Approved by the Director General on 01 October 2022

CERN OPEN SCIENCE POLICY

The European Organization for Nuclear Research (CERN), the world's largest high-energy physics (HEP) laboratory, has the mission to: perform world-class research in fundamental physics at the forefront of human knowledge; provide a unique range of particle accelerator facilities that enable this research; educate the next generation of scientists; and unite people from all over the world to push the frontiers of science and technology, for the benefit of all.

The CERN Open Science Policy reflects values that have been enshrined in the CERN Convention for almost seventy years and were reaffirmed in the update of the European Strategy for Particle Physics[1] in 2020. These values recognise the universal importance of the fundamental scientific knowledge produced at CERN, the duty to make this knowledge available to everybody, and the key role of open science in the pursuit of CERN's mission. Supported by long-term financial investment from its Member and Associate Member States, with significant contributions also from non-Member States, CERN is committed to the advancement of science and the wide dissemination of knowledge by embracing and promoting practices making scientific research more open, collaborative, and responsive to societal changes.

Open science is defined by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as "an inclusive construct that combines various movements and practices aiming to make multilingual scientific knowledge openly available, accessible and reusable for everyone, to increase scientific collaborations and sharing of information for the benefits of science and society, and to open the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the traditional scientific community."[2] CERN accordingly recognises the holistic practice of open science as one of its guiding principles and commits to it by:

- encouraging research processes and tools that foster international collaboration;
- supporting new and innovative research practices;
- enabling the free dissemination of knowledge and the accessibility of research outputs;
- requiring open access to publications and their metadata;
- encouraging and facilitating the sharing of data and analysis software;
- sharing software sources and hardware designs under appropriate free, open source licences;
- enabling knowledge preservation to support reusability and reproducibility;
- supporting citizen science and the development of open training/education resources;
- building and maintaining the necessary infrastructure to support open science; and
- fostering skills and developing incentives to support open science practices.

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[1] European Strategy Group (2020), European Strategy for Particle Physics update: https://cds.cern.ch/record/2721370/files/CERN-ESU-015-2020%20Update%20European%20Strategy.pdf

[2] UNESCO (2021), UNESCO Recommendation on Open Science: https://unesdoc.unesco.org/ark:/48223/pf0000379949.locale=en

CERN will actively engage with stakeholders and partners in the worldwide scientific community to ensure effective coordination and cooperation to advance open science. Through its commitment to open science, CERN also aims to cultivate a dynamic and evolving ecosystem of initiatives, projects and interoperable technologies to maximise the global impact of its research. CERN's open science efforts are prioritised based on their potential impact on society, particularly in support of the UN Sustainable Development Goals.

The CERN Open Science Strategy Working Group[3] will establish a dedicated monitoring framework to assess the implementation of this policy. The policy will typically be reviewed every two years and updates will be approved by the CERN Directorate.

1. Open access to publications

All CERN scientific publications are to be made immediately publicly available and reusable. The Open Access Policy for CERN Publications (2014, updated 2017 and 2021) requires that all original research publications by CERN authors are published open access, centrally supported by the CERN Open Access fund. CERN users and visiting scientists are also encouraged to publish their work under similar terms, according to the CERN General Conditions applicable to the Execution of Experiments.

CERN scientific publications, including submissions to trusted repositories (such as arXiv), should be released under an open licence, with CC-BY as the default standard. Publication-related metadata are made available for reuse under the CC0 waiver in line with FAIR principles (findability, accessibility, interoperability, reusability). Open access publishing support is also provided for monographs related to CERN experiments or accelerators, applied research processes or technologies, and other areas of relevance.

2. Open data

CERN experimental collaborations are committed to making their research data publicly available. The CERN Open Data Policy for the LHC Experiments (2020) aims to support CERN experiments' consistent approach towards the openness and preservation of experimental data to maximise their long-term value. All data are released with persistent identifiers. Data and associated data services apply open and FAIR principles. For experimental data releases, CC0 waivers are applied as standard. Researchers and experiments are expected to develop data management plans for their research activities.

3. Open source software

CERN software is made available as open source wherever possible, applying a licence approved by the Open Source Initiative (OSI). CERN handles its research-related software as an integral part of its research products. Analysis of the CERN experiments' physics data must be possible with open source software. External communities should be invited to use and contribute to the evolution of CERN's software projects. CERN's software expertise should be shared with other science disciplines. Software development processes are

[3] As constituted by the CERN Director for Research and Computing.

expected to follow best practices[4]. CERN contributes to open source software relevant to its mission through code contributions, participation in the evolution of software, and standardisation.

4. Open hardware

CERN makes its technologies broadly available to society and has introduced open hardware licensing as a key mechanism to achieve this goal. Open hardware designs are made available through the Open Hardware Repository. The legal basis for the sharing of open hardware is enabled through variants of the CERN Open Hardware Licence. Hardware design releases will consider opportunities for collaboration with other research communities and industry. In cases where extensive documentation and ancillary components like software for interfacing and testing are required for projects, these should be licensed under appropriate open source documentation and software licences respectively.

5. Research integrity, reuse and reproducibility

CERN is committed to ensuring the integrity of research. In order to facilitate the reuse of its research products, CERN provides infrastructures to accommodate the scale and complexity of its research outputs. Reuse and reproducibility are facilitated by practising comprehensive analysis preservation to capture relevant research objects, such as research data releases with supporting metadata, auxiliary data, linked software, reproducible analysis workflows, documentation, etc.

6. Infrastructure provision for open science

CERN ensures that open science infrastructures meet trusted quality standards, comply with FAIR principles (e.g. use persistent identifiers such as DOIs and ORCIDs), have long-term preservation plans and are interoperable with international standards and initiatives such as the European Open Science Cloud (EOSC).

7. Research assessment and evaluation

CERN is committed to collaborating with its Member and Associate Member States to incentivise quality-assured and reusable open science practices for research and career assessments. As part of this effort, CERN strives to support strategic discussions and implementation of community-specific rewards systems, such as responsible metrics covering the full diversity of the community's research outputs.

8. Education, training and outreach

CERN is committed to developing training courses to facilitate the adoption of open science and equip researchers and supporting personnel at all levels with the necessary skills and expertise to conduct research

[4] For instance, as laid out by the Core Infrastructure Initiative: https://bestpractices.coreinfrastructure.org/en

in an open and reusable (FAIR) way. Furthermore, CERN commits to facilitating the use of open educational material in teaching/education at schools and universities. CERN encourages the preparation of resources to engage pupils and teachers, both inside and outside the classroom setting, in interactive learning exercises with open datasets and software products. Wherever possible, CERN links open data, software, hardware and additional open resources to published research articles so that they can be used in university courses to practise research and corresponding methodologies (e.g. statistics, machine learning).

9. Citizen science

CERN encourages meaningful public participation in citizen science programmes that contribute to advancing the Organization's mission or responding to societal challenges. Working with Member and Associate Member States and other relevant stakeholders, CERN aims to support a diverse range of practices to open up science and innovation to citizens, in particular the younger generations.