



THE EUROPEAN SOLAR TELESCOPE NEWSLETTER

## JUNE 2022

### **INSIDE THIS ISSUE**

- EST presentations in Madrid and Bratislava
- PRE-EST highlights
- Science instrument suite
- Heat rejecter preliminary design
- EST building and civil works
- Update on industrial contracts
- EST School Competition
- The EST Solarpedia

## **COORDINATOR'S CORNER**

EST continues making progress in all the activities in which the project is engaged. In this issue, we learn that the Spanish National Research Council and the Slovak Academy of Sciences hosted events to present the project, accompanied by the exhibition of the EST documentary "Reaching for the Sun", to representatives of their respective national governmental, scientific and industrial communities. The events attracted the attention of the Spanish and Slovak media and EST reached wide diffusion in both countries.

The year started with a second review meeting with the participation of our European Commission project officer and an external reviewer. As in the first review, the outcome of the evaluation was positive and important advice for a successful project finalisation was received.

The works for the preliminary design of the Telescope Structure, Pier, Enclosure, Primary and (Adaptive) Secondary Mirrors, and Heat Rejecter of EST are underway by the awarded companies. International consortia are working towards the preliminary design of the EST Tunable Imaging Spectropolarimeters and Integral Field Spectropolarimeters. These works, as well as others directly managed by the EST-PO, will be presented at the 2022 SPIE Astronomical Telescopes & Instrumentation conference.

The feasibility of the construction of EST at the approved site has been confirmed. The preliminary studies of the building and civil works have led to the adaptation of the EST shape to the site configuration.

As part of the intense communication activities, we describe the participation of the project in UNESCO's International Day of Women and Girls in Science, the development of the EST Solarpedia and the international school competition "The Sun at a glance", with an outstanding participation.

We all wish you enjoy reading the description of these activities.

# **EST NEWS**

## PRESENTATION OF THE EST PROJECT IN MADRID AND BRATISLAVA

The Spanish National Research Council and the Slovak Academy of Sciences hosted events to present the project to representatives of their respective governments, scientific and industrial communities. The EST documentary "Reaching for the Sun" was also premiered during the events.



State Secretary for Research, Raquel Yotti, addressing the audience at the EST presentation in Madrid. Credit: Vinca Page /CSIC

The European Solar Telescope was presented to the Spanish Ministry of Science and Innovation and the scientific and industrial communities on May 3, 2022. The act was held at the Residencia de Estudiantes, an iconic place for the history of Science and Culture in Spain, managed by the National Research Council (CSIC). Antxon Alberdi, director of the Instituto de Astrofísica de Andalucía (IAA-CSIC) conducted the event.

The audience was welcomed by Ángeles Gómez Borrego, CSIC Vice-President for International Affairs and member of the EST Board of Directors. She highlighted the importance of the EST project for the solar research community in Spain and more broadly in Europe. She confirmed the strong support of CSIC to this project.

Manuel Collados and Luis Bellot briefly described the project and the main

scientific goals of the European Solar Telescope. The role of the two Spanish institutions in the consortium, the Instituto de Astrofísica de Canarias (IAC) and the Instituto de Astrofísica de Andalucía (IAA-CSIC), was highlighted, as well as the contributions of the Spanish industry to the EST design.

Next, the EST documentary "Reaching for the Sun" was premiered. The film director, Emilio García (IAA-CSIC), presented this journey through 400 years of history of solar astronomy in Europe, from Galileo to several state-of-the-art observatories across Europe. A path that leads to the next step of the journey: the European Solar Telescope. He thanked the film crew and production/post-production teams for their work. The film was acclaimed by the audience and authorities alike.

Inmaculada Figueroa, Deputy Director General for the Internationalization of Science and Innovation and ESFRI Vice-chair, recalled that only a few projects have been supported by Spain for inclusion in the ESFRI Roadmap, and the European Solar Telescope is one of them.

Closing the act, the State Secretary of Research of the Spanish Ministry of Science and Innovation, Raquel Yotti, highlighted that EST is an inspiring project for future scientific challenges. Yotti pointed out that the European Solar Telescope was an example of collaboration, not only between scientific institutions and countries, but also with industry, making it possible to foster technological innovation.

Yotti stressed the importance of longtime projects, "to get further and to reach goals that seemed impossible a few years ago".

The event was well attended by



Manuel Collados, Peter Gömöry, and moderator Otakar Horák during the discussion held in Bratislava on May 10. Credit: SAS

leading authorities of the Spanish scientific community, including the president of the Spanish Astronomical Society, Benjamín Montesinos, the coordinator of the Spanish Network of Astronomical Infrastructures, Martín Guerrero, and representatives of the Centre for Technological and Industrial Development (CDTI), among others.

The presentation attracted the attention of the Spanish media, which covered the event thoroughly. The EST representatives were interviewed by several press, TV and radio journalists, and their declarations reached wide national diffusion.

## "Reaching for the Sun" premiere in Bratislava

On May 10, 2022, the EST documentary Reaching for the Sun – The Story of a Magnetic Star was premiered in Bratislava (Slovakia), in an event held at the main headquarters of the Slovak Academy of Sciences (SAS).

Slovak scientists from the Astronomical Institute of the SAS have a prominent role in the film, where they highlight the importance of the coronographic observations carried out at Lomnický štít. On this occasion, the EST coordinator Manuel Collados (IAC) and the head of the EST Communication Office and executive producer of the film, Luis Bellot (IAA-CSIC), visited Bratislava. The premiere was followed by a discussion with Manuel Collados and Peter Gömory, the director of the Astronomical Institute of the SAS, who took questions from the audience.

"The European Solar Telescope is a planned revolutionary instrument aimed at studying the basic processes on the Sun - our star, which dominates active phenomena and physical conditions in the heliosphere and thus directly affects the Earth's biosphere" explained Peter Gömöry, who added that it will be the largest solar telescope in Europe, with a primary mirror 4.2 metres in diameter

In his introductory speech, the president of the SAS, Prof. Pavol Šajgalík, emphasised that we are at the beginning of a new chapter in the study of the Sun from Europe. "I am very glad that the Astronomical Institute of the SAS has been involved in this project. In addition to achieving very good results, the institute also has a long history of research in the field of solar physics".

Addressing the students in the audience, he added "Science is a very exciting journey that I recommend to each one of you, and if you want to be part of it, study physics, mathematics, technical and natural sciences. I hope this film will convince you that it's worth it."

Twenty three scientific institutions from 16 European countries are currently involved in the EST project. They operate key solar infrastructures such as GREGOR, THEMIS, SST, and VTT in the Canary Islands, and the iconic Einstein Tower in Germany. The coronal station at Lomnický štít is an integral part of these facilities. According to Peter Gömöry, "It is the only functional workplace of its kind in Europe. As EST will not be optimised for solar corona observation, coronographs at Lomnický štít will always be considered an important part of comprehensive solar research in Europe".

The event was closed with a reception offered by the Spanish Ambassador to Slovakia, Ms. Lorea Arribalzaga Ceballos, to the president of the SAS, Prof. Pavol Šajgalík, the vice-president of SAS for International Relations, Dr. Zuzana Panczová, the director of the Astronomical Institute of the SAS, Dr. Peter Gömory, and the representatives of the EST team. Prof. Manuel Collados and Dr. Luis Bellot. The Ambassador and the president of the SAS agreed to meet in the near future to monitor the scientific collaborations between Spain and Slovakia, with a focus on the European Solar Telescope project.

## PROJECTS

## **EST PREPARATORY PHASE**

The project will end on September 30, 2022. A report of the activities carried out during the last 6 months is provided, and plans for the future are described



Members of the EST Project Office at the EST headquarters in La Laguna

The Preparatory Phase of EST ends on September 30, 2022 and is already facing its last months. The PRE-EST consortium is working hard on the completion of the last deliverables and milestones in order to present all the work that has been done to fulfill the objectives of the preparatory phase. All this work will permit the project to tackle the upcoming interim and construction phases.

The year started with a second status review meeting with the participation of our European Commission project officer and an external reviewer with large experience in management and consultancy in the fields of physics and astrophysics. As in the first review, the outcome of the evaluation was positive and important advice for a successful project finalisation was received.

The evaluation results were discussed during the annual PRE-EST Board meeting, held online at the beginning of February 2022. The main observation was related to the national support both for the Interim and for the Construction and Operation phases. Although this is a common problem shared by most single-site ESFRIs, actions to be taken were agreed by all PRE-EST partners in order to close the Preparation Phase with the signing of a legal figure for the Interim Phase, in close coordination with the EST Board of Directors. This aspect will be discussed during the next meeting of the EST Board of Directors on June 20, 2022.

Significant efforts are being made by all partners to guarantee the institutional support of their countries to the EST project. With this aim, and taking advantage of the reduction of COVID-19 restrictions in most European countries, the EST project and the documentary "Reaching for the Sun" are being presented officially to national authorities and funding agencies. Institutional presentations of EST have already been held in Spain and Slovakia, and are being planned in other partner countries.

As described elsewhere in this issue, the EST Project Office has made important technical advances related to the design of all EST subsystems complying with the planned timetable, in close collaboration with industrial companies, the Science and Technical Advisory Groups and the instrument consortia. The main preliminary design contracts are in the prototype phase. The companies and the Project Office are working together very satisfactorily to make EST a success.

The preliminary studies of the building and civil works, at the approved EST site, have led to the adaptation of the EST shape to the site configuration and permitted to advance in the definition of the civil works requirements.

Also, preparations for the Final Project Meeting have started. The plan is to hold the meeting on La Palma, where EST will be constructed, during the last week of September 2022. There will be a PRE-EST Board Meeting and the first in-person meeting of the EST Board of Directors, together with a series of outreach activities in order to promote the EST project among local authorities and the population of the island.

# **EST INSTRUMENTATION**

## **UPDATE ON THE SCIENCE INSTRUMENT SUITE**

International consortia are working towards the preliminary design of the EST Tunable Imaging Spectropolarimeters and Integral Field Spectropolarimeters

The EST-PO and the Science Instrumentation Suite (SIS) Consortium Leads have been iterating during the last months through different meetings. In these online and also offline exchanges we have tackled the key design performance and interface parameters together with the corresponding responsibilities related to the conceptual design phase for the different types of instruments: Tunable Imaging Spectropolarimeters with Fixed Band Imagers (TIS/FBIs) and Integral Field Spectropolarimeters (IFS).

## SIS General Design and Interface Requirements

To ensure their traceability, the General Technical Requirements derived from the Science Requirements Document (SRD) have been captured by the SIS General Design and Interface Requirements Document as "SIS Top Level Performance Requirements".

The compliance towards these requirements shall be reached by both systems: the EST Telescope and its SIS. Indeed, the overall performance of EST, as an observatory, is somehow the result of the entanglement or combination of the capabilities of these two systems. That translates into a set of technical interface requirements that are currently being identified and agreed between the EST-PO and the SIS leaders.

Some points related to crucial parameters like telecentricity and chromatism of the science focal plane (F3) delivered by the telescope have been discussed. The design of the Pier Optical Path that transfers F3 to the instruments and to the Multi Conjugated Adaptive Optics wavefront sensors is currently being enhanced thanks to these iterations with the consortium team members. Other system-level interface requirements that are currently under discussion have been directly specified from design needs required by the telescope and the SIS. Recent exchanges related to the instruments' envelopes definitions are helping EST-PO have more insight for the design of the Coudé rooms (where the different instruments will be accommodated) and the EST light distribution system.

This close collaboration between the EST-PO and the SIS consortium teams will thus converge in an instrument conceptual design compliant with both the EST SRD and the SIS General Design and Interface requirements.

#### **SIS Systems Engineering Plan**

Besides requirements specification, building EST calls for commonality between the tasks and goals of the consortium team members and those of the EST-PO.

The EST SIS Systems Engineering Plan aims for sharing a common development approach encompassed by the telescope development life cycle. It also describes the processes, activities and methods that can be beneficial for large and complex projects as EST.

The plan has been divided into different instrument development phases with clear objectives to be fulfilled in order to provide guidance and meaningful workforce allocation information to the different SIS consortium teams.

Additionally, the EST-PO has developed many internal open-source tools that are now accessible to the SIS consortium members to bring a smooth an agile working environment. These tools will ensure requirements flow-down traceability, documentation configuration control and tasks management across the different teams, avoiding any interface gap between the EST-PO and the SIS consortia.

The content of the EST SIS Systems Engineering Plan will be shared soon and the feedback from the SIS consortium teams will be precious at this level to end up with a global commitment and follow the proposed common goals. In this way we can help each other to have a smooth yet robust workflow, that will lead us as a team to build the EST observatory: stay tuned!

We thank the Science Instrumentation Suite consortium institutions for their present and future support:

#### **Tunable Imaging Spectropolarimeters**

Spanish Space Solar Physics Consortium (consortium leader), University of Rome Tor Vergata, Institute for Solar Physics of Stockholm University, Istituto Nazionale di Astrofisica, Istituto Ricerche Solari di Locarno, Leibniz-Institut für Sonnenphysik, Mullard Space Science Laboratory, Queen's University Belfast, and University of Catania.

#### Integral Field Spectropolarimeters

The Institute for Solar Physics and Max Planck Institute for Solar System Research (microlens-approach consortium leaders), Instituto de Astrofísica de Canarias (slicer-approach consortium leader), Astronomical Institute of the Czech Academy of Sciences, Instituto de Astrofísica e Ciências do Espaço of the University of Coimbra, Department of Optics of the Palacký University Olomouc, Istituto Ricerche Solari di Locarno, University of Applied Sciences Western Switzerland (HEIG-VD), and University of Applied Sciences and Arts of Southern Switzerland.

# EST TECHNOLOGY

## INDUSTRIAL CONTRACT FOR THE PRELIMINARY DESIGN OF THE HEAT REJECTER

The company CITD has been awarded the contract for the preliminary design of the heat rejecter

The preliminary design development of the Heat Rejecter (HR) of EST is underway since February 10, 2022, when the kick-off meeting of the contract was held. CITD is studying and analysing in detail this critical subsystem to find an optimal solution that fulfills the challenging requirements associated with it.

Basically, the HR is a mirror with a central hole that lies at the prime focus of the telescope (F1) and operates as a first field stop of the optical system. The aim of the HR is to reject the solar radiation outside the selected field of view, avoiding the development of thermal plumes, i.e., avoiding internal seeing.

The solar radiation generates a thermal load on the HR of about 13.5 kW. The sun image size at the focal plane is about 70 mm, resulting in a heat load of 0.5 MW/m<sup>2</sup> absorbed by the mirror. The analyses carried out during Phase 1 of the contract have shown large thermal gradients around the central hole of the HR, making it impossible to keep the mirror temperature within ±3°C of the ambient temperature, just using liquid cooling. During the Phase 1 review meeting, that took place on May 23, 2022, both parts agreed to initiate the second phase of the contract with two main lines of work: (a) optimisation of the jet impingement system; (b) development of the air suction system.

The jet impingement optimisation consists in adjusting the parameters of the system to reduce the maximum temperature on the mirror surface: number of jets, distance between jets, jet diameters, flow speed, substrate thickness and material, etc. In parallel, the air suction system will be developed, with the goal of absorbing the hot air plumes that will appear in the HR mirror, since we do not expect gradients



Conceptual model of the EST heat rejecter. Credit: CITD.



Phase 1 review meeting held on May 23, 2022. Credit: Nauzet Vega /IAC.

smaller than ±10°C with respect to the ambient temperature in the worst case.

The optical group is studying the HR central hole geometry, for letting the required FoV go through while minimising stray light. Preliminary studies have shown that a biconical shape is a good design solution but the reflections on the internal walls of the hole are still a source of stray light. A non-reflective painting would reduce stray light but would increase the absorbed heat, worsening the thermal behaviour. During the second phase of the contract, these aspects will be studied in detail, to find a good balance between optical and thermal parameters.

The HR contract also includes the development at conceptual level of a pointing system, which uses the image of the Sun at F1 and four mechanical references to calculate the position of the telescope (blind pointing).

At the end of Phase 2, a prototype will be designed and manufactured to validate by test the most important requirements of the HR: the mirror/external surfaces temperature, the sensor locations, the operational ranges, the control system monitoring, the cabling and equipment dimensions, and safety.

## TELESCOPE STRUCTURE, PIER AND ENCLOSURE PRELIMINARY DESIGN

A description of the activities performed in the framework of the industrial contract for the preliminary design of the EST telescope structure, pier and enclosure is given

In February 2022, the Telescope Structure, Pier and Enclosure preliminary design passed the Phase 2 design review. The meeting was held at the IACTEC headquarters and was attended by the EST Project Office and IDOM. The Phase 2 review aimed to consolidate the models (finite elements, computational fluid dynamics, thermal and control models) for the final phase analysis.

Another aspect consolidated in Phase 2 was the definition of the interfaces with the main payloads of the Telescope Structure and Pier. Key milestones were the interface consolidation meetings held by EST-PO with IDOM and SENER for the M1 assembly interfaces and with IDOM and TNO for the M2 assembly. The three parties agreed on the main physical characteristics, connections, maintenance and operation access and, as a result, the EST-PO defined the interface specifications, which all parties shall comply.

During the Phase 2 review meeting, IDOM visited the EST site at Roque Los Muchachos Observatory. They also visited the GREGOR and THEMIS facilities at Teide Observatory, which have served as reference telescopes in the preliminary design phase.

Between Phase 2 and Phase 3, IDOM and the EST-PO defined the Wind Tunnel Campaign models and tests. The company selected to carry out the wind tunnel test is Wacker Ingenieure from Birkenfeld (Germany), which has extensive experience in wind tunnel testing of large infrastructures. On April 19, IDOM and EST-PO visited the Wacker headquarters to review the models and the test proposal.

The campaign consisted in three different models for tests. The models were



EST wind tunnel tests at Wacker Ingenieure. Credit: Juan Cózar /IAC

made using additive manufacturing processes. The first model is a detailed site model to measure changes in local wind speed produced by the topography. The second model simulates the details of the Telescope Structure, Pier, Enclosure, Main Building, neighbouring telescopes and surrounding topography. This model will be used to measure the wind speed and turbulence around the telescope. The last model is a significant scale model of the Telescope Structure that will be used to measure the loads over the elevation and azimuth axes, as well as the pressure over the M1 and M2 assemblies.

In Phase 3, the final design analysis will be carried out. In particular, the computational fluid dynamics analyses will be refined with feedback from the wind tunnel test data, and the Telescope Structure, Pier and Enclosure will be specified to the detailed design justified by the preliminary design analyses.

At the end of Phase 3, in July 2022, the preliminary design review (PDR)

will be held. The PDR ensures the feasibility design, the compliance of the performances, the operation and maintenance tasks. The EST-PO will be supported by external reviewers who will provide insight in their areas of expertise. With this review, the EST-PO expects to complete the tasks on the preliminary design level of the Telescope Structure, Pier and Enclosure.

After PDR, the Telescope Structure and Enclosure will be ready to begin the detailed design in 2024 and then manufacturing. In the case of the Pier, the design will be further developed together with the main and auxiliary buildings and civil works, to obtain the administrative authorisation for construction.

These works will be presented at the SPIE Astronomical Telescopes & Instrumentation conference in Montreal (Canada) from 17-22 July 2022. Two talks by the EST-PO and IDOM are scheduled, to give an overview of the systems engineering and the rationale behind the design requirements.

## **EST M1 ASSEMBLY PRELIMINARY DESIGN**

The status of the contract for the preliminary design of the EST M1 assembly is presented

The EST M1 Assembly contract, carried out by SENER, is ongoing. In the last months, the Phase 2 has been satisfactorily finished and we are currently immersed in Phase 3. In parallel, the design of the prototypes was finished and they are currently in production.

During Phase 2, the baseline design adopted for the M1 Assembly was fully developed. The design was analysed in detail and improved in order to ensure the accomplishment of all requirements in the most efficient way.

The axial actuators concept was developed up to a detailed design level. Two options for the drives and gears were proposed, and they will be carefully tested during the prototype test campaign. The concept of the lateral actuators (initially proposed aligned with the Y-axis) was changed to a tangential distribution, which improves mirror safety during manipulation, allows some degree of XY displacement, and reduces thermal effects over the M1 mirror.

The thermal control system was also fully developed. A detailed analysis with a full CFD model was performed in order to ensure that both M1 mirror and cell temperatures fall inside requirements. Apart from that, the most critical updates in design were the inclusion of an external cover that allows passive cooling of the cell and detailed analysis of the fan-induced vibrations.

Concerning the thermal control and the axial actuator prototypes, the design and test plans documentation was finished and approved by the EST Project Office during the first quarter of 2022. The prototypes are currently in production. It is expected that they will be ready for testing during July 2022, when some members of the EST PO will visit SENER near Barcelona



Exploded view of the EST M1 Assembly. Credit: SENER Aerospatial.

(Spain) to check the prototypes and to be present when the most critical tests are carried out. Apart from other minor topics, these tests will address three critical issues: performance of the axial actuators, thermal control of the mirror, and vibrations generated by the fans. The results obtained from the tests will be used to update the M1 Assembly design (if required). Unfortunately, the global situation during the last months, with COVID-19 and the Ukranian war, has made it difficult to procure some materials, which has resulted in delays.

We are currently immersed in Phase 3. During this phase, apart from updating the analysis and design with feedback from the prototype tests, also a new set of documentation is being produced and will be reviewed in the M1 Assembly specific PDR. The review will be conducted in mid-September 2022 and will define the end of the present contract. This documentation is the main output of the contract, and it has two main objectives: to ensure the technical, operational, and economic feasibility of the M1 Assembly and to establish the basis for launching the detailed design and construction tender.

The EST M1 Assembly will be present at the SPIE Astronomical Telescopes & Instrumentation 2022 conference with two oral contributions and the corresponding papers. The EST PO will deliver the talk "M1 Assembly for EST: selection of the most promising baseline configuration for the preliminary design", where the trade-offs performed and the baseline design selected in Phase 1 will be described. On the other hand, SENER will present "The preliminary design of the M1 Assembly for the European Solar Telescope", which will describe the M1 Assembly preliminary design and its main performance.

## ADAPTIVE SECONDARY MIRROR PRELIMINARY DESIGN

The status of the contract for the preliminary design of the EST ASM is presented

The EST M2 preliminary design (PD) contract was awarded to the Netherlands Organisation for Applied Scientific Research (TNO) at the end of 2020. The EST M2 is referred to as an adaptive secondary mirror (ASM) with adaptive optics capabilities for correction of quickly evolving atmospheric high-order turbulence as well as slow and fast positioning. The slow positioning functionality will be part of the active optics system of EST. The fast positioning functionality will be part of the overall pointing and tracking strategy and will be used to correct fast image motion caused by atmospheric turbulence.

The EST ASM PD contract formally started on April 16, 2021 with the celebration of the kick-off meeting. During Phase 1 TNO developed the baseline model to tackle the tradeoffs identified by the EST PO (which were mandatory as part of the bidding contract) as well as other aspects TNO regarded of interest for the design of their proposed baseline: design and geometry of the actuators, the thermal aspects of the ASM unit, the strategies allowing to cover the functionalities of slow and fast positioning, and the overall ASM architecture to be compliant with mass and volume limitations. The EST ASM PD Phase 1 Review Meeting took place on September 22, 2021 but it was officially closed on November 6, 2021.

Phase 2 started right after the Phase 1 Review Meeting on September 22, 2021 and its Review Meeting was celebrated on February 16 2022. Phase 2 was officially closed on March 28, 2022. Among the milestones achieved during Phase 2 we can mention the consolidation of the EST ASM specifications, the detailed study of the ASM interface with the telescope



CAD model for the adaptive secondary mirror actuator breadboard. Credit: TNO.

structure, the control model of the EST ASM unit and the detailed design of the thermal and actuator prototypes (see accompanying figure for a CAD model of the latter). During Phase 2, TNO continued developing systems engineering models for the error budgets of the unit, the active thermal control model needed by the ASM and an identification and preliminary proposal of laboratory tests with the prototypes.

Starting on March 28, 2022 we are into Phase 3 of the ASM PD contract which will be completed by September 30, 2022. During Phase 3, TNO will build the thermal and actuator breadboards according to the designs presented and approved by the EST PO during Phase 2. Those thermal prototypes will be used to run extensive tests in the laboratory. At the moment of writing this newsletter, TNO has nearly completed the thermal prototype and delivered a first draft with the detailed thermal test procedures to be executed with this prototype.

During the upcoming SPIE Astronomical Telescopes & Instrumentation 2022 meeting to be held in Montreal on July 17-22, 2022, the EST PO will present a talk with the title "Adaptive Optics at the European Solar Telescope: status and future developments" with emphasis on the current status of the EST adaptive secondary mirror. Additionally, TNO will give an oral presentation entitled "Preliminary design of the Adaptive Secondary Mirror for the European Solar Telescope". Both oral contributions are scheduled in the "Adaptive Optics Systems VIII" conference.

## **EST BUILDING AND CIVIL WORKS AT ORM**

Progress on the design of the EST building and civil works is reported in this article

The EAST consortium decided in its early phases to promote the design and construction of a large-aperture, 4 m solar telescope in the Canary Islands.

All the information for possible EST sites (Observatorio del Teide -OT- in Tenerife and Observatorio del Roque de los Muchachos -ORM- on La Palma) was studied in order to define the differences between both observatories. Various aspects were analysed, from the sky conditions (atmospheric turbulence, radio electrical or atmospheric pollution, air routes...) to infrastructures (accesses, telecommunications, electricity, water supply, sewerage and other facilities).

The analyses led to the conclusion that no global differences are expected for solar observations at OT and ORM. As a consequence, the technical characteristics of the European Solar Telescope, together with the scientific requirements, are the main criteria driving the selection of the optimum location for the construction of EST. The right choice of a particular location at one of the observatories and the final height of the building above the ground (with the primary mirror looking at zenith at around 35 metres), plus some extra metres for the enclosure, have been the most critical parameters for the decision of the EST site.

The excellence demonstrated by the Swedish Solar Telescope at ORM during 30 years of operation —as a 0.5 m telescope since 1989 until 2000, and as a 1 m telescope after its upgrade in 2002 until now— and the international recognition of its location (demonstrated by other projects such as the Large Earth-based Solar Telescope and the Daniel K. Inouye Solar Telescope) led the PRE-EST Board to propose a site close to the Swedish Solar Telescope



Figure 1. Building and civil work preliminary study design. Credit: Gabriel Henríquez.

and the Dutch Open Telescope as the EST construction site at ORM.

The proposal was presented to SUCOSIP (SUb-COmmittee on SIte Properties of the CCI), a committee of experts that, among other tasks, supervises the impact that new infrastructures may produce on existing facilities and recommends actions that could minimise this impact. SUCOSIP presented recommendations to the CCI (International Scientific Committee), and in May 2021 the site was approved.

The telescope site strongly defines the final shape of the telescope building. The approval of the site represented a very important milestone for the consolidation of the design of the EST building and civil works. The pier of the EST building is a high tower, adequate for reducing the effect of the ground on the local seeing conditions. On top of this tower are the telescope and its enclosure.

The baseline for the telescope pier is

a concrete tower that encloses the Coudé room (instrument laboratory) and the pier optical path (transfer optics from the telescope to the instrument room), while providing the necessary stiffness to the telescope azimuth base to achieve the pointing and tracking performances of the EST.

The enclosure is supported by a transparent framework steel structure that permits to reduce the air obstruction and turbulence in the telescope area.

Attached to the pier lies the main building, which houses the services needed for the operation of the telescope. An auxiliary building also exists to place all the elements of the facilities that produce heat and vibrations, to avoid disturbances in the pointing and tracking and local seeing degradations.

From August 2021 to January 2022, a preliminary study of the building and civil works was carried out by Gabriel



Figure 2. Preliminary integration of the telescope and building designs at ORM including a section of the pier. Credit: Juan Cózar /IAC.

Henríquez Pérez S.L.U., under the request of the EST PO, to justify the feasibility of the construction of EST at the approved site. Also to be defined in this study were the main activities related to the construction of the main building, the auxiliary building, and the urbanization, as well as the access to the different buildings.

A preliminary archaeological and environmental survey of the area has been performed to guarantee that the site is acceptable in these directions. The impact on the nearby William Herschel Telescope was also analysed. The pier height and its exact location were adjusted to minimise the impact on the WHT observations. Further CFD analyses are being carried out to complement the studies of the possible influence of EST on the surrounding telescopes and vice versa.

The original conceptual design of the building, developed in 2011, involved large earthworks at the selected site, which were considered unacceptable. With this in mind, while meeting scientific requirements and minimising the influence of EST on other telescopes, work was done to find an optimal configuration.

The space requirements of the building were reviewed and only those spaces that are strictly necessary to be close to the telescope during operations are allowed. After the study, it was found more convenient to change the shape of the building, from a rectangular building on one side to a circular building hugging the tower.

The facilities that produce heat and vibrations have been moved to the auxiliary building, located next to the access road. Since the heat generated in this auxiliary building may affect the performance of EST, as well as that of other telescopes, heat management analyses are being carried out to minimise any sources of turbulence by sending the heat away of the telescopes' sensible areas, if necessary.

Since February 2021, the preliminary design of the telescope structure, the pier and the enclosure is being developed by IDOM. The design and specifications of the pier obtained with this contract will be the input for

the construction project, the thermal control strategy for the telescope, the pier, the enclosure, and the Coudé rooms, the telescope pier structure and foundations as well as the maintenance strategies for the main elements in the telescope like M1 that will influence the design of the pier and the building.

Figure 2 shows the results of the preliminary integration of the information coming out of the preliminary study of the building and civil works (by Gabriel Henríquez) and the preliminary design of the telescope structure, pier and enclosure (by IDOM).

The administrative process for the preliminary construction project call for tenders is ongoing. It will be published in summer and awarded by the end of the year. The final documentation for this project must include the necessary information for the environmental processing of the project. The preliminary construction project will provide the EST-PO with all the tools and documentations for the administrative authorisations and regulatory compliance for the building detailed design and the construction of EST.

# **EST COMMUNICATION**

## **COMMUNICATION ACTIVITIES**

In the last semester, the EST outreach and education activities have focused on schools. Virtual meetings have been organised along with in-person events.

#### Day of Women in Science

The EST project joined UNESCO's International Day of Women and Girls in Science celebrated on February 11, 2022. Twelve women scientists and engineers from the EST consortium met and shared their work and life experiences with high-school students in Italy and Spain.

Promoting STEM vocations among girls is now more important than ever, and EST is working actively in that direction. For that reason, we organised eleven virtual meetings between students and women scientists involved in the European Solar Telescope project from different institutions and research centers. The students had the chance to learn what a day in the life of a solar physicist looks like, or the challenges that engineers face to build a state-ofthe-art infrastructure like EST.

This activity was proposed to schools in Italy and Spain that had prominent participation in the EST School Contest "The Sun at a glance". Prior to the meetings, the students could read the profiles of the researchers and engineers and prepared questions for them. The speakers not only talked about their work, but were also asked about their motivation, their career path, and even their personal hobbies and tastes.

In Spain, nine secondary schools took part in this activity. The speakers were María Balaguer and Azaymi Siu-Tapia from the Instituto de Astrofísica de Andalucía (IAA-CSIC), and Sara Esteban, Irene Ferro, Ángela Hernández, Cristina Padilla and Claudia Ruiz, from the Instituto de Astrofísica de Canarias (IAC). In addition, Ada Ortiz, data scientist at Expert Analytics and member of the



Virtual meeting with Colegio Nuestra Señora de Lourdes (Cádiz, Spain).

EST Science Advisory Group, and Lucía Ramos, researcher at the University of Oslo, gave presentations from Norway.

In Italy, two different schools participated in the activity. The Italian scientists who chatted with the students were Mariarita Murabito and Elisa Nichelli, from the Osservatorio Astronomico di Roma (INAF-OAR), Clementina Sasso, from the Osservatorio Astronomico di Capodimonte (INAF-OAC), Fabiana Ferrante from University of Catania, and Giulia Lovati, from University of La Sapienza (Rome).

#### **Outreach activities**

In-person events are coming back after the COVID-19 crisis. An example is the series of outreach lectures organised by the Hungarian Academy of Science. On January 20, Robertus Erdelyi gave a public talk at Erkel Gimnazium in Gyula (Hungary) to promote solar physics and the EST project.



'Build your own spectrospe' activity at ASU Open Doors Day. Credit: Jan Jurčák/AICAS.

On the other hand, the Astronomical Institute of the Czech Academy of Sciences celebrated its Open Doors Day on May 20-21, 2022. The EST rollups and promotional materials were on display, and Jan Jurčák organised the activity "Build your own spectroscope" for kids, using the EST Virtual Solar Kit.

#### EST in the media

The presentations of the project and the premieres of "Reaching for the Sun" in Madrid (Spain) and Bratislava (Slovakia) raised much interest among the media.

The Spanish National Research Council published a press release about the EST presentation in Madrid that was mentioned 132 times in digital media and produced 53 news on printed newspapers, 7 news on radio bulletins, and 2 articles on TV news. Among these, an article published in the national newspaper ABC is particularly important, due to the very large audience it has in Spain. The event was recorded by several television channels and extracts made it into information spaces like the bulletins of the Spanish public TV and radio companies, and digital media of national coverage like La Vanguardia, 20Minutos or ElDiario es

The Slovak Academy of Sciences also published a press release on the occasion of the documentary premiere in Bratislava, on May 10, 2022. The event was featured in the TV news of the Slovak public channel RTV, with interventions of Luis Bellot (IAA-CSIC), Aleš Kučera (AISAS), and the president of the Slovak Academy of Sciences, Pavol Šajgalík. The science outreach program "Experiment", from the Slovak public television, recorded a special episode dedicated to solar physics with the participation of Manuel Collados (IAC) and Peter Gömöry (AISAS). Statements by Manuel Collados were published by the Slovak newspapers SME and Denník N.

In connection with these events, EST scientists and engineers were interviewed many times. In Spain, three



Image from the program "Experiment", broadcasted on the Slovak public television.

radio interviews with Luis Bellot (IAA-CSIC) and Manuel Collados (IAC) were broadcasted in different programs of Radio Nacional de España, the Spanish public radio company. Also Mary Barreto (IAC) and Marian Martínez (IAC) were invited to participate in two interviews in different radio channels in the Canary Islands. In Slovakia, the Spanish channel of the national RTV broadcasted a program about EST with Luis Bellot and Manuel Collados.

Two press releases were published by INAF in Italy in connection with the EST contest. The first one announced the Italian team that won the competition, and the second one reported the visit to Osservatorio Astronomico di Roma of the Italian participants in the contest from the Rome area. In Norway, RoCS also published an article describing the prominent presence of Norwegian teams among the finalists.

During the last six months, a number of articles have appeared in local, regional, and national newspapers like the one with Luis Bellot and Emilio García published in IDEAL, devoted to the EST documentary, or another with Mary Barreto in "Diario de Avisos", sharing her experience as EST technical director. "El País", one of the most important Spanish newspapers, recently published a comprehensive article about the European Solar Telescope in its science section, written by Ada Ortiz (Expert Analytics). Last, but not least, ESCAPE, the cluster of ESFRI projects that EST is part of, has released a video about EST. The video explains how ESCAPE is helping EST develop high-level data products and visualisation tools, to exploit the future EST observations in the most efficient way.

#### **Upcoming activities**

On July 9, the Max Planck Institute for Solar System Research (MPS) will celebrate the Night of Science in Göttingen. This is a massive event that gathers around 9000 visitors every year. The EST documentary will be screened in an open air cinema.

The EST Communication Office is facing the final stage of development of the videogame "Solar Mission EST". All the scenarios are already designed and operational, and we estimate that the game will be uploaded to the Android and Apple stores before the end of the summer.

Finally, the EST Communication Office is putting together a communication plan for the construction phase. This is one of the last deliverables of the PRE-EST project. It will define the main goals of the communication activities of the consortium during the construction phase and will identify actions to engage the different target audiences with the project.

## THE EST SCHOOL COMPETITION

An overview of the results of the EST school competition "The Sun at a glance" is presented, including participation statistics, the winning infographics, and the award of the prizes

In 2021, the EST project organised and launched the international school competition "The Sun at a glance", with the goal of raising awareness of the Sun among 14-15 and 15-16 year-old students and promote STEM vocations in the school all over Europe.

The students were asked to research about the Sun and create a visual summary of their results in the form of an infographic. This format was chosen because it is very suitable for cross-disciplinary work. Indeed, collaborations between Science, IT, Art and English teachers were encouraged. The topic of the infographic was free, although the EST Communication Office prepared a list of suggestions to offer different options to the students.

The infographics submitted to the competition have been used to set up and populate the EST Solarpedia, a solar encyclopedia that is hosted on the EST website and covers a broad range of topics about the Sun, with proper attribution to their authors. All the material in the Solarpedia can be downloaded freely under a Creative Commons international license.

The students had to work in small groups of four people, led by a teacher. The teacher was the person who motivated the students to participate in the contest, supervised their work, and managed all aspects of the organisation within the school, including the communication with the EST team. They proved to be an essential element for the success of this activity.

The preparations began in April 2021, several months before the start of the school year where the activity was going to take place. The EST Communication Office set up a dedicated website,



Country	Schools	Teams	Students	Teachers
AUSTRIA	3	12	46	3
BELGIUM	1	5	18	1
CZECH REPUBLIC	4	6	23	4
FRANCE	2	7	26	2
GERMANY	7	16	60	7
GREECE	45	94	345	58
HUNGARY	10	14	51	10
IRELAND	26	73	269	28
ITALY	29	84	322	41
NORWAY	6	46	171	9
PORTUGAL	6	21	79	7
SLOVAKIA	12	29	109	13
SPAIN	83	335	1260	112
SWEDEN	2	3	11	2
SWITZERLAND	1	2	7	1
υκ	5	17	62	5
TOTAL	242	767	2859	303

Table 1. Participant statistics, broken down by country. Source: EST website.

drafted the contest rules, and designed a poster to announce the competition. At the same time, national contact points were identified among the members of the EST-Comm group, to provide students and teachers with help and advice in matters related with the competition. This activity mobilised a total of 32 people from 23 EST partner institutions in 14 European countries. The national contact points translated the competition materials to their own languages, to ensure a more efficient distribution of the information. Also the registration and submission forms were translated to 7 different languages.

The competition was announced by the end of May 2021, and the registration opened on June 1, 2021. In this way, a generous heads up was given to the teachers to organise their teams well before the start of the school year. The registration period closed on November 12, 2021 to allow everyone to sign up until the very last moment.

Significant efforts were devoted to publicise the competition at local, national and European levels. These efforts were channelled through the individual EST partner institutions. Thanks to their good knowledge of the national education systems, it was possible to reach out to a large number of schools and teachers across Europe.

In Spain, for example, 2137 emails were sent directly to secondary schools, teacher's training centres, teacher's unions, educational administrations and astronomy clubs to promote the contest. In Ireland, Trinity Collegue Dublin informed the schools participating in the I-LOFAR educational activities and provided them with support as needed. The Rosseland Centre for Solar Physics in Norway contacted the Norwegian Directorate for Education and Training of the Ministry of Education and Research and distributed the information through Facebook groups with more than 70,000 teachers sharing best practices in education matters. In Slovakia, the



Students from Ernst-Abbe-Gymnasium (Jena, Germany) discuss about the Sun.



Students from Colegio Zazuar (Madrid, Spain) working on their infographic.

Slovak Academy of Sciences contacted secondary schools across the country. In Greece, a request was submitted to the Ministry of Education in June and approved in September, after which the information was officially sent to all Greek secondary schools, which ensured a very high participation of Greek students. Other countries carried out similar distribution activities.

As a result of these joint efforts, the participation in the competition was outstanding. A summary is given in Table 1. More than 2850 students and 303 teachers from 242 schools signed

up for the contest, representing 16 European countries. Communicating with so many teachers was not easy, but a mailing list was created at the beginning of the process and used thoroughly with good results. About 61% of the students were in the age group 15-16 and 39% in the age group 14-15. Very interestingly, the percentage of girls and boys was nearly the same. In Spain, for example, 51% of the students were girls and 49% boys. This similarity is quite remarkable, as the students entered the competition because they had genuine interest in the activity, not because they were forced by the teachers.

The students could submit their infographics from the moment they registered until December 20, 2021. The deadline was extended by a few days, until December 23, to allow more teams to submit their entries.

In total, we received 561 infographics from 214 schools in all 16 participating countries. This must be considered a great success, given the topic of the competition itself (which is usually not included in the education curriculum of the various countries) and the amount of work required to prepare the infographics.

The EST Communication Office then undertook a revision of all the submitted infographics, asking the teams to correct conceptual errors and typos, or resubmit higher quality files, as needed. This process was very time consuming and took more than a month, but resulted in a more homogeneous and accurate set of infographics for the EST Solarpedia.

All entries were evaluated by an international jury consisting of 7 experts in solar physics, graphics design, and science communication. The evaluation was blind, as the jury members did not know any detail of the infographics, particularly the school or country of origin. Selecting three infographics out of 561 was a very tough process which required several iterations. But an agreement was reached in the end, and the jury announced the winners on February 3, together with 10 finalists.

The infographics that won the EST school competition are:

1. Brief History of Solar Observations, by team "Elio-eccentrici" from Liceo Scientifico A. Labriola (Rome, Italy)

2. Magnetic Carpet & Heating of the Corona, by team "Bookworms" from Gymnázium Varšavská (Žilina,Slovakia)

3. Coronal Mass Ejections, by team "The Sun Set" from Santa Sabina Dominican College (Dublin, Ireland)



Infographics that won the EST school competition "The Sun at a glance".

The results of the competition were published on the EST website and posted on social media, attracting an incredible interest and generating unprecedented traffic on the website. The prize for the first two teams was a trip to Tenerife (Spain) to visit Teide Observatory and the solar telescopes in operation there. The third team got a complete H-alpha telescope for ob-



Visit of the winning teams to Observatorio del Teide on April 12, 2022.

servations of the solar chromosphere. The EST Communication Office organised the travel for the Italian and Slovak teams during February and March 2022, and the trip took place from April 10-14, 2022. On Monday April 11, an award ceremony was held at Museo de la Ciencia y el Cosmos de Tenerife, with speeches by the IAC director Rafael Rebolo and the EST coordinator Manuel Collados (IAC), and presentations of the infographics by the winning teams. The students and their teachers received an award certificate. The next day, the two teams visited Teide Observatory. Tours of GREGOR, VTT and THEMIS were given by Christoph Kuckein (IAC), Carsten Denker (AIP) and Bernard Gelly (CNRS). A visit to the EST Project Office headquarters and the Instituto de Astrofísica de Canarias took place on April 13. There, the students spoke with the EST engineers and saw the clean rooms where some of the future EST instruments are currently being tested.

All the students who registered for the competition received a certificate of participation signed by Mats Carlsson (RoCS), the EAST president.



Left: Visit of Italian students to INAF-Osservatorio Astronomico di Roma. Right: students from IES Juan López Morillas (Jódar, Spain) with certificates.

Also the teachers got a certificate to acknowledge their work, signed by Luis Bellot (IAA-CSIC).

Finally, several partner institutions awarded prizes to their national teams. The students in the Rome area were invited by INAF to visit the Osservatorio Astronomico di Roma on February, 24. The Rosseland Centre for Solar Physics invited the two Norwegian finalist teams, ranked in fourth and fifth position, to visit their premises within the Open Days of the University of Oslo, which is normally reserved for students in the last grade of secondary school.

## THE EST SOLARPEDIA

The project has released the EST Solarpedia, an open educational resource consisting of 444 infographics dealing with various aspects of solar physics and solar observations.

The EST Solarpedia is one of the most important educational activities undertaken by the EST project. Conceived to be a comprehensive resource of solar physics, useful for both the general public and the teaching community, the amount of work required to complete it was not within the reach of the project partners.

For this reason, we requested the help of the students participating in the school competition "The Sun at a Glance". The students, organised in small groups of 3-4 people and led by a teacher, were asked to produce infographics dealing with any topic of their choice related to solar physics, solar observations, solar history, Sun-Earth relations, and societal aspects. The goal was to obtain a large set of infographics to build up the EST Solarpedia. A list of topics was prepared by the EST Communication Office to ensure no important theme was left aside. Several EST partners met with the students, either virtually or in-person, to provide advice and feedback on the topics of the infographics.

Thus, the EST Solarpedia consists of material contributed by high-school students aged 14-15 and 15-16, who had to research on a given topic and summarise their findings in a concise and attractive way. In other words, the infographics do not only provide precise scientific descriptions, but are also beautiful compositions with lots of design work behind them.

All the infographics in the EST Solarpedia were revised by the EST team members, who went through the texts and images suggesting corrections and additions as necessary. The infographics share the same format and are provided as high-resolution files that can be



The Solarpedia can be accessed on the EST website at https://est-east.eu/solarpedia



Example of infographics prepared by Claudia García, Natalia Guzmán, Ruth Hidalgo and Andrés Rodríguez, led by Julián Elvira, from Colegio Zazuar (Madrid, Spain).

downloaded freely under a Creative Commons BY-NC-ND 4.0 international license. This ensures that the Solarpedia is a high-quality, homogeneous source of information about the Sun, with proper credit attribution for the authors of the infographics and all the graphic material they used.

Currently, the EST Solarpedia contains 444 infographics distributed in 14 general categories and 53 subcategories. It

can be found on the education section of the EST website, at https://est-east. eu/solarpedia. The EST Solarpedia is a living resource and we expect it will grow with time thanks to the contribution of solar physicists, amateur astronomers, and students. Everyone is welcome to submit new infographics to the Solarpedia. And the possibility remains open to organise new editions of the competition "The Sun at a glance" as a way to collect additional material.

## **EST NEWCOMERS**

## JONAI BIENES MECHANICAL ENGINEER



Jonai Bienes is a Mechanical Engineer, with a Master's degree in Electronic Engineering from the University of La Laguna, a Master's degree in Manufacturing Engineering from the University of Cádiz and a Master's Degree in Teaching from the Catholic University of Ávila. He has previously worked for the Gran Telescopio Canarias focusing on collaboration and execution of maintenance engineering work to improve its operability. Later, he joined the Instituto de Astrofísica de Canarias, working on the HARPS3 Spectrograph within the Terra Hunting program as well as the High Resolution Optical Spectrograph (HoRUS).

Jonai is part of the EST team, working on the Transfer Optics and Calibration Assembly.

## ANTONIO MATTA SOFTWARE ENGINEER



Antonio got interested in the field of robotics while he was studying his Bachelor's Degree in Systems and Computer Science at the Pontificia Universidad Javeriana in the city of Cali, Colombia. There, he was involved in the ROBOMOSP research project. He later got a Master's Degree in Automation and Robotics at the Universidad Politécnica de Madrid. He was a member of the Robotics and Cybernetics research group and worked in the European FP7 project "Networked Multi-Robot Systems (NM-RS)".

He is currently pursuing a Ph.D. degree in Systems Engineering and Automation at the Universidad de La Laguna in Tenerife, Spain. He joined the EST team as a software engineer.

## ÁNGELA HERNÁNDEZ SOFTWARE ENGINEER



Ángela has a degree in Computer Science from the University of La Laguna, a MSc in Computer Engineering and Mathematics from the Universitat Oberta de Catalunya and the Universistat Rovira i Virgili. She has experience in the private sector participating in computer vision and instrumentation projects. She was involved in ESA's Clean Space Industrial Days 2017 with the project "Assessment of Plenoptic Refocusing Methods for 3D Vision-Based Relative Navigation". She joined the EST team in 2021 as a software engineer.

# **EVENTS**

Due to the COVID-19 pandemic, most meetings have been postponed. Until normal activity resumes, a list of EST invited talks in future and past international meetings will be given here. An updated list is available on the EST website at <a href="http://www.est-east.eu/est-invited-talks">http://www.est-east.eu/est-invited-talks</a>

#### THE EUROPEAN SOLAR TELESCOPE

Francesca Zuccarello, in XV Scientific Meeting of Spanish Astronomical Society, Tenerife (Spain) 8 September 2022

#### THE SECRETS OF SUNSPOT PENUMBRAE AND STATUS OF EST

Rolf Schlichenmaier, *Colloquium Talk at Udaipur Solar Observatory (India),* online, 27 July 2021

#### MAGNETIC FLUX EMERGENCE

Ada Ortiz, in XV Scientific Meeting of Spanish Astronomical Society, Tenerife (Spain) 6 September 2022

#### PHOTOSPHERIC MAGNETIC FIELDS: CHALLENGES AHEAD

Luis Bellot Rubio, in *Advances in Observations* and *Modeling of Solar Magnetism and Variability*, IIA Bangalore (India), online, 1 March 2021

# **OTHER EVENTS**

COSPAR 2022 THE DYNAMIC SUN AT SMALL SCALES Athens (Greece), 16-24 July 2022

SPIE ASTRONOMICAL TELESCOPES AND INSTRUMENTATION Montreal (Canada), 17-22 July 2022

IAU SYMPOSIUM 372: THE ERA OF MULTI-MESSENGER SOLAR PHYSICS Busan (Republic of Korea), 2-5 August 2022

> ADVANCES IN SOLAR MHD NUMERICAL SIMULATIONS Eastbourne (UK) 7-10 August 2022

#### SUMMER SCHOOL ON SOLAR SPECTROPOLARIMETRY

Boulder (USA), 22 August-2 September 2022

8TH SOLAR ORBITER WORKSHOP Belfast (UK), 12-15 September 2022

HINODE-15/IRIS-12 MEETING Prague (Czech Republic), 19-23 September 2022

EUROPEAN SPACE WEATHER WEEK Zagreb (Croatia), 24-28 October 2022

#### SOLAR POLARIZATION WORKSHOP 10 Kyoto (Japan), 7-11 November 2022

#### **EDITORS**

Luis Bellot Rubio (IAA-CSIC) Víctor Aníbal López (IAA-CSIC)

#### CONTRIBUTORS EST NEWS 10, JUNE 2022

Mary Barreto (IAC; 10), Luis Bellot Rubio (IAA-CSIC; 2, 14, 18), Manuel Collados (IAC; 1), Juan Cózar (IAC; 7, 10), Bruno Femenía (IAC; 9), Víctor Aníbal López (IAA-CSIC; 2, 12, 14), Ángel Mato (IAC; 8), Claudia Ruiz (IAC; 5), Nauzet Vega (IAC; 6), Francisco Yeray Ramos (IAC, 4)

#### EST COMMUNICATION OFFICE

Email: est-communication@iaa.es Website: www.est-east.eu EST NEWS ISSN: 2792-4289 Instituto Astrofísica Andalucía, Granada

- facebook.com/EuropeanSolarTelescope
- 🕥 @estsolarnet
- in /company-european-solar-telescope
- instagram.com/european\_solar\_telescope
- youtube.com/ESTtvCHANNEL





All content licensed under a Creative Commons Attribution-Noncommercials-NoDerivs 3.0 Unported International license, except where stated otherwise This newsletter is supported by the European Commission H2020 pogramme under Grant Agreement No. 739500 (PRE-EST)