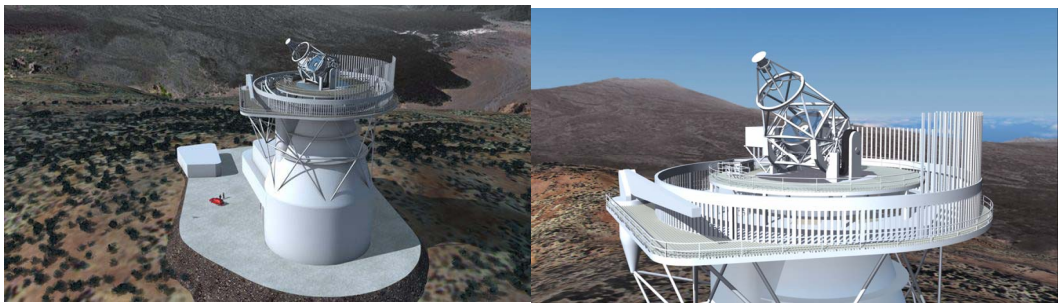
EST: Understanding our Sun

The European Solar Telescope (EST) will be a 4-meter class solar telescope, to be located in the Canary Islands. It will be used to optimise studies of the magnetic coupling between the deep photosphere and upper chromosphere. This will require diagnostics of the thermal, dynamic and magnetic properties of the plasma over many scale heights, by using multiple wavelength imaging, spectroscopy and spectropolarimetry. To achieve these goals, the EST will specialize in high spatial and temporal resolution using instruments that can efficiently produce two-dimensional spectral information.



Understanding physical processes in the Sun is crucial

There is a fundamental link between the Earth and the Sun. The Sun is of paramount importance because it maintains life on Earth. Any change in the conditions of the Sun could have dramatic consequences for us. Large amounts of energy, stored in the magnetic fields, can be transferred to the plasma in very short time scales, within seconds and minutes. These transfers can accelerate the plasma to speeds within a fraction of the speed of light. In the event that this accelerated plasma (in the form of a coronal mass ejection) reaches the Earth's magnetopause, it can give rise to fascinating events (auroras) and phenomena that are potentially dangerous for our environment (damage to satellites, overloading of energy lines, excessive radiation exposure for space crews or the International Space Station, etc.). This means that it is essential for us to study all of these processes in order to be in a position of predicting them.

The Sun produces its energy by nuclear fusion. Humans have worked for decades to reproduce this process (in a controlled manner) here on Earth. It is a basic physics laboratory since the interaction between the hot plasmas and the strong magnetic fields can only be studied in the Sun's extreme physical conditions. To unveil these interaction mechanisms is a top priority for understanding our Sun.

The Sun is a fundamental model for understanding the rest of the Universe (all stars are suns). The EST will look at the fundamental solar processes at their tiniest scales, allowing us to analyse physical phenomena in the greatest possible detail.

Designing a new generation Solar Telescope

The project main objective has been the development of a conceptual design study of a large aperture Solar Telescope; this study has demonstrated the scientific and technical feasibility of the EST. Financial aspects have been also analysed in detail, assuming different possible scenarios. The design study has been made possible thanks to the combined efforts of all the participant institutions and the decisive support from the EC. From the scientific point of view, the design has been driven by the requirement that the telescope must allow the users to observe simultaneously the solar photosphere and chromosphere by means of high-spatial resolution spectropolarimetry in

the visible and near-infrared, so that the EST will be used to optimise studies of the magnetic coupling between the deep photosphere and upper chromosphere. The feasibility concerning key aspects needed for the conceptual design of the whole telescope, such as opto-mechanical design, cooling mechanisms, adaptive optics, instrumentation and control system, has been demonstrated. Besides, the financial feasibility of the project has been analysed in depth, as well as the potential socio-economic impact that would arise from the construction and operation of the EST.

Different existing alternatives have been examined for all telescope systems and subsystems, and decisions have been taken on those ones that are most compatible with the scientific goals and the technical strategies. The selected baseline design for each subsystem has been developed, providing the whole Telescope conceptual design. The final construction plan and budget have also been raised (preliminary and detailed design which will be required to carry out the construction, assembly and commissioning stages).

Keeping Europe in the frontier of Solar Physics

European solar physicists unanimously share the view that a large aperture new generation solar telescope is needed to further understand the fundamental processes of plasma physics in the Sun's upper layers. The report "A Science Vision for European Astronomy, 2007" for the European ASTRONET network, underlines this by advocating, as part of the range of medium size infrastructure, the construction of a ground-based large aperture 3 to 5 metre solar telescope equipped with adaptive optics and integral field spectropolarimeters for observing astrophysical processes at their intrinsic scale. This would allow interaction between magnetic fields and plasma in the solar atmosphere to be observed. In recent years several European research institutes have achieved a high level of competence in designing, building and operating advanced scientific instruments and this has given them a high profile in the area of ground-based observation technology. The combined experience of these institutions, together with the advanced capability of European industries in the sector, certainly make possible the design and construction of a solar telescope like the one proposed.

It would also enhance the strengths and capacity of the organisations involved. This framework for European collaboration, with research centres and industries working together, has already been applied in the EST conceptual design phase. The level of co-operation between the partners in EAST is such that it has already been agreed to focus resources from the countries involved on operating this new jointly developed telescope and, over time, to close and dismantle almost all of the existing solar physics facilities. As the EST can operate using various instruments simultaneously, it will be possible for many more groups than is usual at a solar telescope to use it during observation campaigns, thus optimising observing time, data and the scientific results obtained.

Who is involved?

The EST is a pan-European project involving 29 partners plus 9 collaborating institutions, from 15 European countries: Austria, Croatia, Czech Republic, France, Germany, Hungary, Italy, the Netherlands, Norway, Poland, Slovak Republic, Spain, Sweden, Switzerland, and United Kingdom. The EST is promoted by the European Association for Solar Telescopes (EAST); a consortium with the aim, among others, of undertaking the development of this new Telescope, to keep Europe in the frontier of Solar Physics. In addition, the Solar Physics community is already executing the SOLARNET European project, which brings together and integrates the major European research infrastructures in the field of high-resolution solar physics in order to promote their coordinated use and development. The project achievements will be of paramount relevance to contribute towards the realisation of the EST.

How much money has the EU invested in this?

The EST Conceptual Design Study cost nearly € 7 million, out of which € 3.2 million were funded by the EC for a period of 42 months (2008- 2011).

For more information visit: http://www.est-east.eu