# Jamboree FCC - France

vendredi 4 juil. 2025, 08:40 → 17:40 Europe/Paris

**09:00** → 09:15 **Introduction/News de FCC et du meeting de Stratégie de Venise**

Orateur: Gregorio Bernardi (APC Paris CNRS/IN2P3)

**09:15** → 09:30 **ZH cross section and Higgs Mass measurements in ZH events at 240 GeV @ APC**

Orateurs: Gregorio Bernardi (APC Paris CNRS/IN2P3), Tom Fournier (APC Paris CNRS/IN2P3)

**09:30** → 09:45 **Higgs couplings measurements at 240 and 365 GeV @APC**

Orateurs: Alexis Maloizel (APC, Paris), Giovanni Marchiori (APC Paris)

**09:45** → 10:00 **ALLEGRO ECAL Overview**

Orateur: Zhibo Wu

**10:00** → 10:15 **Plans for the optimization of the SiW-ECAL**

Orateur: Yukun Shi (LLR, ecole polytechnique de paris)

**10:15** → 10:30 **Performance of the electromagnetic barrel calorimeter of ALLEGRO with different active and absorber materials**

Orateurs: Fares DJAMA (CPPM), Mohammed Reguig (CPPM)

**11:00** → 11:15 **Search for HNL at the FCCee**

Orateurs: Gaëlle Sadowski (Iphc), jeremy andrea (IPHC)

**11:15** → 11:30 **Full simulation of the FCC-ee tracker: progress in the Digitisation**

Orateurs: Adrien Sabard, Gaelle Boudoul (IP2I/AICP (CNRS/IN2P3)), Jessy DANIEL (IP2I, groupe CMS)

**11:30** → 11:45 **sensitivity study of direct CP asymmetry in $D^0 \to \pi^0\pi^0$**

Orateurs: Stephane Monteil (Laboratoire de Physique de Clermont - UCA/IN2P3), Willy WEBER (LPCA)

**11:45** → 12:00 **Study of Pulse Shape Discrimination to measure the electromagnetic fraction in hadronic shower.**

Orateurs: Stephane Monteil (Laboratoire de Physique de Clermont - UCA/IN2P3), Yingrui Hou (LPC Clermont)

**12:00** → 12:15 **Implementing the time in Particle Flow** ¶

Orateur: Hao LIANG (LLR, CNRS, École polytechnique, France.)

**12:15** → 12:30 **ALLEGRO Ecal electrode measurements**

Orateur: Zuchen HUANG (IJCLab)

# News from the U.S. impacting European Strategy

1) US president's budget request

2) US NAS report "Elementary Particle Physics: The Higgs and beyond"

# US President's Budget request

DOE Office of Science

**Science ($K)**

| | FY 2024 Enacted | FY 2026 Request |
|---|---|---|
| Advanced Scientific Computing Research | 1,016,000 | 1,016,000 |
| Basic Energy Sciences | 2,625,625 | 2,241,000 |
| Biological and Environmental Research | 900,000 | 394,920 |
| Fusion Energy Sciences | 790,000 | 744,780 |
| High Energy Physics | 1,200,000 | 1,112,836 |
| Nuclear Physics | 804,000 | 767,860 |
| Isotope R&D and Production | 130,193 | 162,330 |
| Accelerator R&D and Production[1] | 29,000 | — |
| Other Science Programs | 518,351 | 425,443 |
| Program Direction | 226,831 | 226,831 |
| **Total, Office of Science** | **8,240,000** | **7,092,000** |

High-energy physics proposed to be reduced by ~10%

NSF operation budget

**MAJOR FACILITIES FUNDING, BY PROJECT**
(Dollars in Millions)

| | FY 2024 Current Plan | FY 2025 (TBD) | FY 2026 Request | Change over FY 2024 Current Plan Amount | Change over FY 2024 Current Plan Percent |
|---|---|---|---|---|---|
| **Operations and Maintenance of Major Facilities** | **$1,065.73** | | **$745.00** | **-$320.73** | -30.1% |
| National Ecological Observatory Network (NEON) | 78.05 | | 47.00 | -31.05 | -39.8% |
| ***Biological Sciences*** | ***$78.05*** | | ***$47.00*** | ***-$31.05*** | ***-39.8%*** |
| Academic Research Fleet | 153.06 | | 92.00 | -61.06 | -39.9% |
| National Center for Atmospheric Research (NCAR) FFRDC | 127.66 | | 77.00 | -50.66 | -39.7% |
| National Geophysical Facility[1] | 39.48 | | 39.00 | -0.48 | -1.2% |
| Ocean Observatories Initiative (OOI) | 39.34 | | 8.00 | -31.34 | -79.7% |
| U.S. Sub-seafloor Sampling (S3P)[2] | 48.51 | | 10.00 | -38.51 | -79.4% |
| ***Geosciences*** | ***$408.05*** | | ***$226.00*** | ***-$182.05*** | ***-44.6%*** |
| Large Hadron Collider (LHC) - ATLAS and CMS | 20.50 | | 12.00 | -8.50 | -41.5% |
| Laser Interferometer Gravitational Wave Observatory (LIGO) | 48.00 | | 29.00 | -19.00 | -39.6% |
| National High Magnetic Field Laboratory (NHMFL) | 38.57 | | 23.00 | -15.57 | -40.4% |
| National Radio Astronomy Observatory (NRAO) FFRDC | 107.90 | | 71.00 | -36.90 | -34.2% |
| *NRAO O&M* | *43.59* | | *24.00* | *-19.59* | *-44.9%* |
| *Atacama Large Millimeter Array (ALMA) O&M* | *54.76* | | *44.00* | *-10.76* | *-19.6%* |
| *Green Bank Observatory* | *9.55* | | *3.00* | *-6.55* | *-68.6%* |
| National Solar Observatory (NSO) FFRDC | 27.67 | | 17.00 | -10.67 | -38.6% |
| *NSO O&M* | *6.24* | | *4.00* | *-2.24* | *-35.9%* |
| *Daniel K. Inouye Solar Telescope (DKIST)* | *21.43* | | *13.00* | *-8.43* | *-39.3%* |
| NSF's National Optical-Infrared Astronomy Research Laboratory FFRDC | 66.12 | | 53.00 | -13.12 | -19.8% |
| *NOIRLab O&M (Mid-Scale Observatories & Community Science and Data Center)* | *23.68* | | *6.00* | *-17.68* | *-74.7%* |
| *GEMINI Observatory O&M* | *24.73* | | *15.00* | *-9.73* | *-39.3%* |
| *Vera C. Rubin Observatory O&M* | *17.71* | | *32.00* | *14.29* | *80.7%* |
| ***Mathematical and Physical Sciences*** | ***$308.76*** | | ***$205.00*** | ***-$103.76*** | ***-33.6%*** |
| Antarctic Facilities and Operations (AFO) | 262.93 | | 263.00 | 0.07 | 0.0% |
| IceCube Neutrino Observatory (ICNO) | 7.94 | | 4.00 | -3.94 | -49.6% |
| ***Office of Polar Programs*** | ***$270.87*** | | ***$267.00*** | ***-$3.87*** | ***-1.4%*** |
| **Major Research Facilities Construction Investments** | **$266.38** | | **$268.00** | **$1.62** | **0.6%** |
| **R&RA Design Stage Activities[3]** | **$33.38** | | **$18.00** | **-$15.38** | **-46.1%** |
| **Major Research Equipment and Facilities Construction (MREFC)** | **$233.00** | | **$250.00** | **$17.00** | **7.3%** |
| **Total, Major Research Facilities** | **$1,332.11** | | **$1,013.00** | **-$319.11** | **-24.0%** |

ATLAS and CMS operation proposed to be reduced by ~ 40%

Next steps:

- ❑ Congress (Senate and House mark-ups → reconciliation bill); traditionally, budget can be partially restored
- ❑ A budget appropriation (decision) is needed by Sept 30th, otherwise US government operates under Continuing Resolution

# US NAS report ”Elementary Particle Physics: The Higgs and beyond”, released on 11 June

NATIONAL ACADEMIES Sciences Engineering Medicine

At the request of DOE and NSF to set a **long-term vision** for the field
Previous decadal study in 2006

Report available at:
https://nap.nationalacademies.org/catalog/28839/elementary-particle-physics-the-higgs-and-beyond

## Elementary Particle Physics: The Higgs and beyond

SHARE

# The charge to the Committee

The National Academies of Sciences, Engineering, and Medicine will convene an ad hoc committee to:

- ❑ Identify the fundamental questions in particle physics that could motivate research in the next decade and beyond*, irrespective of the tools and techniques to address them.
- ❑ Distinguish which of these questions could be addressed with available experimental and theoretical tools in the coming decade and which could require new techniques or approaches.
- ❑ Suggest technical research areas that could provide particle physics with new tools needed to enable new techniques and approaches.
- ❑ Suggest different ways of thinking and alternative approaches from other areas of science that could be incorporated into and benefit the overall particle physics enterprise.

* In agreement with the sponsors, the committee interpreted 'next decade and beyond' as a **40-year time horizon** and that workforce was implicitly included in the scope of the charge.

Main features of the NAS report (in comparison to the P5 process and report):

- ❑ Longer term
- ❑ No budget constraints/scenarios
- ❑ High-level vision, no discussion of detailed projects

# Committee's members

- **Maria Spiropulu**; *Co-Chair*, California Institute of Technology
- **Michael S. Turner**; NAS, *Co-Chair*, UCLA
- **Nima Arkani-Hamed**; NAS, Institute for Advanced Study
- **Barry C. Barish**; NAS, California Institute of Technology
- **John F. Beacom**; The Ohio State University
- **Philip H. Bucksbaum**; NAS, Stanford University
- **Marcela Carena**; Perimeter Institute for Theoretical Physics
- **Bonnie Fleming**; NAS, Fermilab/UChicago
- **Fabiola Gianotti**; NAS, CERN
- **David J. Gross**; NAS, University of California, Santa Barbara
- **Salman Habib**; Argonne National Lab
- **Young-Kee Kim**; NAS, The University of Chicago
- **Piermaria J. Oddone**; NAS, Emeritus Fermilab/Lawrence Berkeley National Laboratory
- **Fulvia Pilat**; Oak Ridge National Laboratory
- **Natalie Roe**; Lawrence Berkeley National Laboratory
- **Tim Tait**; University of California, Irvine

# Main recommendations (out of total of 8) relevant to CERN

**Recommendation 1: The United States should host the world's highest-energy elementary particle collider around the middle of the century. This requires the immediate creation of a national muon collider research and development program to enable the construction of a demonstrator of the key new technologies and their integration.**

**Recommendation 2: The United States should participate in the international Future Circular Collider Higgs factory currently under study at CERN to unravel the physics of the Higgs boson.**

**Recommendation 3: The United States should continue to pursue and develop new approaches to questions ranging from neutrino physics and tests of fundamental symmetries to the mysteries of dark matter, dark energy, cosmic inflation, and the excess of matter over antimatter in the universe.**

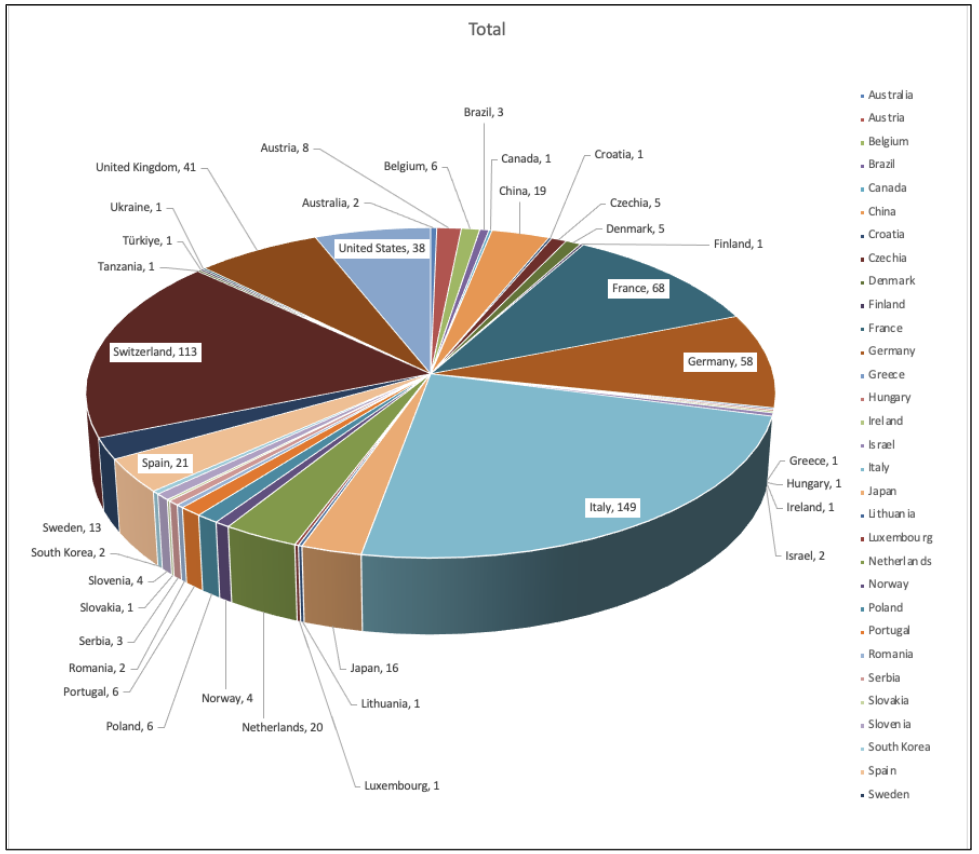
**Recommendation 7: The United States should engage internationally through existing and new partnerships and explore new cooperative planning mechanisms.**

Particle physics programs of CERN and the United States have become interdependent to the mutual benefit of both. American involvement at CERN is now a major element in the U.S. program. It is important for the United States to be more involved in the decision-making process.

# Status of the European Strategy for Particle Physics

# ESPP timeline

# ESPP Open Symposium, Venice, June 23-28


~ 630 in-person participants and ~ 720 remote participants per day

Many thanks to INFN and the Local Organizing Committee chaired by Sandra Malvezzi

# European Strategy Group (ESG) remit from Council

The remit of the European Strategy Group (ESG), established in June 2024, is to develop an update of the European Strategy for Particle Physics and submit it for approval by the Council. **The aim of the Strategy update should be to develop a visionary and concrete plan that greatly advances human knowledge in fundamental physics through the realisation of the next flagship project at CERN. This plan should attract and value international collaboration and should allow Europe to continue to play a leading role in the field.**

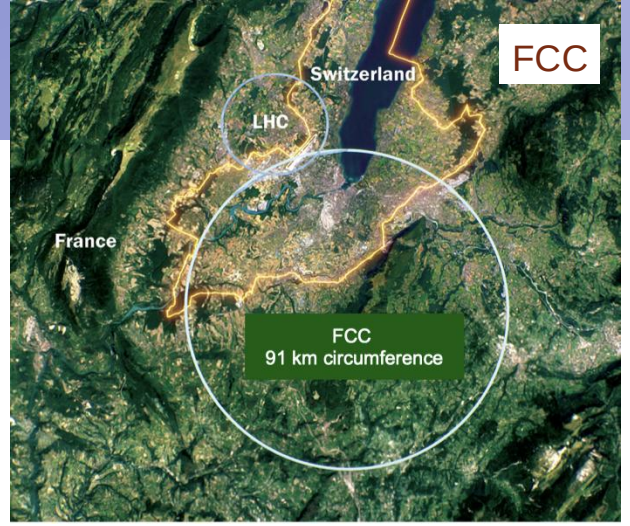
The ESG should take into consideration:

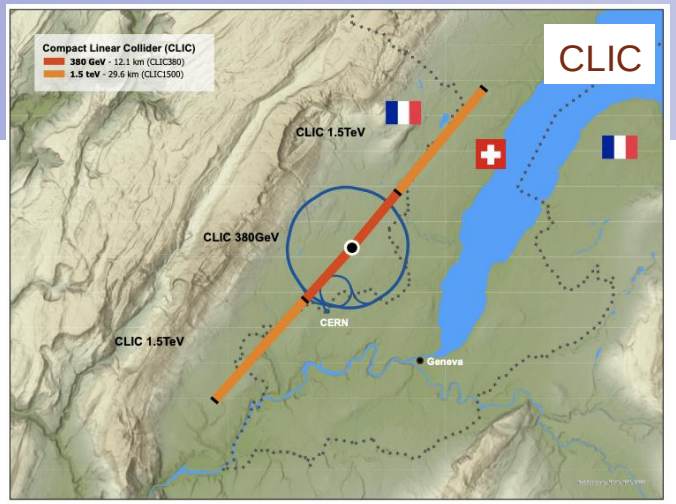
- ❑ the input of the particle physics community;
- ❑ the status of implementation of the 2020 Strategy update;
- ❑ the accomplishments over recent years, including the results from the LHC and other experiments and facilities worldwide, the progress in the construction of the High-Luminosity LHC, the outcome of the Future Circular Collider Feasibility Study, and recent technological developments in accelerator, detector and computing; the international landscape of the field.

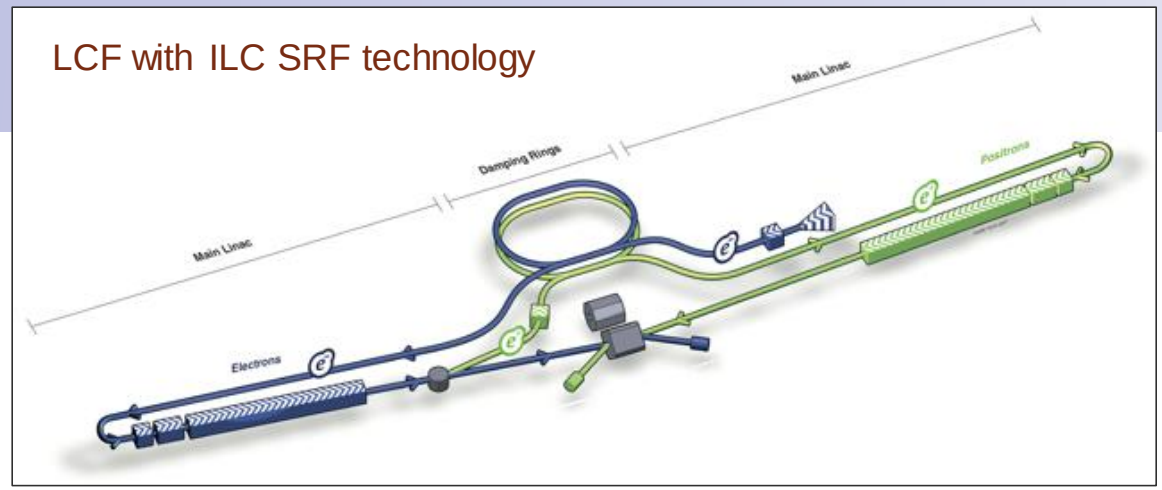
**The Strategy update should include the preferred option for the next collider at CERN and prioritised alternative options to be pursued if the chosen preferred plan turns out not to be feasible or competitive**. The Strategy update should also indicate areas of priority for exploration complementary to colliders and for other experiments to be considered at CERN and at other laboratories in Europe, as well as for participation in projects outside Europe.

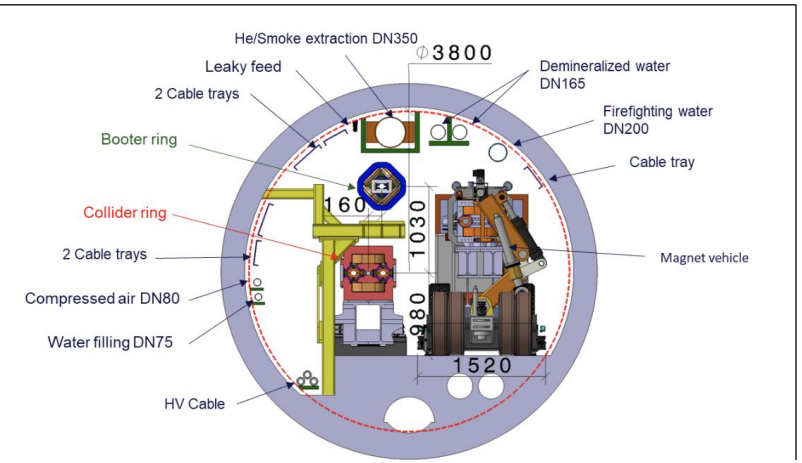
The ESG should review and update the Strategy and add other items identified as relevant to the field, including accelerator, detector and computing R&D, the theory frontier, actions to minimise the environmental impact and to improve the sustainability of accelerator-based particle physics, the strategy and initiatives to attract, train and retain the young generations, public engagement and outreach.

The ESG should submit the proposed Strategy update to the Council by the end of January 2026.



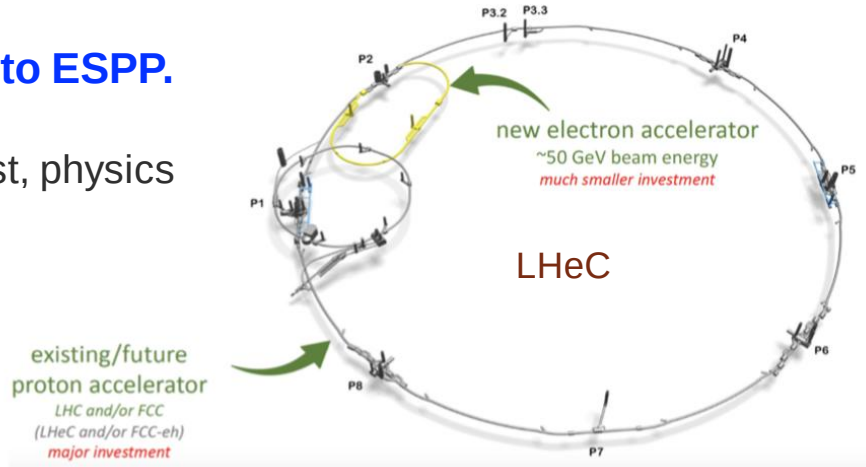



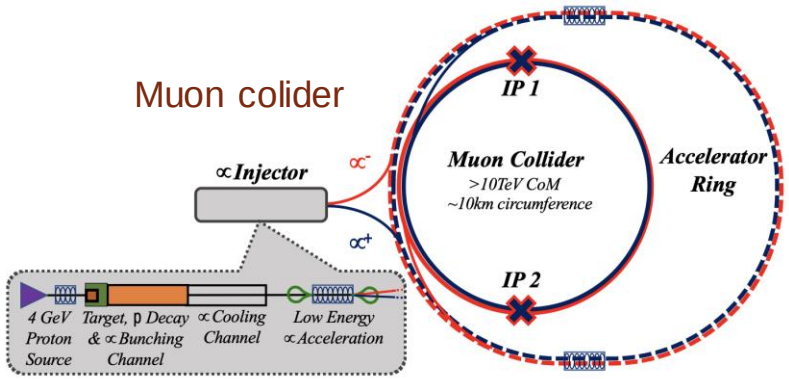



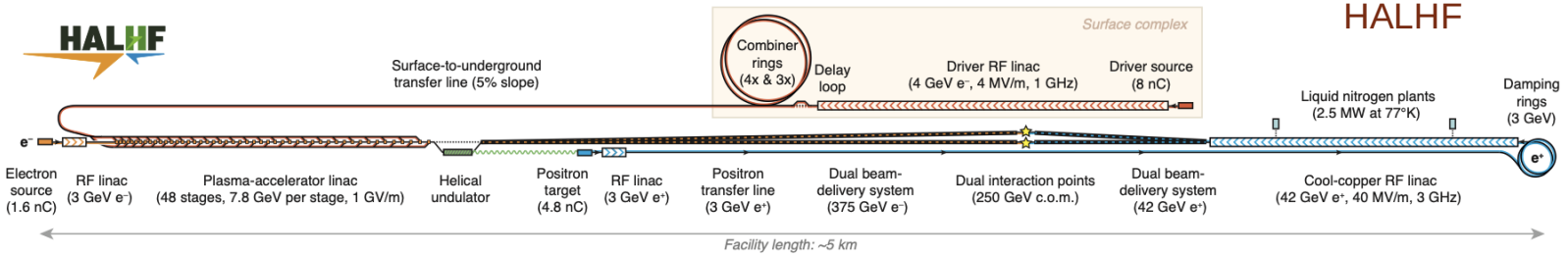

## Future collider proposals submitted to ESPP.

Huge amount of R&D and design work.

Different levels of maturity, time scale, cost, physics reach/performance



# FCC Feasibility Study

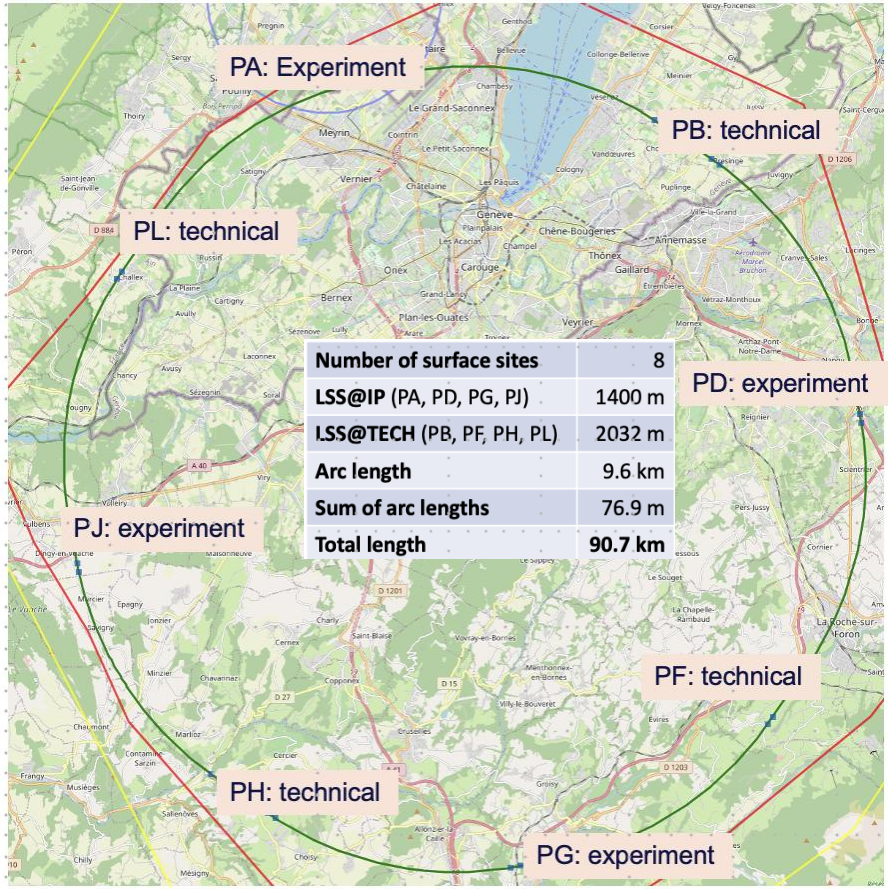
- Started in 2021 → Report completed in March 2025, earlier than initially planned, to align with ESPP input submission deadline
- It covers the geological, technical, environmental and territorial feasibility of a 91-km ring and its infrastructure in the Geneva basin, and scientific potential and required technologies for FCC-ee and FCC-hh.
  Good progress also on financial aspects (→ see later)
- Total cost-to-completion: 83 MCHF

Vol. 1: Physics, Experiments and Detectors (~ 260 pages)
Vol. 2: Accelerators, Technical Infrastructure and Safety (~ 600 pages)
Vol. 3: Civil Engneering, Implementation and Sustainability (~ 330 pages)

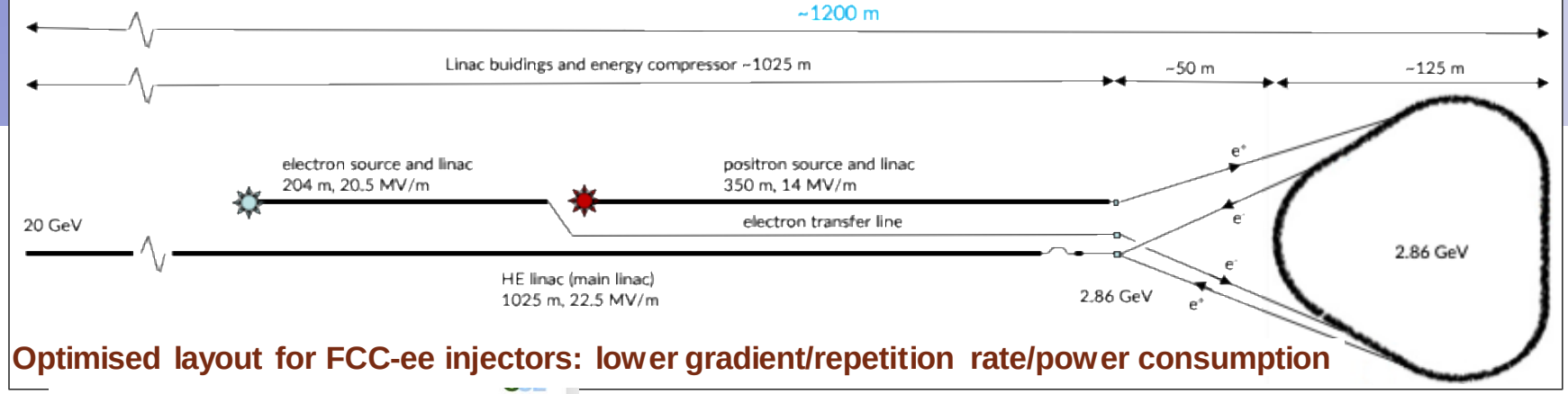
An extraordinary collective effort by the FCC community, involving some 1500 contributors from 162 institutions in 38 countries

The **breadth and depth of the results are unprecedented for a project at this stage of development.**

Report being reviewed by expert committees, and then by Council and its subordinate bodies before end of year.



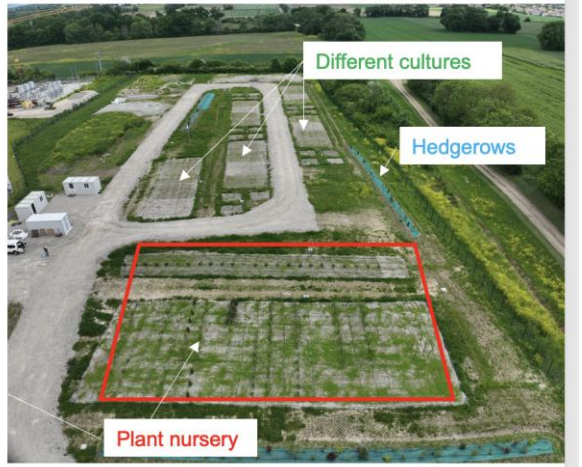

Ring placement selected out of ~ 100 variants taking into account geological, environmental, surface (land availability, access to roads, etc.), infrastructure (water, electricity, transport) constraints, machine performance, etc.




**Optimised layout for FCC-ee injectors: lower gradient/repetition rate/power consumption**

**Geological site investigations: 28 drillings; ~80 km seismic lines**

de 125 ml (surface plateforme estimée : 12 x 12 m soit environ 150 m²)




**OpenSkyLab: to transform molasse into fertile soil;** applicable to any tunnel excavated in North Alpine basin


**Communications campaign targeting local population**

**Environmental initial state analysis**

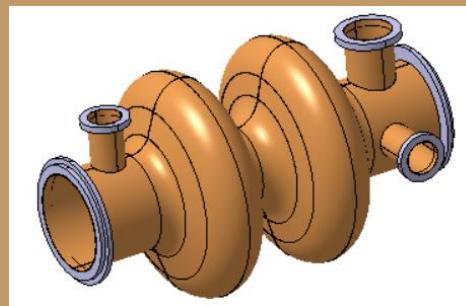
**Single 400 MHz 2-cell cavity for Z, W, ZH operation**

Niobium thin film on Copper

Operation at 4.5 K

Max. accel. gradient 13 MV/m

Quality factor $Q_0$ = 3.3 x $10^9$



**<u>Direct</u> discovery reach (5σ) of FCC-hh at various collision energies**

| Resonance | 100 TeV | 80 TeV | 120 TeV |
|---|---|---|---|
| $Q^*$ | 40 | 33 | 46 |
| $Z'_{TC2} \to t\bar{t}$ | 23 | 20 | 26 |
| $Z'_{SSM} \to t\bar{t}$ | 18 | 15 | 20 |
| $G_{RS} \to WW$ | 22 | 19 | 25 |
| $Z'_{SSM} \to \ell\ell$ | 43 | 36 | 50 |
| $Z'_{SSM} \to \tau\tau$ | 18 | 15 | 20 |

# Building a viable financial path

Updated project cost for FCC-ee up to and including operation at ZH and 4 experiments
t-tbar upgrade requires additional 1.3 BCHF

| Domain | Cost [MCHF] |
|---|---|
| Civil engineering | 6160 |
| Technical infrastructures | 2840 |
| Injectors and transfer lines | 590 |
| Booster and collider | 4140 |
| CERN contribution to four experiments | 290 |
| **FCC-ee total** | **14 020** |
| + Four experiments (non-CERN part) | 1300 |
| **FCC-ee total, including four experiments** | **15 320** |

Funding of FCC (or any other major future collider project) expected to come from two main sources:

- ❑ CERN Budget (i.e. revenues from Member and Associate Member States): would cover more than 50% of FCC investment cost
- ❑ External contributions:
  - additional voluntary contributions (in-cash or in-kind) from Member and Associate Member States
  - contributions from non-Member States
  - exploring possible contributions from the European Union in the next Multiannual Financial Framework (MFF 2028-2034)
  - exploring possible contributions of private donors (→ in Dec 2024, Council approved "*Policy for fundraising from private donors for scientific activities at CERN* ")

→ good progress over the past months

Several funding scenarios developed, based on different assumptions (e.g. constant or slightly increased CERN Budget)
→ ongoing discussions in Council

# FCC Feasibilty Study and FCC study continuation ("pre-TDR phase")

| in MCHF | 2021-2023 | 2024 | 2025 | 2026 | 2027 | Total |
|---|---|---|---|---|---|---|
| **FCC feasibility phase** | **44.2** | **29.7** | **9.3** | | | **83.2** |
| *Material* | *21.4* | *18.0* | *6.1* | | | *45.5* |
| *Staff* | *22.8* | *11.7* | *3.2* | | | *37.7* |
| **FCC study continuation** | | | **41.0** | **54.7** | **58.9** | **154.5** |
| *Material* | | | *24.5* | *27.9* | *29.9* | *82.4* |
| *Staff* | | | *16.4* | *26.8* | *29.0* | *72.1* |
| **Total** | **44.2** | **29.7** | **50.2** | **54.7** | **58.9** | **237.7** |

Note: Budget allocations for 2026 and 2027 are dependent on Council's conclusions on the Feasibility Study in November 2025

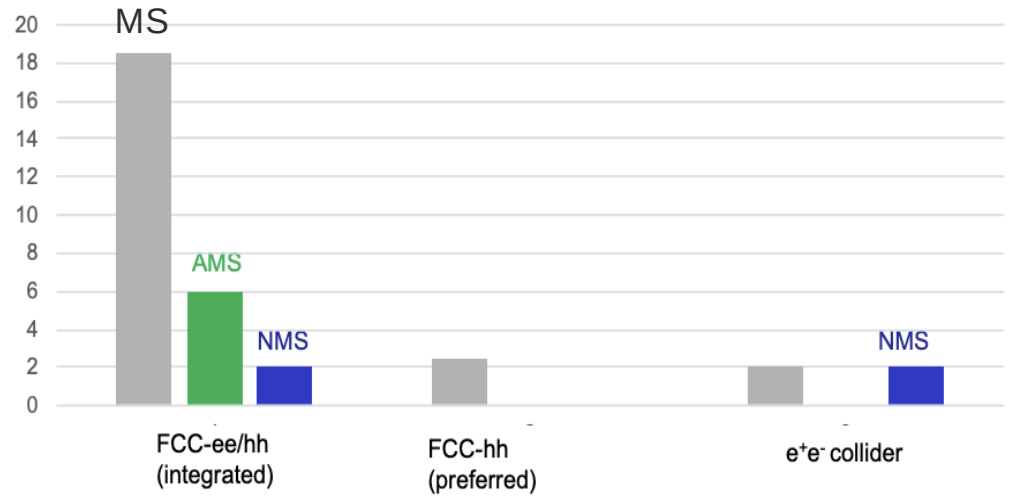
The FCC study continuation will bring the project to the level needed by the Council to take a decision in ~ 2028 on whether or not FCC should go ahead. It covers the period April 2025 to end 2027.

Main goal: further develop the civil engineering and technical components and their integration, in particular to provide a consolidated cost estimate with reduced uncertainties (aim at Class 2 uncertainty for main components, i.e. -5 to -15% / +5 to +20%)

Total funding of ~ 154 M over 2.5 years for:
-- detailed R&D and design study of main technical components and civil engineering to reduce cost uncertainty
-- full project integration study, as needed for consolidated cost estimate
-- environmental impact study (quantitative analysis of impact of FCC-ee components and mitigation measures)
-- CERN contribution to detector conceptual design and integration studies
-- implement long-term recommendations of committees

# National input to the ESPP

## Preferred option




| | |
|---|---|
| FCC-ee/hh (integrated) | MS: Belgium, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Israel, Italy, Norway, Poland, Portugal, Romania, Slovak Republic, Spain, Sweden, Switzerland, (United Kingdom)<br>AMS: Brazil, Croatia, Lithuania, Pakistan, Slovenia, Ukraine<br>NMS: Canada, USA |
| FCC-hh preferred (but accept ee first) | Czech Republic, Serbia, (United Kingdom) |
| $e^+e^-$ collider | MS: Austria, Bulgaria<br>NMS: Australia, Japan |

K. Jakobs, CERN Council, 20th June 2025

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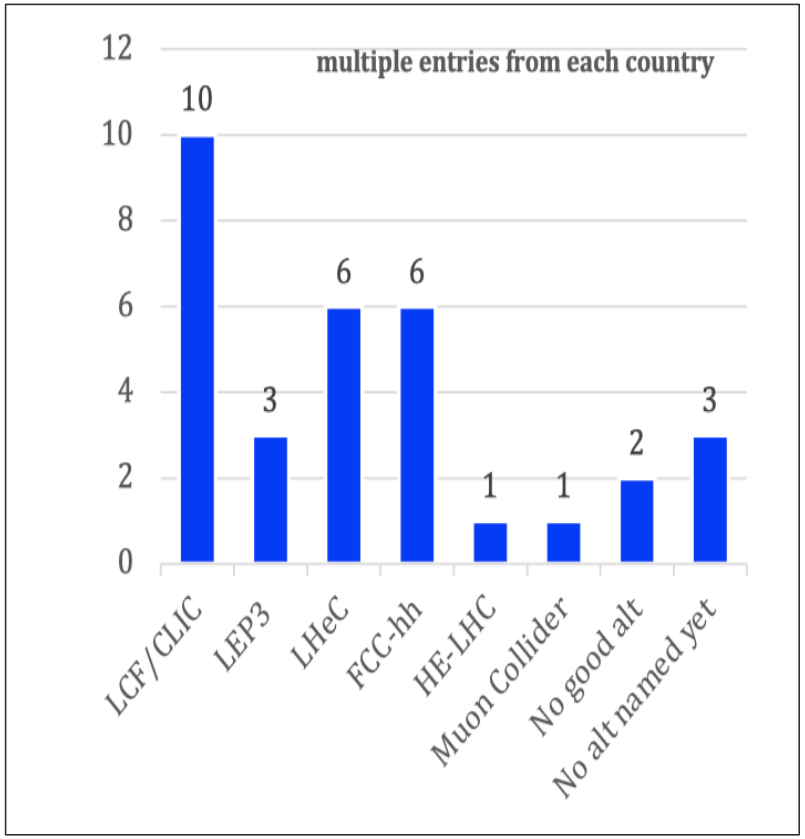
## Alternative if preferred option not feasible




Publicly available at: https://indico.cern.ch/event/1439855/contributions/
Summary compiled by European Strategy Group

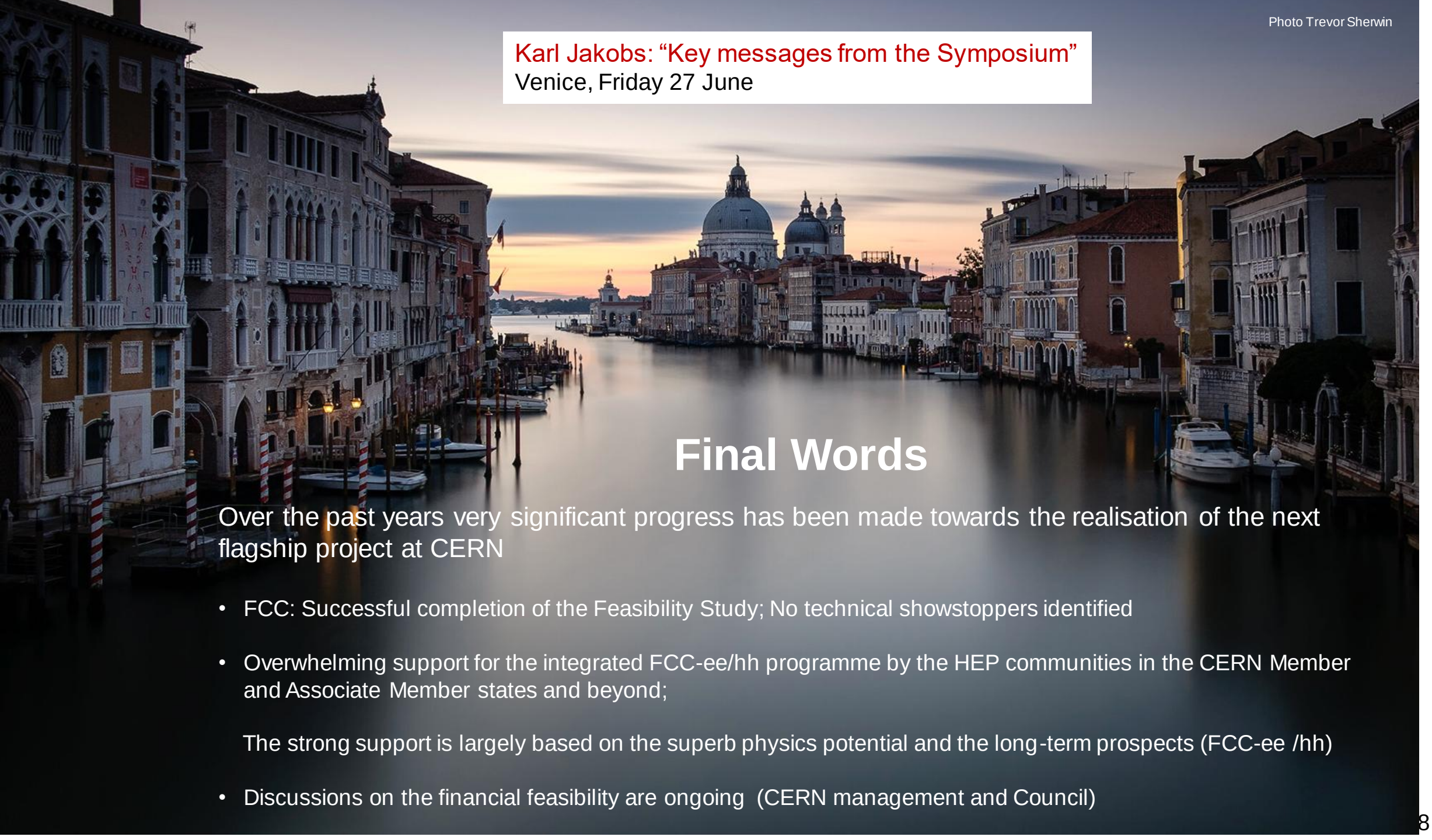


Photo Trevor Sherwin

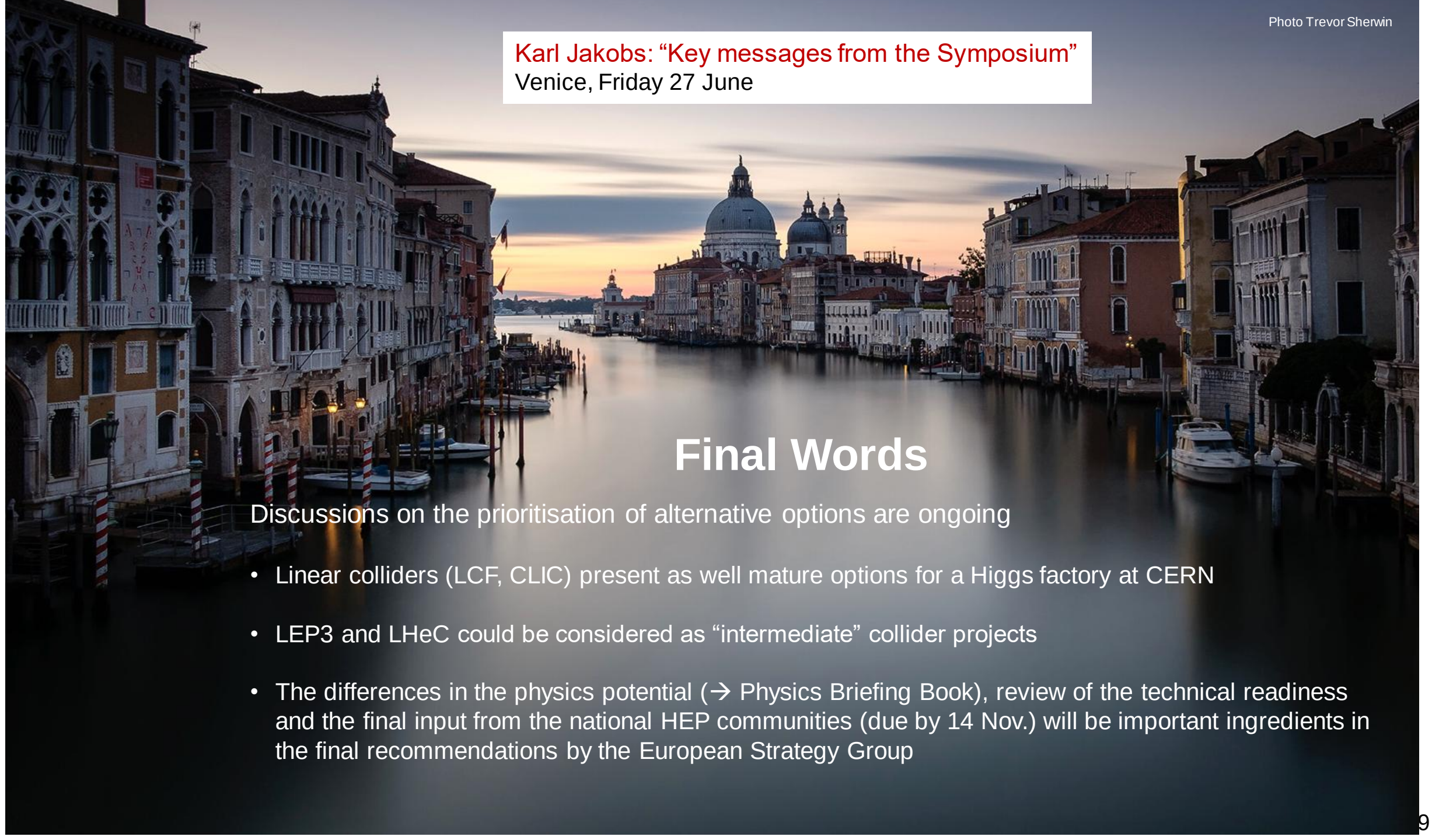
Karl Jakobs: “Key messages from the Symposium”
Venice, Friday 27 June

# Final Words

Over the past years very significant progress has been made towards the realisation of the next flagship project at CERN

- FCC: Successful completion of the Feasibility Study; No technical showstoppers identified
- Overwhelming support for the integrated FCC-ee/hh programme by the HEP communities in the CERN Member and Associate Member states and beyond;

  The strong support is largely based on the superb physics potential and the long-term prospects (FCC-ee /hh)
- Discussions on the financial feasibility are ongoing (CERN management and Council)



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# Final Words

Discussions on the prioritisation of alternative options are ongoing

- Linear colliders (LCF, CLIC) present as well mature options for a Higgs factory at CERN
- LEP3 and LHeC could be considered as “intermediate” collider projects
- The differences in the physics potential (→ Physics Briefing Book), review of the technical readiness and the final input from the national HEP communities (due by 14 Nov.) will be important ingredients in the final recommendations by the European Strategy Group

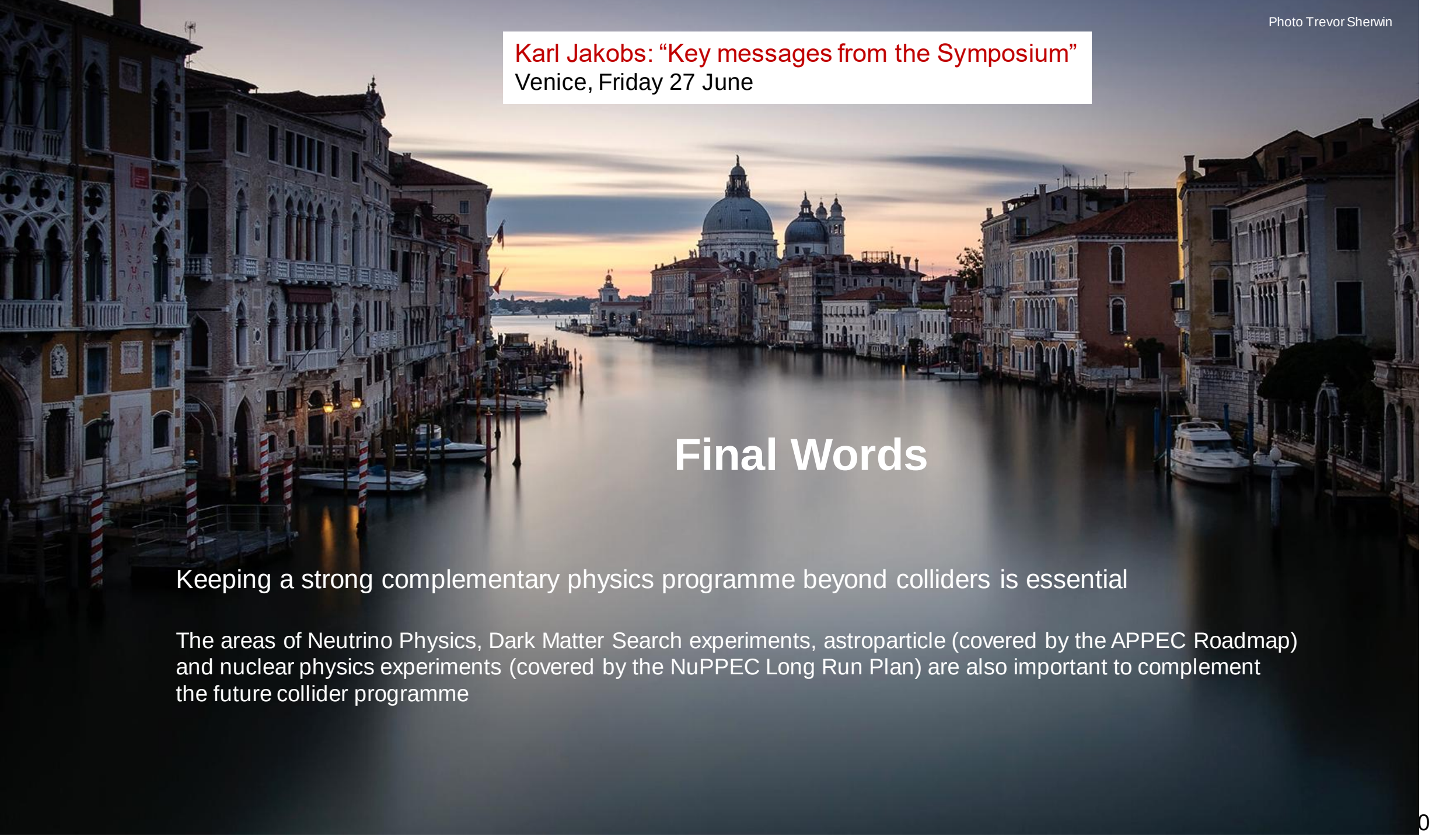

Photo Trevor Sherwin

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Venice, Friday 27 June

# Final Words

Keeping a strong complementary physics programme beyond colliders is essential

The areas of Neutrino Physics, Dark Matter Search experiments, astroparticle (covered by the APPEC Roadmap) and nuclear physics experiments (covered by the NuPPEC Long Run Plan) are also important to complement the future collider programme

# NAS report: other recommendations

**Recommendation 4: The United States should explore new synergistic partnerships across traditional science disciplines and funding boundaries.**

**Recommendation 5: The United States should invest for the long journey ahead with sustained research and development funding in accelerator science and technology, advanced instrumentation, all aspects of computing, emerging technologies from other disciplines, and a healthy core research program.**

**Recommendation 6: The federal government should provide the means and the particle physics community should take responsibility for recruiting, training, mentoring, and retaining the highly motivated student and postdoctoral workforce required for the success of the field's ambitious science goals.**

**Recommendation 8: Funding agencies, national laboratories, and universities should work to minimize the environmental impact of particle physics research and facilities.**

# CERN family is growing

**25** Member States:

Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, **Slovenia***, Serbia, Spain, Sweden, Switzerland, United Kingdom

* Joined on 21 June, flag-raising ceremony tomorrow

**9** Associate Member States:

Brazil, Croatia, Cyprus, India, Latvia, Lithuania, Pakistan, Türkiye, Ukraine

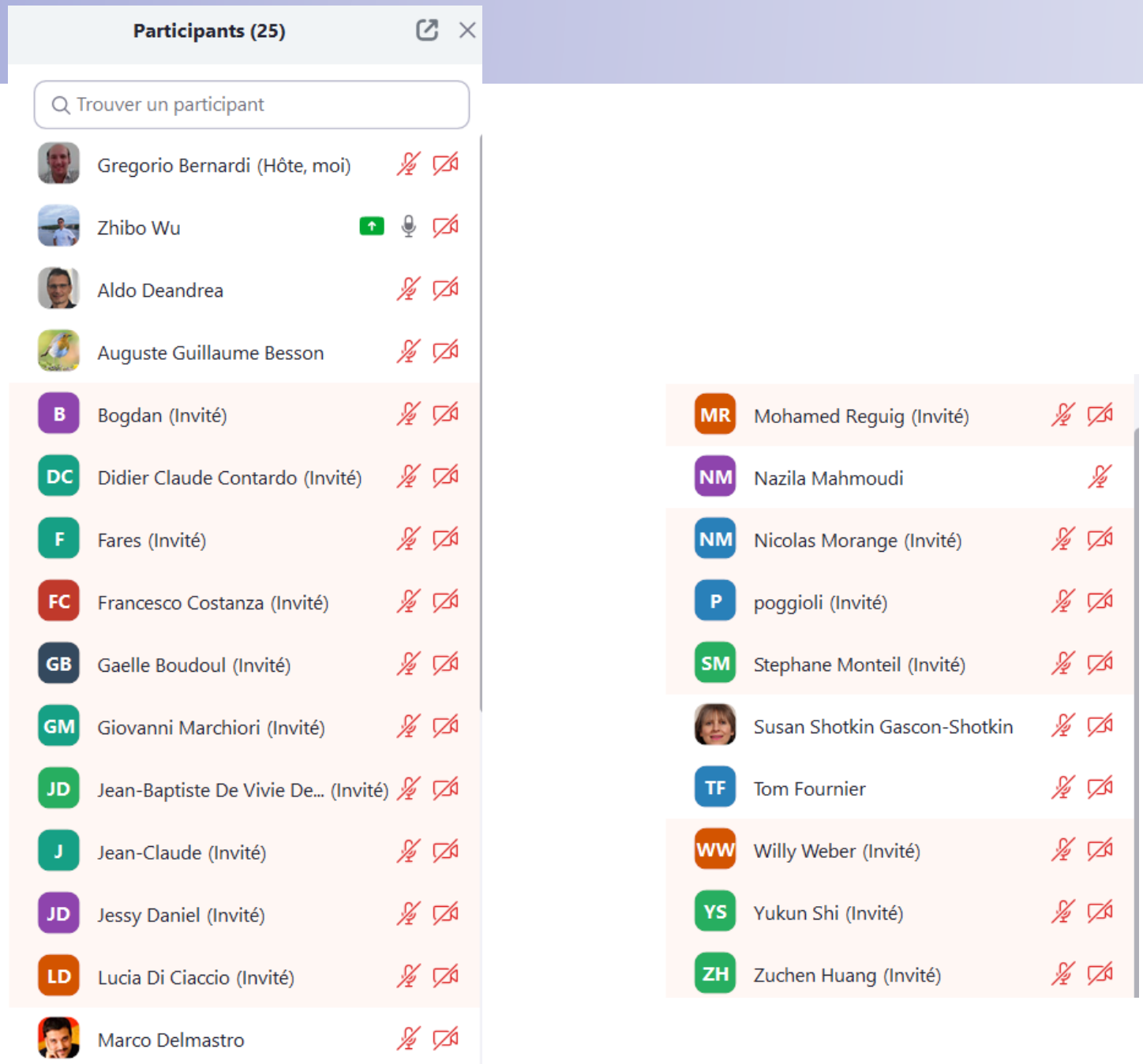
**4** Observers:

Japan, USA, European Union, UNESCO

**~ 50** ICA (International Cooperation Agreements):

with non-Member States, some with countries with developing particle physics communities (CERN mission is also to help build capacity and foster growth of particle physics worldwide).

Agreements admitting Chile and Ireland as Associate Member States signed in May.
They will enter into force once countries complete all necessary accession and ratification processses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Trouver un participant
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