

AGREEMENT BETWEEN

THE ISTITUTO NAZIONALE DI ASTROFISICA (INAF)

AND

THE INSTITUTO DE ASTROFÍSICA DE CANARIAS (IAC)

ON THE INSTALLATION AND THE OPERATION OF THE

ASTRI ARRAY

AT

THE TEIDE OBSERVATORY

AGREEMENT

Professor Rafael Rebolo López, in his capacity as Director of the Consorcio Instituto de Astrofísica de Canarias (hereinafter, IAC), Calle Vía Láctea, s / n, 38201 San Cristóbal de La Laguna, Santa Cruz de Tenerife, Spain and CIF Q3811001A, acting on its behalf by virtue of the appointment made by the Governing Board of the IAC on August 2, 2013, and with the powers conferred on him in accordance with the Law 14/2011 of June 1st, on Science, Technology and Innovation, and in the Statutes of the IAC (BOE of December 21, 2018),

AND,

Prof. Marco Tavani, in his capacity as President of the *Istituto Nazionale di Astrofisica* (hereafter, INAF), based in Rome, Viale del Parco Mellini 84, 00136 Roma Italy, acting on its behalf by virtue of the appointment made by the *Ministero dell'Università e della Ricerca* (MUR), on October 9th, 2020 and with the powers conferred on him in accordance with the current INAF Statute and the Italian Laws n. 213 of 31 December 2009, n. 218 of 25 November 2016 related to the Public Research Institutes.

The IAC and INAF shall be referred to jointly as the “**Parties**” and individually as a “**Party**”. The Parties recognize their legal capacity to enter into this agreement on behalf of their institutions, and

MANIFEST

- I. That the Spanish State Administration has exclusive competence for the promotion and general coordination of scientific and technical research in Spain, in accordance with the Spanish Constitution of December 29, 1978, in article 149.1.15^a.
- II. That the IAC is a Spanish Public Research Organization, legally constituted as a Public Consortium and integrated by the General Administration of the State, the Public Administration of the Autonomous Community of the Canary Islands, the University of La Laguna and the Superior Council of Scientific Research (CSIC), in accordance with the Law 14 / 2011 of June 1, of Science, Technology and Innovation.
- III. That the purposes of the IAC, in accordance with its Statutes (Official State Gazette, December 21, 2018), are astrophysical research, the development of scientific instrumentation, the training of research personnel, the administration of the Canary Islands Observatories (hereafter, “Observatorios de Canarias”) and scientific outreach.

- IV.** That the INAF is an Italian Public Research Institute legally constituted in accordance with the Italian Law 488 of 23 Dec 1999 and the following modifications and integrations:
- I. Italian Law n. 138 of 4 June 2003 “Riordino dell’Istituto Nazionale di Astrofisica”;
 - II. Decreto Legislativo 213 del 31 dicembre: “Riordino degli Enti di Ricerca in attuazione dell’art. 1 della legge 27 settembre 2007, número 165”
- V.** That prior to INAF’s constitution Italy signed on 2 July 1992 the Protocol on Cooperation in Astrophysical research in Spain.
- VI.** That the INAF, which is acting on behalf of the Partners of the ASTRI project, and the IAC have mutual interest in the installation and operation of the ASTRI at the Teide Observatory, in accordance with the Record of Understanding undersigned by Professor Rebolo and Professor D’Amico on 12 June 2019;
- VII.** That the INAF also manages the “Fundación Galileo Galilei, Fundación Canaria” (FGG), a Spanish non-profit institution. The FGG's aim is to promote:
- i. astrophysical research by managing the Telescopio Nazionale Galileo (TNG), located in the Island of San Miguel de La Palma, together with other scientific, technical and administrative facilities, and;
 - ii. also any other astrophysical activity that INAF wants to develop.
- VIII.** The ASTRI project intends to install and operate an array of at least 9 (and up to 12) dual-mirror “small-size” telescopes of 4 m diameter in order to study the Universe in gamma rays by using the Imaging Atmospheric Cherenkov Technique (IACT) approach. Compared to currently operating IACT systems such as the MAGIC, HESS and VERITAS telescopes, the ASTRI array will extend the sensitivity up to a few hundred TeV, an almost unexplored energy range so far. Thanks to the novel dual mirror configuration adopted by the ASTRI telescopes (already proven with the ASTRI-horn end-to-end telescope prototype installed in Sicily by INAF during the past few years), the ASTRI array will benefit from a much larger field of view, which in turn will make it possible to monitor simultaneously a few close-by sources during the same pointing. The combination of the sensitivity extended beyond 100 TeV and of the homogeneous performance across the Field of View will make it possible to study e.g. emission from extended sources such as SNRs and PWNs at $E > 10$ TeV. The use of a SiPMs-based camera will improve the duty cycle of the system allowing safe and effective operation in principle with any level of moon condition. The ASTRI array will be able to perform astronomical observations with a great energy resolution (about 10–15 %). In addition, fruitful synergies with HAWC (Mexico), surveying a very large stripe of the northern sky, with pointed observations are also clearly foreseen. In summary, the ASTRI array will make it possible to carry out seminal studies on both Galactic and extra-Galactic sources, tackling frontier issues at the intersection of the fields of astrophysics, cosmology, particle physics and

fundamental physics. The use of the array to perform intensity interferometry studies of stellar sources with unprecedented angular resolution is also foreseen. In order to implement the ASTRI array at the site hosted by the Observatorio del Teide, it is necessary to prepare the agreed site with inner tracks, concrete platforms, power and data lines. The array will be operated for data taking during at least four (4) years. After that, the agreement could be either renewed or the telescopes could be dismantled and the site returned to its pristine state. The Teide Observatory is an ideal location for the ASTRI, not only for its internationally recognized quality, low precipitable water vapour (PWV), and number of clear nights, but also because of its geographical location giving access to the northern sky. The first-rate infrastructure and the opportunities for outstanding scientific interactions make the IAC and the Teide Observatory a perfect host for the ASTRI. It is expected that the operation of the ASTRI will start at the beginning of 2021 and continue for an initial period of four (4) years, which could be extended by mutual agreement for a further four (4) years. After the second period any further extension will require the signature of a new Agreement.

- IX.** That as the Kingdom of Spain opened the Observatorios de Canarias to the international scientific community by means of the International Treaty: “Agreement on Co-operation in Astrophysics and its Protocol”, which was signed on 26 May 1979, and Italy adhered to the Treaty in 1992, the proposed ASTRI experiment is invited by IAC to be installed at the Teide Observatory in accordance with the terms and conditions hereby established.
- X.** In accordance with the International Treaty, an International Scientific Committee (hereafter, “CCI” from its initials in Spanish) has been established to provide the Telescope Operators a forum where they can express their needs and preferences concerning the Observatory Management and its Common Services.
- XI.** The INAF will represent the ASTRI vis-a-vis all third parties related to the Observatorios de Canarias, such as the CCI, and shall have the right to appoint a representative on the corresponding Subcommittees and Working Groups established by the CCI.
- XII.** The INAF, acting on behalf of the ASTRI Partners with minor share, in particular, the University of Sao Paulo/FAPESP (Brazil) and the North-West University (South Africa) and the IAC have established this Agreement, as expressed in Clauses 1 to 8 and the attached Appendices A, B and C, which are an integral part of this Agreement, in accordance with the following:

CLAUSES

1. OBJECT OF THE AGREEMENT

The purpose of this Agreement is the installation and operation of the ASTRI array of IACT telescopes at the Teide Observatory, Tenerife, under the terms and conditions contemplated under this Agreement and the Appendices that accompany it.

2. RIGHTS AND OBLIGATIONS OF THE PARTIES

- 2.1 Each Party of the present agreement will be responsible for the acts of its respective personnel that is working in the ASTRI installation. The INAF will be responsible for the installation of the ASTRI telescopes and related equipment while the IAC will be responsible for any of its installations used in this experiment.
- 2.2 The INAF is authorized to proceed with the installation, operation and removal of the ASTRI telescopes, as described in Appendix A, at the place identified at the Teide Observatory in Appendix B. A large enough area has been selected to host from a minimum of nine (9) up to twelve (12) Telescopes forming the ASTRI Array.
- 2.3 The IAC will provide a suitable connection point to allow passage of power and data cables to the site, according to the agreed specifications (Appendix C). The responsibility for the works and costs of all connections from this point to the installation lies with INAF. At the time of the signature of this Agreement the IAC and Spain have fulfilled all obligations to provide infrastructure at the Teide Observatory, therefore all costs related to the development of additional infrastructure, or the upgrading of existing infrastructure at the site, are the responsibility of INAF.
- 2.4 The INAF shall review the preparatory work to provide the connection point and shall be responsible for the delivery, installation and commissioning of the ASTRI telescopes and facilities. The INAF will ensure that expert personnel will accompany the telescopes to the Teide Observatory and stay during the time needed for installing, aligning, and testing the units. The INAF, with advice from the IAC, will ensure that the current environmental protection legislation is adhered to during the installation work.
- 2.5 The INAF will bring an adequate set of spares of the components deemed from experience most likely to fail. The INAF shall be responsible that the expert personnel visit the site at least once per year to inspect the ASTRI telescopes and coordinate ongoing activities with IAC personnel. The INAF shall be responsible for the operation and maintenance of the ASTRI array with local support from the IAC. The costs of the IAC support shall be charged in

accordance with the published tables for work at the Teide Observatory, which are updated on an annual basis. Local support from the IAC will include responding to alerts and, possibly, to collaborate with the INAF in performing periodic instrument-part replacements/maintenance following defined protocols (such as for the mirror cleaning).

- 2.6 The partners of the ASTRI collaboration may at any time during the term of this Agreement repair or replace ASTRI's instruments, or update its operational or observing protocols. The ASTRI partners may also train IAC's staff in performing some of these replacements.
- 2.7 All persons using the ASTRI telescopes shall observe the rules for its operation laid down by the ASTRI partners and the recommendations of the Safety Officers of the Teide Observatory and the IAC. The INAF must guarantee that the personnel authorized to use the ASTRI telescopes and its auxiliary equipment know and respect the health and safety regulations applicable in the Teide Observatory.
- 2.8 The INAF shall protect the local environment during the site works and by leaving the area in a clean and orderly state on completion of the installation work so as to fulfil the stipulations of the "Effect on the Environment Report". This report will be prepared with the assistance of the IAC at the cost of the INAF, in the process of obtaining the corresponding permissions and permits. Any damage to the Observatory caused by construction and installation work for the ASTRI and any auxiliary equipment, or resulting from its operation, shall be repaired as soon as possible by the INAF.
- 2.9 The INAF, acting on behalf of the ASTRI partners, must guarantee that the IAC is not required to cover with its own funds any expenses that are the responsibility of the ASTRI partners.
- 2.10 At the end of the period during which this Agreement is in force, INAF shall be responsible to remove the equipment from the Teide Observatory and leave the ground in a clean and proper state at its own cost in accordance with the prevailing environmental regulations, unless the equipment is transferred to the IAC, or to a third Party with the prior agreement of the IAC. In the latter case the new owner/operator and IAC will negotiate in a written agreement the relevant conditions, respecting those established herewith.
- 2.11 The IAC shall be responsible for presenting on behalf of the INAF all required documents to obtain local construction licences.
- 2.12 During the period in which this Agreement is in force the IAC shall ensure that the INAF is guaranteed the right to use the site as set forth in Appendix B in order to install and operate the ASTRI as described in Appendix A. The IAC shall only allow access to the ASTRI to those persons whose authorization has been notified in writing to the Site Management by INAF.

- 2.13 IAC shall also make available to the ASTRI partners the services that are necessary (Appendix C) for the installation and proper operation of the ASTRI. The IAC shall ensure that the infrastructure and the common services are kept in a proper condition that guarantees the correct operation of the ASTRI. All costs of Common Services that are required by the ASTRI collaboration shall be borne by the INAF.
- 2.14 The equipment, materials and goods including accessories, spare parts and instruments, required for the installation, operation and maintenance of the ASTRI array experiment will benefit from all rights applied to the IAC, including, when possible, their import and re-export free of Custom Duty, exemption from taxation, as well as the application of the required procedures and formalities as speedily as possible. IAC will recommend a Customs Agent to assist with importing this hardware into Spain. All costs incurred after the start of the project related to the importing of this hardware shall be borne by the INAF, although the IAC shall endeavour to obtain those exemptions which are legally available to it under the prevailing legislation.
- 2.15 All persons, including those from the IAC and INAF who use the infrastructure and common services within the framework of this agreement, must respect the rules and recommendations established by the IAC and approved by the CCI, under the supervision of the IAC Director or his delegate, especially those related to health and security.
- 2.16 The IAC and the INAF together with the other ASTRI Partners shall each appoint a Responsible Scientist in the collaborative project and their names and positions are presented in Appendix D. Their duties shall include their collaboration in the oversight of the operation of the telescopes and their equipment so as to assure that they produce the best quality and quantity of data possible. One of the principal responsibilities of the Responsible Scientists shall be to produce, and to present annually to the ASTRI Partners and the IAC Director, a report of not more than two (2) pages on the operation, use and achievements of the ASTRI Array. They shall also offer contributions to the CCI Annual Report on outstanding scientific results and/or relevant technical improvements to the installation, as and when appropriate. The Parties may nominate other persons in the future by giving written notice. Communication between the Parties, whether concerning any collaboration, or use of IAC facilities and services, shall be conducted, wherever appropriate, by means of these designated Representatives. The designated Representatives identified in Appendix D shall incur no personal liability for the fulfilment of this Agreement.

- 2.17 So as to foster the collaboration between the Parties during the period that this Agreement is in force, and in exchange for authorising the installation and operation of the ASTRI mini-array, the INAF will make an annual economic contribution to the IAC of 50000 (fifty thousand) euros for 1 post-doc position per year, plus 27000 (twenty seven thousand) euros for 1 PhD student per year. Both researchers will participate in the research group stipulated in clause 2.18. It is foreseen that the PhD student can have supervisors at the INAF and IAC. This amount will be adjusted annually in accordance with the Canary Islands Official Price Index. This provision implements the regulations in Article 5.c of the Agreement on cooperation in astrophysics and Article 4.1.c of its Protocol.
- 2.18 Article 5 of the International Treaty and Article 4 of the Protocol, provide for the IAC to have at its disposal 20% of the observing time of all the telescopes and instruments installed at the Observatorios de Canarias free of charge and an additional 5% of the observing time to be dedicated to collaborative programmes between all of the User Institutions, as defined in the Protocol, including the IAC. Given that the ASTRI array will not be operated as an entirely conventional telescopic installation, and hence the time allocation referred to in the aforementioned Articles of the International Treaty cannot be distributed in the standard way, under the provisions of this Agreement the IAC can have a research group which will participate as a full Partner in the scientific exploitation of the data of the ASTRI array. The IAC will appoint at least one Representative on the highest decision making body of the ASTRI collaboration (hereafter the "ASTRI Board") carrying the weight equivalent to a third of voting rights. In the event of one or more additional full partners joining this collaboration the weight of the IAC's voting rights shall not fall below the level of 25%, thereby respecting the basic provisions of the International Treaty in regard to the distribution of observing time on telescopes and instruments installed at the Observatorios de Canarias. As with the Responsible Scientists, the parties may appoint other persons in the future by giving written notice. The ASTRI Board will be considered constituted when all Parties are represented. Decisions shall be taken unanimously.
- 2.19 The IAC designated research group may include researchers, post-docs and PhD students and will have the right to contribute to and participate in all scientific publications of the ASTRI project, as well as leading at least 25% of them in accordance with the IAC's weight in the project under Article 2.18. The participation of the IAC staff or co-investigators, in the terms foreseen by the previous Clauses, will not suppose any costs for the IAC or the INAF.
- 2.20 The ASTRI array will be dedicated to scientific research, technological development and the advanced training of scientists and technologists.

- 2.21 The ASTRI Board will also act as the Publication Board, having the responsibility of designating the scientific group that will be responsible for every scientific project, of defining the authorship (and the order of the authors) of every scientific paper and conference proceedings, and accepting conference talks showing the ASTRI scientific results.
- 2.22 The ASTRI Board acting on behalf of the ASTRI partners, shall endeavour to ensure that when reference is made to the data obtained an appropriate acknowledgement of the IAC and the ASTRI collaboration is included in papers and press releases, indicating that the data has been obtained at the Teide Observatory, Tenerife, of the Instituto de Astrofísica de Canarias. The CCI has agreed the following text, *“This article is based on observations made in the Observatorios de Canarias del IAC with the ASTRI array operated on the island of Tenerife by the ASTRI’s partners in the Observatorio del Teide.”*
- 2.23 Any commercial exploitation of all types of data and software must be agreed in writing between the INAF and the IAC.
- 2.24 ASTRI shall pay its proportion of the cost of all current expenditure on Common Services, in accordance with the Distribution Table agreed by the CCI as well as the corresponding contributions to the budgets for the publication of the CCI Annual Report and its Secretariat. This corresponds approximately to 7,700 €/year for the first telescope and about 7,700 €/year for each of the others. Therefore, the total financial obligation for this concept once all 9 telescopes have been installed will amount to approximately 69,300 €. The exact amount will be updated and communicated in accordance with the undifferentiated Common Services Budget (CSB), approved annually by the CCI. The initial CSB contribution for the first telescope shall be made effective according to the Budget for 2020. The corresponding contribution for each additional telescope shall be made effective for the year when their construction commences.
- 2.25 Electricity use shall be metered and the cost shall be covered by INAF. This is estimated, in view of the specifications of the proposed set of telescopes, at an approximate cost of 7,500 euros p.a., per telescope.

3. MONITORING COMMISSION

- 3.1 The Parties agree to set up a Monitoring Commission to guarantee the correct execution, follow-up and control of the provisions of this Agreement, each party appointing a Responsible Scientist as its main representative in the collaborative project object of this agreement, whose name and status is specified in Appendix D.
- 3.2 This Monitoring Commission will resolve the interpretation and compliance problems that may arise with respect to this agreement. For the fulfilment of its functions this Commission will meet at least once a year in ordinary session,

and as many times as requested by one of the parties in extraordinary session. It will be considered constituted when all the Parties are represented. The possible agreements will be adopted unanimously.

- 3.3 The meetings of this Commission, both in ordinary session and in extraordinary session, may be in person or by telematic means.
- 3.4 The Parties agree to elevate any disputes to their respective legal representatives who will try to find a decision acceptable to all parties.
- 3.5 In the event that an agreed solution cannot be found, the Parties may invite the CCI to appoint an independent arbitrator. In the event that the matter is still not resolved to the satisfaction of the Parties, the matter will be resolved in accordance with the procedure established in Clause 8 of this Agreement.

4. DURATION OF THE AGREEMENT

- 4.1 This Agreement will be effective once it has been signed by the representatives of the Parties.
- 4.2 This agreement will have an initial duration of four years, and may be renewed for additional periods by mutual agreement in writing between the authorized representatives of the parties while Italy is adhering to the International Treaty and it has not been cancelled by Spain.

5. TERMINATION OR RESOLUTION OF THE AGREEMENT

- 5.1 This Agreement will terminate when the objectives have been achieved or in the event of its cancellation.
- 5.2 The following are the causes of termination:
 - a) Completion of the period of its validity without an agreement to extend it.
 - b) The unanimous agreement of the signatories.
 - c) Failure to comply with the obligations and commitments assumed by one of the signatories.
 - In this case, any of the parties may notify the non-performing party of a requirement to comply in a certain period with the obligations or commitments that are considered unfulfilled. This requirement shall be communicated to the person in charge of the mechanism for monitoring, enforcing and controlling the execution of the agreement and to the other signatory parties.
 - If after the period specified in the request the breach persists, the party who addressed it will notify the signing parties of the concurrence of the cause of resolution and the agreement will be deemed resolved.

- d) By judicial decision declaring the Agreement to be null and void.
- e) Due to force majeure or failure to comply with the proposed object, such as not having sufficient funding to participate. In this case, formal notification must be provided to the other party at least six months in advance.
- f) It is recognized that it is difficult to predict with accuracy each of the time periods set out in this Agreement. However if the INAF has not installed at least one of the ASTRI telescopes by the end of 2021, the IAC may withdraw from this Agreement.
- g) For any other cause different from the previous ones that is foreseen in law.

6. MODIFICATION OF THE AGREEMENT

- 6.1 This Agreement may be modified by unanimous agreement of the original signatories or their duly authorized representatives. This agreement, in accordance with the provisions of Article 49.g) of the Ley 40/2015, of October 1st, can be modified in writing and by mutual agreement between the parties before the end of the period of validity or of the corresponding extension.
- 6.2 In the event that additional Parties adhere at a later date to this Agreement they shall be subject to the same conditions as those established herewith. The distribution of voting rights on the ASTRI Board will be adjusted accordingly and they may change their Representative in accordance with due procedure.

7. CLASSIFICATION OF THE AGREEMENT

This agreement is an International Administrative Agreement, which is subject to International Law, as established in article 2.b) of the Spanish Law 25/2014 on Treaties and other International Agreements.

8. RESOLUTION OF DISAGREEMENTS

- 8.1 Any dispute over the interpretation or application of this agreement must be submitted to the consideration of the Monitoring, Commission and can be resolved between the legal representative of INAF and the IAC Director, or through CCI arbitration.
- 8.2 If the differences are not resolved through the application of Clause 8.1, the disputed issues will be submitted to the usual means of resolution in International Law.

APPENDICES ATTACHED ARE:

APPENDIX A – TECHNICAL DESCRIPTION OF THE ASTRI ARRAY
APPENDIX B – OBSERVATION SITE OF THE ASTRI ARRAY
APPENDIX C – SERVICES TO BE SUPPLIED BY THE IAC
APPENDIX D – DESIGNATED REPRESENTATIVES AND PARTICIPANTS

Signed in four copies, two in Spanish and two in English, all with the same authority.

**For the ITALIAN INSTITUTE
FOR ASTROPHYSICS**

**For the INSTITUTO DE
ASTROFÍSICA DE CANARIAS**

**Prof. Marco Tavani
President**

**Prof. Rafael Rebolo López
Director**

Date:

Date: 22 December 2020

A handwritten signature in blue ink, appearing to read 'R. Rebolo', with a long horizontal line extending to the right from the end of the signature.

APPENDIX A

TECHNICAL DESCRIPTION OF THE ASTRI ARRAY

1. Introduction

A detailed description of the ASTRI Array is beyond the scope of this document. In this Appendix, we will give a brief overview of its characteristics, especially of those parts that will have to be placed in Tenerife either at the Teide Observatory or at IAC in La Laguna.

The ASTRI Array Product Breakdown Structure down to the second level is shown in Figure 1.

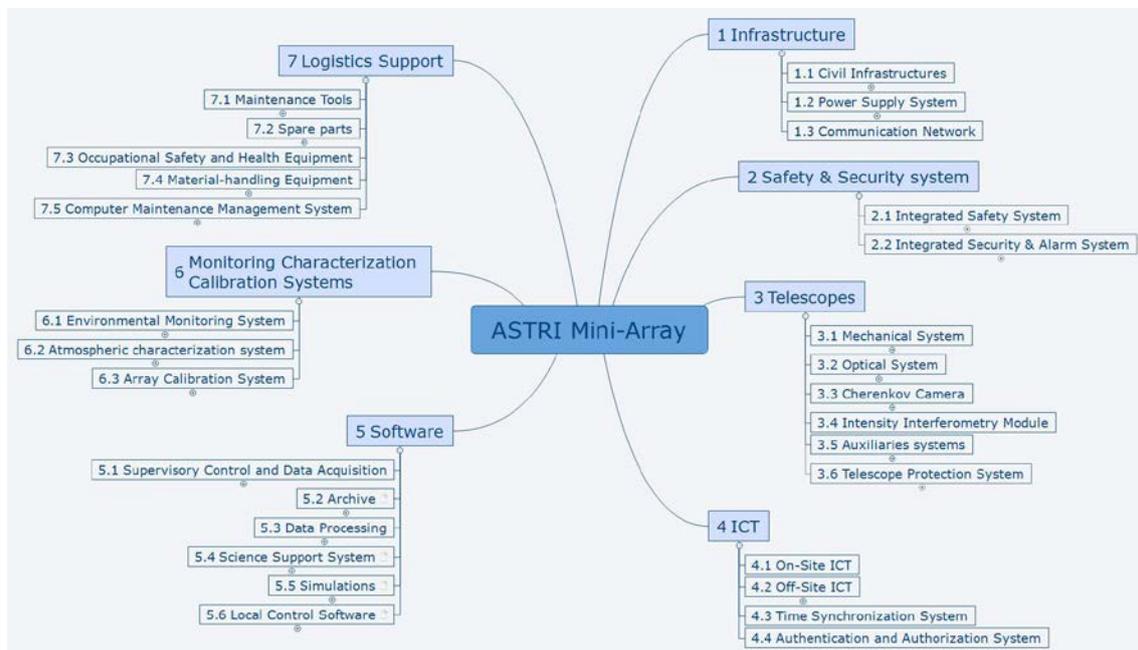


Figure 1. ASTRI Array PBS

2. Infrastructure

The ASTRI Array infrastructure is composed of different subsystems and everything is needed to make the observational site suitable to host the telescopes of the ASTRI. Appendix B contains a description of the civil infrastructures needed at the Teide Observatory, including the use of services such as workshops, canteen and guest-house.

It is important to note that the ASTRI Array will be developed in order to be operated, after the initial assessment phase, remotely. In this respect, when the array will become fully operational, no human presence is foreseen at the observing site during night observations.

Apart from the infrastructure on site, the ASTRI project will need an office space to host the ASTRI personnel in charge of the coordination, the array control room and part of the ICT, in La Laguna at IAC. Also, a warehouse will be needed to store spare parts and handling tools and a few parking spaces for service vehicles. The use of the workshops at IAC will also be needed for the integration and maintenance of some opto-mechanical and electrical parts before the installation at the Teide Observatory site. The Safety & Security System will be connected to everything that will be installed at the Teide observatory. The INAF and ASTRI personnel will also need access to the IAC canteen.

3. Safety and Security system

The Safety and Security System (SAS) is an independent system for the protection of the Site assets. The SAS shall integrate all information available in real-time from the ASTRI components. It provides an interface to monitor the status of all the site system components. SAS must implement safety functions in order to remotely stop the operation of all site system components in the event of danger.

4. ASTRI Telescopes

Figure 2 shows a 3D model of one of the ASTRI telescopes to be installed at the Teide Observatory site.

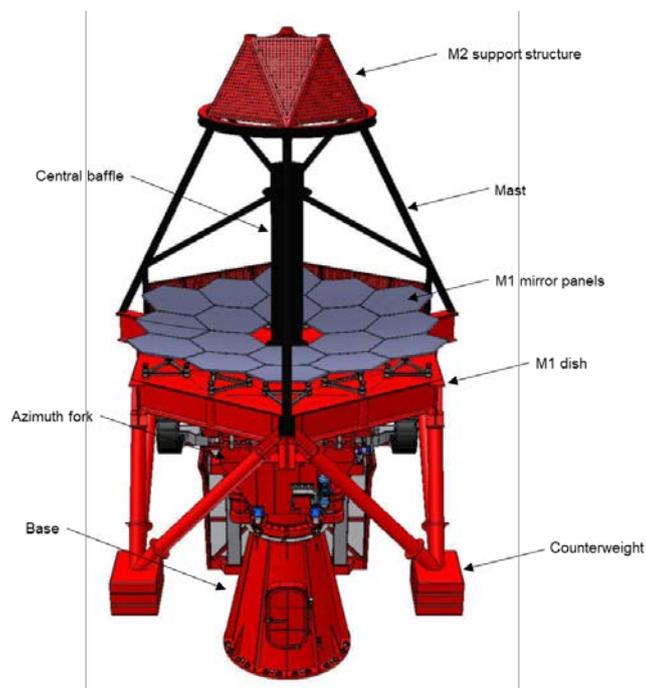


Figure 2. 3D model of a telescope of the ASTRI mini-array. Some of the opto-mechanical components are explicitly indicated.

The main subsystems of the ASTRI telescope are:

1. The Optical subsystem
2. The Mechanical Structure subsystem
3. The Cherenkov camera subsystem

4.1. Optical Subsystem

The optical design is based on a dual-mirror Schwarzschild-Coude configuration. This configuration allows better correction of aberrations at large incident angles even for small focal ratios and hence facilitates the construction of compact telescopes. This optical system is an attractive solution since it enables good angular resolution across the entire field of view and allows reducing the focal length and therefore the physical pixel and overall camera size.

The primary mirror is segmented while the secondary is monolithic. The primary is composed by a set of 18 hexagonal-shaped panels. The profiles of both mirrors are aspheric with substantial deviations from the main spherical component.

The primary mirror has a diameter of 4.3 m while the secondary mirror diameter is 1.8 m. The primary-to-secondary distance is 3 m and the secondary to camera distance 0.52 m.

This optical setup delivers a plate scale of 37.5 mm/degree, an equivalent focal length of 2150 mm and an effective area of about 5 m².

4.2. Mechanical Structure

The ASTRI telescope adopts an altitude-azimuthal design in which the azimuth axis will permit a rotation range of $\pm 270^\circ$. The primary mirror dish, which supports the primary mirror, is mounted on an azimuth fork, which allows rotation around the elevation axis from 0° to $+91^\circ$. The mast structure, that supports the secondary mirror and the camera, is placed on the primary mirror dish.

4.3. Cherenkov Camera

The ASTRI Cherenkov is based on SiPM detectors. The camera has 2368 distributed pixels on a curved focal plane. The pixels have a linear dimension of 7×7 mm². Coupled with the characteristics of the optical system this corresponds to an angular pixel size of 0.19 degree and a field of view of 10.5 degrees. Furthermore, more than 80% of the light emitted by a point source is collected within the dimensions of a pixel over the full field of view of the telescope.

The design of the electronics ensures a high efficiency detection of a Cherenkov event, with over 600 events per second, with a very high dynamical range (from 1 to 1500 photoelectrons per pixel).

5. Information & Communication Technology (ICT)

The onsite ICT will be made by all the hardware necessary to control the array, a buffer mass memory for temporary storage of a few nights of observations if needed and network devices.

6. Software

The Array software is being designed to carry out all the steps needed to prepare and execute a scientific observing run. The software system will provide a set of tools to the user from the preparation of an observing proposal to the execution of the observations, the analysis of the acquired data online and the retrieval of all the data products from the archive.

7. Monitoring, Characterization and Calibration System

The Monitoring Characterization and Calibration system consists of the set of devices that will have to monitor the Site environmental conditions, to characterize the atmosphere during the observing night and to calibrate the ASTRI array. Some of these instruments will be installed on telescopes (e.g. UVSiPM) or on specific structures (e.g. meteorological towers) some will be movable (e.g. the illuminator device).

8. Logistics Support

The logistics support includes all the hardware & software necessary for the preventive and corrective maintenance of the ASTRI Mini-Array.

APPENDIX B

SITE OF THE ASTRI ARRAY

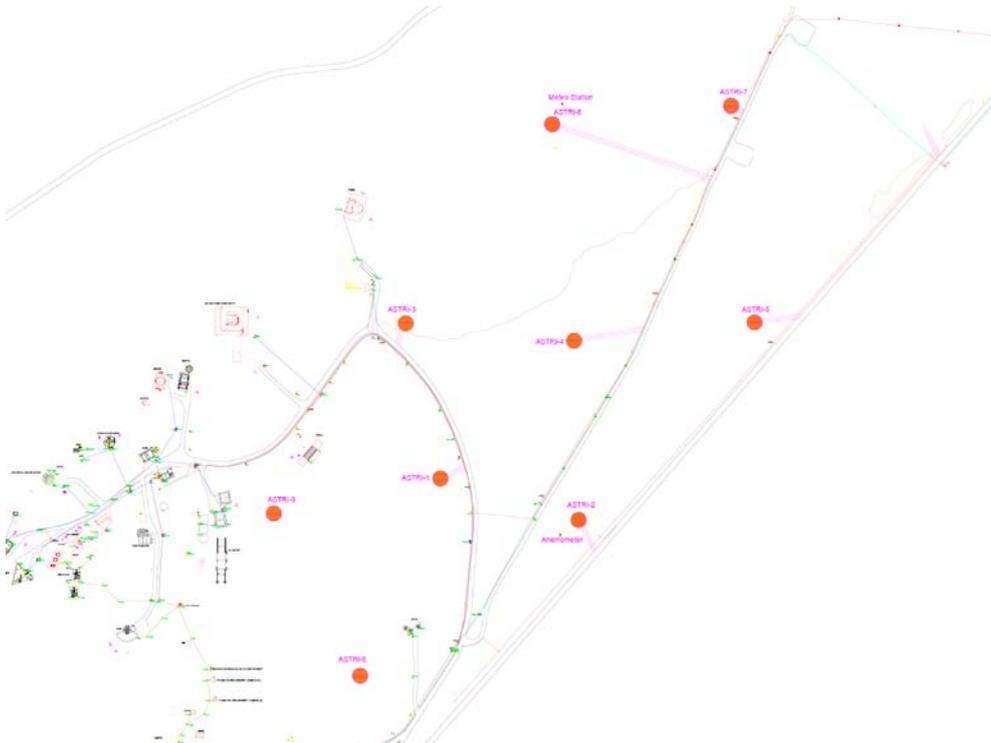


Figure 3. The proposed layout for the ASTRI Array.

A preliminary schematic layout of the ASTRI array at the Teide Observatory is shown in Figure 3. Only permanent structures are shown. The permanent structures are those that will stay when the array will operate while the temporary ones will be necessary only for the construction and commissioning phase. In the latter case the affected areas will be restored to the conditions before the construction.

List of permanent structures

1. Nine (9) areas for telescope installation (see Figure 4 for a more detailed description).
2. A standard 40 feet container (or an equivalent area inside an existing building) for the operation phase (named hereafter Control room).
3. A container (or an equivalent area inside an existing building) for the data center (approximate size: 7 meters x 3 meters) close to the Control room.
4. Two meteorological towers.
5. An area (2 meters x 2 meters) to place the LIDAR.
6. Access tracks to telescope areas & Control room.
7. Trenches, cable ducts for power and data cables.
8. Manholes.
9. An area to place the power back up diesel generator.

List of temporary structures

1. A series of prefabricated buildings for commissioning phase (named hereafter Service Area).
2. An area for container storage for construction phase.

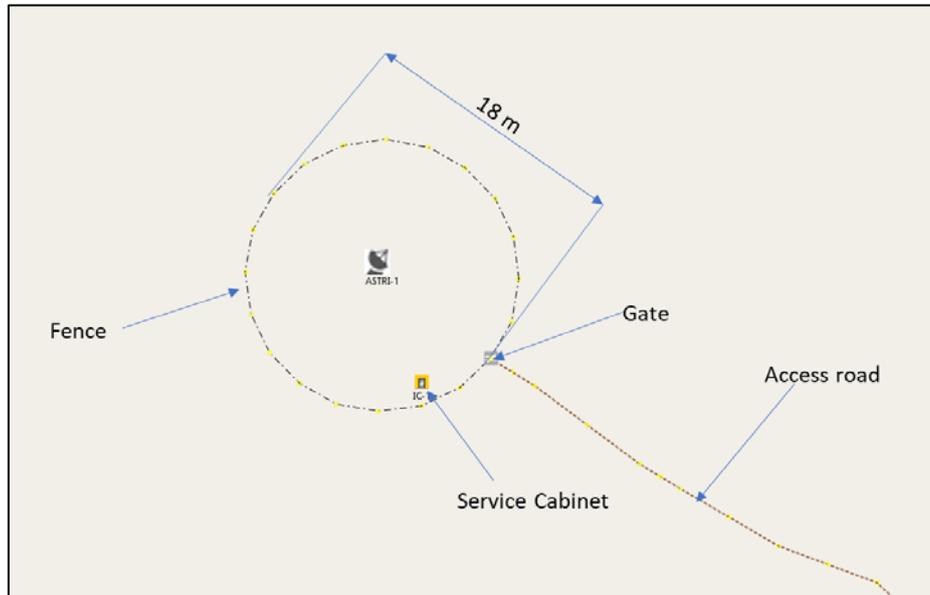


Figure 4. Possible layout of the area around each telescope

Figure 4 shows a possible layout of the area around each telescope. The main components inside each area are the following:

1. Telescope foundation
2. Service cabinet for electrical power and data connection
3. Fence surrounding the area
4. Access gate connected to array interlock/alarm system
5. Manhole
6. Telescope

An area around the telescope of 9 meters of radius shall be flat to allow maintenance operations. The area will be surrounded by a fence and the access will be possible only through a gate.

APPENDIX C

SERVICES PROVIDED BY THE IAC

1. The site to install the ASTRI array and the use of existing roads and trenches.
2. Access to the Teide observatory to personnel of the ASTRI collaboration and during the construction phase to people with ASTRI related business.
3. Maintenance & Cleaning of the access tracks to the ASTRI facilities at the Teide Observatory including:
 - a. 9 telescopes (extendable to 12)
 - b. 2 meteorological towers
 - c. Control room & Data Centre
4. Access to Internet network, telephone network and general power supply of the Teide Observatory.
5. Offices in the IAC's installations in La Laguna to host the ASTRI administration and coordination office, the Array control room & ICT.
6. A warehouse in the IAC's installations in La Laguna to store spare parts & maintenance tools.
7. Parking spaces in the IAC's installations in La Laguna for service vehicles.

COMMON SERVICES

Electrical power

The peak requirement for electrical power for the ASTRI array during operations will be 100 kW, provided at 380/220 V.

Communication system

ASTRI will provide for its own requirements its own communication system connected to the various systems (telephone, computer links, etc.) at the Teide Observatory. The specifications must conform to the system in use by the site unless otherwise agreed.

Water Supply

In case of necessity (e.g. for the water cleaning operations) IAC will provide access to its water supply. The cost will be established if this supply is required.

Canteen and accommodation facilities

During normal operation of the ASTRI array, no persons are foreseen on site during night-time operations at the Teide Observatory.

For maintenance operations during daytime 2 to 3 persons will have to stay on site occasionally. In this case, the use of the canteen and accommodation facilities will be needed.

Access to the facilities of the Residencia will be required for up to ten persons during installation, commissioning and the early phase of the ASTRI array operations.

At IAC or in its installations the use of the canteen and office space for the INAF and ASTRI resident staff (up to 4 persons) will be needed.

Interference from stray light

The operation of the ASTRI array telescopes, observing the faint light generated in cosmic air showers, requires protection from direct disturbance by stray light. The ASTRI Collaboration expects that similar precautions against stray light from the Residencia or from cars will be taken as for the more distant optical telescopes. The ASTRI Collaboration will be authorized to set up warning signs on the nearby road in order to indicate ongoing Cherenkov observations.

APPENDIX D

REPRESENTATIVES AND PARTICIPANTS

THE PARTIES' RESPONSIBLE SCIENTISTS

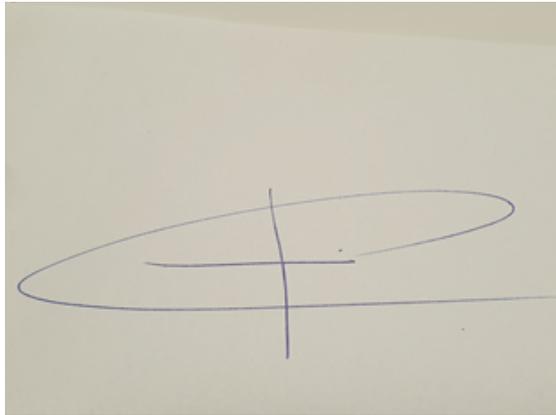
The INAF Responsible Scientist: Dr Giovanni Pareschi

Signature: _____

Date: 22 December 2020

The IAC Responsible Scientist: Prof. Ramón García López

Signature:

A photograph of a handwritten signature in blue ink on a light-colored background. The signature consists of a large, horizontal oval shape with a vertical line intersecting it in the center, and a horizontal line intersecting it near the top.

Date: 22 December 2020