A project included in the ESFRI Roadmap

EST - EUROPEAN SOLAR TELESCOPE

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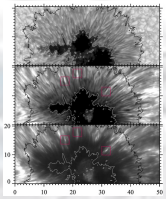
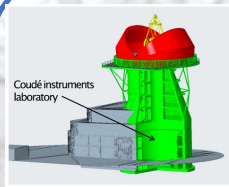


Summary of EST future capabilities

Telescope	On axis Gregorian telescope
Aperture	4.2 m with a central obscuration of 1.1 m
Secondary mirror	ASM with 5 degrees of freedom (piston, δx, δy, and tip-tilt)
Mount	Altitude-azimuth mount
FOV	125″ diameter
AO	MCAO
Spatial resolution	Diffraction limited at 0.025″ at 500 nm
Polarimetric accuracy	5×10^{-4} of I_c
Spectral range	380-2300 nm
Observations	Multi-wavelength simultaneous observations
Coudé lab	Non-rotating platform
Instruments	1. Integral Field Spectropolarimeters, 2. Tunable Imaging Spectropolarimeters, 3. Fixed Band Imagers
Polarimeters	Polarimeter(s) in the blue, visible, red and near-infrared
Lifetime	At least two Hale solar cycles, i.e. 44 years



Left: Telescope structure (yellow), the pier (green) and the enclosure (red) of the EST.

Below: EST site at Roque de Los Muchachos Observatory (La Palma, Spain), approved by the International Scientific Committee of the Canarian Observatories

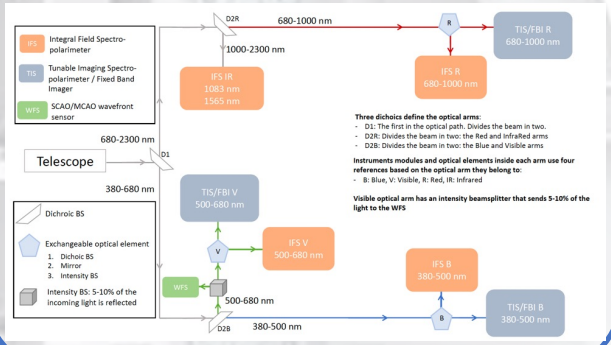
EST Science

The European Solar Telescope is an initiative to construct and operate a ground-based large-aperture (4-metre class) solar telescope for the visible and near-infrared. The project is promoted by the European Association for Solar Telescopes (EAST), which gathers research institutions from 18 European countries.

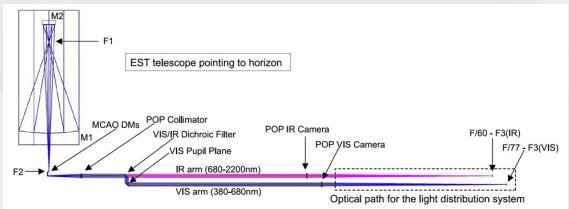
The top-level science questions that drive EST can be summarised as:

– How does the magnetic field emerge to the surface and evolve?
– How is the energy transported from the photosphere to the chromosphere?
– How is the energy released and deposited in the upper atmosphere? Why does the Sun have a hot chromosphere?
– Wave propagation from the photosphere to the chromosphere
– Dynamics of large-scale magnetic structures

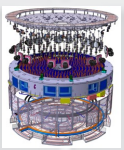
Light distribution and instrument suite inside the Coudé room of EST.

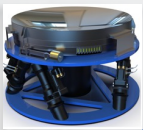


EST Optical Design



Optical layout of EST. The telescope delivers the focal plane F3 to the instruments after passing the MCAO set of deformable mirrors and the Pier Optical Path (POP) system.





Left: Preliminary design of the primary mirror assembly (by SENER-aerospace). Right: Concept of the ASM (by TNO).

Summary of the Tunable Imaging Spectropolarimeter general requirements

Spatial resolution	Diffraction limit in each optical arm
FOV	60″ × 60″
Cycle time	A measurement cycle per spectral line of 20 s (goal: 10 s)
Spectral resolution	Minimum of 50000
Wavelength samples	10 per line including a nearby continuum point
Number of filters per module	At least 5
Reference spectral lines	1. Blue: Ca II 396 nm, Ba II 455 nm, Sr I 461 nm, H_β 486 nm 2. Visible: Mg I 517 nm, Na I 589 nm, Fe I 630 nm, H_α 656 nm 3. Red: Fe I 709 nm, K I 770 nm, Ca II 854 nm
Broadband reference camera	Each module has 2 reference broadband cameras to perform image reconstruction techniques
Operation modes	1. Narrowband spectropolarimeter 2. Broadband context imager
Polarimetry	Dual-beam to reduce the seeing-induced crosstalk

EST Timeline, People and Funds

- Project started in: 2008 – First light planned for 2028 - 2029
- ~ 620 European researchers; ~ 40 Italian researchers; 3 Italian SME involved in FP7 and H2020 related projects
- Opportunity for in-house R&D and technologic transfer (MCAO, optomechanic design, big data, data mining, instrument control,…)
- Total EC Funds : 26.2 M€; EC funds to Italy:: 3.28 M€

C. Quintero Noda et al. 2022, submitted to A&A

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