

# EST NEWS

THE EUROPEAN SOLAR TELESCOPE NEWSLETTER

AUTUMN 2019

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## COORDINATOR'S CORNER

Here is again our Newsletter with the most recent information about EST. The last months have brought important news for the project.

A proposal has been presented to the International Scientific Committee of the Observatorios de Canarias to consider the former LEST site, at Roque de Los Muchachos Observatory (La Palma), as a preferential site for EST. This proposal represents a fundamental step for the consolidation of the final construction site.

In parallel, important milestones have been achieved by the Scientific and Technical Advisory Groups (SAG and TAG, respectively). The SAG has just released the second edition of the Science Requirement Document. A substantial revision was made to account for the latest scientific advances in the field. In September, the TAG decided to include an adaptive secondary mirror as a major change in the telescope concept. With such a modification, the number of required optical surfaces would be reduced by a factor of 2 and the performance of the telescope would be greatly enhanced.

The calls for tenders for the telescope structure, primary and secondary mirror will be announced early 2020. By the end of PRE-EST, the preliminary design of all these subsystems will be ready for PDR. An extension has been requested to the EU to finalise PRE-EST in December 2021 to make sure that the designs are completed within the project timeline. The extension has been approved.

News about the National Research Infrastructure Roadmaps have also appeared. EST has made good progress in the Czech Republic, United Kingdom and Switzerland. The decisions by Germany, Norway and Sweden are not so positive and more work is needed to increase their involvement in EST.

Finally, the project continues to make all efforts, through its Communication Office and the consortium partners, to reach out to the society, explaining the need of EST and the benefits it will bring.

*M. Collados, EST project coordinator*

## ROQUE DE LOS MUCHACHOS OBSERVATORY PROPOSED AS PREFERRED EST LOCATION

*A preferred location of the European Solar Telescope at Observatorio del Roque de los Muchachos was proposed to the International Scientific Committee of the Observatorios de Canarias*



*Artistic recreation of the site proposed for the European Solar Telescope at Observatorio del Roque de los Muchachos, near the Swedish Solar Telescope (lowermost facility) and the William Herschel Telescope (at the top left). / Image: Gabriel Pérez (IAC)*

The EST project presented a proposal to the International Scientific Committee of the Observatorios de Canarias (CCI) to consider a location near the Swedish Solar Telescope (SST) at Observatorio del Roque de los Muchachos (La Palma) as a preferential site for the telescope, following the decision adopted by the European Solar Telescope project Board on October 4th.

The proposal was presented to the SUCOSIP (SUB-COMmittee on Site Properties of the International Scientific Committee) during its meeting in La Laguna on November 13th. SUCOSIP is a committee of experts which, among other tasks, supervises the impact that proposed new infrastructures may have on existing facilities and recommends actions that could minimise this impact.

The SUCOSIP acknowledged the excellence of the proposed site for solar observations, as has been demonstrated by the outstanding performance of the Swedish Solar Telescope.

### **SUCOSIP ACKNOWLEDGED THE EXCELLENCE OF THE PROPOSED SITE BUT ASKED FOR FURTHER ANALYSIS TO ASSESS THE IMPACT ON THE NEARBY WILLIAM HERSCHEL TELESCOPE**

The group recommended that the EST project perform further analyses to study the influence of the EST building and associated facilities on the nearby William Herschel Telescope, taking into account the particular wind profiles at the observatory. The impact on other minor surrounding facilities should

also be analysed.

The SUCOSIP concluded that it is most important to carry out parallel solar site testing measurements at the SST and the Vacuum Tower Telescope, located at Teide Observatory (Tenerife) using the Wide-Field Wavefront Sensor installed by the Stockholm University at these two telescopes. The outcome of such parallel measurements will be most interesting for the diurnal characterisation of both observatories.

The SUCOSIP presented these recommendations to the CCI during its 82nd meeting, held in the University of La Laguna on November 14th. The CCI agreed with the recommended actions. The process of evaluation will require further iterations in SUCOSIP's future meetings before a final decision on the location of the EST can be taken.

# EST AND THE NATIONAL RESEARCH INFRASTRUCTURE ROADMAPS: AN OVERVIEW

*The evaluation of the applications presented by several partners for the inclusion of EST in their national roadmaps has been announced in the last months, with various degrees of success*

During the last months, relevant news for the future of EST have appeared. The evaluation of the applications presented by several partners for the inclusion of the EST project in their corresponding national roadmaps has been announced, with various degrees of success.

The recently updated **Czech Republic** Roadmap has prioritised the project EST-CZ to consolidate and ensure the participation of the Czech Republic in the construction and operation of EST. The application was led by the Astronomical Institute of the Czech Academy of Sciences. Funds for the Preparatory Phase have already been released to the EST Project Office for the implementation of the technical works during this phase.

The **United Kingdom** included EST in the 2019 update of its Roadmap as a priority project for understanding the universe with ground-based observational astronomy. This decision opens the door to further applications for funding requests in 2020. Within the coming months, the UK EST community will work together with the EST Project Office for the preparation of a funding proposal for the Preparatory Phase, mainly focused on the EST adaptive optics system and instrumentation.

In its 2019 Roadmap update, **Switzerland** set EST in the category of infrastructures in which Swiss institutions have shown an interest, with the decision of not pursuing the option of participating in EST at the current time. Further work needs to be done in order to establish a stronger Swiss solar consortium to be able to upgrade the EST category in the new 2023 national roadmap.



Cover of the Roadmap of Large Research Infrastructures of the Czech Republic (left) and the UK's Research and Innovation Infrastructure (right)

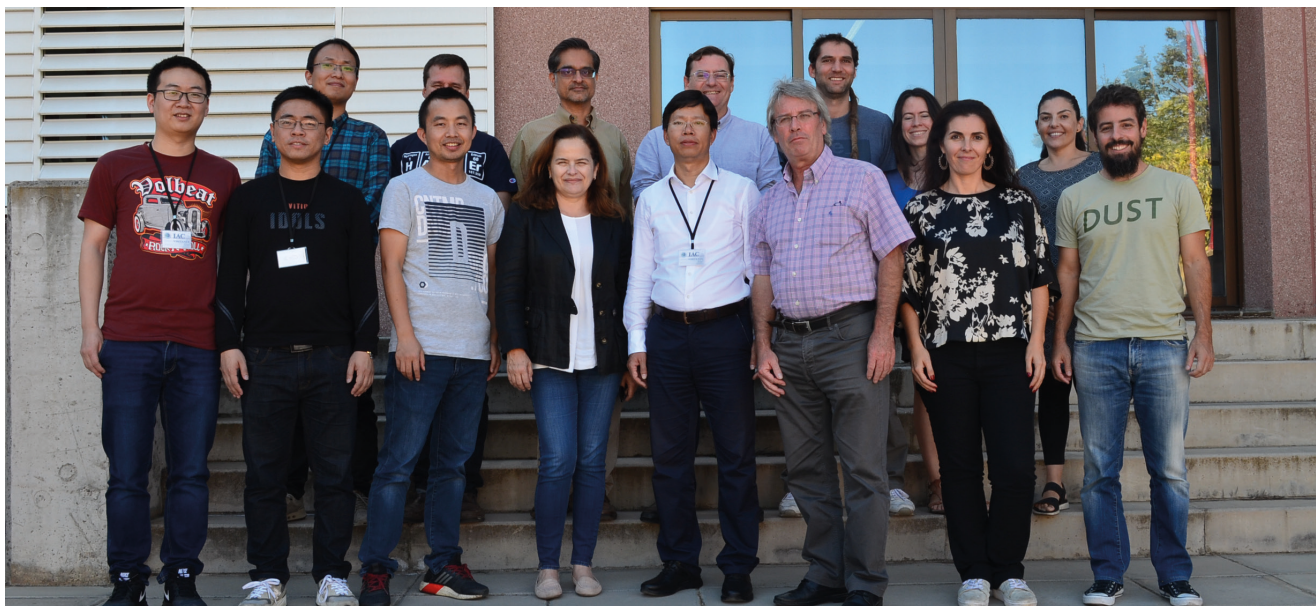
For the moment, IRSOL is providing Swiss funds to the Preparatory Phase.

**Germany** also announced the outcome of the application for the German participation in the construction and operation of EST put together by the EST German institutions. The Advisory Committee expressed specific doubts as to the technical feasibility of several EST subsystems and recommended that the conclusion of the preliminary phase be followed by a technical review. As a result of this recommendation, the proposal for funding was not approved, but the decision opens the door to the individual German institutes to apply for funding and contribute to the consolidation of the EST design and construction.

The Roadmap Committees of **Norway** and **Sweden** expressed similar concerns as the German Committee and did not select the corresponding applications for funding. The lack of a final construction proposal has been key in the limited success of the

applications. The Rosseland Centre for Solar Physics (University of Oslo) and the University of Stockholm have already committed their national contribution to the Preparatory Phase. New applications will be submitted to the next call in 2021.

These decisions were not expected by the project, given that the Preparatory Phase in which it is involved is exactly intended to consolidate the EST design, demonstrate the most critical parts with adequate prototypes, update the construction budget and involve the different Ministries in the process to guarantee a smooth transition from a European- to a country-prioritised project. In view of the criticism that has been received, the project will focus on finalising the EST construction plan by 2022. The EST team and partner institutions will continue working at scientific, technical and political level with the final goal of having EST included in the new National Roadmap updates that will take place between 2022 and 2024.



*A delegation from the Institute of Optics and Electronics of the Chinese Academy of Sciences visited the EST Project Office*

## MEMORANDUM OF UNDERSTANDING SIGNED WITH THE CHINESE INSTITUTE OF OPTICS AND ELECTRONICS

A delegation from the Institute of Optics and Electronics (IOE) of the Chinese Academy of Sciences visited the Instituto de Astrofísica de Canarias (IAC). This visit led to the signature of a Memorandum of Understanding between the IAC and the IOE to collaborate during the coming years in the development of adaptive optics techniques and instrumentation.

The Institute of Optics and Electronics has built a 1.8 metre solar telescope which is presently under integration. The IOE has capabilities to build its own tip-tilt and deformable mirrors and have installed and tested them at, for instance, the 1-m New Vacuum Solar Telescope at Fuxian Solar Observatory in southern China.

## ESTABLISHING BONDS WITH ASIAN INSTITUTIONS

Several contacts have recently been held with a number of Asian institutions to present the current status of EST and gauge their interest in the project, especially considering the most recent changes in the design with the inclusion of an adaptive secondary mirror which greatly simplifies the optical design and makes the telescope more efficient in all aspects.

During a two-week visit to South Korea and Japan in September, the EST coordinator Manuel Collados met with Korean groups at the Korea Astronomy and Space Science Institute, Kyung Hee University and Seoul National University. These groups have expertise in constructing and operating instruments for solar telescopes (for example, they built the FISS spectrograph for the Goode Solar Telescope at Big Bear Solar Observatory) and neural networks (an aspect of great relevance for EST for AO/MCAO and image reconstruction applications). During his stay at Daejeon, Manuel Collados also had the opportunity of visiting the Korea Basic Science Institute, with excellent facilities for manufacturing high-precision optical elements.

In Japan, Collados visited the National Astronomical Observatory of Japan and the Kyoto University. The basis of the discussion was the ongoing collaboration with the National Astronomical Observatory under the SOLARNET H2020 project for the production of thin metallic slices for integral-field spectrographs. Visiting Hida Observatory of Kyoto University was most useful to have direct insight of the Japanese capabilities for ground-based solar observations.

The EST project will be presented by Andreas Lagg (Max Planck Institute for Solar System Research) at the 5th Asia-Pacific Solar Physics Meeting, which will be held in Pune (India) in February 2020.

## PRE-EST EXTENSION APPROVED: THE PROJECT WILL RUN UNTIL DECEMBER 2021

*PRE-EST (GA-739500) is the H2020 project that supports the preparatory phase for EST. It has been running for 32 months and recently requested an extension, now granted*

PRE-EST started on 1st April 2017, and has been actively running for 32 months, with the aim of providing both the EST international consortium and the funding agencies with a construction plan for EST. This plan will contain the information needed to make decisions, addressing organisational and technical issues as well as cost and risk analysis, among others.

In this context, the PRE-EST coordinating institution considered appropriate to request an extension of the project to the European Commission. The request, which was first approved by the PRE-EST Board and then by the European Commission, is now accepted. Therefore, PRE-EST will be running until 31st December 2021.

Several reasons have led to this request. Some were related to the initial difficulties encountered in hiring qualified and experienced technical and managerial staff, which produced a delay in the implementation of PRE-EST's annex of work. The first measure to counteract the negative impact of this situation was to increase the dedication

of in-house experienced staff. Also, additional communication measures were implemented to disseminate job vacancies and, as result, the staff of the EST Project Office is now well structured and a team of 23 people is set.

The other reason for requesting an extension is linked to the technological upgrade of the secondary mirror, one of the main systems of the telescope. During the EST Conceptual Design (2008-2011) a potential upgrade of the secondary mirror to an Adaptive Secondary Mirror (ASM) was considered. However, the technology was still immature, and a monolithic secondary mirror was chosen instead. Eight years later, the technology has progressed and several night-time

astronomical facilities have successfully assembled ASMs.

Still, an adaptive secondary mirror of about 800mm in diameter for a solar telescope has never been produced, and represents a technological challenge. A Public Market Consultation was done by the EST Project Office during the first half of 2019 to enquire companies about the feasibility of an ASM fulfilling EST specifications. As a result, we now know that the industry considers ASMs a feasible option for EST.

The evolution in the ASM concept adds a high-technology component to EST, making the project more attractive/competitive for science.



## EXTRAORDINARY MEETINGS OF THE PRE-EST BOARD: JUNE AND SEPTEMBER 2019

The ordinary annual PRE-EST Board meeting was held last January in Brussels, celebrated in coordination with the EAST General Assembly and the SOLARNET General Assembly. Later, in June and October, two extraordinary Board meetings took place on-line.

During these meetings, key aspects

for the future implementation of EST were discussed. As a result of the discussions, three main decisions were adopted:

- To propose the LEST site at the Roque de los Muchachos Observatory on la Palma (Spain) as the preferred candidate site for EST to the SUCOSIP committee.

- To initiate contacts with non-EU institutions to study the possibility of involving additional partners

- To create an intermediate legal entity, based on the contributions of individual institutions (rather than at national level), to manage the preparation of the EST Construction Plan during the current Preparatory Phase.

## EST, AT THE ESFRI WORKSHOP ON THE FUTURE OF RESEARCH INFRASTRUCTURES

*Representatives of European science and research infrastructures attended the ESFRI Workshop on the Future of Research Infrastructures in the European Research Area*

From 6 to 8 November, La Palma (Spain) hosted a workshop on the Future of Research Infrastructures in the European Research Area. Organised by ESFRI, the European Strategy Forum on Research Infrastructures, the meeting gathered more than 100 representatives of European science and major infrastructures, including the European Solar Telescope - which entered the ESFRI Roadmap in 2016.

Intended as a comprehensive reflection process on the future role and current challenges of existing and future European research infrastructures, the meeting was co-organised by the Instituto de Astrofísica de Canarias, the EST consortium coordinator. During his welcome speech, Rafael Rebolo, IAC Director, emphasized the need for the European Solar Telescope to become a reality and to function as a global infrastructure, open not only to European researchers but also to Asian scientists. Extending cooperation outside European borders was also emphasized by

Adam Tyson, Head of the Unit for Research and Industrial Infrastructures of the European Commission.

Topics covered during the workshop included the integration of infrastructures in the European Open Science Cloud, financing models, good practices, synergies with other national programmes and infrastructures. The discussions and reflections will be used to write a prospective white paper on

the future of research infrastructures in Europe.

ESFRI, the European Strategy Forum on Research Infrastructures, is a strategic instrument to develop European scientific integration and to strengthen its international outreach. Its mission is to support a coherent and strategy-led approach to policy-making on research infrastructures in Europe.



*Rafael Rebolo, IAC director (first from the left), emphasized the need for the EST to become a reality. / Photo: Iván Jiménez (IAC)*

## A DEDICATED STAND AT THE FORUM VENUE



The EST Project Office set up a dedicated stand at the hotel hosting the ESFRI Workshop. Promotional material was given away to both forum's participants and tourists, who also had the opportunity of contemplating the EST model.

In the picture, EST members pose together with representatives of the Spanish Ministry of Science, Innovation and Universities attending the meeting.

## EST AT FITOC2019: FUTURE INSTRUMENTS FOR OBSERVATORIOS DE CANARIAS

Scientists and engineers from the European Solar Telescope participated in FITOC2019, the meeting on Future Instruments for the Telescopes at the Observatorios de Canarias

Scientists and engineers from the European Solar Telescope participated in FITOC2019, the meeting on Future Instruments for the Telescopes at the Observatorios de Canarias. The event was held in Tenerife (Canary Islands, Spain) from 11 to 13 November, and gathered more than 80 international experts.

Mary Barreto, EST Technical Director, gave an update on EST ongoing work, which at this point focuses mainly on the design and construction plan, and the site selection. Barreto also emphasized the international aspect of this project, in which 26 European research institutions are involved, "making EST a truly European venture".

The day before, EST engineer Icíar Montilla, from the Instituto de Astrofísica de Canarias, had presented the main projects on adaptive optics being developed by her institution. This included



Mary Barreto, EST Technical Director, explains the current status of the EST technical works to FITOC2019 assistants / Photo: IAC

the Multi-Conjugate Adaptive Optics system (MCAO) for EST, designed to correct the turbulence for a wide range of observing elevations, from the zenith to very near the horizon, providing high spatial resolution observations over

large fields of view in the visible. During her talk, she dubbed the MCAO as "one of the most challenging AO systems ever built, with uniform correction over FOVs of 1 arcminute at 500nm running at 2KHz". A little earlier, EST researcher Dan Kisman, from the Institute for Solar Physics (Stockholm University), called the Swedish Solar Telescope "a trailblazer for EST", and listed the lessons learnt from this telescope, one of EST's older sisters together with THEMIS and GREGOR.

The aim of the meeting was to examine the plans for existing and future instrumentation installed in the Canary Island observatories. Key issues for discussions were the future scientific direction of the observatories, possible "blind spots" and overlaps between instrumentation, synergies between current and prospective facilities, and the specific observational strengths of Observatorios de Canarias.



EST researcher Dan Kisman, from Stockholm University, called the Swedish Solar Telescope "a trailblazer for EST". / Photo: IAC

More information on the meeting [website](#).

## THE FIRST YEAR OF SOLARNET H2020: HIGHLIGHTS FROM THE PROJECT TEAM

*The second incarnation of SOLARNET began the 1st January 2019. As the first year of business draws to a close, the SOLARNET team shares some of the highlights from their activities*

The main aim of SOLARNET is the integration of the major European infrastructures in the field of high-resolution solar physics. The team behind the project is significant, with 32 institutions from across the EU and abroad. The consortium is focusing on a number of objectives that strive to foster networking activities, enable mobility, conduct joint research activities, and ensure access to research infrastructures.

One of the first milestones of the project was to establish a community website that would act as the central hub for sharing information on the consortium and its activities (<https://solarnet-project.eu>). The site highlights the key members from each research institution and industrial partner, as well as the research facilities involved (e.g. observatories, computer clusters). Furthermore, it acts as a portal for information with regards to calls for the Mobility



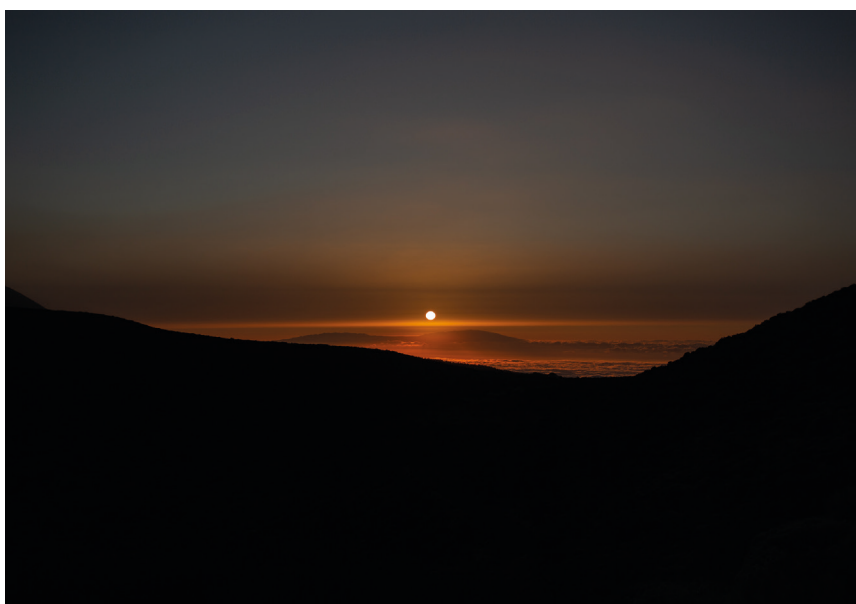
*Participants in the summer school 'A Week Above the Clouds' (Tenerife, Spain)./  
Photo: SOLARNET*

Programme, the Transnational Access and Service Programme and all training events, workshops and conferences.

**SOLARNET schools.** With delivering

education and promoting networking a critical aspect to our success, we ran the first training events and schools of the project. Organised by Dr. Nazaret Bello González (Leibniz-Institut für Sonnenphysik, Freiburg), 'A week above the clouds' took place in August on Tenerife (Spain). The training week gave 15 students a chance to live the life of a solar observer. Under careful guidance of experts, the students gained experience how to operate international solar observational facilities (e.g. GREGOR), and received lectures and tutorials on related solar science and cutting-edge developments within the field (e.g. machine learning). The attendees (and staff) told us that they all had an amazing week and have even planned to submit an observing proposal to the Access Programme. There are another three opportunities for students to be a part of this unique experience, with schools planned every year until 2022.

This year also saw the first of five planned



*Sunset over La Palma, viewed from Tenerife / Photo: Galina Chikunova, attendee of the "Week Above the Clouds" training event*





Participants in the summer school 'Solar Spectropolarimetry: from Virtual to Real Observations' (Lugano, Switzerland)./ Photo: SOLARNET

summer/winter schools. In September, the 'Solar spectropolarimetry: From virtual to real observations' workshop was held at Università della Svizzera italiana (Lugano, Switzerland), run by Prof. Oskar Steiner (Istituto Ricerche Solari Locarno / Leibniz-Institut für Sonnenphysik). Twenty four student and post-doc participants spent a week developing competence and skills for the interpretation of spectropolarimetric observational data with the help of synthetic data from numerical simulations. During the school, techniques and practical examples for the production of synthetic data and comparison to real photospheric and chromospheric data were introduced.

Next year will see two further schools taking place in March at the Mullard Space Science Laboratories in the UK and in October at the University of Graz (Austria). The first full-scale SOLARNET conference, 'Sun and Society', will be held at the Venice International University (Venice, Italy), from 5-9 October 2020.

#### **SOLARNET Mobility Programmes.**

Mobility is another key pillar of SOLARNET, with the ambition of sharing knowledge throughout the EU and bringing in new expertise from our international colleagues. To this end, we aim to provide opportunities

for a number of researchers to spend extended periods of time at leading research centres around the world through the Mobility Programme. This year saw the first and second calls issued for the programme, with those successful in the first round already undertaking visits in Austria, Germany, Italy, Sweden, and the USA.

Furthermore, we kicked off the SOLARNET Transnational Access and Service Programme, releasing a call for supported observational time on Europe's major ground-based observational facilities (e.g. the Swedish Solar Telescope and GREGOR). The first call selected a number of proposals that covered a wide range of science goals, with many of them taking place over the summer observing period. In addition to the observing facilities, this SOLARNET project has a collaboration with CSCS, the Swiss National Supercomputing Centre, that enables access to the Piz Daint supercomputer – the most powerful computer in the EU. The initial call for science proposals went out a couple of months back and the successful projects are due to be run in January 2020.

**Joint activities.** During this first year, the joint research activities aiming at improving the instrumentation for observing the Sun ramped up

their actions, too. The work includes detailing the requirements for new post-focus instrumentation, multi-conjugate adaptive optics, and synoptic observations. Furthermore, the first coordinated observing campaigns to test harmonization of multi-site observations took place. The work on concepts for extracting the necessary information out of future data and how to handle the expected data volumes also began. The next year will see the first designs and the first results of technical feasibility studies.

As with every project, it is vital to share the research with the wider scientific community and general public. We have been working closely with the EST Communication Office in promoting the project and its activities through social media. We hope this collaboration will blossom in the next year.

We are looking forward to 2020 and all the exciting events and developments it will bring. We hope that our close relationship with the PRE-EST community will continue to flourish, and that working in synergy towards our respective goals will ensure a vibrant future for European Solar Physics. Should you have any questions or would like to participate in the SOLARNET activities please visit the website or contact [solarnet-office@leibniz-kis.de](mailto:solarnet-office@leibniz-kis.de)

## SOLARNET ANNOUNCES ITS FIRST TRAINING WORKSHOP ON PUBLIC ENGAGEMENT

*The SOLARNET Public Engagement Training Workshop will take place on 31 March - 1 April 2020. The results of a community survey on public engagement will be used to inform the workshop*

The first SOLARNET Public Engagement Training Workshop is now scheduled to take place on 31st March – 1st April 2020 at Northumbria University (UK).

Communicating science is an integral part of the research process for many researchers. Over two days, we will cover an extensive introduction to communication and engagement, with a particular emphasis on working with schools. We will explore why we communicate science, the range of approaches and opportunities available, and practice the skills you will need for a variety of contexts.

Examples of practice will include structured school workshops and family events, and we will also look at ongoing developments in public engagement: how we identify and work with disparate audiences, approaches to evaluation and evidencing, and more.

The course will be led by highly experienced teachers and public engagement trainers, who have

worked extensively in the UK and worldwide. They will draw on their own practice, best-practice examples from around the world, and common mistakes and mis-steps.

The workshop is aimed at introductory and intermediate-level communicators.

In 2021 a follow-up session will further develop the ideas and practice explored in this initial workshop. A workshop page on the SOLARNET website will follow shortly.

For details, contact Richard Morton ([richard.morton@northumbria.ac.uk](mailto:richard.morton@northumbria.ac.uk)).



Poster for the SOLARNET Public Engagement Training Workshop

## SURVEY ON ATTITUDES TOWARDS PUBLIC ENGAGEMENT AMONG SOLAR PHYSICISTS

The SOLARNET project is collecting data on the attitudes towards public engagement across the member organisations and researchers that are involved in SOLARNET, PRE-EST, and Solar Physics research generally.

Since public engagement is becoming an increasingly prominent part of the work of researchers, the SOLARNET project would like to explore how attitudes and activities differ between countries. The data will also be used to inform the

design of training workshops and other support for public engagement.

We would like to encourage you to participate in the survey, which will take around 10 minutes of your time. We want to hear from you whether you are currently engaged in public engagement or not.

The survey can be found at <https://cutt.ly/be58GkE>

## SECOND EDITION OF THE SCIENCE REQUIREMENT DOCUMENT APPROVED BY THE SAG

The EST Science Advisory Group held 4 meetings in the course of 2019 to update the Science Requirement Document. The final document was approved on December 3rd, 2019

The EST Science Advisory Group (SAG) held 4 meetings in the course of 2019 to continue its work on the update of the Science Requirement Document (SRD). After completing the science cases, including detailed observational sequences that would allow to answer the science questions, the main task of the SAG was to derive the actual telescope specifications.

In order to deal with this task, it was necessary to analyse the compiled list of science cases, taking into account the baseline concept for the optical design and the developments that have occurred since the preliminary design was released in 2011. In particular, the new technological developments may allow for a deformable secondary mirror (M2). This would imply major improvements of the telescope performance. By having all multi-conjugate mirrors between M2 and M6, the transfer optics with its 7 mirrors would not be needed any longer. This substantial reduction in the number of mirrors simplifies the optical alignment and enormously increases the photon flux. For example, at a wavelength of 400 nm the photon flux would increase by a factor of 3, i.e., by 300%. The SAG members were most excited by this possibility and recommended to study the feasibility of such a design. Among other advantages, the Nasmyth instrument platform for observations at short wavelengths would become obsolete.

Since the telescope is designed to be a 'microscope' that should have the best imaging and polarimetric capabilities, the SAG supports an

<b>Science Requirement Document (SRD) for EST</b>	
<b>Prepared by the EST Science Advisory Group</b>	
<b>I Introduction</b>	<b>4</b>
<b>II Top-level science goals</b>	<b>5</b>
<b>1 Structure and evolution of magnetic flux</b>	<b>5</b>
<b>2 Wave coupling throughout solar atmosphere</b>	<b>12</b>
<b>3 Chromospheric dynamics, magnetism, and heating</b>	<b>19</b>
<b>4 Large scale magnetic structures: sunspots, prominences and filaments</b>	<b>24</b>
<b>5 Coronal Science</b>	<b>30</b>

Contents of the Science Requirement Document prepared by the EST Science Advisory Group

on-axis design for two reasons. First, its compact mount allows for a high elevation of the EST tower. Since the seeing at the two Canary Island sites is dominated by ground-layer turbulence, high elevation improves the image quality. The second reason is that an on-axis design facilitates the polarimetric calibration of the telescope.

As the science cases ask for simultaneous multi-wavelength observations with short time cadences, the SAG concluded that EST should be equipped with a suite of spectro-polarimetric instruments working at 6 different wavelengths. These instruments should preferably be Integral Field Units (IFUs) and should receive all available photons at their specific wavelength range. The size of the field of view was also subject of discussions. Taking into account that the instrument cost increases non-linearly with the size of the field of view, the requirement is a minimum field of view of 125 arcsec in diameter.

Another task for the SAG was to derive

measures that guarantee that the polarimetric measurements performed by EST reach the accuracies and signal-to-noise ratios requested by the science cases. While the polarimetric sensitivity can be quantified with a single number (a value of 1/33000 was set for EST), the polarimetric accuracy has to be quantified with a 4 by 4 matrix, since 4 independent parameters are needed to specify the polarimetric state of the light. The 16 elements of such a matrix represent the maximum errors that are allowed in the four polarization parameters, due for example to instrumental crosstalk between them. In the case of EST, the error matrix cannot be larger than

$$\mathcal{E} = \begin{pmatrix} 10^{-2} & 1 & 1 & 0.1 \\ 5 \cdot 10^{-4} & 10^{-2} & 5 \cdot 10^{-2} & 1 \cdot 10^{-3} \\ 5 \cdot 10^{-4} & 5 \cdot 10^{-2} & 10^{-2} & 1 \cdot 10^{-3} \\ 5 \cdot 10^{-3} & 5 \cdot 10^{-1} & 5 \cdot 10^{-1} & 10^{-2} \end{pmatrix}$$

The second edition of the EST Science Requirement Document incorporating the new science cases and observing sequences, along with the final telescope/instrument specifications, was approved on December 3rd, 2019.



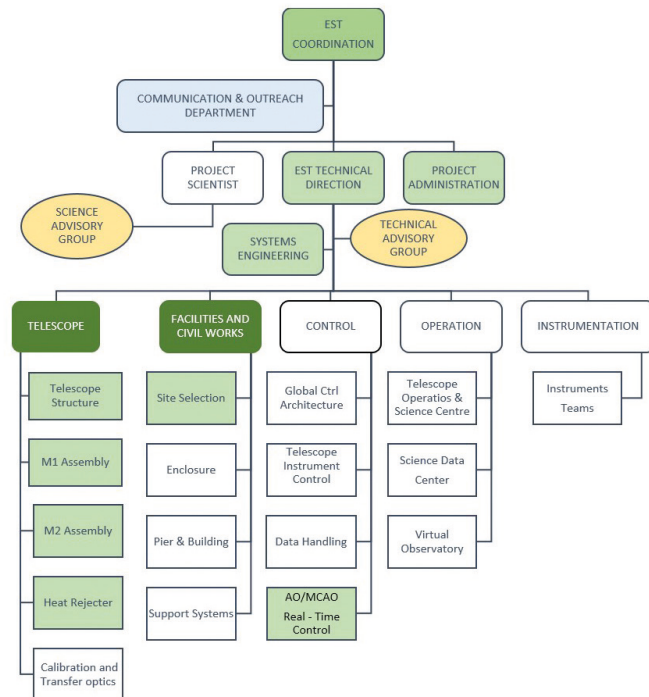
## STATUS OF THE EUROPEAN SOLAR TELESCOPE PROJECT OFFICE

*The EST Project Office, in close collaboration with the EST Scientific and Technical Advisory Groups, is the responsible structure for consolidating the conceptual design of the telescope*

The technical objective of the Preparatory Phase is to accomplish the preliminary design of the telescope at system and subsystem level, down to a level that detailed design and construction can be started as soon as it is finished, fulfilling all scientific requirements.

The tasks for the preliminary design have already started, thanks to the results obtained during the previous conceptual design phase and the additional progress achieved with the SOLARNET FP7, GRESt and SOLARNET H2020 projects. The following sub-phases are being implemented: (1) Update of the scientific and technical requirements set in the conceptual design phase; (2) Consolidation of the conceptual design; (3) Definition of subsystem specifications for the preliminary design; (4) Preliminary design; and (5) Definition of specifications for detailed design and fabrication, updating the cost estimates and construction schedule.

The EST Project Office (PO), in close



*EST Project Office structure diagram. Green and yellow boxes represent the areas where work is in progress.*

collaboration with the EST Scientific and Technical Advisory Groups (SAG and TAG), is responsible for those tasks, including the scientific and technical management of the project, and the preparation and supervision of

the international calls for preliminary design with industrial participation. At the end of the Preparatory Phase, the EST PO will define the specifications for the final detailed design and construction phase.

## EST PROJECT OFFICE HEADQUARTERS



The EST Project Office is based at the Instituto de Astrofísica de Canarias and a team of 23 people is currently working on the areas marked in green in the above diagram. Soon the team will move to the new IACTEC building, located at the Polo Científico y Tecnológico de La Laguna (Tenerife, Spain). For more information and pictures of the inauguration, see the EST website.

# THE TECHNICAL ADVISORY GROUP SELECTS CONCEPT FOR ADAPTIVE SECONDARY MIRROR

*The EST Technical Advisory Group was formed at the beginning of 2019. During its September meeting, the group decided to pursue the concept of an adaptive secondary mirror*



*The last meeting of the Technical Advisory Group was held online on September 9, 2019*

The EST Technical Advisory Group (TAG) was formed at the beginning of 2019 as one of the main advisory committees to the Project Office.

The TAG consists of partners that have had previous technical responsibilities on the EST conceptual design, and on the design, manufacturing, integration and operation of solar telescopes. Currently, it is formed by Paolo Di Marcantonio (INAF), Ilaria Ermolli (INAF), Reiner Volkmer (KIS), Dan Kiselman (SU), Francesco Berrilli (UNITOV), Dario Del Moro (UNITOV), Manuel Collados (IAC), and Mary Barreto (IAC). The TAG welcomes EST partners willing to actively participate in it.

## **THE TAG IS FORMED BY PARTNERS WITH PREVIOUS RESPONSIBILITIES ON EST CONCEPTUAL DESIGN**

In the TAG meeting of 9 September 2019, the group took a major technical

decision: to pursue the concept of an 800-mm adaptive secondary mirror (ASM) for EST.

During the meeting, the results of the Public Market Consultation done by the EST Project Office during the first half of 2019 were presented. This consultation enquired companies in the market about the feasibility of an ASM fulfilling the EST specifications. Two different companies delivered their analysis reports on this topic: Adoptica (Italy) and TNO (The Netherlands).

## **RESULTS FROM THE PUBLIC CONSULTATION ON THE FEASIBILITY OF AN ADAPTIVE SECONDARY MIRROR WERE PRESENTED DURING THE LAST MEETING**

In the same meeting, the TAG discussed the implications in optomechanical design of the telescope derived from the inclusion of the ASM. A considerable advantage of this change is that the new design will only be composed of

6 mirrors (including the MCAO system) and a double lens (to be compared with the original 14-mirror design). This modification represents a great advantage in terms of photon flux and image quality.

As a consequence of the changes, the image rotation introduced by the telescope is not compensated anymore. The rotation is acceptable for imaging instruments and spectrographs based on integral field units. Long-slit spectrographs would need to be equipped with an internal de-rotator to avoid image rotation.

This proposal was reported to (and approved by) the PRE-EST Board in their meeting of 4th October 2019.

During the upcoming months, the proposed EST location at Observatorio del Roque de los Muchachos on La Palma (Spain) will be studied in depth, and the work and licenses needed for the construction will be defined.

## WORKING WITH EUROPEAN INDUSTRY TOWARDS THE CONSTRUCTION OF THE EST

*EST represents an important technological challenge and thus, close collaboration with industry to develop innovative solutions is an important goal of the project*

From the technical point of view, the project's main goal is to develop a design capable of addressing the EST scientific questions. EST represents an important technological challenge in critical areas such as thermal control, adaptive optics and instrumentation. Moreover, it is a European example for the European Commission for promoting co-innovation. Within the different EC-funded projects, the institutions of the EST consortium are developing innovative solutions for the telescope in close collaboration with European industry.

The construction of EST offers a unique opportunity in terms of technological development, as well as the possibility of creating industrial contracts to improve European competence in the design and manufacturing of mechanical structures, large format optical elements, high speed detectors, precision scientific instrumentation or data management systems. For this reason, special efforts to involve industry through collaboration agreements and to inform them through dedicated infodays are being made by the EST project.

An **Information Day for Czech technological companies** was held on June 13, 2019 at the Technological Centre of the Czech Academy of Sciences. The event was organised in collaboration with the Enterprise Europe Network, the Czech Ministry of Education, Youth and Sport, and the Astronomical Institute of the Czech Academy of Sciences. Mary Barreto, EST Technical Director, and Juan Cózar, EST Chief Mechanical Engineer, provided a



*General view of the ESO-Swiss Industry Information Day (November 15, 2019)*

detailed technical description of the telescope and its main subsystems. Business-to-business meetings were held with Czech companies after the presentations.

Alejandra Martín, PRE-EST Project Manager, also participated in the workshop organised by the **Spanish Centre for the Development of Industrial Technology (CDTI)** on October 30 in Madrid. This event was dedicated to showcase the business opportunities offered by Big Research Facilities to the Spanish industry involved in science. During the meeting, EST was presented and a special effort was made to inform the industrial representatives about the upcoming calls for tenders for the preliminary design of the main telescope subsystems.

In addition, EST was invited to participate in the **2nd ESO – Swiss Industry Information Day**. During his

talk, EST System Engineer Miguel Núñez described the technology needs of the project for the next years (tendering activity, procurement batches...), detailing the high-tech demands of the EST instrumentation. He was accompanied by Juan Cózar, EST Chief Mechanical Engineer, and Michele Bianda, Swiss Coordinator of EST.

The event took place on November 15, 2019 in the city of Olten. Organised by the Laboratory of Astrophysics of the École Polytechnique Fédérale de Lausanne and the Industry Liaison Office, the meeting was mainly focused on the current contract status and technology roadmap of the ESO, and included keynote speakers from the ESO Organisation in Munich. The meeting also included information on the procurement status of international projects like the Square Kilometre Array, the Cherenkov Telescope Array, and the European Solar Telescope.

# THE EUROPEAN SOLAR TELESCOPE WILL ISSUE A CALL FOR TENDERS IN 2020

*A call for tenders for the preliminary design of the primary and secondary mirrors and the telescope structure will be issued by the Project Office in the first half of 2020*

EST will be the largest solar telescope ever built in Europe. With a 4-metre primary mirror, and state-of-the-art technology, it will furnish astronomers with a unique tool to understand the Sun, our active star. EST represents an investment of about 200 M€. Its construction phase is expected to start around 2022 and will last 6 years. Its life is estimated to be 30 years, with an annual operation cost of 12 M€.

## THE EST CONCEPTUAL DESIGN HAS BEEN REVISED AND UPDATED DURING 2019

During 2019, the 2011 EST conceptual design has been revised and intensive work has been done on the definition of the specifications to be included in contracts for the preliminary design of the main subsystems of the telescope structure and the primary mirror (M1) and the secondary mirror (M2).

These revised specifications will allow the EST Project Office to prepare the necessary documentation for the call for tenders that will be issued in the first semester of 2020. The call for tenders will be co-funded by PRE-EST funds (H2020).

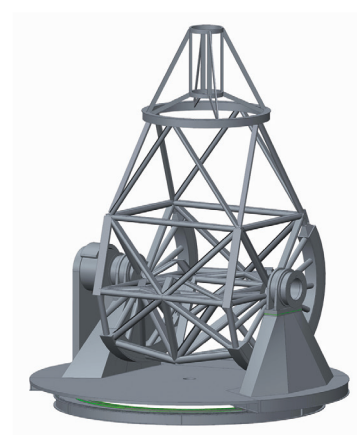
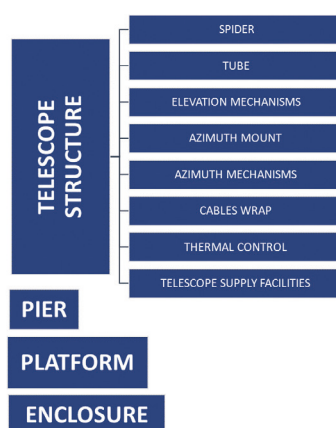
## EST REPRESENTS AN INVESTMENT OF AROUND 200 M€. CONSTRUCTION WILL LAST 6 YEARS

This call is estimated to be launched in the first trimester of 2020. More information can be found on the EST website ([www.est-east.eu](http://www.est-east.eu)).

The ongoing EST procurements email is [contratacion@iac.es](mailto:contratacion@iac.es).

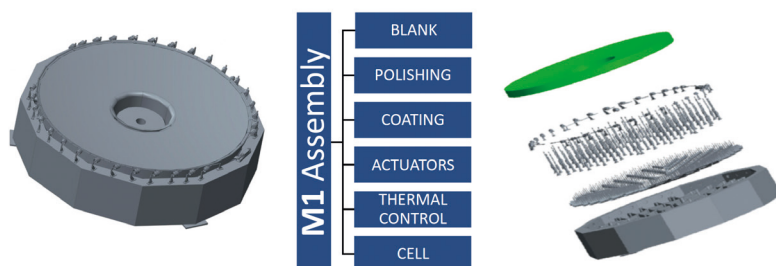
### TELESCOPE STRUCTURE, PIER, PLATFORM AND ENCLOSURE

*The telescope structure includes the telescope itself and a system to support the primary and secondary mirrors. It also includes all the mechanisms required to precisely rotate the telescope for an accurate pointing and guiding of the solar image. The pier, platform and retractable enclosure will be considered in the studies to ensure correct interfaces between all the components.*



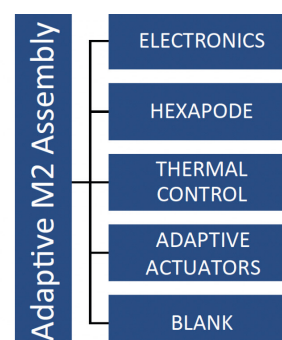
### PRIMARY MIRROR SYSTEM

*The primary mirror (M1) is a light-weighted monolithic mirror, with a diameter of 4 meters, made of a material that makes it very stable to temperature variations. The preliminary design will also focus on the cell design, its actuators and thermal control.*



### SECONDARY MIRROR SYSTEM

*The secondary mirror is an adaptive 800mm diameter secondary mirror concave ellipsoid, which defines the telescope pupil. It includes slow alignment drives to keep the optical alignment, fast tip-tilt and focus drives to correct dynamic perturbations.*



## OUTREACH ACTIVITIES AND EVENTS: EST MEETS WITH EUROPEAN CITIZENS

*From public observations to cinema festivals, these are some of the activities EST people have engaged in over the last six months. An overview by country – including the ERN 2019*

**UK.** During the transit of Mercury, on November 11, EST scientists from the University of Sheffield organised an open observation with their H-alpha telescope (and also streamed it on YouTube).

**Spain.** In September, the EST coordinator Manuel Collados, from Instituto de Astrofísica de Canarias, opened the new season of science popularization talks of Museo de las Artes y las Ciencias (Valencia, Spain) with "El Sol. Una estrella sorprendente", an educational talk in which Collados explained solar features and how they affect us, plus the techniques astronomers use to study them, to an audience of more than 200 people. He also explained how the European Solar Telescope will deepen our understanding of the Sun and, hopefully, other stars too. In July, EST participated in the XIII Meeting of Astronomy Teaching held in Úbeda (Spain), organised by the Spanish Association for the Teaching of Astronomy. During the meeting, the EST team introduced the European Solar Telescope and the outreach resources that are being developed.

**Norway.** In September, Norway immersed itself into the Forskningstorget, their nationwide science fair. One of the main streets in Oslo, Karl Johan, hosted a myriad of different activities and booths, including one of the Rosseland Center for Solar Physics (RoCS), the Norwegian partner of the EST project.

**Slovakia.** In mid October, participants in Astrofilm, an

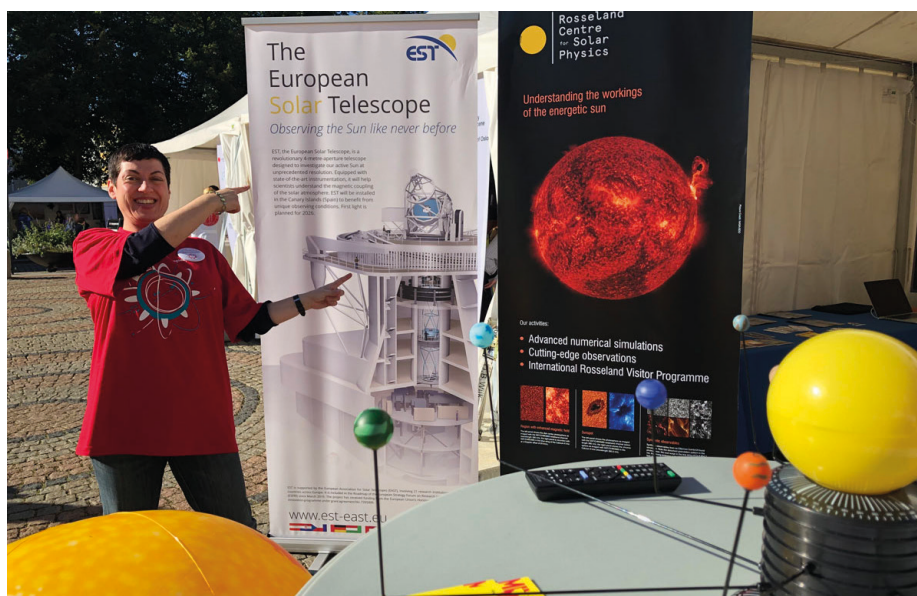


*Attendants to the SAVinci conference (Bratislava, June 26, 2019)*

astronomical film festival in the Slovak city of Piešťany, had the opportunity to learn about solar activity and the mysteries EST will unveil thanks to Dr. Peter Gömöry, from the Astronomical Institute of the Slovak Academy of Sciences. Prior to that, in July, Gömöry was one of the lecturers of the SAVinci conference series in Bratislava

– an initiative to popularize high-quality Slovak science. Besides learning about the Sun and EST, attendees were able to perform real observations with small telescopes and had the opportunity to learn about EST using the EST model.

**Italy.** In July, Francesco Berrilli delivered



*Forskingstorget, Norway's nationwide science fair*



a public talk about EST and its possible use for space weather investigations at the LUNA 50 event, organised by the University of Roma Tor Vergata on the occasion of the 50th anniversary of the Moon landing.

**Austria.** In October, EST researchers at Graz University took part in the Night of Museums.

**European Researchers' Night 2019.** In September, EST scientists and engineers from the Czech Republic, Greece, Hungary, Ireland, Italy, Slovakia, Spain and Sweden engaged in the European Researchers' Night 2019. Children and adults alike participated in solar observations, talks and workshops, and had the opportunity to meet EST people, learn about solar physics research and discover the opportunities that EST will open.

In the **Czech Republic**, the Astronomical Institute of the Czech Academy of Sciences organised a guided visit to their observatory, including an exhibition of historical instruments for solar observations. In **Hungary**, researchers from Eötvös Loránd University organised solar observations with optical and H-alpha telescopes, plus planetarium shows. In addition, Bernadett Belucz gave an educational talk covering stellar constellation, star formation, the Sun and the European Solar Telescope.

In **Slovakia**, Peter Gömöry also delivered a talk to the people attending the daily event at Poprad city mall covering the traits of our star, the impact they have on Earth and how scientists use their knowledge of the Sun to better understand other stars.

EST scientists from Trinity College Dublin (**Ireland**) participated in



*EST model on display in Granada (Spain) during the European Researchers' Night*

PROBE, a free public pop-up festival showcasing a diverse range of academic research that took place in Dublin. The members of the Solar and Space Weather Research Group and the Dublin Institute for Advanced Studies -EST partners in Ireland- had their own booth, where they answered questions about solar physics and the European Solar Telescope. In **Greece**, the National Observatory of Athens -EST Greek partner- also had its own stand at Athens' main event for the night, where people could learn about solar storm forecasting or satellite monitoring.

In **Italy**, activities were organised both in Catania and Rome. In Catania, several institutions devoted to physics, astrophysics, nanotechnology, and material sciences joined forces in a pop up science show, including members of the Department of Physics and Astrophysics of Catania University. Together, they prepared exhibitions, talks, and workshops covering all kind of topics from exoplanets to Moon exploration, and the Sun and the European Solar Telescope. In Rome, researchers of the INAF Osservatorio Astronomico di Roma offered seminars and guided tours to the historical instruments, plus a lecture on Sun-Earth relations addressing also the role of the European Solar Telescope. Finally, the Physics Department of the University of Roma Tor Vergata (together

with the university section of the National Institute of Nuclear Physics) organised a "space night" in which researchers involved in the EST project gave talks on space research and on the role of the active Sun in the physical conditions of the circumterrestrial space.

In **Spain**, the Instituto de Astrofísica de Andalucía had its own stand at the official, outdoor venue for the European Researchers' Night in Granada, and Luis Bellot -Communications Coordinator for the EST project- gave a public talk on the Sun and the role of the European Solar Telescope. A model of EST was also on display. In La Laguna, the Instituto de Astrofísica de Canarias had their own stand in the city science fair, and one of the EST researchers, Tobías Felipe, answered questions on solar physics via YouTube.

In **Sweden**, the European Researchers' Night and the Day and Night of Astronomy were organized together, and thus the Department of Astronomy at Stockholm University prepared a full programme of activities including solar observations and workshops. There were also a handful of public talks, including one about the European Solar Telescope by Dan Kiselman, EST researcher at Stockholm University.

# EST WEBSITE, UPDATED: NEW SECTIONS AND CONTENTS TO SUPPORT OUTREACH ACTIVITY

*During the last months, the EST Communication Office has reorganized the EST website to support the outreach and communication activities of the EST consortium*

The EST website is now continuously updated with the latest news about the activities carried out by the project. Here is a quick overview of the contents available in the revamped Outreach section.

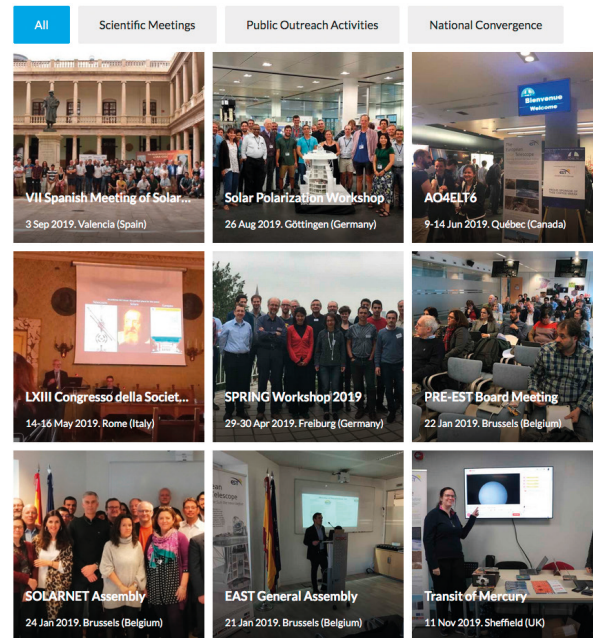
**EST Around the World.** The EST partners are very active in communicating the project goals at local, regional and national levels. Scientists, engineers and other members of the team have organized or have participated in outreach activities. Moreover, the EST community is present in different science, technology and policy forums worldwide. This section of the website summarizes the events in which EST has participated and lists the upcoming ones.

**The Science of EST.** The "Science of EST" is a series of short articles written by scientists involved in the

EST project. They have been published on the EST social media since May 2018, and now they are also available on the EST website. These articles, targeted to the non-specialist public, explain some of the scientific problems that EST will address. A new contribution is added every Wednesday.

**The QuEST.** The cartoon video series "The QuEST" was launched in June 2019. This section of the EST website presents the series and its main characters. It also includes links to the episodes released so far, with captions available in up to 13 different languages and versions narrated in English, Italian, and Slovak.

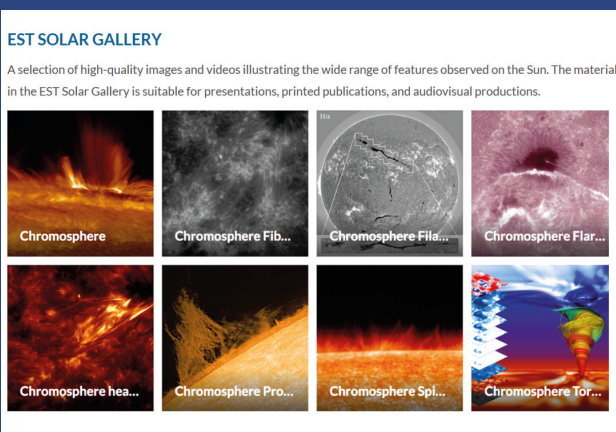
**EST promotional material and calendar.** EST merchandising is available for download through this section. This includes the project brochures, roll-ups, and the EST calendar.



**EST Documentary.** This area is devoted to the EST documentary "Reaching for the Sun". For the moment, it hosts the trailer and a gallery of pictures showcasing the documentary "making of". The technical credits

and the names of some of the scientists that were interviewed can also be found there. In the future, this section will be updated with news about the documentary such as the release date, exhibition tour, festivals, and prizes.

## LAUNCH OF THE EST TEACHER'S CORNER



The EST website now hosts an all-new Teacher's Corner. The goal of this section is to help teachers and educators raise awareness of the Sun and promote STEM vocations, providing them with useful tools and resources. Some of the contents in the Teacher's Corner are the EST Solar Gallery and an extensive compilation of educational resources. In the near future, the EST Virtual Solar Kit will be added to this section as well.

The new area is intended to direct teachers, educators and the general public to websites describing interesting educational initiatives carried out by other research centers. There we list citizen-science projects, activities, tools, documents, pictures, and movies, ready to be used in school to learn about the Sun.

# THE EST SOLAR GALLERY: A VISUAL TOUR OF THE SUN

*The EST Solar Gallery compiles high-quality images and movies showcasing the broad range of features that can be observed on the Sun*

The EST Communication Office has recently released the EST Solar Gallery, which is a collection of high-quality images and movies showcasing the broad range of features that can be observed on the Sun. It is accessible through the EST website (<https://cutt.ly/ArqLHVt>)

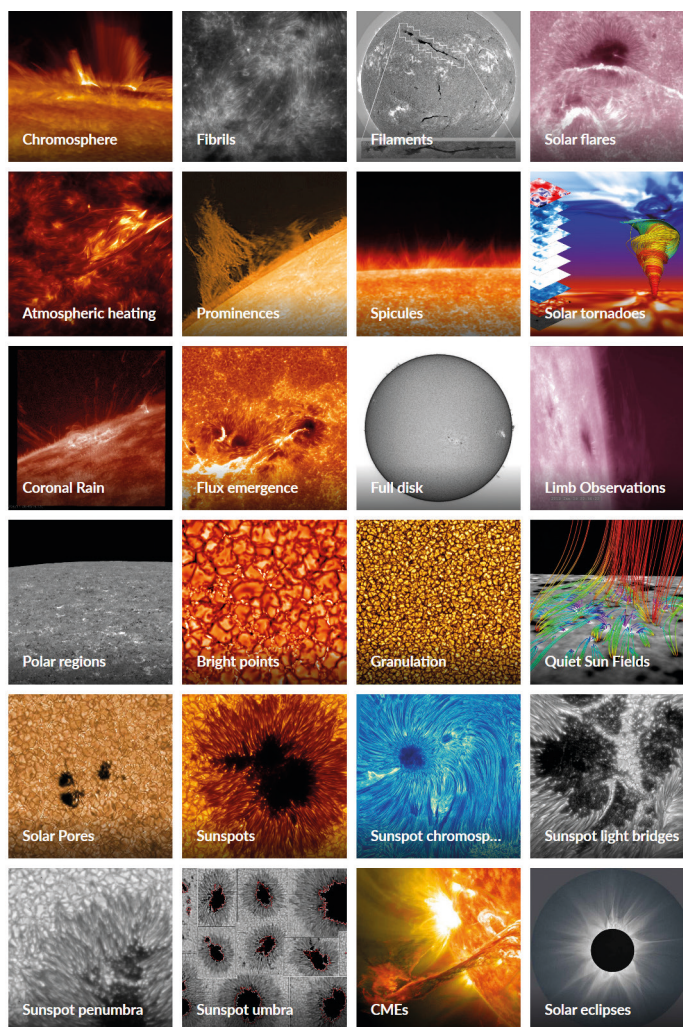
Conceived mainly as an educational and public outreach resource, the gallery is offered as a service to teachers, students, amateur astronomers, and the general public. It contains selected observations carried out by the leading ground-based and space solar telescopes, both in Europe and elsewhere. All the material can be downloaded at high resolution under a Creative Commons license granting permission for non-commercial purposes.

**FOR THOSE WHO WANT THE GALLERY ON PAPER, THERE IS ALSO A BOOK THAT CAN BE DOWNLOADED FROM THE EST WEBSITE**

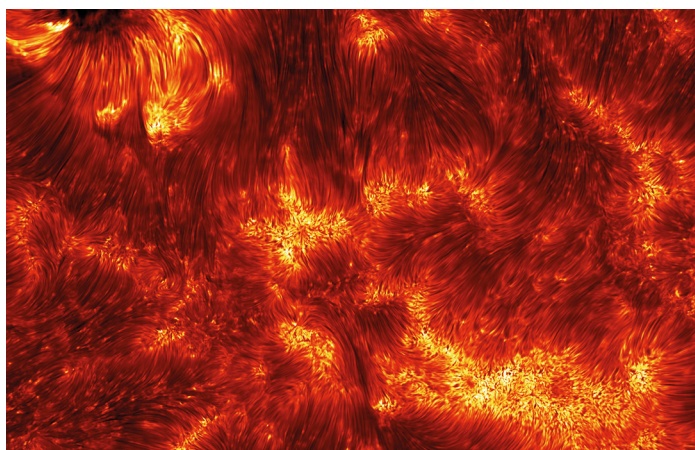
The EST Solar Gallery consists of 105 images and 77 videos, organized in 25 categories. Each item is accompanied by a descriptive text that explains the targeted solar feature in simple words and identifies the date of observation, the telescope, the instrument, and the authors of the observations and the description. It is because of this additional information that we hope the gallery provides a truly useful resource for both educators, students and interested people. The images and movies are visually appealing and, at the same time, of great scientific relevance. They will surely find many applications in school projects, scientific presentations, audiovisual productions, and printed documents.

For those who want to have the EST Solar Gallery on paper, the EST Communication Office has prepared the book entitled "A Tour of the Sun", which presents a visual summary of the material in the gallery in a convenient format. It can be downloaded as a PDF file from the EST [website](#).

The EST Solar Gallery is intended to be a living resource that will grow with time.



*A screenshot of the EST solar gallery*



*One of the images of the solar gallery. It shows an active region observed on August 2010 with IBIS at the Dunn Solar Telescope (USA)/ Image: Kevin Reardon (INAF-Arcetri, NSO/AURA/NSF)*

# FIRST TWO CHAPTERS OF EST CARTOON VIDEO SERIES RELEASED

*The first two episodes of "The QuEST" have reached more than 3000 views. Subtitles or dubbed versions are available in twelve different European languages*

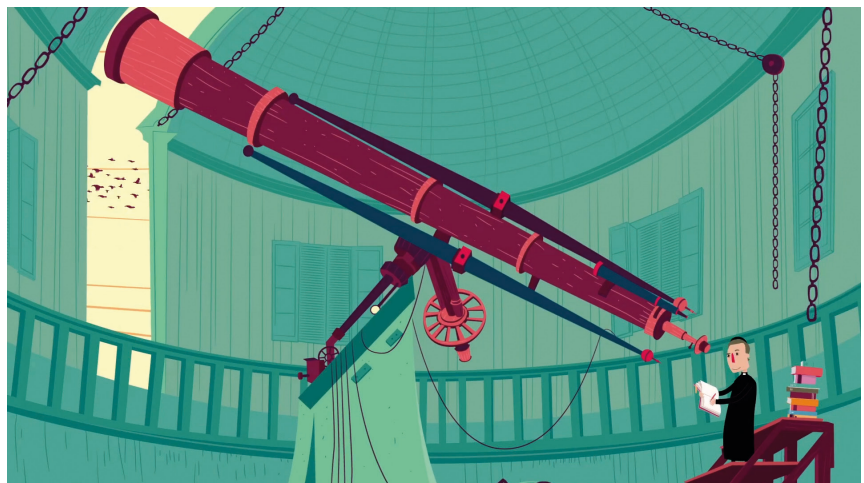
On 28 June 2019, the first episode of the cartoon video series "The QuEST" was released. "The QuEST" presents some of the scientific goals of EST through the stories of the astronomers who first addressed them. The series aims at making concepts of solar physics easily understandable by the general public. To connect with young people, the cartoons are based on funny characters and entertaining narrations.

In the first chapter, entitled "The QuEST for Sunspots", we move to Italy, in the 17th century, to meet Galileo and learn about the discovery of sunspots. Later, a time leap takes us to the US, at the beginning of the 20th century, where we meet George E. Hale and the spectroscopic techniques he improved to discover magnetic fields in sunspots.

"The QuEST for Spicules", the second episode, tells the story of Father Angelo Secchi and his passion for solar observations. In the 19th century, he discovered the existence of spicules, a new type of structures covering the solar surface.

"The QuEST" has received a warm welcome thus far, reaching more than 3200 views in the different social media channels and online platforms. Not only is it having a large impact on the Internet, but it also has been shown in several outreach and dissemination events, such as the European Researchers' Night and others across the continent.

The first two episodes can be found on the EST YouTube channel. More information and links to the videos are given in the 'Outreach' section of the



*Galileo and Father Secchi as featured in The QuEST two first episodes*

EST website. The original language is English, but captions in twelve different European languages are available. In addition to that, "The QuEST" has been fully dubbed into Italian and Slovak, and a Spanish version is in the making. The translations have been carried out by the members of the EST consortium.

The third episode, "The QuEST for Sunspots Dynamics", will be online very soon. It tells the story of John and Mary Evershed and how they discovered gas motions in sunspots

thanks to their work at Kodaikanal Observatory (India).

In the first quarter of 2020 we will watch Richard Carrington in "The QuEST for Flares". The unexpected discovery of the British researcher is the subject of this episode, which will be the last of the video series (or, at least, of the first season).

More information is available in The QuEST section on the website (<https://cutt.ly/erqHwTn>)

# "THE SCIENCE OF EST" SERIES: EST SCIENTIFIC CHALLENGES, EXPLAINED

*The Science of EST is a weekly series covering the scientific challenges that will be addressed by the European Solar Telescope. It has been online since May 2018*

Since March 2019, we publish on a weekly basis our short "The Science of EST" posts on all the social media channels. As a reminder, these posts consist of an outreach text written by scientists about a particular research topic they are working on. An important part of the text is to emphasize how EST could help with their own investigation. The main goal of this series is to reach out to non-scientists that have an interest in science and astronomy, as well as to increase the visibility of EST

**ABOUT 40 CONTRIBUTIONS FROM 26 INSTITUTIONS IN 17 COUNTRIES ACROSS EUROPE HAVE BEEN PUBLISHED IN 2019**

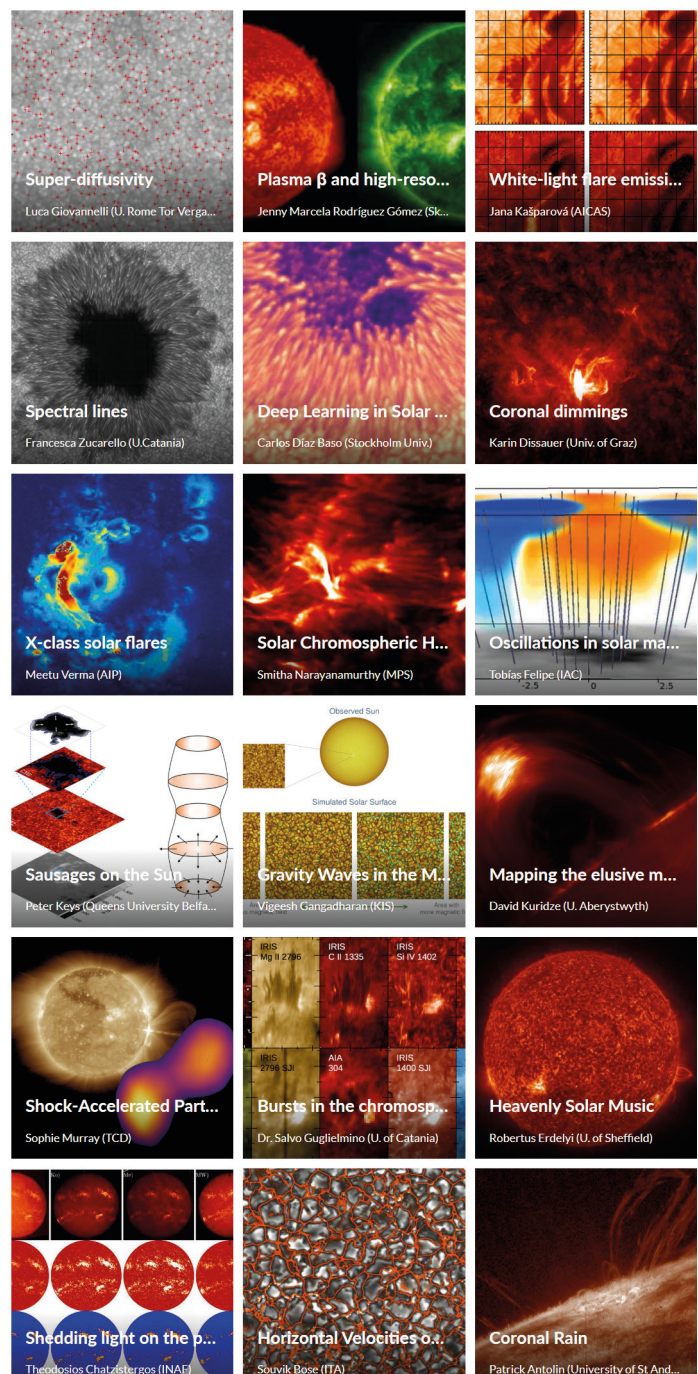
The series continues to be extremely successful. About 40 contributions from 26 institutions in 17 countries across Europe have been published this year, many of them reaching more than 1,000 people on social media. One third of the contributions were written by female scientists and most of the researchers were at postdoctoral or permanent staff level. Often the social media posts are shared by astronomical associations and institutes, because of its interesting scientific content. This at the same time increases the impact of the posts and the number of followers in the EST social media, which has been steadily growing since the beginning of the year. An effort is being made to share the posts on the partner institute social media.

**ALL POSTS IN THE SERIES ARE NOW COMPILED ON THE EST WEBSITE**

Recently, one major milestone was the launch of a dedicated website for all the "The Science of EST" contributions. This was heavily demanded by scientists and fans of the series. The EST Communication Office prepared and hosted the material on the EST website under the tab "Outreach". The future plans are to continue with the series for a few more months and afterwards release an online book that will collect all contributions. We are still searching for outreach contributions. If you would like to participate, please feel free to contact us.

## THE SCIENCE OF EST

The Science Of EST is a weekly series of short articles explaining the scientific problems that will be addressed by the European Solar Telescope. Written by scientists involved in the EST project, they are published also in the EST social media channels under the hashtag #TheScienceOfEST. The series has been running since May 2018.



A screenshot of "The Science of EST" section

# EST NEWCOMERS

## ÁNGEL MATO MARTÍNEZ

EST MECHANICAL TEAM



Ángel is a mechanical engineer with 10 years' experience in the field of astrophysical instrumentation. He is skilled in the design and analysis of mechanical components as well as the assembly, integration and verification of large instruments. He has been involved in EMIR, an infrared spectrometer. Currently he works on the upgrade of the GRIS spectropolarimeter, installed at the GREGOR solar telescope. For the EST project, he is mainly involved in the definition and specification of the secondary mirror mechanism.

## SEBASTIÁN HIDALGO RODRÍGUEZ

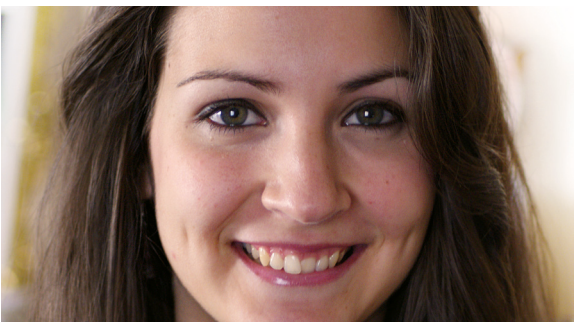
EST SITE CHARACTERIZATION



Sebastián obtained his Ph.D. in Astrophysics by La Laguna University in 2006. He has been postdoctoral researcher at the University of Minnesota (USA), Pisa (Italy), and IAC (Spain) working on resolved stellar populations. He has developed several algorithms for stellar population synthesis, spectral analysis for GAIA, and machine learning for exoplanets detection. He will lead the analysis of historical databases of climate conditions of the Canary Islands (OT and ORM) for the daytime characterization of the observatories to support the decision on the location of EST.

## IRENE FERRO RODRÍGUEZ

EST POLARIZATION MODELLING



Irene has a degree in Optics and Optometry, and a MSc in Methods in Advanced Physics (University of Granada). She has experience in optical instrumentation, optics lab testing and AIV attained through her work in PANIC and CARMENES at IAA-CSIC, and in the Optical Engineer Traineeship Program at ESTEC (ESA). She was also involved in the automotive industry as an optical engineer. Currently, she is in charge of the EST polarization modelling and non-sequence design.

## ALEJANDRO MAHY SOLER TRUJILLO

EST MECHANICAL TEAM



Mahy has a degree in Industrial Engineering, a MSc degree in Industrial Mechanics and a Ph.D. in Mechanical Engineering and Industrial Organization. He carried out his research at Universidad Carlos III de Madrid and Oxford University in the field of bio-structures. After his PhD, he joined a consultancy company where he was involved in international projects, as the ITER and the CASH benchmark (Nuclear Energy Agency), both related to seismic design. He is now part of the EST Project Office, and works in the mechanical team, with a focus on finite element analysis.

## DAVID JIMÉNEZ MEJÍAS

### EST ENGINEERING TEAM



David is an electronic engineer, holding a Technical Industrial Engineering and Electronic Degree, and Electronic Engineering Master. He started his professional career as operations technician at Teide Observatory (IAC) and Javalambre Astrophysical Observatory (CEFCA). He was a control engineer at Javalambre's Observatory, designing and developing the Observatory Control System during two years. This experience gave him the opportunity to work as an operation engineer at GTC during the last four years. David has a broad engineering experience in telescopes and observatories.

## YANIRA CARBALLO MARTÍN

### CIVIL ENGINEER



Yanira is a civil engineer. She managed construction works in international construction companies and she worked as an engineering, environmental and occupational risk prevention consultant. After more than 10 years of experience, she joined the IAC as responsible for civil works and edification of the Cherenkov Telescope Array (CTA) being built at the Roque de Los Muchachos Observatory on La Palma. She joined the EST Project Office in October 2019.

## NUZET VEGA REYES

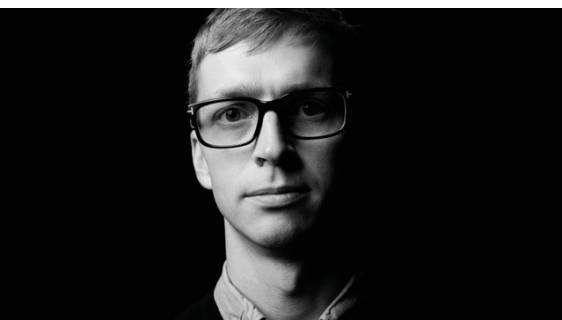
### EST LEAD THERMAL ENGINEER



Nauzet holds a MSc degree in Mechanical Engineering (ULPGC-UPC) and an Expert Degree in Numerical Simulation in Engineering with Ansys CFD (UPM). The integration of EMIR at GTC, the opto-mechanical design of the IFU for the GREGOR telescope, research about "Additive manufacturing applied to astronomical instrumentation" or the thermal analysis of EST are some of the areas he has been involved since he started at IAC in 2008. He worked for DKIST as Principal Mechanical Engineer, and recently joined the EST Team as Lead Thermal Engineer of the telescope.

## RICHARD MORTON

### SOLARNET COMMUNICATIONS LEADER



Richard is a Senior Lecturer at Northumbria University and leads the work package on Engagement, Dissemination and Communication Work Package within SOLARNET. His research focuses on wave phenomena in the solar atmosphere. Richard is also a keen science communicator, and is currently working on a large-scale funded project that uses science and art to engage children across multiple schools in the North-East of the UK.

## EST MEETINGS

### EAST GENERAL ASSEMBLY

Prague (Czech Republic), 21 January 2020

### PRE-EST BOARD MEETING

Prague (Czech Republic), 22 January 2020

### SOLARNET PUBLIC ENGAGEMENT TRAINING WORKSHOP

Northumbria University (UK), 31 March - 1 April 2020

### 1st H2020-SOLARNET MEETING "SUN AND SOCIETY"

Venice (Italy), 5-9 October 2020

## OTHER EVENTS

### 2ND NCSP DKIST-DATA TRAINING WORKSHOP: IMAGE PROCESSING AND TIME SERIES

CSU Northridge, CA (USA), 13-15 January 2020

### MICHAEL KNÖLKER SYMPOSIUM: FROM SOLAR PHYSICS TO EXOPLANETS

Boulder (USA), 26-28 February 2020

### 1ST ARTIFICIAL INTELLIGENCE DATA ANALYSIS SCHOOL FOR HELIOPHYSICISTS

Bologna (Italy), 20-22 January 2020

### COHERENT STRUCTURE TRAINING WORKSHOP

Orsay (France), 3-4 March 2020

### 5TH ASIA-PACIFIC SOLAR PHYSICS MEETING

Pune (India), 3-7 February 2020

### 1ST PARKER SOLAR PROBE MEETING

John Hopkins Applied Physics Lab, Laurel (USA), 23-27 March 2020

### ESA/NASA SOLAR ORBITER LAUNCH

Cape Canaveral (USA), 5 February 2020

### SPIE ASTRONOMICAL TELESCOPES + INSTRUMENTATION

Yokohama (Japan), 14-19 June 2020

**EDITORIAL COMMITTEE:** Luis Bellot, Manuel Collados, Alejandra Martín, Adelina Pastor

**ADDITIONAL CONTRIBUTORS:** Mary Barreto, Alberto Escobar, Christoph Kuckein, Víctor Aníbal López, Richard Morton, Rolf Schlichenmaier

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 [/company-european-solar-telescope](https://company-european-solar-telescope)

 [instagram.com/european\\_solar\\_telescope](https://instagram.com/european_solar_telescope)

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