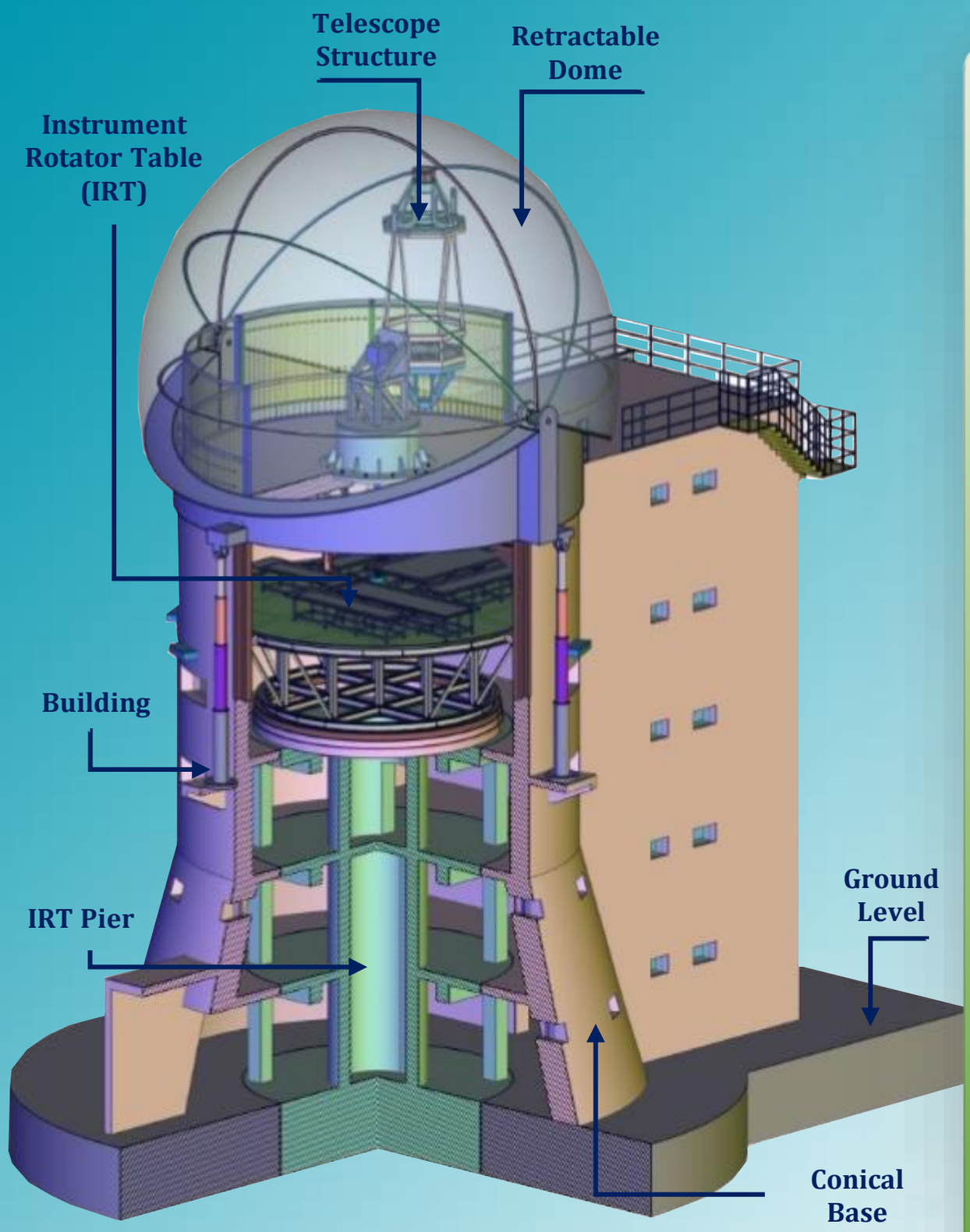
The National Large Solar Telescope

The 2 meter National Large Solar Telescope of India will be the world's most powerful solar telescope on Indian soil. It will address critical problems in astrophysics, Sun's important influence on Earth and understanding the release of solar energy into the solar system.

Background



Overall tower design with retractable dome

- The National Large Solar Telescope (NLST), to be located in J&K at an elevation above 4300 meters, to profit from the site's outstanding atmospheric conditions, with an aperture of 2 meters will be the world's largest and most powerful telescope to study the Sun.

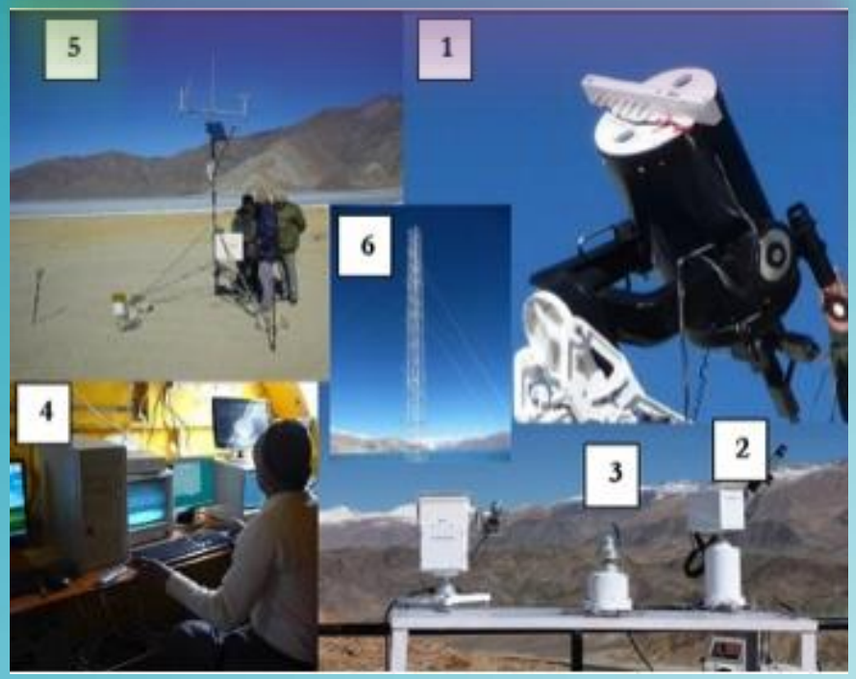
- NLST is based upon proven technologies enabling it to become operational in less than five years. It will be built with international partners, providing access to the state-of-the-art technologies, while important and substantial components will be achieved within India.

- NLST will provide the best images of the Sun to study the ever changing magnetized surface, enabling them to tackle fundamental astrophysical questions towards a predictive capability of Sun's impact on the Earth, and assuring Indian international preeminence in space sciences.

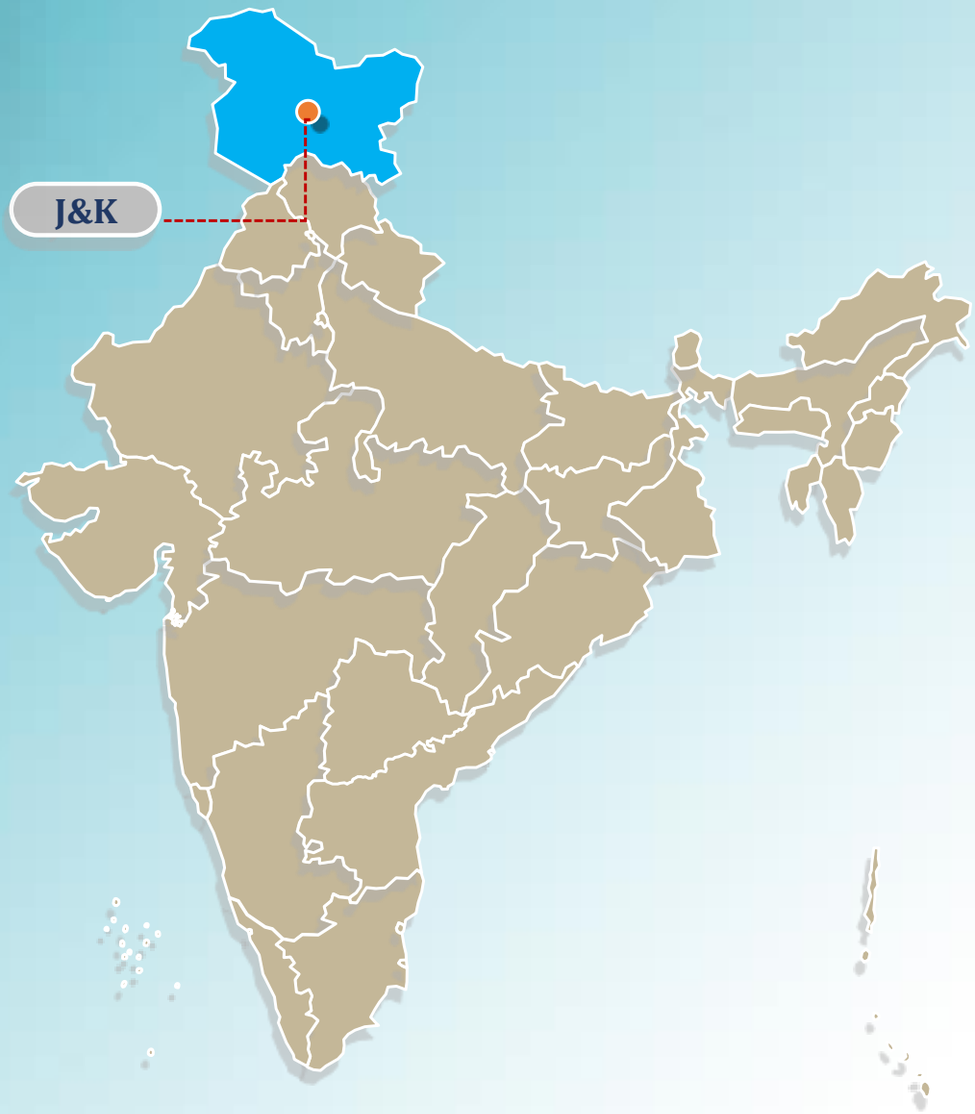
Site

An extended survey of several potential sites has been carried out with internationally accepted techniques and instrumentation. Merak on the shore of Pangong Tso, has been identified as the world class site.

This is to take advantage of the well-known terrestrial atmospheric stabilizing effect of a large body of water



Collage of instruments used in site survey at Merak; clock wise from top right: (1) Solar Differential Image Motion Monitor (SDIMM) and SHAdow BAnd Ranger (SHABAR), (2) sky radiometer, (3) All sky camera, (4) Data acquisition facility , (5) Automatic Weather Station (AWS), and (6) micro thermal tower

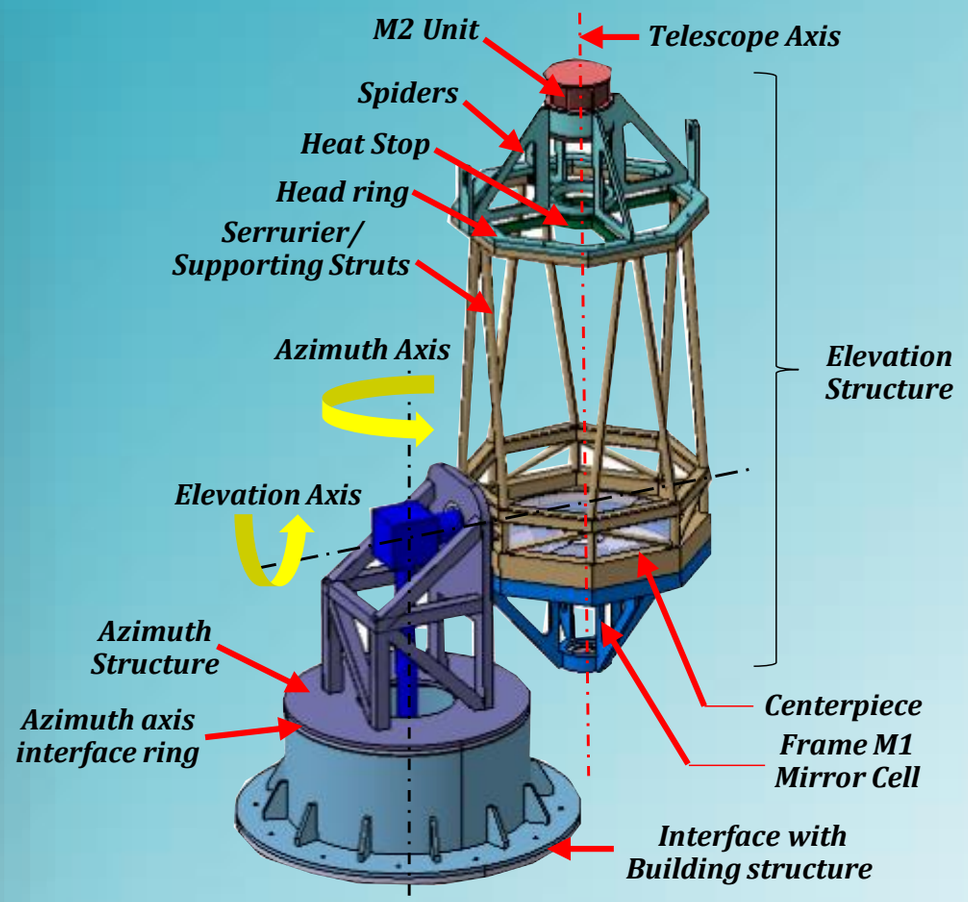


Design and Instruments

In order to achieve the required measurements of the solar magnetic fields with high accuracy and sensitivity, a large aperture (2 meter) telescope is necessary to provide the requisite high spatial resolution and light collecting on the relevant timescales.

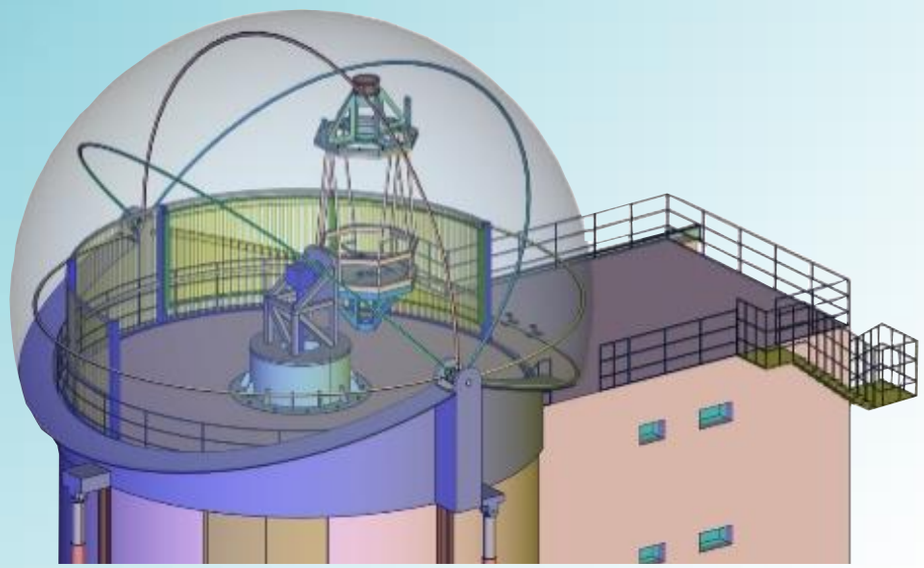
To control atmospheric and thermal perturbations of the observations an innovative, completely open structure (12m) will allow the telescope to achieve its full potential atop a 20 meter tower.

A suite of instruments, located in a controlled, stable environment immediately below the telescope, will analyze the light from the telescope using advanced and well-tested techniques



Schematic structural design of National Large Solar Telescope.

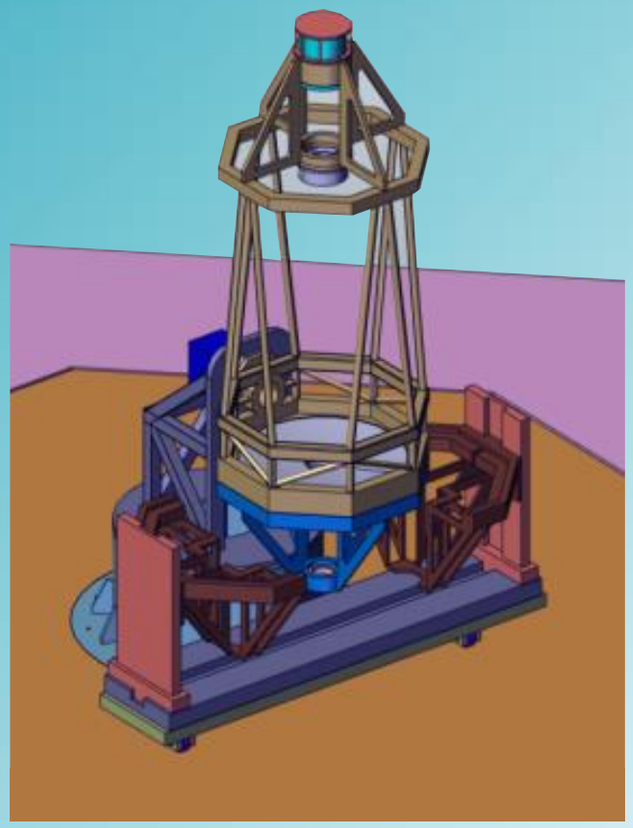
Wind Shield



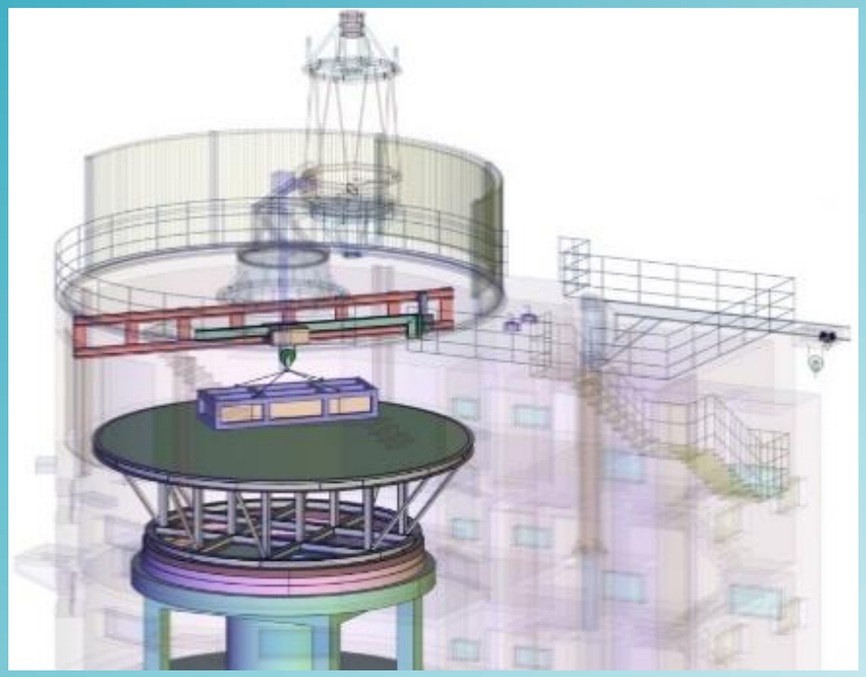
Retractable Dome

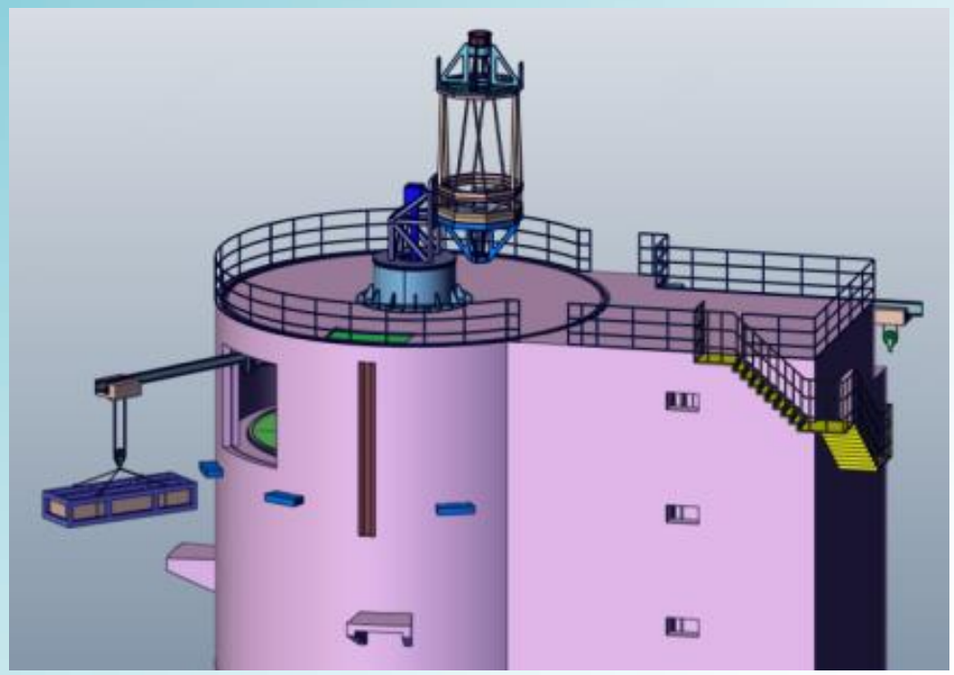
Design and Instruments

Concept for Handling of Secondary Mirror.



Concept for Handling of Primary Mirror.

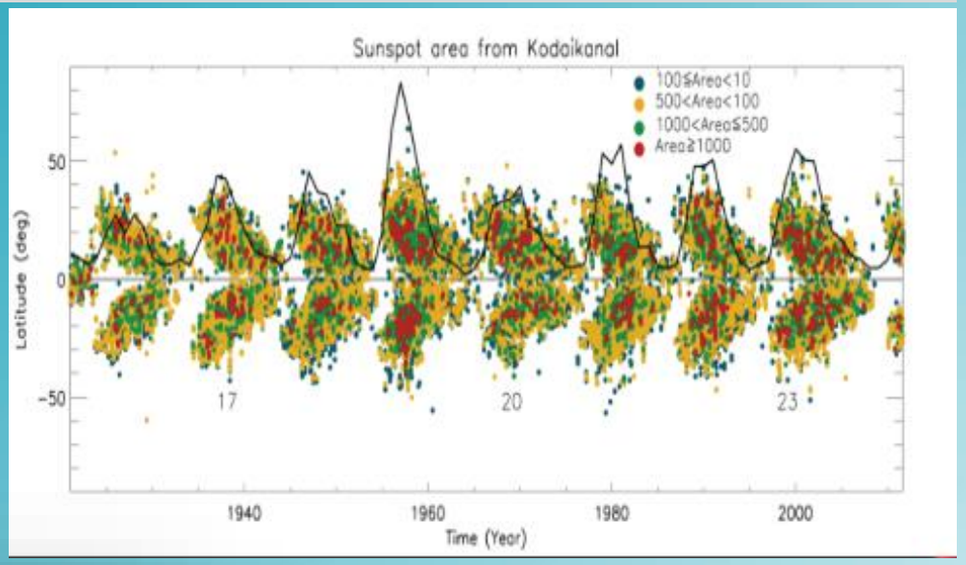




IRT Lab Instruments Handling Concept.

MAGNETIC FIELD GENERATION AND THE SOLAR CYCLE

The mechanisms responsible for magnetic field generation and 11 year solar cycle are still not fully understood. Butterfly diagram (Right panel) depicting the sunspot distribution with latitude). The area size distribution is also shown. Kodaikanal Observatory is observing the Sun since 1904 to till date. This century long observation has been carried out in White Light (since 1904), Ca K (1904-2007) and in Hα (1912-1999). This figure has been generated from the white light digitized data.

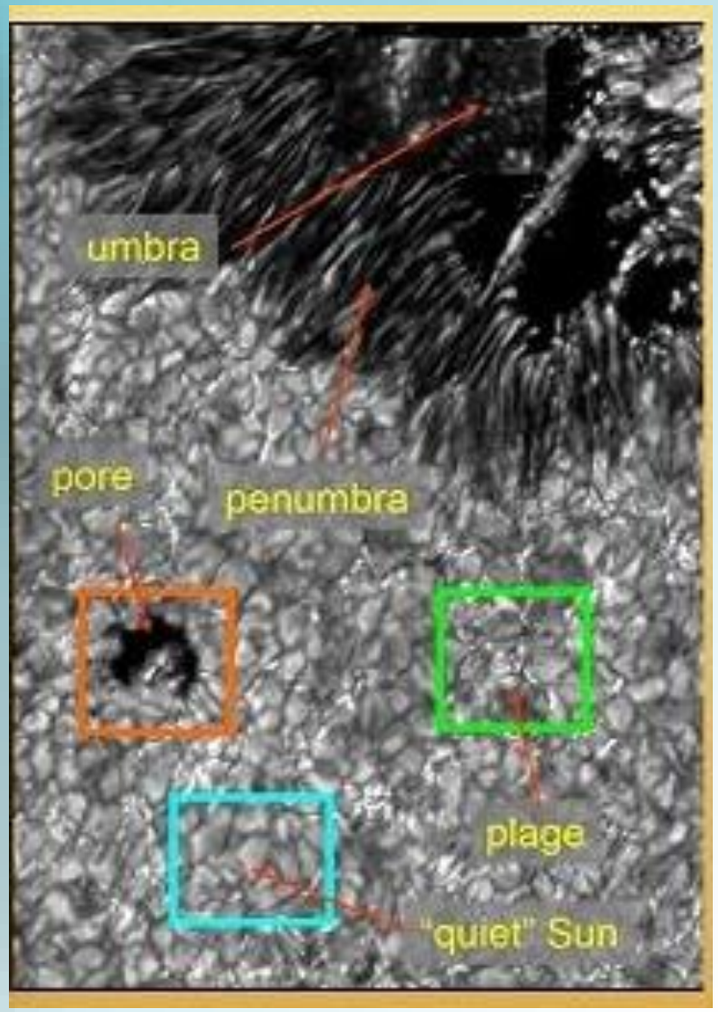


INTERNATIONAL CONTEXT

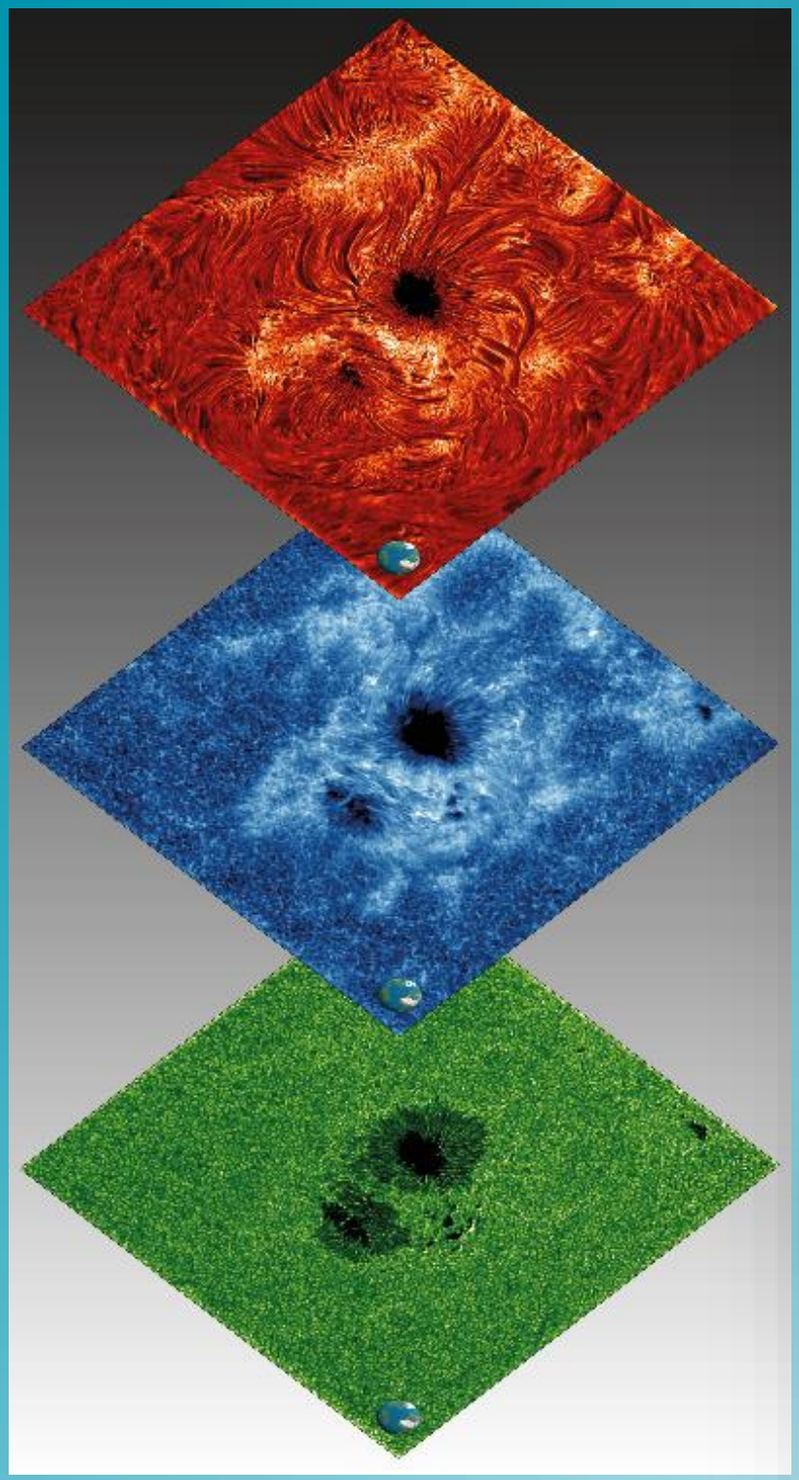
The heating of the solar atmosphere is intimately related to the dynamical processes occurring in the magnetic network.

DYNAMICS OF THE MAGNETIZED CHROMOSHPERE

Magnetic structures in the solar atmosphere involve characteristic spatial scales that are too small to be fully resolved with the current solar facilities. The magnetic filed plays a crucial role in controlling the dynamics, so the connection of magnetic field between the photosphere-chromosphere-transition region and corona is most essential and this will be possible with simultaneous measurements of magnetic fields with NLST and Aditya. Aditya is India's first dedicated space scientific mission to study the sun. “Aditya-L1 mission” will be inserted in a halo orbit around the L1, which is 1.5 million km from the Earth.



Fine structure of a sunspot and pore region.



Images of different layers of the Sun's tenuous atmosphere, allows to piece the jigsaw puzzle together and provide understanding on how magnetic fields permeate the dynamic atmosphere.

SUN & INTERPLANETARY MAGNETIC FIELD

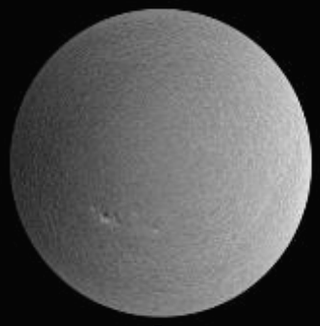
The visible surface of the Sun, where the energy generated by fusion of Hydrogen into Helium at the center of the Sun escapes into space, is also the transition from the matter-dominated interior to the magnetic dominated outer atmosphere and interplanetary space. The interplay between models and observations has highlighted the critical importance of high spatial and temporal resolution observations of the Sun's magnetic field, velocity field and thermodynamic state with high precision and sensitivity in order to understand the creation, evolution and explosive dissipation of the magnetic field responsible for the complex structures of the Sun's atmosphere and interplanetary space.

INTERNATIONAL CONTEXT

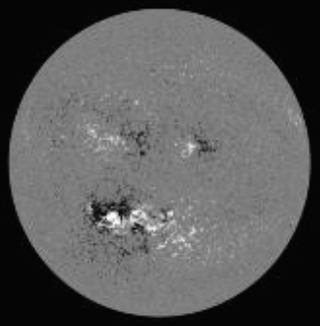
NLST will build upon the experience gained in the development and construction of smaller facilities. It will take a major step forward working in very close technological and scientific collaboration with those projects. The NLST will achieve a significant improvement in spatial resolution and more importantly, a much higher quantity of light delivered to the instruments.

DEMOGRAPHICS AND SOCIETAL BENEFITS

The world's largest and the highest performing solar telescope, as an open national facility will attract and develop a diverse scientific and technical workforce, as well as constituting a powerful magnet for talent from around the world, In addition to the technical challenges, this workforce will be energized by not only the intrinsic, astrophysical interest that the Sun presents, by also that it is arguably the one astronomical body exercising a determining influence upon humanity. The telescope project will usher in significant new economic developments in the Ladakh region and offer direct and indirect employment opportunities for the local population.

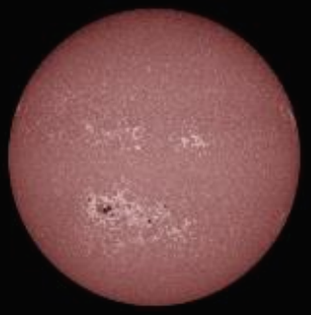


Dopplergram



Magnetogram

Continuum



Ca K

An artists impression of the Sun-Earth connection.

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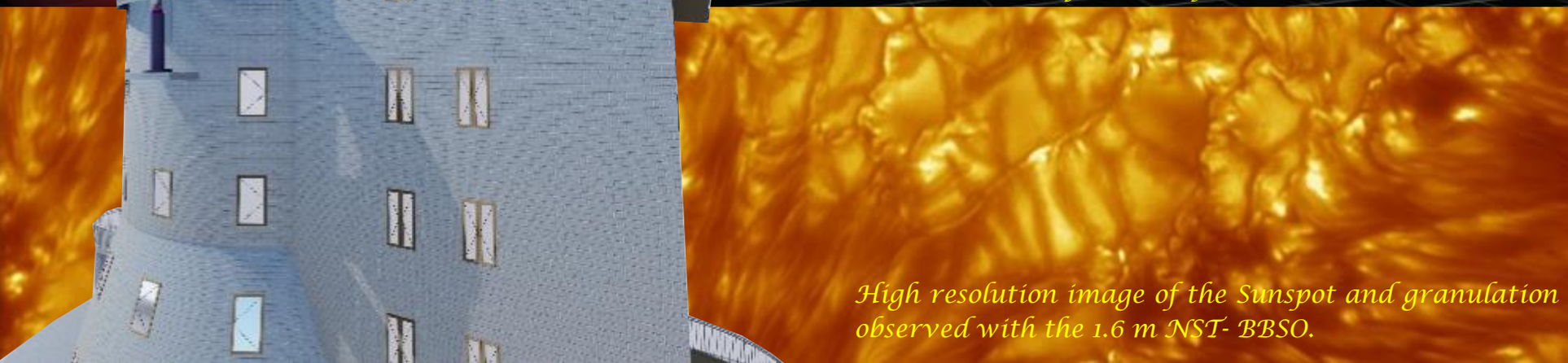

High resolution image of the Sunspot and granulation observed with the 1.6 m NST- BBSO.