



# **The relationship of Astroparticle Physics with CERN, ESO, ESA, and JINR**

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Work Package 5 - Task 5.5 - Deliverable 5.6

Report

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## **Editorial Board**

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# 1. Introduction

One of the major tasks within the work programme of ASPERA-2, Task 5.5, was to prepare a long-term plan for sustaining the successful collaboration between European funding agencies supporting research in Astroparticle Physics resulting from the ERA-NET projects ASPERA-1 and ASPERA-2 and activities initiated by the original ApPEC (Astroparticle Physics European Coordination) founded by several European funding agencies in 2001. The result of this planning was the creation of an Memorandum of Understanding (MoU) to describe the foundation of the new APPEC (Astroparticle Physics European Consortium). This document has initially been signed by 11 ASPERA partners in June 2012.

The planning for APPEC – as the sustainable structure taking over the achievements of all earlier activities among European funding agencies in astroparticle physics – included a discussion of the relationship of astroparticle physics to the large transnational organisations CERN, ESA, and ESO as well as JINR, the Joint International Institute for Nuclear Research in Dubna (Russia). The latter institution was included in the discussion when the Russian Foundation for Basic Research (RFBR) joined ASPERA-2 as an associate partner. It is important to note that “Develop closer relationships with organizations involved in Astroparticle Physics research such as CERN, ESA and ESO” is defined in the APPEC MoU as one of the strategic objectives. Furthermore, the MoU defines an observer status to allow such institutions to establish a link to APPEC.

Astroparticle physics is an interdisciplinary research field with strong links into the neighbouring domains of astrophysics, particle physics, nuclear physics and cosmology. Either there is a strong scientific overlap given by studying the same cosmic source or particle or detection methods or detector technologies are shared.

To identify these overlapping interests a literature study and an internet search has been performed. Results are provided in Tables 1.

	Direct Dark Matter Search	Gravitational Wave Detection	Gamma-Ray Astronomy	Cosmic-Ray Detection	2 $\beta$ Decay Experiments	Low Energy Neutrino Physics	High Energy Neutrino Detection	Astroparticle Theory
CERN	S, T			S, T		S, T		S
ESA		S, T	S					
ESO			T					
JINR	S, T			S, T	S, T		S, T	S

**Table 1:** Summary of potential scientific (S) and technological (T) interest of relevant transnational institutions.

Table 1 is not claimed to provide complete or definite information, it is compiled to provide some guidance for the discussion of the relationship between astroparticle physics and the large transnational labs.

## 2. Relationship with individual institutions

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### 2.1 CERN

As the largest international laboratory in the field of particle physics, CERN has unique experience in the design, construction, and operation of large accelerators and particle detectors. CERN recognizes experiments in fields allied to particle physics, including astroparticle physics, under the conditions that substantial participation of physicists from several CERN Member States is given and the experiment is already approved by relevant agencies and reasonably funded. Currently, there are 15 experiments with having a “CERN Recognized Experiment” status. Ten are active in astroparticle physics.

On the coordination level, CERN and the original ApPEC (Astroparticle Physics European Coordination) gave each other observer status such that a CERN observer could attend the meetings of the ApPEC Steering Committee and a representative of ApPEC was able to participate in the CERN meetings of the European Strategy Sessions of Council (ESSC).

From the very beginning CERN was a partner of the EC funded ERA-NET projects ASPERA-1 and ASPERA-2. Within the ASPERA network the role of partner CERN was to establish an ASPERA outreach responsible in its public outreach office. ASPERA benefited strongly from this arrangement since it gave ASPERA access to a fully functioning outreach structure with lots of experience and relevant contacts all over the world.

Following the recommendation by the CERN Council in September 2009, ASPERA, was invited to join the European Particle Physics Communication Network (EPPCN), which was set up by the CERN Council. An ASPERA representative became a permanent member of EPPCN.

Within the frame of work package 4, members of the ASPERA Scientific Advisory Committee (SAC) participated in the meetings of the Preparatory and Strategy Working Groups for the CERN strategy and prepared the scientific input from the European astroparticle physics community to the current process of defining the CERN European Strategy of Particle Physics. Common activities in theory and detector R&D have been suggested.

CERN is one of the partners of the Technology Transfer Network (TTN), composed of Technology Transfer offices of public research organisations active in particle, astroparticle and nuclear physics with the mandate of increasing the effectiveness of Knowledge and Technology Transfer activities in Member States. TTN representatives have been invited to ASPERA Technology Forums and vice versa. The third ASPERA Technology Forum dedicated to vacuum & cryogenic technologies was commonly organised with TTN.

To continue and further develop relationships with CERN the new APPEC (Astroparticle Physics European Consortium) will discuss with CERN to become an observer in the APPEC General Assembly.

Concerning the relationships CERN-APPEC, the following statement has been included in the strategy document drafted in the European Strategy Group meeting at Erice (20-26 January 2013) and is proposed to the CERN council for approval (march 2013 session): *“A range of important non-accelerator experiments take place at the overlap of particle and astroparticle physics, such as searches for proton decay, neutrino-less double beta decay and dark matter, and the study of high-energy cosmic-rays. These experiments address fundamental questions beyond the Standard Model of particle physics. The exchange of information between CERN and ApPEC has progressed since 2006. In the coming years, CERN should seek a closer*

*collaboration with ApPEC on detector R&D with a view to maintaining the community's capability for unique projects in this field."*

## **2.2 ESA**

In several subfields of astroparticle physics space-born projects are flying or are being planned. Scientifically speaking, there is an obvious overlap in gamma astronomy, where Fermi and H.E.S.S., MAGIC, and CTA (in the future) provide complementary data. Another clear example is the domain of gravitational wave physics, where the European New Gravitational wave Observatory (NGO, ex LISA) and GEO600, VIRGO, LIGO, and the Einstein Telescope (in the future) provide complementary data. Furthermore, astroparticle physicists are discussing the multi-messenger approach as well as computing models for their projects. Beyond these examples there are even more topics that are commonly related to ground-based and space-born experiments, e.g. the multi-messenger approach, access to alert systems for rare events in the cosmos, virtual observatory, and computing. On the working level ASPERA was able to invite two computing experts from ESA to its first workshop on astroparticle physics computing in October 2010 in Lyon. Furthermore, those astroparticle physicists that are directly involved in ESA projects take care of an information exchange and a line-up of space-born and ground-based experiments.

To initiate an exchange of thoughts on astroparticle physics on the organisational level, the ESA Coordinator for Astronomy and Fundamental Physics missions was contacted several times – unfortunately – without any success. Establishing an information exchange with ESA shall be continued within the frame of the new APPEC.

## **2.3 ESO**

ESO is the transnational institution with great experience in building and running world-class telescopes and very efficiently operate observatories in Chile for the astronomical community in Europe.

ESO has been an observer to the original ApPEC (Astroparticle Physics European Coordination) and the ERA-NETs ASPERA-1 and ASPERA-2. ESO was therefore continuously informed about the developments of ASPERA. A representative of ESO attended several meetings of the ASPERA Governing Board.

A visit by the management of ASPERA to the management of ESO has been conducted in ASPERA-1 to discuss topics of common interest. The discussions made clear that ESO is currently operating at full capacity a very ambitious and challenging work programme including the planning and construction of the E-ELT. The ESO management expressed to be open for an exchange of ESO's experience and knowledge with non-ESO projects.

It is quite obvious that in case of larger gamma-ray telescope projects such as the Cherenkov Telescope Array (CTA) there is an overlap of interest with ESO. For example, the technology to control a larger array of telescopes pointing to the sky (cf. ALMA), organising an observatory with external observers, data processing and handling, and the connection to the virtual observatory.

Furthermore, ESO has a great expertise in developing key technologies together with industry. ASPERA, and in the future the new APPEC, is very much interested to discuss and learn from ESO's expertise to perform technology transfer and procurement.

There is clear interest of the new APPEC consortium to continue the information exchange with ESO and an observer status for ESO shall be established within the General Assembly of APPEC.

## **2.4 JINR**

The Joint Institute for Nuclear Research (JINR) located in Dubna in the Moscow region is an international intergovernmental scientific research organisation established in the 1950s with now 18 member states and agreements with six other countries. The main fields of JINR's activity are theoretical and experimental studies in elementary particle physics, nuclear physics, and condensed matter physics.

After the Russian Foundation of Basic Research had become a partner of ASPERA, the potential for a closer relationship between European astroparticle physics and JINR was discussed and led to the organisation of a dedicated ASPERA Dubna Town Meeting in September 2012. With more than 50 scientists and representatives of funding agencies the current Astroparticle Physics (ApP) programs in Russia and Europe have been presented, to identify areas of common interest, and start discussing the strategy of future common activities. The results have been summarised and published in a communiqué that is available from the ASPERA website. To intensify the relationship after the ASPERA Town meeting in Dubna it has been agreed to set up three working groups to

1. formalize the relationship on agency level that a Russian partner joins ApPEC and JINR receives observer status,
2. define a common action plan for the study of rare processes underground and underwater in neutrino physics and direct dark matter searches, and
3. elaborate a fostering of collaboration between Russian and European scientists and institutions in studying the high-energy universe (cosmic rays, high-energy gamma rays, neutrinos, and gravitational waves).

## **3. Summary and concluding remarks**

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In this report we investigated the relationship between astroparticle physics and the transnational institutions CERN, ESA, ESO, and JINR. These institutions have a long-standing tradition and very detailed experience in enabling research with many international scientific partners. For the success of the new APPEC it is important to take advantage of this experience and further develop the relationship to these institutions. Depending on the individual scientific interest in astroparticle physics and the individual interest in R&D towards key technologies required for astroparticle physics projects, the relation to the four institutions may develop on different levels. In some cases there might be a potential for cooperation in astroparticle physics projects.

On the other hand, as confirmed by the study of Task 5.2, large national research laboratories are already involved in many astroparticle physics projects and play an important role. It may equally important for the new APPEC to discuss the relationship to these laboratories as well.