Final report on project monitoring

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Monitoring the Implementation of Roadmap Projects in the framework of ASPERA-2 - Introduction

1. Purpose and possible methodologies: background.

One of the purposes of ASPERA-2 has been to broaden and deepen the work undertaken in ASPERA-1 in coordinating the planning and the implementation of Astroparticle Physics (Astroparticle Physics) programmes and projects. This purpose was attained by means of a number of tasks grouped together in Work Package 5. Beside planning and launching common calls, elaborating common evaluation criteria and processes, designing a European-wide process for the whole life-cycle of a project, the agencies participating in ASPERA-2 planned to develop **a tool that should act as a *trait-d'union* between the Roadmap projects and their actual implementation**. Indeed, since the "Magnificent Seven" projects presented in the Roadmap are in the process of being implemented, although at different stages, it is much clearer to all actors and stakeholders that their success requires not only a major scientific and technical effort, but also a careful management and an effective communication strategy. Therefore, the need arises to take care of those crucial features, particularly to do it by means of a common tool. This is precisely the domain of Task 5.2.

In the original ASPERA-2 Programme of Work, the envisaged common tool was going to take the form of a Programme Committee entrusted to monitor and guide the implementation of the Roadmap projects. The idea behind the Committee was that it whould help improve the scientific and technical quality of proposals, increase consensus within the scientific community, and ensure that commonly acknowledged best practices in legal and financial matters were reiterated. Therefore, its mission was thought to be the scrutiny of proposals concerning the implementation of the Roadmap projects and possibly the advice to proponents and their funding agencies on scientific, technical, legal and financial issues. Proposals whould have been subsequently handled in accordance with the funding procedure applicable in each specific case (i.e. the common procedure envisaged in ASPERA-1 D2.4, EC call, national funding procedure etc.).
Since the early days of ASPERA-2 however, the envisaged tasks of the Programme Committee proved to overlap with those of the Scientific Advisory Committee (established under Task 4.2) and of the common competent bodies acting in the framework of individual projects. Moreover, the mission of the envisaged Programme Committee showed close links with the future status of ApPEC (Astroparticle Physics European Consortium), which was at the time under discussion in the framework of Task 5.5.
Nevertheless, a thorough discussion lead to the conclusion that even if a Programme Committee as such would create duplication of effort, there was still a need for a common tool acting as *trait-d'union* between the Roadmap and its implementation, which would be tailored in a different fashion. Indeed, participating agencies expressed great interest in a thorough study of **the organisation of Roadmap projects, with the aim of understanding the peculiarities of each organisational model and the differences among them.** As a result, it was decided by ASPERA-2 to carry out a survey of the Projects that would cover at least the following issues: projects' legal frameworks, including the status of sites, decision-making, finance, members (addition or withdrawal), staff policy and rules, procedures for scientific, technical and financial reviews, links with funding agencies and safety rules.

The common survey would be carried out to the advantage of all the actors (scientists and technicians) and the stakeholders (funding agencies and possible future proponents), and therefore the option to entrust its implemention to a Working Group (WG) of experts in the fields concerned (legal, finance, management, etc.) was carefully considered. These experts would have been selected amongst the staff of funding agencies, noting that when accomplishing their duties as members of the WG they would have acted independently. Their appointment would have been carried out by the ASPERA-2 Governing Board with a view to ensure that membership was fairly distributed among countries represented within ASPERA-2.

2. The approach underlying the work carried out in the framework of ASPERA-2 and the workshop at LNGS.

The discussion over the WG-of-experts option revealed that the agencies not only wanted to understand the different organisational models actually adopted by some significant sample projects, **but also the latter to take the occasion to meet, exchange information and possibly engage in a discussion on related issues.** Moreover, the maximisation of the benefit arising from such experience in the long-term required that the projects did not get the impression that an assessment of their choices were being carried out.

As a result, the decision was made to design the WG in a different fashion, i.e. as **a WG of members of the ASPERA-2 Joint Secretariat with the task to collect information of some sample projects from public sources, organise them in factsheets whose structure was agreed by the Joint Secretariat in advance, and to ask projects' spokespersons for their feedbacks.** Based on these factsheets, the Working Group organised a Workshop at the Gran Sasso Laboratory (LNGS) where the spokespersons of the sample projects were invited as speakers. The assumption upon which the Workshop was designed was two-fold:

a) projects typically act in full autonomy of one another, but they can exchange experiences and future plans to their mutual advantage; they can also learn from other past and ongoing projects;
b) the funding agencies' interest is that the Astroparticle Physics Roadmap is successfully implemented and that Astroparticle Physics research advances.

Consequently, the Workshop at Gran Sasso was designed as **the occasion for all those bearing responsibilities in the implementation of the Roadmap projects to engage in a open-ended discussion that hopefully could increase everyone's awareness, improve everyone's toolkit and perhaps even help develop synergies**. The discussion was triggered by the presentation of the sample projects considered by the WG and covered three core topics: governance (including site-related issues and relations with hosting lab), communication strategy, and fund raising and managing.

The specific purposes of the discussion were as follows:

1) to achieve a better understanding of the relevant issues **for agencies' officers and the representatives of projects;**

2) to mutually exchange experiences **for scientists and project managers;**

3) to engage in a discussion over the standardization in projects' planning and implementation encouraged by ASPERA-2.

The present Report is a résumé of the information collected by the WG and at the Workshop, presented in such a way as to meet the purposes of the discussion at the latter.

3. The projects selected for survey.

The criteria adopted in the choice of the sample projects were as follows:

1) to cover projects at a **different implementation stage**, with a view to establish a virtuous relation between "junior" and "senior" projects. "Junior" projects should be at least at the design-study phase, whereas "senior" projects should be at least in construction.

2) to cover a sufficient range of **both open-field projects and projects implemented in existing labs**, since this was acknowledged to be a crucial distinctive feature in terms of problems to face and decisions to be taken.

3) to cover **all the Astroparticle Physics fields included in the Roadmap**.

The selected projects were (in alphabetical order): **AUGER, Borexino, CTA, ET, KATRIN, KM3NeT, XENON**. A short description, including their participating Institutions, is contained in the Appendix.

II. Governance

1 Legal framework

Being or not open-field is the main distinguishing feature of the projects under survey as far as their governance is concerned, especially in terms of their legal form and the status of their sites. Accordingly, the survey will primarily focus on those points and will be carried out separately for experiments in existing laboratories and for open-field experiments. The analysis of the projects' management will also be based on the above distinction, with a view to understand whether and, if so, to what extent the latter affects also this feature.

1.1 Experiments in Labs

Two of the experiments under examination here (Borexino and XENON) are located at the INFN Gran Sasso Laboratory (LNGS) following the related decision by the governing bodies of INFN. The ongoing Borexino operation phase is now covered by a Memorandum of Understanding (MoU) amongst all the participating Institutions that was finalised in January 2010 and will be in force for 4 years. Before that, the Collaboration had been constructed around an old MoU where the sharing of responsibilities among the various groups was specified on a non-legally binding basis. The Xenon Collaboration has also chosen to put in place an MoU among all the participating institutions. The MoU, in place since 2011, covers the operation of XENON100 as well as the construction, operation and dismantling of XENON1T. In both cases, the MoU cover the governance of the experiments and the participation therein, the sharing of responsibilities amongst the participating institutions (including the construction costs for XENON and the operating expenses for both), site conditions and safety procedures, personnel matters, duration and termination.
Another experiment hosted in an existing Laboratory is KATRIN, which is located in the Tritium Laboratory Karlsruhe (Karlsruhe Institute of Technology - KIT Campus). KATRIN is an LKII facility (i.e., a large-scale facility with more than 5 M€ of yearly running costs in the US accounting style) of the Helmholtz Association. The KATRIN Collaboration acts on the basis of an Agreement of Objectives and bilateral MoUs between KIT and the participating institutions. All (major) legal issues have to be solved by the KIT's Board of Directors and contracts are issued by KIT´s purchase department (or their off-site equivalents).

As a consequence of being hosted in existing Laboratories, all three of these experiments are required to adhere to the latter's safety procedures and entrust specific tasks to their staff/members.

1.2 Open-field experiments

The open-field experiments considered under Task 5.2 currently lay at very different stages. The Southern Pierre Auger Observatory (project AUGER) is in full operation since 2008, with data collection having started in 2004, and its nominal lifetime end date is 2023 since it was designed for 15 years of operation after its completion; Conversely, AUGER is carried out on the basis of a non-legally binding international agreement signed in 1999. Its content includes the following: commitments of the parties; organization and responsibilities; funding; data rights; reporting; liability; ownership; withdrawal. Under this agreement, all partners are equal. The activities are

supervised by the funding agencies on a consensus basis. Moreover, the design was a common effort, i.e., no national flag has been placed on any component.
the design study of CTA will be completed in 2013; Km3Net is in the process of preparing its first phase of construction, its design study having terminated in 2010, with the approval of the Technical Design Report, and the successive preparatory phase in February 2012; ET is now undergoing a post-design study phase focused on the needed technologies development, its Conceptual Design Document having being released in the second half of 2011.
This affects the projects' legal form a great deal, along with the fact that AUGER is the only one whose facility is established outside the European Union.
Currently CTA, KM3Net and ET have no legal form in proper terms since they all are too "junior". Moreover, with the exception of CTA, their respective collaborations do not even rely on Memoranda of Understanding among funding agencies. For KM3NeT, whose first phase of construction is in preparation, a collaboration is being formed and a related Memorandum of Understanding is reportedly in the process of being drafted. For ET, in the current post-design study era the idea is to preserve as much as possible the organization bodies of the ET design study (Executive Board and Governing Council) with the aim of coordinating the evolution of the project.

Instead, as mentioned above CTA is taking advantage in its preparatory phase of a Memorandum of Understanding (Krakow, 12-13 May 2009) that has been prepared and signed during the design phase, whose object includes the organisation of the consortium. This is very remarkable since the first ideas on the current CTA were presented to the ESFRI panel in 2006. The initial MoU is still in force with small modifications, and it is now complemented by the Project Management Plan, the rules of the Speakers And Publication Office (SAPO), the FP7-PP Consortium Agreement and other minor documents.

Concerning the future, it is noteworthy that for all these projects plans are being made to set up European Research Infrastructure Consortia (ERICs).
In the case of CTA, whose preparatory phase includes the task of defining the legal framework and governance structure of the CTA collaboration and observatory, the ERIC legal framework gives rise to the issue of the status of non-European countries, which cannot be members of an ERIC. Moreover, since the project includes two sites, none of which is dominant, the question arises as to whether setting up two corresponding legal entities and whether they should be additional to the one including the project's seat, headquarter and operation and data centres. This legal entity could be either an ERIC or another national-law entity. In any event, the other options considered as legal frameworks for CTA in the current preparatory phase are as follows: to be incorporated in an intergovernmental/international organisation such as CERN or ESO; to be an organisation under the national law of some country; to be an association of independent national or regional infrastructures.
In the case of ET, the elaboration of its actual structure as an ERIC could well take advantage of the experience gained with the EGO international consortium.
Concerning KM3Net, the ERIC legal form is reportedly included in the forthcoming MoU.

2 Site selection and site legal framework in open-field experiments

The AUGER project is currently taking advantage on one facility known as the Southern Auger Observatory located near Malargüe, a town in the Mendoza Province in western Argentina. Whereas the AUGER headquarters are based at the Malargüe site, the project management is hosted at Fermilab. A proposal to build a complementary facility – Auger North, in Colorado, USA – was then prepared but was not supported by the US funding agencies. As a consequence, the collaboration is currently working in a worldwide effort on the planning of a future facility, which either would be constructed in the northern hemisphere to gain full sky coverage (possible appropriate sites will soon be searched), or would be a substantial extension of Auger South.
The Auger South site was selected by the collaboration on the basis of a two-fold prerequisite: to meet the physical requirements for the observatory and the ability of the host country to offer scientific and financial support. Concerning the relations with the host country, the taxation regime for the import of equipment applicable during the construction phase was the result of an arrangement accepted by the latter, under which each participating country was to apply for a customs waiver to the Argentine foreign ministry for each shipment.
As for the status of the site, contracts were signed with landowners to deploy the detectors on the site and to allow access. Moreover, a foundation under Argentinian law (Fundación Pierre Auger Argentina – FOPAA) was established with the following responsibilities: to employ Observatory staff; to process staff salaries; to hold and disburse funds for Observatory operations; to maintain legal requirements for accounting, taxes and social services; to obtain legal and accounting services as needed. Operation, including the related contracts, and routine maintenance of the Observatory are under the responsibility of the Site Management Organisation headed by the Site Manager. It also serves as point of contact with landowners and local government officials. FOPAA acts as legal agent for the Auger Observatory. It operates in agreement with the Auger Finance Board.

In the case of the future CTA infrastructure, whose sites will be selected in 2013, site selection criteria include geographical conditions, observational and environmental conditions, physical requirements for the Observatory and issues of logistics, accessibility, availability, political stability and local support[1].

Concerning ET, three alternative European sites have been identified in the Design Study, which are respectively located in Hungary, Spain and Italy. They all feature a level of seismic noise, they are all placed in an underground location, and are compliant with the ET requirements identified in the Design Study in accordance with its established goal. In any event, a more detailed and longer measurement will be needed to identify the quieter site. Moreover, this list is not exhaustive and further locations can be identified with a larger survey that has not been a goal of the Design Study. When making the final choice, special attention should be devoted to sites located in countries having access to the European Regional Development Fund (ERDF). The ET infrastructure might be single-sited in Europe, but it will be embedded in a network of similar observatories, 2nd generation detectors and multi-messenger observatories in the World.

The KM3NeT Research Infrastructure (RI) is being designed as geographically distributed over three installation sites. Two of them have been provided so far in order for the first step of the

[1] Northern site candidates include the Canary Islands, India and California; in addition, two sites in the Himalayas were proposed. Southern site candidates include Namibia, Chile and Argentina. Argentina has presented a concrete proposal for hosting the southern observatory.

construction phase to be implemented, both with a seafloor network and a shore station. They are located off-shore Capo Passero, Italy, and off-shore Toulon, France, and they are hosted by collaborating institutions. However, the project will be operated centrally. It has reportedly been agreed that the latter's headquarters, including a project office, should be in Amsterdam. Data will be streamed directly from the installation sites to a central repository at the data centre in Lyon, France, for further processing and for access by scientists (KM3NeT Data Centre).

3 Management

3.1 Experiments in Labs

Borexino: Until the beginning of 2005, the day-to-day activity of Borexino has been managed by a Project Manager. As early as January 2005, the Borexino Collaboration approved an Organisation and Management Plan (now attached to the MoU in force since 2010) and a Steering Committee was then established. A major revision and some adjustments were approved at different stages until the final version of the MoU was finalised as reported above. The current management is structured as follows:

- Spokesperson: represents the collaboration for international matters (elected by the Institutional Board).
- Steering Committee (SC): the main body of the Borexino Collaboration. It is composed of seven members elected for a 3-year period by the General Meeting (see below). The SC defines the overall experimental strategy of Borexino, executes the Strategic Plan, is responsible for preparing the overall schedule of the Experiment and carries out periodic monitoring of the progress. Its membership is required to have an active record in the Collaboration, whose definition is provided in the MoU.
- General Meeting (GM): the assembly of all Borexino members. It gathers at least twice per year. In these meetings the main guidelines of the scientific activities of Borexino are discussed.
- Institutional Board: composed by the Principal Investigators of the collaboration, specifically one Principal Investigator for each Institution with a significant investment in the project. Its responsibility includes the procurement of the funding and of the personnel needed for the implementation of the Strategic Plan, interactions with the funding agencies and with the whole scientific community, communication with the LNGS scientific committee, the publication of scientific papers, the participation of new institutions, the general safety guidelines. It is also responsible to ensure that employees or agents of their institutions are covered by their respective institutions (or other contracting body) to the extent allowable by applicable law against claims such as liability, loss, personal injury, death, property damage, etc, or claims arising out of any act or omission of their employees or agents in connection with the Management Plan). According to the latter, within the Institutional Board there shall be a group of National Spokespersons, one for each nation, selected by the institutions of their respective nation, whose responsibility is to take care of the interactions with national funding agencies.

Xenon: The 2011 MoU lays down the Collaboration Management, which is structured as follows:

- Spokesperson: the leader and formal representative of the Collaboration, who oversees its overall scientific and technical program. He/she is elected by the Collaboration Board along with a Deputy Spokesperson.

- Principal Investigator (PI): the leader of each collaborating institution who carries the scientific and financial responsibility of that institution concerning the XENON program, and who represents that institution within the Collaboration Board.
- Collaboration Board (CB), which is the main decision-making body of the Collaboration. It is a committee composed of the Spokesperson, Deputy and all of the Principal Investigators, and with possible addition of other senior technical and/or engineering staff. The CB also elects the Technical Coordinator (TC) and the various WG coordinators. The CB aims at achieving consensus through discussion, with the goal of finding optimal solutions for the physics goals of the Collaboration. Whenever a vote is deemed necessary, or during formal elections, each Principal Investigator will have one vote. A simple majority of votes will decide unless where specified differently in the MoU. In particular, elections for governance positions require a simply majority.
- Editorial Board (EB): responsible for the management of the papers to be submitted for publication. It is composed of an elected Chair and up to four members, appointed by the Collaboration Board. Drafts of the publications will be submitted to the Editorial Board who will thereafter assign internal referees to the papers.
- Speakers Bureau: responsible for keeping an up-to-date list of upcoming conferences and for speaker coordination. It will also keep track of past conferences and speakers.

KATRIN: The KATRIN Collaboration, founded in June 2001, is structured as follows:

- two Co-Spokespersons, who represent the Experiment for scientific matters
- Collaboration Board: it is KATRIN's governing body, where each member institution is represented.
- Executive Board, entrusted with targeting important issues arising during the commissioning, as well as with planning and supervising long-term tests measurements with major KATRIN components such as the main spectrometer or the source.
- Project Leader and the Technical Coordinator, responsible for on-site coordination.
- Publication and Conference Committees with the responsibility to supervise the scientific output of the experiment.

3.2 Open-field experiments

Due to its "senior" character, the only open-field project with an established organisation is AUGER. The project is overseen by a Collaboration Board and a Finance Board. The Collaboration Board is responsible for the scientific and technical activities, i.e. it sets up the scientific and the publication policies, monitors operations, decides on membership. The Collaboration Board is also responsible for all matters related to contributions of national or international partners. It is composed by one representative per institution and it meets twice a year. The Finance Board is responsible for project finances, i.e. it supervises international funding, monitors costs and funding, approves the operating budget. It is composed by representatives of the Auger Project Funding Agencies or their designees.

CTA: Based on the 2009 MoU that summarizes all scientific matters and organizational issues, including funding strategies and other joint initiatives as well as publication policies, the CTA Consortium is governed by the Collaboration Board (CB), which represents the ultimate internal authority therein. The CB is composed of one representative from each institute representing a Regular Party, with voting right, and by a few ex-officio members (the Spokesperson, the Deputy Spokesperson(s) and the Project Coordinator(s)) without voting right. The MoU requires the CB to

make all possible efforts to decide by consensus, but occasionally a vote may be required. Votes are weighted on the basis of the contributions of the Parties. Initially, weights depended on the number of FTEs contributed to the CTA Design Study by the Parties, while currently voting rights depend on manpower and money.
The CB is responsible for the appointment of the Executive Board, whose membership includes the spokesperson, the co-spokesperson, the project coordinator(s), the chair of the CB, the Workpackage coordinators and additional members selected to ensure overall balance and competence in the EB. The organisation chart also includes a Project Committee whose two branches are the Science Project Committee and the Technical Project Committee.

Concerning KM3NeT, whose structure is currently being defined, in October 2012 an interim management team for the implementation of the first phase of the KM3NeT Research Infrastructure (KM3NeT-phase1) has been established. It is composed by one member per funding agency (CNRS, France; INFN, Italy and Nikhef, The Netherlands).

After the completion of its design study phase, the ET collaboration decided to preserve the organization bodies of the design study (Executive Board and Governing Council) as far as possible, with the aim of coordinating the evolution of ET. The last ET general meeting was held at the beginning of December 2012 in Hannover. Moreover, the Institutions participating in ET are currently engaged in the EU-funded project ELiTES. The latter is a FP7-IRSES initiative, funded for four years, that supports the exchange of scientists between EU and Japan focused on Cryogenic and Underground technologies for ET and KAGRA (a gravitational wave observatory in Japan). ELiTES has recently held its first meeting, hosted by the EU delegation in Japan.

II. Communication

1. Available tools

1.1 Experiments in existing laboratories

Borexino: The Borexino experiment has an official website (http://borex.lngs.infn.it) divided in two sections, one for the external community and another one for the internal exchanges amongst the members of the collaboration. In the external section, papers, publications, talks at conferences and workshops and important news are shown. Information on the Experiment – including its science, technical challenges and supporting collaboration are also provided via the LNGS website.
XENON: The XENON Dark Matter project has an official website (http://xenon.astro.columbia.edu), which covers XENON10 and XENON100 featuring presentations, publications, a photo gallery and a news archive. A XENON page is also maintained on the LNGS website with information on its science, technical challenges and the collaboration, in accordance with the format of the LNGS website. Additional tools are under discussion.
KATRIN: KATRIN has an official website (http://www.katrin.kit.edu) that is accessible to the general public. It includes publications, talks, a news archive and a media gallery, besides an internal section.

1.2 Open-field Experiments

AUGER: There is a public website (http://www.auger.org) that is largely targeted to the general public. Moreover, the Auger Collaboration agreed to make 1% of its data available to the public. More generally, the philosophy of the AUGER management reportedly is that outreach and good contacts with the local community are a key element for the success of a big open-field project. Therefore, a number of activities and programmes are organised. The Observatory is equipped with a visitors' centre that has attracted more than 74,000 visitors to date. A planetarium, which would be the only planetarium outside the country's capital, Buenos Aires, will hopefully be built in the future. A full scholarship programme for a student of Malargüe to attend Michigan Technical University is also active with a huge success. Members of the Auger Collaboration traditionally participate in Malargüe Day parades. Such good relations with the local community is witnessed by the establishment of the James Cronin School, whose official inauguration took place on 16 November 2006 with many Auger collaborators, representatives from the Mendoza and Malargüe governments, and media representatives attending. The residents named the school after the Nobel prize winning physicist, because of his contributions to the local community. At the Argentinian national level, the Pierre Auger Observatory regularly contributes to Technopolis, an exhibition organized by Presidencia de la Nación and conceived to exhibit the work, capacity, effort and talent of Argentine scientists.
CTA: CTA has an external public website (www.cta-observatory.org). Internal websites are in the process of being set up. A centralised site for communication and documentation is under development. An Outreach Plan will be developed during the preparatory phase in the framework of a dedicated workpackage.
ET: The ET project shares a website (http://www.et-gw.eu/) with the ELITES Project, which is focused on the cryogenic technologies for the ET and KAGRA. The common website is due to the fact that both projects are supported by the European Commission in the framework of FP7 and, as made clear already in the graphic frame of the website, they have strong connections with EGO.

A tool codifying and storing the documents produced by ET and ELiTES has been developed by EGO and it is publically available (https://tds.ego-gw.it/ql/?i=ET). Other documents are organized in a sharing area always managed by EGO (https://workarea.et-gw.eu/). It is worth noticing that that the first general meeting of Elites (Tokyo, October 2012) will be hosted by the European Union delegation in Japan and will see the participation of the scientific attachés of the embassies of the European countries collaborating in ELiTES.

2. Future developments

An outreach programme is deemed essential for the support of scientific experiments. The main challenge for European Astroparticle Physics projects is **to coordinate efforts among individual projects and laboratories, national funding agencies and ApPEC, i.e. at the European level**. Such coordination is required by the need to address **different audiences**: local communities, national politics, the European Union, the general public. Indeed, an effective communication strategy is needed at all these levels. The idea is generally shared that each laboratory should develop and maintain its own outreach programme and mainly address the local/national audience. ApPEC should mainly convey a general message on Astroparticle Physics and be responsible for the relations with the European Union as well as with European large communities. Moreover, since projects in the implementation stage require outreach planned and carried out at professional level, ApPEC should also support projects with advice of its own outreach team. Coordination, at least at the level of avoiding overlaps, is required also by the low level of funding available for outreach and the subsequent need of all projects to optimise their use of resources.

IV. Fund raising and management

1. Projects in preparation

It is noteworthy that all the projects in preparation took advantage of European funding to this purpose.The preparatory phase of CTA is being funded through a EU FP7 grant. The ET project has also been funded as a design study by the European Commission on the basis of FP7. A new phase is currently open, focused on the needed technologies development, and it is still receiving support under FP7 (People, IRSES): the project currently in the process of being implemented (it started on 1 March 2012 and its duration is 4 years) is ELiTES, focused on the development of the cryogenic technologies for KAGRA and ET. The Design Study for the infrastructure of KM3NeT was funded in the framework of EU FP6 and the subsequent Preparatory phase in the framework of EU FP7.
European financial support should have a role also in the construction of the KM3NeT Research Facility, which is to take advantage of a total amount of 24 M Euro from the European Regional Development Fund (whose breakdown is 20M Euro from Italy and 4M Euro from France), to be spent within March 2015. The availability of a further ERDF amount from Greece is currently unclear. The difficulty inherent in receiving financial support from ERDF is reportedly the applicability of several constraints (timing, recipients, tendering, etc). ET is also planning to obtain financial support by the ERDF, given that one of the criteria for its site selection is the related eligibility of the region where a feasible site is located.

In addition, CTA is currently taking advantage of a considerable amount of national funding (from France, Germany, Italy, the Netherlands, Poland, Portugal, Romania, Spain and Switzerland) for Targeted R&D and Design Study, collected as a result of the First ASPERA common call. The same is true for AUGER Next, i.e. the proposed northern hemisphere cosmic ray observatory, which is to complement and extend the existing Pierre Auger Observatory in Argentina in the framework of the AUGER project. AUGER Next has recently been awarded a grant for targeted R&D, whose source is national (the States involved are Germany, The Netherlands, Poland, France, Portugal, Spain, Italy and Romania) although the selection & awarding procedure was carried out at European level, in the framework of the Second ASPERA common call. Finally, R&D for ET is financially supported in the context of the 3rd ASPERA Common Call (funding coming from Germany, Russia, Poland, the Netherlands and the United Kingdom).

As a conclusive remark it should be noted that, while the European Union supported the preliminary stages of the above projects, the construction and operation of the related facilities should mainly rely on national funds, with the sole exception of the ERDF where applicable.

2. Projects at the implementation stage

Most of the projects under survey currently being implemented share some common features. Annual operation costs are covered by a Common Fund which is supported by all participating Institutions. **Contributions to the Common Fund are apportioned according to the number of people from each country eligible to be authors on scientific papers.** In AUGER, these people cannot be students; in Borexino, they qualify as “post-PhD researchers and other permanent staff who participate full-time in the Experiment”; in XENON, permanent technical staff members should also be considered. In all cases the Collaboration designated body is to establish the number of eligible staff for this purpose (the Finance Board in AUGER, the Institutional Board in Borexino, the Collaboration Board in XENON).

There are some differences however amongst the projects. These are as follows:

- In AUGER, Argentina provides in-kind contributions only. In addition to the operating costs, participating countries have also contributed to the accumulation of a reserve fund.
- In Borexino, common expenses include those related to the liquid nitrogen (LN and LAKN), the cost of personnel other than participating Institutions' staff, cost of consumables, disposal of chemical and wastes, general extraordinary expenses.
- In XENON, contributions to the Common Fund can exceptionally consist of in kind delivery of materials or services. This must be done following the approval of the Collaboration Board. The MoU establishes that expenses to be covered with the Common Fund include detector maintenance, consumables and services, contracts for on site personnel.

Any equipment that is placed in one of the above experiments, whether contributed or owned by a collaborating institution, cannot be withdrawn without the permission of the relevant managing body of the Collaboration until the end of the experiment. Each institution is in general responsible for the maintenance and repair of the equipment and components of the experiment that it has provided. In case of a major failure of detector components, the resulting technical and/or financial problems shall be addressed by the appropriate managing body.

KATRIN is being funded to a large part by the Helmholtz Association HGF, by the host laboratory KIT and by the University partners (German Universities are funded by the BMBF Verbundforschung, while the US institutes are funded by the DOE Office of Nuclear Physics). The R&D work of the on-site groups are funded by KIT, while the other partners are also supported by various funds to perform R&D activities. As KATRIN is a so-called LK-II facility (see above, Part II) of the Helmholtz Association, the forward planning for the next funding period (POFIII period from 2015-19) is especially important. The breakdown of costs (investment, yearly running costs and costs for R&D) is of particular importance as both the HGF and KIT contributions to the overall investment costs of KATRIN is fixed. On the other hand, a detailed memorandum lays down the criteria for the sharing of the yearly running costs among the KATRIN partners.

APPENDIX

1. AUGER

Relations with Roadmap – Auger is identified as the priority project for high-energy cosmic ray physics in the Astroparticle Physics Roadmap. The roadmap recommends the construction of Auger North (the predecessor to the current AugerNext proposal).

Character – The Southern Pierre Auger Observatory is an array of 1,660 surface detectors and 27 fluorescence telescopes covering an area of 3000 km^2 in western Argentina. The project management office is based at Fermilab. The collaboration is also starting R&D for a possible future facility, AugerNext, which would concentrate on the highest energies above 10^{19}eV.

Involved Institutions – The Pierre Auger Collaboration includes more than 490 scientists from Argentina, Australia, Brazil, Croatia, the Czech Republic, France, Germany, Italy, Mexico, Netherlands, Poland, Portugal, Romania, Slovenia, Spain, the United Kingdom, the United States, and Vietnam.

Timeline – Construction of the southern observatory took place from 2000 to 2008, with commissioning completed in 2010. Data collection started in 2004. The observatory was designed for 15 years of operation after its completion (nominal lifetime end date 2023). The collaboration presently prepares for an upgrade of the observatory aimed at improving the UHECR detection capabilities of the Auger Observatory by 2015. In parallel, a worldwide effort has been started to work on a concept for a Next Generation Giant Observatory to be presented within the next 5 years.

2. BOREXINO

Relations with Roadmap – The European Astroparticle Physics Roadmap acknowledges Borexino as a precursor of the recommended large infrastructure for proton decay and low energy neutrino astrophysics, since it is one of the currently operating experiments whose results will be input in the physics perspectives and feasibility of the aforementioned large underground facility.

Purpose – The primary purpose of the Experiment is the study of solar neutrino physics and other related topics in the fields of low background neutrino detection and underground physics. In addition the study of solar neutrinos is an important tool in order to investigate various aspects of the neutrino oscillation phenomenon and the neutrino physics, as the hypothesis of Non Standard Neutrino Interactions (NSI).

Character (distributed/single sited) – Borexino is conducted in the Gran Sasso Underground Laboratory (INFN – Italy), Hall C.

Involved Institutions – The Borexino collaboration consists of 15 Institutions from 6 countries, including 4 European Union countries (Italy, France, Germany, Poland), the United States and Russia.

Timeline – A Borexino prototype called Counting Test Facility (CTF) was built and operated in the Hall C of LNGS. This detector demonstrated the achievement of ultralow count rates (radiopurities of the order of E-16 gr/gr of U-238 equivalent) on the several-ton scale. The Borexino detector has been built on the CTF experience. In May 2007 the Borexino filling was completed, the first run with full detector took place and data taking started. August 2007 marked the first real time detection of Be7 solar neutrinos by Borexino. Phase I of Borexino ended at the end of 2010. After a successful campaign of further purification of the scintillator at the beginning of 2012, phase II started. This second phase is expected to be completed by the end of 2014. After phase II a test on a possible existence of sterile neutrinos is planned with artificial sources.

3. CTA

Relations with Roadmap – CTA is included in the European Astroparticle Physics Roadmap. Being the future project in Gamma astronomy, it is one of its key projects and therefore Roadmap very strongly recommends construction of the facility.

Purpose – The Cherenkov Telescope Array will explore the universe in very high-energy gamma rays and investigate cosmic processes leading to relativistic particles. It will also study the origin of cosmic rays and their impact on the constituents of the universe through the investigation of galactic particle accelerators, the exploration of the nature and variety of black hole particle accelerators through the study of the production and propagation of extragalactic gamma rays, and the examination of the nature of matter and physics beyond the Standard Model through searches for dark matter and the effects of quantum gravity.

Character (distributed/single sited) – CTA will be an observatory consisting of two telescope arrays, one in the southern hemisphere and another one in the northern hemisphere. There will also be a data analysis centre and an operations centre.

Involved Institutions – The CTA collaboration comprises institutes from 26 countries. Those include 15 European Union countries, 4 European non-EU countries, 2 countries from South America, 1 from North America, 2 from Asia, 2 from Africa.

Timeline – The preparatory phase, including a design study, covers the period 2010 – 2013. The sites will be selected in 2013. The construction phase will go from early 2014 to 2018 (plan as of first half of 2012). The commissioning should start in 2017. There will also be a US led expansion of the southern site in the medium energy range using dual mirror telescopes. This will have a 5-year prototyping/testing phase from 2010 – 2015 and then a construction phase from 2015 – 2021. It is foreseen to operate the observatory for at least 20 years.

4. ET

Relations with Roadmap – The ET is included in the “Magnificent Seven” pointed out in the European Astroparticle Physics Roadmap.

Purpose – The Einstein Telescope (ET) project concerns the study and conceptual design for a new research infrastructure devoted to the observation of gravitational waves (GW). More specifically, the ET design study represents an important step in the conception the third generation of gravitational wave observatories. This third-generation observatory is expected to be a hundred times more sensitive than initial interferometric detectors. Furthermore, ET is designed to be a wide spectrum observatory, allowing the detection of all the GW frequencies measurable on Earth, the entire range between 1 Hz and 10 kHz, thanks to the underground site location, that reduces the disturbances at low frequency, and to the complexity of the optical design, that places side by side, detectors specialized in different frequency ranges (Xylophone design). ET will detect compact binary mergers from far corners of the Universe and will therefore open a new era of precision GW astronomy; ET will be a new tool for measuring the acceleration of the Universe, the properties of dark matter and dark energy and it will put to test different cosmological models of the Universe, in a network of other GW detectors or in synergy with the optical telescopes. ET will test General Relativity in strong gravitational field regime, observing coalescing events involving black holes; it will investigate the mechanisms of catastrophic events, like the supernova explosions, and it will study the most hidden properties of compact objects, like the neutron and strange matter stars.

Character (distributed/single sited) – The ET facility needs an underground site to limit the direct and indirect (gravity gradient, wind, cultural activities) effects of the seismic noise. It will be a single-sited infrastructure.

Involved Institutions – The Institutions participating in the ET Design Study funded by the European Commission were 8 from 5 EU countries (France, Germany, Italy, the Netherlands, the United Kingdom). However, the ET design study has been organized as an open project, thanks to the Science Team body, that had a relevant role in the design of the infrastructure. Consequently, more than 220 scientists, belonging both to the 8 participating Institutions and to other European, American and Japanese institutions, participated in the ET design through the Science Team.

Timeline – The ET project has been funded as a design study by the European Commission with a duration of 38 months, starting on 5 Nay 2008 and terminating on 4 July 2011. A new phase is currently open, focused on the needed technologies development, with a duration of 4 years (the ELiTES project). The timeline of the ET observatory has been evaluated in the design study document. Before the detection of the GW by the 2nd generation of GW interferometers, envisaged after about one year of joint observation, with a relatively good sensitivity (approximately within 2016-2017), an intense R&D programme is needed to develop the technologies needed in ET but not present in the advanced detectors, like cryogenics, silicon optics, frequency dependent squeezing, lasers at 1,550nm of wavelength, Newtonian noise suppression technologies. After the first detection, the procedures for the site final identification and realization should start. In this scenario the infrastructure could be available for the middle of the next decade and the first scientific data taking could be analysed few years later.

5. KATRIN

Relations with Roadmap – KATRIN was included in the first ASPERA roadmap document.

Purpose – The KATRIN experiment is designed to measure the mass of the electron neutrino directly with a sensitivity of 200 meV. It is a next generation tritium beta-decay experiment that will scale up the experimental precision of previous experiments by two orders of magnitude (in particular the intensity of the tritium beta source) to push forward into the sub-eV mass regime.

Character (distributed/single sited) – KATRIN is a single-sited project currently under construction at Karlsruhe. The host laboratory (Tritium Laboratory Karlsruhe, TLK) at the KIT Campus North site offers access to unique technologies and infrastructure that is of vital importance for the tritium related components of KATRIN.

Involved Institutions – KATRIN is a joint project of several European as well as U.S. institutions. The European institutions involved are from Germany, the Czeck Republic, the United Kingdom. At the moment about 140 researchers, technicians and students from the following institutions are working on KATRIN.

Timeline – The start of the KATRIN operation is planned for the second half of 2015, with first data taking with full intensity a few months later.

6. KM3NeT

Relations with Roadmap – KM3NeT is included in the ASPERA roadmap.

Purpose – KM3NeT is a future deep-sea research infrastructure hosting a neutrino telescope with a volume of several cubic kilometres, to be constructed in the Mediterranean Sea.

Character (distributed/single sited) – For the KM3NeT Research Facility, the option between one or multiple sites is currently under discussion.

Involved Institutions – 40 institutes or University groups from 10 European countries constitute the KM3NeT consortium. The countries involved are Cyprus, France, Germany, Greece, Ireland, Italy, The Netherlands, Romania, Spain and the UK.

Timeline – The Design-Study Phase run from 2006 to 2008 and the Preparatory Phase from 2008 to 2012.

7. XENON

Relations with Roadmap – Dark matter experiments are within the seven (group of) projects prioritized in the Roadmap. More specifically, those projects include XENON, defined as a USA-European liquid xenon detector operated in the Gran Sasso underground laboratory in Italy. The Roadmap also recommends supporting the technology development towards their next-generation versions on a ton scale.

Purpose – The scientific goal of the XENON Dark Matter Project is to progressively improve the sensitivity to particle dark matter direct detection with a liquid xenon (LXe) target in a dual-phase Time Projection Chamber (TPC).

Character (distributed/single sited) – The XENON Dark Matter project is carried out at the Gran Sasso Underground Laboratory (INFN – Italy).

Involved Institutions – The XENON collaboration includes 15 Institutions from 9 countries, 5 from the European Union (France, Germany, Italy, The Netherlands, Portugal), Switzerland, Israel, the United States and China.

Timeline – The construction of XENON100 and its installation in the same passive shield developed for the XENON10 prototype was completed in 2008. The experiment is expected to continue to take data beyond 2012. A design study for the XENON1T phase was initiated in 2010. A proposal for XENON1T at LNGS was submitted to the LNGS Scientific Committee in Spring 2010, followed by a Technical Design Report in Fall 2010. In May 2011, XENON1T was approved by the INFN to be located in Hall B of LNGS. Construction of XENON1T will start in Fall 2012 and commissioning should be completed by early 2015.