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REPORT ON THE IMPLEMENTATION OF THE WORK PLAN CONCERNING THE MEMORANDUM OF UNDERSTANDING BETWEEN THE EUROPEAN COMMISSION AND CERN

The Memorandum of Understanding between the European Commission (EC) and CERN is implemented through bi-annual work plans, approved by the Director-General of CERN and the Director-General of the EC Directorate-General for Research and Innovation (DG RTD).

The present document contains a summary of the main activities in the different areas of cooperation between CERN and the EC, carried out during the period September 2015 – August 2016 in the framework of the work plan for 2014-2015 (CERN/3104/RA) and the work plan for 2016-2017 (CERN/3224/RA).

FOREWORD

This document contains an overview of the activities in the different areas of cooperation between the European Commission (EC) and CERN, carried out during the period September 2015 – August 2016 in the framework of the work plans for the implementation of the Memorandum of Understanding between the EC and CERN.

For each area of cooperation with the EC, a short summary / highlight is provided, followed by a list of the main activities undertaken in the period.

Note: The numbering of the sections in this report is in line with the numbering of the areas of cooperation featured in the work plan for 2016-2017. It starts from section 2.2 since section 1 of the work plan is "Scope" and section 2.1 is "Overview".

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2.2 General policy issues

2.2.1 Follow-up, implementation and update of the European Strategy for Particle Physics and links with ESFRI

The HL-LHC project has been included in the 2016 ESFRI Roadmap as one of the Landmark projects.

In March 2016, the updated ESFRI Roadmap was published, featuring the High-Luminosity LHC as one of the 29 European Landmark projects[1]. This was preceded by discussions and a panel hearing with the ESFRI Working Group on Physical Sciences and Engineering, with the participation of the CERN Director-General and Director of Research and Computing.

A representative of the EC is permanently invited to attend the Council's Open Sessions and the Restricted Sessions where European Strategy matters are discussed.

The next update of the European Strategy for Particle Physics is expected to be in 2019-2020.

2.2.2 Contribution from CERN to the European Research Area (ERA)

CERN has contributed to a number of policy initiatives for the ERA.

Together with the other European Intergovernmental Organisations that are members of EIROforum[2], CERN has contributed to a number of policy initiatives relating to the functioning of the ERA, such as the European Charter for Access to Research Infrastructures[3], the sustainability of Research Infrastructures[4], the implementation of a European Open Science Cloud[5], as well as the ongoing discussions about the European Innovation Council[6].

2.2.3 International cooperation

In the field of international cooperation, several topics have been addressed, namely CERN-EC support to SESAME, Japanese and US participation in EU projects coordinated by CERN, and collaboration with Japan and Russia.

- CERN and the EC pursued their joint efforts to support SESAME. Under the FP7-CESSAMag project[7], CERN has led the collaboration with SESAME to design, test and characterise the components of the magnetic system (magnets, power supplies and controls):
  - All pieces of equipment were delivered to SESAME on schedule. Their quality exceeds the specifications and this will contribute to SESAME being one of the world's most effective light sources for this type of magnetic system.

[1] http://www.esfri.eu/roadmap-2016
[2] www.eiroforum.org
[3] https://ec.europa.eu/research/infrastructures/pdf/2016_charterforaccessto-ris.pdf
[4] http://www.eiroforum.org/downloads/20150325_discussion-paper-research-infrastructures-sustainability.pdf
[5] https://ec.europa.eu/research/openscience/pdf/eosc-workshop-11-2015/eiroforum_27_november_2015.pdf
[6] http://eiroforum.org/downloads/20160517_position-paper-european-innovation-council.pdf
[7] Project implemented by CERN: full costs of ~9 MEUR with EC contribution of 5 MEUR.

- Thanks to savings due to tight follow-up by CERN and voluntary in-kind contributions of three SESAME Members, CERN was able to deliver more components than foreseen in the CESSAMag Grant Agreement.
- The training of SESAME staff has been a strategic aspect, integrated in all CESSAMag work packages.
- The procurement of components for the magnetic system allowed some SESAME Members to showcase their industry and to demonstrate their ability to obtain good industrial returns.
- The CESSAMag team was honoured by the visit of EU Commissioner Moedas to SESAME in April 2016 and by his vivid interest in this endeavour.
- Communication on CESSAMag has been active, with a number of articles appearing in the CERN Courier and Bulletin.

- Significant contributions were made to the FP7 HiLumi LHC design study (completed in November 2015) by several US DOE laboratories (BNL, Fermilab, LBNL and SLAC), one US university (Old Dominion) and by Japan's KEK.

- KEK, BNL, Fermilab, LBNL and National High Magnetic Field Laboratory at Florida State University are also involved in the H2020 EuroCirCol project, a conceptual design study for a future circular collider, coordinated by CERN.

- E-JADE, the Europe-Japan Accelerator Development Exchange Programme under the Horizon 2020 Marie Skłodowska-Curie programme, coordinated by CERN, is in its second year. The project covers cooperation on R&D and implementation of future accelerators for particle physics (HL-LHC, ILC / CLIC, FCC, and BELLE-II), through staff exchanges between Japanese and European institutes.

- The H2020 CREMLIN project, coordinated by DESY, is in its second year. Its aim is to foster scientific cooperation between the Russian Federation and the European Union in the development and exploitation of large-scale research infrastructures. CERN is contributing to the project for a Super tau-charm factory in the field of lepton colliders in collaboration with BINP.

2.3.4 Researcher Careers and Mobility

CERN has maintained excellent working relations with the Research Executive Agency (REA) and the EC Directorate-General for Education and Culture (DG-EAC), and continues to provide excellent training opportunities for young scientists and engineers in the framework of H2020 Marie Sklodowska-Curie Actions (MSCA).

- CERN adheres to the EU Charter for Researchers and the EU Code of Conduct for the Recruitment of Researchers. With a view to obtaining the "HR Excellence in Research" award, CERN has updated and resubmitted its gap analysis with respect to the Charter and Code to take into account the results of the recent Five-Yearly Review.
- CERN continues to use its strong social media presence to advertise staff, fellowship and student opportunities at CERN, including the MSCA Actions in which it is either coordinator or beneficiary. MSCA opportunities at CERN are also promoted in job fairs in the CERN Member States.

- A representative of CERN's HR department was invited to give talks at a dedicated COFUND conference at the end of Luxembourg's EU Presidency (December 2015) and at a "Bridging Business and Research" event in Stockholm (February 2016) with a focus on the strategic use of MSCA to recruit the best international employees.
- Under the MSCA H2020 Programme, CERN is the coordinator of one new Innovative Training Network (RADSAGA) and a beneficiary of another (AVA). Two individual fellowships have been accepted. A COFUND proposal has been submitted to the 2016 Call with a new focus on technological development.

2.2.5 Promoting gender equality in research and innovation

CERN participates in a number of gender-equality-related events and carries out gender-equality actions in the framework of several EU projects.

- CERN is an Observer in the EU's GENERA project[8] in which framework it is co-organising a "Gender in Physics Day" to be hosted in Geneva in January 2017.
- CERN's Diversity Office organised the first meeting of the EuroCirCol gender equality task force in December 2015.
- CERN's Diversity Office has been collaborating with the FP7 Innovative Doctoral Program PACMAN on outreach activities for schoolgirls.
- CERN's Diversity Programme Leader was invited to make a presentation at the 2nd Workshop on String Theory and Gender (June 2016, Paris), a gender-equality awareness-raising activity within the String Theory Universe, a COST Action.
- CERN has updated its employment conditions through improvements in diversity-related social conditions, such as recognition of registered partnerships, support to parents and families, and professional-personal life balance. A summary of these new measures was sent to the relevant EC contact persons.
- Under one of CERN's Marie-Curie COFUND grants, CERN has recruited two scientists (one man and one woman) on post-career-break fellowships.

2.3 Priority areas of thematic cooperation

2.3.1 Research Infrastructures

The European Commission continues to provide support through ongoing FP7 and new Horizon 2020 projects for the development of European Research Infrastructures in the field of High Energy Physics.

CERN is actively involved of the following EU projects, co-funded by the FP7 or H2020 Research Infrastructures programmes:

- the AIDA-2020 Integrating Activity for detectors at accelerators (coordinated by CERN and DESY) with extended scope and focus on innovation (currently in its second year);
- the HiLumi LHC FP7 Design Study, with the participation of Japanese and US laboratories (completed in October 2015 and flagged as a "success story" by the EC);

[8] http://genera-project.com/

- the EUCARD-2 Integrating Activity on accelerator R&D (coordinated by CERN and due to complete in April 2017);
- the new ARIES Integrating Activity on accelerator science and technology (coordinated by CERN), with extended scope and focus on innovation and applications of accelerators, recently selected for funding;
- the EuroCirCol H2020 project, a conceptual design study for a post-LHC energy frontier accelerator lead by CERN (currently in its second year);
- the QUACO H2020 project, a pre-commercial procurement instrument for some of the high-tech magnets of the High-Luminosity LHC, started in March 2016.

Preliminary discussions on the long-term sustainability of joint accelerator R&D programmes in Europe have been held between TIARA and the Research Infrastructure unit of DG RTD.

2.3.2 e-Infrastructures

CERN continues to be involved in the implementation of the European e-infrastructure through participation in a number of EU projects, and has actively contributed to relevant policy developments and initiatives such as the Research Data Alliance and the European Open Science Cloud.

In 2015 and 2016, CERN has been active in a number of e-infrastructure-related H2020 projects, namely EGI-Engage, EUDAT2020, OpenAIRE2020, INDIGO DataCloud and AARC.

CERN has acted as coordinator for the following EU projects:

- FP7 ICE-DIP: Intel – CERN Industrial Doctorate Programme. This project is funded under the Marie Curie programme and provides an example of how public-private partnerships can contribute to training the next generation of highly qualified IT specialists to take on leading roles in European research and industry.
- H2020 PICSE: Procurement Innovation for Cloud Services in Europe. PICSE was successively completed in spring 2016 and led to the creation of the HNSciCloud Pre-commercial Procurement action.
- H2020 HNSciCloud: Helix Nebula Science Cloud[9] was launched in January 2016 and brings together 10 research organisations across Europe to procure innovative cloud services to support the big data needs of their scientific programmes.

CERN has actively contributed to the activities of the Research Data Alliance (RDA) by:

- putting forward representatives to sit on the RDA Europe Synchronisation Board and the RDA Council working group on Sustainability, as well as the co-chair of the Organisational Assembly working group on Value and Engagement;
- co-chairing an RDA Interest Group on federated identity management, and co-chairing the Preservation e-Infrastructure Interest Group;
- being the main organiser of a workshop on Active Data Management Plans, held at CERN in June 2016.

CERN also:

[9] http://www.hnscicloud.eu/

- participated in the e-Infrastructure Reflection Group (e-IRG) workshops held in Luxembourg in November 2015 and Amsterdam in March 2016;
- organised and chaired a meeting between the EIROforum IT Working Group and DG-CNECT in Brussels in March 2016;
- attended the Open Science conference organised by the Dutch EU Presidency in Amsterdam in April 2016 and contributed to the review of the published call for action;
- participated in the meeting with the High Level Expert group of the European Open Science Cloud in Brussels in November 2015;
- provided and published an input paper[10] for the pilot phase of the European Open Science Cloud, in which CERN will collaborate as an unfunded partner within the consortium led by STFC;
- has been an active member of the EGI Council and GEANT General Assembly;
- provided a representative in the end-user board of the Mikel Angelo project[11], as well as reviewers for the GreenDataNet project[12];
- responded to the e-infrastructure consultation survey launched by the EC at the end of 2015.

2.3.3 Knowledge transfer and intellectual property management

Collaboration in this area has continued through activities linked to the Enterprise Europe Network, the European Technology Transfer Office Circle, and the development of innovative detector and accelerator technologies in the framework of EU projects.

- CERN participated in the 2016 Enterprise Europe Network (EEN) Annual Meeting (Bratislava) and cooperated with EEN on participation at the Pollutec 2016 trade fair (Lyon).
- CERN co-organised and contributed to the 2nd TTO Circle Workshop on Best Practices "Software as an asset for technology transfer" and took part in the 9th TTO Plenary meeting.
- Two EU projects coordinated by CERN (AIDA-2020 and ARIES) include a “Proof-of-Concept” fund, which is a novel activity based on CERN’s positive experience with its Knowledge Transfer Fund. It is targeting the development of innovation and the testing and validation of detector and accelerator technologies for use in societal or industrial applications.

2.3.4 Open access

EC and CERN services have exchanged opinions and compared strategies on existing and planned Open Access, Open Data and more generally Open Science policies and initiatives through regular contacts and participation in events organised by one or the other.

- In the framework of the EC actions on open access, CERN has communicated on the lessons learned from initiating and operating the pioneering open access initiative SCOAP3, which is now entering its maturity phase. SCOAP3 is the embodiment of the European Council’s vision of a complete transition to open access to research results based on transparency, integrity, sustainability and fair pricing.

[10] https://zenodo.org/record/50072
[11] https://www.mikelangelo-project.eu/
[12] http://www.greendatanet-project.eu/

- In terms of Open Data, CERN has communicated with the EC services and the fora they sponsor (e.g. the Research Data Alliance) the experience learned from launching and expanding its Open Data portal and related services. A noteworthy development in 2016 is the public release of more than 320 Tb of open LHC data for research and education purposes. The positive feedback received was a good indicator of the potential of the global Open Science movement.

- CERN contributed to work on researcher and data identifiers and how these can facilitate FAIR (findable, accessible, intelligible and reusable) Open Science outputs. In addition to bilateral discussions, CERN supported this agenda through involvement in relevant H2020 projects (e.g. THOR) and the governance of the DataCite and ORCID international initiatives.

- CERN continued to operate the flagship Zenodo repository, which provides open access to Horizon 2020 publications, as part of the OpenAIRE infrastructure[13]. This repository has now been expanded to provide open access also to data within the framework of the Open Research Data Pilot. The relevant technology and knowhow have further been shared with the B2SHARE service as part of the EUDAT infrastructure[14].

2.3.5 Science Communication

CERN continues to be involved in the European Researchers' Night, with active participation of CERN Marie-Curie fellows in the event, as well as in hundreds of visits of the general public to the Laboratory.

- CERN participated in the European Researchers' Night in September 2015, which was co-funded via the H2020 POPSCIENCE project, with highly successful events taking place in Geneva and neighbouring France. The overall theme was "Pop science is for everyone". Participants were given the opportunity to learn about the latest discoveries in physics and cosmology through poetry, theatre and music, in addition to more traditional science communication activities.

- CERN Marie-Curie fellows were active participants in the European Researchers' Night 2015, across several activities, namely demonstration of augmented reality through the FP7 EDUSAFE project, animation of CMS and ATLAS virtual visits, LEGO demonstration of ATLAS, as well as explanations for the general public during animations organised in a shopping mall in Geneva.

- From July 2015 to July 2016, the CERN Visits service organised over 4,700 visits and welcomed more than 110,000 visitors from some 70 countries, with guided tours in various languages. The pool of guides for these visits includes close to 30 Marie Curie fellows, who thus gain useful experience in science communication.

2.3.6 Science education

CERN continues to contribute to strengthening the European science education base, in particular with regard to physics in higher education.

- CERN is a partner in the FP7 Go-Lab project, enabling school students to do inquiry-based science learning and to perform personalised scientific experiments. CERN has contributed to

[13] https://www.openaire.eu/
[14] https://www.eudat.eu/

the inventory of existing online labs with the Particle Physics Masterclasses, and a new online lab on ”particle physics with cloud chambers” is being developed. CERN is also helping to test the Go-Lab inquiry classroom scenarios on a large scale, with the help of teachers from the national teacher schools taking place at CERN.

- HOPE (Horizons of Physics Education) is a large project supported by the EU Lifelong Learning Programme, with the overall aim of enhancing the impact of physics in Europe and its visibility in society. CERN is contributing its expertise in inspiring and motivating pupils through its school programmes (S’Cool Lab, visits, exhibitions, video conferencing, Beamline for schools competition, physics Masterclasses etc.) and - indirectly - by offering school teachers one-week training courses on modern physics for schools at CERN.
- CERN is also involved in CREATIONS, a H2020 project aimed at developing creative approaches based on art for an engaging science classroom. CREATIONS aims to improve the skills of young people in STEM (science, technology, engineering, mathematics) and to pool talent with a view to promoting careers in science. CERN is involved in the coordination of science debates by providing physical and virtual platforms for real-time exploration of, and engagement with, big science.

2.3.7 Common activities in key technology areas

CERN continues to provide support to ITER and to take part in various projects and initiatives related to the use of detector and accelerator technologies for health applications.

ITER / Fusion for Energy (F4E)

Two meetings of the CERN-ITER Steering Committee took place in December 2015 and June 2016. Ongoing areas of cooperation under active implementation agreements cover:

- metallurgical and material testing support
- high-temperature superconductor current leads
- design of ITER cryolines
- interlock and safety systems
- instrumentation.

Under a general consulting task agreed between the two sides, CERN provides expert consultancy support to ITER on an ad hoc basis in a number of technical areas.

Technologies for Health

Several events related to health technologies have been organised:

- The third biennial International Conference on Translational Research in Radio-Oncology and Physics for Health in Europe was held in Geneva in February 2016 and co-organised by CERN, with more than 400 participants. The keynote speech was given by Vytenis P. Andriukaitis, EU Commissioner for Health and Food Safety.
- MEDAMI 2016 – IV Mediterranean Thematic Workshop in Advanced Molecular Imaging took place in Ajaccio in May 2016, co-organised by CERN, with key participants from the EC. A Vision Paper, which includes input from the different stakeholders, was published after the workshop[15].

[15] https://indico.cern.ch/event/544053/

CERN continues to develop technologies for medical applications in the framework of a number of EU projects:

- development and testing of new technologies for measuring energy distribution and dosimetric variables (FP7 Marie-Curie Training Network ARDENT);
- radiopharmaceutical R&D, radioisotope production, and use of carbon ions for hadron therapy and PET imaging (H2020 Innovative Training Network MEDICIS-PROMED);
- beam imaging and diagnostic systems, treatment optimisation, and facility design and optimisation (H2020 Innovative Training Network OMA);
- development of fast detectors for HEP and medical imaging, including Time-of-Flight PET scanners, and training of young researchers in these cross-disciplinary fields (FP7 PicoSEC-MCnet, H2020 ERC Grant TICAL, COST action FAST);
- applications of photonic crystals to medical imaging, through the development of novel PET scanners and industrial transfer (H2020 ERC Grant ULTIMA, EUROSTARS TURBO-PET);
- development of scintillating materials for HEP and other applications, including medical technologies (H2020 INTELUM and H2020 ASCIMAT).

2.3.8 CERN-JRC cooperation

Under the umbrella of the CERN-JRC Letter of Intent, signed by the Directors-General of the two sides, collaboration has been pursued in a number of diverse areas such as knowledge transfer, technology and innovation monitoring, big data, medical isotopes and neutron data.

Knowledge transfer and intellectual property management

Collaboration in this area is mainly in the framework of the TTO Circle[16] coordinated by the EC Joint Research Centre. CERN participated in the workshop on Best Practices in "Software as an asset for technology transfer" (September 2015) and the European TTO Circle's 9th plenary meeting (May 2016).

Technology and Innovation Monitoring (TIM)

A production version of the "Collaboration Spotting" software developed by CERN is now available. The version using publication and patent datasets covering the period 2000-2015 is now being tested in OpenStack (Cloud). It supports up to 100 concurrent users. JRC is still working on the development of the TIM tool tailored to its work programme and objectives.

Energy

- CERN experts visited the JRC ISPRA site in October 2015 to discuss best practices in the area of large research infrastructures and energy efficiency of data centres. Both parties expressed interest in further collaboration in these domains. JRC suggested that the scope of the knowledge exchange could be extended to cover facility management in general.
- An expert from the JRC was invited to and attended the workshop "Energy for Sustainable Science at Research Infrastructures"[17] organised by CERN, ERF and ESS, and hosted by DESY (October 2015).

[16] https://ec.europa.eu/jrc/en/tto-circle
[17] http://erf.desy.de/energyworkshop

Big data

- An expert from JRC served as Chair of the Task Force of the PICSE H2020 project[18] on cloud service procurement.
- JRC invited an expert from CERN to make a public science lecture in Brussels on procurement of cloud services[19] (May 2016).
- JRC participated in the Open Day event "Towards the European Open Science Cloud"[20] organised by the Helix Nebula initiative (January 2016).
- JRC visited CERN to get acquainted with the CERN Energy Storage solutions, such as EOS.

Medical radioisotope production

- During the kick-off meeting of the MEDICIS-PROMED H2020 Marie Curie Training Network[21] representatives from the JRC-ITU made a demonstration of the operation of a new isotope generator at the University Hospital of Lausanne, developed to provide novel alpha-therapy treatments[22] (February 2016).
- The JRC is on the way to becoming a member of the MEDICIS collaboration, and is particularly interested in the production of Actinium isotopes by mass separation at ISOLDE, where the first production tests have been carried out.

Neutron data for nuclear energy applications

- Several targets were prepared at the JRC Institute for Reference Materials and Measurements (IRMM) for usage at the n_TOF experiment at CERN. In addition, an existing target was sent by the JRC-IRMM to CERN and some samples were prepared by the JRC-IRMM for characterisation.
- Three new detection systems which will be used for cross-section measurements at n_TOF were successfully tested at the JRC GELINA facility.

[18] http://www.picse.eu/
[19] https://webcast.ec.europa.eu/building-the-european-open-science-cloud
[20] https://indico.cern.ch/event/461262/
[21] www.cern.ch/medicis-promed
[22] https://indico.cern.ch/event/464693/overview