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Federal Department for Economic Affairs, Education and Research EAER

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National research and innovation

SERI/NFI

Swiss Roadmap for Research Infrastructures in view of the ERI Dispatch 2017-2020

(Roadmap for Research Infrastructures 2015)

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Annex A

Management summary

Today, the field of research in all disciplines is dependent on excellent research infrastructures as a key basis of its activities. These include, for example, large-scale research facilities (e.g. particle accelerators), e-infrastructures (e.g. supercomputers) and databases. The significance of such research infrastructures is growing, as is the need for new ones. This requires the funding bodies involved to conduct medium- to long-term financial planning, whereby they should not only carefully consider whether to set up new national research infrastructures or whether to participate in international ones, but also whether to set up new research infrastructures or whether to further development or continue existing ones.

This report “Roadmap for Research Infrastructures 2015” provides a general overview of newly-planned research infrastructures in view of the ERI Dispatch 2017-2020, as well as of existing research infrastructures where funding is set to be continued in the upcoming period.

The roadmap process was coordinated by the State Secretariat for Education, Research and Innovation (SERI) on the basis of its legal mandate set out in the Research and Innovation Promotion Act (RIPA). As part of the survey process, the newly-registered research infrastructures were subjected to a two-phase evaluation. In the first phase of the evaluation, the Swiss National Science Foundation (SNSF) assessed the submitted projects based on scientific criteria and prioritised them in three categories (A,B,C). In the second phase of the evaluation process, the projects prioritised in category A were examined by the relevant responsible funding body (ETH Board, universities, universities of applied science, Confederation/SERI) with regard to their integration in the sponsoring institution’s strategic planning and financial implementation. A total of 23 new projects have been proposed for implementation by the responsible bodies.

The 2015 Roadmap for Research Infrastructures is a planning instrument and serves as a basis for developing the 2017-2020 ERI Dispatch. The roadmap also provides indicators of where there will be further funding requirements at national and international level with regard to medium-term requirements planning post-2020. The roadmap per se does not contain any funding decisions or decisions on the distribution of any federal funding for the realisation of new research infrastructures to relevant promotional credits.

1. Introduction

1.1 Content of the roadmap report

Compilation of the 2015 Roadmap for research infrastructures was coordinated by the State Secretariat for Education, Research and Innovation (SERI). The report is structured as follows: Chapter 2 starts with a review of the current ERI period, looking at which national and international obligations resulted from the 2011 Roadmap and which of the research infrastructures (RIs) that were planned at the time have been realised. Chapter 3 then presents the defining criteria of an RI as well as the process involved in this roadmap and the corresponding responsibilities. Chapter 4 presents the results of the survey and assessment process (first phase of evaluation) and the RIs proposed for implementation. Chapter 5 describes the assignment to the responsible bodies and the results of in-depth reviews by the responsible bodies (second phase of evaluation). Chapter 6 presents the additional measures aimed at promoting RIs, particularly the planned national infrastructure projects of the funding bodies (SNSF, Academies) and the planned ESFRI schemes as part of the European Roadmap[1] and international research organisations. Annex A details the newly-submitted national RIs of great scientific relevance and the international research organisations that need to be verified. Meanwhile, Annex B (inventory) describes the existing national and international RIs in which Switzerland is involved.

1.2 Aim of the roadmap

Access to excellent research infrastructures is highly important for public and private players in the field of research and innovation. In many disciplines, research infrastructures are a crucial prerequisite for obtaining new scientific findings, developing specialist fields and opening up new research areas. The need for such research infrastructures is growing, and so too is the need for funding. In particular, major research infrastructures of national and international significance with medium- to long-term coordination needs require careful planning in order to employ the limited funds as efficiently and effectively as possible. When it comes to Switzerland participating in international research organisations on the basis of international treaties, there are also legal and foreign policy aspects to take into consideration, which increase the planning and coordination needs even further. In light of this, this 2015 Swiss roadmap for research infrastructures serves as a planning instrument and as one of the foundations on which to base the relevant funding decisions of the Confederation under the ERI Dispatch 2017-2020. The roadmap is not a survey for special funding or a process resulting in direct funding decisions.

The funding decisions for implementing individual research infrastructure projects, provided they come under the Confederation's jurisdiction[2], are made as part of the ERI Dispatch 2017-2020:

- drawing on the multi-year programmes of the responsible funding and sponsoring institutions;
- based on the results from the two-phase evaluation process and the submitted implementation plans of the responsible bodies in each case;
- based on a review of the effective need for specific federal support in accordance with the Subsidies Act (SR 616.1).
- based on the anticipated total funds available for the 2017-2020 ERI period.

[1] European Strategy Forum on Research Infrastructures (ESFRI).

[2] For more information on the Confederation's jurisdiction, see Chapter. 5.2.

2. Review of the current ERI period 2013-2016: Roadmap for research infrastructures 2011

The SERI compiled the first Swiss roadmap for research infrastructures, which was approved by the Federal Council on 30 March 2011, as part of a pilot project. It served as a basis for the chapter "Research infrastructures" in the ERI Dispatch 2013-2016. First and foremost, however, it was a response to the ESFRI Roadmap 2008, for which European countries were invited to draw up national roadmaps to better plan and finance extensive, internationally-coordinated research infrastructure projects.

2.1 Inclusion criteria

In order to be included in the Swiss pilot roadmap, the project had to be integrated in either the planning of an international research organisation in which Switzerland is a member, or in the ESFRI Roadmap. Swiss participation in ESFRI projects usually requires national investment in order to subsequently cooperate in European networks. The pilot roadmap therefore primarily focused on developing existing national research infrastructures and positioning them internationally. In addition to these international research infrastructures, the pilot roadmap also featured the following three research infrastructures that fall under the responsibility of the ETH Domain based on decisions already taken in the 2008-2011 ERI period:

- Construction of a national free electronic X-ray source SwissFEL at the PSI;
- The Blue Brain Project at the EPFL (Simulation of the human brain using a supercomputer);
- Strategy for high performance computing in Switzerland[3] with the Centro svizzero di calcolo scientifico, CSCS. This supercomputer strategy also included the Swiss National Grid, which forms part of the European Grid Initiative that was co-financed by the 7th Framework Research Programme of the European Union.

2.2 Decisions of the Federal Council and Parliament in the framework of the ERI Dispatch 2013-2016

The Federal Council took note of the final report of the pilot Swiss roadmap for research infrastructures on 30 March 2011 and decided to plan support for new research infrastructures in line with the existing promotional credits as part of the ERI Dispatch for 2013-2016. The Swiss Science and Innovation Council (SSIC) assessed the roadmap process and criteria in an ex-ante assessment. Based on a review of the need for specific federal support and the funding available for the individual promotional credits, the Federal Council asked parliament to support the following RIs:

National RIs

- Completion of the SwissFEL at the PSI (ETH Domain payment framework);
- Implementation of the Strategy for high-performance computing in Switzerland (ETH Domain payment framework);
- FLARE programme: funding for the construction and maintenance of equipment for international research projects in the fields of particle physics, astrophysics and astroparticle physics and for international research organisations in which Switzerland is involved, such as CERN and the ESO (funded as part of the Special Programme in the SNSF payment framework);
- Swiss National Grid Initiative (commitment appropriation for project contributions in accordance with UFundA)[4];
- Blue Brain at the EPFL (ETH Domain payment framework).

[3] This strategy aims to facilitate the joint use of shared computers and storage capacities in the field of e-infrastructures at national and international level (FC decision 29.5.2009)

[4] This project could not be realised as the credit for project contributions under the UfundA at the time was already used up when the decisions were taken regarding implementation of the pilot roadmap.

International research organisations

In terms of international research organisations in which Switzerland participates based on international treaties, the following research infrastructures were implemented or continued:

- All research organisations mentioned in the 2011 Roadmap: CERN (including further preliminary work for CLIC), ESO, ESRF, ILL, European XFEL, EMBL, ITER (including further preliminary work for IFMIF).

ESFRI projects

The Confederation is not usually directly responsible for Swiss participation in ESFRI projects, unless an international treaty is required. It should be noted, however, that participation in ESFRI projects has implications for investment in the ETH Domain, for investment in universities and universities of applied sciences and for federal contributions in accordance with Art. 15 RIPA and lastly for tasks that come under the remit of the SNSF or Academies.

The list below shows the ESFRI projects[5] where the European consortia have already been formed and in which Switzerland is involved:

- **BBMRI**: Networking of bio-databases; CH node: Swiss Biobanking Platform (SNSF payment framework)
- **ECRIN**: Networking of clinical study centres; CH node: Swiss Clinical Trial Organisation SCTO (SNSF payment framework)
- **ELIXIR:** Bio-informatics structures in the framework of the EMBL[6]; CH node: Swiss Institute for Bioinformatics SIB (payment framework Art. 15 RIPA[7] and Art. 28 RIPA concerning commitment appropriation for international collaboration in research)
- **EPOS**: Earthquake research; CH node: ETHZ / SDS[8] (ETH Domain payment framework)
- **ICOS**: Atmospheric physics-climate research; CH node: ETHZ and HFSJG[9] (SNSF payment framework and personal contributions from the institutions of the ETH Domain)
- **CESSDA**: Networking of social science data archives; CH node: FORS[10] (payment framework in accordance with Art. 15 RIPA)
- **ESSurvey**: Long-term social science surveys; CH node: FORS (SNSF payment framework)
- **SHARE**: Long-term social science surveys; CH node: IEMS[11] and FORS (SNSF payment framework)

[5] For further information, see Annex B. The RIs are usually listed under the responsible institutions (“national node”).

[6] European Molecular Biology Laboratory. For further information, see Annex B.

[7] Based on the completely revised Research and Innovation Promotion Act (RIPA), which entered into force on 1 January 2014, the previous Art. 16 RIPA (subsidiary federal support for non-university research infrastructures) was replaced by Art. 15 RIPA.

[8] Swiss Digital Seismic Network (SDS).

[9] High altitude research stations Jungfraujoch & Gornergrat.

[10] Fondation suisse pour la recherche en sciences sociales (FORS).

[11] Institut d'économie et de management de la santé (IEMS), University of Lausanne

For the following ESFRI project, an agreement was entered into in the 2013-2016 ERI period:

- **ESS (European Spalliation Source):** this international research infrastructure, which aims to develop a neutron source in Lund, Sweden, is to be transferred over to what is known as an ERIC legal form from July 2015. Swiss participation was approved by parliament on 20.3.2015.[12]

Special importance of ERIC for Switzerland

As part of the European ESFRI Roadmap,[13] the legal form of a European Research Infrastructure Consortium (ERIC) is specifically promoted to give European research associations a stable organisational and legal form that is recognised by all EU member states. This ERIC legal form has been applicable since mid-2009. Ten ESFRI projects have already been transferred over to ERICs: for example, BBMRI, ECRIN, ESSurvey and SHARE.[14]

From the point of view of the Confederation's research promotion, ensuring that Swiss research institutions and research groups are not disadvantaged by the founding of ERICs is a high priority. Since RIs that are organised as ERICs will in future be able to apply for EU funding, Switzerland also has a financial interest in being involved in such ERICs. Participation as a full member in a research infrastructure with an ERIC legal form is only possible under state jurisdiction (and not via a participating research institution). For all such ESFRI projects, responsibility would therefore lie with the Confederation, even if it does not reach the critical financial and overall mass at which a commitment at federal level would be justifiable from Switzerland's point of view. The SERI is currently working with the partners involved to identify appropriate solutions.

[12] For detailed information on the ESS, see Annex B.

[13] ESFRI was set up in 2002 and consists of state representatives from EU member states and countries associated to the EU Research Framework Programme (therefore also including Switzerland).

[14] Submitted by ICOS to the European Commission on 2.4.2014; the Finnish government sent the ICOS ERIC formal request letter to the European Commission in April 2015. EPOS is also planning to do so in 2015. CESSDA is still organised as a consortium (no legal entity), but is also set to be replaced by an ERIC, as agreed in the Memorandum of Understanding (MoU of 5.3.2013) between the consortium partners.

3. Swiss roadmap for research infrastructures 2015

The 2015 research infrastructures roadmap is a development of the 2011 pilot roadmap and provides a look ahead to the upcoming 2017-2020 ERI period. In terms of content, it is more heavily focused on RIs with a nationwide mandate. Nevertheless, most RIs have international links, without being formally integrated in an international context (international research organisations; ESFRI Roadmap). In terms of timing, the 2015 national roadmap is aligned with the ESFRI Roadmap Update 2016 to ensure that the results of the national survey can be incorporated in European planning from Switzerland's point of view and in Switzerland's interest.

3.1 Aim and purpose in accordance with RIPA

This roadmap provides an overview of existing RIs on the one hand and newly-planned ones on the other. It therefore acts as an instrument for needs-based material coordination for consistency between national and international research promotion in accordance with the legal mandate (Art. 41 RIPA).[15] Based on this planning work, the Confederation's national and international research and innovation promotion should be aligned as coherently as possible in terms of RIs with the development priorities of the specialist fields and disciplines in Switzerland and the relevant development priorities in the ETH Domain and at the universities (universities and universities of applied sciences) (Art. 55 V-RIPA).

3.2 Operational definition of an RI

This roadmap is based on the following definition of "research infrastructure"[16]:

- The infrastructure makes a key contribution to the development of a particular field of knowledge or research (scientific added value);
- The infrastructure is widely used by researchers in Switzerland (national significance);
- The infrastructure is in principle open to national and international research communities (open access);
- The infrastructure may be situated at a single location or organised in a network with several locations with a centralised management structure.

Characteristically, RIs in Switzerland are publicly or privately owned and are structured/implemented in a medium- to long- term manner (usually more than 10 years). They therefore generally exceed the planning horizon of an individual ERI Dispatch.

Setting up such RIs meets a need of the research community. This creates the foundations on which research can develop and new fields of research can be accessed. An RI does not generally conduct independent research as its primary goal. This is done instead by researchers or research groups from the specialist fields, where necessary in close collaboration with the research infrastructure.[17]

[15] For the coordination of cost-intensive research infrastructures required under Art. 41 Para. 4 RIPA, the rectors' conference Swissuniversities that was newly created under the HEdA – based on the preliminary work carried out by CRUS since 2011- submits proposals with regard to the ERI period 2021-2024 for the attention of the Swiss University Council.

[16] This definition corresponds to the one in the pilot roadmap and was therefore also used in the RIs listed in the inventory.

[17] According to the MERIL definition (Mapping of the European Research Infrastructure Landscape), a further distinction is drawn between RIs with a direct research purpose and RIs that serve to coordinate scientific fields. The three main criteria for the acceptance of a research infrastructure in the MERIL database are quality, accessibility and management.

A distinction can be drawn between three types of RIs:

a. Instruments: large-scale equipment, such as particle accelerators, telescopes, research vessels, measuring stations, specific laboratory equipment;
b. Information and service infrastructures:
    - Research data and data service centres, including scientific data collection and archiving,
    - Archives, libraries and object-related collections,
    - Subject-specific service centres (e.g. in clinical research; for networking scientific fields);
c. Technical infrastructures: particularly e-infrastructures (supercomputers; grid; software/middleware; digital scientific information networks).[18]

The following are explicitly excluded from this definition*:*

- Research programmes per se,
- University institutes or research establishments per se,
- individual equipment,
- Pilot, demonstration and testing facilities,[19]
- Promotional organisations,
- Editions[20],
- Scientific secretariats.

3.3 Responsibilities, procedure and inventory

Responsibilities

Under the terms of RIPA, it is primarily the institutions of higher education or their funding councils that are responsible for supporting RIs. The SNSF plays a subsidiary role by funding RIs that serve to develop specialist areas in Switzerland and that do not fall under the responsibility of university research institutions or the Confederation (Art. 10 Para 3 (c) RIPA). Meanwhile, the Confederation is responsible for providing subsidiary support for research infrastructures of national relevance (Art. 15 Para 3 (a) RIPA) and for Swiss participation in internationally-coordinated RIs governed by international treaties (Art. 28 RIPA). The Academies can support data collections, documentation systems, scientific journals, editions or similar facilities that serve to develop specialist fields in Switzerland but do not fall under the funding responsibility of the SNSF or the university research institutions and are not funded by the Confederation (Art. 11 Para 6 RIPA).

Procedure

In order to survey the newly-planned RIs, the SERI and SNSF issued a survey process (“call”) for applications between October 2013 and January 2014. The call was open to members of universities (ETH and research institutes, cantonal universities and universities of applied sciences) individually or grouped into consortia. For the newly-planned RIs, a signed letter of commitment from the relevant university board or director of the research institute in the ETH Domain had to be enclosed, in which the institution committed itself to providing co-financing and/or follow-up financing. The universities therefore played a crucial role from the outset.

[18] The term used by the E-Infrastructure Reflection Group (E-IRG) distinguishes: “The main e-Infrastructure components and services include networking, high-throughput and high-performance computing, data infrastructures, software/middleware (including authentication and authorisation infrastructures) and virtual research environments that are to be used by virtual research communities.”(E-IRG White paper 2013, p. 5)

[19] The roadmap focuses on research-driven RIs of national relevance that are necessary for further developing the relevant research field. Pilot and demonstration projects can be used to prepare for the setup of an RI or the knowledge and technology transfer from applied research to the economic context (market launch), but are not actual RIs in the sense intended here.

[20] Up to now, editions have mainly been funded by the SNSF as “long-term projects” due to their direct link to research projects via project funding. From 2017, they will be supported via the SNSF research infrastructure funding. For further information on editions and scientific secretariats, see Chapter 6.1.

The roadmap process is based on a two-phase evaluation process. Following a quality check by the SNSF between January and August 2014 (first phase of evaluation, see Chapter 4), the SERI coordinated with stakeholders regarding allocation of the proposed projects to the relevant responsible bodies for in-depth evaluation and informed them of the next steps in October 2014 (second phase of evaluation, see Chapter 5).[21]

Inventory

At the same time as the survey of new RIs, the SERI also compiled an inventory of existing RIs in a national and international context. This inventory was revised in a two-stage consultation procedure with the universities and funding bodies and completed as far as possible. The first consultation round was completed in August 2014, and the second round with the compilation/completion of budgeted figures in November 2014. In addition to the 26 RIs listed in the original pilot roadmap in 2011, additional RIs were added to the inventory by universities and research bodies provided they met the RI criteria. The inventory currently comprises around 70 existing RIs.

[21] Under RIPA, the funding bodies are the SNSF, the Academies and the Confederation (for non-university research infrastructures and internationally-coordinated research infrastructures based on international treaties). The sponsoring institutions of newly-planned research infrastructures may be institutions in the ETH Domain, cantonal universities and universities of applied sciences as well as private sponsors and international organisations.

4. First phase of evaluation: survey and evaluation process

4.1 Evaluation process and criteria

As part of the survey process (call for applications), a total of 47 new projects were registered, supported by a relevant letter of reference from the universities. These were then evaluated by the Swiss National Science Foundation (SNSF) on behalf of the SERI based on the criteria below:

Scientific potential/generation of scientific added value in terms of specialist and interdisciplinary aspects:

- How significant and original are the research questions and approaches that the planned RI facilitates?
- To what extent would they achieve added value compared to research that is already being conducted?

Use and accessibility (nationally and internationally, cross-disciplinary):

- Can the planned RI be widely used and is it accessible?
- To what extent do the track records and specialist skills of future users suggest that the planned RI will allow high-quality research to be conducted?
- To what extent will the planned RI and the data it is used to generate be accessible and available to a significant research community?

Feasibility:

- To what extent does the planned RI comply with the current state of research or development in terms of its technical, logistic, methodical and conceptual aspects?

Financing and institutional integration:

- To what extent is the long-term continuation, financing and institutional integration of the planned RI guaranteed?

Significance for Switzerland as a location for science:

- To what extent does the planned RI link up with Switzerland's existing strengths in research or to what extent does it compensate for a weakness?
- To what extent will international links be guaranteed with the planned RI?
- What role would the planned RI play in the training of talented young scientists?

The SNSF submitted its results to the SERI at the end of August 2014. Based on these criteria, the SNSF evaluated 41 of the 47 projects submitted and prioritised them as follows[22]:

Priority A	High scientific relevance	20 projects
Priority B	Medium scientific relevance	15 projects
Priority C	Low scientific relevance	6 projects

A total of six projects are not listed. Of these, the SNSF considered it impossible to assess or categorise three projects because the context (distinction from existing RIs or legal framework conditions) was unclear. Three projects could not be reviewed as they failed to meet the formal criteria of the survey procedure.[23]

The results of the SNSF evaluation and information on the next steps were sent to the responsible bodies and the submission authors by the SERI on 13 October 2014.

[22] This list includes the four e-infrastructures (two A priorities and two B priorities) where there is a fundamental need for coordination.

[23] Contrary to the usual SNSF procedure, the bodies of the specialist departments mandated to conduct the evaluation could not make any funding decisions.

4.2 Overview

The financial volume of all 41 new RIs reviewed by the SNSF was estimated as per August 2014 at around 652 million Swiss francs (total costs for the 2017-2020 period including investment and operating costs)[24]. Figure 1 below shows how these costs are distributed across the four fields, while figure 2 shows the distribution of the estimated financial volume by prioritisation category. Finally, figure 3 provides an overview of the distribution of prioritisation categories by specialist field.

The 41 RIs reviewed by the SNSF are split as follows across the four main fields[25]:

- 10 humanities and social sciences
- 16 mathematics, engineering and natural sciences (MINT)
- 11 life sciences
- 4 e-infrastructures

The following sponsoring institutions submitted new projects:

- 6 ETH Domain (in some cases together with universities/universities of applied sciences)
- 30 cantonal universities (in some cases together with the ETH Domain/universities of applied sciences/university hospitals)
- 6 universities of applied sciences (in some cases together with the ETH Domain/universities)
- 5 other institutions (university hospitals/foundations)

To summarise, it can be noted that the projects submitted are distributed across all specialist fields, although the MINT field has the most projects (Fig. 3). In terms of the distribution of financial volume by field (Fig. 1), it is clear that life sciences, MINT and e-infrastructures in particular have the highest costs (as measured by the number of projects). In terms of the distribution of costs by prioritisation category, we can see that almost half of the planned costs are incurred by projects categorised under priority A (Fig. 2).

[24] This financing requirement was increased, confirmed or reduced as part of the in-depth evaluation (2nd phase of evaluation) and specified using budgetary clarifications.
[25] Figure 3 does not show the uncategorised RIs (three from life sciences and one from the MINT field).

Fig. 1: Distribution of funds by field

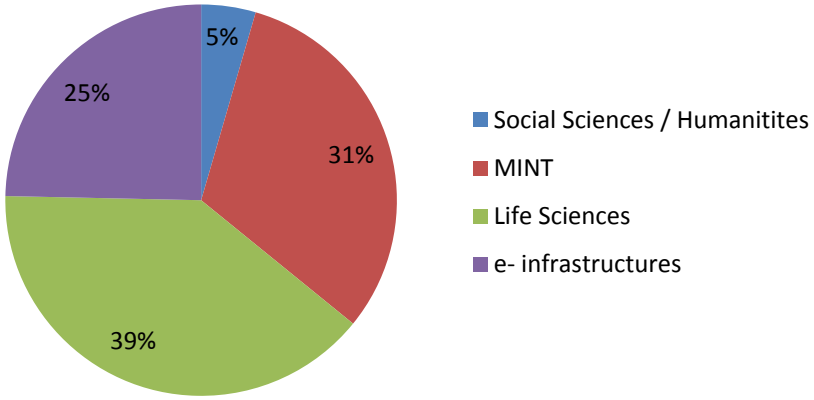


Fig. 2: Distribution of funds by priority (100%= 652 million)

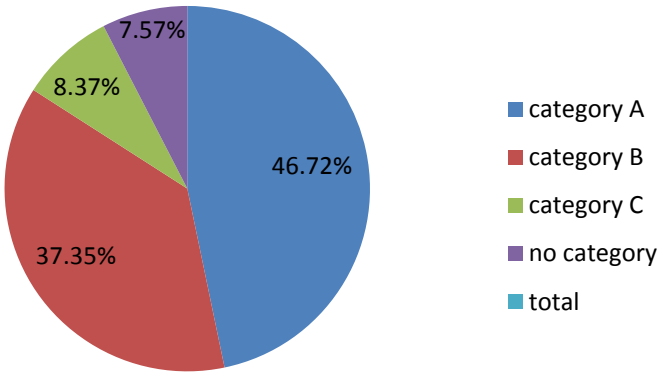
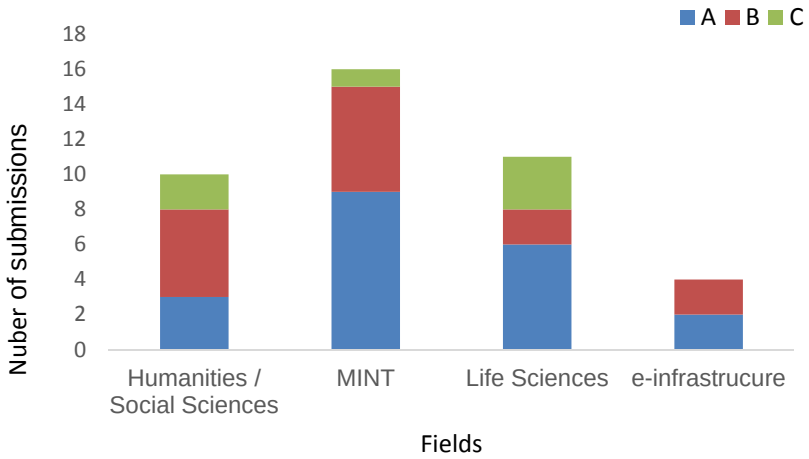


Fig. 3: Distribution of prioritisation categories by field



4.3 RIs put forward for implementation

Of the 41 new projects evaluated by the SNSF, a total of 23 projects were put forward for in-depth review or implementation: in addition to the 20 projects categorised as A priority by the SNSF, three additional projects that were classified as priorities by the responsible bodies.[26] The table below provides an overview of the prioritised RIs by specialist field. The estimated total costs for the 2017-2020 period alone would amount to around 337 million Swiss francs for the Confederation (as at October 2014). A detailed description of the RIs that have been put forward for an in-depth review can be found in Annex A.1 of this roadmap.

Specialist field	Institution	Project
Humanities	University of Zurich	The Swiss Art Research Infrastructure (SARI)
Humanities	University of Basel	Swiss Digital Humanities Center (SDHC)
Life sciences	University of Neuchâtel	Swiss Research Centre for Animal Cognition
Life sciences	University of Basel, University of Zurich	Center for Pediatric Systems Pharmacology and Technology
Life ¨ sciences	University of Zurich, Balgrist University Hospital	Swiss Center for Musculoskeletal Biobanking and Imaging and Clinical Movement Analysis
Life sciences	University of Neuchâtel	The Neuchâtel Platform for Analytical Chemistry
Life sciences	Universities of Lausanne, Basel, HES-SO,	Information and computational service infrastructure network to support biomedical research in Switzerland (BioMedIT)
Life sciences	University of Basel, ETHZ, University of Zurich	Swiss National 1.2 GHz Solution NMR facility
Life sciences	Universities of Zurich, Basel, Bern, Lausanne, Geneva	SwissPedNet
MINT	University of Lausanne	The Swiss National Ion-microprobe Platform
MINT	University of applied science SUPSI	Swiss Laboratory for the “Advanced Studies on the Dynamic Behavior of Materials”
MINT	University of Zurich	Airborne Research Facility for the Earth System
MINT	Empa, Eawag	Next Evolution in Sustainable Building Technologies NEST
MINT	University of Zurich	The future of dark matter detection with liquid xenon XENONnT and DARWIN
MINT	PSI	ATHOS - extending capabilities and doubling capacities for SwissFEL
MINT	PSI	Swiss Light Source SLS 2.0
MINT	University of Geneva	A Common Data Center Infrastructure (CDCI) for Astronomy, Astroparticle and Cosmology
MINT	Lucerne University of Applied Sciences and Arts	Center for Biomedical Research in Space
MINT	EPFL	New Swiss Plasma Center
Social Sciences	University St. Gallen	Mixed-Reality Lab for Behavioral Research MIRAL
e-infrastructure	CSCS (ETHZ)	HPCN-20
e-infrastructure	Foundation SWITCH - a foundation of all universities	The Swiss edu-ID and the Swiss Academic Cloud based on the Academic Network SWITCHlan
e-infrastructure	EPFL	Swiss Research Cloud (Initiative for Data Science in Switzerland)

[26] Of the three projects, two are RIs that were not prioritised by the SNSF (New Swiss Plasma Center und Swiss PedNet) and a B priority RI (Swiss Research Cloud, for which the concept was reworked).

5. Second phase of evaluation: allocation and results

Under the terms of RIPA, it is primarily the institutions of higher education or their funding councils that are responsible for supporting and funding RIs. The Confederation's research promotion bodies (SNSF, Academies) play a subsidiary role in supporting RIs. Meanwhile, the Confederation is responsible for subsidiary funding of research infrastructures with national relevance (Art. 15 Para 3 RIPA) and for Switzerland's participations in internationally coordinated RIs governed by international treaties in accordance with Art. 28 RIPA.

The Confederation is therefore indirectly responsible for

- projects in the ETH Domain: Confederation is the sponsoring body;
- projects at universities (universities and universities of applied science): subsidiary federal support under the terms of the Higher Education Funding and Coordination Act, HEdA;
- projects under the jurisdiction of the research promotion bodies (SNSF, Academies; see Chapter 6.1).

The Confederation is therefore directly responsible for

- research infrastructures established outside of universities: subsidiary federal support in accordance with Art. 15 RIPA ;
- Switzerland's participation in internationally coordinated projects, particularly for international organisations and ESFRI projects, provided they are implemented on the basis of an international treaty (see Chapter 6.2).

5.1 Allocation of newly-planned RIs

Based on the evaluation and the SNSF's allocation recommendations, the SERI designated a responsible body to conduct an in-depth review of the prioritised RIs, after consulting with the representatives of the ETH Board and Swissuniversities.[27] This allocation is shown below for the individual projects.

Allocation to the ETH Domain

Within the ETH Domain, the ETH Board coordinated the in-depth reviews of the following six projects:

- Swiss High-Performance Computing and Networking Initiative (HPCN/HPCN-20)
- ATHOS beamline at the Swiss X-ray Free Electron laser SwissFEL
- Swiss Light Source (SLS 2.0)
- Swiss Research Cloud (-> Initiative for Data Science in Switzerland, IDSS)[28]
- Centre de recherches en physique des plasmas CRPP / Swiss Plasma Center
- Next Evolution in Sustainable Building Technologies (NEST)

Allocation to the cantonal universities and universities of applied science

In terms of universities, the organisation Swissuniversities coordinated the in-depth reviews of the following ten projects:

- Swiss Digital Humanities Center, SDHC: Swissuniversities (with coordination mandate)[29]
- The Swiss edu-ID and the Swiss Academic Cloud based on the Academic Network SWITCHlan: Swissuniversities (with coordination mandate)
- MIRAL - Mixed-Reality Lab for Behavioral Research: University of St. Gallen

[27] The meeting with representatives of the ETH Board took place on 3 September and with representatives of CRUS and KFH (now Swissuniversities) on 8 September 2014.

[28] A working group commissioned by the ETH Board reviewed the RIs originally submitted to the SERI in the field of e-infrastructures (HPCN-20, Swiss Research Cloud und The Swiss edu-ID and the Swiss Academic Cloud based on the Academic Network SWITCHlan) with regard to coordination needs and developed an overarching, joint strategy for data sciences. As a result, the Swiss Research Cloud project led by the EPFL and in collaboration with the ETH Zurich was reworked.

[29] Swissuniversities also clarified the relationship with the project "The Swiss Art Research Infrastucture" and the SUC P2 programme "scientific information" in the process. The results of the evaluation of the pilot project "Digital infrastructures for the humanities"(see mandate ERI Dispatch 2013-2016) managed by the SAHS were also incorporated in these assessments.

- Airborne Research Facility for the Earth System, ARES: University of Zurich
- A Common Data Center Infrastructure (CDCI) for Astronomy, Astroparticle and Cosmology: University of Geneva
- SwissNIP - the Swiss National Ion-microprobe Platform University of Lausanne
- Swiss Research Centre for Animal Cognition: University of Neuchâtel
- The Neuchâtel Platform for Analytical Chemistry: University of Neuchâtel
- Center for Biomedical Research in Space: Lucerne University of Applied Sciences and Arts (LU Uni)
- Swiss Laboratory for the Advanced Studies on the Dynamic Behavior of Materials: SUPSI

Allocation to the Confederation / SERI

Within the scope of federal government support, the SERI coordinated the formal review of the following six projects based on the Art. 15 criteria:

- Clinical Trial Unit EOC (Ospedale San Giovanni, Bellinzona)
- Swiss Center for Musculoskeletal Research and Development in Zurich (Balgrist Campus)
- The Swiss Art Research Infrastructure (SARI)
- Swiss Research Network of Clinical Pediatric Hubs (SwissPedNet)
- Center for Pediatric Systems Pharmacology and Technology
- Information and computational service infrastructure network to support biomedical research in Switzerland (BioMedIT)
- In addition: The future of dark matter detection with liquid xenon: XENONnT and DARWIN (Review FLARE, funding SNSF)

5.2 Funding and implementation plans: results

The responsible bodies were tasked with reviewing the RIs allocated to them with regard to integration in the relevant strategic planning and the funding required to realise the project in the 2017-2020 ERI period. The evaluation was conducted in accordance with the procedures and criteria of the responsible funding/sponsoring organisation. The results of the second phase of evaluation were submitted to the SERI by the responsible bodies by mid-March 2015 in the form of implementation plans and are summarised below.

ETH Domain (as at end of May 2015)

In line with its strategic planning[30] the following RIs are of particular strategic importance for the ETH Board: the Swiss High Performance Computing and Networking Initiative (HPCN-20) at the CSCS at ETH Zurich, the neuroinformatics Blue Brain project at EPFL, ATHOS/SwissFEL at the PSI and the upgrade to the CMS detectors at CERN supervised by ETH Zurich. As part of the roadmap process, HPCN-20 and ATHOS/SwissFEL were submitted as new RIs (see Annex A), while Blue Brain and CMS detectors were incorporated in the inventory as existing RIs (see Annex B).

The ETH Board worked with the sponsoring institutions to check the strategic conformity of the new RIs allocated to the ETH Domain for review and took note of the estimated funding requirement of the institutions in the ETH Domain. The ETH Board supports the inclusion of the following RIs in the roadmap:

[30] Strategic planning 2017-2020 of the ETH Board for the ETH Domain, 2014.

No.[31]	Research infrastructure	Estimated funding requirement 2017-2020 (in CHF millions)	Funding requirement from ETH Domain payment framework 2017-2020 (in CHF millions)	Sponsoring institution with primary responsibility
1	Swiss High-Performance Computing and Networking Initiative (HPCN/HPCN-20)	210	184	ETH Board (ETHZ)
2	ATHOS beamline at the Swiss X-ray Free Electron laser SwissFEL	46	40	ETH Board (PSI)
3	Swiss Light Source (SLS 2.0)[32]	2	2	ETH Board (PSI)
4	Initiative for Data Science in Switzerland (IDSS)	77	64	ETH Board (EPFL/ETHZ)
5	Centre de recherches en physique des plasmas (CRPP) / Swiss Plasma Center	135	85	ETH Board (EPFL)
6	Next Evolution in Sustainable Building Technologies (NEST)	13	2[33]	ETH Board (Empa/Eawag)

Full implementation of the six new RIs will result in an estimated total funding requirement of 483 million Swiss francs for the 2017-2020 period. CHF 377 million (of which CHF 173 million from the ETH Board) will have to be covered from the ETH Domain payment framework. If the ETH Domain cannot guarantee funding from the ETH Domain payment framework that has yet to be decided by parliament, the ETH Board will take a decision in due time regarding their implementation and financing arrangements within its financial capacity.

Besides investments in new RIs, significant funding will be provided from the ETH Domain payment framework for the operation and further development/upgrade of existing RIs in the 2017-2020 period. In its strategic planning for 2017-2020, the ETH Board is therefore envisaging funding for the development of the neuroinformatics Blue Brain project at EPFL of CHF 88 million in total and for the upgrade of the CMS detectors at CERN supervised by ETH Zurich of CHF 15 million (see Annex B). The total expenditure for the further development/upgrade of these two existing RIs from the ETH Domain payment framework amounts to CHF 115 million for the 2017-2020 period.

Conclusion:

- ⇨ The new RIs listed above and the two existing ones mentioned would result in costs of CHF 492 million for the Confederation (as sponsor of the ETH Domain) for the 2017-2020 ERI period.
- ⇨ The amount of funding available will be stipulated/requested via the ETH financial framework in the 2017-2020 ERI Dispatch.
- ⇨ The decision as to whether and to what extent these RIs will be implemented in the 2017-2020 period will be made by the ETH Board or the institutions of the ETH Domain.

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[31] For detailed information, see Annex A, where the projects are listed in line with this numbering.

[32] For SLS 2.0, the design phase is set to take place in the 2017-2020 period with estimated costs of CHF 2 million, the costs of the subsequent implementation phase in the 2021-2024 period are estimated at CHF 83 million.

[33] Plus as yet undefined contributions from the funding aimed at developing measures to strengthen energy research in the ETH Domain in line with the “Coordinated energy research Switzerland” action plan.

Cantonal universities and universities of applied sciences (as at end of May 2015)

As part of its strategic planning, the Swissuniversities rectors' conference (formerly CRUS and CUAS) put forward the following 13 projects for implementation:

No.	Research infrastructure	Estimated funding requirement 2017-2020 (in CHF millions)	Planned funding requirement from PC promotional credit under Art. 59 HEdA (in CHF millions)	Sponsoring institution with primary responsibility
7	**The Swiss edu-ID and the Swiss Academic Cloud based on the Academic Network SWITCHlan**	89	24.5	Swissuniversities
8	**Swiss Digital Humanities Center**	8.58	2.626 (+ 4 applied for under Art. 11 RIPA)	Swissuniversitites University of Basel
9	**The Swiss Art Research Infrastructure**	4.5	1.513	University of Zurich
10	**Center for Pediatric Systems Pharmacology and Technology**	3.2	1.067	University of Basel
11	**The Swiss National Ion-microprobe Platform (SwissNIP)**	6.3	1.5	University of Lausanne
12	**Swiss Laboratory for the Advanced Studies on the Dynamic Behaviour of Materials**	6.774	1.36	SUPSI (University of Applied Sciences and Arts off Southern Switzerland)
13	**Swiss Research Centre for Animal Cognition**	2.47	0.823	University of Neuchâtel
14	**Airborne Research Facility for the Earth System (ARES)**	22.7	7.6	University of Zurich
15	**Mixed-Reality Lab for Behavioral Research MIRAL**	2.564	0.855	University of St. Gallen
16	**The Neuchâtel Platform for Analytical Chemistry (NPAC)**	3.153	1.05	University of Neuchâtel
17	**Proposal for a Swiss National 1.2 GHz Solution NMR facility**	21.34	7.126	University of Basel
18	**A common Data Center Infrastructure (CDCI) for Astronomy, Astroparticle and Cosmology**	5.4	1.867	University of Geneva
19	**Center for Biomedical Research in Space**	0.6	0.2	Lucerne University of Applied Sciences and Arts (LU Uni)

The overall funding requirement for implementing these RIs in full is estimated at around CHF 180 million. Of this, a total of around CHF 52 million of funding has been applied for from Swissuniversities as part of the ERI loans for project contributions (PC) under the HEdA.[34] According to the decision of Swissuniversities, the projects listed can be funded with a maximum of one third PC, while the rest must be guaranteed by the sponsoring institutions. All these projects must go through the normal PC contributions process. How many of the projects will be implemented depends on the decision of the

[34] According to the application from Swissuniversitites, the SUC approved the submitted projects (including the research infrastructures summarised as a project with CHF 27,586,682) in its decision of 28.5.2015 in accordance with Art. 59 HEdA. Swissuniversities must submit the definitive project proposals by the end of February 2016. The funding decision is due in September 2016. The application from Swissuniversities to the Swiss University Council of 7.4.2015 comprises the amount for RI projects No. 8-19 with CHF 27.5 million. In addition, CHF 24.5 million was applied for by SWITCH as part of the follow-up project to P-2 for No. 7, which equates to a total of CHF 52 million PC funding for RI projects.

Swiss University Conference (SUC) on the one hand; and on the funding decisions in favour of PC credits as part of the ERI Dispatch 2017-2020 on the other.

Conclusion:

- ⇨ Full implementation of these new RIs would result in costs totalling CHF 52 million for the Confederation via funding for project contributions in accordance with HEdA for the 2017-2020 ERI period. These costs cover a maximum of one third of the total costs (primarily the investment costs in the start-up phase) for new RIs; the ongoing (operating) costs for the subsequent ERI periods must be borne by the sponsoring institutions/universities in accordance with PC regulations.
- ⇨ The amount of funding available will be stipulated/requested via the PC promotional credit in the 2017-2020 ERI Dispatch.
- ⇨ The decision as to whether and to what extent these new RIs will be implemented will be made by the Swiss University Conference (PC funding) or the universities.

Confederation (as at end of March 2015)

The Confederation may, under Art. 15 RIPA, provide subsidiary funding to research facilities of national relevance if they make a significant contribution to creating scientific added value in specific specialist fields and meaningfully complement the research activities at the universities and in the ETH Domain. Federal support also requires universities, cantons, other public administrations and private institutions to make significant contributions (at least 50 per cent) to basic funding.

The SERI started by reviewing the projects allocated to the Confederation for the second phase of the evaluation with regard to the need for specific federal support and compliance with the formal criteria of Art. 15 and reached the following conclusion:

- The project “The Swiss Art Research Infrastructure (SARI)” and the “Center for Pediatric Systems Pharmacology and Technology (CPSPT)” do not meet the formal requirements for funding under Art. 15 RIPA. They should be funded by the competent sponsoring organisations, the University of Zurich for SARI and the University of Basel for CPSPT.
- For the project “The future of dark matter detection with liquid xenon: XENONnT and DARWIN”, the SERI clarified the partial financing of the RI through the FLARE SNSF funding instrument.[35] The remaining funds must be guaranteed by the participating universities themselves or via third party funds.
- The project “Clinical Trial Unit EOC” cannot be funded as a CTU by the Confederation/SERI, but must instead be reviewed as part of the planned research infrastructure, the SCTO network[36], in accordance with Art. 15.

[35] For more information on Flare, see Chapter. 6.1.1. SNSF.

[36] The Swiss Clinical Trial Organisation (SCTO) was set up in 2009 as a national cooperation platform for clinical research (Clinical Trial Units, CTU) . The SCTO is currently part of the SNSF portfolio, but is intended to be consolidated in the upcoming ERI Dispatch in line with the test mandate in the 2013-2016 ERI Dispatch and funded directly by the Confederation under Art. 15 RIPA.

The following RIs need to be further reviewed by the SERI in the context of funding in accordance with Art. 15 RIPA:

No.	Research infrastructure	Estimated funding requirement 2017-2020 (in CHF millions)	Planned funding requirement from promotional credit Art. 15 RIPA (in CHF millions)	Sponsoring institution with primary responsibility
21	**Swiss Center for Musculoskeletal Biobanking and Imaging and Clinical Movement Analysis**	104.8	23.1	SERI (University of Zurich, Balgrist University Hospital)
22	**Swiss Network of Clinical Pediatric Hubs (SwissPedNet)**	14.49	7.4	SERI (SCTO/Swisspednet)
23	**Information and computational service infrastructure network to support biomedical research in Switzerland (BioMedIT)**	37.4	18.5	SERI (SIB)

The three new RIs must go through the usual application procedure[37] for federal contributions under Art. 15 RIPA. For new applications, there is an in-depth scientific review by the SSIC and other bodies may also be involved (SNSF, Rectors' Conference). Based on these reviews and the relevant recommendations, the Department then decides in accordance with the legal provisions about the amount, duration and any requirements of federal support or in the case of a negative decision, to reject the application.

The SwissPedNet project, together with the planned SCTO research infrastructure, is therefore to be reviewed as one application, as is the new BioMedIT project with the SIB research infrastructure (as planned sponsoring institution of BioMedIT) that is already funded under Art. 15. The Swiss Center for Musculoskeletal Biobanking project is a new, independent research infrastructure, which has already been built using private funds.

Conclusion:

- ⇨ Full implementation of these new RIs would result in costs of CHF 49 million for the Confederation for the 2017-2020 ERI period through contributions under Article 15 RIPA. These costs cover a maximum of 50 per cent of the total costs of the new RIs. The amount of funding available for federal contributions to research facilities of national relevance under Article 15 RIPA is set out or requested in the ERI Dispatch 2017-2020.
- ⇨ The decision whether and to what extent these new RIs will be implemented depends on the payment framework for Article 15 facilities set out or approved in the ERI Dispatch 2017-2020, the result of the in-depth scientific review by the SSIC and on the financial participation of the universities involved.

[37] Art. 12 of the EAER Ordinance on Research and Innovation Promotion (SR. 420.111).

6. Additional infrastructure-related measures

6.1 Funding of RIs by the Confederation's funding bodies

Besides the primary responsibility of universities and/or their funding councils for financing RIs, the funding bodies of the Confederation, in particular the SNSF and the Academies, have a subsidiary funding mandate in this area under the terms of RIPA. They have already submitted their plans for 2017-2020 within the framework of their multi-year planning (MYP).

6.1.1 SNSF

Support of RIs by the SNSF usually takes place on the basis of specific, earmarked funding for a limited period of time. The role of the SNSF in funding research infrastructures is directly linked to its main task of competitive research funding. In this respect, the SNSF sees its RI funding only as start-up financing that usually lasts a maximum of ten years, provided the follow-on funding is secured and that the infrastructure is aligned with the national and international portfolio. In the current 2013-2016 ERI period, the SNSF will probably not launch specific calls for RIs. For the 2017-2020 ERI period, the intention is to only launch calls for proposals in a very limited context and with a focus on heavily research-driven infrastructures.

In connection with the funding of research infrastructures, the SNSF is planning to continue funding longitudinal studies, biobanks[38], scientific editions and R'Equip in the 2017-2020 period. In addition, there is the federal mandate for FLARE. The planned expenditure for research infrastructures including FLARE according to the MYP amounts to around CHF 50 million per year.

Infrastructure	**Budget 2017-2020** in CHF millions (according to MYP)
Research infrastructures and R'Equip	131.6
Editions (new projects)	8
Longitudinal studies	40
Biobanks	9.6
FLARE (additional task)	38.4
total	**227.6**

In the case of what are known as longitudinal studies, the SNSF funds multi-centric, population-based and disease-oriented studies[39] with a longitudinal design. In the 2017-2020 ERI period, coordination of these studies is set to be enhanced with further ongoing medical projects (in the field of personalised medicine) and in particular with the bio-database funded by the SNSF[40]. Through the R'Equip funding scheme, the SNSF receives applications for funding to set up and develop large-scale research equipment every year. Within the framework of FLARE, the SNSF supports the use of international research infrastructures in the fields of particle physics, astrophysics and astro particle physics on behalf of the Confederation, in particular involvement in experiments at CERN in Geneva and the European Southern Observatory in Chile. The SNSF is keen to improve the overall coherence and quality of research decisions in these specialist fields, which are characterised by high infrastructure costs, international collaboration and long-term commitments.

[38] For 2015 the SNSF is planning a call for biobanking linking-up funds.

[39] The SNSF is supporting a total of 10 such longitudinal studies, based on the evaluation conducted in 2013, for the time being limited to a two-year period (budget CHF 27 million).

[40] The SNSF is supporting the setting-up of a Swiss bio-database in order to coordinate, harmonise and standardise biobanks in Switzerland that are relevant to research and also to supplement the European research infrastructure BBMRI at national level. The official launch of the bio-database is planned for 2015.

Excursus: humanities editions and scientific secretariats
On behalf of the SERI, the SNSF and the Academies (SAHS) have agreed on a funding concept that meets the requirements of the RIPA, the competences and tasks of the funding bodies involved and the long-term consolidation of the relevant funding measures in the field of humanities editions and scientific secretariats. With regard to editions, there will in future be a criteria matrix developed jointly by the SNSF and the SAHS to assess national significance with the aim of defining responsibilities early on in terms of evaluation, funding and support of humanities editions with a term of more or less than 10 years[41]. Corresponding regulations are also due to be developed and implemented by the SNSF and the Swiss Academy of Sciences (SCNAT) for scientific secretariats[42].

Conclusion:

- ⇨ The implementation and/or support of RIs that fall under the jurisdiction of the SNSF is carried out within the scope of the total funds provided to the SNSF in the ERI Dispatch 2017-2020 (payment frameworks).

6.1.2 Academies

Within the framework of the MYP 2017-2020, the **SAHS** is planning to fund the following RIs[43]:

Infrastructure	**Budget 2017-2020** in CHF millions (according to MYP)
Swiss National Dictionaries	21.83
Diplomatic documents of Switzerland	3.25
Annual Yearbook of Swiss Politics	2.4
Swiss Inventory of Coin Finds	2.1
Infoclio.ch	1.88
Collection of Swiss Law Sources	2.23
Swiss Historical Dictionary	8.24
Data and service centre[44]	4.12
total	**46.05**

[41] Edition projects lasting less than ten years that are of a project nature fall under the jurisdiction of the SNSF (funded by the SNSF); editions lasting more than ten years should, provided they are of national relevance, be transferred from the SNSF to the SAHS (at the earliest ten years after the launch of the edition).

[42] With regard to scientific secretariats (coordination platforms), a fundamental transfer of tasks to the Academies is planned. From 2017, the SNSF will no longer be responsible for funding in this area.

[43] These RIs – with the exception of the Collection of Swiss Law Sources and the Data and service centre – are listed in Annex B.

[44] Content-wise this corresponds to the project re-submitted by the University of Basel as part of this roadmap “Data and Service Centre for the Humanities”, see Annex A.1, no. 8. The evaluation of the pilot project submitted by the SAHS envisages a shared funding model (SAHS via Art. 11 RIPA, personal contribution from universities/PC under HEdA; total costs estimated at around CHF 8 million).

Within the framework of the MYP 2017-2020, the **SCNAT** is planning to fund the following RIs[45]:

Infrastructure	**Budget 2017-2020** in CHF millions (according to MYP)
High Altitude Research Station Jungfraujoch	0.06
Swiss Optical Ground Station and Geodynamics Observatory Zimmerwald; Swiss GNSS reference network; Swiss National gravity network	0.08[46]
Geological Mapping: geophysical and geotechnical series	0.11
GLAMOS Glacier monitoring Switzerland; PERMOS Permafrost-monitoring Switzerland	0.32
National park research data series	0.6
total	**1.37**

Conclusion:

- ⇨ The implementation/support of RIs under the jurisdiction of the Academies is carried out within the scope of the total funds provided to the Academies under the ERI Dispatch 2017-2020 (payment framework).

[45] These RIs – with the exception of the geological mapping and high altitude research station Jungfraujoch – are listed in the inventory (Annex B).

[46] In coordination with the financial information in the inventory, see Annex B.

6.2 International research infrastructures

6.2.1 Projects already featured in the existing ESFRI Roadmap

Of the projects already featured in the ESFRI Roadmap, most were transferred to an ERIC legal framework (see Chapter 2.2). This has been done for the DARIAH humanities network and is planned for the medical Euro-BioImaging network.

- **DARIAH-ERIC** (Digital Research Infrastructure for the Arts and Humanities)[47], has featured on the ESFRI Roadmap since 2006
- **Euro-BioImaging** has featured on the ESFRI Roadmap since 2008.

Potential Swiss involvement under the aegis of the interested research organisations as part of the ERI Dispatch 2017-2020 will need to be reviewed.

The research community is interested in Switzerland being a member of the following existing ESFRI projects[48], which are expected to be organised in the form of international treaties (see Annex A.2).

- **ELI** (Extreme Light Infrastructure): on the ESFRI Roadmap since 2006
- **CTA** (Cherenkov Telescope Array): on the ESFRI Roadmap since 2008
- **SKA** (Square Kilometre Array): on the ESFRI Roadmap since 2006
- **Neutrino Physics Programme at Fermilab** (Chicago, USA)

Potential Swiss involvement in these RIs under the jurisdiction of the Confederation will need to be reviewed as part of the 2017-2020 ERI period.

Conclusion:

⇨ The decision as to whether and to what extent Switzerland can participate in these new RIs will be based on the results of the SERI evaluation in the 2017-2020 ERI period and the relevant definition of the Confederation's strategic priorities regarding the involvement of Switzerland in the RI projects of international research organisations. In this connection, the long-term funding commitment in particular also needs to be considered.

[47] DARIAH is the most important network in this field and currently involves 15 European countries. Full membership in DARIAH-ERIC is a major need of the Swiss research community. In Switzerland, the universities of Lausanne, Basel, Bern, Geneva and Zurich are included as cooperating partners. The current situation does not offer any coordinated, nationally established link to DARIAH-ERIC, however. Full membership would allow Switzerland to represent its interests in a targeted way to DARIAH-ERIC and help shape the activities in its spheres of activity and supervise them. This would grant Swiss researchers access to resources and highly specific expertise. The planned research infrastructure "Data and service centre for the humanities" could serve as a national point of contact. Besides in-kind payments, full membership would require annual contributions of CHF 45,000 to be paid.

[48] The CTA, SKA and Neutrino Physics projects were submitted as part of the roadmap process and evaluated by the SNSF (B prioritisation).

6.2.2 Update ESFRI Roadmap 2016

Description of ESFRI Roadmap process (criteria, call, results)

The ESFRI forum[49] launched a call for the submission of proposals for new research infrastructures[50] or for the major upgrade of existing infrastructures[51] in order to update the ESFRI Roadmap on 25 September 2014. ESFRI delegations and members of the EIRO forum[52] were allowed to submit proposals until 31 March 2015[53]. The ESFRI Board formally reviewed the proposals, in particular to check whether they were supported by at least three different EU member states or associated countries[54] At least one of these countries must express a formal financial commitment to the submitted project, while the other countries should provide a written declaration of intent to demonstrate their political commitment. If a proposal is submitted by a member organisation of the EIRO forum, a Council resolution expressing financial commitment must be submitted.

The proposals are currently being reviewed with regard to scientific quality by the Strategy Working Group (SWG). The new research infrastructures and major upgrade plans must be perfected from an organisational and financial perspective. The proposals are therefore being reviewed with regard to this aspect in parallel by the ESFRI “implementation” working group.

The updated roadmap is due to be published at the beginning of 2016 and should contain the following:

- a landscape, gap and scenario analysis;
- a list of around 25 active projects and justifications for their selection;
- a list of ESFRI landmarks.

It should be noted that projects featured on the ESFRI Roadmap that are still not implemented after ten years are automatically deleted from the list of active projects. To reactivate projects after ten years, they must be formally re-submitted as new proposals, either with a different concept or correcting any shortcomings. If applicable, they may be entered in the list of ESFRI landmarks.

ESFRI will review the active projects with regard to their implementation status every two to three years. In preparation for the 2018 ESFRI Roadmap (update), the ESFRI working group will evaluate the implementation of all projects in the 2016 ESFRI Roadmap in 2017. In summary and as a result of the 10-year rule, it is certain that at least ten projects will disappear from the roadmap in 2017 and around six additional projects in 2019.

ESFRI received a total of 22 proposals as part of the 2016 Roadmap Update, of which 20 have been classified as “eligible” by the authoritative strategy working group (as at 17 April 2015) and transferred to the next stage of the evaluation process:

- 2 projects in the field of energy,
- 3 projects in the field of the environment,
- 6 projects in the field of health and food,
- 6 projects in the field of physics and technology,
- 3 projects in the field of social and cultural innovation.

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[49] http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri

[50] According to the Horizon 2020 definitions, research infrastructures (including e-infrastructures) are facilities, resources and services that are used by research communities to conduct research and innovation in their fields. (H2020 Framework Programme Regulation No. 1291/2013 - Article 2(6)). These infrastructures comprise: major scientific equipment or sets of instruments; knowledge-based resources, such as collections, archives or scientific data; e-infrastructures such as data and computing systems and communication networks; any other infrastructure of a unique nature essential to achieve excellence in research and innovation.

[51] Major upgrades are intended to achieve a transformative change in scientific output or a complete change of technical approach, They are specifically not routine maintenance or gradual improvements.

[52] http://www.eiroforum.org/

[53] Detailed guidelines for applicants and online submission form at http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri-roadmap

[54] An authoritative list of countries associated to Horizon 2020 can be found at http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/3cpart/h2020-hi-list-ac_en.pdf. Switzerland is deemed an associated country as it has participated in all activities of the so-called first pillar of Horizon 2020 since 15 September 2014.

Positive evaluation of the proposals is a precondition for being included in the 2016 ESFRI Roadmap.

New potential ESFRI projects in which Switzerland is already involved or where there is interest in Swiss participation:

The Swiss research community is interested in participating in four new ESFRI projects, which are to be evaluated by ESFRI by the end of 2015 and then published on the 2016 ESFRI Roadmap.

The SERI has pledged a - financial but non-compulsory - support for the projects vis-à-vis the ESFRI decision-making bodies (such support was a precondition for the proposals to be authorised for evaluation with regard to inclusion in the 2016 ESFRI Roadmap).

In the case of two other potential new ESRFI projects, Switzerland already participates as part of an international research organisation. The projects were re-submitted because additional funds had to be applied for due to a planned upgrade.

Conclusion:

⇨ The decision whether and to what extent Switzerland can participate in these RIs will be made – following the evaluation by the ESFRI – based on the results of the SERI evaluation in the 2017-2020 ERI period, as well as the definition of the Confederation's strategic priorities with regard to Swiss participation in ESFRI projects. In this connection, the long-term funding commitment in particular also needs to be considered.

7. Outlook

The research infrastructures put forward for implementation in this roadmap reflect the state of planning at the end of March 2015. The roadmap per se is a planning instrument and does not contain any funding decisions or any decisions with regard to the distribution of any federal funds to promotional credits in the 2017-2020 ERI Dispatch, which are relevant for the realisation of new RIs. It is therefore not possible to state conclusively which of these new projects will definitely be implemented in the 2017-2020 ERI period based on the current state of planning. The decision whether and to what extent a new RI will be implemented is the responsibility of the relevant sponsoring institution (usually the universities). The Confederation funds RIs based on the subsidiarity principle in accordance with the relevant legal provisions (Art. 59 HEdA, Art. 15 and Art. 28 RIPA) within the framework of the available ERI funds for 2017-2020.

The roadmap provides the research community and the affected decision-makers with an overview of newly-planned and existing RIs. This 2015 Roadmap also serves as a basis for the necessary coordination of national planning in the field of RI with the relevant planning at European level in line with the European ESFRI Roadmap instrument.

Experience gained during the current roadmap process (2015 update) has shown that the Swiss roadmap for research infrastructures instrument should be developed and optimised in collaboration with stakeholders in preparation for the next update.

8. Glossary

In italics: historical bodies/legal bases

Abbreviation	Meaning
CERN	European Organisation for Nuclear Research (Organisation européenne pour la recherche nucléaire)
CRUS	*Rectors' Conference of the Swiss Universities (under HEdA now Swissuniversities)*
CUAS	*Conference of the Swiss Universities of Applied Sciences (under HEdA now Swissuniversities)*
EAER	Department of Economic Affairs, Education and Research
Empa	Swiss Federal Laboratories for Materials Testing and Research (-> ETH)
EPFL	Federal Institute of Technology Lausanne (École polytechnique fédérale de Lausanne)
ERI	Dispatch on the promotion of education, research and innovation
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategy Forum on Research Infrastructures
ESO	European Southern Observatory
ETHZ	Federal Institute of Technology Zurich
FC	Federal Council
FLARE	Funding Large international Research Projects (->SNSF funding scheme)
HEdA	Federal Act on the Funding and Coordination of the Higher Education Sector, SR 414.20
MYP	Multi-year plan
PC	Project contributions
PSI	Paul Scherrer Institute (-> ETH)
RI	Research infrastructure
RIPA	Federal Act on the Promotion of Research and Innovation, SR 420.1
SAHS	Swiss Academy of Humanities and Social Sciences
SCNAT	Swiss Academy of Sciences
SCTO	Swiss Clinical Trial Organisation
SERI	State Secretariat for Education, Research and Innovation
SIB	Swiss Institute of Bioinformatics
SNSF	Swiss National Science Foundation
SSIC	Swiss Science and Innovation Council (formerly SSTC)
SUC	Swiss University Conference (in accordance with HEdA)
Swissuniversities	Rectors' Conference of Swiss Universities (in accordance with HEdA)
UFundA	*University Funding Act (now HEdA)*
Uni	University
USG	*Swiss Conference of Higher Education Institutions (now SUC)*

Roadmap for research infrastructures 2015

Annex A

1. Planned RIs of great scientific relevance

2. Participation in international research organisations that needs to be reviewed

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A.1 Planned RIs of great scientific relevance

The RIs detailed below were submitted as newly-planned projects in response to the call for proposals for the Swiss Roadmap by the institutes of higher education and were evaluated by the SNSF. The RIs listed here have been recommended by the SERI for further review. They include new RIs and existing RIs that have been further developed (upgrade). The information is based on the implementation plans submitted by the responsible bodies and reflects the state of progress at 31.3.2015.

The following preliminary remarks should be made here:

- The funding applications submitted by universities (universities and universities of applied sciences) within the scope of Project Contributions (PC) in accordance with Art. 59 HedA must meet the requirements of the Swissuniversities rectors' conference, according to which a maximum of one third of costs can be applied for via PC as initial funding and two thirds must be borne or secured by the universities themselves.
- The funding figures listed for each RI for the ERI periods 2017-2020 and 2021-2024 are the budgeted figures of the sponsoring institutions and serve as a rough estimation of the anticipated costs in the two upcoming periods.

Details from the implementation plans for the newly-planned research infrastructures

Research infrastructure (RI)	Estimated funding requirement 2017-2020 (in CHF millions)	Of which planned federal funding (in CHF millions)	Payment frameworks/ promotional credits				Responsible body (2nd phase of evaluation)
			ETH domain	PC HEdA	Art 15 RIPA	SNSF	
1. Swiss High-Performance Computing and Networking Initiative (HPCN/HPCN-20)	210	184	x				ETH Board (ETH-Zürich)
		5.81[1]					
2. ATHOS beamline at the Swiss X-ray Free Electron laser SwissFEL	46	40	x				ETH Board (PSI)
3. Swiss Light Source SLS 2.0[2]	2	2	x				ETH Board (PSI)
4. Initiative for Data Science in Switzerland (IDSS)[3]**(formerly Swiss Research Cloud)**	77	64	x				ETH Board (EPFL / ETH Zurich)
5. Centre de recherches en physique des plasmas CRPP / Swiss Plasma Center	135	85[4]	x				ETH Board (EPFL)
		44[5]					
		6				x	
6. Next Evolution in Sustainable Building Technologies (NEST)	13	1.1[6]					ETH Board (Empa, Eawag)
		2[7]	x				
7. The Swiss edu-ID and the Swiss Academic Cloud based on the Academic Network SWITCHlan	89	24.5[8]		x			Swissuniversitites
8. Swiss Digital Humanities Center	8.58	2.4		x			University of Basel
		3.94[9]					
9. The Swiss Art Research Infrastructure	4.54	1.513		x			University of Zurich
		0.5[10]			x		
		0.58	x				
10. Center for Pediatric Systems Pharmacology and Technology	3.2	1.067		x			University of Basel

[1] FDHA/MeteoSwiss, see FCD of 24.04.2015 (acknowledged by the FC; definitive allocation of funds still outstanding).
[2] In the 2017-2020 period, SLS 2.0 will enter its design phase, with estimated costs of CHF 2 million; the costs of the subsequent implementation phase in the 2021-2024 period are estimated at CHF 83 million.
[3] A working group mandated by the ETH Board reviewed the RIs originally submitted by the SERI in the field of e-infrastructures (HPCN-20, Swiss Research Cloud and the Swiss edu-ID and the Swiss Academic Cloud based on the Academic Network SWITCHlan) with regard to coordination needs and developed an overarching common strategy for data sciences. As a result, the Swiss Research Cloud project under the leadership of the EPFL and in collaboration with ETH Zurich was revised.
[4] CHF 10 million investment by ETH Board (according to decision of 5.3.2015), 75 million EPFL budget.
[5] EURATOM, ITER loans: estimated loans from the Dispatch to fund Swiss participation in the European Union Framework Programmes in the fields of research and innovation in the years 2014-2020.
[6] Confederation/ DETEC/ SFOE.
[7] Plus as yet undefined contributions from the continued measures to strengthen energy research in the ETH Domain in accordance with the action plan “Coordinated energy research Switzerland”.
[8] This funding of 24.5 million Swiss francs is being applied for by SWITCH as part of the follow-up project to P-2 “Scientific information: access, processing and storage”.
[9] Art. 11 RIPA (funding via Academies budget, SAHS).
[10] Contributions in kind pursuant to Art. 15 RIPA to fund the Swiss Institute for Art Research (IAR).

Research infrastructure (RI)	Estimated funding requirement 2017-2020 (in CHF millions)	Of which planned federal funding (in CHF millions)	Payment frameworks/ promotional credits				Responsible body (2nd phase of evaluation)
			ETH domain	PC HEdA	Art 15 RIPA	SNSF	
11. The Swiss National Ion-microprobe Platform (SwissNIP)	6.3	1.5		x			University of Lausanne
12. Swiss Laboratory for the Advanced Studies on the Dynamic Behaviour of Materials	6.774	2.258		x			University of Applied Sciences and Arts of Southern Switzerland SUPSI
13. Swiss Research Centre for Animal Cognition	2.47	0.823		x			University of Neuchâtel
14. Airborne Research Facility for the Earth System (ARES)	22.7	7.6		x			University of Zurich
		5	x				
15. Mixed-Reality Lab for Behavioral Research MIRAL	2.564	0.855		x			University of Gallen
16. The Neuchâtel Platform for Analytical Chemistry (NPAC)	2.434	1.050		x			University of Neuchâtel
17. Proposal for a Swiss National 1.2 GHz Solution NMR facility	21.34	7.126		x			University of Basel
		1				x	
		2.62[11]	x				
18. A common Data Center Infrastructure (CDCI) for Astronomy, Astroparticle and Cosmology	5.4	1.867		x			University of Geneva
19. Center for Biomedical Research in Space	0.6	0.2		x			Lucerne University of Applied Sciences and Arts (FHZ)
20. The future of dark matter detection with liquid xenon XENONnT and DARWIN	20	2.6				x	University of Zurich
21. Swiss Center for Musculo-skeletal Biobanking and Imaging and Clinical Movement Analysis	104.8	23.1			x		SERI (University of Zurich/ Balgrist University Clinic)
22. SwissPedNet	14.485	7.4			x		SERI (SCTO)
23. Information and computational service infrastructure network to support biomedical research in Switzerland (BioMedIT)	37.441	18.5			x		SERI (SIB)
total	**836**	**552, including 501 ERI funds[12]**					

[11] ETH is contributing CHF 2 million of investment costs, the CHF 0.62 million contributions towards operating costs still need to be negotiated.

[12] Just the implementation of the planned RIs for which the ETH, universities (universities or universities of applied sciences) or the SERI are directly responsible (Art. 15 RIPA) would result in expenditure of CHF 478 million for the Confederation. Other expenditure for the Confederation under the ERI Dispatch 2017-2020 would be made up of the financial participation of the ETH in the RIs of universities, the SNSF and Academies (which equates to the difference of approx. CHF 23 million).

1. Swiss High-Performance Computing and Networking Initiative (HPCN/HPCN-20)

Category: technical infrastructures

Host institution(s): ETH Zurich

Main funding sources: ETH Domain global budget

Description / Development prospects

a. National level

Overview

The overarching goal of the Swiss High-Performance Computing and Networking (HPCN) initiative and its successor, HPCN-20, is to develop and operate a highly competitive User Laboratory for Simulation-based Science, that is openly accessible through a transparent, peer reviewed process, and allows Swiss scientists to compete at the highest level internationally.

Simulations today play a seminal role in science alongside theory and experiment, allowing scientists to reason about experimental data of complex systems with the most advanced mathematical methods in ways that were not imaginable a few decades ago. This new role for simulations, which is fundamentally different from merely providing numerical solutions to otherwise unsolvable theoretical problems, largely emerged due to the rapid but sustained, exponential performance improvements in information technology since the 1960s. Specifically, every 10 years storage density of magnetic media increases by factor of approximately 100 and supercomputer performance grows by a factor 1000.

Detailed description

The HPCN initiative was passed by the Swiss Parliament in 2009 and included three parts: (1) construction of a new data center capable of housing high-end supercomputers; (2) procurement of a petascale supercomputer; and (3) development of a competence network in Swiss academia for development of application software tools. The necessary initial investments of CHF150 million through 2014 were augmented in 2011 to complete the current ERI period though 2016, when it became clear that the computer hardware and software tools must be constantly renewed. ETH Zurich is committed to fund the operational costs of the facility, which are almost equal to the hardware investments, and the Swiss research community matches the investments in the development of software tools. The competence network for software development was initiated as a structuring project of the Swiss University Conference, and now comprises about 40 research groups throughout Swiss academia. The network is open, that is, new groups can join provided they are committed to investing their own research in methods, algorithms or application software development relevant to the HPCN initiative. Participating groups receive initiative funding to develop algorithmic adaptations and implement or refactor software specifically to create the tools needed for deployments on modern hardware systems.

The Swiss National Supercomputing Centre (CSCS), which has the technical lead for the HPCN/HPCN-20 initiative, devised a strategy to co-develop new computer systems provided by established vendors along with software tools that are implemented by the Swiss competence network of the HPCN/HPCN-20 initiative. The first result of this co-development is Switzerland's first petascale supercomputer "Piz Daint" which recently went in operation. The system has about 20-25% the performance of the fastest systems currently in operation worldwide and has been recognized at the most energy efficient petascale supercomputer in the world. This result was only possible thanks to the prior investments in the development of software tools whereby CSCS and its user community were able to aggressively pursue modern hardware architectures with a better price-performance ratio and far superior energy efficiency.

The plan is to continue this development with a hardware-software co-design approach to create new compute nodes for "Piz Daint", these being required for the planned upgrade in 2016. Furthermore, in

order to maintain the User Lab at its current level through the end of the decade a new system generation will have to be developed and deployed starting in 2018.

In December 2010, CSCS began with the deployment of a data archive and analysis platform called "Eureka". This system provides low-cost but high-quality data archiving services and includes computers with large shared memory for data analysis and graph-based analytics. Any user community with large data archiving requirements that participates in the HPCN/HPCN-20 initiative would simply procure a share in the "Eureka" platform, contributing 50% to the cost recovery. Outside users can acquire shares as well, but at full cost recovery. CSCS is growing its storage systems commensurately with the needs of the user community, but unlike the supercomputers, where investments come in bursts, the funds for storage systems have to be invested on a yearly basis.

The building infrastructure and the collective competence in solving high-end computing and data problems of the HPCN initiative are available to other projects as well. Currently, the production system for operational weather forecasting of MeteoSwiss, the Swiss Tier-2 system of the LHC data grid, the main simulation system of EPFL's Blue Brain project, as wells as several clusters operated on behalf of ETH Zurich and the University of Lugano are being hosted at CSCS. Discussions to develop a cloud usage model in collaboration with the University of Zurich and ETH Zurich are under way.

Several institutional HPC systems have been operated by regional centers, such as the "Centre for Advanced Modeling Science" (CADMOS) that is open to scientists from UNIGE, EPFL and UNIL, or by individual Universities, such as UZH, UBAS and ETH Zurich. Other research institutions such as USI, PSI, SNSF funded NCCR MARVEL, or recently UZH have co-invested their institutional or project funds into extensions of the supercomputers of the User Lab. Such institutional resources serve as entry-level systems that stimulate researchers to use computational sciences in their scientific projects. Furthermore, they give scientists of the respective organizations or projects direct access to limited HPC resources for new developments as well as the exploration of fields in computational sciences that are outside of mainstream HPC of the User Lab.

In order to encourage institutional investments that are coordinated with the national HPCN initiative, the Confederation through swissuniversities will match these investments at universities. The participating institutions are expected to pay for operational expenses of these systems. Co-investment into the HPC systems of the User Lab will continue to be encouraged, and CSCS will make available its infrastructure, charging only incremental costs.

b. International level

The resources of the User Lab are accessible on the international level, through same transparent peer review process. Furthermore, CSCS is a member of PRACE: Partnership for Advanced Computing in Europe. The mission of PRACE is to enable high impact scientific discovery and engineering research and development across all disciplines to enhance European competitiveness for the benefit of society. PRACE seeks to realize this mission by offering world class computing and data management resources and services through a peer review process. PRACE also seeks to strengthen the European users of HPC in industry through various initiatives, and has a strong interest in improving energy efficiency of computing systems and reducing their environmental impact.

c. Development prospects

See detailed description above. Financial requirements of HPCN-20 are included in columns (1), and (3) of the table in section d. Costs for institutional systems that have not been included in HPCN-20 are listed in columns (2) and (4) of the table in section d.

d. Costs (in CHF)

	Total costs (1+2+3+4)	**Confederation, ETH Domain (1)**	**Confederation, swissuniversities (2)**	**Confederation and Cantons (3)**	**Institutions / projects (4)**
2013-2016	207.6 Mio.	181.2 Mio.		13.9 Mio.	12.5 Mio *
2017-2020	210.0 Mio.	183.6 Mio.	5 Mio.	13.9 Mio.	7.5 Mio.*,**
2021-2024	210.0 Mio.	183. 6 Mio.	5 Mio.	13.9 Mio.	7.5 Mio.*,**

[a]subject to strategic planning of the ETH Board for the periods 2017-2020 and 2021-2024

(*) Estimated, could be much higher depending on whether and how institutional systems at ETH Zurich are including;
(**) Estimated OPEX at 25% of CAPEX assumes co-investment at CSCS, would be 50-100% of CAPEX otherwise.

2. *ATHOS beamline at the Swiss X-ray Free Electron Laser SwissFEL*

Category: Instruments

Host Institution: Paul Scherrer Institut

Main funding sources: ETH Domain

Description / Development prospects

a. National level

Overview

X-ray free-electron lasers (XFELs) are a new generation of light sources offering novel experimental capabilities in diverse areas of science by providing very intense and tightly focused beams of x-rays with pulses as short as 10 femtoseconds and wavelengths down to 0.1 nanometer. This time resolution is essential to investigate ultrafast dynamic processes in atomic and molecular structures since these processes are defined by the femtosecond vibration of an atom in a chemical bond.

SwissFEL is designed to cover a wide range of x-ray energies. Phase I of the project is focused on the construction of the accelerator complex and the hard x-ray beamline ARAMIS. The civil construction was finished in 2014 and by fall 2016, the commissioning of the complex will start. First pilot experiments should be performed starting in July 2017.

Phase II of the project, the ATHOS beamline, will expand the capabilities to soft x-rays and will double the scientific capacity of SwissFEL. ATHOS will provide beams for three state of-the-art scientific instruments that are designed to make optimal use of the technical capabilities of SwissFEL, to attract national and international users and to foster scientific, technological and educational exchange within Switzerland and across borders. First light from ATHOS should be realized in the second half of 2019.

As a next-generation cutting-edge research infrastructure ATHOS (together with ARAMIS, the Swiss Light Source (SLS) and the other research infrastructures at PSI) will play an important role in the scientific portfolio of Switzerland. Many of the research results produced at the ATHOS beamline will lead to important knowledge relevant to a large variety of fields, encompassing topics as energy conversion, more efficient drug development and the design of smaller computer chips.

Detailed description

ATHOS will add a second electron beam transport system to SwissFEL that will feed a variable-gap undulator source for producing soft x-ray laser beams. ATHOS will operate simultaneously with ARAMIS (energy range 1.8 keV – 12.4 keV) and will be optimized for producing radiation in the 250 - 1500 eV x-ray regime, with full polarization control. This energy region covers absorption edges for the light elements oxygen, carbon and nitrogen that play an important role in many chemical and biological processes, as well as those of the transition metals manganese, iron, cobalt, nickel and copper, which are prominent components in classical and quantum devices.

A key feature of the ATHOS facility will be the possibility to “self-seed” the x-ray radiation, by introducing a narrow-band filter at the halfway point along the undulator. Such a scheme has been realized at the LCLS at Stanford, using optical elements conceived and realized by PSI. In addition, ATHOS will offer capabilities beyond those implemented at operating facilities:

- Full control of soft x-ray polarization (circular, linear, elliptical). Such a capability is extremely useful for the study of magnetic materials.
- Simultaneous operation with ARAMIS at full 100 Hz rate. With two dedicated accelerating modules in the ATHOS branch the electron and photon beams in ATHOS can be rapidly tuned for its full photon energy range without disturbing ARAMIS operation.

- Simultaneous production of two-color pulses by using the chirped electron pulse and a slotted foil. Such pulses will be particularly convenient for performing stimulated resonant inelastic x-ray scattering (RIXS).
- Energy “broadband” mode providing a unique relative bandwidth (2 - 7%). This capability will allow the simultaneous measurement of orbital and spin moments by observing two absorption *L*-edges shot by shot. Furthermore it will allow the collection of single-shot RIXS spectra.
- Terahertz (THz) pump pulses for ATHOS that will be used to pump samples in two different ways: B-field - to start magnetic dynamics, E-field - to initiate chemical reactions on surfaces. As a second possibility the production of THz radiation by using a specialized undulator as well as the transport to the experimental stations is under study.

Access to ATHOS will be dealt in the same manner as for the existing facilities of PSI (selection of proposals for beamtime based on scientific excellence by an international review committee, access will be handled by the PSI User Office).

b. International level

The impact of XFELs, a novel and extremely promising tool for science, has been demonstrated so far by the first two XFELs in operation: LCLS at Stanford (operating since 2009) and SACLA in Japan (operating since 2011). When SwissFEL begins operation in 2016, it will be one of only five such facilities worldwide (presently under construction: European XFEL Germany, PAL XFEL South Korea, and SwissFEL). Analogous to the other analytical research facilities of PSI, SwissFEL will be open to the international research community. SwissFEL will provide a total of 5000 hours beamtime per year at different experimental stations.

c. Development prospects

The implementation of ATHOS will be performed in a way that the interruptions in the operation of the ARAMIS branch should be kept to a minimum level. All the experience gained during the forthcoming set up of ARAMIS will be the basis for ATHOS, whereas a couple of technologies and novel concepts have still to be addressed (acceleration of two bunches in one radiofrequency pulse, construction of undulators for circularly polarized light, characterization of the produced radiation, generation of THs pulses).A recent assessment on behalf of the DOE Office of Science[13], made a clear statement: “By 2020, Europe will have the most advanced suite of light source tools in the world in terms of both capability and capacity”. The Swiss research community will be able to benefit from this strategic relevant position of PSI at the forefront of these developments, since SwissFEL as national facility is strongly oriented towards the research interests and expertise of Swiss researchers. Due to early and close collaboration between the SwissFEL project and industrial partners, Swiss industry will be able to transfer the acquired technological expertise to the market and allows them to play an internationally competing leading role in the development of high-technology spin-off products.

d. Costs (in CHF)

	Total costs	**Confederation / ETH Domain / PSI**	**Others**
2017-2020*	46 Mio.	40 Mio.	6 Mio.
2021-2024**	16 Mio.	16 Mio.	

*construction phase: only capital expenditure (excl. personal costs)

**operation phase: estimated capital and operational expenditure (incl. personal costs, excl. PSI internal research activities using SwissFEL)

[13]http://science.energy.gov/~/media/bes/besac/pdf/Reports/Future_Light_Sources_report_BESAC_approved_72513.pdf

3. Swiss Light Source SLS 2.0

Category: Instrument

Host Institution: Paul Scherrer Institut

Main funding sources: ETH Domain

Description / Development prospects

a. National level

Overview

The Swiss Light Source (SLS) at PSI is a third-generation synchrotron light source of medium electron energy (2.4 GeV), generating electromagnetic radiation at wavelengths ranging from the infrared to the hard x-ray regime. Having started operation in 2001 with four beamlines, SLS has now eighteen operational beamlines.

SLS 2.0 will provide a dramatically increase of the brilliance by replacing the current magnet lattice of the electron storage ring by a new multiband achromat magnet lattice. Although SLS is already a brilliant x-ray source, the brilliance could be significantly improved by up to two orders of magnitude. This, combined with high flux, will enable much faster imaging of extended objects than presently feasible. SLS 2.0 will bridge the so-called “imaging gap” between the macroscopic and the nano world. Studies of electron bonding in matter will also profit from the higher brilliance; for the first time it will be possible to directly measure by resonant inelastic x-ray scattering (RIXS) the very small energy scales that determine the properties of correlated-electron materials.

The upgrade is planned for the period 2021-2024, with a preparatory design phase during 2017-2020.

Detailed description

The brilliance of the x-ray source increases if the stored electron beam is made smaller or less divergent, or both. The product of divergence and beam size, the “emittance”, should therefore be as small as possible. This can be achieved by steering the electrons along their near-circular path in the storage ring over many small bend angles, i.e., by arranging a large number of special magnets in “arcs” along the ring, resulting in a so-called multi-bend achromat (MBA) magnet lattice. The upgrade focuses on the storage ring lattice with the boundary condition that the locations of beamline source points are maintained. The storage ring tunnel, the technical infrastructure, and the injector complex (linac and booster synchrotron) will require only some small adaptations whereas the accelerator system comprising the lattice, such as magnets, power supplies, vacuum system, and diagnostics have to be replaced. A small number of beamlines has to be upgraded to take full advantage of the emittance reduction of the storage ring, e.g. the x-ray focusing optics has to be adapted so as to produce a smaller beam spot on the sample. Improvements are also necessary at the end stations (e.g. positioning stages, temperature control, and reduction of vibrations). The upgrades of the accelerator and the beamlines will yield unique research opportunities in the imaging and spectroscopy areas in which SLS has presently a leading position.

Since the number of bending magnets along a given circumference has to be increased in order to reduce the emittance, miniaturization of the magnets is essential. Further studies are needed to decide on an engineering concept for the magnets, to define the vacuum chamber dimensions, to perform a proper material selection, to validate the replacement of the RF-system, and to evaluate the possibility to re-use special components of the current setup. Therefore, a preparatory design phase is of highest importance for the success of the upgrade project.

In comparison to other facilities (see chapter b), SLS 2.0 will profit in particular from the brilliance increase, for the following reasons:

- In x-ray ptychography – a microscopic technique pioneered at PSI with SLS being today a few years ahead of other facilities – it will be possible to collect images in seconds or minutes instead of hours, enabling 4D ptychographic scans.
- SLS is among the leaders in time-dependent x-ray tomography. Since SLS 2.0 will generate harder x-rays up to 100 keV with a larger penetrating power, 4D tomography will be possible for thicker material samples.
- The smaller beam produced by SLS 2.0 will eventually enable analysis of nanometer sized protein crystals at room temperature, a feature currently not achievable at SLS.
- SLS houses the world's premier beamline for RIXS at the transition metal *L*-edges, which is an important tool for the characterization of low-energy excitations and electronic bonding in condensed matter. SLS 2.0 will enable PSI to keep the world record in energy resolution.

All these features will benefit from the worldwide PSI leadership in the development of pixelated x-ray detectors.

SLS 2.0 will enable a perfect complementarity for the users with the new generation of research infrastructures at PSI, the x-ray free-electron laser SwissFEL (becoming operational in 2016): SLS 2.0 will focus for imaging and spectroscopic research on the spatial domain at "slow" time scales (ps to ms), whereas SwissFEL will place emphasis on time domain at ultrafast time scales (fs).

b. International level

There are more than 50 synchrotron light sources around the world (for details see www.lightsources.org) with either a national or international focus, carrying out a huge range of experiments with applications in engineering, biology, materials science, chemistry and many more. The feasibility of the MBA lattice concept has been demonstrated at MAX Lab (Sweden): the MAX IV facility, currently under construction, will be the first one with an MBA lattice. At least eight other facilities have submitted or will submit plans for MBA lattices.

c. Development prospects

By 2021, SLS will be twenty years old and will be outperformed by some other facilities. The major upgrade will ensure that SLS 2.0 remains an internationally competitive facility for another two decades. Work is still ongoing and will be subject of the preparatory design phase to push the emittance of the machine to even smaller values.

d. Costs (in CHF)

	Total costs	**Confederation / ETH domain / PSI**	**Canton**	**Others**
2017-2020*	2 Mio.	2 Mio.		
2021-2024**	83 Mio.	83 Mio.		

*design phase

**construction phase: only capital expenditure (excl. personal costs), consisting of 63 Mio.for accelerator[14] costs, 20 Mio.for beamline upgrades

[14] The accelerator costs include the main systems which have to be replaced for the upgrades and in addition twelve super-bends that will be inserted as central magnets of the twelve achromats in order to increase the photon energy. Costs for dis- and reassembly of the storage ring have been included.

4. Initiative for Data Science in Switzerland (IDSS)

Category: Information and Service Infrastructure

Host institution(s): EPFL and ETH Zurich

Main funding sources: ETH Domain

Description / Development prospects

a. National level

Overview

Data science is a new research paradigm concerned with extracting knowledge through the analysis of large, noisy, and heterogeneous data. It is reshaping entire industries and academic disciplines through disruptive technologies and approaches. Examples include innovative applications in all sectors of the economy (e.g., advertising management, drug discovery and personalised health in medicine, many aspects of finance and insurance, root cause defect analysis in manufacturing). In research, data science opens the door to understand, model, and predict in complex systems such as social networks, financial/economic markets, world food systems, environments, and urban planning. Therefore, the ETH Domain has launched the Initiative for Data Science in Switzerland (IDSS) to accelerate data science in the ETH Domain through both an expansion of basic data science education and research, and the provision of infrastructure for data science users across disciplines.

Detailed description

Swiss Data Science Center (SDSC). IDSS will create a new Swiss Data Science Center (SDSC), housed at both EPFL and ETH Zurich, with a distributed multi-disciplinary team of data and computer scientists. The team will initially consist of experts in data science methods and will grow to incorporate specialists in applications to different vertical research fields, including personalized health and personalized medicine, earth and environmental science, social science and digital humanities, and economics.

The center will serve a dual purpose, to first support research projects in selected verticals in the use of data science, and second address research issues in the fields of data science methods and enabling technologies. The center will: (i) develop a network of embedded data science support to work closely with research groups and foster collaboration between users and data scientists; (ii) offer end-to-end data science services to the research community in Switzerland, specifically a set of software and platform stacks provided “as-a-Service” and backed by academic and commercial cloud services; (iii) create a user community to share tools, methods and knowledge in the field. Rather than building its own infrastructure, IDSS’s online services will be backed by existing infrastructures of the ETH Domain, and in particular by housing resources at CSCS.*Context:*

Teaching and Research. Separate from the Data Center, the IDSS will create a new Master in Data Science. The rapid rise of data science has created the need for both thoroughly trained data science specialists with a new profile of expertise, and basic knowledge of data science methods for researchers and practitioners in a broad range of disciplines. We propose to address this need with a new Master in Data Science, a new specialization in data science for Bachelors, and a catalogue of service courses targeted towards groups of application areas. The latter may be extended into a continued education program to provide training to Swiss professionals.

The goal of the new Master in Data Science is to produce graduates with thorough knowledge in data science methods and topics ranging from analytics to software and systems. This knowledge will enable them to stay up-to-date on technology through continuous learning and to become leaders in their field.

The core part of the curriculum will consist of thorough training in data analytics, including courses in machine learning, probabilistic reasoning, computational statistical learning theory, statistics, data mining, natural language, image and signal processing, and artificial intelligence. This core is complemented by courses in data management, security and privacy, cloud computing and computer systems, and programming models. The goal is for EPFL and ETH Zurich to each start their program in Fall 2017.Complementing the teaching plans is an expansion of research in the core data science areas mentioned above.

b. International level

In the past few years, Data Science has become a major trend internationally, with the majority of top-tier international research and teaching institutions investing significantly in dedicated centers and programs focused on Data Science. The IDSS will ensure that the ETH domain and Switzerland possess the necessary expertise and remain globally competitive. Collaboration with top institutions is envisioned and will include exchange of best practices in curriculum development, joint data science research projects advancing the state of the art in data science, including leveraging data science resources offered by SDSC.

c. Development prospects

Data science in practice is characterized in part by its use of large-scale, elastic, cloud compute and storage infrastructures. The new SDSC will operate on a pass-through basis as a broker between users of the infrastructure and appropriate providers of infrastructure (commercial or academic, international or domestic). This is a departure from a classic capital-oriented approach to building out dedicated research infrastructure in IT. Beyond 2020, we expect that most users of SDSC will be able to fund their use of SDSC's stack on a pay-per-use basis as well. In addition we expect in the long term significant industry interest once the expertise in the center has been built up.

d. Costs (in CHF)

	Total costs	**Confederation / ETH Board / EPFL / ETH Zurich**	**Canton**	**Others***
2017-2020	77 Mio	64 Mio		13 Mio
2021-2024	190 Mio	57 Mio		133 Mio

*User fees and grants based on pay-per-use model

5. Centre de recherches en physique des plasmas CRPP / Swiss Plasma Center

Category: Instruments

Host institution(s): EPFL

Main funding sources (2013, including indirect costs): EPFL (38 % direct costs, 29 % indirect costs); SNSF (7 %), EURATOM (10 %), ITER (13 %), other including CTI (3 %)

Description / Development prospects

a. National level

Overview

The CRPP is the major Swiss plasma and fusion laboratory. Its main goal is to contribute to the worldwide development of this new energy source through strong education and research programmes.

Detailed description

Research and development projects of the CRPP are grouped in 7 Research Lines:

- Theory of Plasmas
- Basic Plasma Physics (experimental, TORPEX)
- Hot Plasmas Physics (fusion, tokamak, TCV)
- International collaborations
- Superconductivity for Fusion
- Plasma Processing

Theory of Plasmas
Plasma is an extremely complex medium, characterized by phenomena that occur on a wide range of temporal and spatial scales, which are all nonlinearly coupled. Plasma theory activities aim at the understanding of these physical phenomena mainly through first-principle based simulations.

Basic Plasma Physics (experimental, TORPEX)
The goal of the CRPP Basic Plasma Physics group is to progress in the understanding of fundamental phenomena that occur in magnetized plasmas and that can have an impact in fusion energy research. It also provides a natural link between tokamak research and plasma theory, by offering an optimal environment for the validation of theoretical models, based on the toroidal device TORPEX.

Hot Plasmas Physics (fusion, tokamak, TCV)
The mission of the TCV programme is to apply its unique capabilities (plasma shaping, heating and current drive using waves in the electron cyclotron frequency range, advanced plasma control) to the exploration of the physics of magnetically confined plasmas, partly in direct support of the ITER project but also exploring some of the alternative paths that may be required beyond ITER on the way to DEMO, the first prototype fusion reactor.

International collaborations
Under this heading, besides the work in Superconductivity for Fusion, the CRPP is also involved in activities in the field of electron cyclotron wave sources and antennas for ITER and DEMO, and the scientific exploitation of JET.

Superconductivity for Fusion
Activities in superconductivity are twofold. On one hand, the group carries tests of superconductors using the SULTAN device, the only installation worldwide capable of testing the superconductors used in fusion devices like ITER. On the other hand, it participates to the design of superconducting coils for future installations such as DEMO and develops high temperature superconductors.

Plasma Processing
For several decades, thermal and non-thermal plasmas have found application in various industries and research and development continues unabated in almost all industrialized countries. Applications of plasmas in industry cover important technologies and markets such as semiconductor manufacturing, packing industry, solar cell production, flat screen display manufacturing and tribology.

b. International level

CRPP contributes to the experimental campaigns carried out at JET, to the construction of ITER, to the preparation of ITER scientific exploitation and to the design of DEMO.

c. Development prospects

Capitalizing on the success of CRPP, a Swiss Plasma Center will be created, developing state-of-the-art infrastructures and combining existing human resources at CRPP with nation-wide synergies across interconnected areas of excellence, reinforcing the international aura and impact of Switzerland in plasma and fusion research. The main focus will be on fusion, to enable EPFL to fulfill, on behalf of the Swiss Confederation, its role and obligations in the broader context of Europe, Euratom and ITER. The approach that will be taken in advancing fusion research is based on improving our understanding and control capabilities of plasmas and will cover both fundamental aspects and industrial applications. This investment will enable the CRPP to focus on two thrust areas:

- *TCV tokamak systems and related spin-offs*
  TCV is one of three national tokamak facilities rated as essential for the Fusion Roadmap, which aims at reaching electricity production from fusion energy by 2050. Three infrastructure enhancements are necessary to extend the time horizon of the impact on the international fusion endeavor:
  - a new pumped divertor chamber, to be inserted at the periphery of the plasma to achieve reactor relevant conditions and pioneer solutions to the crucial problem of plasma exhaust;
  - a 1MW NBH system with high-energy capabilities, to study burning plasma regimes;
  - improvements in diagnostic capabilities, with focus to a THz microwave facility, and to imaging systems for 2D plasma coverage.
- *Basic plasma physics*
  A new device, assembled partly using existing hardware, will expand basic plasma investigations to areas of increasing relevance for fusion-enabling research. These include the problem of plasma rotation, important for tokamak stability, and that of cross-scale turbulence in complex systems, crucial for energy transport in fusion reactors. Moreover, as a side benefit, the modernized infrastructure may open the way to the exploration of environmental applications of plasmas, such as water purification, plasma sterilization, or plasma medicine.

In addition to the ongoing upgrades to the TCV tokamak (financed with EPFL's internal funds), the investments necessary for the TCV and the basic plasma laboratory are estimated at 8MCHF and 2MCHF, respectively. Financial support for these developments will come from a special fund allocated by the ETH Board for the period 2017-2020.

d. Costs (in CHF, including indirect costs)[15]

	Total costs	**ETH domain**	**SNSF**	**Canton**	**Others**	**EPFL**
2013 – 2016	121 Mio.	0	6 Mio.	0	40 Mio.	75 Mio.
2017 – 2020	135 Mio.	10 Mio.	6 Mio.	0	44 Mio.	75 Mio.
2021 – 2024	120 Mio.	0	6 Mio.	0	44 Mio.	71 Mio.

[15] The cost table does not include the following item: Costs related to a potential Electron Cyclotron Test Facility (ECTF) for ITER (negotiations have started, capital costs are tentatively estimated to 840k€, to be co-financed by ITER/F4E, implementation expected until 2017)

6. NEST (Next Evolution in Sustainable Building Technologies)

Category: *Technical infrastructure*

Host institution(s): *Empa and Eawag*

Main funding sources (2012-2020)

Construction Backbone: *ETH Domain, Canton of Zurich, SERI, Ernst Göhner Stiftung*

NEST Units: *SFOE (Swiss Federal Office of Energy/BFE), Canton of Zurich, Empa, numerous industrial partners*

Operation NEST: *Empa, Eawag, SFOE, City of Dübendorf, sponsors*

Description:

a. National level

Overview

Empa and Eawag are developing with the support of the entire ETH Domain in collaboration with the public and private sector the research and technology transfer platform NEST (Next Evolution in Sustainable Building Technologies) – a test bed for future building technologies. The project does involve leading partners from industry and several national and international universities.

The vision of NEST is to foster the development of innovative building technologies in order to enable the construction of sustainable – and affordable – buildings, in which occupants feel “at home” and which exhibit the following features:

- zero emission of greenhouse gases,
- minimal demand for energy which then can be covered by local supply
- a highly efficient wastewater purification system.

Detailed Description

NEST will provides a flexible research and innovation platform for the development and evaluation of sustainable solutions for the built environment and for their faster transfer to the market. The final goal is the development of energy efficient buildings which are part of decentralized energy adaptive systems. NEST serves as an academic guest house for researchers at Empa and Eawag from all over the world. They create a true living lab that includes user aspects and practical user experience.

NEST consists of a basic grid (“the backbone”), which provides the load bearing structure and access to services and media (multi-energy grid, water). This “backbone” offers flexibility for the installation of single building components and systems, or even entire living and office spaces (“research and innovation units”). The fact, that NEST is also a guest house with a frequent change of tenants, will facilitate the continuous transformation of the building.

The research and innovation units are clustered in thematic areas with different topics that will are addressed. This allows to tackle all the hot topics of construction. Currently, the following thematic priorities have been identified (they may be adapted to changing needs):

- working environment of the future – future office space that fosters creative and cross-linked cooperation
- glass architecture – intelligent application of glass as future oriented building material
- lightweight construction – great flexibility and efficient use of natural resources
- modular homes – compact constructions for high urban density
- natural construction – healthy living with natural resources
- smart homes – intelligent technology for future generations
- solar fitness and wellness – smart combination of energy efficiency and renewable energies
- The backbone provides a flexible infrastructure that guarantees the implementation of the research and innovation units. It contains:
- the Empa reception and lobby, conference and meeting rooms (at ground level)

- an attractive central access to NEST, the fire escapes and spacious, well accessible technical installation zones
- a supporting structure for the 6-9 m wide demonstration platforms with an overall area of approximately 2'500 m^2 for research and innovation projects on three different levels with the option for double floor constructions on the rooftop
- specially designed presentation rooms for guided tours and events on each floor
- a basement for extensive technical installations (water treatment, central air handling, energy hub)

The backbone provides an infrastructure similar to what we expect in an urban neighborhood of the future. It will allow the realization of different building types under one roof. Technologies that can benefit from a building network will be installed in the backbone including water treatment, an energy hub and the implementation of solar devices.

b. International level

NEST is also internationally a unique platform offering a real living lab. Several living labs are developed in other countries but none of them is offering the same degree of flexibility. The different initiatives form a loose network e.g. via the Climate KIC Flagship project Building Technology Accelerator (BTA).

Thematic subgroups should allow launching international design competitions among research and industry groups in order to attract the brightest ideas for each research topic. They will cover construction technologies for new buildings as well as technologies and processes for building refurbishment.

c. Development prospects

During the period of 2017 – 2020 research will be conducted using the already existing units and the energy hub. Furthermore, 5 – 8 additional new units will be added during this period and will add to the research portfolio as well.

As NEST becomes fully operational in 2015/2016, the technology transfer and communication activities will substantially increase in the period 2017-2020 in order to assure the know-how transfer from NEST to practice.

d. Costs (in CHF)

	Total costs	**Confederation / ETH Domain**	**Canton**	**Others****
2017-2020	13 Mio.	1.1 Mio.***** 2 Mio Empa, Eawag		9.9 Mio.
2021-2024	*15* Mio.	*2* Mio.* *2.5* Mio. Empa, Eawag		*10.5* Mio.

*Swiss Federal Office of Energy
**Partners, sponsors, research funding agencies (Swiss and EU) and earmarked means of the ETH Domain for energy research.

7. *The Swiss edu-ID and the Swiss Academic Cloud based on the Academic Network SWITCHlan*

Category: *e*-infrastructures (Information and service infrastructures)

Host institution(s): SWITCH foundation

Main funding sources: SWITCH's funding scheme is built on contributions of the community and of Swiss and European research funding bodies as well as SWITCH own equities. As the community fully pays for running services, new projects and innovations are supported by additional, national and international funds and own means.

Description / Development prospects

a. National level

Overview

SWITCH is a foundation of the Swiss universities, whose mission is to provide outstanding information and communication services (e-Infrastructures) to research and education. Since its foundation in 1987 SWITCH enables the Swiss Universities to communicate, collaborate and co-operate in Switzerland and worldwide on the basis of state of the art networks, middleware and collaboration tools.

Detailed description

As a physical link, SWITCHlan brings together universities and research institutions from all over Switzerland (http://www.switch.ch/network/). SWITCH has built this Education and Research Network on its own and is constantly developing it further. Stable Internet access, the rapid and secure exchange of data at 100 Gigabit/second and an excellent connection to international networks – SWITCH offers all of this from a single source. Our SWITCHlan education and research network provides the high-quality communication infrastructure that is required for meaningful cooperation and exchange across national borders. Together with our colleagues in Europe, America and a large number of other nations all over the globe, we make sure that the university and research world is optimally connected.

To protect the network and the exchange of the scientific information SWITCH runs a computer emergency response team (CERT), which is constantly expanding its security services in the university environment. SWITCH-CERT is in a position to take effective action in the event of security emergencies – also if they exceed national borders

SWITCHaai – the Swiss-wide authentication and authorization infrastructure – is the very important tool to federate the existing Identity Management Systems of the universities. This is important to share resources and to collaborate within the Swiss academic community. Furthermore, AAI has succeeded in becoming established internationally too: comparable infrastructure has built up and further developed all over the world.

b. International level

On the international level, SWITCH is project partner in the GEANT-Project (www.geant.net). GEANT is the pan-European research and education network that interconnects Europe's National Research and Education Networks (NRENs). GEANT connects over 50 million users at 10,000 institutions across Europe. EC subsidies GEANT as integral part of FP7 and Horizon2020 in the future. Currently GEANT innovates in adapting the newest network technology in the production network, in federated trust and identity infrastructures (AAI) for all e-infrastructures, in bringing cloud technology to research and education.

SWITCH is member of the GEANT Association. This Association offers a forum to collaborate, innovate and share knowledge in order to foster the development of Internet technology, infrastructure and services to be used by the research and education community. It also owns GEANT Ltd., who runs the European Research and Education Network. The main achievements in the last 3 years can be found at: www.geant.net/Resources/Media_Library/Documents/ACHIEVEMENTS.pdf.

c. Development prospects

With the upgrade of the physical network by the end of 2015, SWITCH will have laid the foundations for the developments until 2020 and beyond. Therefore within period 2017-2020, the network will undergo incremental improvements in specific locations and we expect individual institutions to upgrade their connectivity to higher bandwidth. It should also be noted that the benefits of the upgrade consist not only of increased bandwidth and improved resilience, but also in new functionality and flexibility. On the international level, SWITCH will continue its participation in the series of GÉANT projects within the framework Horizon2020. The focus will lie on guaranteeing performing network access to European and worldwide research and education networks, continuing to play a European-wide leading role in fostering the use of access to national authentication and authorization infrastructures through interfederation and on continuing to support the use of federated identity technology for cross-national research communities.

Until 2016 the Swiss edu-ID will be established as identity management platform. Furthermore, the operational framework of the Swiss edu-ID v2.0 will be defined and piloted by the most innovating organizations of the SWITCH community. The main goals of the period 2017 – 2020 will be to deploy and enhance the Swiss edu-ID service inside Switzerland and to set up collaboration with similarly scoped initiatives internationally. The scaling out of the central identity management platform Swiss edu-ID to support additional interfaces to interwork with relevant external attribute and service providers (e.g. e-gov and relevant commercial services) as well as the Operating the Swiss edu-ID in accordance with the operational framework defined will be major tasks in this period. This includes setting up and coordinating multi-stakeholder governance structures.

SWITCH will build and will operate a cloud infrastructure that can serve the special needs and national regulations for academic computing and information management. SWITCH will move therefore towards a more seamless integration of networks, cloud infrastructure and ID/access services. SWITCH will contribute its cloud infrastructure for supporting the research community - in balance with e-Science- and IT-teams of universities. Key goals for 2020 will be: collaborative infrastructure for processing and storing scientific data including primary and secondary research data, digital repository for Swiss researcher's data with data management and archival services including access management with the Swiss edu-ID and metadata catalogue for retrieval of stored data.

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton**	**Others***	**EU****
2013-2016	64 Mio.	3.5 Mio. (PGB)		58 Mio.	2.5 Mio.
2017-2020	89 Mio.	24.5 Mio. (PGB)		62 Mio.	2.5 Mio.
2021-2024	76.5 Mio.	8 Mio. (PGB)		66 Mio.	2.5 Mio.

* from universities for running services, including yield from third party services and own funding.

** subsidies from EU (FP7 and Horizon 2020)

8. Swiss Digital Humanities Center (SDHC)

Category: Information and service infrastructures

Host institution(s): Digital Humanities Lab, University of Basel on behalf of the Universities of Basel, Bern and Lausanne

Main funding sources: Swiss Academy of Humanities and Social Sciences (SAHSS), State Secretariat for Education, Research and Innovation (SERI), Universities

Description / Development prospects

a. National level

Overview

The Swiss Digital Humanities Center (SDHC) shall answer a chronic problem in Swiss Humanities research: There is no systematic way to preserve Swiss Humanities digital research for future use nor is it possible to interconnect scientific data from the humanities with other sources of the international Digital Humanities (DH) research community to find new results based upon the linkage of sources of various types. The SDHC guarantees the long-term accessibility of research data in the Humanities and propagates the use of advanced digital methods and technologies in a way that the persistence of data and tools to work with scientific data from the humanities can be achieved.

Detailed description

The center will offer the following functions:

- A sustainable, reliable and trustworthy data platform for digital research data in the humanities;
- long-term accessibility and long-term archiving;
- state-of-the-art data and access management providing a high degree of control of access authorisation;
- an extensible, open, and flexible toolbox of methods for data management, analysis, and visualization;
- a toolbox/library of basic functions for the development of new tools and research methods;
- connectivity to external data sources and repositories according to the “linked open data (LOD)” standard;
- information and training on digital research methods and data management, focusing on qualitative data and digital sources.

The SDHC is based on Knora, an open, modular, extensible and flexible platform using industry standards such as RDF as data representation, SPARQL 1.1 and a RESTful web service API for access.

The SDHC is organized in the form of a central coordination unit that coordinates the technological development, quality control and provides second level support. Locally anchored satellites at the universities provide first level support, local collaboration, support in research and are responsible for smaller local developments.

Governance is provided by an executive board that is responsible for strategic decisions and overseeing the operations of the SDHC. The members represent the major stakeholders of the SDHC (Universities, SERI, SAHSS, SNSF). A scientific board supports both the executive board as well as the executive director of the SDHC on scientific and operational matters that are at the core of the activities of the SDHC. It consists of 7-10 leaders of national or international standing in the field of Digital Humanities and long-term access to research data.

b. International level

The international comparison shows that there is not a single repository that can meet every-one's needs. There are various approaches to ensuring long-term access to research data. The solution the SDHC proposes is very well positioned in an international comparison. It uses an adequate, very advanced technology that is very promising for the future and shows great potential. It is open to international cooperation using accepted standards (LOD, RDF etc.). A close collaboration and exchange with similar institutions internationally has been established.

c. Development prospects

Since more and more research in the Humanities uses digital data and digital tools and methods, the demand for the services the SDHC may provide will grow dramatically in the future.

d. Costs (in CHF)

The Commission of the pilot project and the Board of the SAHSS proposes a shared funding model: The national coordination office will be funded with CHF 1 million annually on "Art. 11, Abs. 6 und 7 des Bundesgesetzes über die Förderung der Forschung und der Innovation" (FIFG) as a special task of the SAHSS. The remaining CHF 100,000 of the total costs incurred at the national coordination office (incl. long-term archiving) of CHF 1.1 million will be financed through revenue for chargeable services and/or third-party funding. The satellites will be funded by project-bound contributions on the basis of Art. 59) of the "Hochschulförderungs- und Koordinationsgesetzes" (HFKG) with CHF 600,000 annually. The remaining CHF 400'000 will be contributed by the universities from their own resources.

	Total costs	**Confederation**	**Cantons**	**Others**
2017–2020	8.58 Mio.	6.4 Mio.	1.6 Mio.	0.58 Mio.
2021–2024	8.58 Mio	6.4 Mio.	1.6 Mio.	0.58 Mio.

Financing by public sector 2017–2020 (same for 2021–2024):

Art. 11 FIFG:	4.0 Mio.
Art. 59 HFKG:	2.4 Mio.[1]
Universities:	1.6 Mio.
Total:	8.0 Mio.

Financing by third-party funds / own resources 2017–2020 (same for 2021–2024)

SDHC:	0.58 Mio.

[1] In line with the application submitted by Swissuniversities to the SUC on 7.4.2015, CHF 2.626 million has been requested. The Confederation's participation in this project with a total value of CHF 6.4 million would be in line with the ratio defined by Swissuniversities of 1/3 PC (Confederation), 2/3 universities.

9. Swiss Art Research Infrastructure (SARI)

Category: Information and Service Infrastructures

Host institution(s): University of Zurich

Main funding sources: University of Zurich, State Secretariat for Education, Research and Innovation (SERI),

Description / Development prospects

a. National level

Overview

In response to the SERI/SNFS call for New Research Infrastructures of National Relevance 2017-20, the Institute for Art History (KHIST) of the University of Zurich (UZH), in collaboration with the Department of Architecture (D-ARCH/gta) of the ETH Zurich (ETHZ) and the Swiss Institute for Art Research (SIK-ISEA), proposes the Swiss Art Research Infrastructure (SARI).

Detailed description

SARI proposes a network-based research infrastructure for the specific needs of art history and also visual art research in the humanities at large. To Switzerland's universities, research units, museums, collections, and archives SARI offers an unprecedented framework for a sustained, unified, mutual, and mainly open access to research data, first-hand visual resources, and scientific metadata from diverse institutions, research projects, and pre-existing networks. It overcomes not only the institutional and technical fragmentation of the field, but also the national language barriers by giving access to established, yet extendable scholarly keywording and multilingual vocabularies and by implementing international metadata standards. SARI provides several thousands of researchers and students with new tools for annotating, collaborating, and sharing research results as well as presenting hundreds of thousands of digital assets thanks to a state-of-the-art, user-friendly, open-source, and free-of-charge software. Large institutions, such as university libraries, benefit from the industry-grade search technologies and data services thanks to SARI's underlying data architecture and the implementation of internationally acknowledged standards for metadata description, data exchange, and harvesting protocols, such as RDF, LOD, OAI-PMH, thus guaranteeing the compatibility with existing and future national research infrastructures of diverse kinds. A collaboration with other digital infrastructures such as the projected Swiss Digital Humanities Center (SDHC) is welcome.

The UZH, ETHZ, and SIK-ISEA are Switzerland's leading institutions in the field of digital art history. SARI strengthens the UZH's leading role in the digital humanities and makes it visible nationally and internationally. Thanks to its services for the UZH, which hosts Switzerland's largest Faculty of Arts, SARI fosters a cost-effective use of resources and offer tools and large image collections for research and teaching across disciplines. Collaboration and sharing through SARI will further extend and enhance the UZH's scientific network.

b. International level

SARI enhances the accessibility and visibility of Switzerland's most valuable research resources. As SARI is tightly interwoven in the international context and collaborates with major international Advisory Partners, the benefits on a national level increase exponentially on an international level. Thanks to full interoperability with the relevant technical standards for metadata exchange and data harvesting, SARI provides a large international scientific community with unified and multilingual access to Switzerland's visual resources and research data, and conversely retrieves them from international contributing partners. By adopting the international vocabulary programs relevant to art history (e.g. the Getty Vocabulary and the German National Library's GND), SARI ensures maximum acceptance within the international scientific community. The growing relevance of the LOD cloud and of the semantic web will further SARI's international presence and adoption. Although recognized in the field as the next step in the evolution of digital art history and generative humanities, SARI is the first breakthrough initiative internationally.

c. Development prospects

We expect a strong growth of demand from the beginning, in relation to institutions, to content, and to users from the scientific community. Because no infrastructure exists that provides comparable visibility for research data, scientific metadata, and digital assets from holdings, we expect a strong institutional interest. The framework will include all seven Swiss art history departments and probably more than double the number of other contributing national and international partners by 2020 and increase by several per year. We have identified several tenths of thousands of scientific metadata sets from specialized institutions that are not yet present in any of the major vocabulary programs and need to be included. Concerning digital assets, SARI can rely on the Digitale Diathek network established by the UZH and ETHZ and thus will comprise more than 1 MM digital assets from the start and grow fast. We reckon with an increment of more than 12 000 digital assets per annum from 2018 on. Thus, concerning art historians in Switzerland alone, there are about 800 researchers and 6000 students as potential users, and probably 10 000 users from other disciplines and from outside academia. The size of an international or global community of potential contributors and users is thus extremely large. SARI will fully operate from 2020 and, being open source, its further development can be undertaken by other institutions.

SARI is safely founded on previous single and collaborative IT and scientific experience of the Host Institution, its new Service and Support for Science IT (S3IT), its two Core Partners ETHZ and SIK-ISEA, and its international Advisory Partners the Getty Research Institute and the Bildarchiv Foto Marburg. The Partners will not only share technical know-how regarding the development of industry-grade data services and the deployment and curation of multilingual vocabularies in LOD networks, but also aggregate important content directly or from other specialized institutions. All Partners confirm the feasibility of the project, which has been developed and double-checked in numerous meetings and workshops with the Partners, software firms, and other players in the field.

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton**	**Others**
2017-2020	4.54 Mio.	1.58 Mio. PGB[1] 0.58 Mio. ETH	2.38 Mio.	tbd
2021-2024				

[1] In line with the application submitted by Swissuniversities to the SUC on 7.4.2015, CHF 1.513 million has been requested.

10. Swiss Center for Pediatric Pharmacology (SwissPedPha)

Category:

Service infrastructure (Data / Service Center: Clinical research specific services)

Host institution(s):

- University of Basel, Prof Dr med Johannes van den Anker
- University of Basel, Prof Dr med Marc Pfister
- University of Basel, Prof Dr med Christiane Pauli-Magnus
- University of Zurich, Prof Dr med David Nadal
- University of Zurich, Prof Dr med Matthias Baumgartner
- University of Zurich, Prof Dr med Susanne Walitza
- University of Lausanne, Prof Dr med Thierry Buclin
- Universities of Lausanne and Geneva, Prof Dr pharm Chantal Csajka

Main funding sources:

State Secretariat of Education, Research and Innovation (SERI)

Host and partner institutions (in-kind contribution)

Description / Development prospects

a. National level

Overview

The host institution, the University Children's Hospital Basel, the collaborating host institutions, the Department of Clinical Research of the University of Basel, the University Children's Hospital Zurich and the Department of Child and Adolescent Psychiatry of the University of Zurich are committed to the Swiss Center for Pediatric Pharmacology (SwissPedPha). This new research infrastructure closely collaborates with Pharmaceutical Sciences and Clinical Pharmacology at the University of Lausanne to perform computer modeling and simulation and optimize both design and analysis of clinical and translational investigations in neonates, infants, children, and adolescents for all Swiss pediatric research centers. SwissPedPha is a close partner of SwissPedNet and the Swiss clinical trial organization SCTO and will collaborate with the two Swiss technology research centers ETHZ and EPFL.

Detailed description

To allow for strategic, operational and cost disciplined synergies, the central office of SwissPedPha will be co-located with the executive office of SwissPedNet and SCTO in Basel.

- *Schweizer Netzwerk der Pädiatrischen Forschungszentren (SwissPedNet)*
  SwissPedPha) is a complementary partner of SwissPedNet and as such all eight pediatric research hubs in Switzerland will be able to benefit from this new research infrastructure. SwissPedPha will considerably improve quality of the design of pediatric studies conducted by SwissPedNet through computer models and experiments in virtual pediatric patients. Further, systems pharmacology and pharmacometric modeling and simulation will be applied in close collaboration with the advanced pharmacometric research group at the University of Lausanne to quantitatively integrate and analyze data generated by these clinical investigations. Other existing national networks such as the Swiss pediatric oncology group (SPOG), the rare disease initiative Zurich (Radiz), and the Swiss society of neonatology (Neonet) will benefit from this novel and unique research infrastructure.

- *Nationale Kinderarzneimitteldatenbank (National Pediatric Drug Database)*
  BAG is currently supporting efforts to harmonize pediatric medication in the various children's hospitals in Switzerland to improve treatment quality in pediatrics in Switzerland. It has been decided that in the near future this national database will be maintained by the University Children's Hospital of Basel in close collaboration with the Children's Hospital of Zürich. SwissPedPha will not only strongly support the quality of this database scientifically but also leverage advanced computer modeling and simulation approaches to assure safe and effective use of medicines in neonates, infants and children throughout Switzerland.
- *Schweizerische Zulassungs- und Aufsichtsbehörde für Heilmittel* (*Swissmedic)*
  Through computer modeling and trial simulations SwissPedPha will help to assure that designs of clinical studies conducted in Switzerland are optimized and tailored for pediatric patients. Such scientific contributions will generate clinical trial data that are reliable and acceptable for Swissmedic for their approval of these medicines for safe and effective use in neonates, infants and children in Switzerland. SwissPedPha will be a valuable scientific partner for Swissmedic to discuss further reduction in the risks for pediatric patients to participate in clinical studies without jeopardizing the power of such studies. SwissPedPha is performing modeling and simulation analyses that provide a quantitative, scientific basis for optimized, tailored study designs and enhanced, stratified dosing recommendations for neonates, infants and children.

We apply for salaries for staff at the pediatric pharmacology center such as pediatric computer modeling specialists, pediatric clinical pharmacologists and a project manager.

b. International level

This new research infrastructure will benefit not only national but also international networks such as Enpr-EMA.

- *European Network of Pediatric Research at the European Medicines Agency (Enpr- EMA)*
  SwissPedPha will network and collaborate with members from within and outside the European Union (EU), including academia and the pharmaceutical industry.
- SwissPedPha will partner with the *European Drug Disease Model Resources (DDMoRe) consortium* (www.ddmore.eu/content/innovative-medicines-initiative) and other international initiatives in pharmacology and pharmacometrics such as the *C- path consortium (www.c-path.org).*

c. Development prospects

SwissPedPha serves as a partner for investigator-driven research, such as clinical, epidemiological, and translational research projects, bioinformatics, bioengineering, and systems medicine and has the potential to develop innovative bedside support tools such as dosing apps and medical devices for pediatricians.

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton**	**Others***
2017-2020	3.2 Mio.	1.067 Mio. (PGB)	tbd (1.333 Mio.)	0.8 Mio.**
2021-2024	*3.8 Mio.*	*1.9 Mio.*	tbd (1.3 Mio.)	*0.6 Mio.*

* In-kind contributions by host institutions, other universities and pediatric hospitals in Switzerland;

** Includes projected contributions by BAG, SCTO, and/or SwissPedNet

11. Swiss National Ion-microbe Platform (SwissNIP)

Category: Technical infrastructures (platform analytical instruments)

Host institution(s): University of Lausanne (leading house), EPFL (participating institution), University of Geneva (participating institution)

Main funding sources: Universities of Lausanne and Geneva, EPFL

Description / Development prospects

a. National level

Overview

The objective of this proposal is to position Lausanne as a national (and international) leader with respect to high-resolution, quantified isotopic and elemental analysis. In order to achieve this, we will build upon the existing ion microprobe platform, currently federated into a structure named “Center of Advanced Surface Analysis” (CASA), which has participation from UNIL, UNIGE and EPFL. This ion microprobe platform currently consists of a cutting edge instruments: 1) the large radius 1280 HR ion micro probe (the SwissSIMS, co-owned by UNIL, UNIGE, UNIBE and ETHZ, responsible prof. Baumgartner), which is in a national service, and 2) the 50NL NanoSIMS (owned by EPFL, responsible prof. Meibom). Together these two instruments are analytically highly complementary and, already in their current configuration, the constellation is unique to Europe. The two instruments are used in research spanning material sciences, geology, cosmochemistry, stable isotope geochemistry, biomineralization, environmental microbiology, and cell biology. Access to the facility is open for all Swiss and international researchers. It is granted based on project proposals submitted to the SwissSIMS scientific steering committee, which is composed of members of the Swiss and international scientific community. While the SwissSIMS is run entirely as a national facility, the NanoSIMS is made available to the Swiss research community 25% of the time.

With this SwissNIP proposal, we wish to further strengthen this ion microprobe platform to make it a world-leader, characterized by analytical capabilities that exist nowhere else under one roof.

Detailed description

Within this SwissNIP proposal we wish to upgrade our ion microprobes with newly developed RF-oxygen primary sources, which are much brighter than the currently used Duo Plasmatron sources. This will further enhance our capability to perform quantified, high-resolution isotopic and elemental analyses without loss of analytical precision. The new oxygen sources will allow us to analyze metals (e.g. electro-positive elements and isotopes) with high precision and a spatial resolution of ca. 40 nm on the NanoSIMS, and about 1 micrometer on the SwissSIMS. With these two new sources, the ion microprobe platform will become absolutely unique in the world and these capabilities will open up entirely new frontiers of research possibilities - and give Swiss scientist a unique advantage.

In addition, UNIL is set to buy a Field Emission Gun (FEG) electron microprobe (2016/2017). A FEG probe allows users to obtain quantitative analysis of major elements to a scale of ca. 100 nm, which is essential for quantitative analysis of trace-elements and isotopic compositions using ion microprobe. It is the perfect electron-beam instrument in combination with the upgraded ion microprobes. The FEG instrument will be made available (for max. 25%) of the time for project linked to the SwissNIP project.

Furthermore, we are currently in the process of developing the capability to run the NanoSIMS instrument in cryo-mode. This (first ever!) CryoNanoSIMS will become fully operational in the fall of 2015 and will revolutionize studies of biological tissue because samples can be prepared and analyzed for chemical and isotopic composition at ultra-high spatial resolution without any loss of soluble compounds from the cells under study.

b. International level

Today, the combination of cutting-edge large-radius ion microprobe SwissSIMS and NanoSIMS under one roof exists only in two other research institutions in the world. With the proposed upgrade to new and much more powerful ion sources and the development of the CryoNanoSIMS, plus the availability of a FEG electron microprobe for ultra-high spatial resolution major element analysis, the SwissNIP proposal offers to equip Swiss researchers with an analytical facility that has no parallel in the world.

c. Development prospects

With this new ion microprobe platform, Switzerland will have a unique *state-of-the-art* facility to image and quantitatively analyze trace element and isotopic composition of solids (or frozen liquids/tissue) across an extremely broad range of disciplines. This will attract researchers from all over the world and open many new collaborations and scientific frontiers. International interest is documented by the fact that our already existing platform has been solicited to join a Europe-wide network of geochemistry analytical facilities under the Horizon 2020 program (application currently under review).

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton (UNIL + UNIGE)**	**Others (EPFL)**
2017-2020	6.3 Mio.	1.5 Mio. PGB	3.65 Mio.	1.15 Mio.-
2021-2024		*tbd*	*2.27 Mio. (at least)*	*0.84 Mio (at least)*

Fundings asked from the SEFRI

Details of the costs for the period 2017-2020:

Salaries	0.85 Mio.
Equipment	0.36 Mio.
Running costs	0.29 Mio.
Total	**1.5 Mio.**

Matching funds

Details of the matching funds for the period 2017-2020:

	UNIL	**UNIGE**	**EPFL**
Salaries	1.15 Mio.	0.12 Mio.	0.79 Mio.
Equipment	1.8 Mio.	0.18 Mio.	0.36 Mio.
Running costs	0.4 Mio.		
Total	**3.35 Mio.**	**0.3 Mio.**	**1.15 Mio.**

For the period 2021-2024, the matching funds were estimated based on the salary of the permanent staff of the facility. It includes the FEG-EMP technician, paid by UNIL post 2020.

12. Swiss Laboratory for the Advanced Studies on the Dynamic Behavior of Materials (DynaMatLab)

Category: Instruments

Host institution(s): SUPSI

Main funding sources: Host institution, Competitive Funds, State Secretariat of Education, Research and Innovation (SERI)

Description / Development prospects

a. National level

Overview

The Swiss Laboratory for the Advanced Studies on the Dynamic Behavior of Materials is a centre specialised in the mechanical characterization of materials in dynamics able to measure accurately the stress-strain curves of materials in tension, compression and shear in a large range of strain-rates (from 10^{-6} a 10^{5} s^{-1}) and temperature.

The laboratory acts as a point of reference for industry and research centres (at regional, national and international level) as key-player support in design, development and optimization of production processes.

The laboratory develops research on materials and structures subject to dynamic-impulsive loads, fosters technological transfer and diffuses an integrated approach dealing with design-testing in order to improve safety and quality of products.

Detailed description

In the laboratory it is possible to perform tests in tension, compression, shear, torsion and bending for different materials at high strain-rates and in a large field of temperature (77÷1'500 °K). For example:

- Thin sheet steel used by the automotive industry;
- Steel used for the structures of nuclear reactors or defense;
- Plain and fibre-reinforced concrete;
- Aluminum and magnesium alloys used in aero-space;
- Fibre-reinforced composite polymers.

The core facilities of the laboratory are based on the Modified Hopkinson Bars apparatus (MHB). Several set-ups are used to study the uni-, bi- and tri-axial behavior of materials in a wide range of strain-rate tests (1÷10^{5} s^{-1}). These apparatuses' length range from some meters to max.15 m and have different bar diameters, needed to test samples like:

- Metals (diameter 10 and 12 mm).
- Polymers (diameter 20 mm).
- Concretes and rocks (diameter 60 mm).

Additional facilities are available to test materials in intermediate strain rate regime (0.1-100 s^{-1}) and in quasi-static regime. Systems of transient recorder (50 Msample/s) and measurement chains (displacement transducers, fast camera, etc.) permit to register all data.

b. International level

The Swiss Laboratory for Advanced Studies on the Dynamic Behavior of Materials continues in the same way which has been followed by the existing Centre of Competence DynaMat. The Research Infrastructure (RI) will enhance the role as reference point for industry and research centres as well as international universities. The development of training and mentoring of young Swiss and foreign researchers will create the opportunity to do cutting-edge studies and collaborate with other world-class facilities and experts. The laboratory will act as a node of the network of world's leading research institutions involved in the dynamic behavior of materials, providing a supportive environment for

Swiss industry. This infrastructure is inserted in the international network of laboratories of dynamic of materials (DYMAT).

c. Development prospects

Dynamic behavior of materials represents an ever expanding area of broad interest to the scientific community and industry. Understanding the dynamic response of materials improves design and safety of products and structures by means of calibration and validation of numerical models.

The Swiss Laboratory for Advanced Studies on the Dynamic Behavior of Materials is strongly specialized in experimental issues, analyzing material behavior in mono-, bi- and tri-axial loading conditions in combination with additional variables as temperature and other severe conditions (i.e. irradiation).

To reach the objective of being a reference laboratory in the mentioned topics, it is required to constantly improve the set of devices through the design of new machines and the construction of complementary set-ups. New machines are essential to respond to the needs of research and development in the field of dynamic behavior of materials. In order to cover a wide area of applications it is necessary to study the torsion behavior as well as the combination of tension/torsion. Traditional Split Hopkinson Pressure Bar (SHPB) can easily respond to the dynamic indentation purposes (two set-ups have been scheduled). Many industrial applications involve biaxial stress conditions. Consequently dynamic biaxial behavior studies are required. The new RI must cover these issues by developing a biaxial apparatus at medium and high strain rate (biaxial MHB). Moreover the new Tri-axial Hopkinson Bar has to be completed as well as the Collision test apparatuses have to be built. Finally, the system of MHB in bending is required to study the fracture mechanics parameters in a wide range of strain rate.

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton**	**Others**
2017-2020	6.774 Mio.	4.076 Mio.[1]		1.328 Mio. SUPSI 1.37 Mio. Competitive Funds
2021-2024	tbd	tbd	tbd	tbd

[1] In line with the application submitted by Swissuniversities to the SUC on 7.4.2015, CHF 1.36 million was requested. In accordance with the budget adjustment by the SUPSI, CHF 2.258 million has now been calculated and applied for as a PC third of the total volume of CHF 6.774 million. The difference of CHF 1.818 million to CHF 4.076 million must be secured by the SUPSI if scenario 1 is realised.

13. National Research Centre for Animal Cognition

Category: Service infrastructure

Host institution: University of Neuchâtel

Main funding sources: University of Neuchâtel, City of La Chaux-de-Fonds, Canton Neuchâtel, Private funding, State Secretariat of Education, Research and Innovation (SERI)

Description / Development prospects

a. National level

Overview

Our goal is to establish a research and education centre network for studying animal intelligence, enabling Switzerland to take a world-leading role in research, supporting our National zoos in their mission to engage with research, enhancing the public's understanding of science, and establishing links with existing research stations in Africa to initiate new partnerships of excellence. The project will be coordinated by the University of Neuchâtel with four major research centres at the zoos of La Chaux-de-Fonds and Basel and two primate field stations, the Budongo Conservation Field station in Uganda and the Centre Suisse de Recherches in Ivory Coast. Our general vision is to carry out our activities in full public view, with the support of designated research areas that are directly accessible to visitors. Our goal is to link cutting-edge research with education, and so to enhance the public's understanding of scientific processes, both in Switzerland and Africa.

Detailed description

We aim to establish four research facilities at Basel Zoo (unit 1: modification of existing infrastructure for great ape research), at the Zoo 'Bois du Petit Chateau' in La Chaux-de-Fonds (unit 2: new outside area and indoor compartments to house groups of monkeys; one large outdoor enclosure to house a pack of wolves with adjacent testing units that are also suitable for domestic dogs), in Ivory Coast (unit 3: field station in Tai Forest; housing, lab and office space) and in Uganda (unit 4: field station in Budongo Forest: housing, lab and office space). *Unit 1 - Great ape research facility at Basel Zoo*. Modifications to their existing building structures: touch screens in great ape cages, mobile eye-tracking unit, building works. Implementation to start shortly, research activities to start in 2015/16. *Unit 2 – Monkey and wolf research facilities in La Chaux-de-Fonds*. The facilities for monkeys and wolves are planned as extensions of the La Chaux-de-Fonds zoo. The City Council supports the project and has offered city-owned terrain, as well as coverage of the running costs for animal care and building maintenance. Further support is from the Canton of Neuchâtel's Department for Education and Family. The monkey facility will be constructed adjacent to the zoo on roughly 2,500m2 of land designated as 'zone for public use' and includes buildings to house the monkeys, two experimentation labs, and facilities for the researchers (kitchen, rooms). Additional land of about 5,500m2 is for outdoor enclosures. The wolf facility will be located at the periphery of La Chaux de Fonds in a forested area. Investment in terms of infrastructure is relatively minimal (fences, electricity, water, mobile testing units suitable for wolves and dogs. Implementation of unit 2 involves several steps of political approval, including the City's Urbanization Service and the General Council, followed by consultation of the public. *Units 3 & 4 - Field stations in Ivory Coast and Uganda*. Our plan here is to (a) set up a webcam system to make fieldwork accessible via the internet to general audiences and to (b) set up a 2-week field course for undergraduate students to obtain training in tropical field research. Our local partners in Africa are supportive, so that we will be able to pilot this scheme with a first course in 2016.

b. International level

The centre will provide opportunities for research projects and education for local and international scientists and students. A large number of colleagues have expressed their personal interest in using the facilities with collaborative research with their teams, including Dr Christoph D. Dahl (National Taiwan University); Prof Josep Call (Max Planck Institute for Evolutionary Anthropology); Prof Nikos Logothetis (Max Planck Institute for Biological Cybernetics); Prof Tecumseh Fitch (University of Vienna); Prof Brian Hare (Duke University); Prof Josh Tenenbaum (Massachusetts Institute of Technology); Prof Adam Miklosi (Eoetvoes Lorand University); Prof Ludwig Huber (University of

Vienna); Prof Friederike Range (University of Vienna); Prof Malte Rasch (Beijing Normal University); Prof Christoph Kayser (University of Glasgow); Prof Olivier Pascalis (Université Pierre Mendès); Prof Christian Wallraven (Korea University); Prof Joel Fagot (Aix Marseille Université); Prof Robert Hampton (Emory University).

c. Development prospects

Research in animal cognition is a hot topic in modern science, and continues to provide deep answers to some of the most fundamental questions, namely, what it means to be human. Many universities and national funding agencies have recognised this and responded by setting up dedicated research centres. Notable examples are the Max Planck Institute for Evolutionary Anthropology in Leipzig and the Living Links Study Centre for Human Evolution in Edinburgh Zoo. Switzerland has no comparable research centre, although several research groups work on these topics. The SNSF Infrastructure Grant offers the high-level strategic vision required to meet our aspiration to establish such a centre in Switzerland, which will enable our scientists to keep up with the major competitors in Europe and elsewhere. Research will be conducted to promote public understanding of science, by granting insights into the daily work routines of scientists, by offering guided tours through the facilities for groups of visitors and school classes, and by offering a range of educational tools for students at all levels. Research achievements will be showcased and interpreted to the visitors by various means. One idea is to directly engage zoo visitors in experimental procedures, such as by interacting with a zoo animal in a strategy game on touch screen monitors. Further, we will provide open access knowledge by involving contemporary media platforms, such as online 'learning resources' and facility tours. Finally, by interacting with local schools we will be able to bring the natural sciences into the classroom, alongside already existing schemes, such as www.techecole.ch.

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton (UniNE)**	**Others**
2017-2020	2.47 Mio.	0.815 Mio.[1]	0.67 Mio.	0.985 Mio.
2021-2024	*0.6 Mio.*	*0*	*0.4 Mio.*	*0.2 Mio.*

[1] In line with the application submitted by Swissuniversities to the SUC on 7.4.2015, CHF 0.823 million has been requested.

14. Airborne Research Facility for the Earth System – ARES

Category: Vertical infrastructure composed of large physical devices (Earth observation instruments for use in a research aircraft), a data/service center, and an IT platform.

Host institution(s): University of Zurich

Main funding sources: State Secretariat of Education, Research and Innovation (SERI), University of Zurich, ETH Zürich with additional funding from Empa, EPFL, Eawag, University of Lausanne, University of Fribourg, (and ESA PRODEX)

Description / Development prospects

a. National level

Overview

The Airborne Research Facility for the Earth Science (ARES) is a collaborative effort of key Swiss institutions to advance Earth System science using remote observations. ARES builds on a very strong heritage of individual experience in the domain of spectroscopy, radar remote sensing, laser remote sensing, photogrammetry, navigation, and computational efforts. Components of ARES have been recommended for implementation by the Swiss Commission on Remote Sensing (SKF) as well as the Swiss Space Implementation Plan (SSIP). A variety of ESA, SNSF, SERI and institutional efforts and projects are combined into ARES.

Detailed description

The Airborne Research Facility for the Earth Science (ARES) is an integrated and collaborative infrastructure addressing key terrestrial Earth System processes. ARES is composed of an airborne package with up to four Earth observing instruments, a processing and archiving facility (PAF), and an IT platform. The planned Earth observing instruments are an imaging spectrometer, a synthetic aperture radar (SAR), a full waveform laser (LiDAR) and a high performance digital camera.

ARES will deliver information of the Earth's terrestrial surface with unprecedented accuracy and impact in the domains of the lithosphere, geosphere, hydrosphere, cryosphere, biosphere and atmosphere (the latter based on columnar retrievals). New key variables retrieved rely on the possibility to simultaneously obtain chemical, biological, structural, geometrical and physical information from the Earth's terrestrial spheres. Key variables are soil mineralogy, chemical and physical composition (including moisture), rock mineralogy, structure and forms, water quality, surface roughness, distribution of particulate matter, snow and ice composition and impurities, snow and ice extend, vegetation composition, biomass, productivity, functional traits and life forms, as well columnar constituents (NO_x, Methane), Albedo, aerosol optical depth (AOD), and the radiation regime and interactions with the surface.

The ARES core team is composed of 19 research groups spread across Switzerland. They represent all the expertise required to procure, construct and operate the infrastructure, as well as generating data products and modeling for the terrestrial Earth System. The collaborative approach of ARES and its open data sharing principles will allow a multitude of users to obtain data for their particular research fields. The ARES collaborators (more than 85 to date) have expressed interest in making use of the ARES facility. Contributions are ranging from engineering or computational efforts to feeding data products in their own models and applications. In addition, ARES is supported by several entities, representing a larger body of interested parties profiting from this infrastructure. These include the Global Climate Observing System (GCOS), the Swiss Space Center (SSC), the Swiss Federal Research Institute WSL, the European Space Agency (ESA), and the Federal Office for Environment (FOEN). ARES will allow Switzerland to being at the forefront of international Earth System approaches applied to a complex environment with unprecedented accuracy and impact.

b. International level

Airborne research is accessible in Europe through the European Facility for Airborne Research (EUFAR). However, EUFAR currently does not offer combined instrumented approaches as offered with ARES. The ARES consortium is member of EUFAR and significant contribution to European Earth System science research is expected from ARES. Internationally, only dedicated instruments within the NASA airborne program are available at similar performance. Again, those have rarely flown

outside of the US (with the exception of Antarctica and Greenland) in an ARES setup. Strong collaboration with NASA is foreseen with ARES.

c. Development prospects

Several new research areas can be addressed, such as quantitatively tracing biogeochemical flows across spheres (C, N, and isotopes), combining ecological genomics, phylogenetics and spectranomics, reconstructing 3D objects with structure, geometry, texture and biochemistry, tracing structural and compositional changes simultaneously (glacial flows and impurities, land use and cover changes, etc.) as well as scaling from in-situ to regional across broad ranges of the electromagnetic spectrum. Significant transformative research elements are inherent to the collaborative and integrative approach of ARES.

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton**	**Others**
2017-2020	22.7 Mio.	7.6 Mio. PGB 5.09 Mio. ETH-Domain	10.01 Mio.	tbd
2021-2024	*11.4 Mio.*	*tbd*	*tbd*	*tbd*

15. Mixed-Reality Lab for Behavioral Research MIRAL

Category: (Instruments, Information and service infrastructures, Technical infrastructures)

Instruments (Category a)

Host institution(s): Uni St. Gall

Main funding sources: Uni St. Gall, State Secretariat of Education, Research and Innovation (SERI)

Description / Development prospects

a. National level

Overview

With the Mixed Reality Lab for Behavioral Research (MIRAL), the University of St. Gallen plans to establish a research infrastructure (RI) with the objective of developing an internationally renowned mixed-reality lab for research on behavior of consumers, managers, and employees in computer-enhanced environments.

Detailed description

The MIRAL will be of key interest for behavioral researchers of the University of St. Gallen and other Swiss institutions (particularly behavioral consumer and management researchers but also behavioral finance and behavioral economics researchers).

The planned RI will not only allow researchers of the host institution to use a state-of-the-art laboratory to conduct their behavioral research but also to considerably increase its action scope. To scientists in Switzerland and beyond, the MIRAL will represent a unique research environment which will further improve the reputation of the university and the Swiss national research site. The MIRAL also strengthens the excellent status of Switzerland in the research community by providing a one of its kind lab infrastructure investigating research problems of the next decade in the computer-aided environments between the physical and virtual world

b. International level

The senior behavioral researchers at the University of St.Gallen are extensively collaborating with national, European, and collaborators at leading North-American schools, which will profit from the RI and strengthen the academic position of Swiss consumer and management research both nationally and internationally.

c. Development prospects

The MIRAL will be established in two stages. In the first stage (2014-2016), the University of St. Gallen will invest monetary and intellectual resources to establish a state-of-the-art behavioral lab. This lab will include common laboratory infrastructure to address research questions in the real, physical and the virtual, online world (e.g., infrastructure, PCs, shopping aisle). This stage will lay the institutional foundations for MIRAL and its organizational integration into the host university's research landscape. In the second stage (2017-2020), MIRAL will be established with a RI that is targeted at investigating computer-enhanced realities (e.g., head and body movements in an augmented reality).

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton**	**Others**
2017-2020	2.564 Mio.	0.855 Mio. PGB	1.097 Mio.	0.612 Mio.
2021-2024	*2.11 Mio.*	*0*	*0.72 Mio.*	*1.39 Mio.*

16. Neuchâtel Platform for Analytical Chemistry (NPAC)

Category: Technical infrastructure (for the analyses of bioactive chemicals)

Host institution(s): University of Neuchâtel

Main funding sources: University of Neuchâtel (leading house), Users (academic and research institutions, industries), State Secretariat of Education, Research and Innovation (SERI)

Description / Development prospects

a. National level

Overview

The Neuchâtel Platform for Analytical Chemistry (NPAC) was created in 2014 as the result of a merger between the Uni NE chemical analytical facilities and the chemical analytical service of the *Swiss Plant Science Web*. NPAC now performs chemical analytical services for all Swiss universities, federal research institutions and industries. The aim is to expand the platform in order for it to become Switzerland's top, as well as one of the world's leading centers in chemical analytics and metabolomics. This requires an investment in reinforcing and expanding the platform's analytical capabilities, ensuring that NPAC will perform to its full potential.

Detailed description

The analytical service at the University of Neuchâtel currently performs more than 25'000 analyses per year and greatly facilitates the research of scientists and industries throughout Switzerland and beyond. The platform uses state-of-the-art liquid (LC) and gas (GC) chromatography, mass spectrometry (MS), and nuclear magnetic resonance spectroscopy (NMR) in order to support research on the isolation, characterization, identification and quantification of bioactive molecules of scientific and practical interest. In the last four years, more than 100'000 analyses were performed for about 150 research projects conducted at all Swiss universities, as well as several federal research institutions and industries. NPAC also performs analyses for institutions at an international level, charging appropriate fees. We wish to further develop the NPAC facilities and expand the platform to become one of the world's leading centers in chemical analytics and metabolomics in plant research. As such, NPAC can greatly advance national and international research in a field that is of utmost importance to industry, agriculture, and the protection of the environment. This requires reinforcement with additional personnel and state-of-the-art equipment.

b. International level

Advances in chemical analytical technologies, in particular in the field of metabolomics, have greatly increased the potential to help scientists to discover novel biologically active compounds. This has been particularly successful in the field of plant sciences and the University of Neuchâtel, in the context of the NCCR *Plant Survival*, has greatly contributed to these recent developments at an international level. We wish to further develop these unique capacities in plant research in Switzerland and establish a world-class facility. We can claim that there is no equivalent research infrastructure devoted to plant sciences in Switzerland. Within Europep, several institutions, such as the Max Planck Institute for Chemical Ecology (Jena, Germany), Rothamsted Research (Harpenden, UK), and the University of Leiden (The Netherlands), have comparable infrastructures, but they are less devoted to serve other research groups and in some cases even rely on our help. Hence, NPAC is worldwide already recognized as one of the top analytical services.

c. Development prospects

With an appropriate investment to increase the platform's capacity the prospects of further development are extremely good. Such an investment would allow NPAC to obtain the most advanced technologies that are currently available and enable it to handle the expected increase in the number of samples that will need to be analyzed. The implementation steps in terms of equipment purchases and personnel appointments are listed in the next section.

d. Costs (in CHF)

The following specific *roadmap* investments are foreseen:

2015

- Appointment of a technician to assist the engineers with sample preparation and analyses (CHF 105'000/y). Will be filled early 2015. (UniNE funding)
- Purchase of a gas chromatograph coupled to a mass spectrometer (GC-MS; CHF 95'000). This equipment has been ordered. (UniNE funding)
- A state-of-the-art micro-UHPLC tandem mass spectrometer (μUHPLC-Qq; 420'000 CHF). This equipment has been ordered. (UniNE funding)

2016

- Appointment of a second technician to assist the engineers with sample preparation and analyses (to be funded with users-fees).

2017-2020

- NMR 600 MHz (CHF 900'000) (UniNE + third party funding)
- Maldi TOF/TOF (CHF 380'000) (SEFRI-funding)
- Element analyzer (CHF 100'000) (SEFRI-funding)
- UHPLC-QTOFMS (CHF 570'000) (SEFRI-funding)

2021-2024

Further equipment purchases will be based on upgrading or replacing obsolete equipment.

	Total costs	**Confederation**	**Canton (UniNE)**	**Others**
2015-2016	0.72 Mio.		0.72 Mio.	
2017-2020	2.434 Mio.	1.05 Mio. PGB	0.984 Mio.	0.4 Mio.
2021-2024	*≈1.8 Mio.*	*0.6 Mio.*	*0.6 Mio.*	*0.6 Mio.*

17. Swiss National High-Field Solution NMR Facility

Category: A Swiss National High-Field Solution NMR Facility shall be created at the Biozentrum of the University of Basel by the installation of a 1.2 GHz narrow-bore solution NMR spectrometer. Besides providing access to the currently highest magnetic field strength for NMR research in solution, this infrastructure shall also develop into a national center for training and scientific exchange in the field of NMR spectroscopy. The infrastructure shall be operated jointly by the University of Basel, the ETH Zurich and the University of Zurich.

Host institution(s): University of Basel, in association with the ETH Zurich and the University of Zurich

Main funding sources: University of Basel, ETH Zurich, University of Zurich, State Secretariat of Education, Research and Innovation (SERI), Swiss National Science Foundation, other sources of third party funding to be solicited

Description / Development prospects

Spectacular progress in superconducting wire technology has led to a leap in the reachable magnetic field strengths for NMR spectrometers, which will significantly increase the application range of NMR spectroscopy to interesting biomolecular systems. A new generation of NMR spectrometers based on this technology will be available around 2016 and will have a field strength of 1.2 GHz (28 T). The costs of such instruments surpass the financial capabilities of single research institutions.

The Swiss National High-Field Solution NMR Facility will make such a centralized 1.2 GHz instrument available to researchers in high-resolution NMR spectroscopy in Switzerland and possibly in adjacent countries. In addition, the facility shall be developed into a national center for training of young scientists and scientific exchange. This shall be achieved by a Swiss NMR School dedicated to the training of students and staff in the form of summer classes and other regular courses.

a. National level

Overview and Detailed description

The infrastructure will be operated jointly by the three participating institutions. It will provide measuring time to all interested academic scientists in Switzerland according to the scientific merit of respective research proposals. Access may also be provided to industrial and international users pending suitable financial contributions. Scientists from the three participating institutions will be provided with a guaranteed minimum measuring time against a fee that contributes to running costs. Other national, academic users will be asked to contribute to the running costs as well as part of the investment costs. For other users, the fee will reflect running and full investment costs.

The operation will be overseen by a steering board consisting of professors from the participating institutions and external members. Allocation of measuring time will be decided according to a scientific evaluation by a dedicated committee.

b. International level

Scientists from adjacent countries have expressed strong interest in obtaining measuring time. Depending on possible financial contributions and available measuring time, access may also be provided to foreign scientists.

The infrastructure will also seek to develop ties to the INSTRUCT program in Structural Biology within the European Strategy Forum on Research Infrastructures (ESFRI) in order to foster scientific exchange and networking.

c. Development prospects

With ongoing improvements in sample preparation techniques and substantially helped by the advent of the 1.2 GHz high-field magnet, many more biomolecular systems of highest importance in health and disease will become accessible to structural, dynamical and functional studies by solution NMR spectroscopy in the next 10-15 years. It is foreseen that thereby major contributions to the structural biology of such systems will be provided. The obtained information will help to decipher atomic details of biological function and open new prospects for pharmaceutical intervention.

The Swiss National High-Field Solution NMR Facility has the mission to keep Switzerland at the international forefront of biomolecular NMR spectroscopy by constantly implementing new developments in NMR technology, sample preparation, and data analysis and to make them broadly available. The facility will thus bundle efforts among so far partially isolated research groups in Swiss institutions and thereby foster efficient progress.

d. Costs (in CHF)

Purchase, installation and operation of the 1.2 GHz magnet in the period 2017–2020 will require an estimated total budget of CHF 21.34 Mio. divided into an initial investment and annual running costs. The three participating institutions ETHZ, Uni Zurich and Uni Basel will cover a substantial amount of investment and running costs, both as in cash and in kind contributions. In addition the users of the facility will contribute to the running costs. At the moment there is still a minor shortfall in initial funding that the participating Institutions are confident to cover by additional funds from third parties.

For the period 2021-2024, only running and maintenance costs need to be budgeted. These include facility personnel, maintenance, hardware upgrades and facility housing.

	Total costs	**Confederation**	**Canton**	**Others**
2017-2020	21.34 Mio.	7.1 Mio. PGB 1 Mio. SNF 2.62 Mio.* ETHZ	5.22 Mio. BS 2.62 Mio.* ZH	2.78 Mio
2021-2024	*3.98 Mio.*	*1.33 Mio.** PGB* *0.88 Mio.** ETHZ*	*0.88 Mio. ** BS* *0.88 Mio.** ZH*	

* University of Zurich and ETH Zurich will provide 2 Mio. CHF each for investment, details of the contribution to the running costs are under negotiation between the project partners.

** Details of the contribution to the running costs are under negotiation between the project partners.

18. CDCI – Common Data Center for Astronomy, Astroparticle and Cosmology

Category: Technical infrastructures: (e-infrastructure, MINT)

Host institution(s): UNIGE

Main funding sources: Swiss universities; State Secretariat of Education, Research and Innovation (SERI)

Description / Development prospects

a. National level

Overview

The Common Data Center Infrastructure (CDCI) is a proposed service infrastructure to foster the development of data center activities in the context of both space-based and ground-based facilities dedicated astrophysics at large, i.e. including astroparticle and cosmology. The CDCI is based on 20 years of activities, starting with the establishment of the INTEGRAL Science Data Centre in Geneva, which is in charge of a significant fraction of the ground-segment operations of ESA's INTEGRAL space observatory. The CDCI shall provide services to any Swiss scientist interested in leading data center activities, in particular contributing directly to the early phase of the mission and ensuring the preservation of the data and of the specific data analysis expertise after the mission is terminated.

Detailed description

The proposed service infrastructure "Common Data Center Infrastructure (CDCI)" is the result of very significant activities at the University of Geneva (UNIGE) for the establishment, starting in 1995, of a data center for ESA's X-ray and gamma-ray observatory INTEGRAL, the INTEGRAL Science Data Centre (ISDC). The ISDC is in charge of the processing and archiving of the data from the INTEGRAL satellite, as well as of providing software to the community to allow any scientist to exploit the scientific substance of these data. This very successful development has been an opportunity to develop a completely new type of expertise at UNIGE, which is now widely recognized internationally. Based on the success of INTEGRAL, UNIGE started similar activities for a number of different space projects linked to astrophysics, among which the ESA missions Planck, Gaia, CHEOPS and Euclid.

The participation in this project has been largely funded through specific programs of the Swiss Space Office of the Confederation. However, the need for a dedicated infrastructure linking the different projects has been realized very early, as soon as participation in another large project, namely Gaia, has been secured. A minimal infrastructure has been put in place to optimize the synergies between the different projects at all possible levels. These synergies range from administrative management of the project, computer system administration, software and web services, to the software tools and approaches used in the development of such activities. The first goal of the CDCI is to ensure that a stable and efficient infrastructure can be offered to all projects of data center developments for astrophysical space missions. The CDCI, being driven by scientific competence, is also an opportunity to extend the data center activities to any other domain related to astrophysics, like astroparticle and cosmology, including ground-based facilities.

The CDCI shall offer its services to all Swiss scientists interested in participating in data center activities. In the early-development phases, before a dedicated team can be put in place, the CDCI will offer support to the scientists in the preparation of the Swiss contribution to the proposed missions, including the negotiations with the different partners and the preparation of the proposals. Different models of interactions between the team and the CDCI can be put in place, depending on the specifics of the project, and the proximity of the team in particular.

Another task of the CDCI is to cope with the post-operational phase of the missions in which it has been involved. The INTEGRAL mission may be terminated within the next 2-4 years. However, the value of the INTEGRAL data will survive several to many decades longer. The CDCI shall not only maintain the data archives of past missions, but also preserve the knowledge of how to exploit their scientific content. This includes both the preservation of the software that has been specifically

developed for the data analysis, but also the development of higher-level data abstractions, enabling the future users to access the data with little effort.

b. International level

Being at the service of missions that are most often the result of large international collaborations, the activities of the CDCI are very relevant on the international scene. Current activities are mostly concerned with space missions under the leadership of ESA or with ESA participation, and are therefore linked to most European countries. These missions often have participations from other space agencies, like NASA (U.S.A), JAXA (Japan) or China. Participation in data center activities for ground-based facilities could further extend international collaborations to new countries, in particular in South America (CTA), Oceania (SKA) and India (CTA and SKA). The activities supported by the CDCI play a large role in the international visibility of Switzerland in these projects (cfr inventory, Annex B).

c. Development prospects

Data center activities started with a unique mission, INTEGRAL. The University of Geneva and its Swiss partners have been very successful in obtaining significant participations in several space missions either in operation (INTEGRAL, Planck, Gaia) or in development (CHEOPS, Euclid). Additional participations in future ESA missions are likely (Medium-size missions M4 and M5) or already well established (Large-size missions L2 Athena and L3 eLISA). Several projects are currently in discussion with China. For ground-based facilities, the participation in CTA is already well advanced. In view of the foreseen significant increase in the scope of the data center activities for astrophysics missions in Switzerland, the establishment of the CDCI shall ensure the sustainability of these activities on the long term.

d. Costs (in CHF)

L'UNIGE s'engage financièrement à contribuer à ce projet dans la mesure de ses capacités financières ce, en partenariat avec la Confédération, en comptant notamment sur le soutien financier dont elle pourrait bénéficier dans le cadre de l'appel FRI 2017-2020. Faute de financement pérenne de la part de la Confédération, l'UNIGE ne pourrait s'engager à financer à part égale les trois infrastructures dont elle a la charge. C'est pourquoi l'UNIGE a priorisé les projets en estimant indispensable de financer le Common Data Center Infrastructure (CDCI), puis le Cherenkov Telescope Array (CTA), enfin en troisième lieu le Square Kilometer Array (SKA).[2]

	Total costs	**Confederation**	**Canton**	**Other**
2017-2020	5.41 Mio.	1.865 Mio. PGB	2.925 Mio. (UNIGE)	0.62 Mio.
2021-2024	*tbd*	*tbd*	*tbd*	*tbd*

[2] The SERI will review Swiss participation in these two RIs, CTA and SKA, as part of the overall review of multilateral research infrastructures during the 2017-2020 ERI period. For further information, see Chapter 2 of this Annex.

19. Center for biomedical research in space

Category: Instruments and service infrastructure

Host institution(s): Lucerne University of Applied Sciences and Arts, Center of Competence in Aerospace Biomedical Science & Technology (CC ABSaT)

Main funding sources: Internal funding

Description / Development prospects

a. National level

Overview

The Center of Competence in Aerospace Biomedical Science & Technology (CC ABSaT) is planning to establish a new research infrastructure called "**Center for Biomedical Research in Space**" **(CBRS)**. The unique CBRS will allow easy and uncomplicated access to low gravity research platforms for researchers, industry, and individuals in education. Such a progressive center does not yet exist in Switzerland, but does in Europe. The CC ABSaT already maintains a registered ground based facility of the European Space Agency ESA and in this function, it is offering the instruments to conduct experiments under simulated/short-term microgravity conditions to researchers from all over Europe. The aim now is to include our status on a national level and thereby promote microgravity research among scientists, companies and schools in Switzerland.

Detailed description

The core service of the CBRS provides access to several types of ground-based microgravity research platforms like the Random Positioning Machine (RPM), parabolic flights performed by the Swiss Air Force and sounding rockets (Fig. 1, in green). Later on, additional microgravity research platforms will be added like "magnetic levitation", "drop tower" or flights with space carriers of companies like "Swiss Space Systems" or "Virgin Galactic".

Supplementary, the CBRS services include the use of biological laboratories as well as dedicated e-infrastructures (Fig. 1, in gray). The laboratories are of particular use for scientists who are investigating time-critical processes that require immediate post-processing after microgravity exposure. Goal of the e-infrastructure on the other hand is mainly to create a permanent service data infrastructure that responds to the needs of exploitation of intensive data production under simulated and short-term microgravity conditions as well as to establish a flexible, extensible state of the art service infrastructure that is able to provide support during the entire science work cycle including establishing research objectives and road maps, analyzing scientific data and preparing scientific papers.

The CBRS will be a non-profit center that is part of the legal entity of Lucerne University of Applied Sciences and Arts, School of Engineering & Architecture. The center will be available to everyone who is interested in conducting biomedical research under reduced gravitational loads. There will be an outreach program in place to gain maximal visibility to the related science community as well as to the public.

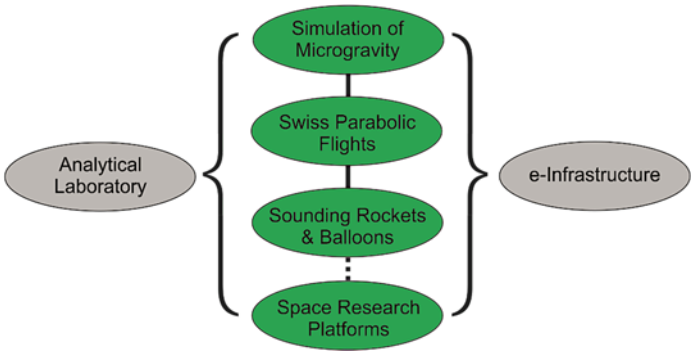

Fig. 1. Services provided by the Center for Biomedical Research in Space (CBRS).

b. International level

In the year 2000, the former Space Biology Group of ETH Zurich, (today the CC ABSaT) was appointed as one of the few official ground based facilities of the European Space Agency ESA. Since then, we have been hosting international research groups for conducting their studies multiple times per year. The service we are providing by making our infrastructure available to them is being paid but also honored by mentioning it in scientific publications as well as in presentations at symposia or conventions.

Being able to establish the CBRS and thus expanding the services further, as described above and illustrated in Fig. 1, will attract even more researchers to conduct their experiments in our center.

c. Development prospects

The RPM is a frequently used instrument all over the world for investigating micro-gravity effects on biological systems. This is reflected in the steadily increasing number of reports published every year in scientific journals that are making use of the RPM. Thus, the CBRS aims at providing enough RPMs for the scientists first and second adding new features to the RPMs like taking microscopy pictures while in operation. This will broaden the operative range of the RPMs substantially, which increases the attractiveness of this instrument even more. Therefore, technological development will be fostered to incorporate more and more analytical tools into the RPM. For doing so, cooperations will be established with leading Swiss research groups in technology and with the industry. There is no doubt that such technological development will end in space or in terrestrial applications. Not only the RPM but other microgravity research platforms will be promoted similarly.

In order to keep up with the demands of scientist on e-infrastructure, substantial effort will be put into establishing and maintaining a database that offers the latest features to their users.

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton**	**Others**
2017-2020	0.6 Mio.	0.2 Mio. PGB	0.2 Mio.	0.2 Mio.
2021-2024	*0.75 Mio.*	*0.3 Mio. PGB*	*0.113 Mio*	*0.337 Mio.*

20. The future of dark matter detection with liquid xenon XENONnT and DARWIN

Category: Instruments

Host institution(s): University of Zurich (Prof. L. Baudis, Prof. B. Kilminster), University of Bern (Prof. M. Schumann)

Main funding sources: SNFS (FLARE), Contributions in kind by Swiss Universities, Horizon2020

Description / Development prospects

Worldwide, the construction and operation of an ultimate detector for direct dark matter detection is considered to be among the highest priorities in experimental astroparticle physics. The proposed research infrastructure, the DARWIN (DArk matter WIMP search with Noble liquids) Observatory, is expected to ddress the nature of dark matter in the Milky Way via various WIMP interaction channels (spin-independent, spin-dependent, inelastic) and to open new research opportunities. Examples are alternative dark matter candidates such as solar axions, galactic axion-like particles, sterile neutrinos with masses in the 100 keV range, or bosonic SuperWIMPs, the real-time direct detection of low-energy solar pp-neutrinos with 1% statistical uncertainty, the fundamental nature (Dirac versus Majorana particle) of neutrinos, and the detection of supernova neutrinos. The direct dark matter search via collisions of dark matter particles with atomic nuclei is highly complementary to indirect searches with AMS, CTA and IceCube and with direct dark matter production at the LHC, and many of the new science channels complement independent experimental efforts in these areas by providing new information.

a. National level

Overview

The Swiss research community is strongly engaged in a series of highly successful direct dark matter detection experiments using xenon as target medium (XENON10, XENON100, XENON1T, XENONnT), with DARWIN being the ultimate detector in this chain. The international XENON programme is co-lead by Swiss groups. The DARWIN observatory was founded and is under the leadership of Swiss groups. Considering the excellent and unique science opportunities offered by the future DARWIN observatory, it is expected that the Swiss community will take advantage of this new research infrastructure and that additional Swiss groups will join the consortium in the future. The data will be equally available to all members of the consortium, and scenarios in which the data is made available to the entire physics community, at national and international level, after a certain time and in a simplified format, are under discussion.

Detailed description

The DARWIN observatory will most likely be located at the Laboratori Nazionali del Gran Sasso (LNGS) in Italy, at a depth of about 3600 m w.e.. The extension of the Modane Laboratory in France is also being considered, as it offers a depth of 4800 m w.e.and thus additional shielding against cosmic muons and secondary particles. The detector is based on the proven technology of a liquid xenon time projection chamber (TPC) housed in a double-walled, low-background cryostat, surrounded by a large water Cherenkov shield. The prompt scintillation light and the charge signals induced by particle interactions in the detection medium will be observed by sensitive, ultra-low background photosensors. The Swiss groups have ample expertise in a variety of techniques that are mandatory to build such a successful observatory for dark matter and other rare event searches: design, construction and operation of low-background, xenon-based TPCs, characterisation and radioactivity monitoring of high quantum-efficiency photosensors under cryogenic conditions, development of voltage-divider circuits for the photosensors, development and operation of data acquisition systems, development of light calibration systems, as well as low-background material screening and selection with high-purity Ge detectors operated underground. The Swiss groups also have a proven track record in terms of data analysis and Monte Carlo simulations for detector optimisation, background estimation and for analysis purposes.

b. International level

DARWIN is a research infrastructure of international relevance, and is listed with high priority on the European Astroparticle Physics (APPEC) Roadmap. In the current R&D and design phase, 22 Institutions from 10 countries (CH, France, Germany, UK, Israel, Netherlands, Portugal, Sweden, Italy,

USA) are part of the consortium, and additional groups are requesting to join. Several of the DARWIN institutions are collaborating within existing direct dark matter detection programmes, others bring in relevant expertise from related fields. A collaboration with a memorandum of understanding will be formed in the future. The website of the observatory provides more details: http://darwin-observatory.org.

c. Development prospects

The current-generation detector XENON1T, operating a total of 3.3 t of liquid xenon (LXe), is under construction at LNGS and will be commissioned within 2015. Its upgrade to more than 7 t of LXe mass, XENONnT, will re-use most of the infrastructure that was built for XENON1T and is in advanced planning stage. DARWIN will greatly extend the reach of XENON1T/nT in direct dark matter detection and will open up access to other science channels. DARWIN will either discover dark matter particles, or, if discovered with XENON1T/nT, measure their fundamental properties such as mass, interaction strength and possibly spin with high statistics. It will operate a 20 t LXe TPC and currently it is in the R&D and design phase. The ongoing projects focus on new light and charge signal detection concepts and their associated electronics, on purification of the noble liquid target, on identification of ultra-clean construction materials, on the development of calibration procedures, and on precise measurements of the light and charge response of noble liquids, among others. Significant progress is to be made on all these topics in order to be able to build and operate DARWIN.

Timeline: XENON1T will start taking science data by the end of 2015, until 2018, when the underground installation of XENONnT will commence. The DARWIN R&D and design phase will end by 2019, after which the construction phase of the various sub-systems will start.

The detector will be installed and commissioned underground starting in 2021, with a first science run to start by 2023. The facility would be operated for at least 5 years, thus until 2027, possibly longer.

d. Costs (in CHF)

The “total costs” refer to the total estimated costs of the project, including Swiss and international contributions. Because Switzerland is leading the project, we aim to contribute with more than 10% to the overall costs. The amount of “Others” contributions will depend on the funding level that can be achieved with RI proposals to the Horizon2020 framework, or other third-party funding.

	Total costs	**Confederation**	**Canton**	**Others***
2017-2020	20 Mio.	2.6 Mio. (SNF)	0.4 Mio.*	tbd
2021-2024	*35 Mio.*	*3.6 Mio. (SNF)*	*0.56 Mio.*	*tbd*

* in-kind contribution by universities and/or host institutions, i.e. the (university) pediatric hospital

21. Swiss Center for Musculoskeletal Biobanking and Imaging and Clinical Movement Analysis

Category: Technology Competence Centre

Host institution(s): Balgrist Campus AG

Main funding sources:

Infrastructure: Donations (51%), Lottery Fund (11%), SERI (19%), Loans (19%)

Yearly running cost: Rental income (69%), SERI (31%)

Description / Development prospects

a. National level

Overview

Balgrist Campus is an initiative of a foundation (www. resortho.com) dedicated to contribute to the creation of an optimal infrastructure for academic musculoskeletal research and education and the over one hundred year old "Schweizerischer Verein Balgrist" (www.balgrist.ch), a non for profit organization with the mission to improve the care of the musculoskeletal patient. Balgrist Campus aims at establishing a Swiss platform for at least nationwide, collaborative research, development, and translation in the field of musculoskeletal science and medicine. It will bring these elements beneath a single roof to channel scientific research to the benefit of musculoskeletal patients of today and tomorrow. The goal is to close the loop between understanding of musculoskeletal disorders, the development of new modes of diagnosis and treatment, and translation to the patient. The core facilities of this musculoskeletal research and development center will include basic infrastructure for biomechanics, biomedical device prototyping, human movement analysis, molecular and cellular biology, and multi- scale imaging. For core infrastructure, we seek SERI funding for the following centers:

Swiss Center for Musculoskeletal Biobanking (SCMB): This platform will form the hub of a nationally accessible (multi-center clinical) network for the indexing, archiving, analysis, and cataloguing of anonymous but well documented human tissue.

Swiss Center for Musculoskeletal Imaging (SCMI): A diagnostic imaging research core facility that leverages the world-leading musculoskeletal radiology center at the University Hospital Balgrist, and its existing collaborations with leading Swiss molecular imaging groups.

Swiss Center for Clinical Movement Analysis (SCMA): Is a center dedicated to functional analysis of musculoskeletal tissues based on movement analysis.

These elements form three pillars of a scientific center that will serve as an open-access repository for patient specific data and derivative analytics and as an open access research infrastructure for musculoskeletal disorders of large socioeconomic importance to Switzerland.

Detailed description

Balgrist Campus fills a big gap in the Swiss research landscape by providing an environment dedicated to connect patient, academic research and the relevant, related industry. Its association with a leading academic clinical center holds large potential for addressing the burden of age-related (neuro-) musculoskeletal diseases, by serving as a national hub for basic and applied research as well as for the development and validation of newly developed strategies of prevention, diagnosis and treatment of musculoskeletal injury and disease.

This project is at least of national importance: Approximately 18% of all Swiss hospitalizations are directly related to musculoskeletal disorders. The project therefore focuses on a subject of worldwide socio-economic relevance, and has the potential to contribute to relieve the burden of musculoskeletal disease; Switzerland is particularly suited to serve this purpose as modern orthopedic medicine has largely been shaped by Swiss academic leaders, but also by the extraordinarily developed Swiss biotechnological industry. Today, Switzerland remains a global power in musculoskeletal research and development attracting world renowned physicians as researchers and engineers. Balgrist Campus intends to consolidate this national strength and substantially build upon it.

Balgrist Campus has already attracted a number of research groups from across Switzerland as well as industrial partners who can translate findings into clinical application. This setting is envisioned to incorporate partners from research hospitals that will contribute to, and profit from, multi-center studies, including the targeted banking of patient tissues for thorough molecular (genetic, proteomic) and cellular characterization. The research network will include engineers, clinical scientists, epidemiologists, and others seeking to understand musculoskeletal injury and disease, and translate gained understanding into viable clinical solutions. Research infrastructure within the Balgrist Campus (large equipment; access to banked biological specimens and related analytical data, high tech research tools) will be made available to external Swiss research institutions on a cost-neutral basis.

In contrast to other national research institutions, the Balgrist Campus will exclusively and strategically focus on musculoskeletal disorders - a fact which makes the Research Infrastructures within the Balgrist Campus particularly well suited and uniquely powerful. The base of this power comes both from the physical connection of the Campus to major Swiss Orthopaedic and Paraplegic clinical centers, and as well as from an already existing critical mass of musculoskeletal research and development in Zurich.

b. International level

The proposed infrastructure and the unique proximity to the clinical environment and well documented patient data repositories would draw international scientist to the Campus. The Campus seems to have gained recognition and acceptance in the global orthopedic community having already attracted prospective tenants from Germany and Canada.

c. Development prospects

Balgrist Campus is currently under construction, slated for completion in summer 2015 and rapid commissioning by November 2015. Sufficient and well-suited space (over 300 m²) in the Campus has been committed by Balgrist Campus AG to accommodate the requested Research Infrastructures.

Long-term outlook with respect to potential collaborations and the integration of the new RI into the development of the host institution: The Balgrist Campus represents an enabling element for the research arms of Swiss Universities. The ETH Zurich, the Balgrist University Hospital and the University of Zurich are planning to permanently relocate personnel and infrastructure in to the Campus in late 2015, for example: Orthopedics (Chairman Prof. Christian Gerber; Muscle Plasticity (Prof. Martin Flück), Orthopedic Biomechanics (Prof. Jess Snedeker, joint chair UZH/ETH), and musculoskeletal tumor research (Prof. Bruno Fuchs); Paraplegiology (Chairman Prof. Armin Curt), Rehabilitation Robotics (Prof. Robert Riener, ETH), Rehabilitation Engineering (Prof. Roger Gassert, ETH), SNSF Chair Mobile Health Systems (Prof. Walter Karlen) and Musculoskeletal Radiology (Chairman Prof. Christian Pfirrmann). The Campus will become a nationwide center and accessibility for outside users is guaranteed by the governance structure with an international scientific advisory board which will competitively allocate space and resources. The Campus will increase the national and international visibility of these already recognized groups, and the University/ETHas a world-leading focal point for musculoskeletal science and medicine.

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton**	**Others**
2017-2020	104.8 Mio.	23.1 Mio. (Art. 15 FIFG)	9 Mio.	72.7 Mio.
2021-2024	*27.5 Mio.*	*8.6 Mio. (Art. 15 FIFG)*	*0 Mio.*	*18.9 Mio.*

22. SwissPedNet – Swiss Research Network of Clinical Pediatric Hubs

Category:

Service infrastructure (Data / Service Centers: Clinical research specific services)

Host institution(s):

- University of Basel, Prof Dr med Urs Frey
- University of Bern, Prof Dr med Christa Flück and Prof Dr med Claudia Kühni (ISPM)
- University of Geneva, Prof Dr med Claire-Anne Siegrist
- University of Lausanne, Prof Dr med Andrea Superti-Furga
- University of Zurich, Prof Dr med David Nadal
- Cantonal Hospital Aarau, Prof Dr med Henrik Köhler
- Cantonal Hospital Luzern, PD Dr med Johannes Rischewski
- Children's Hospital of Eastern Switzerland, PD Dr med Jürg Barben

Main funding sources:

State Secretariat of Education, Research and Innovation (SERI), host institutions (in-kind contribution)

Description / Development prospects

a. National level

Overview

The SwissPedNet is a nation-wide research organization consisting of a central coordination office, a central infrastructure for registries, and Clinical Pediatric Hubs located at the eight largest (university) pediatric hospitals of Switzerland.

Each Pediatric Hub has age- and development-adequate infrastructures (clinical facilities for children) and is staffed with pediatrics-trained personnel, guaranteeing the quality aspects for research in children.

Detailed description

While being dedicated to children, Pediatric Hubs are locally closely linked to Swiss Clinical Trials Organization (SCTO) Clinical Trial Units (CTUs), sharing non-pediatric-specific aspects of clinical research with the corresponding facilities for adults. To allow for resource saving synergies, the central office of the SwissPedNet is located within the SCTO Executive Office.

SwissPedNet will be able to integrate and support most of the existing, disease- or organ-specific research networks and pediatric cohorts in Switzerland and thus to achieve further efficiency and to address the manifold aspects of clinical research. Several interfaces/links with already existing and proposed infrastructure, organizations and projects are already established or ready for cooperation.

The overall objective of this proposal is to further develop, professionalize and fortify the national structures (coordination office, registry center) and the existing Pediatric Hub structures. We apply for salaries for research associates and pediatric study nurses at each Hub. These positions are a prerequisite to guarantee good clinical practice (GCP) compliance and assure all quality and safety aspects within clinical pediatric research. In addition, SwissPedNet needs salaries for central functions. This includes salaries for the pediatric registry center, for a database IT specialist, a post-doc position and administrative staff. The SwissPedNet coordinator (coordination office) is employed at the SCTO Executive Office, his/her salary is applied for by the SCTO.

b. International level

SwissPedNet is member of Enpr-EMA, the European Network of Paediatric Research at the European Medicines Agency, since February 27, 2013. Enpr-EMA works by allowing networking and collaboration with members from within and outside the European Union (EU), including academia and the pharmaceutical industry.

SwissPedNet will join an international application to the ESFRI Roadmap 2016 to become part of the European Paediatric Clinical Trial Research Infrastructure EUPCTRI.

SwissPedNet collaborates with the working groups of **StaR Child**, Standards for Research in Child Health. StaR Child is based in Canada and develops modern guidance for pediatric clinical research with international working groups.

c. Development prospects

SwissPedNet can actually serve as a partner for all investigator-driven research, such as clinical, epidemiological, clinical experimental or interventional, and translational research projects, systems medicine, Transmed, and other translational research initiatives.

d. Costs (in CHF)

	Total costs	**Confederation**	**Canton**	**Others**[1]
2017-2020	14.485 Mio.	7.4 Mio. (Art. 15 FIFG)		7.085 Mio.
2021-2024[2]	*14.485 Mio.*	*7.4 Mio.(Art. 15 FIFG)*		*7.085 Mio.*

[1] in-kind contribution by universities and/or host institutions, i.e. the (university) pediatric hospitals
[2] these figures have not yet been determined

23. BioMedIT "Information and computational service infrastructure network to support biomedical research in Switzerland"

Category: Information and service infrastructures

Host institution(s): **SIB Swiss Institute of Bioinformatics (SIB)**, in collaboration with: Universität Basel, Université de Lausanne, Haute Ecole Spécialisée de Suisse occidentale HES-SO, Universität Bern, Universität Freiburg, Université de Genève, ITS-SIS at ETH Zürich, S3IT at Universität Zürich and the Swiss Tropical and Public Health Institute STPH.

Main funding sources: Structural funds by participating universities and associated university hospitals, direct contributions by large scale research projects; State Secretariat of Education, Research and Innovation (SERI)

Description / Development prospects

a. National level

Overview

We live in one of the most profound periods of advancement in biology and medicine. Over the last decade, new disruptive technologies (e.g. in genetics, genomics, imaging, proteomics, microfluidics, nanotechnologies, portable/implantable measurement devices, etc.) have changed the paradigms for biomedical research and are about to fundamentally transform healthcare and medicine. In order to enable the translation of the wealth of data produced by such modern technologies into medical practice and new treatments, strong capabilities in clinical bioinformatics, computational biology and computational service infrastructure are required. The analysis of clinical and health related data will also raise interesting new questions for fundamental research.

Health related research is of utmost importance from a societal perspective, but when it comes to merging and interpreting basic and clinical research data, the Bioinformatics and IT challenges are large. The BioMedIT proposal aims to establish a coordinated nationwide network of secure infrastructures to support computational biomedical research, including biobanking and clinical bioinformatics. The proposal builds on existing expertise and research infrastructure in the partnering institutions ranging from Bioinformatics and IT competence centers, omics-based fundamental and epidemiological research, biobanking, clinical records and trials, genomic medicine to multimodal data analysis, including medical imaging.

Detailed description

Most current ICT facilities at Swiss universities are tailored towards handling basic research data. Biomedical research aiming at translating from basic research to new innovative approaches in clinical practice and healthcare imposes very high requirements to the IT infrastructure and expertise, which differ substantially from all-purpose research infrastructures. We therefore need to widen the scope of the available infrastructures to fulfil the stringent requirements for technologies and policies on anonymization and codification strategies, prevention of deductive disclosure, secure data encryption, access control and tamper-resistant hardware infrastructure which are required in a clinical research setting.

The proposed "Data/Service Center" Research Infrastructure (RI) network for an information and computational service infrastructure for biomedical research in Switzerland (BioMedIT) builds on top of the centers of expertise established at the various partner universities, ETHs and hospitals. We intend to gather activities of all Swiss universities and major hospitals, coordinated similarly to the way bioinformatics is coordinated by the SIB Swiss Institute of Bioinformatics for Switzerland. BioMedIT will be organized as a project within the SIB, with the „BioMedIT Strategy Board" defining the strategy of the project, and an „International Advisory and Review Board" overseeing and evaluating the implementation. The implementation of the project within the SIB leverages existing collaborative relations with the partner institutions and avoids setting up additional administrative structures.

b. International level

At the international level, several similar research infrastructures are currently being built up in the USA, Belgium, Estonia to name a few. Like the RI we are proposing, foreign examples leverage upon

already existing infrastructures and bring them together in a consortium (similar to the one proposed in here). Translational biomedical research requires the seamless integration of large data collections in order to be able to gain statistically significant results. In order to achieve the goals of personalized medicine and to reach datasets of sufficient size, national and international collaborations in this area are essential to. Important international initiatives with related aims are the biomedical ESFRI research infrastructures such as ELIXIR, EATRIS, ECRIN, BBMRI,INSTRUCT. For personalized data, the epSOS' policy support program is federating all European Electronic Health Records, including Switzerland. The SIB represents the Swiss node of ELIXIR – an initiative to coordinate Bioinformatics infrastructures in Europe - and is therefore the natural partner for interactions with these international initiatives.

c. Development prospects

The proposed BioMedIT research infrastructure project aims to establish a coordinated nationwide secure infrastructure network for computational biomedical research, including biobanking and clinical bioinformatics. The aims of BioMedIT are similar to the "Data Coordination Center" of the proposed "Personalized Health" initiative (PH-CC). In case of the implementation of the Personalized Health initiative, we therefore suggest to combine BioMedIT and PH-CC into a single organizational unit to ensure the efficient implementation of the project goals and to avoid parallel developments of similar structures.

d. Costs (in CHF)

	Total costs	**Confederation**	**Universities**	**Others (*)**
2017-2020	37.441 Mio.	18.5 Mio. (Art. 15 FIFG)	17.441 Mio.	1.5 Mio.
2021-2024(**)	*39.5 Mio.*	*19.75 Mio. (Art. 15 FIFG)*	*18.25 Mio.*	*1.5 Mio.*

(*) Expected direct contribution by large scale research projects.

(**) Assuming no significant increase of overall budget, taking into account annual salary adjustments and changes in age structure of personnel.

A.2 Participation in international research organisations that needs to be reviewed

In the upcoming 2017-2020 ERI period, Switzerland is reviewing participation in the construction and operation of new, multilateral research infrastructures based on international treaties. This review is based on the Swiss strategy in the field of education, research and innovation that was approved by the Federal Council in 2010. According to this, research infrastructures that were designated as priorities by the ESFRI Roadmap and those that meet a fundamental need in the Swiss research community in line with developed or planned research capacities in Switzerland should be considered. A review of this type is currently under way for the following three RIs, which have been featured in the ESFRI Roadmap since 2010. The review is due to be completed during the 2017-2020 ERI period. The Neutrino Physics Programme, which is planned as part of an international research organisation, is also set to be reviewed in this context.

24. ELI: Extreme Light Infrastructure (Laser facilities)

Legal framework: (current) Association without lucrative purpose (AISBL) (foreseen) European Research Infrastructure Consortium ERIC to be established in 2018

Main funding sources:

- Construction (till 2017): Host states contributions supported by EU structural funds
- Exploitation (from 2018): Host states' and member states' contributions

Funding projections till 2017 (CH-share in CHF): 0.5 Mio. (preparation fee)

Funding projections 2018-2020 (CH-share in CHF): 2.5 Mio.

Funding projections 2021-2024 (CH-share in CHF): 3.5 Mio.

Background and Development perspectives

ELI is being built until 2018 by its three host countries (CZ, RO, HU) relying on funding provided through the EU structural funds. Machines shall be ready to use from 2018 onwards. Construction costs amount to 850 Million Euro, fully paid by the EU and the host countries. Parallel to the building, future members of ELI grouped in an AISBL are preparing the statutes of the organisation managing the infrastructure, which shall take the form of an ERIC to be established in 2018. Joining the preparation of the statutes early on grants members many advantages, starting with the ability to write those statutes according to their interests. It costs 0.2 Million Euro per year for each of its member to take part in the AISBL. Once the ERIC is established, its Member states will share the operating costs of ELI, estimated at 80 Million Euro per year.

The Swiss research community interested in ELI is organized through a SNF National Center of Competence in Research (NCCR) called MUST, launched in 2010. MUST brings together 18 Swiss research groups working in Ultrafast Science across the fields of physics and chemistry. This research field has reached a critical mass in Switzerland since then, and deeper international involvement and use of the best facilities worldwide is considered crucial by the researchers. Construction of medium sized laser infrastructures is being planned at ETHZ (FastLab) as well as at EPFL (Lacus), to be operational before 2020. Taken this development into account, NCCR MUST has sent a letter to SERI in March 2016 for expressing interest in collaborating and securing access to ELI, as it would allow Swiss researchers to access the ultimate level of laser performance. They also underlined the need to network facilities in Switzerland within this international endeavor.

A participation of Switzerland in the preparation of the ERIC statutes is being currently examined. Once the statutes will be ready, participation of Switzerland in ELI would be negotiated with the international partners and formalized through an appropriate decision-making process.

25. CTA: Cherenkov Telescope Array (TeV astroparticle physics facility)

Legal framework: (foreseen) German company GmbH to be established in 2016

Main funding sources: Host states' and member states' contributions

Funding projections 2013-2016 (CH-share in CHF): 0 (participation fee for the preparation phase is paid by participating Swiss institutions)

Funding projections 2017-2020 (CH-share in CHF): 8 Mio.

Funding projections 2021-2024 (CH-share in CHF): 8 Mio.

Background and Development perspectives

CTA is a joint international research endeavor under preparation involving currently 13 countries. It shall comprise one observatory site in the south hemisphere and another one in the north hemisphere. Site selection and shall be achieved by 2016. Construction will start then based on an international funding agreement. Construction costs are currently estimated at 200 MEuro, while for the operation about 16 Million Euro will be needed per year. As soon as the construction of CTA will be ready to start, presumably in 2016, an international funding agreement will have to be signed from all the countries wishing to take part, at the government level.

Swiss groups (University of Zurich, University of Geneva, ETHZ) became interested and joined the collaboration in 2007, shortly after CTA had been listed as an emerging project in the ESFRI roadmap of 2006. Since 2009 the Swiss groups are supported by SNF for their participation in the CTA research and development. A Swiss Steering Board coordinates the Swiss involvement in CTA. It ensures communication between the Swiss representatives in the governing and advisory boards of CTA as well as within the Swiss CTA community. In 2012 a "Declaration of Interest (DoI) for the pre-construction phase" was signed by the funding agencies and ministries of 13 countries (of which 8 are European). Following a consultation led by the Swiss Institute of Particle Physics (GHIPP), involving SERI, the University of Zurich has been allowed to sign the DoI in July 2012. The countries which signed the DoI created a CTA Resources Board (RB) as the main government body of CTA, in which Switzerland is represented by University of Zurich. SERI supports this effort by taking part in the meetings of a subcommittee of the RB for administrative and financial affairs (AFAC) since 2013. It was recognized early on, that an Organization would be needed, which can act as the legal representative for deciding on the final sites of the CTA observatory. Thus, in 2014 a gemeinnützige Gesellschaft mit beschränkter Haftung (gGmbH) was founded by Germany, Switzerland and Italy, Switzerland again represented by UZH, relying on a written encouragement from SERI. The other DoI signatories will join the CTAO gGmbH soon, whereas several other countries also are interested in joining. The mandate of the CTAO gGmbH is strictly limited to works preliminary to the construction.

Participation of Switzerland in the preparation of CTA is already ongoing, under the full responsibility of the Swiss research groups involved. Once the international funding agreement will be ready, participation of Switzerland in CTA would be negotiated with the international partners and formalized through an appropriate decision-making process.

26. SKA: Square Kilometer Array (Radio telescope)

Legal framework: Not defined yet

Main funding sources: Host states and member states contributions

Funding projections 2013-2016 (CH-share in CHF): 0

Funding projections 2017-2020 (CH-share in CHF): 20 Mio.

Funding projections 2021-2024 (CH-share in CHF): not defined yet

Background and Development perspectives

SKA is a joint international research endeavor under preparation involving currently 11 countries. Site selection has already been achieved. SKA shall comprise one observatory site in South Africa and one other in Australia SKA shall be built in two phases. SKA Phase 1 is planned for construction 2017-2020 and will consist of a dish array in South Africa and a low frequency array and a dish survey instrument in Australia. Its cost is capped at 650 MEuro. The full SKA Phase 2 has a cost cap of 1500 MEuro and will comprise thousands of dishes and millions of radio antennae across Africa and Australia. It seems that only SKA Phase 1 is secured internationally. A lot of preparatory work still needs to be completed in any case.

Within Switzerland, there is no established infrastructure for the radio astronomy covered by SKA - no leading house or national radio observatory. Some thought would be required in Switzerland as to how to organize a Swiss participation. The potential user community is large and comprise all astronomers in the country, but the established user community for the radio astronomy covered by SKA is at present very small. However, enthusiasm of the Swiss astronomy community for SKA has been communicated to the Swiss authorities.

The development of SKA shall be closely monitored, although a participation of Switzerland from now on is not recommendable. Should the user community reach a critical mass in Switzerland, an active involvement in the preparation of SKA shall be considered further. This could take place during the financing period 2017-2020. Participation of Switzerland in SKA would be then negotiated with the international partners and formalized through an appropriate decision-making process.

27. Neutrino Physics Program at Fermilab (Chicago, USA)

Legal framework: (foreseen)

The legal framework for physics programs at Fermilab (Fermi National Accelerator Laboratory) consists in the participation of University groups in the experimental collaborations through a “Memorandum of Understanding”. Liaison between the projects, the international partners and the funding agencies are implemented through dedicated committees to mutually agree on the contributions and also act as controlling. There are developments that will lead in the next years to an evolution of this framework, which may involve a further internationalization of Fermilab that foresees support from international funding agencies to the laboratory. The U.S. Department of Energy (DOE) could also act as intermediary and possibly follow up on agreements at the federal level.

Main funding sources: (Host states’ and member states’ contributions)

Fermilab is operated by the Fermi Research Alliance and its budget provided by the U.S. DOE. The funding of common infrastructures to experiments and operation is covered in part by Fermilab as the host laboratory and by a “common fund” specific to each international collaboration with contributions agreed with the participating institutes / funding agencies. Depending on the evolution of the legal framework, additional international funding channels would open through agreements between the host and international partner states.

The Swiss contribution to the Fermilab program is currently covered by a combination of SNSF research grant funds, the FLARE instrument and University funds.

A coordinated contribution to the Fermilab infrastructure would allow to fully exploiting the neutrino physics program.

Funding projections 2017-2020 (CH-share in CHF): 4 Mio. CHF

Funding projections 2021-2024 (CH-share in CHF): 5 Mio. CHF

Background and Development perspectives:

The P5 (Particle Physics Project Prioritisation Panel, HEPAP, Office of Science, DOE) report “Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global Context”, May 2014, recommends Fermilab and the U.S.A. to develop and host a global program in neutrino physics in collaboration with international partners (e.g. CERN). The report received very strong support from the worldwide community and Fermilab is aligning the mission of the laboratory with the P5 recommendations.

An approved Short-Baseline Neutrino Physics Program (SBN) is ongoing at Fermilab with three experiments, with Swiss interest and participation in SBND and MicroBooNE.

The planned construction of a Long-Baseline Neutrino Facility (LBNF) takes shape with the newly founded international collaboration Deep Underground Neutrino Experiments (DUNE).

In view of an international long-term planning, there is a clear interdependence among the actual Short-Baseline (SBN), future Long-Baseline (LBNF, DUNE) and also CERN based test experiments.

The Swiss neutrino physics community is actually preparing a White Paper with respect to the coordination and definition of priorities for the Swiss interests and participation in neutrino programs and projects in the US, Japan, Europe and at CERN.

The White Paper will contain a strategy for the exploitation of all these programs. Swiss involvement will be driven by the R&D program currently being performed at CERN and in Swiss Universities, the current neutrino program at Fermilab and its evolution and by the unfolding of the physics landscape. Any funding decision in Switzerland shall be in-line with the recommendations in the White Paper.