FCC Community Building

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FCC Physics Workshop 2025 @ CERN
13 January 2025

http://cern.ch/fcc

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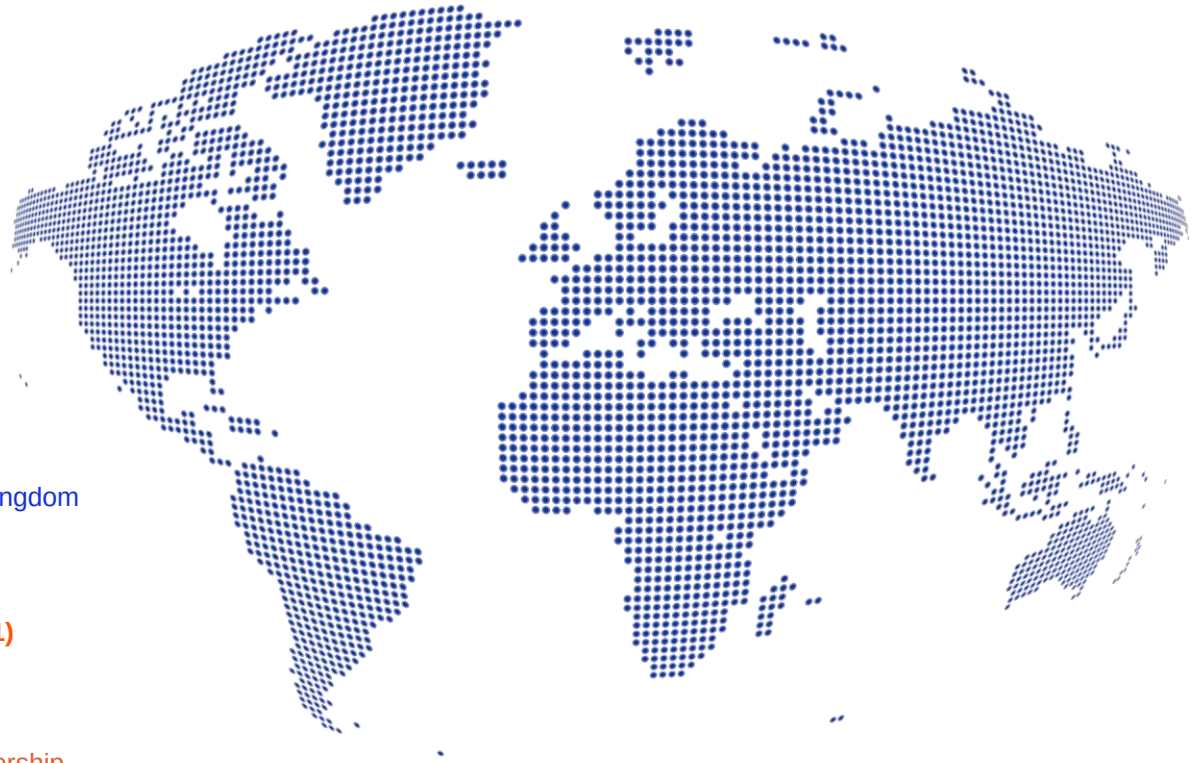
European Commission | Horizon 2020 European Union funding for Research & Innovation

photo: J. Wenninger

The example of CERN:
CERN was founded in 1954 with 12 European Member States

Today:



24 Member States (7467 persons)
Austria – Belgium – Bulgaria – Czech Republic
Denmark – Estonia – Finland – France – Germany
Greece – Hungary – Israel – Italy – Netherlands
Norway – Poland – Portugal – Romania – Serbia
Slovakia – Spain – Sweden – Switzerland – United Kingdom

10 Associate Member States (581)
Brazil – Croatia – Cyprus*– India – Latvia – Lithuania
Pakistan – Slovenia* – Türkiye – Ukraine

(*) Associate Member State in the pre-stage to Membership

4 Observers (2226)
Japan – USA – European Union – UNESCO

CERN's annual budget is 1200 MCHF (equivalent to a medium-sized European university)

As of 31 December 2023
Employees:
2666 staff, **1002** graduates
Associates:
12 370 users, **1513** others

Around **50 Cooperation Agreements** with non-Member States and Territories
Albania – Algeria – Argentina – Armenia – Australia – Azerbaijan – Bangladesh – Bolivia – Bosnia and Herzegovina – Canada – Chile – Colombia – Costa Rica – Ecuador – Egypt – Georgia – Honduras – Iceland – Iran – Jordan – Kazakhstan – Lebanon – Malta – Mexico – Mongolia – Montenegro – Morocco – Nepal New Zealand – North Macedonia – Palestine – Paraguay – People's Republic of China – Peru Philippines – Qatar – Republic of Korea – Saudi Arabia – Sri Lanka – South Africa – Thailand – Tunisia – United Arab Emirates – Vietnam

Geographical & cultural diversity
Users of **110 nationalities, 22.5 % women**

FCC Community building, why do we care ?

Community building is critical for the success of the FCC project, because it fosters political, public, and financial support, encourages scientific collaboration and interdisciplinary innovation, promotes education and outreach, and helps ensure the project's long-term impact and sustainability.

By creating an engaged, well-informed, and enthusiastic community, the FCC can position itself not only as a ground breaking scientific endeavour but as a global, inclusive project with far-reaching benefits for society.

➔ The FCC collaboration gives high priority to Collaboration building, to achieve global objectives which will permit the scientific success of the project:

- Establish a Global Scientific Network
- Develop Transdisciplinary Collaboration
- Inspire the Next Generation of Scientists and Engineers
- Convince society to fund such a visionary project:

Recommendations of the FCC feasibility study mid-term review committee related to the FCC community development

1. to work with the scientific community, institutes, laboratories and funding agencies to ensure support and resources for **four experiments**, facilitating the exploitation of the full scientific potential offered by the large investment in the FCC-ee facility;

2. to dedicate additional human and financial resources to the project, with a resource-loaded schedule of work and clear priorities;

3. to develop the coordination and structure to enable theoretical work needed to match the anticipated experimental precision of the FCC data, both at CERN (fellows, scientific associates, visitors) and by engaging Collaborating Institutes (e.g., European networks);

4. to establish a dedicated FCC team in the CERN research sector, with specific new positions associated, and to quantify its size and makeup in terms of seniority so that the resources required can be estimated.

➔Medium Term Plan (MTP) for the period 2025-2029 / Theory effort

In June 2024, the CERN Council approved the **Medium Term Plan** (MTP) for the period 2025-2029, including the funding of a bottom-up resource request for FCC specific new positions:

→ dedicated new positions (fellows, students,scientific associates, visitors) over the next three years.

- → strong signal to the HEP community worldwide of the host lab commitment to FCC.
- → Past experience has shown that even a moderately-sized host-lab group crucial leverage on contributions from the particle-physics community at other institutes.
- → We expect that the creation of this group will be a strong incentive for CERN contract holders to reassign part of their time to the FCC project.

→ Many more engineers and detector physicists will be needed soon

The coordination and structuring of the **theoretical work** needed to match the anticipated experimental precision of the FCC data has started during the Feasibility Study.

Several successful mini workshops were organised (Targets and Tools, Flavour Physics Programme, BSM Physics Programme, Higgs/Top/EW Physics Programme, Parton Shower, Phenomenology) with an attendance between 100 and 350 participants.

The CERN/TH FCC team currently consists of three physicists, with the occasional participation of up to eight staffs and fellows. More dedicated resources will be needed for a worldwide organization during the pre-TDR phase.

The FCC Approach to Global Collaboration

- FCC Collaboration being formed through a **global, two-way and integrative process**, while being **geographically balanced** and **topically complementary**.

- Open to **areas beyond conventional accelerator R&D** (environment & sustainability; education & training; knowledge transfer to society; & public engagement) and in areas that are **non-core activities** for CERN (e.g. geology, geodesy, logistics & materials science).

- Prepare foundations for **industrial R&D** and contributions via national laboratories, institutes and universities.

- CERN is engaging in **discussions with potential major partners** as part of the FCC Feasibility Study for such a global project being hosted at CERN.

FCC Global Collaboration Working Group (FGC)

- Engage with the participants - **national laboratories, institutes and universities** as well as **industry** in the MS, AMS and NMS - to carry out the following mandate:

  - Encourage an **expanded membership**.
  - Explore **opportunities** for future prospective participants.
  - Support new participants in **application process**.
  - Assist the new participants in defining **areas of collaboration**.
  - Conclude relevant **agreements**.
  - Facilitate the **integration** process.
  - Facilitate interest in **CERN non-core areas** - geology, geodesy, logistics, materials science.
  - Prepare the foundations for R&D and contributions by **industry.**
  - Liaise with **national contact persons** and **forums**.

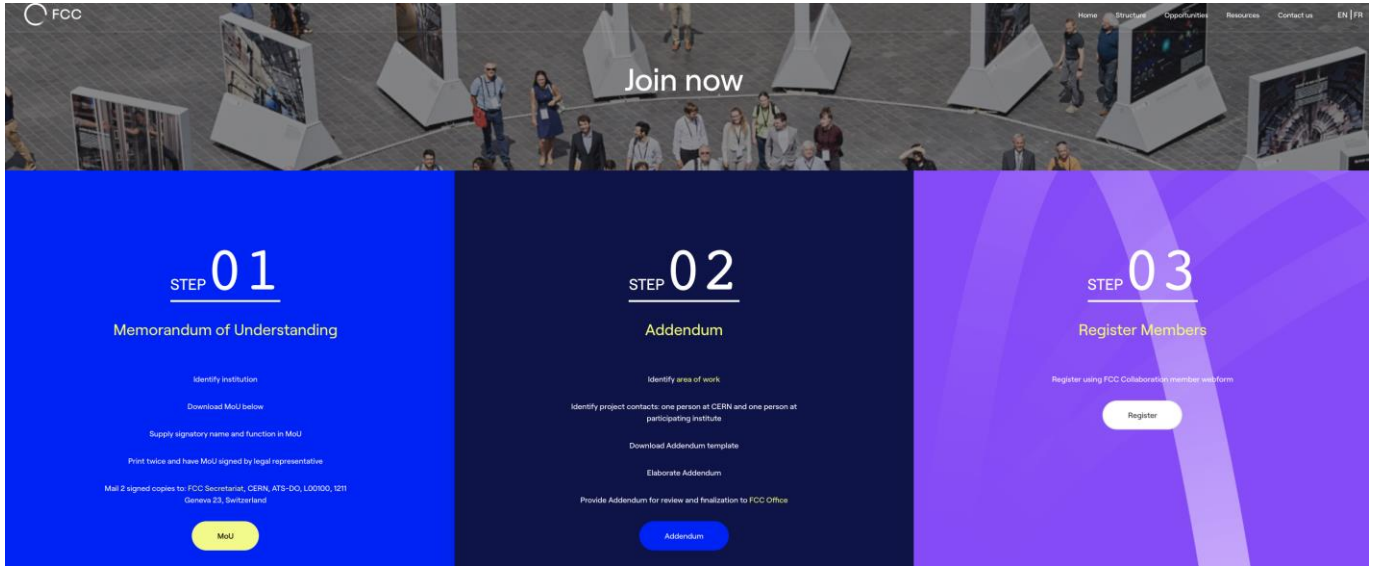
Convened by Emmanuel Tsesmelis (CERN International Relations)

FCC Feasibility Study Collaboration Membership

Participation in FCC through **MoU and Addenda**.

The FCC MoU for the first phase of the study is being **updated to cover the Feasibility Study**.

The current participating institutes who wish to take part in the Feasibility Study can continue to participate on the basis of the previously signed MoU until the updated MoU is signed.



https://fccis.web.cern.ch/join-now

FCC Engagement Meetings

Overview

- Extended forums with interested countries to discuss collaboration with FCC.
- Topics:
  - Introduction to FCC Feasibility Study.
  - Presentation of FCC physics, experiment, detector, accelerator and global collaboration.
  - Presentations from the country scientific community.

Meetings

- Mexico (mini meeting on accelerator)
  - June 2021
- Republic of Korea
  - September 2021
- Pakistan
  - September 2021
- Portugal
  - November 2021
- Estonia
  - March 2022
- Greece
  - January 2023, June 2023
- India
  - September 2024
- Lithuania
  - 2025 (date to be confirmed)

Much interest expressed by participating countries and the FCC looks forward to stronger / deeper involvement in the follow-up.

FCC Collaboration Meetings

FCC Week 2024
San Francisco, USA

449 participants

374 in person and 75 remote

US Institutes in FCC

More than 40 US institutes expressed interest to join the FCC at the US FCC Workshop in April 2023
Participation being formalized through conclusion of separate MoUs

Institutes that have already signed an FCC MoU for the Feasibility Study Phase.

Northern Illinois University
University of Iowa
University of Houston
Cornell University
University of New Mexico
University of California Santa Barbara

Addendum III to Accelerator Protocol III between CERN and the DOE

Institutes that have signed an FCC MoU for the Conceptual Design Phase

Center for Accelerator Science and Education
The Department of Energy of the United States of America
Brookhaven National Laboratory (part of DOE)
Duke University
Jefferson Lab
Massachusetts Institute of Technology (MIT)
Northern Illinois University
Stanford University
University of California, Irvine
University of California Santa Barbara
University of Houston
The University of Iowa
University of Michigan

Statement of Intent – CERN & USA

CERN and the US government have released a joint statement concerning future planning for large research infrastructures, advanced scientific computing and open science.

CERN and the US intend to enhance collaboration in planning activities for large-scale, resource-intensive facilities with the goal of providing a sustainable and responsible pathway for the peaceful use of future accelerator technologies.

"Should the CERN Member States determine the FCC-ee is likely to be CERN's next world-leading research facility following the high-luminosity Large Hadron Collider, the United States intends to collaborate on its construction and physics exploitation, subject to appropriate domestic approvals."

CERN Director-General, Fabiola Gianotti (right), and Principal Deputy US Chief Technology Officer, Deirdre Mulligan, of the White House Office of Science and Technology (left) at the signing ceremony. (Image:US Department of State, Bureau of Oceans & International Environmental & Scientific Affairs)

Washington, D.C., 26 April 2024

Alltogether, 39 MoUs signed since June 2023….

(in this page those signed before June 2024)

INSTITUTION	COUNTRY
Grand Accélérateur National d'Ions Lourds (GANIL)	France
Indian Institute of Technology Hyderabad	India
University of Petroleum and Energy Studies	India
Università degli studi Roma Tre	Italy
Vinča Institute of Nuclear Sciences	Serbia
Gangneung-Wonju National University	South Korea
Hanyang University	South Korea
Kyung Hee University	South Korea
Kyungpook National University	South Korea
Pusan National University	South Korea
Sungkyunkwan University	South Korea
University of Seoul	South Korea
Yonsei University	South Korea
Uppsala University	Sweden
Chulalongkorn University	Thailand
Srinakharinwirot University	Thailand
Thailand Center of Excellence in Physics	Thailand
İzmir Bakırçay Üniversitesi	Türkiye
Akdeniz University	Türkiye
Uludag University	Türkiye
Brookhaven National Laboratory	United States
Cornell University	United States
The University of New Mexico	United States

in this page those signed after June 2024:

Pontificia Universidad Católica de Chile (PUC)	Chile
SAPHIR Millenium Institute	Chile
Universidad Nacional de Colombia (UNAL)	Colombia
Georgian Technical University (GTU)	Georgia
University of Miskolc	Hungary
Universidad Autonoma de Sinaloa (UAS)	Mexico
Centro de Investigación y de Estudios Avanzados del IPN (CINVESTAV)	Mexico
National Institute for Research and Development of Isotopic and Molecular Technologies (INCDTIM)	Romania
Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering (IFIN-HH)	Romania
Taras Shevchenko National University of Kyiv (TSNUK)	Ukraine
V. N. Karazin Kharkiv National University	Ukraine
Kharkiv Institute of Physics and Technology (NSC KIPT)	Ukraine
Bogolyubov Institute for Theoretical Physics (BITP), National Academy of Sciences of Ukraine	Ukraine
Institute for Scintillating Materials (ISMA), National Academy of Sciences of Ukraine	Ukraine
Imperial College London (ICL)	United Kingdom
University of Manchester	United Kingdom

…for a total of around 160 fully-signed Feasibility Study MoUs

FUTURE CIRCULAR COLLIDER

Signing Ceremony of FCC Feasibility Study MoU with Ukraine

Friday Jan 10, 2025, 10:30 AM → 11:35 AM Europe/Zurich

30/7-010 (CERN)

BITP-MoU | ISMA-MoU | Karazin-MoU | NSC-KIPT-MoU | TSNUK-MoU

zoom MoU signature with Ukraine

10:30 AM → 10:35 AM **Welcome**

Speaker: Emmanuel Tsesmelis (CERN)

10:35 AM → 10:42 AM **Introduction to the FCC and Collaboration**

Speaker: Michael Benedikt (CERN)

10:42 AM → 11:17 AM **Comments from Universities and Research Institutes from Ukraine**

Volodymyr Bugrov – Rector, Taras Shevchenko National University of Kyiv (TSNUK)

Tetyana Kaganovska - Rector, V. N. Karazin Kharkiv National University

Mykola Azarenkov - Director, Kharkiv Institute of Physics and Technology (NSC KIPT)

Sergiy M. Perepelytsya – Director, Bogolyubov Institute for Theoretical Physics (BITP), National Academy of Sciences of Ukraine, Kyiv

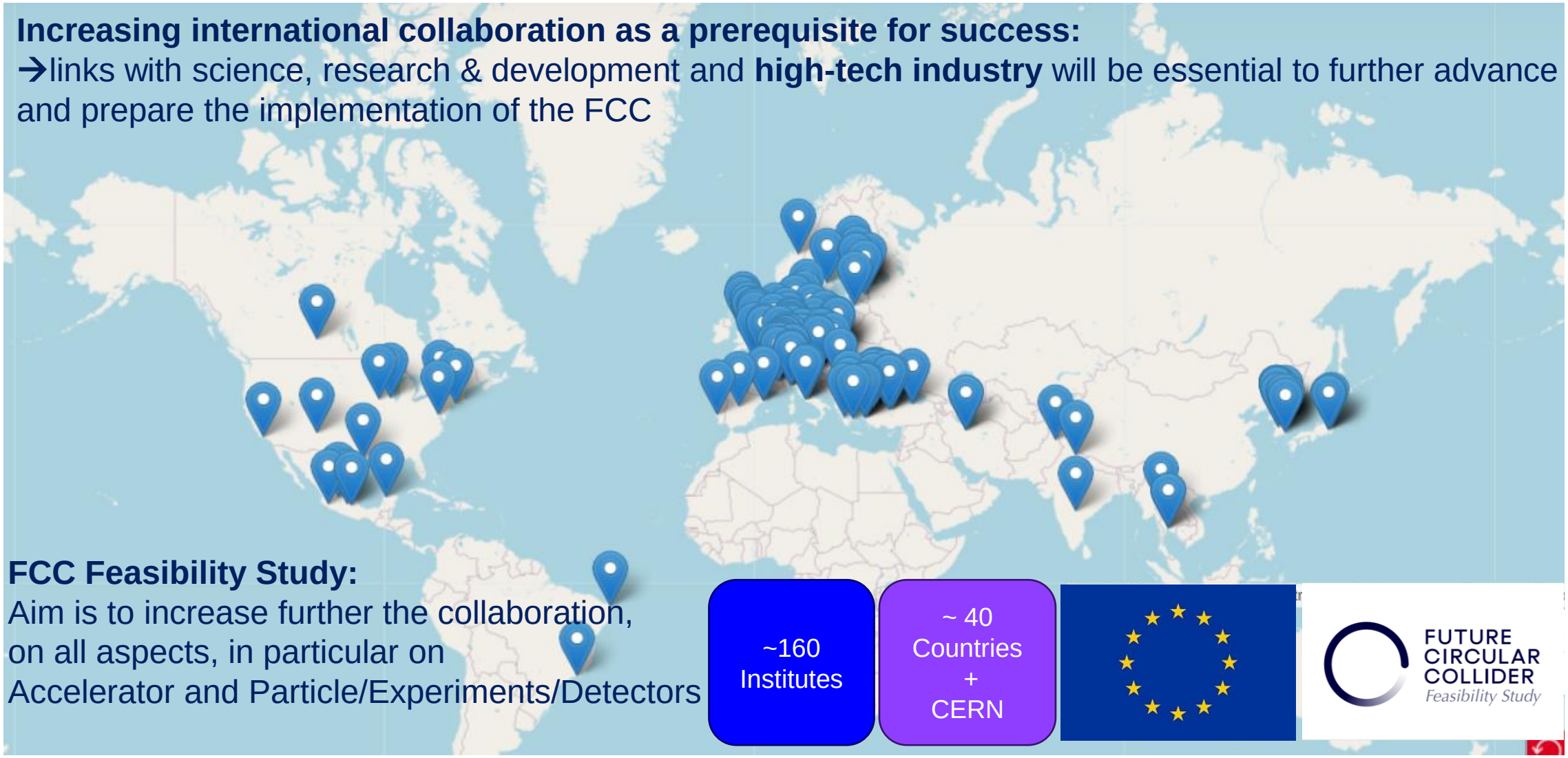
Borys Grynyov - Director, Institute for Scintillating Materials (ISMA), National Academy of Sciences of Ukraine, Kharkiv

11:17 AM → 11:30 AM **Signing of FCC Feasibility Study MoU with Universities and Reserach Institutes from Ukraine**

UKRAINE - FCC MOU SIGNAGE CEREMONY (January 10, 2025):

Status of the FCC Global Collaboration

Increasing international collaboration as a prerequisite for success:
→links with science, research & development and **high-tech industry** will be essential to further advance and prepare the implementation of the FCC



FCC Feasibility Study:
Aim is to increase further the collaboration, on all aspects, in particular on Accelerator and Particle/Experiments/Detectors

~160 Institutes

~ 40 Countries + CERN

FUTURE CIRCULAR COLLIDER
Feasibility Study

FCC Feasibility Study

EU Projects
NN

Collaboration building
Gregorio Bernardi, Tadeusz Lesiak, Emmanuel Tsesmelis,

Communications
Panagiotis Charitos, Arnaud Marsollier

Study Support and Coordination
Study Leader: Michael Benedikt
Deputy Study Leader: Frank Zimmermann

Study Support Unit
IT: Sylvain Girod
Procurement: Adam Horridge
Quality management: Beatriz Arias
Resources: Sylvie Prodon
Secretariat: Julie Hadre, Jeanette Kotzian

IFNC
G.B. / T.L.

Physics, Experiments and Detectors
Patrick Janot, Christophe Grojean

- **Physics programme** — Matthew McCullough, Frank Simon
- **Detector concept** — Mogens Dam, Marc-André Pleier, Felix Sefkow
- **Physics performance** — Patrizia Azzi, Emmanuel Perez, Michele Selvaggi
- **Software and computing** — Gerardo Ganis, Brieuc François

Accelerators
Tor Raubenheimer
Frank Zimmermann

- **FCC-ee accelerator design** — Christian Carli, Frank Zimmermann
- **FCC-ee technical implementation** — Jean-Paul Burnet, Tor Raubenheimer
- **FCC-ee injector** — Paolo Craievich, Alexej Grudiev
- **FCC transfer lines** — Wolfgang Bartmann
- **FCC-hh design** — Massimo Giovannozzi
- **EPOL** — Jacqueline Keintzel, Guy Wilkinson
- **MDI** — Manuela Boscolo, Fabrizio Palla

Technical Infrastructures
Jean-Paul Burnet
Klaus Hanke

- **Integration** — Jean-Pierre Corso
- **Geodesy & survey** — Hélène Mainaud Durand
- **Electricity and energy management** — Jean-Paul Burnet
- **Cooling and ventilation** — Guillermo Peon
- **Cryogenics systems** — Laurent Delprat
- **Computing and controls infrastructure, communication and network** — Pablo Saiz
- **Safety** — Thomas Otto
- **Operation, maintenance, availability, reliability** — Jesper Nielsen
- **Transport, installation concepts** — Roberto Rinaldesi

Host State processes and civil engineering
Timothy Watson

- **Administrative processes** — Friedemann Eder
- **Placement studies** — Johannes Gutleber
- **Environmental evaluation** — Johannes Gutleber
- **Tunnel, subsurface design** — John Osborne
- **Surface sites layout, access and building design** — A. Mayoux

Organisation and financing models
Florian Sonnemann

- **Project organisation model** — NN
- **Financing model** — Florian Sonnemann
- **Procurement strategy and rules** — Anders Unnervik
- **In-kind contributions** — Anders Unnervik
- **Operation model** — Verena Kain

Enlarging the Collaboration Further → 2nd Approach: IFNC

FCC has two approaches: one globally-oriented **(FGC),** as just described, the other more PED oriented **(IFNC),** both to engage with countries with mature communities, a long-standing participation in CERN's programmes and the potential to contribute substantially to the Organization's long-term scientific objectives ➔ facilitate opportunities for national participation in the Feasibility Study and enlarge the HEP community of FCC

International Forum of National Contacts (IFNC)

- **Contact directly Physics groups in a country,** typically from LHC or Future Colliders groups to ask them **to join as new institution**
  - Discuss the physics case and the opportunities
    → To study **R&D/ Detector concepts** for FCC
    → To expand the FCC Physics scope via the study of **physics case studies**
    → To improve the **theoretical calculations** to exploit the FCC physics potential
  - Help **forming a national FCC group in each country**, with strong PED component, which can hold its national FCC meetings, including the Accelerator community when possible
  - Identify one, two or three **National Contacts** to exchange information between country situation and the FCC management, and to strengthen the national community
  - Exchange experience across countries (**IFNC meetings**)
  - Orient the new efforts towards the FCC working groups
  - Establish list of participating institutes and institute contacts **(IFIC)** inside each country

Convened by Gregorio Bernardi and Tadeusz Lesziak (also National Contacts of France and Poland)

Enlarging the Collaboration – IFNC Actions

IFNC: FCC PED Kick-off Meetings (cf. FGC: FCC Engagement Meetings)

- **Overview**
  - Forums with interested countries to discuss collaboration with FCC on PED topics:
    - Introduction to FCC Feasibility Study.
    - Detailed presentations of FCC physics, experiment, detector.
    - More general on accelerator and global collaboration.
- **Recent Kick-off Meetings**
  - Nordic Countries (Denmark, Norway, Sweden, Finland), March 2021
  - India (Bangalore), November 2022
  - Brazil (Rio de Janeiro), March 2023
  - Mexico (Mexico city), November 2024
  - + informal meetings (e.g. ECR Japan in 2024)
- **On-going discussions**

- **Several other initiatives, such as encouraging national meetings; examples since FCC week in Paris:**
  - Joint FCC France-Italy Workshop in 2022 and 2024 **Joint FCC-France & Italy Workshop in Venice** (120 participants)
  - annual US-FCC Workshops in 2023, 2024, 2025 **US FCC Workshop (MIT, March 2024)** ➔ ~42 US institutes signed up for FCC (cf France, UK, Italy, ~13-20 institutes each)
  - In May 2024 German meeting on future Colliders@CERN (150 participants)
  - Many others

FUTURE CIRCULAR COLLIDER

HEP Collaboration Building

- **EOI for subdetectors and proto-detector concepts to be submitted by March 2025**
- **Set-up process for proto-collaborations formation in 2027-2028 if everything goes smoothly**

The CRP recommends to work with the scientific community, institutes, laboratories and funding agencies to ensure support and resources for **four experiments**, facilitating the exploitation of the full scientific potential offered by the large investment in the FCC-ee facility

- Completing list of tasks of the Institutes in the IFNC
- Iterate with National Contacts to gather latest information of possible funding of the HEP teams
- Explore how the countries/institutes position themselves on the current and future potential detector concepts

A possible strategy for pushing further community building in the next five years

- Start with EOI for subdetectors and detector concepts in 2025

- Assuming positive recommendation to push forward by end of 2027 by the CERN Council:
  - Start setting up FCC Committee (FCCC) and proto-collaborations, possibly around proposed detector concepts, following call for CDR.
  - Find a scheme to reduce the number of proto-collaborations (merging) if more than 4 proposals
  - Process could converge by 2030-2031

More discussions on this and on National FCC EOI's tomorrow 14/01 at 6PM in the IFNC meeting

following update ➔ FCC Week 2025 - Vienna

Event Overview

- **Venue**: **Hofburg Palace**, a historical and cultural landmark in **Vienna, Austria**.
- **Dates**: **Monday 19 to Friday 23 May 2025**
- **Presentation of the Feasibility Study Report and review of its findings and opportunities for future R&D projects**

- **Please save the date and join us in Vienna**

70th Anniversary of CERN 2024

"….No European country alone could have built the world's largest particle collider. CERN has become a global hub because it rallied Europe and this is even more crucial today.

I am proud that we have financed the feasibility study for CERN's Future Circular Collider (FCC). This could preserve Europe's scientific edge and could push the boundaries of human knowledge even further. *And as the global science race is on, I want Europe to switch gears. To do so, European unity is our greatest asset. …."*

Ursula von der Leyen, President of the European Commission

Concluding Remarks

Strengthening the FCC Collaboration

Starting from the unequivocal support of the **CERN Host States**, build the support of the **Member States, Associate Member States and non-Member States**.

- The successful realisation of the **LHC** is testament to the **strong and consistent support** CERN received from its **Member States and Associate Member States**.
- CERN Council required significant support from **Non-Member States, including the Observer States**, before giving final approval to the LHC.
- **High-level events** similar to that with the US should be organized with strong statements of intent.

Set up **governance structure** that will encourage participation / contribution / commitment to the FCC.

- FCC requires **long-term engagement and support of participants** from CERN's Member, Associate Member & Non-Member States. As the project evolves further, it is crucial to refine and adapt the collaboration model to ensure the efficient allocation of resources and sustained momentum.

  ➔ Continue building interest in the FCC through the engagement with communities world-wide through the

  FCC Global Collaboration (FGC) Working Group and the **International Forum of National Contacts** (IFNC).

Thank you

A laboratory for people around the world

Distribution of all CERN Users by the country of their home institutes as of 31 December 2023

Geographical & cultural diversity
Users of **110 nationalities**
23.7 % women

Member States (7467)

Austria 86 – **Belgium** 129 – **Bulgaria** 46 – **Czech Republic** 252
Denmark 47 – **Estonia** 29 – **Finland** 88 – **France** 842 – **Germany** 1296
Greece 112 – **Hungary** 80 – **Israel** 74 – **Italy** 1609 – **Netherlands** 167
Norway 77 – **Poland** 322 – **Portugal** 105 – **Romania** 113
Serbia 38 – **Slovakia** 67 – **Spain** 413 – **Sweden** 106
Switzerland 419 – **United Kingdom** 950

Associate Member States (581)

Brazil 135 – **Croatia** 37 – **Cyprus** 14* – **India** 145 – **Latvia** 21
Lithuania 17 – **Pakistan** 30 – **Slovenia** 26* – **Türkiye** 129 – **Ukraine** 27

* Associate Member State in the pre-stage to Membership

Observers (2226)

Japan 219 – **United States of America** 2007

Cooperation Agreements (1596)

Algeria 2 – **Argentina** 16 – **Armenia** 16 – **Australia** 26 – **Azerbaijan** 3 – **Bahrain** 3 – **Canada** 206 – **Chile** 45
Colombia 24 – **Costa Rica** 3 – **Cuba** 3 – **Ecuador** 4 – **Egypt** 24 – **Georgia** 34 – **Hong Kong** 15 – **Iceland** 3 – **Indonesia** 7
Iran 14 – **Ireland** 4 – **JINR** 293 – **Jordan** 3 – **Kazakhstan** 3 – **Kuwait** 2 **Lebanon** 7 – **Madagascar** 1 – **Malaysia** 4
Malta 1 – **Mexico** 56 – **Montenegro** 3 – **Morocco** 18 – **New Zealand** 2 **Nigeria** 2 – **Oman** 1 – **Palestine** 1
People's Republic of China 414 – **Peru** 3 – **Philippines** 1 – **Republic of Korea** 168 – **Saudi Arabia** 6 – **South Africa** 61
Sri Lanka 10 – **Taiwan** 52 – **Thailand** 17 – **Tunisia** 4 – **United Arab Emirates** 10 – **Vietnam** 1