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EST NewsLetter

Editor's Corner



New steps forward! Manuel Collados Vera EST Coordinator

When completed, EST will be the most powerful astronomical observatory available to help Europe unveil fundamental questions in solar physics. The inclusion of the EST project in the ESFRI roadmap has been a major turning point in the road to this unique solar telescope becoming a reality. It has breathed fresh air into the project's Preparatory Phase and resulted in the achievement of several relevant milestones; such as the approval by the Canary Islands government of 4.5 M€ to install, equip and recruit the necessary personnel for the start-up of the EST Project Office. This funding, added to the H2020 funds of PRE-EST and the national contributions of the partners totals a Preparatory Phase budget of 15 M€.

Another key landmark has been the formation of the EST SAG (Scientific Advisory Group), whose most important task at the moment is to review and update the scientific requirements specified in the EST conceptual design elaborated in 2010. This international group of experts, drawn from the different targeted fields, will work together closely with the Project Office to define the final design of the EST by the end of the Preparatory Phase in 2021.

In addition to the scientific and technological progress, the members of the EST consortium are working together on the strategic aspects, which are so important for the future of the EST, taking firm steps towards establishing EST's legal and governance structure.

Next Events

Four-in-One Workshop Tackling Outstanding Problems in Heliophysics and Space Weather

Cardiff, UK
3-8 December 2017

AGU Fall Meeting

New Orleans, USA
11-15 December 2017

Winter School in Solar Physics

Kodaikanal, India
8-13 January 2018

The UK Missions Forum, Royal Astronomical Society

London, UK
11 January 2018

Dynamic Sun II. Solar magnetism from interior to the corona

Ankor Wat, Cambodia
12-16 February 2018

IAU340 Meeting, Long-Term Datasets for the Understanding of Solar and Stellar Magnetic Cycles

Jaipur, India
19-24 February, 2018

First European presentation of the EST

On October 5th, 2017, the prestigious venue of the *Accademia dei Lincei* in Rome hosted the first European presentation of EST.

The event was attended by representatives of Italian institutions (INAF National Institute for Astrophysics, Università della Calabria, Università di Catania, Università di Roma Tor Vergata) and companies (ADS, SRS Engineering) that have participated in the project, delegates of national entities (ASI Italian Space Agency, AM Italian Air Force) interested in solar physics and space weather monitoring, Italian high-tech companies willing to participate in the definition of the infrastructure (EIE GROUP), high-school students, and media.

National and local media widely diffused key information on EST, increasing public awareness on its science and challenges.



It is worth recalling that the Italian scientific community has contributed to the development of the EST project from the very beginning, by organizing the ESF Exploratory Workshop 2006 "New Generation Large Solar Telescopes: Science Drivers, Observational Strategies and Perspectives" that led to the foundation of EAST.

Since then the Italian community has contributed to developing the project in several aspects, e.g. by leading the conceptual design of several EST key components and by contributing to the definition of the science requirements and to the MCAO design. It also led the education and outreach activities promoted by the FP7 EST Design Study project, e.g. thematic meetings and mobility of young researchers, and gave access to high resolution IBIS observations. In addition to participating in all activities planned now for the present preparatory phase, the Italian community is also contributing to the analysis of the performances of the EST MCAO system and fast cameras for large format WFS, and to the development of CS Fabry-Perot interferometers.

The Italian scientific community with the support of the national institutions and world-leading companies experienced in the realization of large ground-based infrastructures for astrophysics (e.g. VLT, LBT, ALMA, SKA, CTA, ELT) looks forward to the EST final design and construction phase.

The meeting at the *Accademia dei Lincei*, which counts with representatives of Italian institutions, national scientific community and companies interested in EST, was very fruitful and supposes another step forward to build the most powerful European tool to observe the Sun.



EST workshop in Austria

A workshop to discuss the current status of the EST took place at *Bairisch Kölldorf* (Austria), last October. This conference was organised by the Institut of Physics IGAM (University of Graz), the Austrian Academia of Sciences, the Mayor Bad Gleichenberg and the PRE-EST project.

The workshop was dedicated to review the main issues concerning the EST Preparatory Phase. In particular, the discussion on possible collaborations, scientific cases or public outreach strategy were some of the key topics discussed during the event.

Also, the contact with potential stakeholders and funding agencies of the region were crucial. Thus, members of the EST project have the opportunity to



meet with representatives of the Ministry of Science, Research and Economy, University of Graz and the Academy of Sciences. They declared their willingness to support the project at the current stage and contribute financially during the Preparatory Phase.

Perspectives of Astrophysics in Germany

The European Solar Telescope (EST) was prominently featured in the *Denkschrift* 2017 “Perspectives of Astrophysics in Germany 2017–2030: From the Beginnings of the Cosmos to Clues for Life on Extrasolar Planets“. The document was publically released at the annual meeting of the German Astronomical Society in Göttingen on 2017 September 19 by the Council of German Observatories (*Rat Deutscher Sternwarten*, or *RDS* for short). The RDS represents scientific research institutions of the Astronomical Society and gives recommendations for the coming decade ensuring the high standard of astrophysical research in Germany. With respect to ground-based research infrastructures, the RDS recommends the participation of Germany in the construction and further development of major observatories such as the Extremely Large Telescope and other observatories by the European Southern Observatory (ESO) in Chile, the Square Kilometer Array in South Africa and Australia, and EST.

The *Denkschrift* identifies several central questions in the field of solar physics: How do the inner flows in the Sun drive the so-called solar dynamo? How does this explain the activity cycle of the Sun? How does



Credit: Thomas Klawunn

the Sun interact with its heliosphere, i.e., how is space influenced by the solar wind? etc. A much more detailed and in-depth presentation of solar physics and its perspective is given in the community white paper “The Sun: A Laboratory for Stellar and Plasma Physics“. Similar white papers from other fields of astronomy and astrophysics served as the input for the *Denkschrift* of the German Astronomical Society, which are also accessible from the aforementioned website.

In solar physics, Germany operates the 1.5 m GREGOR telescope on Tenerife, which was inaugurated in 2012 and is currently the world's most powerful solar telescope.

RoCS becomes a Centre of Excellence

The Research Council of Norway has recently granted ten research groups status as Norwegian Centres of Excellence (SFF centres). The new centres will receive a total of NOK 1.5 billion over a ten-year period to carry out world-class research.

In particular, the new Rosseland Centre for Solar Physics (RoCS) directed by Prof. Mats Carlsson has been selected as one of those new centres.

The centre's objective is to understand the actual working of the Sun. By combining solar observations with advanced computer modelling, the centre will generate new knowledge about particle acceleration and heating both in and around the Sun. This will help to reveal processes that have a direct impact on Earth's atmosphere and conditions for life on Earth.

Establishing RoCS will enable a strong Norwegian contribution to EST project. The telescope will have a symmetric design with a minimum of instrumental polarisation making it ideal for measuring chromospheric magnetic fields. Its first light is not foreseen until the end of RoCS but building on the success of using synthetic observations from models for the design of IRIS, the realization of RoCS will allow us to fill a similar role in the EST project.

A high level of scientific merit in relation to international standards is the main criterion used to grant SFF centre status. This applies to the planned research activity and to the centre's key scientific staff. The centres must work with ambitious ideas and complex problems that require coordinated, long-term research activities.



Regional funding approved

The Government Council of the Canary Islands has recently approved a multi-annual budget necessary for the execution of two key specific projects, the European Solar Telescope (EST) and the Liverpool 2 Telescope (LT2). Distributed in five years and led by the Canary Islands Astrophysics Institute (IAC), the total amount will be €6,5 million.

This is an action of strategic interest for the Archipelago that will contribute to the leadership of the Canary Islands in the Astronomy sector and is specified in two actions: the funding of the preparatory phase of EST (€4,5 million) and the design and construction of LT2 (€2 million) for the period 2017-2021.

Regarding EST, the execution of this project and the financial investment will provide to the region new opportunities to continue advancing in the diversified development of the economy of the Archipelago based on R&D.

The priority objective of the Canary Islands Government is to generate scientific and technical knowledge of excellence in the areas declared as priority areas for the Canary Islands in RIS3. The materialization of this initiative will have an important technological and industrial return for the economy, contributing to the generation of a competitive business network in high technology. The materialization of this initiative will have an important technological and industrial return for the economy, contributing to the generation of a competitive business network in high technology.



It will have a pulling effect both for the creation of technology-based companies and for the establishment of large companies in the sector in the Archipelago and will lead to contact and close links with the most advanced European technology companies in technological specialties such as mechanics, optics or electronic mechanisms, among others.

Finally, it should be noted that the Governing Council of the IAC has recently approved its Strategic Plan for the next four years in a meeting held under the presidency of the head of the Canary Islands Government, Fernando Clavijo. The president of the Canary Islands showed his support to IAC, where EST is one of the key infrastructures. It should also be mentioned that EST has also been included in the Strategic Plan of the CSIC for 2018-2021, as a project of institutional interest.

ASTERICS project

Members of the EST team attended to the “2nd ASTERICS – OBELICS Workshop” that took place in Barcelona last October. ASTERICS project (Astronomy ESFRI and Research Infrastructure Cluster) is a €15 million EU funding which will help to support and accelerate the implementation of the ESFRI projects, enhancing their performance beyond the current state-of-the-art, interoperating as an integrated, multi-wavelength and multi-messenger facility.

ASTERICS aims to address the cross-cutting synergies and common challenges shared by the various astronomy ESFRI and world-class facilities. It brings together for the first time, the astronomy, astrophysics and particle astrophysics communities, in addition to other related research infrastructures. In particular, the workshop addressed potential connections between the ESFRI projects and the implementation of European Open Science Cloud for data interoperability.

EST was invited to enter into ASTERICS as a new ESFRI. The EST team attending the meeting identified several key points that can be approached under the framework of ASTERICS. Firstly, EST will generate data at a rate similar to other ESFRI and much can be learnt from their experience. Of special relevance is the amount of on-site data handling and data reduction that can be achieved, ideally without any significant human intervention. Of crucial importance are the improvements to the Virtual Observatory (VO) for ground-based solar data, with a strong reliability and also interoperation with other existing VOs. There are avenues of collaboration in this field with other ESFRI. The second point of interest is the increasing amount of machine-learning methods that are in application in several ESFRI. Real-time data reduction or detection of events using deep learning techniques will be widespread. Studies along this line are now under investigation for EST and how machine-learning can improve our understanding of the Sun.

Highlights of EAST board meeting

EAST General Assembly

Last Nov 23 took place at Kiepenheuer Institute for Solar Physics (KIS) premises in Freiburg, the annual EAST General Assembly. During this meeting representatives of the main European solar research institutions and facilities met there to discuss about relevant matters concerning the future of solar physics.

Applications for new membership were also accepted. The *Observatoire Royal de Belgique* (ROB) (Belgium), the *Hungarian Solar Physics Foundation* (HSPF) (Hungary) and the *National Observatory of Athens* (IAASARS) were welcome to the association.

The status of the EAST Preparatory Phase was one of the main topics for discussion. EAST GA, as EST project promotor and advisory body of the different EST related projects, took the opportunity to discuss different crucial aspects for the future establishment of this singular infrastructure.



EST Science Advisory Group

One of the main aspects discussed was the composition of the EST Science Advisory Group (SAG).

The EST Science Advisory Group, consisting of a number of experts from different countries, met also on November 24 at the Kiepenheuer Institute for Solar Physics for discussing the EST science requirements.

The SAG task is to refine the EST concept, building on the existing EST Conceptual Design, the prioritised scientific goals and technical updates. To that end, the current needs of the solar community will be assessed taking into account the technologies likely to be affordable over the next decade. There was consensus during this first meeting that a reorganisation of the top level scientific objectives will be necessary, but that most of the science questions in the EST Scientific Requirements Document from 2010 are still compelling.

The SAG will closely work together with the EST Project Office and the Technical Advisory Group in order to produce the EST final design.



New ERC Grants in Solar Physics

Dr. Jaime de la Cruz Rodríguez (Institute for Solar Physics, Stockholm University) has been awarded a prestigious ERC's Starting Grant for the project **SUNMAG**: "*Understanding magnetic field regulated heating and explosive events in the solar chromosphere*".

The aim of SUNMAG is to identify the mechanisms that heat the chromosphere and characterize the energy flux that is being released into the outer layers of the Sun in active regions and flares. By investigating how the chromosphere regulates the energy and mass transport we can also contribute to an understanding of the heating of the corona and the acceleration of the solar wind.

Dra. Lena Khomenko from the Canary Islands

Astrophysics Institute (IAC) has also recently been awarded with an ERC's Consolidator Grant. Her project, **PI2FA**: "*Partial*

Ionisation: Two-Fluid Approach" is aimed to make a major breakthrough in our understanding of the magnetised solar chromosphere under a novel frame of a multi-fluid plasma theory.

The results of both projects will open a new window of astrophysical research with important implications for our understanding of the Sun and its magnetic activity.

Sweden and Spain are both members of the EAST promoting the construction of EST. Both research centres are participating actively in the EST preparatory phase through the EC-funded project PRE-EST.



Knowledge for Innovation

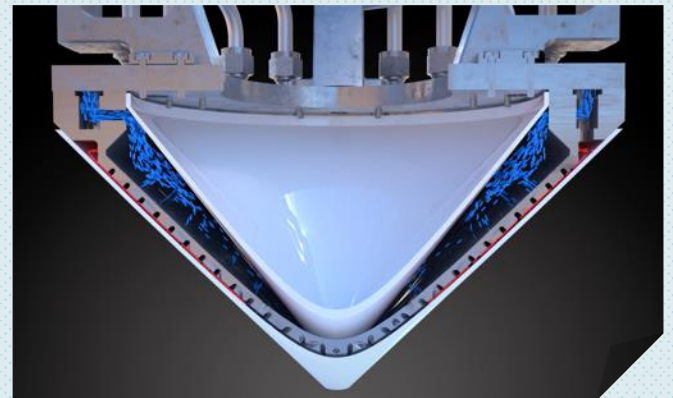
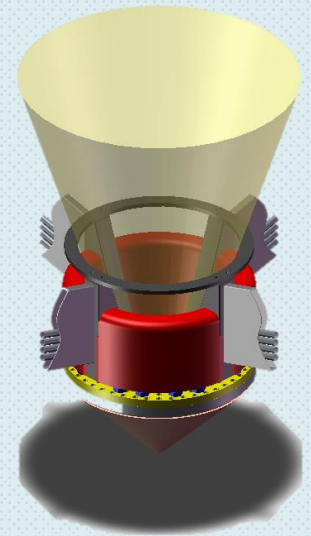


HEAT REJECTER

■ Approximately 13 kW of solar radiation enters through the 4 metre aperture of EST and is concentrated into an image of the solar disk at its primary focus. However, most of this light is not desired since it will heat all subsequent optics leading to a self-inducing seeing. Thus, the heat dissipation at the primary focus is a critical issue. The energy density of the sunlight on this surface will be about 4 MW/m², higher than what is found in a nuclear power plant core. To address this crucial technical challenge, an innovative concept was designed under the framework of the EST Design Study and improved later projects. This combines a very efficient heat transfer system adopted for the inner cooling system, and an external air suction. Those features will keep the component at a safe low temperature and will be able to avoid warm air plumes.

The heat rejecter prototype has been developed in collaboration with S.R.S. Engineering Design (Italy) under the framework of the SOLARNET EU-funded project to test the efficiency of the heat removal system. It implements a "jet impingement" scheme on the rear face of the "First Wall" (i.e. the surface on the prime focus heated by the solar disk image). One interesting additional feature is the possibility of varying the diaphragm diameter by interchanging the external back cone.

This type of component is unique to the solar telescopes for which it has been developed. But potentially the technology has other possible applications in which extremely high thermal heat fluxes need to be controlled, such as solar towers, particle accelerator, laser systems, medical equipment, nuclear fusion reactors, etc. Just talking about medical devices, the impressive capabilities of 21st century medical technology, from imaging equipment to surgical instruments and automated immunoassays, are in many ways a tribute to the advances in microprocessor computing power. However, more computing power means more heat, generally in a smaller space, as in our case at EST. This issue affects all high performance computing facilities, in a world where Big Data and Internet of Things are more and more fundamental, thermal control becomes critical.



HYPERSPECTRAL IMAGING WITH MICROLENSSES

■ One of the ongoing efforts for developing a high-resolution, diffraction limited hyperspectral imager for the EST is the Micro-lensed Hyperspectral Imager prototype (MiHI). The development of this instrument is taking place at the Max-Planck Institute for Solar System research in Göttingen (Germany) and revolves around the use of an array of micro-re-imagers (MLA), that are used to reduce the size of an array of image elements in size, to free up space for a restricted range of high-resolution spectral information.

The combination of a microscopic optical system and a macroscopic spectrograph requires the components of the MLA to be aligned with exceptional accuracy and stability. The manufactured array was executed on a single sheet of SiO₂, and measures 128x128 elements, of which only ≈20 did not meet the < 1 μm alignment requirement between the optical elements on the front and the back side of the sheet. The high spectral resolution of >200000 that was achieved in tests at the Swedish Solar Telescope (SST) indicates that this technique allows us to achieve a spectral resolution that is high enough to measure atomic line profiles in detail.



Front view of the double sided microlens array. The image shows a superposition of all the microlens array elements, viewed at different angles through the array.

EST Newcomers



Antonio Campos de España
GREST Optical Engineer

Antonio Campos de España obtained a degree in Optics and Optometry from Universidad Complutense de Madrid in 2012. After finishing a MSc in Optical and Imaging Technologies in 2014, he started a PhD at the Space Optical Instrumentation Laboratory at INTA.

His research is focused on the study of the dynamics of liquid crystal and their application for space instrumentation. His main topic is the study of the polarimetric and temporal performance. In particular he is working on the development of large format liquid crystal variable retarders that will be employed as polarization modulators in EST.



Sergio Velasco
GREST Optical Engineer

Sergio is a physicist and MSc in astrophysics who joined the IAC in 2013 as telescope operator, in charge of sky characterization instruments, as SHABAR-EST. Later, he was granted with a thesis research as a Resident Astrophysicist at the IAC. During his PhD thesis, he has combined the development of the AOLI (Adaptive Optics Lucky Imager) instrument with the study of low mass stars and sub-stellar companions.

Based on his experience at AO optics and imaging and on assembly, integration and verification duties, he will work at EST designing and developing an atmospheric and telescope simulator together with and AO test bench.



Alba Eva Peláez Santos
GREST Optical Engineer

Alba Eva Peláez obtained a Degree in Physics from Universidad de Oviedo in 2011, and a MSc in Astrophysics from Universidad de La Laguna in 2013. She has been working as a PhD student at the IAC, where she developed several tools for the analysis pipeline of the first instrument of QUIJOTE, a CMB polarization experiment set up at Teide Observatory.

She will be working for the GREST project in the optical design of the EST, updating the transfer optics subsystem for the adaptive optics requirements, and the main telescope subsystem for the thermal and mechanical charge specifications.

EST Project Office

Since the inclusion of the EST in the ESFRI Roadmap and the endorsement of PRE-EST under H2020 Framework the Preparatory Phase of the EST is unstoppable. A key step to consolidate the project has been the decision of the Government Council of the Canary Islands of supporting this phase with €4,5 million.

With such enabling framework, the EST project Office will be installed at La Laguna (Tenerife) within the coming months. The necessary staff to carry out the technical works under the Preparatory Phase will be hired. A team of 20 experts in different related fields will be created. The high expertise needed to accomplish the technical works will be sought from civil engineering, optical mechanics, adaptive optics or administrative, project manager, etc.

The Project Office will be responsible for the consolidation of the conceptual design of all subsystems of EST, the definition of subsystem specifications for preliminary design of telescope mechanics and the preliminary design of telescope mechanics. The Office will be in charge as well of the preparation and supervision of adequate international calls for preliminary designs with industrial participation.

Technical Advisory Group (TAG)

EST partners that have had previous technical responsibilities on the design shall form this Team. The Project Office will work closely with TAG and SGA towards the achievement of its goals.



+ Find last job opportunities at EST website

Outreach & Dissemination

Where is the EST model?

The model of EST, on a scale of 1:50, was moved to the Elder Museum of Science and Technology in Las Palmas de Gran Canaria last September after few days at the “Adaptive Optics for Extremely Large Telescopes” (AO4ELT5) conference in Puerto de la Cruz, Tenerife. Its presentation ceremony was carried out by Manuel Collados, the coordinator of the project, and José Gilberto Moreno, director of the Museum. The event was attended by a large number of regional and national media outlets (see cover photo).

Later, after its exhibition at the Accademia dei Lincei on the occasion of the first European presentation of the project, on Oct 5th 2017 the EST model was moved to INAF Osservatorio Astronomico di Roma in Monte Porzio Catone, about 20 km South of Rome, where it was exposed in the institute’s hall, together with other historical instruments from the rich collection of the institute.

General public and students attending education and outreach activities organized by the institute were informed about the EST model to the science and technological challenges of the project. The most attended activities during the EST model exposition were an open-day devoted to teachers and media on Oct 20th, the Moon night on Oct 28th, and the “Light in Astronomy” week Nov 13th-17th, with hundreds of participants.

The model was exhibited Dec 1st-3rd at the Maker Faire Rome, the European Edition 4.0 of Maker Faire.

It is an event designed to turn the spotlight on hundreds of projects from around the world that are able to catapult visitors into the future. It combines science, science fiction, technology, entertainment and business to create something totally new.

The EST model was part of the stand set up by the University of Rome Tor Vergata. The model and its augmented reality features perfectly fitted the aim of the Maker Faire to catch public attention on science projects using high tech outreach exhibitions. In 2016 Maker Faire Rome had more than 110 thousand visitors. Even more attended this year so we expect the EST project to receive high exposure and to be very well promoted.



#ESTAroundtheWorld

One of the first actions of the Communication Office has been the printing and distribution of two roll-ups explaining the EST project. The first roll-up talks about the main aspects of the project, while the second one focuses on the scientific and technological challenges of such a big project.

These roll-ups were distributed among the PRE-EST partners from June to September 2017. Up to now they have been displayed in a dozen solar physics workshops, conferences and outreach meetings.

This action has allowed the European astronomers to know the most important details of the project which is set to be the cornerstone of the European Solar Physics in a few years. The EST Communication Office has identified a number of events and national meetings where the roll-ups are going to be exposed in the coming months.

To obtain a pdf version of the roll-ups, please visit the EST website.

New artistic design of the EST

In the past months, the EST Communication Office has been working in the new artistic design of the European Solar Telescope. These images use the colours of the EST logo and will be used in the design of some merchandising products that will be distributed in the coming weeks to promote EST within the solar physics community. Which one do you prefer? (see back cover page).



Utazó planetárium - Family Day
Ikrény, Hungary - 14 October, 2017

Outreach & Dissemination

European Researchers Night

On September 29th the European Researchers Night 2017 took place. This big event is simultaneously celebrated across Europe, and tries to building bridges between scientists and citizens. Every year this big science party brings together researchers from the main European laboratories and institutions, to let them explain their latest discoveries to a general public. EST was present this year in Granada (Spain), Ondrejov (Czech Republic) Athens (Greece), Budapest (Hungary), Catania and Rome (Italy) and Tatranská Lomnica (Slovak Republic).



With this initiative EST could be known by a wide audience, ranging from scientists from other fields to people completely outside the science. The Communication Office would like to thank all the PRE-EST colleagues for they support and collaboration in this European Researchers Night. The success of this edition makes that we will try to be present in more cities and countries next year.

Mats Carlsson:

“The study of stellar atmospheres and stellar atmosphere codes are essential for our knowledge of stars”

Mats Carlsson, Director of the centre of excellence "Rosseland Center for Solar Physics" in Oslo (Norway) and current EAST President, organization that promote the next-generation large aperture European Solar Telescope (EST), was recently in Tenerife to attend the XXIX Canary Islands Winter School of Astrophysics, organized by IAC. The IAC team took advantage of this opportunity to interview him about the latest advances in the study of stellar atmospheres, the interest of the Norwegian community in EST or the interest of his observations of the dynamics and magnetic field of the solar atmosphere.

Mats Carlsson uses computer simulations to manage giant amounts of data in order to shed light about this field of study: stellar atmospheres codes.

During this year's Winter School, you will talk about stellar atmosphere codes. What should the public know about this field?

Stellar atmosphere codes” deals with understanding stellar atmospheres through computer simulations. This is extremely important because the “stellar atmosphere” is defined as the region of a star from which light escapes. Most of what we know about stars comes from analysing the radiation they emit – in contrast with Astrophysics we cannot perform experiments so we just have to extract a maximum of information from the light the star emits. The study of stellar atmospheres, and stellar atmosphere codes, is thus essential for our knowledge of stars.



In order to create the codes and software that analyse this information, you have to understand the physics behind this process. What physical phenomena are happening inside the stars? Do we understand them well or do we think we understand them well?

We understand most of the physical processes rather well but the problem is that it is not possible to include all our detailed knowledge about the physics in stellar atmosphere codes – the computers of today are not powerful enough to enable the inclusion of all the physics. We have to be smart and do the right simplifications in order to be able to complete a simulation in a reasonable amount of time. Much of the research is thus about what simplifications we can do.

See the rest of the interview in our [YouTube channel](#) and at the [IAC news website](#).

Outreach & Dissemination



european solar telescope



european solar telescope

Visit our website for more information

www.est-east.eu

Stay tuned...

In the coming months a large number of international events will take place, and many of them will see the presence of members of the EST team. Below we highlight some of these events where anyone can learn more about the status of the project. Do not hesitate to approach us during these events in case you have any question about EST.

EWASS 2018

From 3 to 6 of April 2018, the annual European Week for Astronomy and Space Science (EWASS) will take place for the first time in Liverpool. With more than 25 years of tradition, it has imposed itself as the largest conference for European astronomy. In addition to plenary sessions and the award of prestigious prizes, the conference hosts many symposia held in parallel.

In particular, there will be a symposium entitled "High resolution solar physics, the dawn of a new era", that will provide the opportunity to bring together ground and space-based, observational and modelling communities to foster new collaborations and increase the scientific return from DKIST, EST and Solar Orbiter.

Members of the EST Project Office will attend this meeting representing the project. An EST expositor will be displayed with the model of the telescope, the projection of several short videos, etc. Do not hesitate to visit our exhibition space and know more about us.

EST presentations in international events...

14th European Space Weather Week

Ostend, Belgium. November 27 – December 1

Francesca Zuccarello, Markus Roth, Marian González and others

Maker Fare

Rome, Italy. December 1-3

Francesco Berrilli, Luca Giovanelli

AGU Meeting

New Orleans, USA. December 11-15

Francesca Zuccarello

Solar Winter School

Kodaikanal, India. January 8-13

Robertus Von Fay-Siebenburgen

Dynamic Sun II: Solar Magnetism from Interior to the Corona

Angkor Wat, Cambodia. 12 –16 February 2018

Luis Bellot (IAA)

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