ASPERA

Linking of existing infrastructures report

Acknowledgements
Stavros Katsanevas, CNRS - ASPERA Coordinator
Deborah Miller, STFC - Workpackage 2 Leader
Thomas Berghöfer, PT-DESY – Task 2.3 leader, Document Coordinator
Laura Metzger, PT-DESY – Document Coordinator
Christine Rülle, PT-DESY – Document Coordinator
Franz-Josef Zickgraf, DESY – Document Coordinator

ASPERA - 2009

1. Introduction

A key element of the ASPERA ERA-NET project is the creation of a roadmap for astroparticle physics in Europe. The conceptual design of the ASPERA work programme is laid out in a way that the bottom-up organised roadmap process is accompanied by a number of tasks defined in Workpackage 2 and 3 that shall help the funding agencies involved to set up a common action plan for the realisation of the roadmap priorities. This document provides the results of Task 2.3 entitled “Linking of existing infrastructures”.

The purpose of investigating linking of existing infrastructures within ASPERA is to foster sharing, distributing, and managing between existing institutions and to understand how the next generation of projects in astroparticle physics can be realised under conditions of limited funding and limited available resources. Clearly, it is important to maximise the use of all that exists, create a minimum of new structures, and try to avoid duplicating structures. The linking (or networking) approach for a new project can be considered as an alternative to a central host that is in charge of the action required to build a project. Depending on the project requirements, one or the other project structure - or even a mixture of both – might be advantageous.

At any rate, as far as science projects are concerned, linking should not be misunderstood as a possible method to force cooperation between collaborations or institutions. Collaboration building for a large science project is a process that should be initiated by the researchers themselves and be followed by funding agencies to assess whether the collaboration is able to build the project. Many successful science projects, especially in particle or nuclear physics, demonstrate that this process works and funding agencies should intervene only in difficult situations.

At about the time when the original work programme of ASPERA was designed, the collaborations of the major Gravitational Wave antennas in the world (LIGO incl. GEO and Virgo) prepared and signed an agreement to coordinate common R&D work, common observing strategies, and publication policies. The question for ASPERA at that time was: may this example of an obvious a posteriori linking of existing infrastructures serve as a model to foster collaboration between other experiments of the same kind?

In the case of the Gravitational Wave antenna collaborations the cooperation was driven by the fact that none of the antennas alone is able to measure gravitational waves and networking is absolutely essential. Furthermore, improvements to the sensitivity have to be made on all antennas and this can be achieved faster and possibly cheaper if the R&D work is coordinated in between the partners.

After a careful elaboration of this structure and discussions with spokespersons from a variety of experiments it became clear that such a procedure cannot simply be adapted to other collaborations. In situations where competition is an important driver of developments linking is definitely not the right approach and funding agencies should not force competing groups into collaborations. Furthermore, cooperation between unequal partners is difficult to achieve. All parties involved should be committed to the benefit of collaborating, and a cooperation agreement should reflect a win-win situation. Any collaboration or cooperation must be supported by the partners and an agreement can only provide some guidance in case of problems. For research groups working on similar topics that coordinate common measurements or cross calibrate their detectors and instruments from time to time, it may not be worth the time to work out a detailed cooperation agreement.

However, when research groups that are currently working on different projects decide to join in a collaboration to build a larger and more expensive project an a posteriori linking of existing infrastructures may serve as a starting platform even before the new project officially gets started. To maximise the benefit of such a linking process it is rather important to understand the initial conditions that are required to efficiently start with a big science project

The present document is structured as follows: Section 2 provides the reader with definitions of the terms used throughout the document. In Section 3, the method applied to carry out Task 2.3 is described in detail, whereas Section 4 lists the existing infrastructures above a certain size with interests in astroparticle physics and neighbouring fields that might be considered as strong partners to astroparticle physics projects. In Section 5 existing linking approaches are described and Section 6 provides a practical start-up guide concerning new infrastructures and linking. In a more general way it summarises the results of a best practice study in science project management, administration, and legal frameworks that has been accumulated during the course of Task 2.3. The conclusions in Section 7 are followed by appendices providing a glossary, a summary of the Berlin workshop dedicated to ASPERA Task 2.3 as well as a summary of lessons learnt from experienced project managers on issues for the start-up phase and management, and a compilation of management structures presented during this workshop.

In addition to the actual scope, this document may serve as a practical start-up guide for setting up new large projects in astroparticle physics and beyond. It can obviously not be complete and for a detailed introduction to project management the reader is referred to the literature dealing with this topic. ■

Contents

2. Definitions

The experience gained during several workshops, interviews, and discussions with scientists, project managers, and colleagues shows that for example the terms "infrastructure", "facility", "host", and "laboratory" are sometimes used as synonyms or can have completely different meanings. To avoid misunderstandings and to improve the readability of this document this section clarifies the use of some expressions in this document, which are used frequently in the context of research infrastructures. Note that this set of definitions may differ from definitions made by other authors or institutions; however, we tried to follow as close as possible definitions made by the European Strategy Forum for large Research Infrastructure (ESFRI) and the European Commission (EC).

2.1 Research Infrastructure (RI)

There are different ways to characterise RIs in the context of the European Research Area. We consider in the following the views of the EC, ESFRI, and European Research Infrastructure Development Watch (ERID-Watch).

According to the EC research infrastructure can be described as follows:
The term 'Research Infrastructures' refers to facilities, resources and related services used by the scientific community to conduct top-level research in their respective fields.

This can include i.e. singular large-scale research installations, collections, libraries, databases, highly distributed capacity and capability computing facilities, data infrastructure, telescopes, synchrotrons and accelerators, networks of computing facilities, as well as infrastructural centres of competence which provide a service for the wider research community based on an assembly of techniques and know-how.

Moreover, RIs help to create a new research environment in which all researchers - whether working in the context of their home institutions or in national or multinational scientific initiatives - have shared access to unique or distributed scientific facilities (including data, instruments, computing and communications), regardless of their type and location in the world.

ESFRI uses a broader definition by considering the fact that research infrastructures occur in different research areas. RIs are seen as
"… facilities, resources or services of a unique nature that have been identified by pan-European research communities to conduct top-level activities in all fields. Examples are libraries, databases, biological archives, clean rooms, communication networks, synchrotrons, accelerators, telescopes."

ERID-Watch describes the term «research infrastructures» as
… facilities and resources providing essential services to the research community in both academic and/or industrial domains. Research infrastructures may be «single-sited» (single resource at a single location), «distributed» (a network of distributed resources, including infrastructures based on grid-type architectures), or «virtual» (the service being provided electronically).

In this document we adopt the following view which is a selective synthesis of these descriptions adapted to the environment of astroparticle physics:

Research Infrastructures, which may be single-sited, distributed or virtual, are facilities, resources and related services used by the scientific community to conduct top-level research. A main characteristic of RIs is their ability to offer services to researchers to enable them to conduct their scientific work. This implies that RIs need to have a certain size to be able to offer these services, i.e. size is one of the relevant characteristics of a research infrastructure. It also means that a research infrastructure is a self-sustained institution with respect to the infrastructures necessary to support its own operations.

2.2 Laboratory

In the context of astroparticle physics (and particle physics as well) the term "laboratory" is often used as a synonym for "research infrastructure". Examples are CERN, which is called a "particle physics laboratory", and "underground laboratories" like Gran Sasso or Modane.

There is, however, also the "traditional" use of the term in the sense of a laboratory as part of a larger institution or research infrastructure which depends on the services and infrastructure of the higher-level institution. An example is a laboratory at a university institute. A laboratory of this kind would not be considered as a research infrastructure even if it is large in size.

In this document we use the term "laboratory" as a synonym.

2.3 Experiment

The meaning of the term "experiment" depends strongly on the context. An experiment can be a hardware construction itself, but also the effective research carried out. This term can describe the infrastructure at a whole, but also several small studies or tests at a large machine which can then be again an experiment itself or even an infrastructure.

2.4 Host

The host institution guarantees that the infrastructure necessary to support the research will be available. In particular, it provides the administrative framework. It can be a laboratory / research infrastructure where several researchers, a group of researchers or an experiment as a whole can be hosted. This means that they can be attached to the host in that way that they can use some of its facilities, infrastructure, staff, organisational structure etc. For example financial aspects could be organised by the host so that an extra department of the attached group regarding finances is not needed. This includes the possibility to directly benefit from the staff of the host, either technical or administrative.

2.5 Project

Basically, a project has to be distinguished from a standard duty or general operation. The following definition is extracted from the "Guide to the Project management Body of Knowledge (PMBOK Guide) Newtown Square 2000" (p.4):

"A project is a temporary endeavour undertaken to create a unique product or service."

"Temporary means that every project has a definite beginning and a definite end. Unique means that the product or service is different in some distinguishing way from all other products or services."

The main difference between general operations and projects is therefore that operations are ongoing and repetitive while projects are temporary and aim at a unique purpose. Thus the main characteristics of a project are duration and uniqueness.

These aspects are important to consider especially in the context of the new infrastructures in astroparticle physics because one of the critical issues is the lifetime of such an infrastructure.

2.6 Linking

The literal meaning of "to link" is "to merge" or "to bring together". In a broader sense "linking" can also have the meaning of "to interconnect", "to get in contact with something and to result in something new", "to join and to maintain something", "to combine a transaction or project with another transaction or project" or "to attach a transaction or project to another".

In general and in the context of this document, the meaning of "linking" thus is related to collaboration. This can either be collaboration between equal partners, such as universities or research infrastructures, or the collaboration between partners of a different level. The latter refers mainly to the collaboration between a host and a project partner.

In conclusion, often an overlap of different meanings of the terms defined above cannot be prevented. e.g. an institution might be a research infrastructure and a host at the same time. Therefore it is important to include detailed definitions of these terms which are appropriate in the respective context dealt with in a Memorandum of Understanding (MoU). This helps to prevent confusion and misunderstanding stemming from different interpretations. ■

3. Method

To obtain a complete picture of all the important managerial, administrative, financial, and legal aspects concerning the successful realisation of large projects and to study the aspects of linking in terms of sharing, contributing, and managing, ASPERA organised an initial workshop on October 26, 2007. Experienced project managers and those who plan to set up new large projects in astroparticle physics were invited to come to the headquarters of the Helmholtz Association in Berlin for an initial exchange of experiences and requirements of large science projects. To help the participants in preparing their contributions to the workshop the following set of guidelines has been put together and sent to the participants prior to the workshop:

Guidelines for Participants:

… for those who have already set up a large project in the past

1) What size does your project have in terms of Personal, Financing, Construction…

2) How long did it take to set up a project?

3) What kind of information, experiences, circumstances … helped in doing this?

4) Imagine you could start again – what would you do differently?

5) What big difficulties would you mention in the different phases of planning, set up, operation?

… for those who plan to set up a new large project in the near future

1) Which ideas do you and your colleagues in your country have concerning the new experiments on the Roadmap?

2) Which management do you think you might need for these projects?

3) Which financial size do these projects (preparation, construction, maintenance and operation) have?

4) Which steps are already planned? Preparation, Construction, Maintenance, Operation…

5) Which SPECIAL requirements do you need for a certain project?

The following list provides the names, projects, functions, and organisation of project managers who attended the workshop:

Name	Project	Function	Organisation
H. Araujo	ELIXIR	ELIXIR representative	Imperial College London
G. Drexlin	KATRIN	KATRIN spokesman	FZ Karlsruhe
W. Hofmann	H.E.S.S.	H.E.S.S. spokesman	MPIK Heidelberg
H. Kraus	EURECA	EURECA spokesman	University of Oxford
M. Mariotti	MAGIC	MAGIC representative	INFN, Univ. of Padua
F. Menzinger	EGO	EGO director	EGO Cascina
T. Niinikoski	EURECA	EURECA representative	CERN
Y. Petroff	ESRF	former director	ESRF Grenoble
I. Siotis	KM3NeT	DS WP8 coordinator	Demokritos Athens
C. Spiering	IceCube	IceCube spokesman	DESY
K. G. Strassmeier	LBT	LBT representative	AIP Potsdam
M. Teshima	MAGIC	MAGIC spokesman	MPI für Physik, Munich
J. Yeck	IceCube	project director	Univ Wisconsin, Madison
A. Zalewska	LAGUNA	LAGUNA representative	Inst of Nucl Physics, Cracow

Based on the outcome of the Berlin workshop (a summary of the workshop results can be found in Appendix A.2) it was decided to further extend the study by a series of interviews with selected science project managers, especially those who follow a kind of linking approach to realise their projects that goes beyond the usual collaborative approach. It turned out that compared to a workshop surrounding an interview allows a much deeper and more detailed discussion especially if the person is interviewed in their home institution. The above listed guidelines for the participants of the Berlin workshop were used to prepare the interviews. The following table summarises the interviews that have been conducted during the course of Task 2.3:

All the information obtained during the workshop and the interviews was sorted, categorised, and processed in this report. A summary of lessons learnt from these interviews and the Ber-lin workshop focussing on issues for the start-up phase and management is provided in Appendix A.3.

Furthermore, during a COMAG meeting held on October 6, 2008, members of ASPERA had the opportunity to be informed on the activities of COMAG (Coordination and Management Committee of the European Underground Labs) and exchange ideas for the future of this network (see Section 5.3). ■

Date	Interviewed Person(s)	Function	Organisation
Oct. 4, 2007	G. Drexlin	KATRIN spokesman	FZ Karlsruhe
	M. Neuberger	Projects Central Department	FZ Karlsruhe
Oct. 5, 2007	P. Jenni	ATLAS collab. spokesman	CERN
	M. Nordberg	ATLAS resources manager	CERN
Oct. 5, 2007	M. Tiirakari	Group leader logistics serv., finance department	CERN
Dec. 4, 2007	S. Lettow	CFO	CERN
Feb. 26, 2008	M. Basbilir	Head of project management	ESO
Mar. 12, 2008	M. Tarenghi	ALMA & ex-VLT director	ESO
Mar. 13, 2008	P. Mantsch	Auger project manager	Fermilab

4. Existing national and international infrastructures

This section describes infrastructures above a certain size with interests in astroparticle physics and neighbouring fields that might be considered as strong partners to astroparticle physics projects and may play a role for hosting new experiments.

4.1 International infrastructures with interests in astroparticle physics or neighbouring fields

4.1.1 CERN (European Organisation for Nuclear Research)

CERN, established in 1954, is the world's largest particle physics laboratory, situated in the northwest suburbs of Geneva. The organisation has twenty European member states: Belgium, Denmark, Germany, France, Greece, Italy, Norway, Sweden, Switzerland, Netherlands, United Kingdom, Austria, Spain, Portugal, Finland, Poland, Hungary, Czech Republic, Slovakia, and Bulgaria. Eight additional international organisations or countries have «observer status»: European Commission, India, Israel, Japan, Russia, Turkey, UNESCO, and the United States. It is currently the workplace of approximately 2600 full-time employees, as well as about 7900 scientists and engineers representing some 500 universities and 80 nationalities.

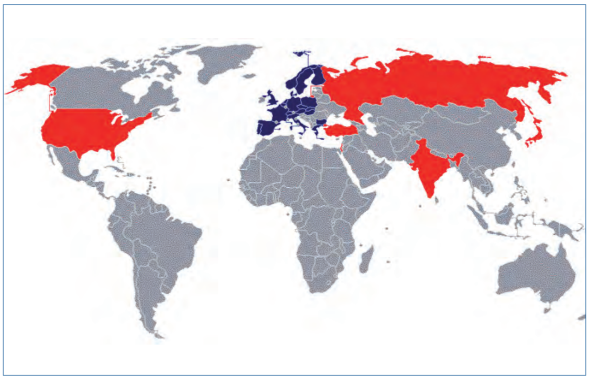


Figure 1 CERN members (in blue) and observers (in red: USA, Israel, Turkey, Japan, India, and Russia) as of 2008 (Source Wikipedia.org).

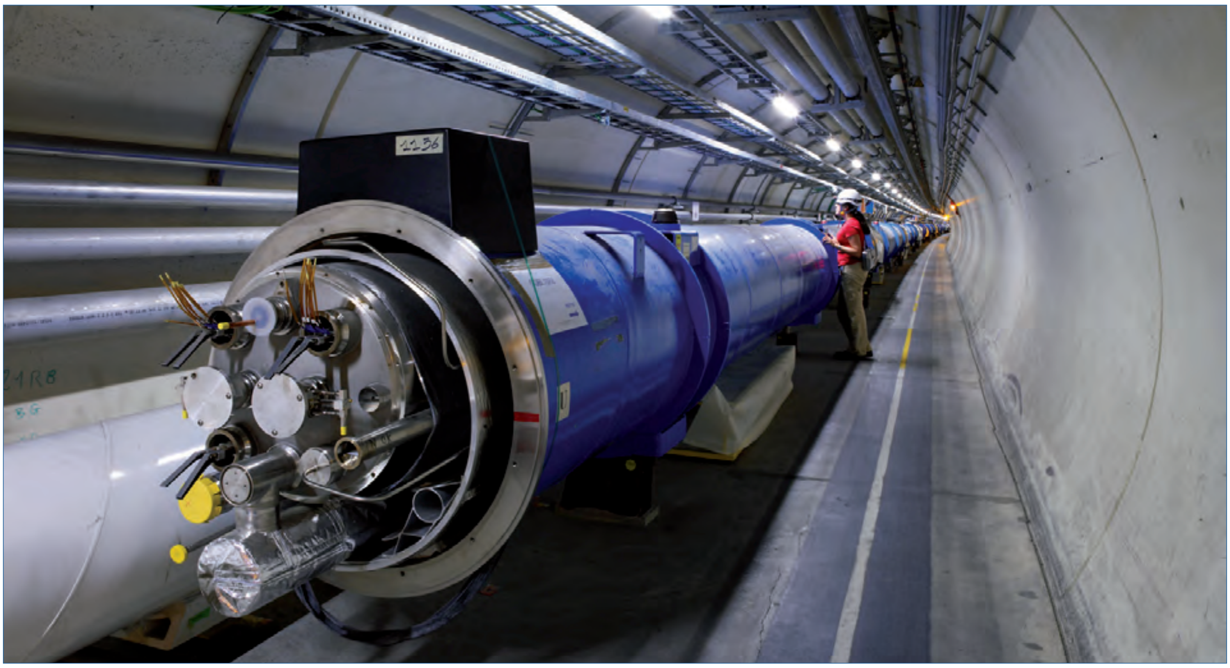
CERN's main function is to provide the particle accelerators and other infrastructure needed for high-energy physics research. Numerous experiments have been constructed at CERN by international collaborations used by them. The main site at Meyrin also has a large computer centre containing very powerful data processing facilities primarily for experimental data analysis, and because of the need to make them available to researchers elsewhere, has historically been (and continues to be) a major wide area networking hub.

As an international facility, the CERN sites are officially under neither Swiss nor French jurisdiction. Member states' contributions to CERN for the year 2008 totalled CHF 1 billion (approximately € 664 million, US$ 1 billion).

Beyond the service to operate the largest accelerator in the world, CERN has a wider interest in projects in particle physics and neighbouring fields. CERN has developed a scheme to provide support to such projects, the so-called "CERN recognised experiment status" and some experiments in the field of astroparticle physics have obtained this status. This classification is not only a scientific label; it also allows an experiment to make use of CERN's basic facilities. Experiments with this status may discuss with CERN about obtaining project management support. For example, an experiment may have its payment traffic executed through a CERN account or could make use of the CERN purchasing department for their acquisitions.

CERN may grant the status of a recognised experiment in fields allied to particle physics, such as astroparticle physics. Details on the CERN recognised experiment status are provided in Section 5.2.

CERN is a member of the EIROforum, the partnership of the seven European intergovernmental research organisations that operate major research infrastructures.



The Large Hadron Collider (LHC) at CERN is a particle accelerator, which will provide a new range in energies to explore matter and the Universe by recreating the conditions of the very early Universe (Credit: CERN).

4. Existing national and international infrastructures

4.1.2 ESO (European Organisation for Astronomical Research in the Southern Hemisphere)

ESO, the European Organisation for Astronomical Research in the Southern Hemisphere, is an intergovernmental organisation with 14 member states. Created in 1962, at that time located at CERN, ESO provides state-of-the-art research facilities to European astronomers and astrophysicists and is supported by Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Several other countries have expressed a strong interest in joining the organisation. The annual member state contributions to ESO are approximately 120 million Euros and ESO employs around 600 staff members.

The Paranal platform with the four main VLT units and the four auxiliary telescopes (Credit: ESO/H.H.Heyer).

Whilst the Headquarters (comprising the scientific, technical and administrative centre of the organisation) are located in Garching near Munich, Germany, ESO operates, in addition to the Santiago Centre, three observational sites in the Chilean Atacama desert. At La Silla, 600 km north of Santiago de Chile and at 2400 m altitude, ESO operates several medium-sized optical telescopes. The Very Large Telescope (VLT) is located on Paranal, a 2600 m high mountain south of Antofagasta, which also hosts the VLT Interferometer and two survey telescopes, the VST and VISTA. The third site is the 5000 m high Llano de Chajnantor, near San Pedro de Atacama. Here a new submillimetre telescope (APEX) is in operation, and a giant array of 12 m submillimetre antennas (ALMA) is being constructed in collaboration with the United States, Japan and Chile. ESO is currently engaged in design studies for an Extremely Large optical/near-infrared Telescope, the E-ELT.

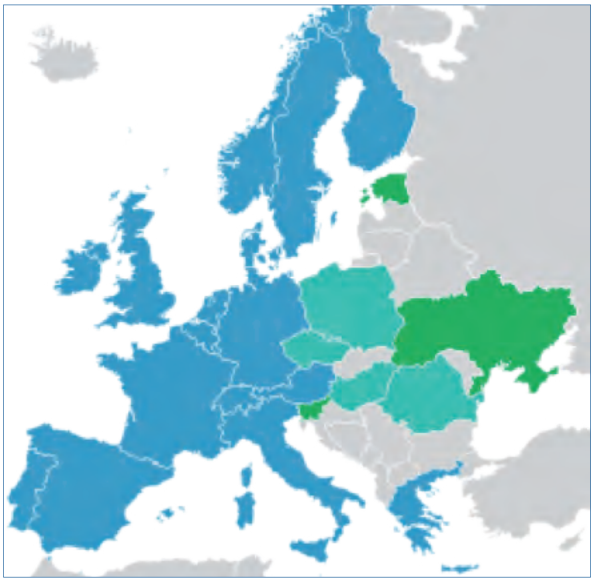
ESO is the foremost organisation for ground-based astronomy in Europe. Since its establishment in 1962 it has become the main developer and operator of the largest research infrastructure projects in astronomy but also, in line with the Convention, played a major role in fostering and organising European cooperation in astronomy in general.
ESO has well defined processes for project approval, controlling and reporting processes. ESO is working with external contractors (institutions, university groups…) to build instrumentation.

Together with ESA (European Space Agency) ESO operates at the Garching headquarter the Space Telescope-European Coordinating Facility (ST-ECF). The ST-ECF is based on a MoU between both partners to finance a small group of astronomers, software scientists and media specialists who support science with the Hubble Space Telescope (HST) in Europe and collaborate internationally on HST science, instrument, archive and outreach activities. This cooperation between ESO and ESA will be further described in Section 5.1as a successful example of linking of existing infrastructure.

ESO is a member of the EIROforum.

4.1.3 ESA (European Space Agency)

ESA's responsibility is to draw up and carry out the European space programmes. The ESA programmes are designed to explore the Earth, its immediate space environment, the Solar System and the Universe, as well as to develop satellite-based technologies and services, and to promote European space industries. ESA also works closely with space organisations outside Europe. ESA´s mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world.



ESA member countries (blue) - ECS (European Cooperating States) signed Cooperation Agreement (Turquoise) - and observers as of 2008 (Green) - Source: wikipedia.

ESA is an international organisation with 17 member states (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom). Canada takes part in some projects under a Cooperation agreement. The Czech Republic is in the process of joining ESA as a Member State. Hungary, Romania and Poland are 'European Cooperating States' (ECS). Estonia and Slovenia have recently signed cooperation agreements with ESA. By coordinating the financial and intellectual resources of its members, it can undertake programmes and activities far beyond the scope of any single European country.

ESA's headquarters are in Paris which is where policies and programmes are decided. ESA also has sites in a number of European countries, each of which has different responsibilities:

• EAC, the European Astronauts Centre in Cologne, Germany;
• ESAC, the European Space Astronomy Centre, in Villafranca del Castillo, Madrid, Spain;
• ESOC, the European Space Operations Centre in Darmstadt, Germany;
• ESRIN, the ESA centre for Earth Observation, in Frascati, near Rome, Italy;
• ESTEC, the European Space Research and Technology Centre, Noordwijk, the Netherlands.
• ESA also has liaison offices in Belgium, USA and Russia; a launch base in French Guiana and ground/tracking stations in various parts of the world.

4. Existing national and international infrastructures

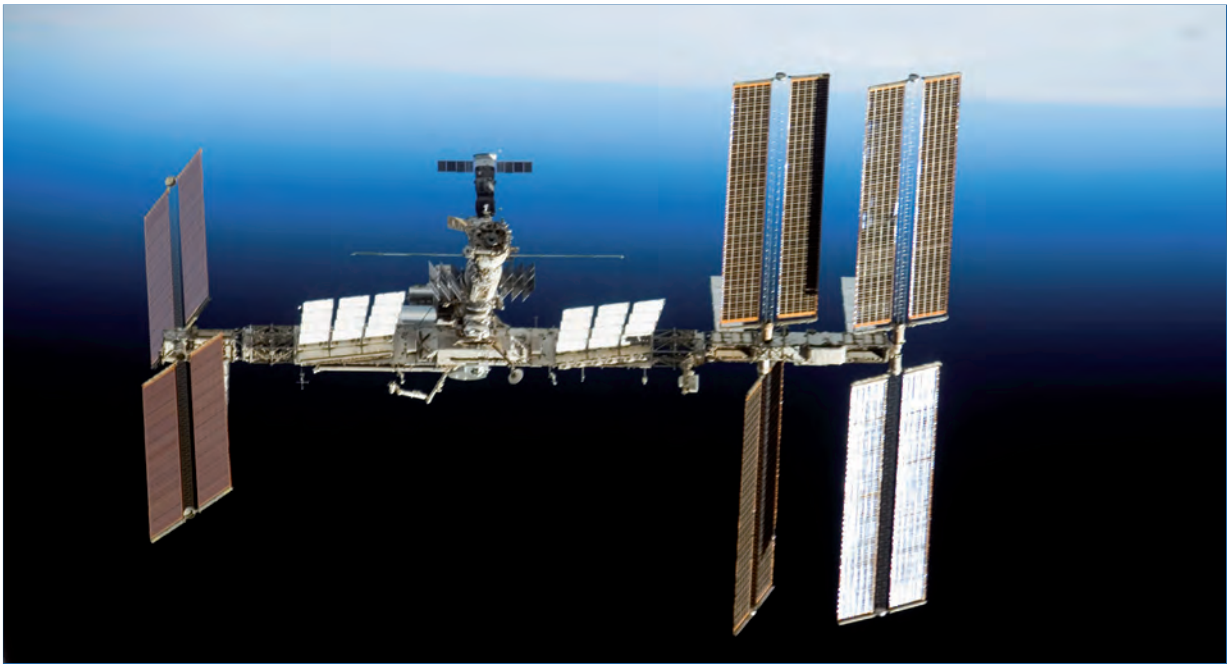
In February 2008, the total number of staff working for ESA numbered 2043, from all the Member States and includes scientists, engineers, information technology specialists and administrative personnel.

ESA's mandatory activities (space science programmes and the general budget) are funded by a financial contribution from the entire Agency's Member States, calculated in accordance with each country's gross national product. In addition, ESA conducts a number of optional programmes. Each Member State decides in which optional programme they wish to participate and the amount they wish to contribute.

ESA's budget for 2008 was 3028 M€. ESA operates on the basis of geographical return (juste retour), i.e. it invests in each Member State, through industrial contracts for space programmes, an amount more or less equivalent to each country's contribution.

ESA's joint venture with ESO, the ST-ECF is described in Section 4.1.2 and in Section 5.1.

ESA is a member of the EIROforum.



View of the International Space Station (Credit: NASA).

4.2 Institutes based on a bilateral commitment

4.2.1 EGO (European Gravitational Observatory)

In December 2000 CNRS and INFN created in Cascina (Italy) the Consortium "European Gravitational Observatory" (EGO), a civil society under host country (Italian) law, in order to host the construction and operation of the gravitational wave antenna Virgo. EGO undertakes non-profit making activities for basic research and has as its purpose the promotion of research in the field of gravitation in Europe. Established for an initial period of ten years, it may be automatically extended for successive periods of five years with the unanimous agreement of all its members. Each member puts at the disposal of the consortium the technical and scientific know-how, professional capabilities and all the necessary means for the best possible achievement of the consortium's purpose, in accordance with medium-term scientific and financial programmes. New members may accede to the consortium subject to the unanimous decision of the Council. INFN makes available free of charge for the consortium's use, the site in Cascina. The site, buildings and equipment remain the property of the respective owners and are granted free rights of occupation and use. The protocols and right of use were defined in a specific agreement between the Consortium and the member concerned.

Presently, CNRS and INFN are the sole members of the consortium and they contribute annually to the operating costs (both to the capital expenditure and to the current operating expenses) with equal share. If new members accede to the consortium, the Council shall set up a new apportionment of the annual contributions. The consortium is open to other users, i.e. to organisations and research groups not acceding to the consortium but willing to make long term use of its facilities. In the latter case, an ad hoc arrangement is stipulated with the consortium. An agreement of the latter type was signed with NIKHEF in 2007. The Consortium may also make arrangements for scientific and technical cooperations with other entities sharing an interest in the field of gravitational waves. For instance, agreements were signed with LIGO in the US and GEO600 the Germany-UK antenna for a sharing of the data and a common publication signature policy.

The Virgo interferometric gravitational wave observatory (Credit: CNRS/IN2P3).

4.3 National laboratories with interests in astroparticle physics (according to a census conducted among ASPERA partners)

This (non exhaustive) list comprises existing national research infrastructures (laboratories, institutes, independent experiments) of a certain size and independent legal form) with activities in astroparticle physics or in neighbouring fields (e.g. accelerator laboratories) that could play a role for hosting new experiments. Most of them are experienced in the development, building, and/or operating of complex large-scale research facilities (head/spokesperson of a collaboration) and/or have had "hosted" research experiments.

Following the practice used in ASPERA Deliverable 1.1, the order of the countries in this subsection is alphabetical according to the 2 letter abbreviation used at the end of internet addresses.

4.3.1 Switzerland (CH)

PSI (Paul Scherrer Institute)
The Paul Scherrer Institute (PSI) is a multi-disciplinary research centre for natural sciences and technology. PSI collaborates with national and international universities, other research institutions and industry in the areas of solid-state research and materials sciences, particle physics, life sciences, energy research and environmental research.

PSI concentrates on basic and applied research. The Institute is actively involved in the transfer of new discoveries into industry, and offers, as an international centre of competence, its services to external organisations.

PSI employs 1300 members of staff, making it the largest of the national research institutions, and the only one of its kind, within Switzerland. It develops, builds and operates complex large-scale research facilities that impose particularly high requirements in terms of knowledge, experience and professionalism. PSI is one of the world's leading user laboratories for the national and international scientific community.

The Paul Scherrer Institute (PSI) is the largest national research institute and is the only one of its kind in Switzerland (Credit: PSI).

4.3.2 Czech Republic (CZ)

FZU (Institute of Physics of the Academy of Sciences of the Czech Republic)
The Institute of Physics is the major institute of the Academy of Sciences of the Czech Republic. It employs about 740 staff and it covers a broad range of solid state physics, plasma and laser physics, optics, elementary particle physics and astroparticle physics. The Division of Elementary Particle Physics is active in FERMILAB, DESY and CERN collider experiments, and within non-accelerator physics, in AUGER. The Division of Optics also participates in this experiment. The institute operates the Joint Laboratory of Optics together with the Palacky University in Olomouc and the laboratory has considerable expertise in the design and production of optical instruments both for accelerator and astroparticle physics (Čerenkov counters, fluorescence and Čerenkov telescopes).

ASI (Astronomical Institute of the Academy of Sciences of the Czech Republic)
The principal activity of the ASI is scientific research and development in the fields of astronomy and astrophysics covering in particular the origin, evolution, dynamics and physical properties of stars, stellar systems and relativistic objects, exploration of the Sun, solar activity and its impact on terrestrial processes and, in interplanetary space, exploration of the Earth's near-space environment, the dynamics of natural and artificial bodies of the solar system, and study of the interplanetary matter and its interaction with the Earth's atmosphere. The potential of ASI for astroparticle physics is connected with its strong ties to ESO and ESA.

NPI (Nuclear Physics Institute of the Academy of Sciences of the Czech Republic)
Nuclear Physics Institute ASCR, v. v. i. performs research across the range of nuclear physics, both experimental and theoretical. Especially nuclear beta decays including neutrino mass problem, reactions of light and middle nuclei at low energies, heavy ion collisions at intermediate and high energies are studied. Nuclear theory is devoted to nuclear structure, hypernuclei, interactions of elementary particles with nuclei, mesonic degrees of freedom in nuclei. Selected problems of theoretical subnuclear physics and mathematical physics are studied. The neutrino physics and the studies of nuclear reactions important for star evolution overlap with the astroparticle physics.

4.3.3 Germany (DE)

FZK/ KIT (Forschungszentrum Karlsruhe/ Karlsruhe Institute of Technology)

Forschungszentrum Karlsruhe is one of the largest German national research centres. It is a member of the Helmholtz Association. Currently it employs about 3700 staff who run a broad spectrum of highly multidisciplinary research in the areas "Energy", "Earth and Environment", "Key Technologies" and "Structure of Matter". R & D is planned and performed in a matrix structure of programme management groups and scientific institutes which provide the expertise necessary for the particular programme. The available broad scientific and technical infrastructure is the backbone of the comprehensive, long term, interdisciplinary research in all the FZK/KIT programmes, which aims for excellence and international competitiveness. This includes large scientific facilities for internal and external users, for example, the Grid Computing Centre (GridKa) for the international Particle Physics community, FZK/KIT's contribution to the international Pierre Auger Laboratory for astrophysics in Argentina, the Tritium Laboratory Karlsruhe TLK for the European fusion programme, the international KATRIN experiment for neutrino mass measurements and the synchrotron radiation facility ANKA for a broad user community. FZK/KIT has consistently intensified its cooperation with universities over the past fifteen years. All directors of FZK/KIT institutes hold professorships at neighbouring universities.

The decision in December 2007 to merge of Forschungszentrum Karlsruhe and Universität Karlsruhe (TH) into the Karlsruhe Institute of Technology (KIT) established a research institution unique and novel in Germany in which the two missions, national research centre and university, and the three main tasks, research, teaching and innovation, are closely meshed. KIT is planned as an institution of internationally outstanding research and teaching in science and engineering. Its staff of approx. 8000, and an annual budget of more than half a billion Euro, enable KIT to become a worldwide leading science institution in selected areas. In 2006, Universität Karlsruhe was one of three universities awarded elite status in the competition for excellence run by the German federal and state governments.

The final 7 km through the small village of Leopoldshafen was the most spectacular part of the KATRIN voyage (Credit: KATRIN collaboration).

DESY (Deutsches Elektronen Synchrotron, Hamburg)
DESY is one of the world's leading centres for the investigation of the structure of matter. DESY develops, runs and uses accelerators and detectors for photon science and particle physics. DESY is a national research centre supported by public funds and member of the Helmholtz Association, with locations in Hamburg and Zeuthen (Brandenburg). It has approximately 1900 employees, including 600 scientists working in the fields of accelerator operation, research, and development. DESY carries out fundamental research in a range of scientific fields and focuses on three principal areas: Accelerators, Photon science and
Particle physics. Scientists from around the world use DESY's accelerators to investigate the fundamental building blocks and forces of the universe. The spectrum of research at DESY is correspondingly diverse – as is the cooperation with partners both national and international. All in all, more than 3000 scientists from 45 countries come to Hamburg each year to work at DESY. DESY is closely involved in a number of major international projects, including the European X-ray free-electron laser XFEL in Hamburg, the Large Hadron Collider LHC in Geneva, the International Linear Collider ILC.

DESY also conducts research in astroparticle physics, in particular at its location in Zeuthen (involvement in IceCube, MAGIC, and CTA). In the past, DESY hosted the HERA accelerator and is currently hosting a variety of light sources. DESY is involved in the planning and construction of the XFEL-project. XFEL will be a GmbH (limited liability company) linked via a governmental agreement to DESY.

View from the sky of the DESY site (Credit: DESY).

MPIK (Max Planck Institute for Nuclear Physics Heidelberg)
The Max Planck Institute for Nuclear Physics (MPIK) is one out of 80 institutes and research establishments of the Max Planck Society. Founded in 1958, the initial scientific goals were basic research in nuclear physics and the application of nuclear-physics methods concerning questions in the physics and chemistry of the cosmos. Today, the activities concentrate on the two interdisciplinary research fields, astroparticle physics and Quantum Dynamics (Many-Body Dynamics of Atoms and Molecules).

Presently, the institute consists of 5 divisions in addition to several further research groups and junior research groups, scientific and technical departments as well as the administration support the researchers. The institute has about 380 employees, and many diploma students and scientific guests. Scientists at the MPIK collaborate with other research groups in Europe and all over the world and are involved in numerous international collaborations, partly in a leading role. Particularly close connections to some large-scale facilities like GSI (Darmstadt), DESY (Hamburg), CERN (Geneva), INFN-LNGS (Assergi L'Aquila) exist. The MPIK is leading the construction and operation of H.E.S.S and GERDA and is involved in CTA and Double Chooz.

MPP (Max Planck Institute of Physics Munich)
The Max Planck Institute of Physics (MPP) is devoted to fundamental research in the physics and astrophysics of elementary particles, from both an experimental and a theoretical perspective. For experiments the large particle accelerators of CERN, DESY and BNL (Brookhaven, USA) as well as the facilities of the Gran Sasso underground laboratory and the La Palma observatory are used. The MPP has also been contributing to the construction of three sub-detectors for ATLAS.

With a total of 280 employees, including 60 scientists and 80 junior scientists and researchers, the institute's experiments are all conducted in the frame of large international collaborations. Astroparticle physics experiments investigate high-energy cosmic gamma radiation (MAGIC experiment in La Palma, Spain) and search for dark matter in our Universe (CRESST experiment at Gran Sasso, Italy). For the future EUSO mission, devoted to observe the highest energy cosmic rays from the International Space Station ISS, detector development is performed.

The MPP is leading the construction and operation of the MAGIC experiment.

GSI (Gesellschaft für Schwerionenforschung, Darmstadt)
The research programme at GSI covers a broad range of activities extending from nuclear and atomic physics to plasma and materials research to biophysics and cancer therapy. GSI is also involved in nuclear astrophysics research. GSI has 1050 employees, including 300 scientists and engineers. GSI operates a large, and in many aspects, worldwide unique accelerator facility for heavy-ion beams. GSI physicists together with scientists from universities and research institutes in Germany and abroad, are building a new international accelerator Facility for Antiproton and Ion Research (FAIR). The legal framework for FAIR is the FAIR GmbH, which is a private limited liability company under host country law.

4.3.4 Spain (ES)

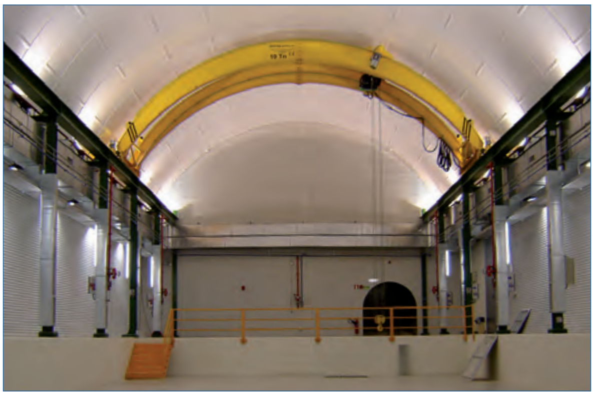
CIEMAT (El Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas)

The CIEMAT, an Organism of the Ministry of Science and Innovation, is a Public Research Agency for excellence in energy and environment, as well as in many vanguard technologies and in various areas of fundamental research; in particular, particle physics and astroparticle physics. Since its creation in 1951, then as the JEN, and since 1986 as the CIEMAT, it has been carrying out research and technological development projects, serving as a reference for technical representation of Spain in international forums, and advising government on matters within its scope.

CIEMAT activities are organised around research projects that span the bridge between R&D and the interests of society. The CIEMAT team is made up of approximately 1200 people, of whom 47% are university graduates.

LSC (Canfranc Underground Laboratory)

The Laboratorio Subterráneo de Canfranc (LSC) is a new facility for Underground Science. It is conceived as a Consortium of the Spanish Ministry of Education and Science, the Aragon Regional Government and the University of Zaragoza. Located under the Pyrenees mountain «El Tobazo», the over burden at the site provides 2500 meters water equivalent of shielding from cosmic rays and offers a low background environment for the next generation of experiments exploring the frontiers of particle and astroparticle physics.



View of the new Canfranc Underground laboratory (Credit: LSC).

CSIC (Consejo Superior de Investigaciones Científicas)

The CSIC is the largest public research body in Spain. With centres throughout Spain, it plays an active role in the scientific policy of all the country's autonomous regions. As a mul-tidisciplinary body it covers all fields of knowledge, from basic research to advanced technological development.

ORM (Observatorio del Roque de los Muchachos)

ORM is situated on the island of La Palma. It is home to one of the most extensive array of telescopes to be found anywhere in the world. Conditions at the Observatory are ideal not only for night time observations but also for Solar Physics. The Observatory also attracts researchers in High Energy Astrophysics. ORM is the site of the MAGIC experiment.

4.3.5 France (FR)

CNRS (Centre National de la Recherche Scientifique)

The CNRS (National Centre for Scientific Research) is a government-funded research organisation, under the administrative authority of France's Ministry of Research. CNRS carries out research in all fields of knowledge, through its 9 institutes (Mathematics, Physics, Nuclear and Particle Physics, Earth Sciences and Astronomy - Chemistry - Life Sciences - Humanities and Social Sciences - Environmental Sciences and Sustainable Development - Information and Engineering Sciences and Technologies). Two of them have a national mission: IN2P3 (National Institute of Nuclear and Particle Physics) and INSU (National Institute of Earth Sciences and Astronomy). They both support astroparticle physics research.

CNRS laboratories (or research units) are located throughout France, and employ a large body of tenured researchers, engineers, and support staff (30000). Laboratories are all on renewable four-year contracts, with bi-annual evaluation by the National Center for Scientific Research. There are two types of labs:

- Proper units (UPR) fully funded and managed by CNRS and
- Joint units (UMR): partnered with universities, other research organisations, or industry.

IN2P3 contains 17 joint labs and a few proper units of which the large majority have astroparticle physics activities. It manages several Very Large Equipment projects among which are the LHC and SPIRAL2, but also jointly with INSU and CNRS i.e. H.E.S.S., Virgo and Auger. The "Centre de Physique des Particules de Marseille (CPPM)" is the main institution inside IN2P3 leading the construction and running of ANTARES. IN2P3 also manages, with an important contribution from CEA, the CC-IN2P3 a Tier1 computing centre devoting presently one quarter of its computing power to astroparticle physics. INSU also manages many laboratories, of which 15-20 are involved in astroparticle physics.

CEA (Commissariat à l'énergie atomique)

The CEA is the French Atomic Energy Commission and is a French government-funded technological research organisation with more than 15.000 employees. A prominent player in the European Research Area, it is involved in setting up collaborative projects with many partners around the world. The CEA mission statement has two main objectives: To become the leading technological research organisation in Europe and to ensure that the nuclear deterrent remains effective in the future. The CEA is active in three main fields: energy, information and health technologies, and defence and national security. In each of these fields, the CEA maintains a cross-disciplinary culture of engineers and researchers, building on the synergies between fundamental and technological research.

LSM (Laboratoire Souterrain de Modane)

The Laboratoire Souterrain de Modane is jointly operated by IN2P3 of CNRS and IRFU, which is an institute of CEA. It was founded in 1980 for the purpose of investigating the possible instability of the proton in an environment protected against cosmic rays. These activities have been extended to other wide-spread disciplines like astrophysics, earth science, environment, and techniques for precise age determination, which all benefit from the low level radioactivity environment. All of these research activities need to be carried out in an underground laboratory.

View of the new Modane Underground laboratory (Credit: LSM).

APC (AstroParticle and Cosmology)

APC is an Institute created in Paris by CNRS, CEA the Observatory of Paris and University Paris 7, devoted to particle astrophysics and cosmology. The scientific activities of APC are centred on three domains: High-energy astrophysics: the study of extreme sources in the universe through the high-energy particles that they emit; modelling of these sources and of the phenomena responsible for the emission of these high-energy particles. Cosmology: the study of the evolution of the universe through the observation of the extra-galactic medium: detailed investigation of the cosmic microwave background, study of dark energy and dark matter. Neutrino physics: the study of the properties of neutrinos as well as their role in astrophysics (solar models, supernovae explosions). To further enhance collaboration, three groups are transverse to these activities: Theory: the theory group covers the whole range between phenomenological analysis close to observational data and fundamental theories such a string theory and quantum theory. It provides thus not only expertise on how to analyse and interpret present and expected data but also insights into observations of a more distant future. Data processing: this group identifies specific problems in data processing and sets up task forces to find new and innovative solutions. These task forces consist of physicists in the particular field but also applied mathematicians and computer scientists. Photodetection: APC intends to develop specific R&D activities centred on photodetection: detection of light, of various wavelengths whether from distant galaxies: or from high energy particles is central to the activities of the lab.

4.3.6 Greece (GR)

NOA (National Observatory of Athens)
The Observatory has five institutes in Astronomy, Seismology, Space, Environmental science and finally the Institute for Astroparticle Physics, «NESTOR», which is the leading partner in the NESTOR project for Neutrino Telescope. NESTOR has its main facilities in Pylos located in the Southwestern Peloponnese and runs a smaller office in Athens. It is active participant in KM3Net.

The NESTOR Institute for Deep Sea Research, Technology and Neutrino astroparticle physics was created by the Greek government in August 1998 as a small national laboratory. It had the legal status of an Independent Research Institute under the authority of the General Secretariat for Research and Technology of the Ministry of Development. In 2003, NESTOR became the fifth institute of NOA.

View of the astroparticle-physics dedicated boat under construction in Pylos (Credit: NESTOR collaboration).

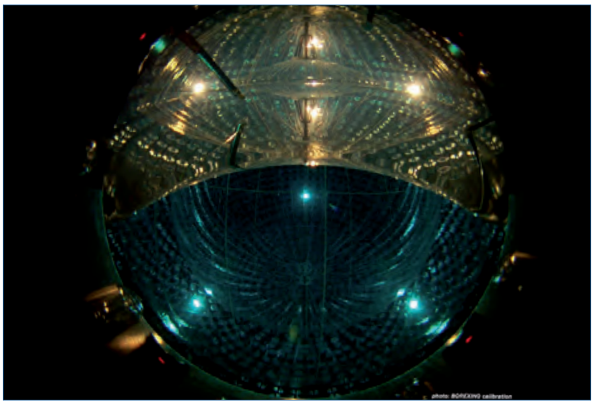
4.3.7 Italy (IT)

INFN (Istituto Nazionale di Fisica Nucleare)
The INFN - the National Institute of Nuclear Physics - is a Research Public Institution dedicated to the study of the fundamental constituents of matter, and conducts theoretical and experimental research in the fields of subnuclear, nuclear, and astroparticle physics. The cutting-edge technologies and instrumentation required for the research in these fields are developed by INFN both in its own laboratories and in collaboration with the world of industry. These activities are conducted in close collaboration with the academic world.

Research activity at the INFN is carried out at two complementary types of facilities: the Divisions (Sezioni) and the National Laboratories. Each of the 20 Divisions is located at a university physics department. The Divisions thus provide a direct connection between the Institute and the academic world. The four laboratories — in Catania, Frascati, Legnaro, and at Gran Sasso — are home to major facilities which are available to the national and international scientific community. In the framework of its mission, INFN promotes and participates in collaborations and activities at European and International research infrastructures.

The INFN workforce includes about 2000 employees, almost 2000 university employees involved in research conducted by the Institute, and 1300 young researchers, including undergraduate and graduate students and research fellows.

The main INFN research infrastructures related to astroparticle physics in Italy are the Laboratori Nazionali del Gran Sasso (LNGS) and the Laboratori Nazionali del Sud (LNS). The other two INFN National Laboratories also host or give support to astroparticle physics activities: LNF (Frascati, Rome) hosts the resonant gravitational wave antenna Nautilus, provides infrastructures dedicated to space based investigations and has supported the Opera detector construction; LNL (Legnaro, Padua) hosts the resonant gravitational wave antenna Auriga, the Pvlas detector and gives support to the Cuore experiment.



View of the Borexino experiment being filled with water (Credit: Borexino collaboration).

4. Existing national and international infrastructures

LNGS

The Gran Sasso National Laboratory (LNGS) is one of four INFN national laboratories. It is the largest underground laboratory in the world for experiments in astroparticle physics and nuclear astrophysics. It is located between the towns of L'Aquila and Teramo, about 120 km from Rome. The underground facilities are located on a side of the ten kilometres long free-way tunnel crossing the Gran Sasso Mountain. Scientists, presently 750 in number, from 22 different countries, working at about 15 experiments, use it as a worldwide facility.

The mission of the Laboratory is to host experiments that require a low background environment in the field of astroparticle physics and nuclear astrophysics and other disciplines, like geophysics and biology, that can profit from its characteristics and from its infrastructures.

Main research topics of the present programme are: neutrino physics with neutrinos naturally produced in the Sun and in Supernova explosions and neutrino oscillations with a beam from CERN (CNGS program), search for neutrino mass in neutrinoless double beta decay, dark matter search, and nuclear reactions of astrophysical interest.

View of a hall in the Gran sasso National Laboratory (Credit: LNGS / INFN).

LNS (Laboratori Nazionali del Sud)

The Laboratory is the host of NEMO, whose aim is to carry out the necessary R&D towards a cubic kilometre neutrino telescope in the Mediterranean Sea.

4.3.8 Netherlands (NL)

Nationaal instituut voor subatomaire fysica, NIKHEF

Nikhef is the National Institute for Subatomic Physics in the Netherlands based in Amsterdam. It is a collaboration between four universities and the funding agency FOM and has about 250 employees including about 120 physicists of whom more than half are Ph.D. students and postdoctoral fellows. Technical support is provided by well equipped mechanical, electronic and information technology departments with a total staff of about 100. The institute coordinates and supports major Dutch activities in experimental and theoretical subatomic physics, among them the ATLAS, LHCb and ALICE experiments at the Large Hadron Collider at CERN and several astroparticle physics projects, such as neutrino telescopes (Antares/ KM3NeT), Cosmic ray observatories (Auger), and Gravitational Wave detectors, (Virgo, LISA, ET).

Detector R&D, design and construction of detectors and the data-analysis for these projects take place at the laboratory located in Science Park Amsterdam and at the participating universities. Nikhef has a theory group with both its own research programme and close contacts with the experimental groups.

Nikhef participates in ApPEC and ASPERA.

National institute for radio astronomy, ASTRON

ASTRON is the Netherlands Institute for Radio Astronomy with its headquarters in Dwingeloo and is an institute of the Netherlands Organisation for Scientific Research (NWO). Its mission is to enable discoveries in radio astronomy via the development of novel and innovative technologies, the operation of world-class radio astronomy facilities, and the pursuit of fundamental astronomical research.

ASTRON is currently building an innovative new low-frequency radio telescope, LOFAR. This telescope is an important scientific and technological pathfinder for the next generation of radio telescope, the Square Kilometre Array (SKA), a global project in which ASTRON plays a leading role. LOFAR is being developed in a consortium of knowledge institutes, universities and industrial parties, led by ASTRON.

ASTRON also operates the Westerbork Radio Observatory and is involved in the development of instrumentation for optical and IR telescopes, including ESO's Very Large Telescope and the James Webb Space Telescope (JWST).

AstroTec Holding B.V (ATH) facilitates the transfer of innovative ASTRON technology to the market place, in collaboration with regional partners and other major industrial players.

4. Existing national and international infrastructures

Kernfysisch Versneller Instituut (KVI, Groningen) (National institute for nuclear physics)
The KVI is a leading Dutch institute in the fields of fundamental and applied subatomic and atomic physics. The main facility of the institute is the superconducting cyclotron AGOR. The KVI is situated on the campus of the University of Groningen and it is financed by the university, the Dutch Foundation for Fundamental Research of Matter (FOM) and the Gesellschaft für Schwerionenforschung (GSI) in Darmstadt, Germany. KVI is a user facility for the international scientific community. Being part of a European collaboration of nuclearphysics institutes, KVI receives EU money for transnational access of users of the AGOR-accelerator facility.

The KVI actively stimulates and participates in interdisciplinary fields of research, both within and outside the KVI, and undertakes application-oriented research together with industries, businesses and the public sector.

The research in the field of Astroparticle Physics at the KVI focuses on the study of the sky map of the high-energy Universe, addressing the unknown origin of cosmic rays at the highest energies. For this research line KVI contributes to the development and exploitation of observatories located in the Netherlands (WSRT/LOFAR), the Mediterranean Sea (ANTARES/KM3NeT) and Argentina (Pierre Auger Observatory).

National institute for space research (SRON, Utrecht)
As a part of the Netherlands Organisation for Scientific Research (NWO) SRON is the national centre of expertise for the development and exploitation of satellite instruments in astrophysics and Earth system science. It acts as the Dutch national agency for space research and as the national point of contact for ESA programmes.

The main activities of SRON are the development and exploitation of satellite instruments in high energy astrophysics, low energy astrophysics and Earth system science. SRON is also involved in the LISA Pathfinder project.

Royal Netherlands Institute for Sea Research, NIOZ
NIOZ Royal Netherlands Institute for Sea Research is the National Oceanographic Institute of the Netherlands. NIOZ is part of the Netherlands Organisation for Scientific Research (NWO). The institute employs around 220 people and the annual budget is approximately €20 million. The mission of NIOZ is to gain and communicate scientific knowledge on seas and oceans for the understanding and sustainability of our planet. The institute also facilitates and supports marine research and education in the Netherlands and Europe.

The basic oceanographic disciplines at NIOZ are physics, chemistry, biology and geology. Multidisciplinary research is regarded as one of the main strengths of the institute.

Each of these institutes has a staff exceeding 100 employees.

4.3.9 Poland (PL)

IFJ PAN (The Henryk Niewodniczanski Institute of Nuclear Physics Polish Academy of Sciences)
IFJ PAN in Krakow carries out basic and applied research in physics, with emphasis on nuclear physics. It aims to explain the structure of matter from microscopic to cosmic scales, through experiments and/or the application of theoretical methods. The institute employs 400 people, including 37 full professors, 30 associate professors and over 100 post docs. The division of Particle Physics and Astrophysics is the main unit of IFJ PAN and is involved in astroparticle research. The Department of Hadron Structure (6 FTS, 1 PhD student) is involved in the ZEUS experiment (DESY) and the ALICE collaboration (CERN). The Department of Cosmic Rays Research (4 FTS, 1 Ph.D. student) is involved in the Pierre Auger Project (study of the optical image of a shower; analysis of light scattering in the atmosphere; study of the influence of local variation of the atmosphere on shower evolution; identification of photons among ultra high energy cosmic rays). The team contributes also to the construction of the detector array of Pierre Auger Observatory. The Department of Neutrino and Dark Matter Studies (5 FTS, 3 PhD students) is involved in the international projects ICARUS (participating in detector tests, software development, data analysis, phenomenological description of neutrino cross sections, electronics development and mechanical projects), WARP, and T2K (involved in the work for liquid argon T2KLAr and SMRD detectors). The Department participates in FP7 LAGUNA project. The ATLAS Experiment Department has 22FTS and 1 PhD student.

IPJ (The Andrzej Soltan Institute for Nuclear Studies)
IPJ in Otwock-Swierk carries out pure and applied research on subatomic physics, i.e. the elementary particle and nuclear physics, the hot plasma physics and related fields. The Department of Cosmic Ray Physics in Lodz of IPJ (4 FTS, 2 PhD students) is involved in basic research in the area of high energy and cosmic ray physics related to studies of: structure and properties of Extensive Air Showers (EAS) induced by cosmic ray particles; asymptotic properties of hadronic interactions based on the analysis of EAS development in the atmosphere; mass composition of cosmic rays in the energy range 1015 - 1017 eV; observations of Solar activity by cosmic ray muon flux registration in the underground telescope. The muon telescope is placed in the underground laboratory at the depth of 13 m. It is registering directions of muons which have minimum energy of 5 GeV. The High Energy Physics Department (30 FTS, 6 PhD student) is involved in DELPHI (at LEP), ZEUS (at HERA), COMPASS, Pi OF THE SKY, preparation of RHIC, ICARUS, ALICE and CMS (at LHC), and K2K.

4. Existing national and international infrastructures

4.3.10 Romania (RO)

Horia Hulubei Institute of Physics and Nuclear Engineering (IFIN-HH)
IFIN-HH is the largest national institute in Romania, focused on physics and nuclear engineering activities. IFIN-HH benefits from a rather good infrastructure in Nuclear Physics (ex: the FN Van de Graaff Tandem accelerator and related experiments in nuclear structure) and it is part of large European collaboration in Nuclear and Particle Physics: CERN, FAIR, SPIRAL2. In astroparticle physics IFIN-HH participates in the international cosmic rays experiments KASCADE-Grande and LOPES, studying high-energy cosmic rays in the knee region and developing the radio detection technique of air showers, respectively. In addition, in collaboration with FZK in Karlsruhe, Germany, IFIN-HH Bucharest performs the project CORISU for measuring the muon charge ratio in extensive air showers with the dedicated small-scaled detection system WILLIEAS, which is under construction in IFIN-HH. In collaboration with Max-Planck Institute for Physics, München, IFIN-HH started a project DETCOS for investigating cosmic radiation in the Romanian salt mine Slanic using a new technology of muon detection and measuring the attenuation of radio waves in salt. IFIN-HH is a partner in LAGUNA FP7 project, which includes the salt mine Slanic, as one of the possible sites for developing a Large Apparatus studying Grand Unification and Neutrino Physics.

Institute of Space Science (ISS)
ISS has an ongoing investment infrastructure project, the Centre for Spatial Sciences and Technologies. It will host technological facilities, a large computing centre and equipment for space communications. ISS intends to use this facility for space and astroparticle physics activities, including its technical contribution to the KM3NeT construction, to be defined in the KM3NeT - PP project. ISS is developing a network of cosmic ray detectors distributed in high schools. It intends to start from locations in the Bucharest area, and then to expand around other University centres in Romania. The network (RoLTA - Romanian Large Time coincidence Array) could in the future be linked to other such networks in Europe, as suggested in the EuroCosmics proposal.

View of the salt mine in Slanic (Credit: ASPERA).

4.3.11 United Kingdom (UK)

Rutherford Appleton Laboratory (RAL, STFC)
The Rutherford Appleton Laboratory (RAL) is part of the Harwell Science and Innovation Campus near Didcot in Oxfordshire. It has a global reputation for excellence and is one of the foremost laboratories of its kind. RAL supports research in areas including materials and structures, light sources, astronomy and particle physics.

Every year about 10,000 scientists and engineers use the Laboratory's facilities to advance their research. Around 1,200 of STFC's own scientific and support staff work at RAL. Key facilities located at the Campus are the Diamond Light source a synchrotron producing x-ray, infrared and ultraviolet beams of exceptional brightness and ISIS, the world's leading pulsed neutron and muon source.

Daresbury Laboratory (STFC)
Daresbury Laboratory is part of the Daresbury Science and Innovation Campus in Cheshire. Daresbury Laboratory employs around 550 staff, and its facilities are used by more than 5,000 scientists and engineers, mainly from the university research community. Daresbury Laboratory supports research in nuclear physics, accelerator science, materials science, surface science and engineering. It also hosts the Cockcroft Institute - an international centre for Accelerator Science and Technology in the UK.

View of a hall in the Boulby Underground Laboratory (Credit: Boulby Underground Laboratory / ILIAS).

Boulby Underground Lab
The Boulby Underground Laboratory is a facility housing and supporting ultra-low background and deep underground science projects. The laboratory is one of the 5 deep underground science facilities linked by ILIAS - the European initiative designed to promote and develop large scale infrastructures supporting astroparticle physics across Europe. The Boulby laboratory is located at Boulby Mine, between Saltburn and Whitby on the North-East coast of England and on the edge of the North Yorkshire moors. Boulby is a working potash and rock-salt mine operated by Cleveland Potash Ltd. At a deepness of 1100m it is the deepest mine in Great Britain. With this rock overhead (reducing cosmic rays by a factor 1 million) and with the surrounding rock salt being low in natural background radioactivity - the laboratories make an ideal site for ultra-low background and deep underground science projects. Within the salt caverns there are housed the Zeplin II, Zeplin III and DRIFT experiments. ■

5. Linking of exisiting infrastructures

Historically speaking, about 50 years ago the realisation of large endeavours in science was straight forward: a standalone research infrastructure would have been founded and the aspect of linking was reduced to the question of how to share the costs for building and running such an institution. During the last 50 years a variety of national and transnational research infrastructures have been built and within the ESFRI process a list of 44 new research infrastructures in Europe are discussed. However, the creation of any new research infrastructure has to be carefully crafted since any research infrastructure is a long lasting (financial) commitment.

Compared to the more rigorous approach, to also close a research infrastructure when its original mission is finished, a way followed in the United States for example, in Europe the tradition is to maintain such a research infrastructure and try to define new scientific objectives, duties and responsibilities. Having that in mind, existing research infrastructures themselves should also be interested in new evolving ideas in neighbouring research fields. Furthermore, it is hard to explain to the tax payer that existing infrastructure, which has been built by public money is not being used as efficiently as possible.

During the course of ASPERA Task 2.3 some examples of successful linking repeatedly occurred in the discussion, namely the Space Telescope European Coordinating Facility (ST-ECF) at ESO, a CERN recognised experiment, the Coordination and Management Committee of the European Underground Laboratories (COMAG), the Pierre Auger Observatory, and the FAIR and XFEL facilities. In the following these examples are described in more detail to provide the reader with ideas on how to successfully initiate linking of existing infrastructure.

5.1 ST-ECF – an example of linking of two transnational institutions, ESA and ESO

In October 1977 a Memorandum of Understanding (MoU) was signed by NASA and ESA, governing their collaboration on the Hubble Space Telescope project. This stipulated that ESA provided one of the science instruments, the Faint Object Camera (FOC), the solar arrays plus their associated electronics, and fifteen ESA staff members on assignment to the Institute. In exchange, ESA astronomers got a minimum of 15% of the observing time on Hubble and a complete copy of the science data archive.

The concept of a European Coordinating Facility (ECF) for the Space Telescope developed subsequently and was stimulated in part by the FOC instrument science team. It became clear that, for astronomers with the relatively primitive software tools available in the1980s, the process of observing with and reducing the data from the FOC and the other Hubble instruments would be a formidable task. It was also realised at an early stage that, for a digital archive to be established and utilised properly, a lot of new ground would need to be broken.

In response to these concerns, ESA issued the Call for Proposals for the Space Telescope – European Coordinating Facility in mid-1980. The idea was that the successful bidder would host the organisation and provide half the financial support in the form of a fraction of the staff as well as an institutional infrastructure within which the ECF could operate. Five organisations responded, and the European Southern Observatory (ESO) was selected as the host institute. The formal agreement to establish the ST-ECF as a separate unit at the ESO Headquarter in Garching, near Munich, Germany, was signed in February 1983 by the respective Directors General of ESA (E. Quistgaard) and ESO (L. Woltjer). Strong points of the ESO proposal were the large, although not 100%, overlap of the ESA and ESO scientific communities and the fact that ESO was already operating a major multi-national observatory in Chile using an operating concept similar in many respects to that foreseen for Hubble. During the early part of its history, the ECF was an entirely European affair. Its role was purely the support of European astronomers, and its existence was neither acknowledged nor accounted for in the ESA/NASA MoU.

Following the conclusion of the ESA/ ESO MoU, the ST-ECF started operating in early 1984. The staffing level was set at fourteen: seven ESA and seven ESO employees. However, with ESO providing the infrastructure and operational support the effective level was somewhat larger. The head of the ST-ECF was to be the European Hubble Project Scientist.

Members of the ECF have, over the years, played their part in many Hubble administrative and oversight affairs. ECF has helped in the selection of, and travel support for, European members of the TAC and its associated panels, membership of science review and study teams.

ESO has provided much more than an operational infrastructure for the ECF. It has created a rich and active scientific environment for the staff and enabled the exchange of ideas on a wide range of technical issues. While maintaining its individuality, the ECF is very firmly integrated into ESO and participates fully and without prejudice in many of the host's activities.

5.2 CERN recognised experiment – linking with CERN

When CERN was founded about half a century ago its statues were laid out such that CERN might also participate or carry out experiments in cosmic-ray physics. As described in Section 4.1.1 CERN developed a tool, the so-called CERN recognised experiment status. Projects, which successfully applied for this status, could benefit from the CERN infrastructure. Without the need of having CERN scientists directly involved, an astroparticle physics project can link to CERN and make use of the existing infrastructure CERN. CERN may grant the status of a recognised experiment in fields allied to particle physics, such as astroparticle physics, under the following conditions:

- Recognised experiment must have substantial participation of physicists from several CERN Member States.
- Recognised experiments must already be approved by relevant agencies and be reasonably funded.
- Whenever an experiment requests this status a rapporteur will be appointed whose task will be to assess the implications to CERN of such a request. Following a presentation of the experiments by its proponents and a report by the rapporteur, the Research Board will judge whether recognition by CERN is appropriate in which case this should not be taken to imply that CERN has in any sense approved the experiments.

Once an experiment has received the status of a CERN recognised experiment:

- The groups involved will be able to open visiting team accounts at CERN.
- The members of the experiment will be allowed to become registered as CERN users; this would not imply automatic assignment of office space.
- CERN would allow such teams the use of CERN´s premises to organise meetings and to use the basic services, provided that the costs to CERN are truly marginal and on the condition that approved CERN activities would always take priority.
- Additional services could be provided by mutual agreement, on the understanding that CERN will charge if there are costs for the Organisation.
- Recognition will be granted for up to three years, with the possibility of renewal following discussion with the CERN Management and, if it is judged necessary, a further presentation to the Research Board.

Presently, the astroparticle physics experiments with the status of a CERN recognised experiment are:

- RE1 (AMS) Alpha Magnetic Spectrometer (AMS) for Extraterrestrial Study of Anti-matter, Matter and Missing Matter on the International Space Station
- RE3 (AUGER PROJECT) The Pierre Auger Observatory Project
- RE5 (EXPLORER) The Gravitational Wave Detector EXPLORER
- RE6 (ANTARES) ANTARES: An Undersea Neutrino telescope
- RE7 (GLAST) GLAST
- RE8 (LISA) Laser Interferometer Space

- RE9 (NESTOR) NESTOR-Neutrino Extended Submarine Telescope with Oceanographic Research
- RE10 (ICECUBE) IceCube
- RE11 (MICE) Muon Ionization Cooling Experiment
- RE12 (MEG) MEG: search for the mu e decay at PSI
- RE13 (T2K) Neutrino Oscillation Experiment at JHF
- RE14 (KATRIN) Tritium beta-decay experiment for direct measurement of the electron neutrino mass
- RE15 (WARP) Search for cold dark matter using a cryogenic noble liquid detector
- RE16 (HESS) High Energy Stereoscopic System
- RE17 (MAGIC) MAGIC Major Atmospheric Gamma Imaging Čerenkov Telescope
- RE2A (CAPRICE) Cosmic AntiParticle Ring Imaging Čerenkov Experiment
- RE2B (PAMELA) Search for Antimatter in Space

5.3 COMAG – Linking of European Underground Laboratories

In the framework of ILIAS (Integrated Large Infrastructures for Astroparticle Science), the EU funded FP6 Integrated Infrastructure Initiative (I3) project in the astroparticle physics domain, the four most advanced national underground laboratories in Europe created COMAG, the “Coordination and Management Committee of the European Underground Labs». COMAG is a committee formed by the directors of the four underground laboratories and the ILIAS pro-ject coordinator.

Within ILIAS, COMAG is set up as a networking activity (N2) designed to implement a mechanism for the joint structuring and co-ordination of the four underground laboratories, with the overall objective being to provide a better service to users with more efficient use of resources. The goal is to ensure a full exchange of information among the underground la-boratories on their activities and to set up a coordination of the actions of common interest, which are

- Performance improvement and possible extensions of the deep underground science laboratories scientific coordination
- Safety problems and accident prevention in underground sites
- Public communication

5.4 Pierre Auger Observatory – an example of linking in astroparticle physics

The Pierre Auger Observatory, an array of 1600 water Čerenkov surface detectors spread over 3000 km², is located in Argentina. Its collaboration consists of about 69 institutions in 17 countries spread over Europe, North and South America and Australia.

The organisation is headed by two oversight bodies - Collaboration Board and Finance Board. The Collaboration Board, consisting of representatives from all of the Auger member institutions, is the governing body of the collaboration that deals with such issues as science policy, admission of new members and publications. The Finance Board, on the CERN model, consists of representatives of each of the funding agencies - often more than one per country. The Finance Board provides financial and management oversight. The meetings of this body provide a forum for funding agencies of the partner countries to resolve funding related problems. Below the Finance Board and Collaboration Board in the Auger organisation chart is the spokesperson and the project office. The project management structure is fairly typical. The project management office staff consists of the project manager, deputy project manager, the project engineer, a cost and schedule officer and part time help with quality assurance and safety. Task Leaders (level two managers) head task groups for the detector subsystems, site activities, data acquisition, data processing, communications and data analysis.

Auger is based on an international agreement that has been accepted by the collaborating countries. The agreement developed from a synthesis of governance schemes from collider experiments and large astronomy projects. Basically the Auger International Agreement is a simple statement of support for the project together with concise statements on financing, membership, withdrawal, ownership and related governance issues. The collaboration formed an independent foundation (Fundación Observatorio Pierre Auger Argentina) to act as legal agent for the Auger Project in Argentina. The Auger Foundation enables hiring of staff, holding contracts and handling operating funds for the Observatory within Argentina.

Concerning the financial setup of Auger it is interesting to mention that contributions to the construction of Auger are limited to a maximum of 25% so that none of the partner countries may dominate the project. Furthermore, Auger is not anchored to some strong institution that could provide financial stability. However, the stability is guaranteed by well established partners (infrastructures) that participate in the Auger collaboration. By the terms of the International Agreement the contribution of each country was to consist of 80% inkind deliverables and 20% cash, the latter contributed to a common fund. Auger obtained the CERN recognised experiment status and thus is able to hold the common fund on a CERN account. At the same time the Common Fund account served as a convenient neutral collection point for construction and operating funds independent of larger currency changes in the host country. The internal project accounting is performed by converting the value of all of the contributions to a standard

Auger currency (nominally US dollars) corrected for the cost accounting system of each country. To avoid paying many millions of dollars in customs charges when importing the equipment for Auger into Argentina an arrangement was worked out in which the embassy of each participating country would apply for a customs waiver to the Argentine foreign ministry for each shipment of equipment.

As is now common practice, operating costs for the Observatory including salaries, utilities and maintenance are apportioned by the number of scientists that sign scientific papers.

Beyond a collaborative approach that is typically exercised in science projects, Auger demonstrates the linking of the existing infrastructures CERN, basically as the financial hub (compare also Sect. 5.2), Fermilab, as the location of the overall project managing unit, and the foundation in Argentina, which was created to solve problems at the site.

5.5 FAIR & XFEL – linking to an existing national laboratory

Aspects of linking to an existing infrastructure are also present in the case of the two developing facilities FAIR (Facility for Antiproton and Ion Research) and XFEL (X-Ray Free-Electron Laser) in Darmstadt and Hamburg. In both cases, based on an intergovernmental agreement, a German GmbH (limited liability company) will be founded to build an international facility on the premises or close by an existing large national laboratory (infrastructure), namely GSI and DESY. While the intergovernmental agreement for FAIR and XFEL is justified by the size (investments are of the order of 1.000 M€) and the long-standing character of these facilities, interagency agreements should be adequate – if required – for projects on the 100 M€ scale. However, when for a planned science project is in the vicinity of an existing infrastructure, a way of linking the project to the infrastructure should seriously be considered. When the existing infrastructure is a national laboratory a new legal framework and subsequent foundation of a new structure should be examined to allow contributions from foreign funding agencies to the building and running of the facility. ■

6. New infrastructures: a practical start-up guide

The implementation of the "Magnificent Seven" calls for and benefits from European coordination in the course of their realisation and subsequent operation. Independent of the project's setup, either single-sided or distributed, in addition to scientific rationale and technical feasibility funding agencies and key players in the field need to address legal, financial and administrational aspects in the run-up to the implementation process.

The process for realising a scientific collaboration generally proceeds in three phases:

- building consensus about possible and desirable scientific goals,
- the design of an organisation that could achieve those goals,
- an implementation phase putting the design into practice.

While the first step generally is achieved by the scientific community in a process which is science driven, the second and third step involves policy-making partners and funding institutions which are usually guided by national strategic deliberations.

On a national level, there are many established precedents, channels, procedures and funding sources. Inherently international projects are, in general, more difficult to organise and implement and there are yet few established pathways for setting up international scientific projects. The normal procedure is presently to negotiate individually each proposed project, even if it is merely bilateral. For complex and financially challenging projects, in particular, the proponents may see the need for a dedicated formal arrangement and raise the relevant issues to an inter-governmental or at least inter-agency level. This might lead to an increased level of difficulties and subsequent delays in the realisation.

Earlier, the OECD Global Science Forum (GSF, formerly Megascience Forum) has already assessed the legal basis of very large scientific facilities (VLFs) on the scale of ESO or ESA. Infrastructures on a smaller, but still large scale, which are typically an order of magnitude smaller by budget than these VLFs, have also been assessed. Likewise, ESFRI has taken the initiative to start a series of workshops to assess legal forms of research infrastructures of pan-European interest. These issues are particularly important for the next generation of large scale facilities in Europe.

The chapter first gives an overview on the legal framework, financial issues, and the governance structure relevant for international project collaborations. We consider the case that the linking of a new project to an existing entity is an option. Since linking may not always be a desirable or viable solution we also have a look at solutions requiring the creation of a new entity.

The second part addresses issues which, according to experienced project managers, are essential for setting up and managing large science projects. It summarises the advice on these topics by project managers and leading scientists collected either via interviews or at the Task 2.3 October 2007 workshop in Berlin.

6.1 Legal framework, financial issues and governance

In this section we refer in large parts to OECD publications on legal etc. matters relevant for science projects in a transnational setting.

6.1.1 Legal framework

A key requirement in any complex international scientific collaboration is the creation of a body with a legal identity, which is able to undertake or manage the work programme. The necessity of a legal identity for an organisation building and operating an infrastructure stems from the prerequisite of being able to employ staff, purchase goods and services, and possess and secure ownership of property. In order to ensure that project partners make their agreed financial contributions and that the work is carried out in accordance with the agreed work plan legal arrangements may be strictly necessary. The legal identity therefore also includes the ability to sue and be sued.

As depicted in Figure 3 a legal identity can be provided basically in two ways to a body created for the realisation of an infrastructure: either the structure of an existing body can be used or a new body is established for this purpose by a legally binding agreement amongst the participants.

Possible options for a legal identity are:
building consensus about possible and desirable scientific goals,

- an inter-governmental agreement,
- an inter-agency agreement, possibly within the framework of a broad intergovernmental agreement,
- creation of a subsidiary body, often under the umbrella of an inter-governmental and/or inter-agency agreement.

Inter-governmental agreements (or conventions) play a role especially for the creation of a new independent international entity. The participants creating such a new entity are usually countries, which then generally mean that a treaty-level inter-governmental agreement is the choice of the legal identity. In this case, the body which is created is usually an international organisation which is not linked to a pre-existing host entity. One should be aware that because in most countries treaty-level agreements require ratification by the parliaments or their equivalent, complex and time consuming procedures may result. In the astroparticle and astrophysics domain CERN, ESO and ESA are examples for this type of entity.

A less demanding model for the creation of a special purpose body is a civil contract amongst the participants on the level of agencies, i.e. an inter-agency agreement. In this case, the body will probably be created in the country of one of the participants. It is then subject to the laws of that country. The agreement can for instance take the form of a company under national law. This model has been frequently used to set up research infrastructures. Examples in astronomy are Themis S.L. for the solar telescope THEMIS and the LBT Corporation for the LBT.

Linkage to an existing body

In the latter cases the companies are independent entities. However, as stated by E. James in an OECD report[1],

"there are practical advantages in making use of an existing organisation, either as a parent body, or to actually conduct the scientific work. Setting up a completely new organisation will always be a substantial task, the more so when a number of participants have to reach agreement on every aspect of its structure and operation. Using an existing legal identity, which already has the ability to employ staff and carry out a range of other functions, will often be an easier and quicker option."

If the solution of linking to an existing entity is considered, this then leads to further options:

- The existing body may undertake the work itself, perhaps as an extension of its own scientific activities,
- it may contract the work out to one or more other organisations with the necessary facilities and competence, or
- it may establish a subsidiary body especially for the purpose.

Examples for this approach are the X-ray Free Electron Laser (XFEL) and the Facility for Antiproton and Ion Research (FAIR) which are linked via governmental agreements to the existing infrastructures of DESY and GSI, respectively. In both cases a subsidiary body of the corporation type (limited liability company) will be established for the realisation of the facilities.

Auger is based on an international agreement and uses the legal form of a foundation subject to the laws of the host country (Argentina) for the creation of a legal body performing the daily business (see above). The Auger project is linked to CERN as a recognised experiment which allows making use of CERN's financial infrastructure and to Fermilab providing the project management infrastructure.

Other options for a new entity

One could think about making use of European entities established by the European Community as an alternative. These are the European Economic Interest Grouping (EEIG), the European Cooperative Society (SCE), and the Societas Europeae (SE). However, each of these has severe drawbacks.

The European Cooperative Society (SCE) and the Societa Europeae (SE) are not suitable at all for European wide large infrastructures because of their purpose and composition.

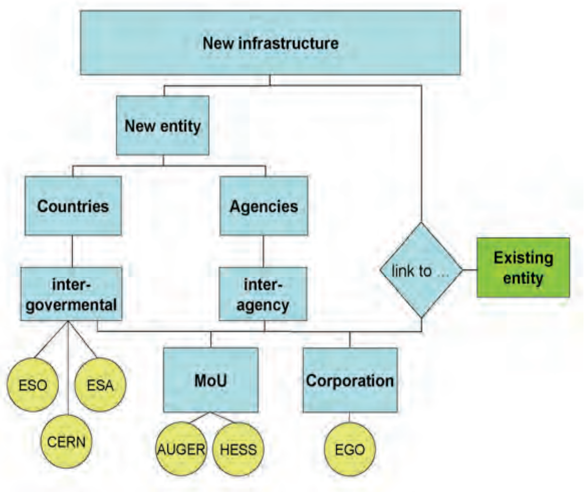
The EEIG is rarely used for cooperation in the field of Research and Development within Europe. The main reason for this is because the EEIG requires unlimited as well as joint and several liabilities of its members. Unlimited liability is the liability without any limitations. The expression "unlimited joint and several liabilities" is a combination of "joint liability" and "several liabilities". If parties have joint liability, then they are each liable

[1] *«Establishing International Scientific Collaborations: Lessons learned from the Global Biodiversity Information Facility» prepared by E. James (http://www.oecd.org/dataoecd/48/8/2073676.pdf).*

up to the full amount of the relevant obligation. In the case of several liabilities the parties are liable for their respective obligations only. The case of "joint and several liabilities" describes the situation if a claimant pursues one party and receives the full payment, that party can then pursue the other obligors for a contribution to their share of the liability.

This makes it impossible for universities and other legal entities primarily financed by public authorities, such as research organisations, to participate. Furthermore private institutions would also be aware of large risks involving any collaboration under these conditions.

This explains why efforts are made at the moment towards the formation of a new legal entity for the European Area which could be adapted by collaborations in the Research Area.



Legal identities for research infrastructures and facilities. Examples for existing infra-structures/facilities are shown as yellow circles.

6.1.2 Considerations about finances

With regard to financial issues, individual solutions have to be found since there is no single best way of dividing contributions to international collaborations between the partners be it countries or agencies. There is a whole suit of options for determining the contributions. Flat fees and sliding scales based on GDP are often be used, the maximum contribution of any one country may be limited, and a flat basic component can be applied. The use of GDP may not be always an acceptable or desirable solution because it neglects possible national aspirations and strategic interests. This can make contributions deviate in either direction from what GDP suggests desirable. Which option finally is selected for a transnational project necessarily depends on these considerations, as well as on the size of the project and on the status of the partners. If a new project is linked to an existing transnational infrastructure usually the funding model of that infrastructure is used also for the new entity.

A method frequently applied by international organisations to calculate the partner contributions is to consider a percentage of the project budget rather than an amount in currency (e.g. ESO). This approach has the advantage that income and expenditure are always in balance. It should be noted, however, that this funding model has a possible disadvantage in the start-up phase of a project if the number of partners is not yet clear. Then application of this model could create considerable uncertainty as to the amount participants would have to pay, and hence difficulty in seeking funds from government or other sources. In such a situation it might be a better solution to decide for fixed contributions.

6. New infrastrucures and linking:

A special situation may be generated by the use of in-kind contributions. The problem here is that it is difficult to place an accurate value on an in-kind contribution. In the end a project might find itself without sufficient cash. The question of how much can be accepted in the form of in-kind contributions will have to be decided case by case and tools are needed to convert in-kind contributions to cash. Clear provisions should be made in a Memorandum of Understanding (see below) to avoid this problem.

In addition to these considerations about managing finances it might of interest to take into account a cultural difference which could play a role in trans-Atlantic collaborations. In Europe the usual procedure of funding agencies is to try to continue funding a project even if substantial cost increases incur unexpectedly or if the scope of the project has to be re-adjusted significantly. Non-European funding agencies may deal differently with such situations. For instance, funding agencies in the U.S. normally do not extend the budget beyond the original budget estimates including contingency. The project management of an international project must consider such differences and shall seek for a satisfactory solution.

6.1.3 Governance structure for an international collaboration

The collaboration and its governance structure can be established by a Memorandum of Understanding (MoU). It provides the tools to make an infrastructure independent and addresses the need for a body to have a legal identity.

Note: In the context of a Memorandum of Understanding the question of what constitutes a binding agreement is complex and the meaning of the term may vary from one country and legal jurisdiction to another. Even if consideration is limited to agreements between governments, there is a range of possibilities. An agreement that is accorded the status of a treaty, requiring the approval of parliament, in one country, may be approved by executive action in another. An agreement that is seen by one country as committing it only to use its best efforts to comply may be interpreted elsewhere as having much greater force. This needs to be borne in mind in drafting and negotiating text.1

A Memorandum of Understanding regulating the governance structure should generally describe three bodies:

- the Governing Board,
- the Secretariat Host,
- the Secretariat.

The elements constituting a template for a Memorandum of Understanding are shown in Figure 4.

The Governing Board is the principal decision-making body for the collaboration. It conducts its business in accordance with the provisions in the MoU which regulates the membership in the Governing Board and the voting procedures. Usually it is a non-binding agreement and therefore does not confer legal powers on the Governing Board. This means that the Governing Board then has no ultimate authority to enforce its decisions.

Ideally but not necessarily, the Secretariat Host is an existing body with a legal identity. The host's role is to provide the location, facilities and services needed by the Secretariat. Furthermore, the legal status required for the Secretariat is provided by the host. The Secretariat may be created within the Secretariat Host or alternatively as a separate organisation. The need for a legal identity of the Secretariat results from the requirement of being able to employ the staff, to hold the project's funds and other assets and to enter into financial contracts with participants guaranteeing their contributions. The Secretariat usually is managed by an Executive Secretary or Director whose responsibilities are described in the MoU.

The relation between the collaboration and the host country is regulated in a Country Agreement. In particular, the status, rights and obligations of the collaboration and its secretariat vis-à-vis the laws of the host country need to be defined in this agreement. The relationship between the host on one side and the collaboration and its secretariat on the other side is defined in the Host Agreement. It may be meaningful to propose a Secretariat separate from the Secretariat Host. This would be useful to keep the project and its Governing Board separate from the host country's or the Secretariat Host's influence. It should be taken into account, however, that even in the case that countries interested to host the Secretariat offer a separate legal entity; the entities proposed may be different.

A possible form of legal entity for the Secretariat may be an independent, international, non-profit tax-exempt organisation. According to some countries' law it may be possible to grant such a status (as well as accompanying immunity) to an international organisation that receives its income through membership fees from member states and which does not perform commercial activities. Other possibilities are bodies established under the domestic laws of the host country without international status, although with certain taxation exemptions. Arrangements will always depend on the laws of the host jurisdiction. There is, therefore, a case for deciding the host jurisdiction as early as possible in the establishment process, allowing agreements and other documents to be drafted in the knowledge of the law that will apply to them.

Finally, issues of Intellectual Property Rights (IPR) and the model for the financial contributions of the partners should be regulated in the MoU. As mentioned above, there exist various payment contributions models which should fit the requirements of each individual project and the project partners. Questions of how in-kind contributions are handled or how partners from small countries interested in participation can be incorporated adequately, especially in large projects, should also be taken into account. ■

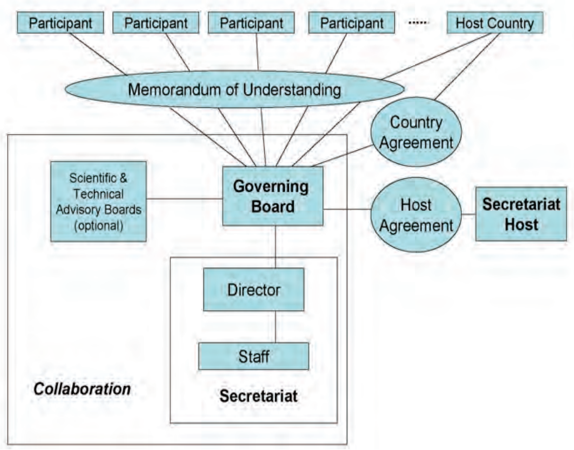


Figure 4 Elements of a template governance structure (adopted from Michalowski, 2005 [2])

[2] *Stefan Michalowski, A Template for Establishing, Funding, and Managing an International Scien-tific Research Project Based on an Agreement Between Governments or Institutions, OECD 2005*

Conclusions

In those cases where a science endeavour in its size and duration can be characterised as a project with a well defined beginning and a well defined end, it should be motivation enough to carefully analyse ways of linking in terms of sharing, distribution, and managing such a project.

Nevertheless, when the installation of an infrastructure is required to carry out an astroparticle physics experiment it is again important to carefully examine if the whole task can be divided into a project part that finishes at the end of the science mission and an infrastructure part requiring a long-term planning; an experiment that is carried out in an Underground Laboratory is a good example for such a situation where the project is kept apart from the actual infrastructure, the Underground Laboratory. In the same way of thinking one may also imagine the installation of an Underwater Laboratory that - among other functions - enables the realisation of a neutrino project. In actual fact, the implementation of the infrastructure shall then be envisaged outside the science project that later makes use of the infrastructure. Consequently, the major task for the science project is to define the legal and technical interfaces to the infrastructure.

A clear benefit for astroparticle physics projects is the possibility of receiving CERN recognised experiment status. This link to CERN opens up a variety of options to make use of CERNs infrastructure. The example of the Pierre Auger Observatory demonstrates that the project's cash flow running through a CERN account helped it to avoid currency instabilities in the host country. The confidence of the Auger partners in a real common pot action based at CERN is quite large.

Generally speaking, cooperation (and linking) between unequal partners is intrinsically difficult. To implement cooperation all parties involved should feel a benefit in a win-win-situation. For example, among the underground laboratories within COMAG, the Gran Sasso Laboratory is by far the largest and most developed laboratory. Taking into account the interest of existing and emerging partners and the demands of a variety of underground laboratory users requires a careful management. It is recommended that all stakeholders (present and potential operators and users of underground laboratories and funding agencies involved in underground sciences) define a forum to discuss the next levels of linking.

Underground laboratories are important for the future of astroparticle physics. At least four out of the seven prioritised projects in the ASPERA Roadmap require an underground surrounding. As the entire field of astroparticle physics undergoes an internationalisation, underground laboratories start entering the play of global sharing of large facilities, and future plans for further underground laboratories in several European countries (e.g., Finland, Poland, and Romania) exist, more advanced aspects concerning sharing, contributing, and managing of underground facilities must be considered. To face this situation the following steps are required:

- Establish a common strategy for deploying the new generation of experiments.• the Secretariat Host,
- Assess the future demands for underground laboratory space in Europe.
- Create a solid intergovernmental structure to advocate to a central authority the resources and the scientific programme.
- Develop a collaboration on a European level that allows the underground laboratories to speak with one voice and establish a common strategy.
- Define a model for a possible linking.

So far, the linking among existing infrastructures is being implemented by means of the COMAG network, established in the framework of the EU funded project ILIAS. Within COMAG, the four European underground labs share their experiences concerning safety standards and outreach. Therefore, it represents a useful but limited level of linking. Moreover, the EU funded project ILIAS will end in March 2009. It follows that the first step for improving the existing cooperation is to establish a tool for continuing COMAG independently from short-term project funding. Within ASPERA Task 3.3 a Memorandum of Understanding shall be developed to enable such a step for the involved stakeholders. Furthermore, the linking of underground labs by sharing information and projects should be extended to training of young researchers.

Further developments of linking are distributing resources and projects among labs, in particular access to external users and R&D plus tests, and, at an upper level, establishing a common management of resources and future installations, including a common scientific programme.

Concerning the last and most advanced level of linking, it should be noted that the major difficulty in its implementation arises, not from the different size and background of existing labs, but from the fact that they are born independent. A completely different situation would be the ex novo establishment of a solid intergovernmental structure, on a CERN type model, or a new «axis» for CERN with an underground labs infrastructure.

A.1 Glossary

AIP	Astrophysikalisches Institut Potsdam
ALMA	Atacama Large Millimetre Array
ANTARES	Astronomy with a Neutrino Telescope and Abyss environmental Research
APEX	Atacama Pathfinder Experiment
ASTRON	Netherlands Institute for Radio Astronomy
BMBF	Bundesministerium für Bildung und Forschung
CEA	Commissariat à l'énergie atomique
CERN	Conseil Européen pour la Recherche Nucléaire
CIEMAT	El Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas
CSIC	Consejo Superior de Investigaciones Científicas
CNRS	Centre National de la Recherche Scientifique
COMAG	Coordination and Management Committee of the European Underground Labs
CRESST	Cryogenic Rare Event Search with Superconducting Thermometers
CTA	Čerenkov Telescope Array
DESY	Deutsches Elektronen-Synchrotron
EAL	European Associated Laboratory
EGO	European Gravitational Observatory
ELIXIR	was European LIquid Xenon Identification of Recoils
ERID-Watch	European Research Infrastructure Development Watch
EIROforum	European Intergovernmental Research Organisations Forum
ESFRI	European Strategy Forum on Research Infrastructures
ESRF	European Synchrotron Radiation Facility
ESA	European Space Agency
ESO	European Southern Observatory - European Organisation for Astronomical Research in the Southern Hemisphere
EURECA	European Underground Rare Event Calorimeter Array
EUSO	Extreme Universe Space Observatory
FAIR	Facility for Antiproton and Ion Research
Fermi	Fermi Gamma-ray Space Telescope (ex GLAST)
FNAL	Fermi National Accelerator Laboratory
FOM	Stichting voor Fundamenteel Onderzoek der Materie
FZK	Forschungszentrum Karlsruhe
GDP	Gross Domestic Product

GERDA	GERmanium Detector Array
GLAST	Gamma-ray Large Area Space Telescope (renamed to Fermi)
GSF	Global Science Forum
GSI	Gesellschaft für Schwerionenforschung
H.E.S.S.	High Energy Stereoscopic System
IceCube	Neutrino Telescope at the South Pole
ILIAS	Integrated Large Infrastructures for Astroparticle Science
INFN	Istituto Nazionale di Fisica Nucleare
IN2P3	Institut National de Physique Nucléaire et de Physique des Particules
INSU	Institut National des Sciences de l'Univers
IRFU	Institut de Recherches sur les lois Fondamentales de l'Univers
JEN	Junta de Energía Nuclear
KATRIN	Karlsruhe Tritium Neutrino Experiment
KIT	Karlsruhe Institute of Technology
KM3NeT	Cubic Kilometre Neutrino Telescope
KVL	Kernfysisch Versneller Instituut
LAGUNA	Large Apparatus studying Grand Unification and Neutrino Astrophysics
LBT	Large Binocular Telescope
LHC	Large Hadron Collider
LIGO	Laser Interferometer Gravitational Wave Observatory
LNGS	Laboratori Nazionali del Gran Sasso
LNS	Laboratori Nazionali del Sud
LOFAR	Low Frequency Array
LSC	Canfranc Underground Laboratory
LSM	Laboratoire Souterrain de Modane
MAGIC	Major Atmospheric Gamma Ray Imaging Čerenkov Telescope
NASA	National Aeronautics and Space Administration
Nikhef	Nationaal instituut Institute voor for subatomaire Subatomic fysica Physics
NIOZ	Royal Netherlands Institute for Sea Research
NOA	National Observatory of Athens
NROA	National Radio Astronomy Observatory
NWO	Nederlandse Organisatie voor Wetenschappelijk Onderzoek
OECD	Organisation for Economic Cooperation and Development
ORM	Observatorio del Roque de los Muchachos
PSI	Paul Scherrer Institute
RHIC	Relativistic Heavy Ion Collider
SKA	Square Kilometre Array

SLAC	Stanford Linear Accelerator
SRON	Netherlands Institute for Space Research
ST-ECF	Space Telescope-European Coordinating Facility
STFC	Science and Technology Facilities Council
THEMIS	Télescope Héliographique pour l'Étude du Magnétisme et des Instabilités Solaires
VISTA	Visible and Infrared Survey Telescope for Astronomy
VLT	Very Large Telescope
VST	VLT Survey Telescope
XFEL	X-Ray Free Electron Laser

A.2 Summary of the Berlin workshop

« Linking of existing infrastructures »

26.10.2007, Berlin, Head Office of the Helmholtz Association

Summary

1. Introduction

The purpose of investigating linking of existing infrastructure within ASPERA is to understand how the next generation of projects in astroparticle physics can be built. Since resources are limited it is important to maximise the use of existing infrastructures and create a minimum of new structures. Based on the requirements of the individual projects, which are elaborated at the beginning of the task, options of linking and possible limitations shall be investigated.

In this first meeting on « Linking of existing infrastructures », project managers and spokes persons with experience in larger size projects met with leading scientists and project managers involved in the current planning of the next generation projects in astroparticle physics. The initial exchange of experiences and requirements between these two groups shall serve as a starting point.

Beyond the direct benefit from the exchange for the individual start-up projects, the results of the first meeting shall be used to work out the important managerial, administrative, financial, and legal aspects concerning the successful realisation of large projects. In a second step, a careful consideration of the requirements shall allow conclusions on how to share management and administration of upcoming projects in astroparticle physics and understand what kind of linking of existing infrastructures is necessary and possible.

Before the meeting, guidelines were compiled to help the participants in preparing their contributions to the first part of the workshop, the presentation session. All participants were able to present their projects, experiments, or infrastructure that they are working on or planning for with special emphasis on management, administration as well as financial and legal issues. This was followed by a discussion in the second part, in which the participants could exchange their views and point out relevant issues that should be further examined or worked on by ASPERA. Results were noted on a flip chart.

2. Analysis

The presentations and the succeeding discussion during the workshop provided a large variety of input ranging from very general topics to important detailed questions to be addressed. To prepare the analysis of the meeting, the participants' input has been sorted and the following list of categories has been defined: "essential setup issues", "management structures", "staff", "finances", "legal aspects", "relation between management and stakeholders", "special circumstances", "technical coordination", "specific needs for cooperation beyond Europe", "host and linking", "site issues", "safety" as well as a more general category "problems, difficulties and challenges".

A summary of all relevant input collected from the presentations and the discussion in these categories for running and future projects, respectively, is provided in the document ASPERA_Berlin_2007-10-26_summary-table.doc. Additionally, the table provides information that has been collected by L. Metzger and T. Berghöfer during discussions with project managers of ATLAS and KATRIN when visiting these experiments. Furthermore the document named ASPERA_Berlin_2007-10-26_m-structures.ppt includes all the charts of management structures.

For the different categories the following outcomes can be pointed out:

- **Essential setup issues**

It is essential to establish realistic goals and to define responsibilities to avoid inefficiency and insecurity. It is crucial to start as early as possible with e.g. setting up a core team, management, organisation, project design and hiring the right people.

- **Management structures**

Strong Project Leadership and a dedicated and flexible internal structure are essential to ensure a professional work flow. A further important aspect is the communication between management, collaboration, and funding agencies.
The specific management system of KATRIN is a good example of how technical coordination is integrated in the management.

- **Staff**

It is essential to hire high quality staff and to ensure that a suitable amount of management staff is available during planning, construction and operation-phase. Co-location of the staff is important to intensify communication and coordination within the management team.

- **Finances**

One of the main issues is the budgeting of costs and the decision to consider contingency. Take care of running costs and provide a scheme of how to cover these costs. Avoiding tax payments and cost controlling have to be discussed. Furthermore, crucial to the success of the experiment is the coordination of in-kind and cash contributions; in case of problems cash is the only method to keep going.

- **Legal aspects**

Legal Agreements are needed concerning internal relations (e.g., staff, site, techniques) and regarding external relations such as cooperation with the host lab, other institutions, and funding agencies. Generally speaking, many existing projects and experiments are based on a MoU. The task is to find a legal entity for the project and choose a suitable legal framework.

- **Relation between management and stakeholders**

The project management is responsible for dealing with subcontracts, deliverables from all groups, arrangements with new partners/contributors, and contacts including industrial partners. Furthermore, it maintains the credibility with all stakeholders, incl. risk management analysis.

- **Special circumstances**

The requirements of the next generation underground experiments need to be discussed with the underground labs.

- **Technical coordination**

Supervision is essential for the success of a project. The KATRIN experiment has a detailed structure for the technical coordination and could serve as a model for other experiments. The site of a project may require specific solutions concerning the logistics, the technical coordination, and the installation.

- **Specific needs for cooperation beyond Europe**

Different systems in accounting and other formal differences between Europe and e.g. the U.S. require detailed information about the other system. Agreements in advance may help to minimise friction.

- **Host and linking**

A host lab with an infrastructure that can be used right from the beginning is essential. Check the costs of services provided by the host lab. Collaborations may consider becoming a CERN Recognised Experiment status to be able to make use of CERN infrastructure. In case of a distributed management check the efficiency and costs.

- **Site issues**

The site of experiments may produce extra costs and require agreements with countries, land owners, etc. Remote operation might be an option. Hiring personal for a remote location may be difficult.

- **Safety**

Running projects show that it is essential to have a detailed safety plan especially for the staff and as early as possible. Safety of personnel is more important than installation goals.

- **Problems, difficulties and challenges**

A variety of organisational, financial and timing issues that are project- specific and do not fit in the above given categories (cf. document ASPERA_Berlin_2007-10-26_summary-table.doc)

3. Concluding Remarks and Future Prospects

Participants of the workshop had a direct benefit from the interesting exchange with each other. The participants list may help to keep the contacts between experienced project managers and those who want to start new projects.

With certain instruments like check lists or libraries of existing documents, ASPERA could ease the process of setting up and running a project regarding the managerial issues. These shall be prepared within Task 2.3

Additionally, within Task 2.3 the potential of linking with the known large transnational organisations CERN and ESO shall be studied.

Where needed, further expert workshops will be planned to investigate specific requirements for the management and the linking of existing infrastructures.

A.3 Lessons learnt from experienced project managers on issues for the start-up phase and management

In this subsection we confront the aspects discussed above on a general level with the real life experience of high-level project managers and reproduce their advice on how to set up and manage projects. From the point of view of funding agencies all measures leading to the success of a project are desirable. It is therefore meaningful to encourage proponents of new projects not only to consider the legal and management framework issues described above but also to search the advice of experienced project managers.

A.3.1 Advice on issues for the start-up phase

Definition of Methods

The main task of the project management at the beginning of each project is to determine which management methods will be used in this specific project and how they should be assessed.

The management structure depends on whether the new project uses the linking option or whether a "stand-alone" solution is chosen.

Establish realistic project goals

The project goals should be defined in a realistic manner both from the scientific and the management point of view. Especially the issues of finances and personnel should be considered realistically and estimated in an appropriate manner. Existing projects have shown that a plan, which is too optimistic, may end up in an even more expensive and complicated situation as would have been the case with a more conservative plan.

Making use of existing structures could prevent the necessity of "re-inventing the wheel" for many management aspects.

Communication, Information & Reporting

These are key issues of successful project management. Rules have to be defined for communication and information exchange as well as for the reporting within the collaboration and managing bodies, and towards the funding agencies. This includes the question of "who is informed by whom, about what and when". Therefore, establishing communication and information channels is an indispensable task.

All project managers interviewed emphasised that in large projects, soft skills of the staff at key positions are very important. Insufficient communication and information skills might lead to misunderstandings, complications and mistakes within the project which could result in delays of the project. With appropriate skills and tools these conflicts can be avoided or at least the settling of a conflict will be faster, cheaper and more satisfactory for all involved parties.

In the linking environment existing and well-established communication channels could be used

An important aspect for a project in the start-up phase is to monitor and communicate with processes running concurrently with the project such as ASPERA, ApPEC, and ESFRI.

Management

The management structure should be set up in a way that the decision making process is clear. Ideally, only one body/person is taking final decisions. An exact 50:50 sharing between two partners/persons should be avoided (cf. ALMA).

The establishment of a well-organised management board is essential for the success of a project. This should be created as soon as possible to give the project the required organisational frame. In the start-up phase of a project it is important to set up a core management group. The management should follow the requirements of the parties involved and the characteristics of the project itself. Here again the bottom-up principle is highly important and one of the essential points to be considered regarding management. Interlocking between the researchers and the management and administration of a project is essential for its success.

A crucial task for the management board is the nomination of a suitable coordinator or project leader. This person should be experienced in project management, group leading, and should have a special knowledge regarding the scientific, technological, managerial, and political challenges of the project. Generally speaking, the coordinator's position is more than a fulltime job. He or she should have certain flexibility, particularly concerning time. Organisational skills are mandatory and the project leader should be socially and communicatively talented. The more different countries or continents are involved in the project, the more a good knowledge of the different cultures is helpful. Excellence in science thus is not a sufficient criterion for the selection of a person for position of the project leader.

The management board and the project coordinator define deliverables and establish accounting mechanisms for the project. Their duty includes also the definition of responsibilities during the whole project.

The management tasks include the development of partnerships with the key participants of the project. This is an issue which is closely related to the subject of communication and information.

Project managers should investigate whether in the participating national organisations there are persons who have already experience in the establishment and managerial support of large projects and make use of this knowledge.

Staff and Technical Coordination - "Get the best"

In order to hire the best suited staff the job market should be examined. The level of salaries required to hire the desired staff should be checked against the financial constraints of the project. Depending on the hiring organisation different salary systems may have to be applied.

Furthermore, depending on the exact characteristics of the project it is important for some projects that special experts regarding safety, installation operations, special technical circumstances or unusual site issues are hired when starting the project.

Budget and Finances

The concept of how finances are organised differs from project to project and may also be influenced by certain traditions or given by the host institution. Cultural differences may also be important.

All interviewed project managers pointed out that it is important and necessary for a successful project that the design phase gets completed
. A well worked-out design saves time and money during the construction and operation phase. One should realise that any additional R&D during the construction or operation phase may lead to delays and thus leads to extra costs.

In Europe and the USA the general approach is to have a short design and preparation phase. The advantage certainly is that a technical design report can be presented to the public and especially to the national funding agencies very fast. However, experience shows that an approach with a short design phase is prone to later, possibly expensive, design modifications during the construction phase. In Japan the approach is different. Here the design and preparatory phase last much longer than in Europe and the USA to ensure a very detailed planning and to avoid expensive changes during the construction phase of a project. Both approaches have advantages and disadvantages and may result in conflicts when planning a large project together.

It is essential to have an estimate of all costs of a project as detailed as possible right from the beginning. The more advanced the project is the more accurate the cost estimates should be.

Financial rules should be established right from the beginning for all participants. Depending on the partner's contributions (cash/in-kind) it is important to develop an internal project accounting system that also takes into account inflation. The internal accounting can be based on units of project components and/or a currency with exchange rates fixed to a certain date. The project accounting system should also take into account the compensation of R&D work necessary for the progress of the project. Start up funding is often essential to test new concepts in the design phase.

Legal aspects

Right from the beginning the project management should consider legal aspects as important and the project should be assisted by a legal expert. Finding the right legal framework is often a difficult task which cannot be solved without legal experts consulting the project management. Also during later phases of a project legal issues may appear which need to be addressed in a timely manner by legal experts knowing the project and its circumstances. Legal aspects mean the general legal structure of the consortium as well as agreements in between the collaboration, the funding agencies or site-related agreements when a project is build abroad.

Establishing an organisation

Whether a new project requires the establishment of an own (legal) organisation/entity should be considered in the very beginning. A careful discussion of the circumstances and project needs is important. It might be more cost effective to make use of existing infrastructure. Nevertheless, a project may need to establish a new organisation if it neither can be linked to an existing organisation nor can exist on its own. This will be discussed further in the chapters about "host" and "linking".

It must be kept in mind that establishing an organisation with several European or international partners might be a complicated process and it may take a long time until final agreements are signed by all partners (c.f. EGO).

Structure of reliability (mutual trust)
Establishing and maintaining a structure of mutual trust between all partners involved in a project, either belonging to the collaboration, management, funding agencies, or decision makers on the political level, is a key issue for being successful. This is not only important between national partners, but especially between international partners due to the different national backgrounds which can involve different kinds of organisation, cooperation and various systems of information and responsibilities.

A.3.2 Advice on management structures and relation between management and stakeholders

Internal Organisation of the Management
Project managers pointed out that among the tasks of the management there is in particular a need for a project plan, task schedules, milestones, an overall cost schedule, monthly progress report and a yearly financial planning.

Especially for the aspect of management it is important to reduce prejudices against managerial structures in general. It is clear that management structures which hinder science should be avoided in general. Nevertheless, the existing successful projects demonstrate that a certain degree of structure and management is not only necessary, but can also support the success of the science project itself. The balancing between "enough regulation or structure" and "too much regulation or structure" has to be done in a way satisfying both the researchers and the funding agencies. Project management and structure should not be established as an end for itself. Rather, they should be considered as means to an end and as indispensable for the successful construction and maintenance of an experiment.

An important issue is the way of "making decisions". Certainly, the management should seek consensus whenever possible, but should also be strong enough to decide where this is not possible. This might be a problem if the project management is shared between equal partners. An example is the way of how the ALMA project is organised. The management of ALMA is divided between European and American partners with shares of 50:50. The responsible institutions are ESO and NROA, respectively. Each partner has its one project manager. Every decision about an expenditure of more than 500.000 Euros has to be approved by the joint ALMA Board which naturally slows down the decision process. In general, projects with double (management) structures prove to be complicated in decision making (c.f. management of the ALMA project) and may block each other in case of problems. It should be realised that any delay in the project costs money.

The core management team shall serve as an umbrella to the project team. This means that it has the overview of ongoing procedures and takes the responsibility for the implementation of decisions. It is therefore important that the management gets regularly an overview of the output of every department. The management also develops strategies and revises goals as needed.

Often a scientific director and a management director are hired from the beginning on for the whole duration of the project. Experienced project managers pointed out that the different phases of a project may have different demands on the project management. This may also require changing the project leader during the project phases. A typical phase transition happens when a project is commissioned and the operational phase starts.

Management – staff relation

The experience gained at Auger is that management is best done by the scientists themselves. Within Auger they followed this scheme which was already applied at Fermilab.

From point of view of Auger the project has been successful because all involved parties are driven by a passionate commitment to the science ambition and aims without following the rigid theoretical guidelines of professional management. Nevertheless it must be stated that this does not mean that there is not any structure. As the project manager of Auger points out there is a need to have some rules to stick on and to have clear responsibilities.

The lesson learnt from the Auger project was that it is essential for the success that the Project Manager was available all the time. That means visiting regularly the different partners, having a direct exchange of information and talking face-to-face about problems. This allows immediate reaction to newly occurring problems.

Relation between management and stakeholders

The contact between project manager of the experiment and the Spokesman of the various Funding Agencies is crucial to the success of the experiment. Therefore it is essential to have regular meetings between these people and to understand the importance of that relation from both sides.

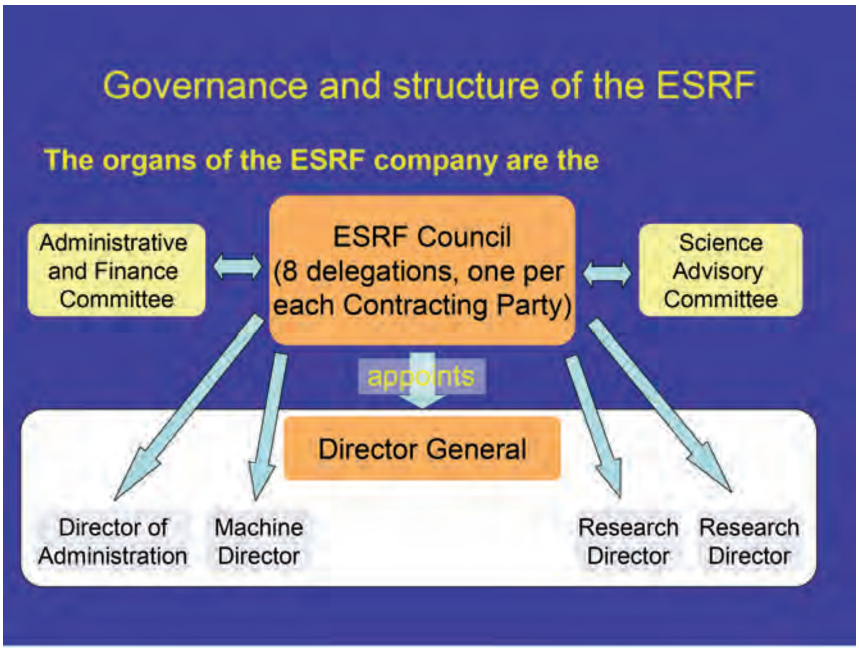
Challenges

In the interview with the Auger project manager he pointed out that in the beginning the frequent technical reviews, change control actions and requests for cost and schedule information were often considered bureaucratic harassment. However, once the essential role of these tools was understood, the Auger collaborators accepted and even promoted them.

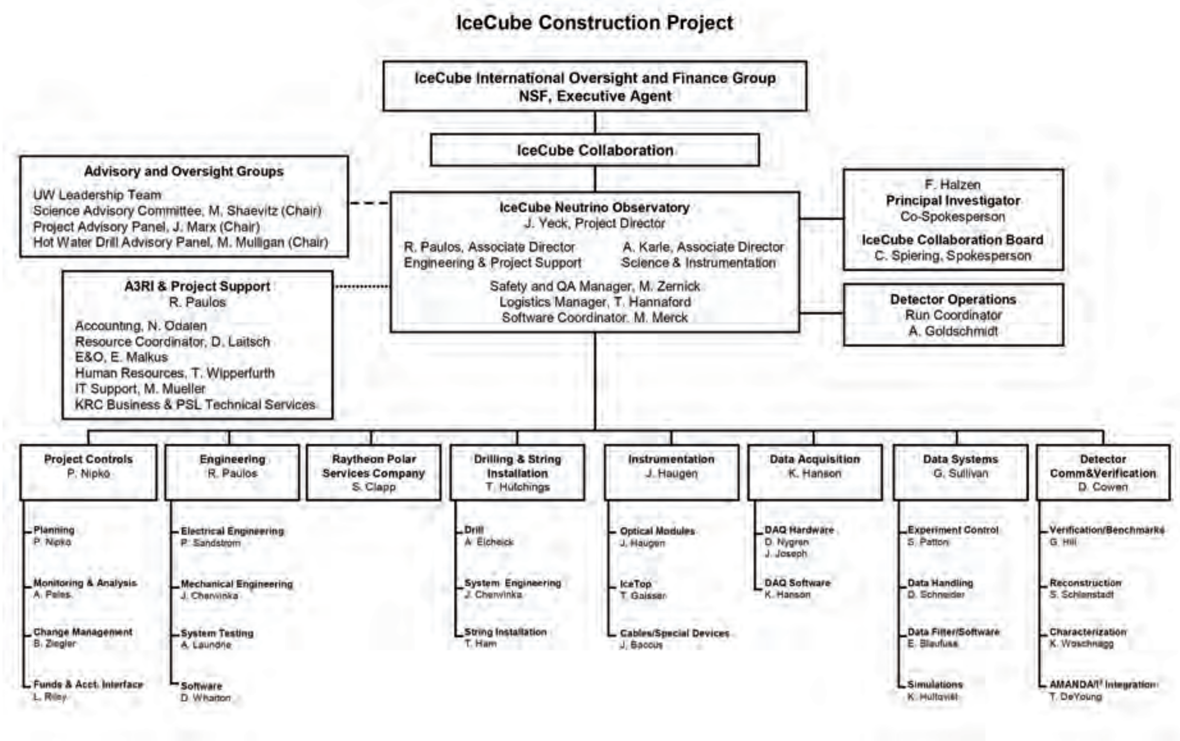
A.4 Compilation of management structures presented during the workshop

European Gravitational Observatory EGO:

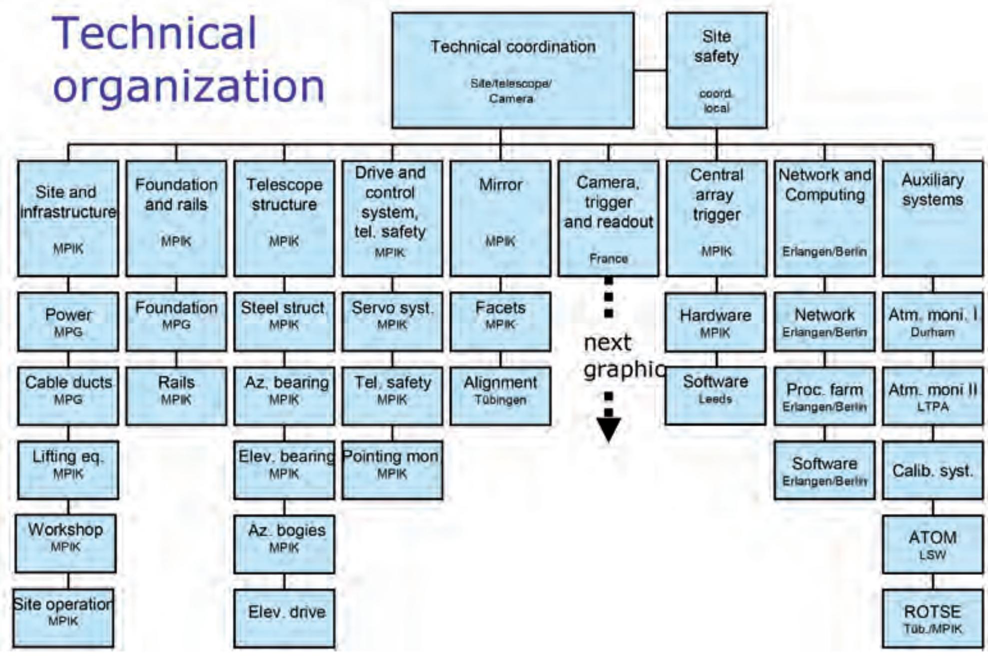
European Synchrotron Radiation Facility ESRF:

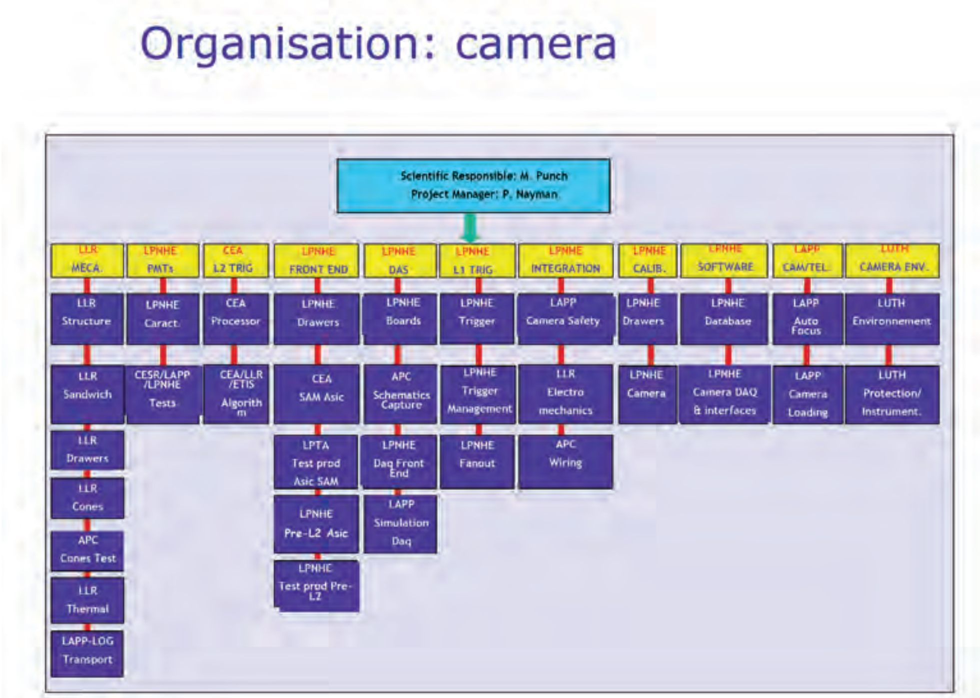


IceCube (as of October 2007):

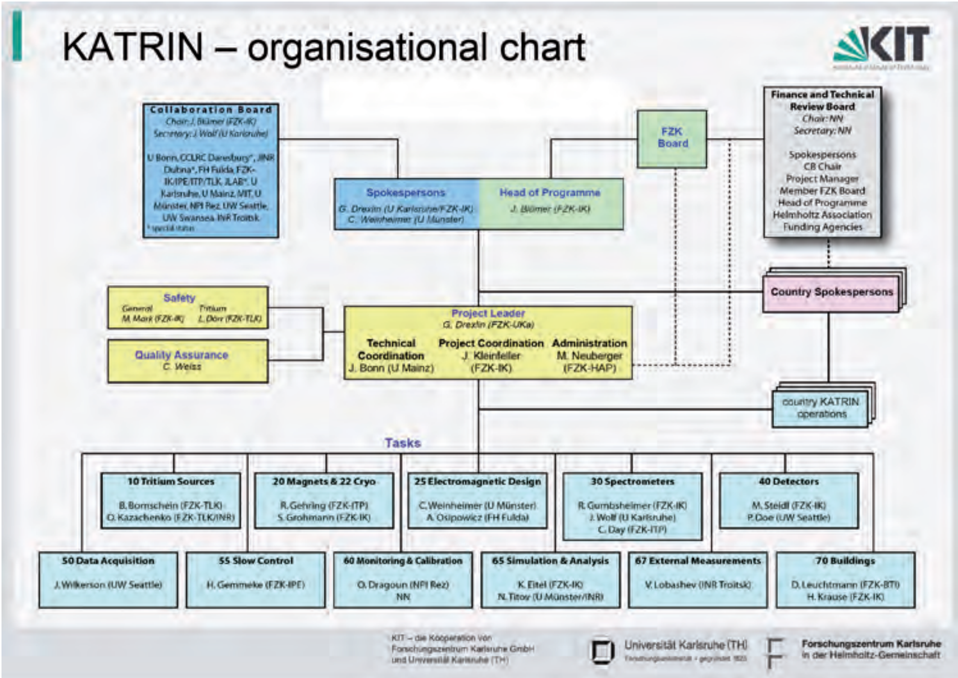


HESS:

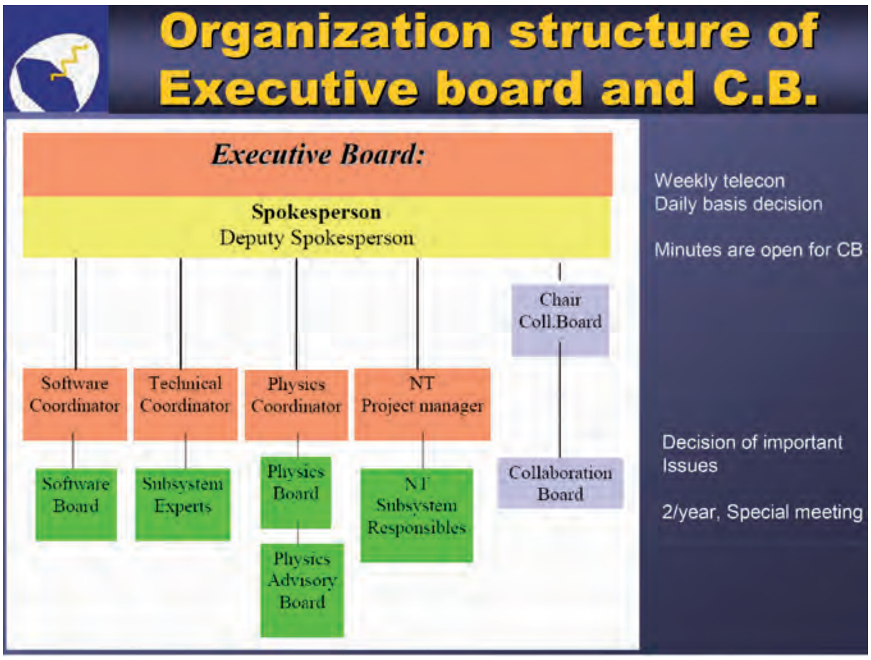

Technical organization
Technical coordination
Site/telescope/ Camera
Site safety
coord. local
Site and infrastructure
MPIK
Foundation and rails
MPIK
Telescope structure
MPIK
Drive and control system, tel. safety
MPIK
Mirror
MPIK
Camera, trigger and readout
France
Central array trigger
MPIK
Network and Computing
Erlangen/Berlin
Auxiliary systems
Power
MPG
Foundation
MPG
Steel struct
MPIK
Servo syst.
MPIK
Facets
MPIK
next graphic
Hardware
MPIK
Network
Erlangen/Berlin
Atm. moni. I
Durham
Cable ducts
MPG
Rails
MPIK
Az. bearing
MPIK
Tel. safety
MPIK
Alignment
Tübingen
Software
Leeds
Proc. farm
Erlangen/Berlin
Atm. moni II
LTPA
Lifting eq.
MPIK
Elev. bearing
MPIK
Pointing mon
MPIK
Software
Erlangen/Berlin
Calib. syst.
Workshop
MPIK
Az. bogies
MPIK
ATOM
LSW
Site operation
MPIK
Elev. drive
ROTSE
Tüb./MPIK


Organisation: camera
Scientific Responsible: M. Punch
Project Manager: P. Nayman
LLR MECA.
LPNHE PMTs
CEA L2 TRIG
LPNHE FRONT END
LPNHE DAS
LPNHE L1 TRIG
LPNHE INTEGRATION
LPNHE CALIB.
LPNHE SOFTWARE
LAPP CAM/TEL.
LUTH CAMERA ENV.
LLR Structure
LPNHE Caract.
CEA Processor
LPNHE Drawers
LPNHE Boards
LPNHE Trigger
LAPP Camera Safety
LPNHE Drawers
LPNHE Database
LAPP Auto Focus
LUTH Environnement
LLR Sandwich
CESR/LAPP /LPNHE Tests
CEA/LLR /ETIS Algorith m
CEA SAM Asic
APC Schematics Capture
LPNHE Trigger Management
LLR Electro mechanics
LPNHE Camera
LPNHE Camera DAQ & interfaces
LAPP Camera Loading
LUTH Protection/ Instrument.
LLR Drawers
LPTA Test prod Asic SAM
LPNHE Daq Front End
LPNHE Fanout
APC Wiring
LLR Cones
LPNHE Pre-L2 Asic
LAPP Simulation Daq
APC Cones Test
LPNHE Test prod Pre-L2
LLR Thermal
LAPP-LOG Transport

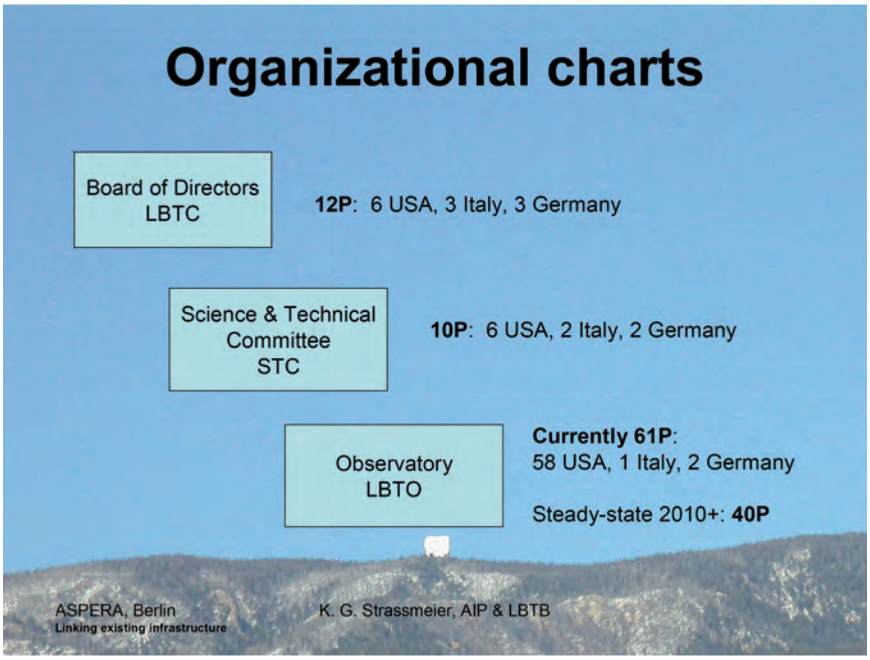
KATRIN:

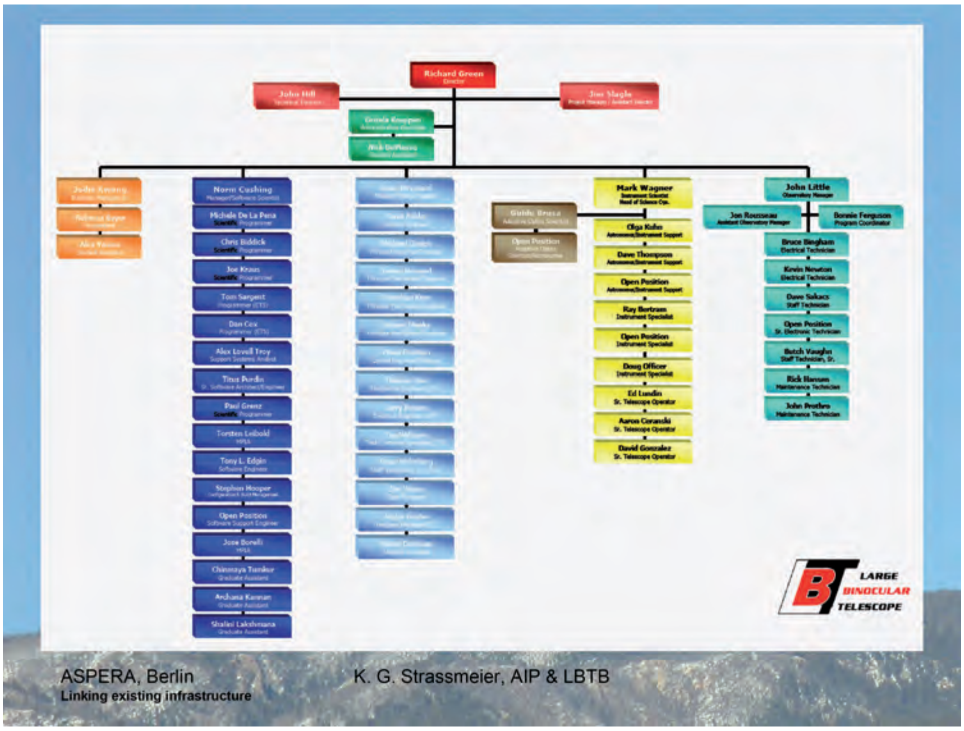


MAGIC:

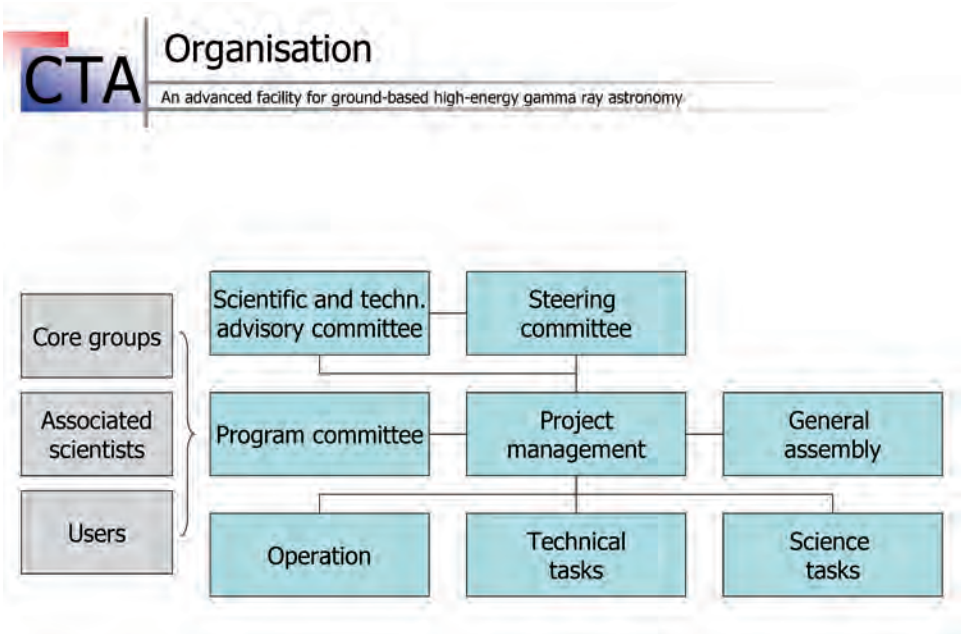


Large Binocular Telescope LBT:

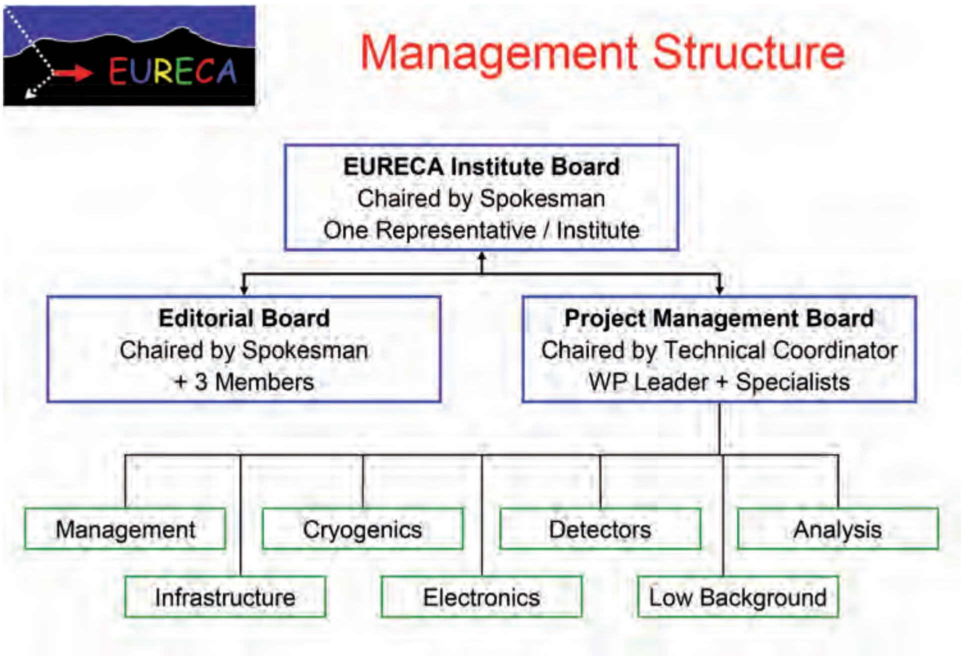




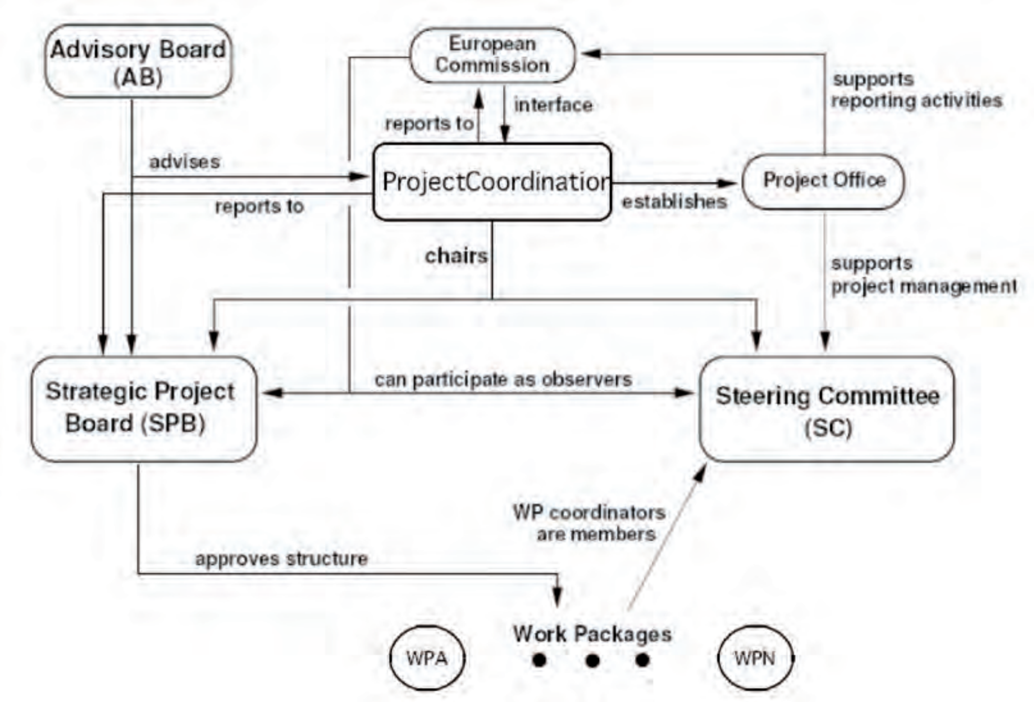
CTA:


CTA
Organisation
An advanced facility for ground-based high-energy gamma ray astronomy
Core groups
Associated scientists
Users
Scientific and techn. advisory committee
Steering committee
Program committee
Project management
General assembly
Operation
Technical tasks
Science tasks

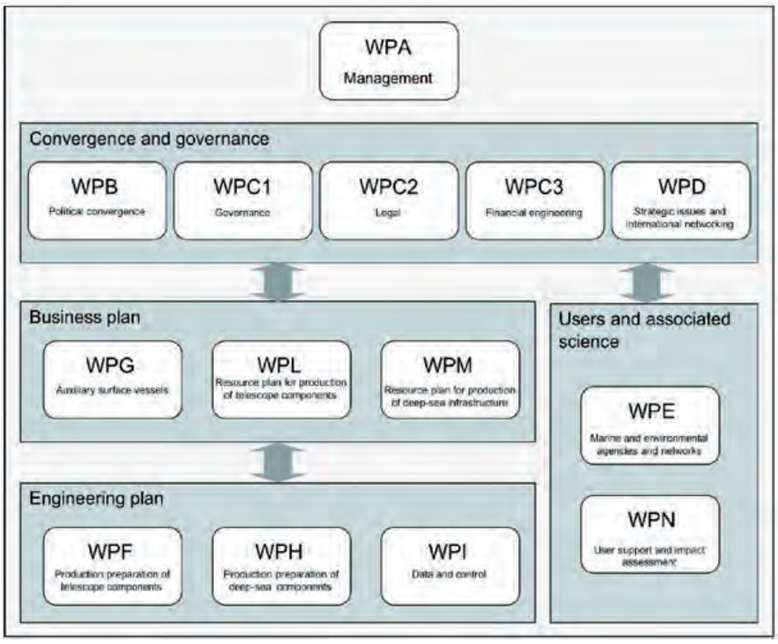
EURECA:


EURECA
Management Structure
EURECA Institute Board
Chaired by Spokesman
One Representative / Institute
Editorial Board
Chaired by Spokesman
+ 3 Members
Project Management Board
Chaired by Technical Coordinator
WP Leader + Specialists
Management
Cryogenics
Detectors
Analysis
Infrastructure
Electronics
Low Background

KM3NeT (as established in Annex I of the Grant agreement- Preparatory Phase)



Each work package has its own coordinator and executive committee, responsible for the progress of the work in the package.



ASPERA

www.aspera-eu.org