant advantages of LoI process for new ideas and participants.

- There is an ECFA LC physics study/group - but it is likely that ECFA will move towards a more general Higgs-factory physics focus, covering Higgs physics at accelerators of all geometries (as seen in preparation of the ESPP input – Higgs WG)
- How do we deal with the fact that there will be European Physics and Detector interests in all other Higgs factories - CLIC, FCC-ee and CEPC - this is a particularly important issue for Europe, with two of these proposed in Europe ? Our FAs might be truly confused if several similar funding applications come in, proposing Higgs studies for different machines. Is this a concern ?

What is needed on the European side as a "European" organisation for the ILC detector and physics (including R&D) short term (in the development phase), but also organising some initial planning for what is needed in the preparation phase in Europe ?

Answer:
Nothing or let us wait -> next slide

Answer:
A more co-ordinated European approach to our ambitions within ILC detectors and physics can be useful

Possible next steps, we don't want to act as regional block but if we do want more common European activities, what could we realistically address:
- Specific work to reactivate a wider European user community - some countries active earlier are now dormant (the community is key to European support)
- Improve communication across the European Detector and Physics community ?
- More common work on funding ideas/proposals (aiming for the next phase - the 4 year preparation phase), at EU level and national levels ?
- Is there a special role of CERN needed in these areas (not now, but later if the project really moves) ?

We will arrange a special meeting in August to continue the discussion

How do we make sure European groups/labs/individuals can participate and be informed in the IDT phase

- ✓ Revive "E - JADE" accelerator working group, extend/adapt it;
- ✓ What is needed on European side as "European" organization for the ILC Physics and Detectors ?
- ✓ Will the concepts move towards TDR's or will there be an LoI process ? Do we have a preference ?

From the 2020 EPSSU to the 2021 Snowmass Process

The Snowmass Process is organized by the DPF of the American Physical Society: **https://snowmass21.org**

→ Identify and document a vision for the future of particle physics (PP) in the US in a global context

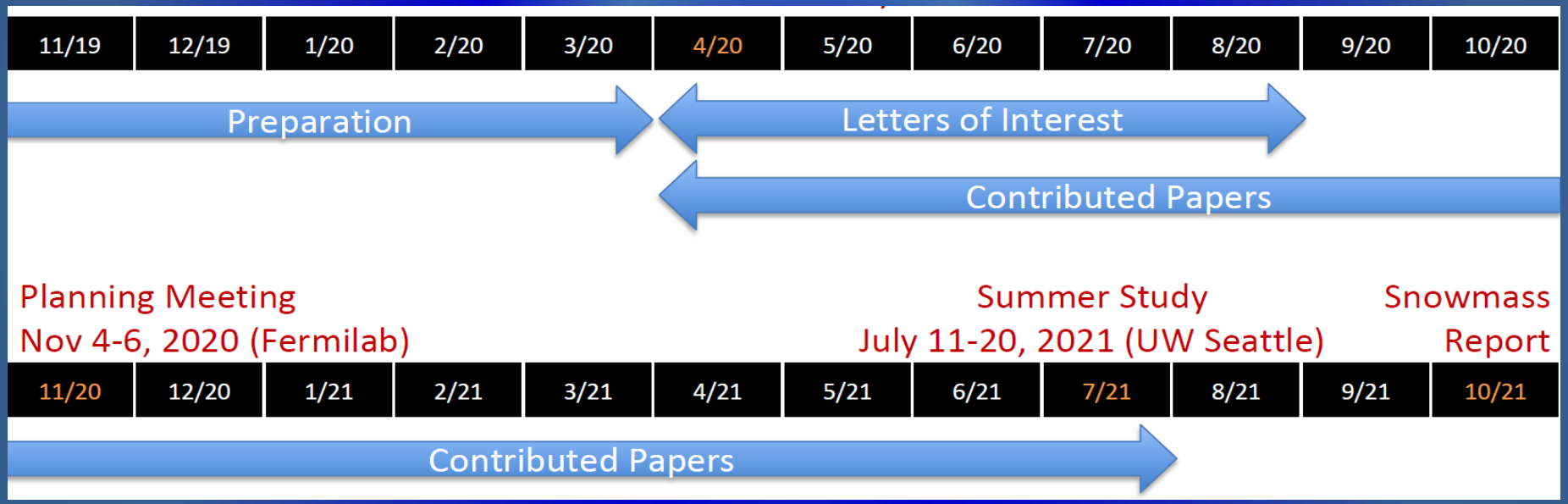
→ Communicate opportunities for discovery in PP to broader community and to the (US) government.

✓ **"The Energy Frontier Workshop" on July 20-22, 2020 :** https://indico.fnal.gov/event/43963

Discuss "open questions" and "new ideas" to define the strategy of the EF during Snowmass 2021 process.

Submit a 2-page Letter of Interest: https://snowmass21.org/loi ; deadline - August 31, 2020

Submit a contributed paper: https://snowmass21.org/submissions/start ; deadline - July 31, 2021



✓ **"ILC Study Questions for Snowmass 2021" (document prepared by the LCC Physics WG):**

→ *To aid contributions to the Snowmass 2021 US Community Study on physics at the ILC and other proposed e +e − colliders, the document presents a list of study questions that could be the basis of useful Snowmass projects*

✓ New "ILD Guest Membership" concept to perform ILC/ILD physics studies has been adopted