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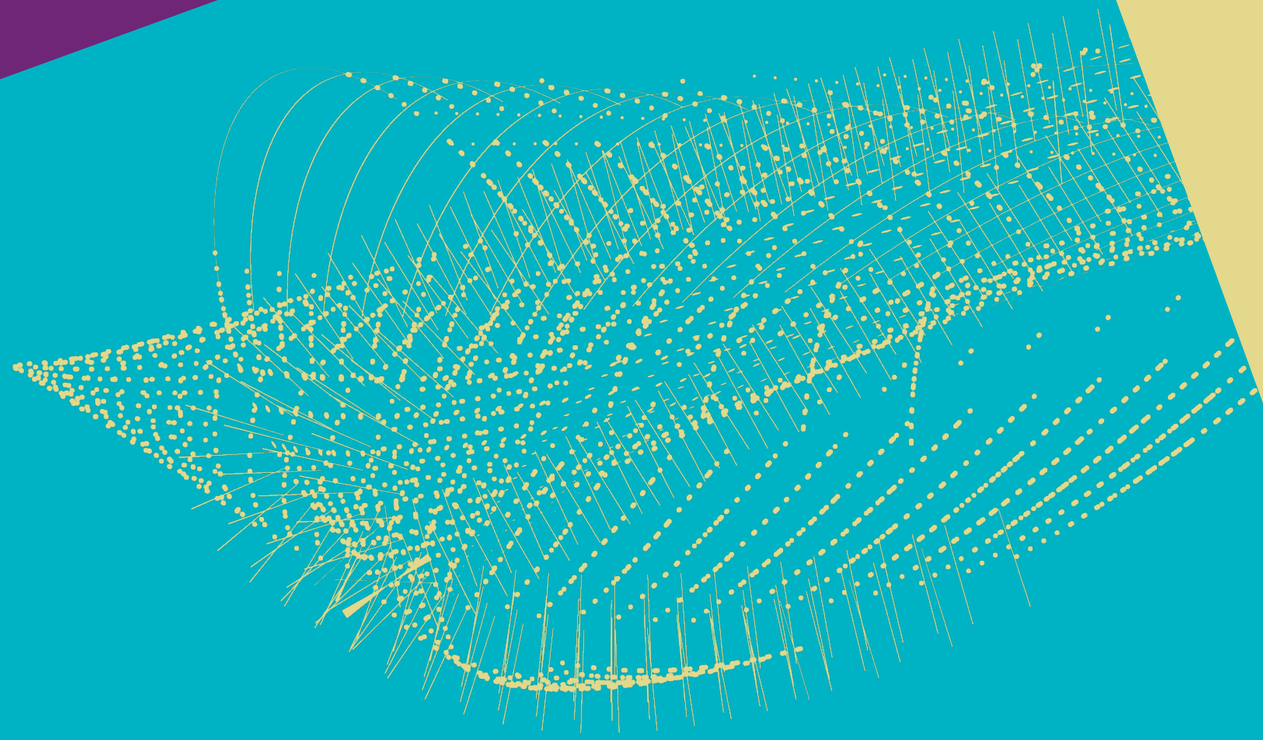

STRATEGY DAY

Scientific Diversity

January 13, 2025

Most recent European Strategies

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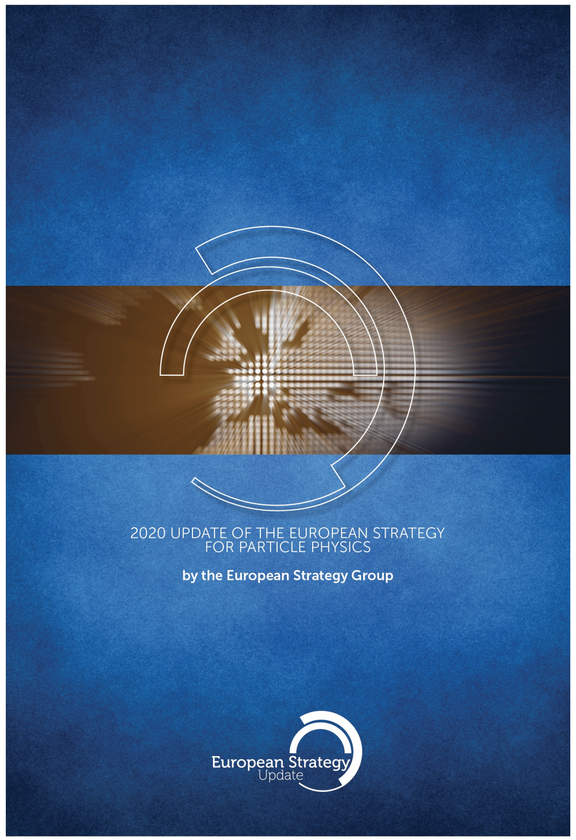

2020 Update of the European Particle Physics Strategy

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Long Range Plan 2024
Perspectives in Nuclear Physics

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2017-2026 European Astroparticle Physics Strategy

Most recent European Strategies

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Community-driven strategies reflecting our ambition to address the open questions in particle, nuclear & astroparticle physics and they serve as guidance for funding bodies to develop resource-loaded research programmes.

2020 Update of the European Particle Physics Strategy

Long Range Plan 2024 Perspectives in Nuclear Physics

2017-2026 European Astroparticle Physics Strategy

Most recent European Strategies

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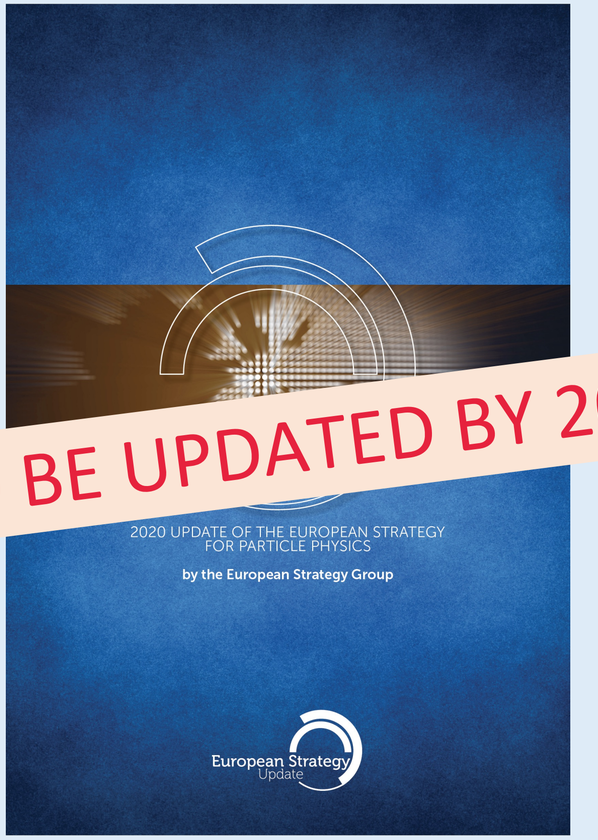

TO BE UPDATED BY 2026

2020 Update of the European Particle Physics Strategy

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European Strategy for Particle Physics Update 2020

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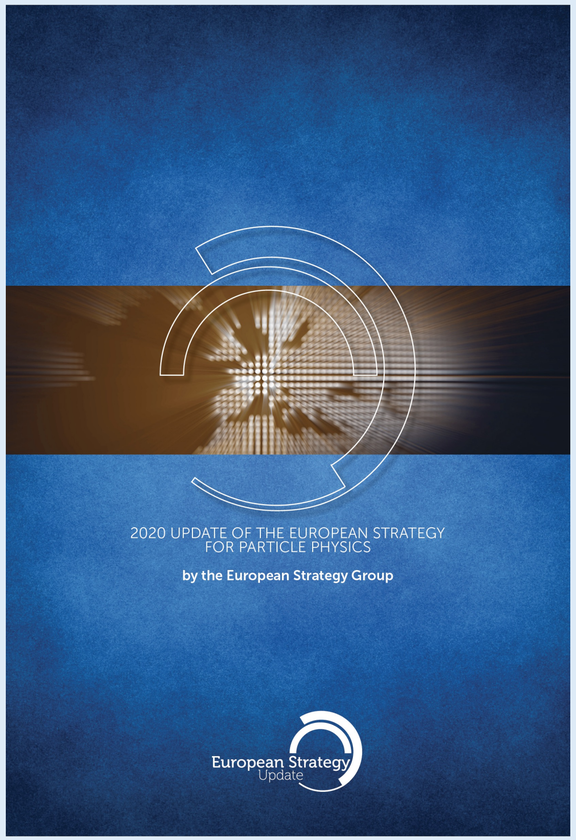

2020 Update of the European Particle Physics Strategy

TWO KEY DOCUMENTS MADE PUBLIC:

(MAIN WEBSITE HTTP://EUROPEANSTRATEGYUPDATE.WEB.CERN.CH/WELCOME)

1. A BRIEF DOCUMENT INCLUDING ALL RECOMMENDATIONS:
   HTTPS://HOME.CERN/SITES/HOME.WEB.CERN.CH/FILES/2020-06/2020%20UPDATE%20EUROPEAN%20STRATEGY.PDF

2. A LONGER DELIBERATION DOCUMENT ELABORATING ON THE RECOMMENDATIONS IN A CONTEXT:
   HTTPS://HOME.CERN/SITES/HOME.WEB.CERN.CH/FILES/2020-06/2020%20DELIBERATION%20DOCUMENT%20EUROPEAN%20STRATEGY.PDF

European Strategy for Particle Physics Update 2020

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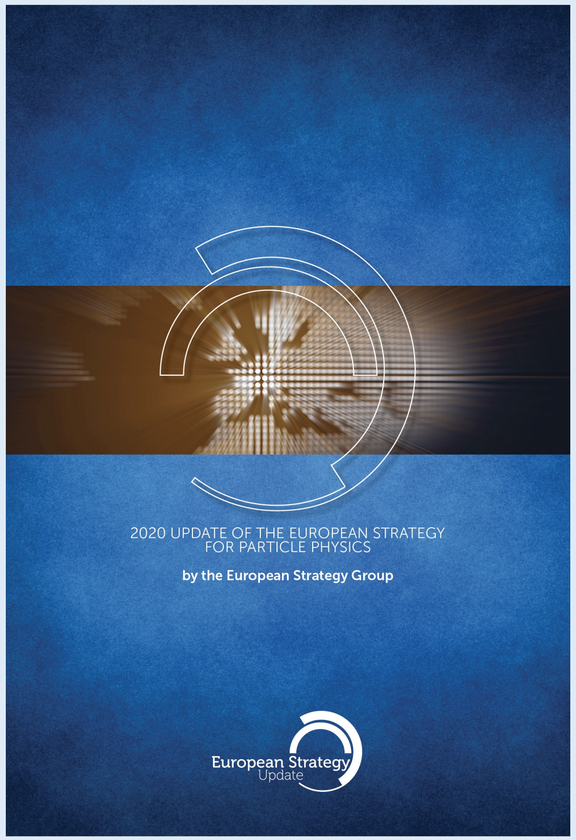

2020 Update of the European Particle Physics Strategy

Major developments from the 2013 Strategy

1. *The successful completion of the high-luminosity upgrade of the LHC 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.*

European Strategy for Particle Physics Update 2020

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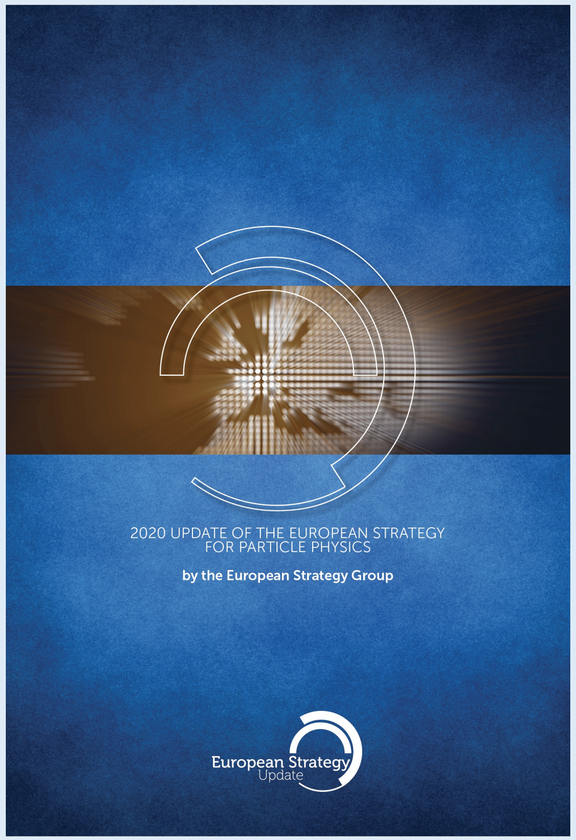

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European Strategy for Particle Physics Update 2020

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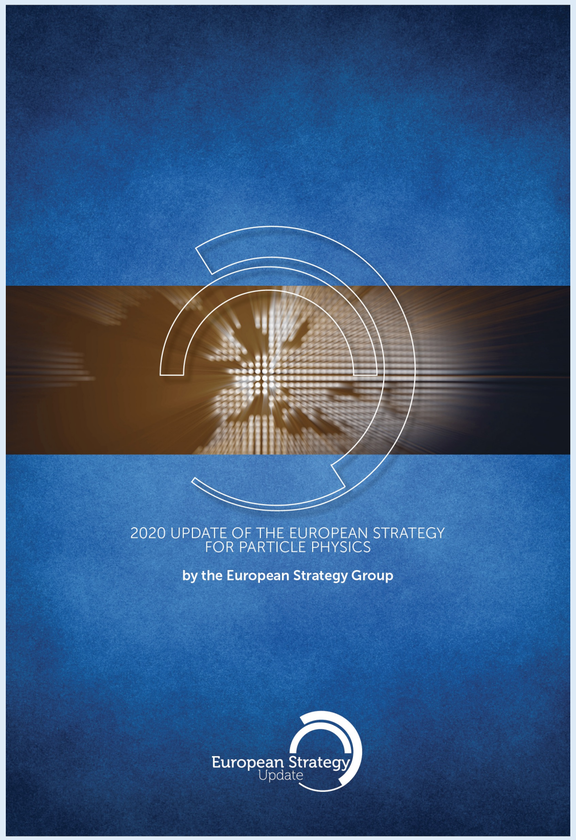

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2. *Europe, and CERN through the Neutrino Platform, should continue to support long baseline experiments in Japan and the United States. In particular, they should continue to collaborate with the United States and other international partners towards the successful implementation of the Long-Baseline Neutrino Facility (LBNF) and the Deep Underground Neutrino Experiment (DUNE).*

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European Strategy for Particle Physics Update 2020

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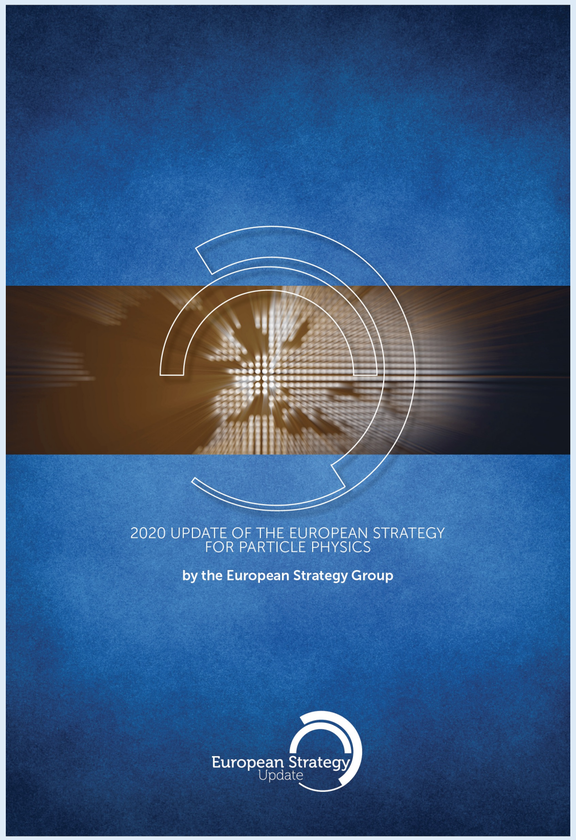

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Complementarity with neutrino physics without accelerators?

European Strategy for Particle Physics Update 2020

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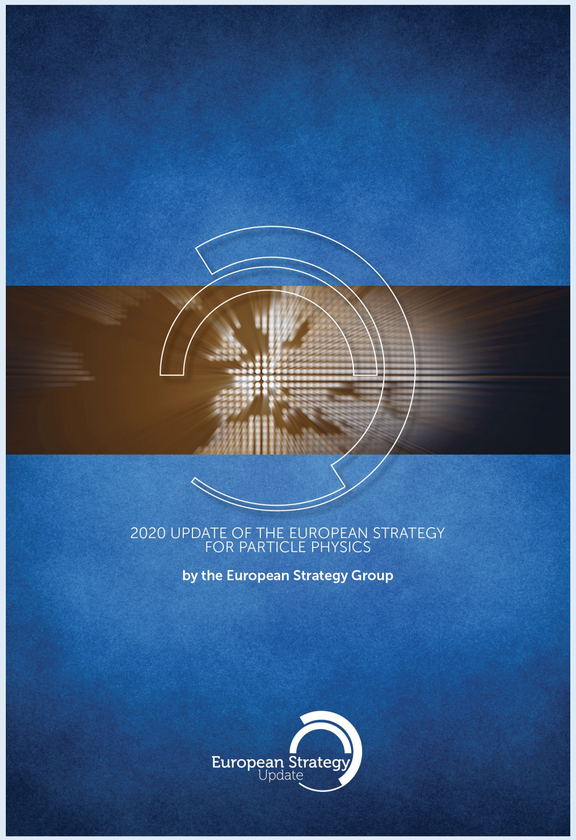

2020 Update of the European Particle Physics Strategy

General considerations for the 2020 update

1. *This Strategy update should be implemented to ensure Europe's continued scientific and technological leadership.*

2. *The particle physics community must further strengthen the unique ecosystem of research centres in Europe. In particular, cooperative programmes between CERN and these research centres should be expanded and sustained with adequate resources in order to address the objectives set out in the Strategy update.*

3. *The implementation of the Strategy should proceed in strong collaboration with global partners and neighbouring fields.*

European Strategy for Particle Physics Update 2020

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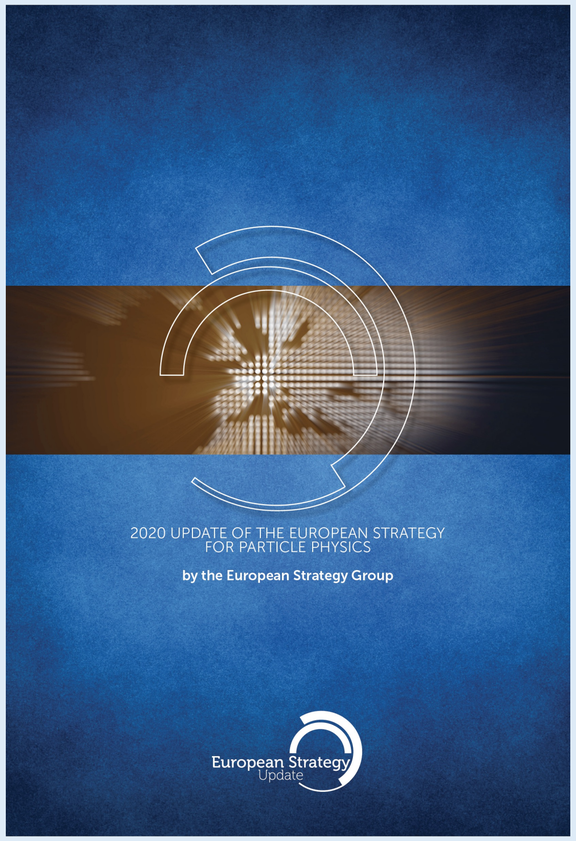

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Most institutions in Europe embrace research in astroparticle & particle (& nuclear) physics.

Given that several puzzles in particle physics are related to observations in the universe (e.g. dark matter, matter over antimatter), is there sufficient collaboration?

European Strategy for Particle Physics Update 2020

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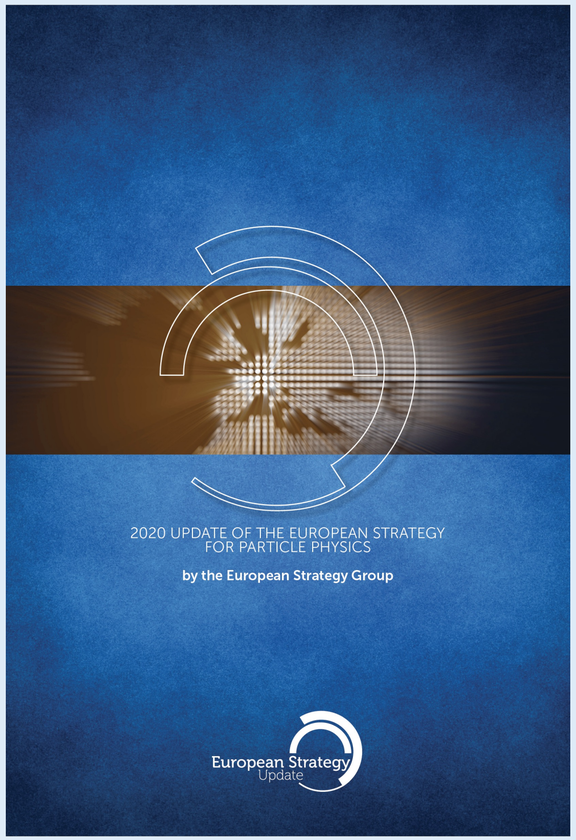

2020 Update of the European Particle Physics Strategy

High-priority future initiatives

1. *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;*

2. *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.*

European Strategy for Particle Physics Update 2020

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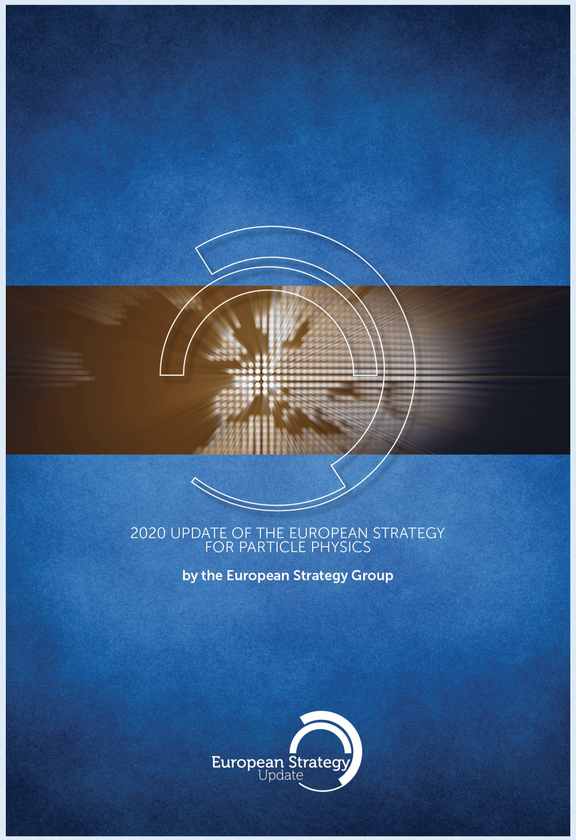

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Topics for our Strategy Day on February 12

European Strategy for Particle Physics Update 2020

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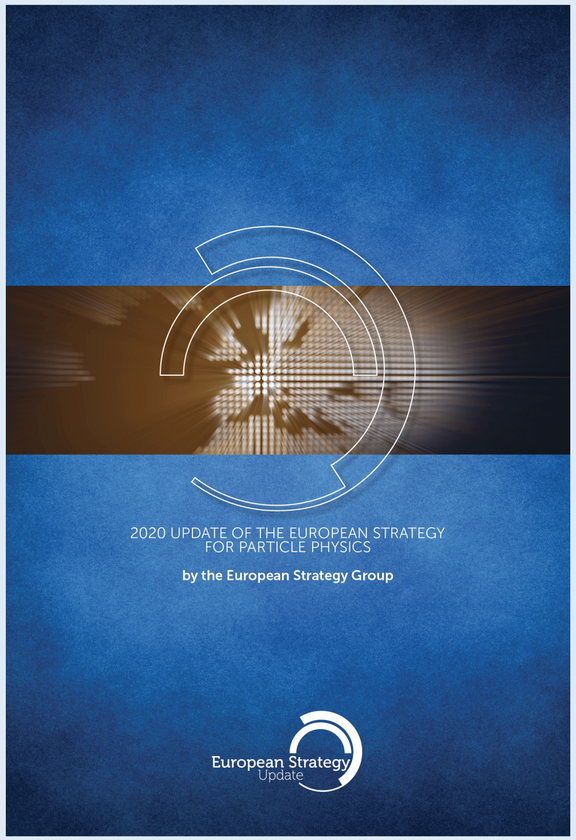

2020 Update of the European Particle Physics Strategy

High-priority future initiatives

3. *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.*

4. *The European particle physics community must intensify accelerator R&D and sustain it with adequate resources. A roadmap should prioritise the technology, taking into account synergies with international partners and other communities such as photon and neutron sources, fusion energy and industry. Deliverables for this decade should be defined in a timely fashion and coordinated among CERN and national laboratories and institutes.*

European Strategy for Particle Physics Update 2020

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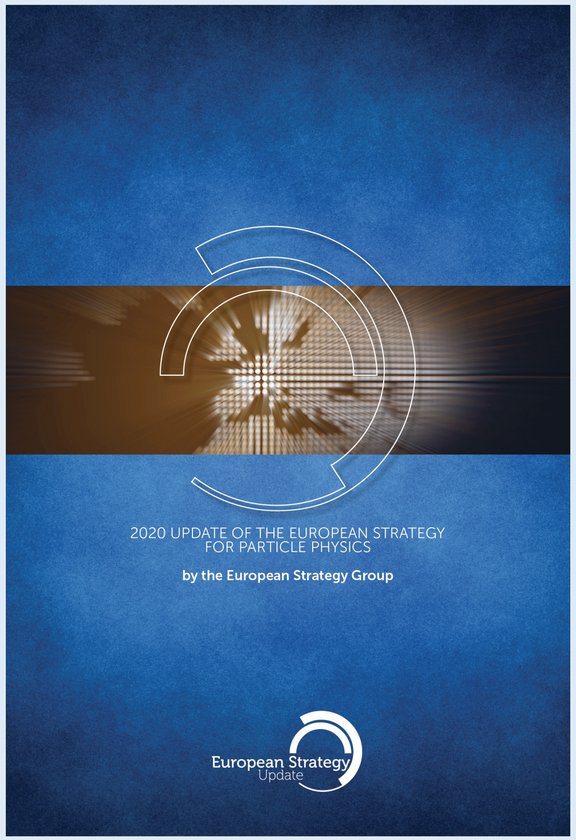

2020 Update of the European Particle Physics Strategy

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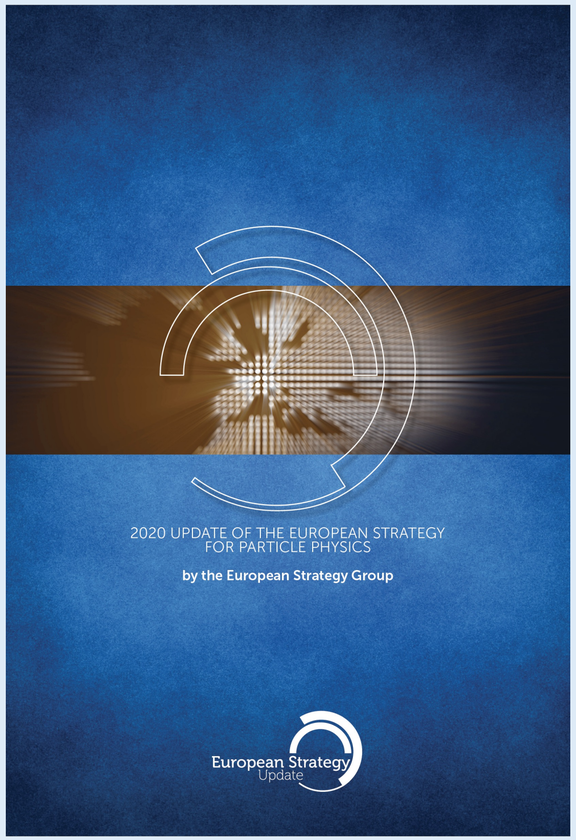

2020 Update of the European Particle Physics Strategy

Other essential scientific activities for particle physics

1. *The quest for dark matter and the exploration of flavour and fundamental symmetries are crucial components of the search for new physics. This search can be done in many ways, for example through precision measurements of flavour physics and electric or magnetic dipole moments, and searches for axions, dark sector candidates and feebly interacting particles. There are many options to address such physics topics including energy-frontier colliders, accelerator and non-accelerator experiments. A diverse programme that is complementary to the energy frontier is an essential part of the European particle physics Strategy.*
   Experiments in such diverse areas that offer potential high-impact particle physics programmes at laboratories in Europe should be supported, as well as participation in such experiments in other regions of the world.

European Strategy for Particle Physics Update 2020

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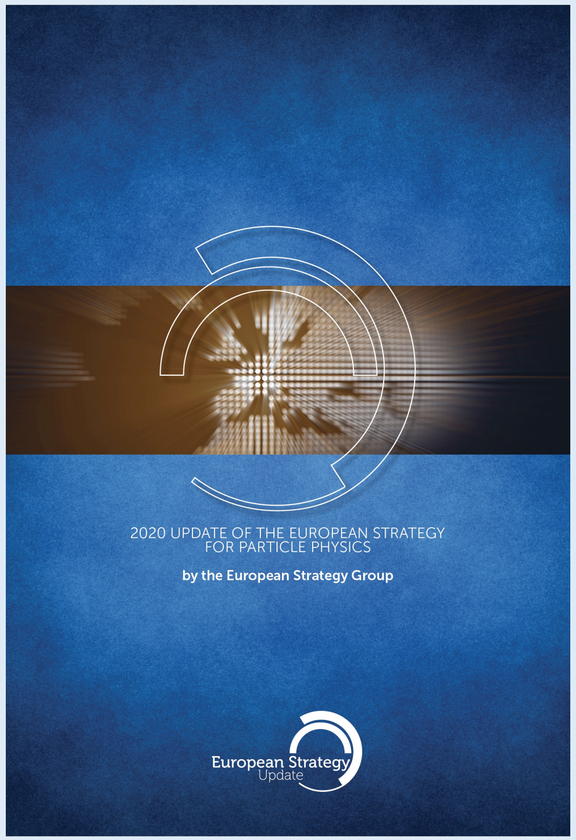

2020 Update of the European Particle Physics Strategy

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Key topic for today

European Strategy for Particle Physics Update 2020

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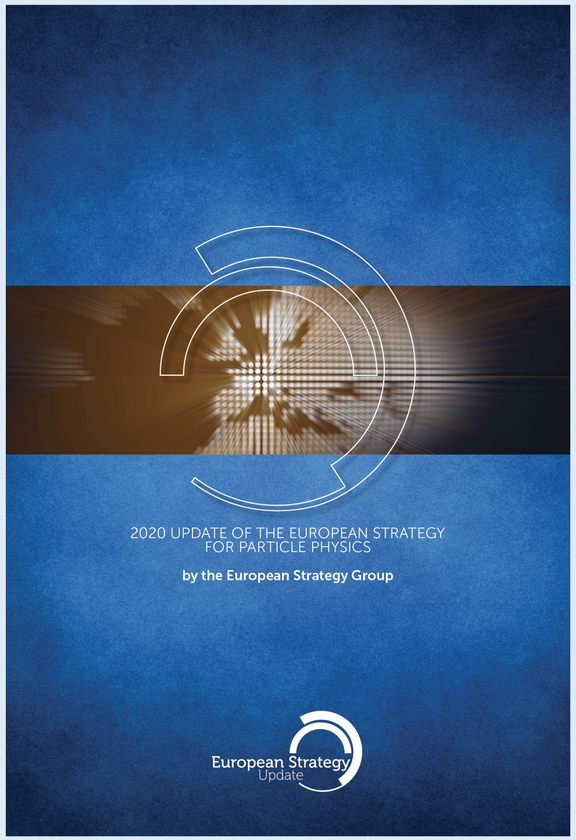

2020 Update of the European Particle Physics Strategy

Other essential scientific activities for particle physics

2. *Europe should continue to vigorously support a broad programme of theoretical research covering the full spectrum of particle physics from abstract to phenomenological topics. The pursuit of new research directions should be encouraged and links with fields such as cosmology, astroparticle physics, and nuclear physics fostered. Both exploratory research and theoretical research with direct impact on experiments should be supported, including recognition for the activity of providing and developing computational tools.*

European Strategy for Particle Physics Update 2020

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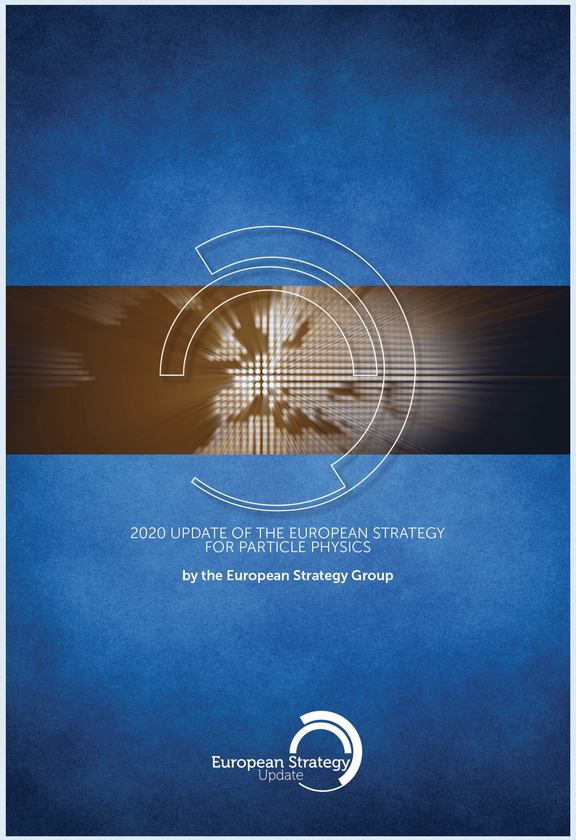

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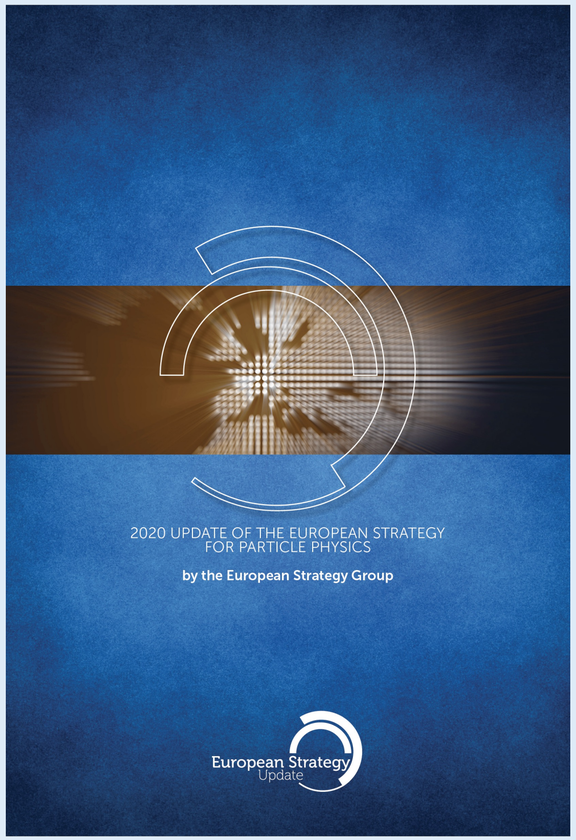

2020 Update of the European Particle Physics Strategy

Other essential scientific activities for particle physics

3. *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.*

European Strategy for Particle Physics Update 2020

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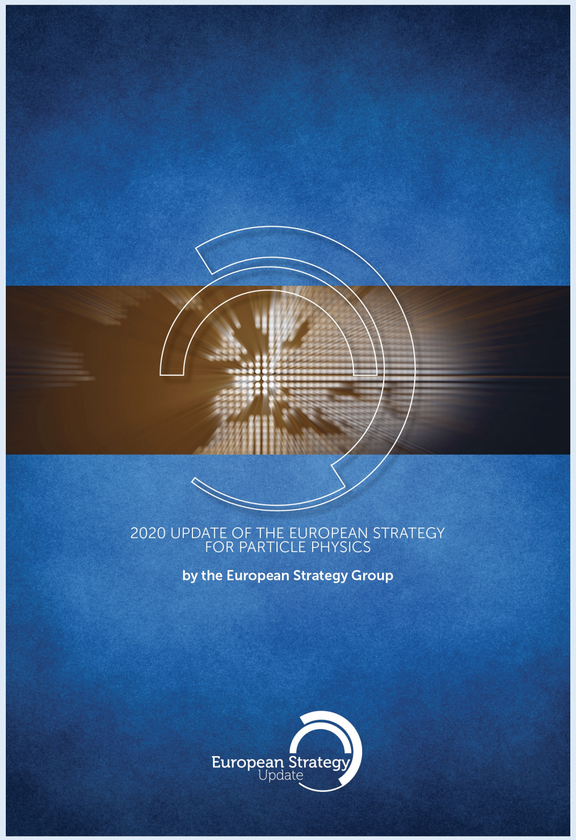

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Topics for our Strategy Day on January 27

European Strategy for Particle Physics Update 2020

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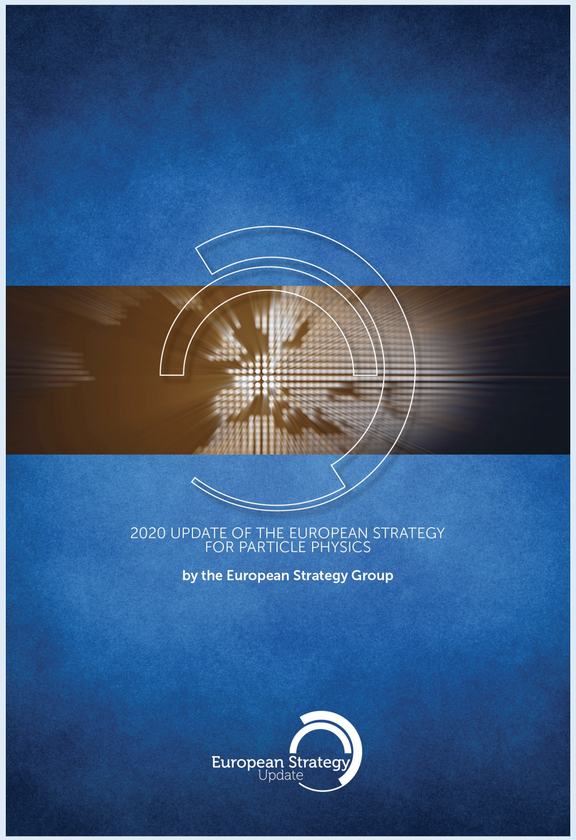

2020 Update of the European Particle Physics Strategy

Other essential scientific activities for particle physics

4. *The community must vigorously pursue common, coordinated R&D efforts in collaboration with other fields of science and industry, to develop software and computing infrastructures that exploit recent advances in information technology and data science. Further development of internal policies on open data and data preservation should be encouraged, and an adequate level of resources invested in their implementation.*

European Strategy for Particle Physics Update 2020

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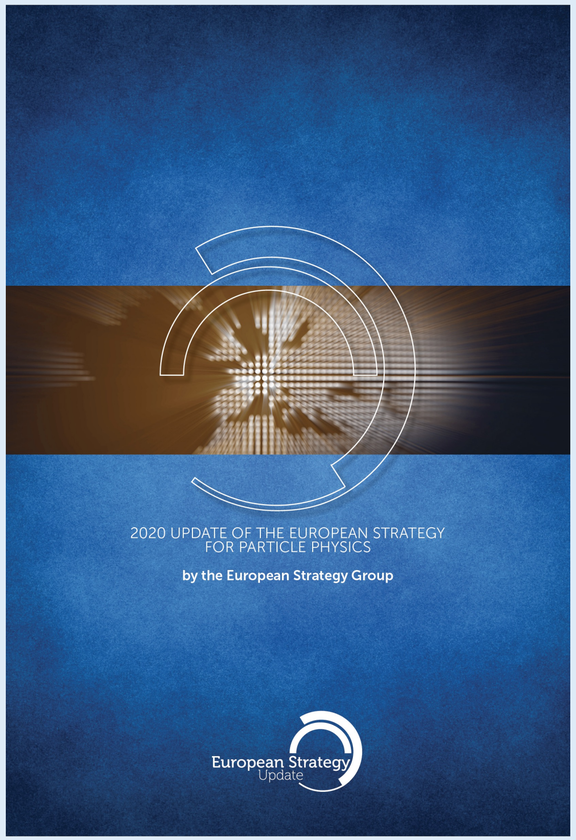

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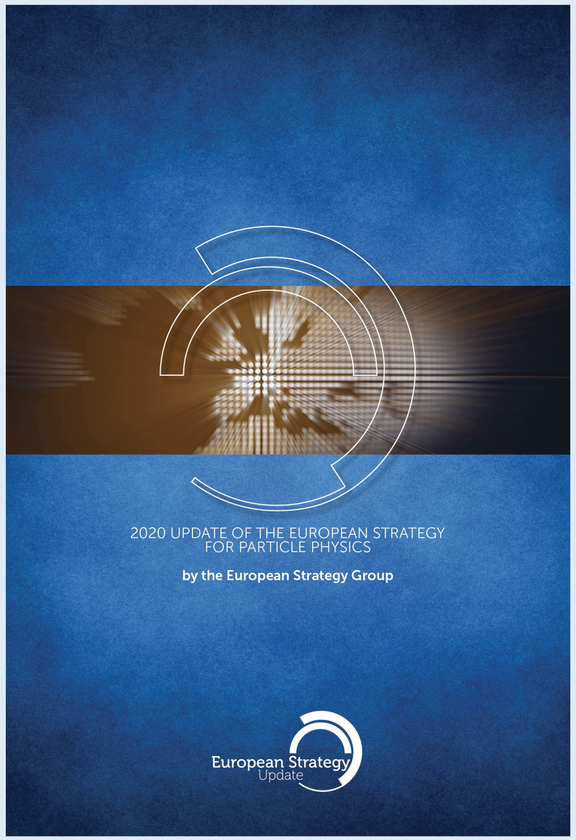

2020 Update of the European Particle Physics Strategy

Synergies with neighbouring fields

1. *Europe should maintain its capability to perform innovative experiments at the boundary between particle and nuclear physics, and CERN should continue to coordinate with NuPECC on topics of mutual interest.*

2. *Synergies between particle and astroparticle physics should be strengthened through scientific exchanges and technological cooperation in areas of common interest and mutual benefit.*

European Strategy for Particle Physics Update 2020

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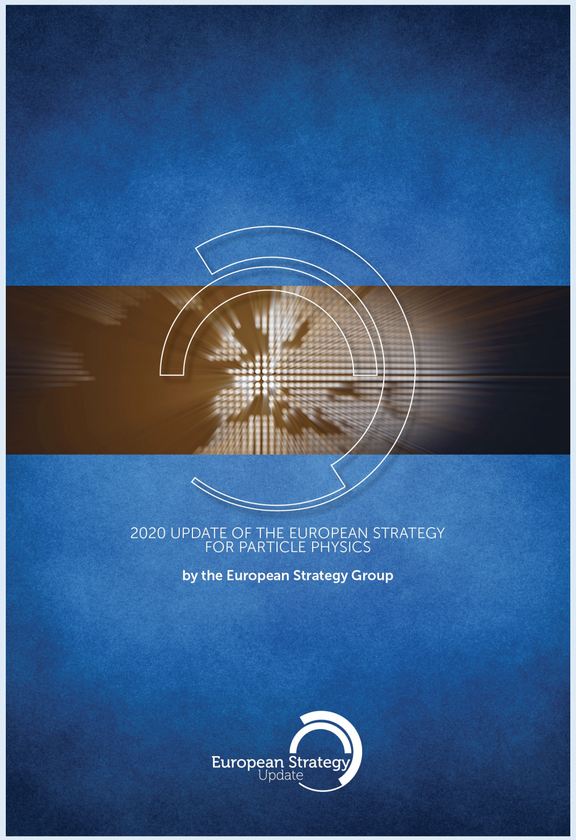

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European Strategy for Particle Physics Update 2020

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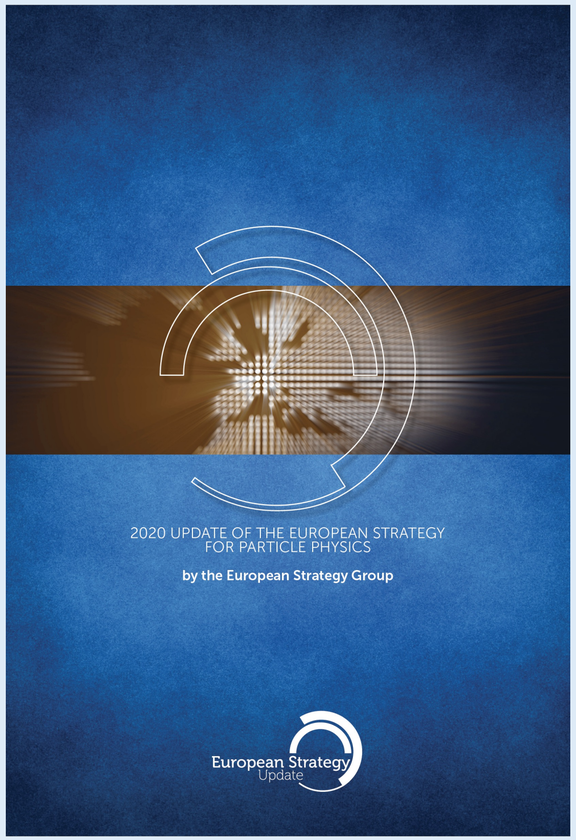

2020 Update of the European Particle Physics Strategy

Organisational issues

1. *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.*

European Strategy for Particle Physics Update 2020

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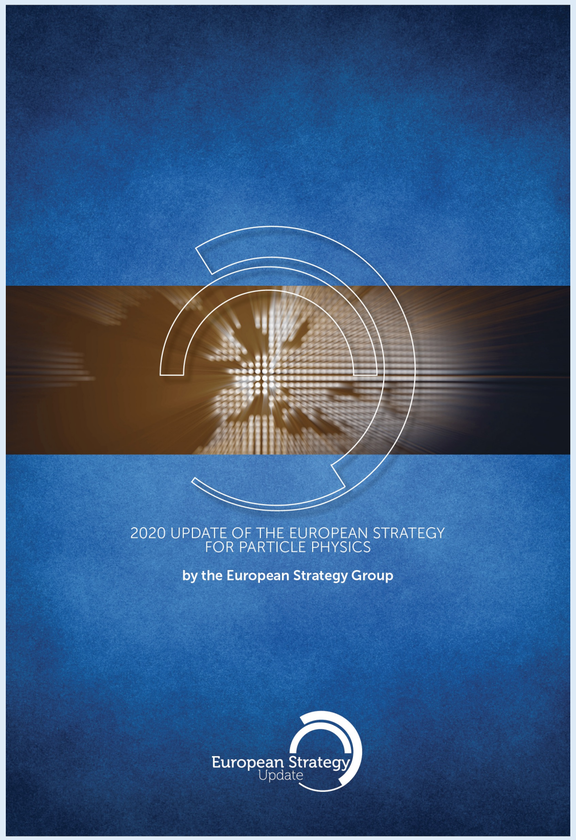

2020 Update of the European Particle Physics Strategy

Organisational issues

2. *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.*

3. *The particle physics community should work with the relevant authorities to help shape the emerging consensus on Open Science to be adopted for publicly-funded research, and should then implement a policy of Open Science for the field.*

European Strategy for Particle Physics Update 2020

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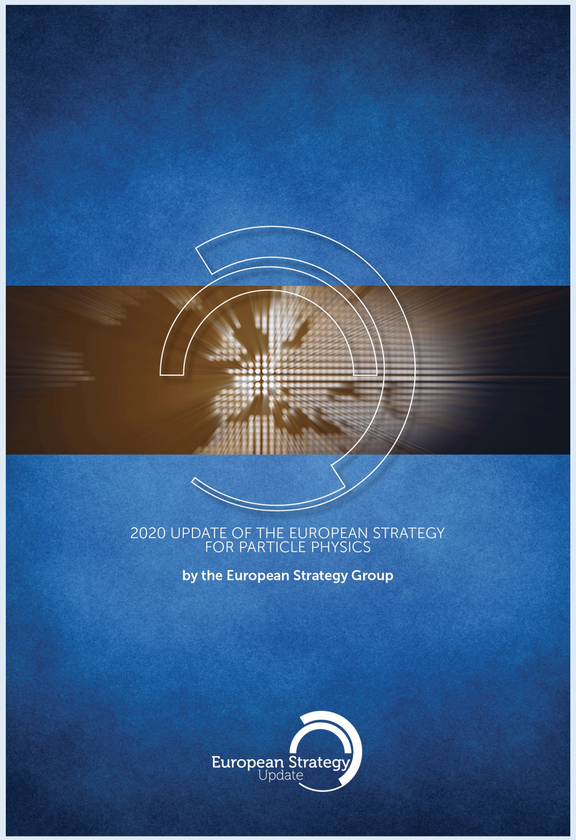

2020 Update of the European Particle Physics Strategy

Environmental and societal impact

1. *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. Alternatives to travel should be explored and encouraged.*

2. *For early-career researchers to thrive, the particle physics community should place strong emphasis on their supervision and training. Additional measures should be taken in large collaborations to increase the recognition of individuals developing and maintaining experiments, computing and software. The particle physics community commits to placing the principles of equality, diversity and inclusion at the heart of all its activities.*

European Strategy for Particle Physics Update 2020

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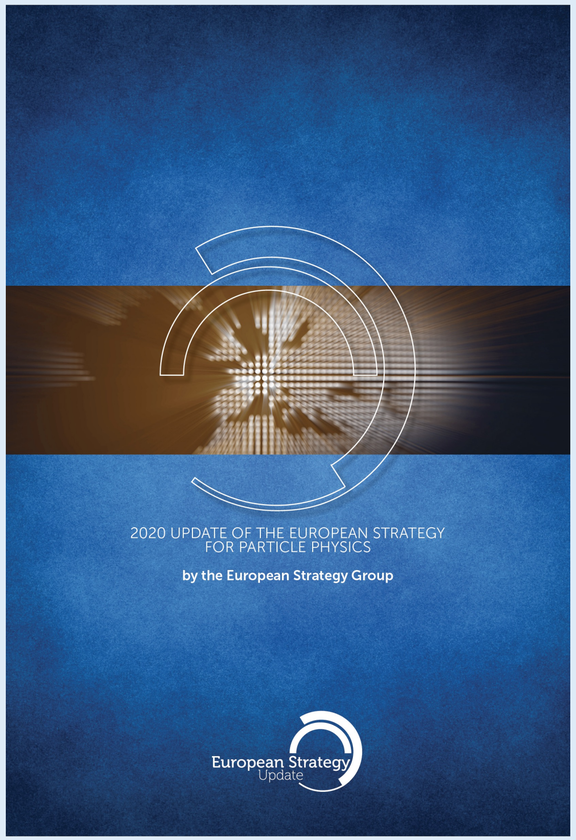

2020 Update of the European Particle Physics Strategy

Environmental and societal impact

3. *Particle physics research centres should promote knowledge and technology transfer and support their researchers in enabling it. The particle physics community should engage with industry to facilitate knowledge transfer and technological development.*

4. *Public engagement, education and communication in particle physics should continue to be recognised as important components of the scientific activity and receive adequate support. Particle physicists should work with the broad community of scientists to intensify engagement between scientific disciplines. The particle physics community should work with educators and relevant authorities to explore the adoption of basic knowledge of elementary particles and their interactions in the regular school curriculum.*

European Strategy for Particle Physics Update 2020

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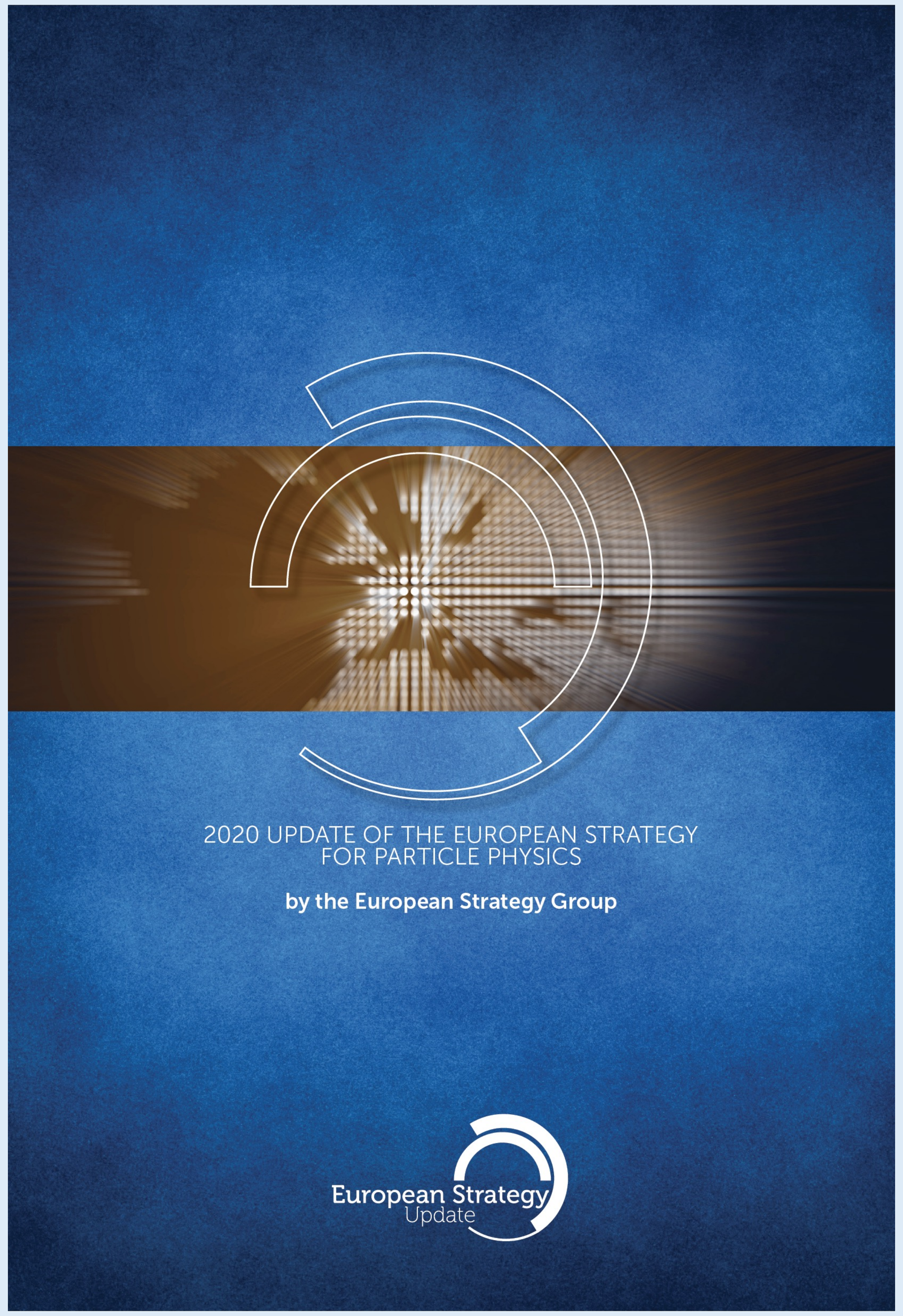

2020 Update of the European Particle Physics Strategy

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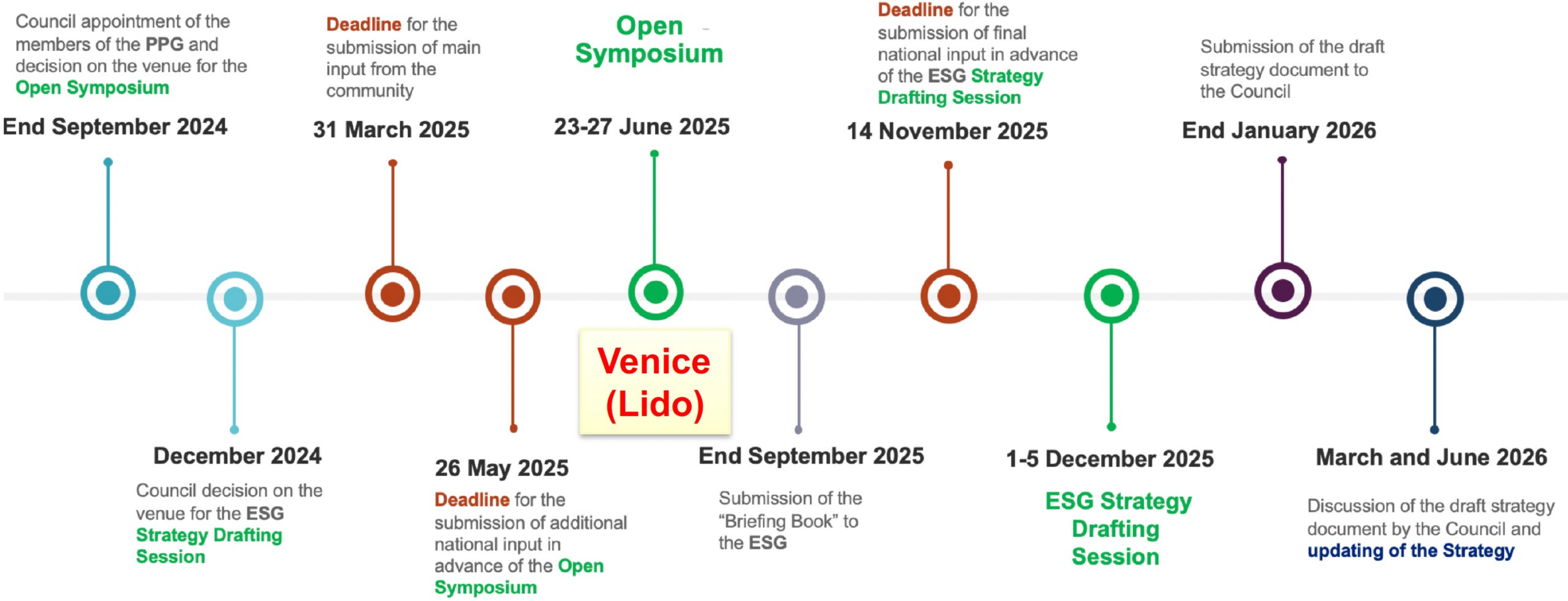
In the European Strategy Group there will be dedicated Working Groups on various organizational, environmental, societal, education/career, knowledge transfer, open science and other aspects.

European Strategy for Particle Physics Update 2026



APPEC – AstroParticle Physics European Consortium

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2017-2026 European Astroparticle Physics Strategy

TWO KEY DOCUMENTS:

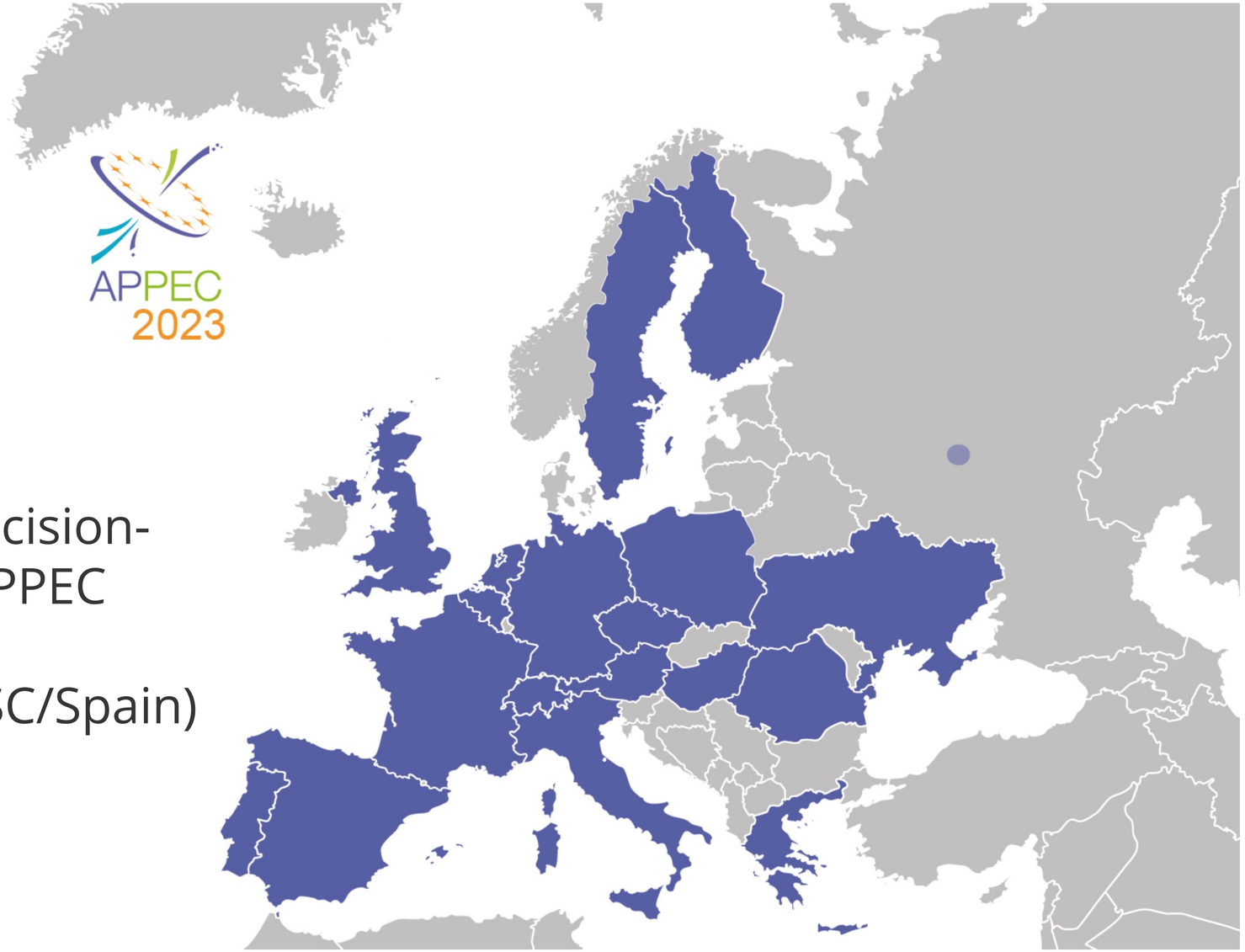
(MAIN WEBSITE HTTPS://WWW.APPEC.ORG)

1. ROADMAP 2017-2026:
HTTPS://WWW.APPEC.ORG/EUROPEAN-ASTROPARTICLE-PHYSICS-STRATEGY-2017-2026/

2. MID-TERM REPORT (SEPTEMBER 2023):
HTTPS://WWW.APPEC.ORG/MID-TERM-REVIEW/

APPEC – AstroParticle Physics European Consortium

APPEC is a consortium of funding agencies, national government institutions, and institutes from 18 European countries, responsible for coordinating and funding national research efforts in astroparticle physics.



General Assembly: the strategic, decision-making, and supervisory body of APPEC

Chairperson: Carlos Peña Garay (LSC/Spain)

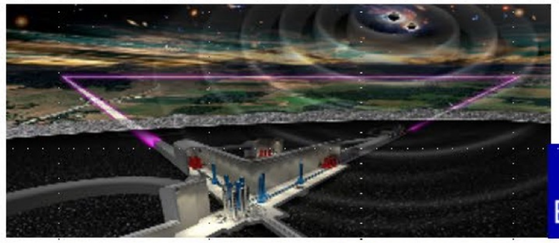
For the Netherlands:
Rosemarie Aben & Jorgen D'Hondt

APPEC flagship research infrastructures (dynamic list)

[construction KM3NeT 2020-2026; IceCube-Gen2]

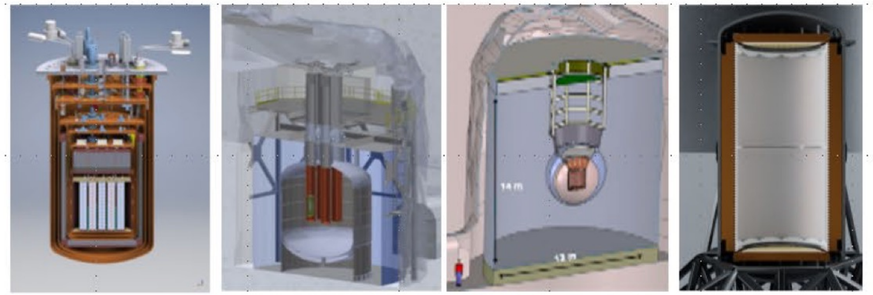
ESFRI

HE Neutrinos



ESFRI

[construction Einstein Telescope 2026-]



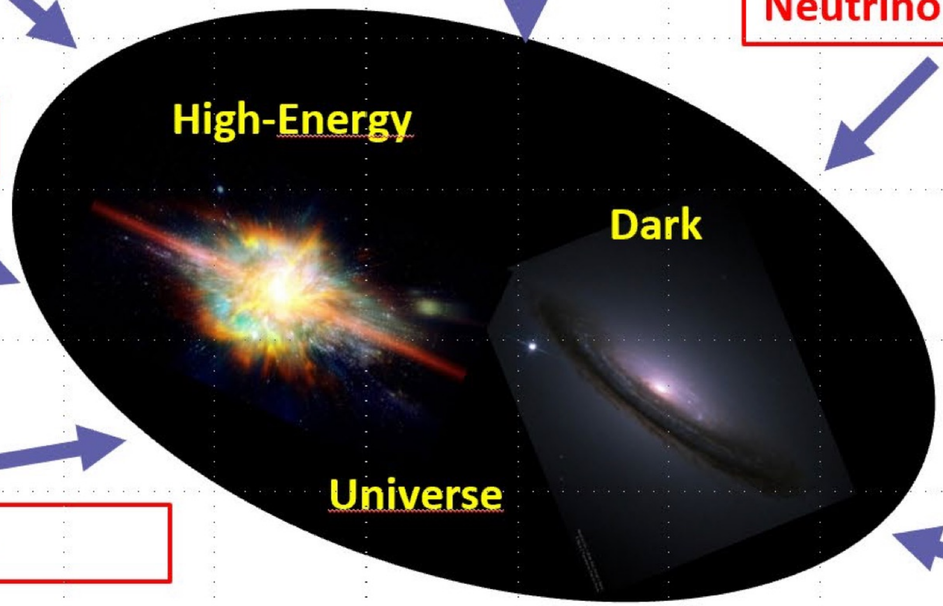
[construction LEGEND-1000 / nEXO 2023- ; …]

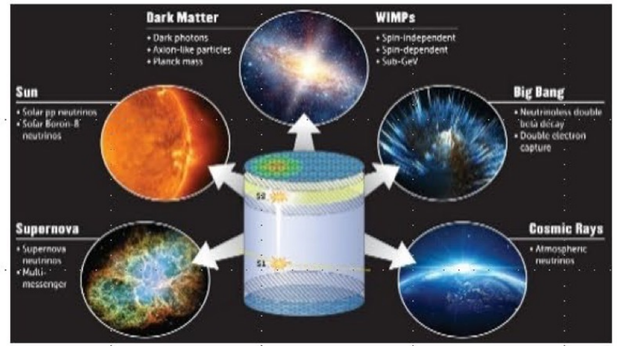
Gravitational Waves

[construction AugerPrime 2019-2023]

HE Cosmic Rays

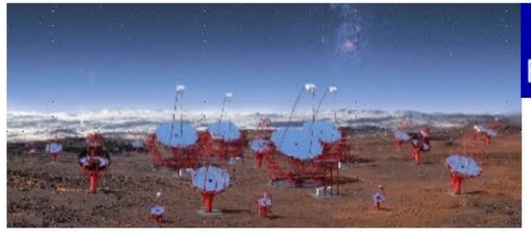
Neutrino Properties





[construction DARWIN 2024- ; XLZD, ARGO, …]

[construction CTA 2021-]



ESFRI

HE Gamma Rays

Dark Matter

APPEC – priorities in mid-term report 2023

HIGH-ENERGY γ RAYS

CTA in both the northern and southern hemispheres, SWGO, THESEUS satellite mission

HIGH-ENERGY NEUTRINOS

KM3NeT for both ORCA (mass hierarchy) and ARCA (neutrino astronomy), IceCube Upgrade, IceCube-Gen2

HIGH-ENERGY COSMIC RAYS

exploitation of AugerPrime, R&D on new cost-effective detector technologies for a next-generation observatory

GRAVITATIONAL WAVES

Virgo, Einstein Telescope, LISA

WIMP DARK MATTER

at least on major Xenon or Argon detector at LNGS, detector R&D to reach down to the neutrino floor

AXIONS, ALPs AND OTHER NON-WIMP DARK MATTER

axions and ALPs detection in mass ranges complementary to the established cavity approach

APPEC – priorities in mid-term report 2023

NEUTRINO MASS AND NATURE

CUPID and LEGEND 1000 double-beta decay experiments, further development of NEXT,
KATRIN direct neutrino mass measurement

NEUTRINO MIXING AND MASS ORDERING

KM3NeT with ORCA, long baseline neutrino oscillation experiments DUNE and Hyper-Kamiokande,
as well as in the JUNO reactor experiment

COSMIC MICROWAVE BACKGROUND

Japanese LiteBIRD mission, R&D for further space-based CMB studies and for ground-based experiments,
CMB Stage 4

DARK ENERGY

ESA Euclid satellite mission, next-generation ground-based projects (Rubin-LSST and DESI)

APPEC – priorities in mid-term report 2023

MULTI-MESSENGER ASTROPARTICLE PHYSICS
development and coordination of optimised multi-messenger observational strategies

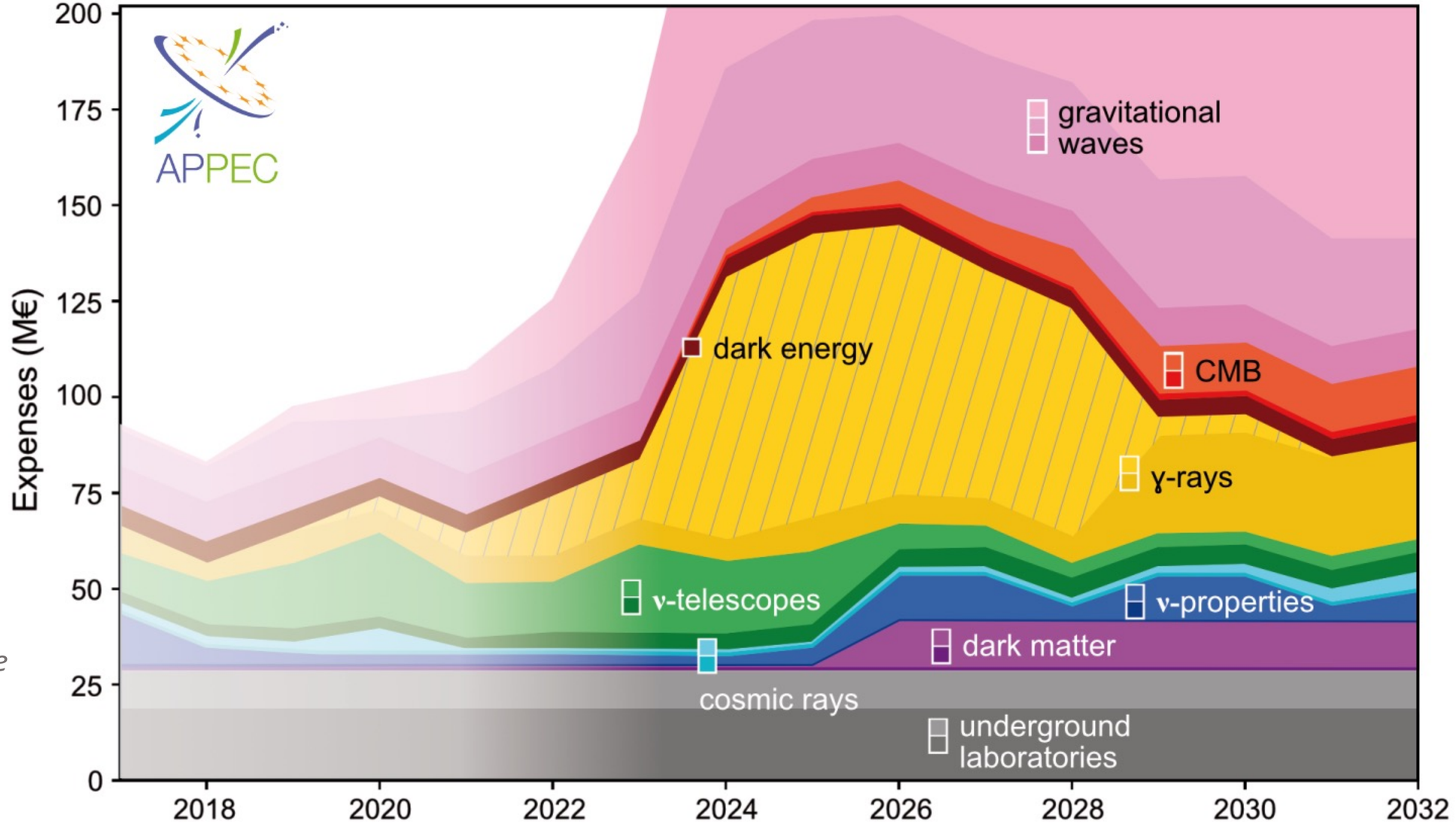
THEORY
EuCAPT as a thriving hub for astroparticle physics theorists from Europe and the rest of the world

DETECTOR R&D and COMPUTING AND DATA POLICIES and ECOLOGICAL & SOCIETAL IMPACT and OPEN SCIENCE & CITIZEN SCIENCE and HUMAN TALENT MANAGEMENT and CENTRAL INFRASTRUCTURES and EUROPEAN & GLOBAL COOPERATION and INTERDISCIPLINARY OPPORTUNITIES

APPEC – AstroParticle Physics European Consortium

Projected annual capital investment from European astroparticle physics strategy mid-term update (2023)

plot with projections made in 2017



The exploitation is given by the darker shade for each colour and the investment budget by the lighter shade.

Today – Scientific Diversity for Particle Physics

- *Is scientific diversity beyond colliders essential in our particle physics research portfolio?*
- *Which research directions are very relevant and complementary to collider experiments?*
- *Is the balance between investments in collider and non-collider research adequate?*
- *Are we well organised to embrace both collider and non-collider research in our community?*
- *Do we sufficiently embrace the synergies between particle and astroparticle physics?*
- *Are these synergies that impactful such that we must co-organise both fields?*
- *…*

Several topical presentations, each leading to concrete statements on the topic. In an online survey you will be able to express your opinion and level of agreement to each of the statements. The survey will be opened after the last talk. The survey's overview will be discussion in today's closing session.

This analysis will help us to write our national input to the European Strategy for Particle Physics (final reading planned on March 5, 13:00-17;00).