Update on MAST and back-end instruments

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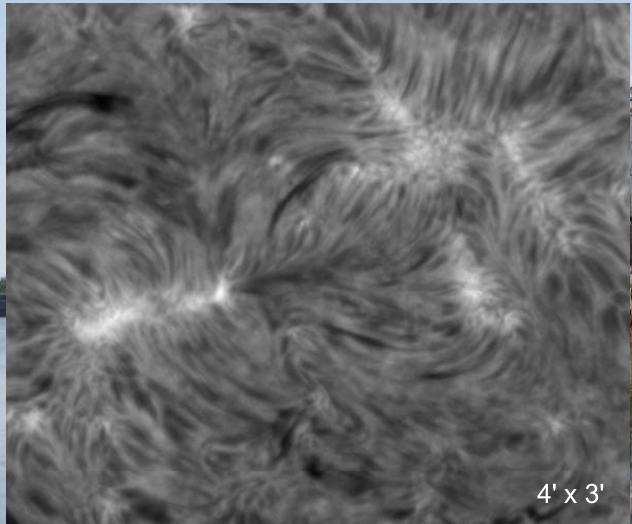
MAST is a 50 cm, a multi-application, off-axis solar telescope, which is getting ready for installation at the Udaipur Solar Observatory

Location : Rajasthan, India, Latitude : 24°, Longitude : 73°, Average seeing : 3 – 4 arc-sec, (r_0 : 5 – 4 cm), Best seeing : 2 arc-sec

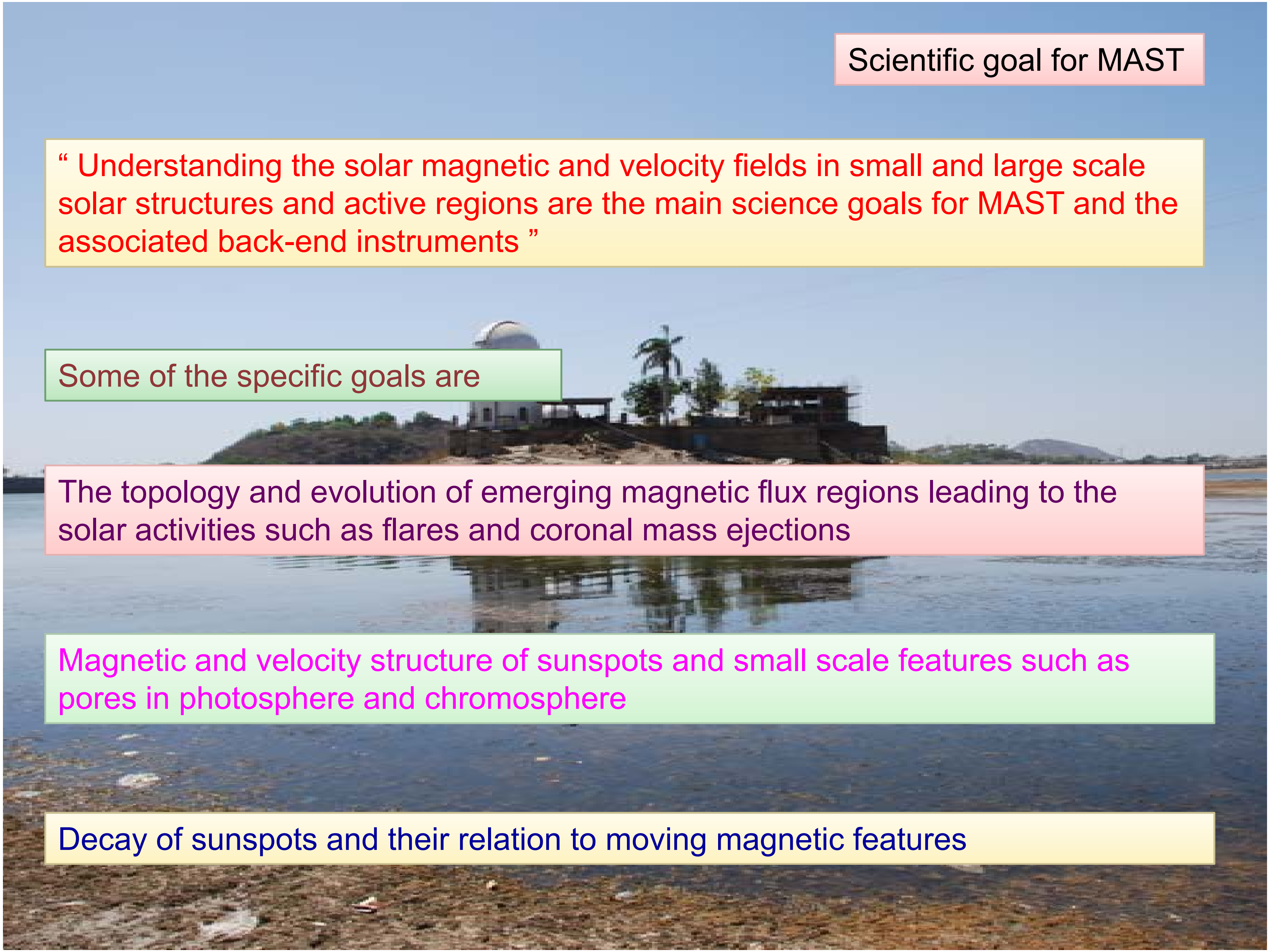
Present capabilities



Full disk & High resolution H-alpha observation → (X)

Solar Vector Magnetogrpah (SVM) → [Waiting for new shelter]

Recently installed a new telescope for full disk G-band and H-alpha Doppler, observations



Scientific goal for MAST

" Understanding the solar magnetic and velocity fields in small and large scale solar structures and active regions are the main science goals for MAST and the associated back-end instruments "

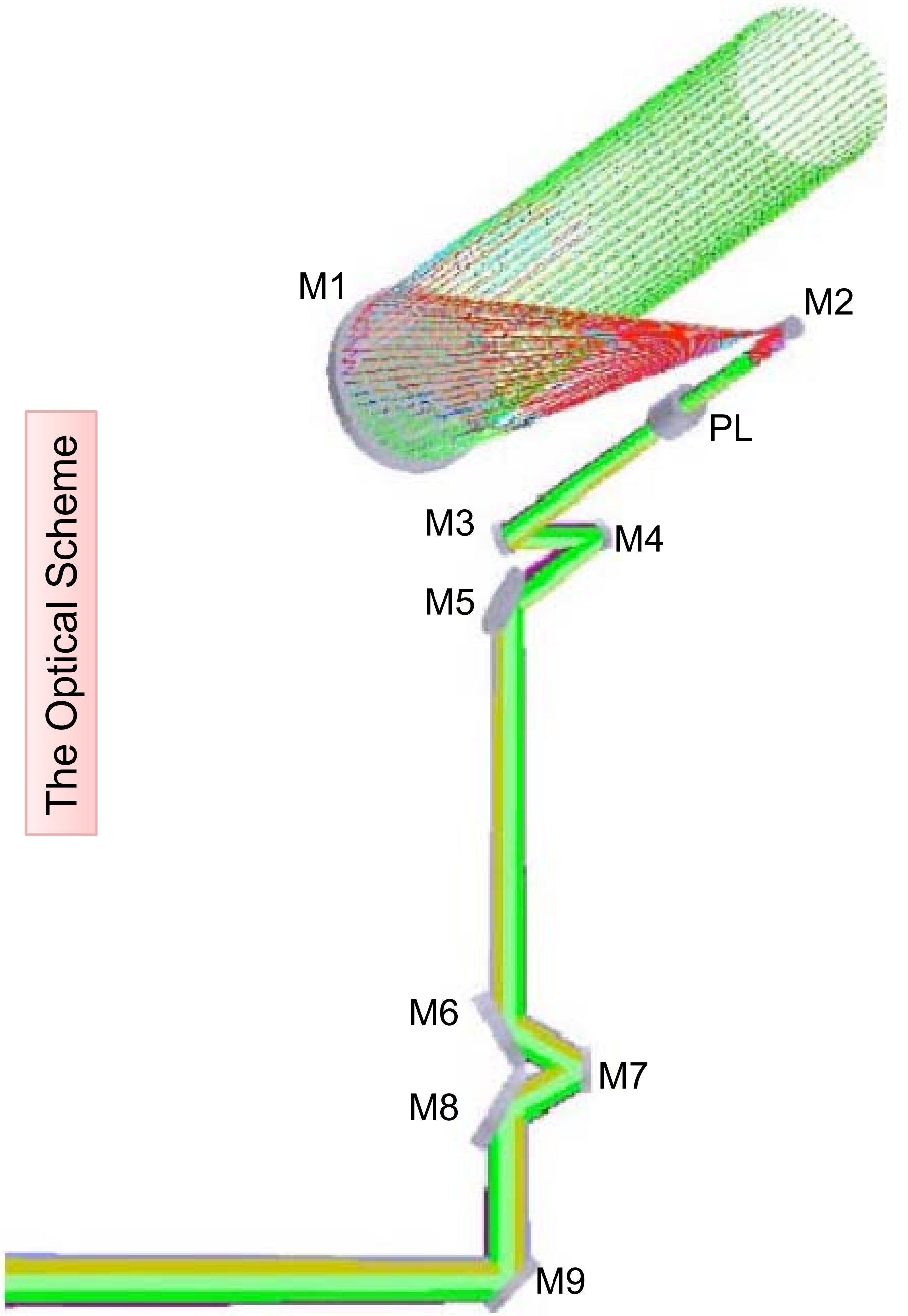
Some of the specific goals are

- The topology and evolution of emerging magnetic flux regions leading to the solar activities such as flares and coronal mass ejections

- Magnetic and velocity structure of sunspots and small scale features such as pores in photosphere and chromosphere

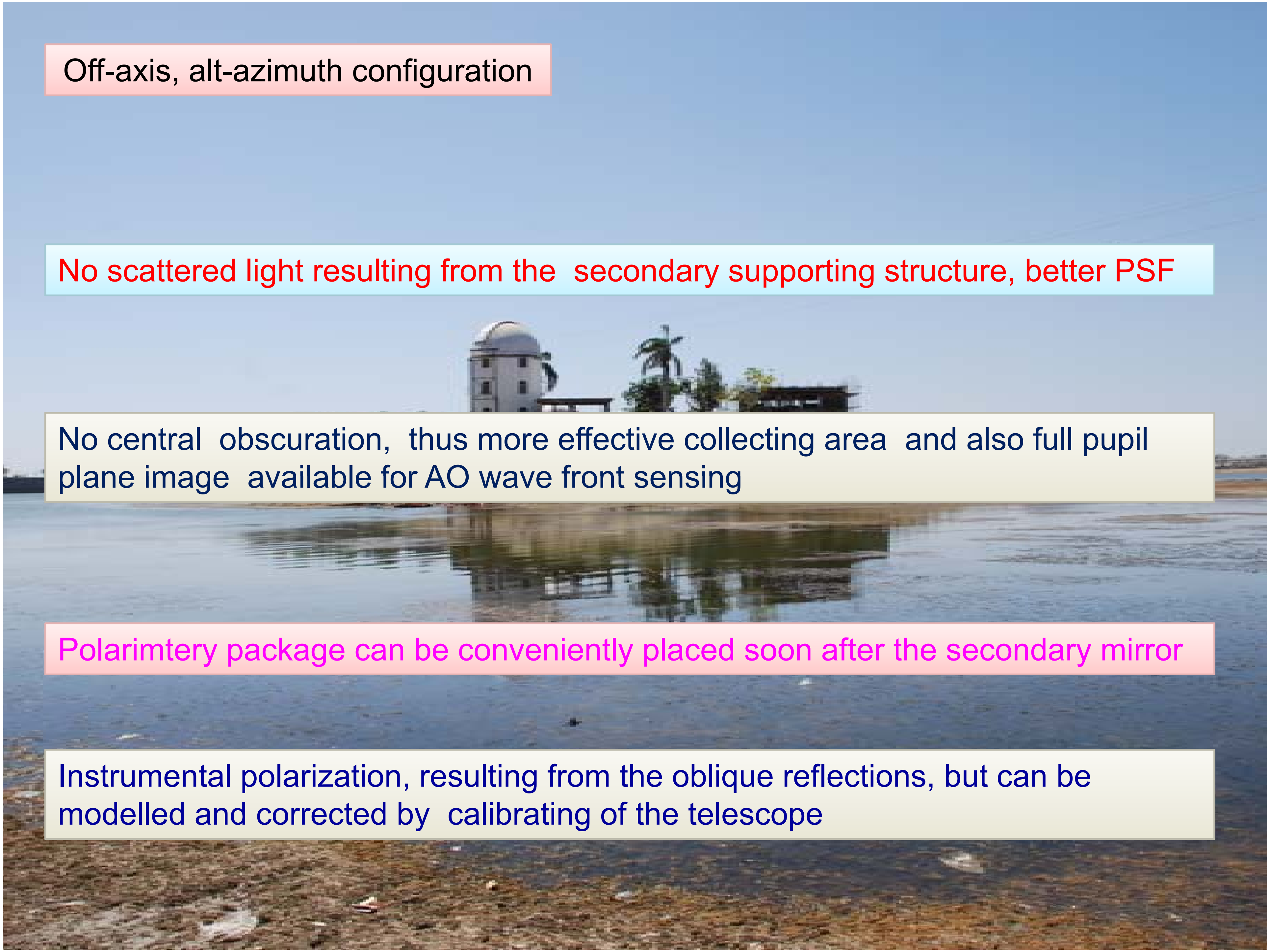
- Decay of sunspots and their relation to moving magnetic features

The Optical Scheme



- Aperture : 50 cm
- F # : 4
- Configuration : Off-axis Gregorian
- Mount : Alt-azimuth
- Primary mirror : Zerodur
- Secondary and folding mirrors : SiC

Source : AMOS, Belgium



Off-axis, alt-azimuth configuration

No scattered light resulting from the secondary supporting structure, better PSF

No central obscuration, thus more effective collecting area and also full pupil plane image available for AO wave front sensing

Polarimtery package can be conveniently placed soon after the secondary mirror

Instrumental polarization, resulting from the oblique reflections, but can be modelled and corrected by calibrating of the telescope

Mechanical design: Highlights

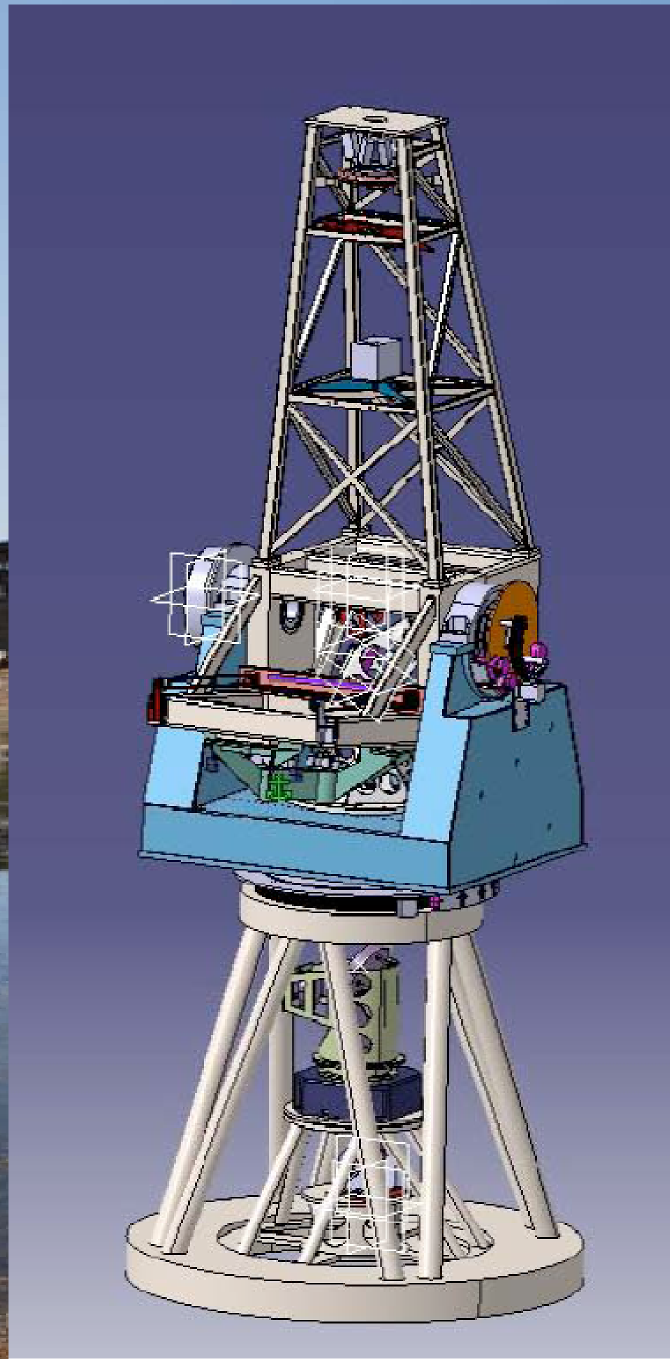
Mount : Alt-azimuth

A stiff central structure connecting the two altitude shafts

M2 is mounted on a hexapode with correction capabilities for tilt, decentring, and translation

Closed loop tracking : 0.1 arc-sec for 1 Hr

Differential pointing accuracy: 0.5 arc-sec



Thermal considerations

The thermal design of the telescope is aimed at;

controlling the solar flux falling on the opto-mechanical components to avoid any differential expansion of the support structures

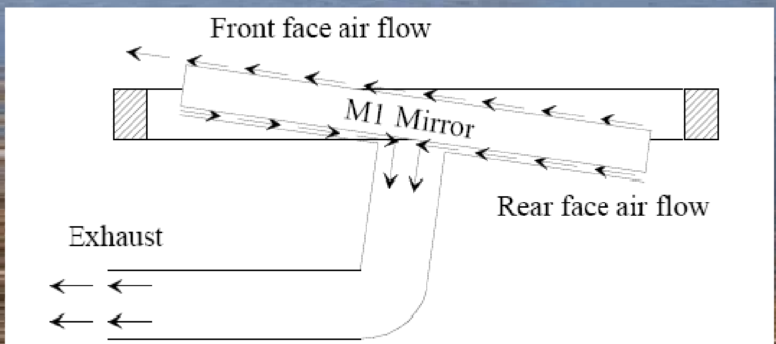
controlling the temperature of the equipment so that the difference between the ambient temperature is minimum in order to limit seeing degradation

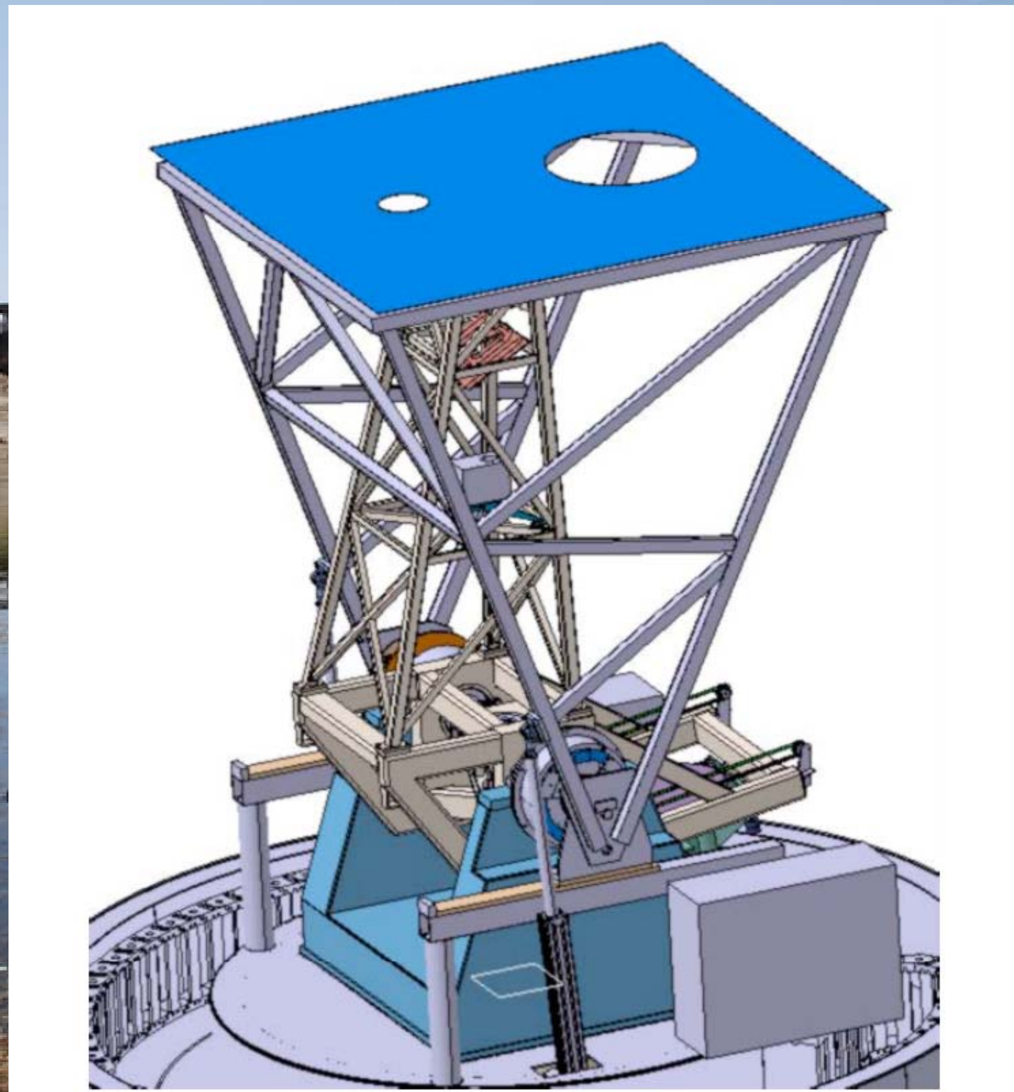
This is achieved by heating and cooling of the main telescope elements.
Thermal design and control is difficult because of large variations of operating temperature and fast temperature variation

The tubes and the fork, are shaded from the sun illumination by an upper sunshield system.

The M1 mirror is thermally controlled by mean of 2 airflows with controlled Temperature

The primary mirror surface will be kept at within ±1ºC ambient





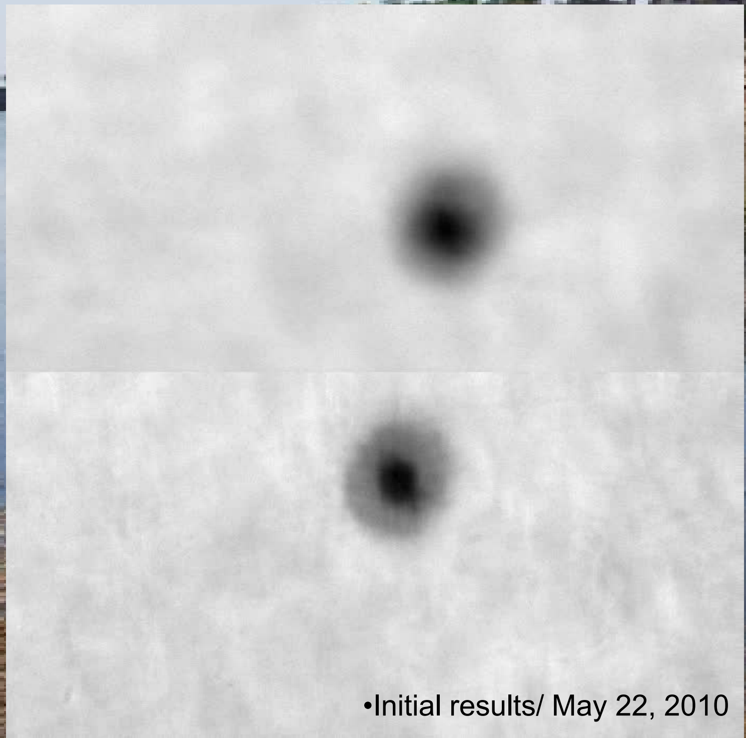
Photographs taken on May 22, 2010, at AMOS in Belgium

Back-end instruments : Adaptive Optics System

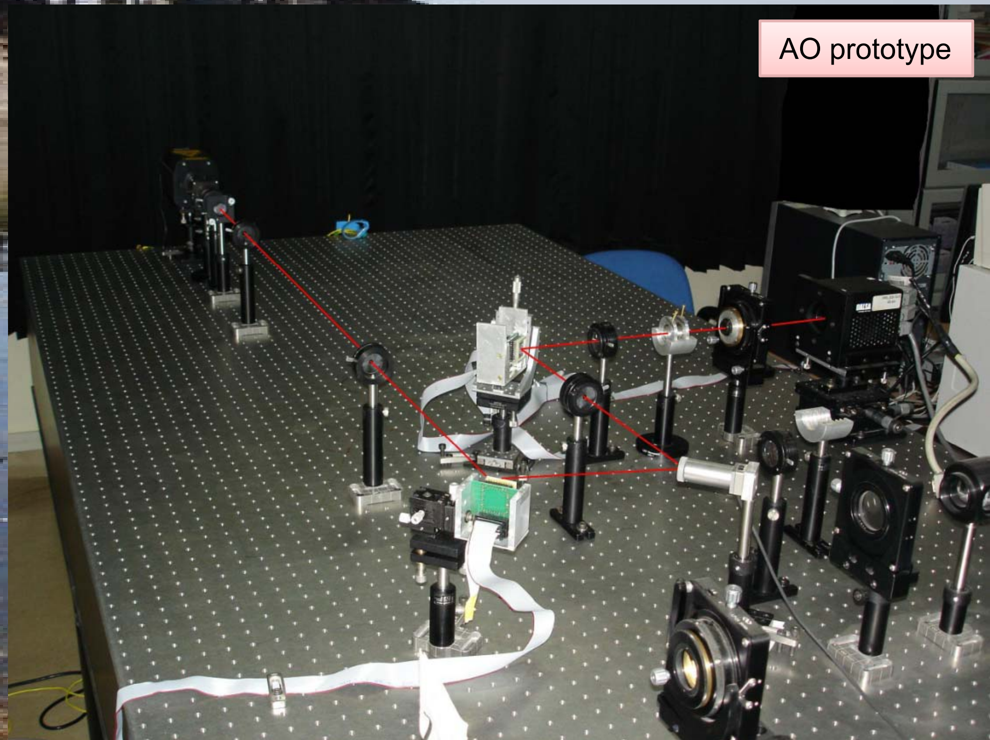
Tip-tilt (piezo) mirror for the first order correction

Deformable membrane mirror with 39 actuators for the higher order corrections

Prototype is under development, first results with the AO system are being analysed

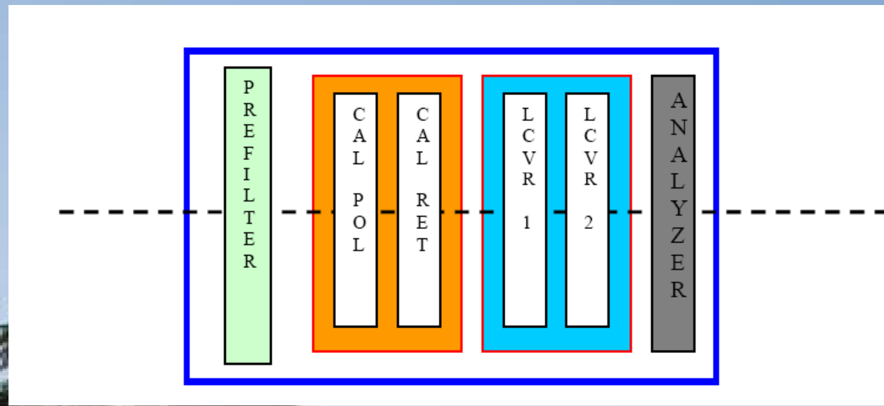


•Initial results/ May 22, 2010



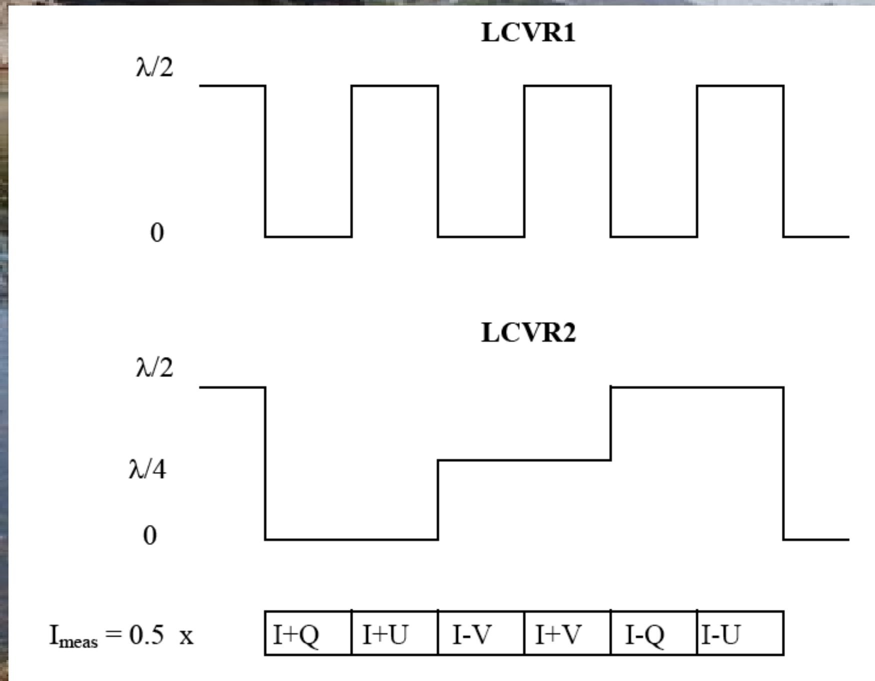
Back-end instruments : Tunable LIquid crystal Polarimeter (TULIP)

Two Liquid Crystal Variable Retarders (LCVRs) from Meadowlark Inc. as modulators



Initially single beam, a linear polarizer as the analyzer

Option to place the polarimeter just after the secondary



Calibration unit consist of a linear polarizer and zero order λ/4 plate installed on rotating stages

Modulation scheme as described in Collados, 2002, SPIE paper

Back-end instruments : Narrow band imager – I for MAST

Based on two tunable narrow-band Fabry-Perot etalons in tandem

Initially for two spectral lines, FeI 6173 Ǻ and Ca II 8542 Ǻ

Lithium niobate etalons with FWHM of 54 mǺ and 104 mǺ

3 Ǻ blocking filters to suppress the side band from the etalon

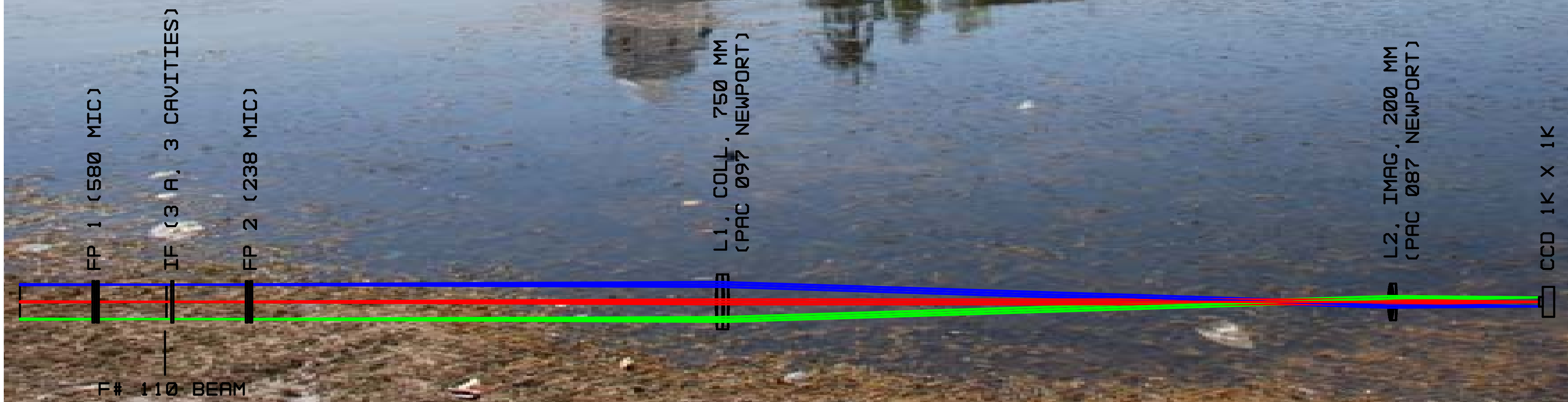
Combined spectral resolution of 114, 000 at 6173 Ǻ

The Lithium niobate etalons are of thickness 580 microns and 238 microns

A filter wheel having two interference blocking filters placed between the FPs as blocking filters

F #110 beam at the FP and provides a plate scale of around 0.175 arc-sec/pixel

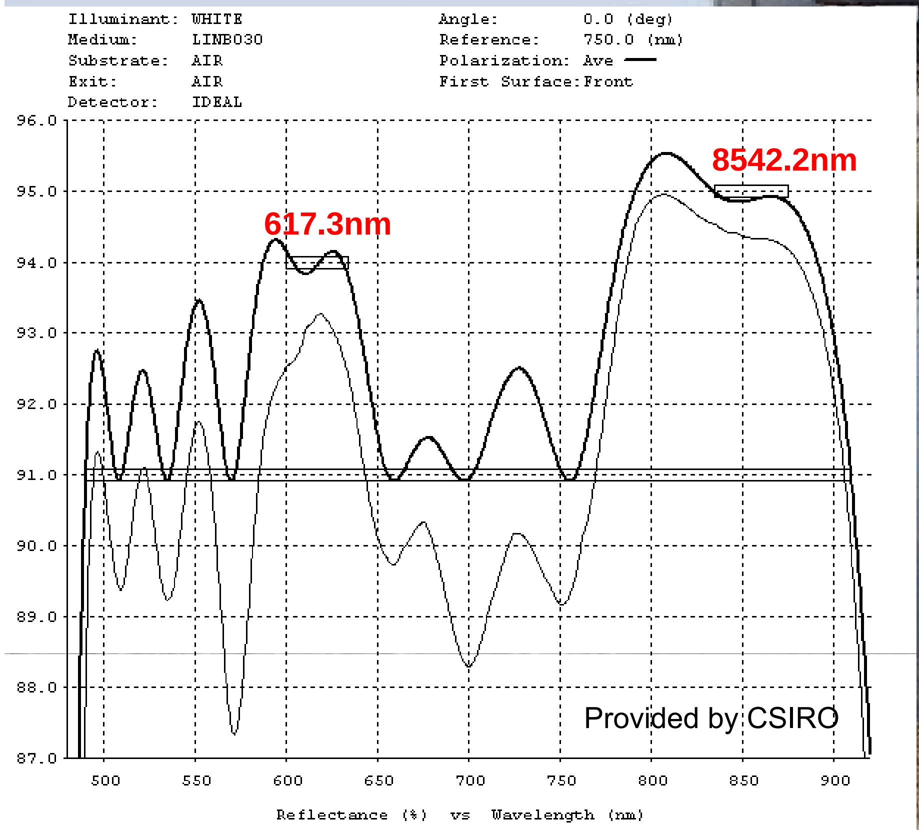
Acton PhotonMax 1024 x 1024, EMCCD for faster exposures

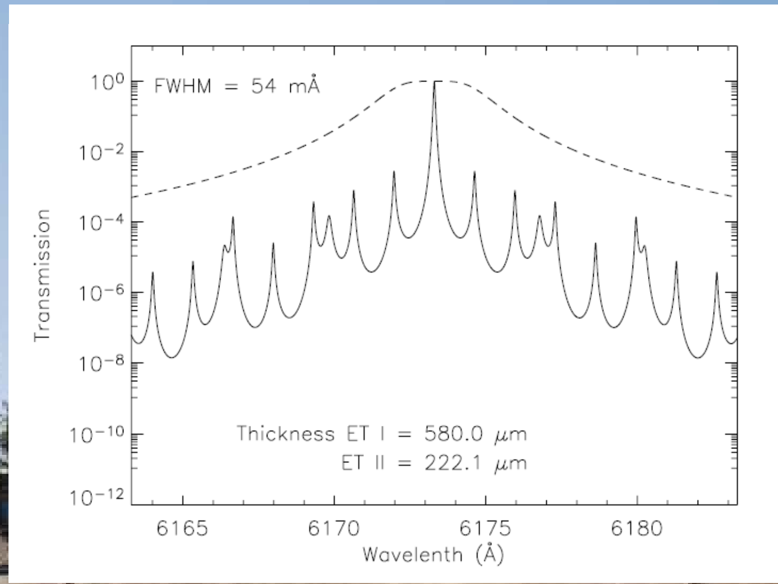


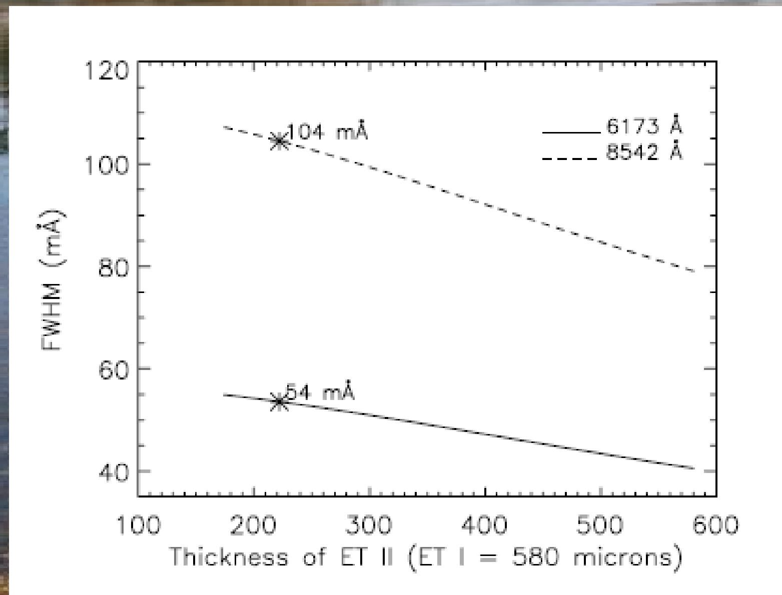
FP Characteristics

Resultant computed transmission of the narrow-band imager

Reflectivity curve

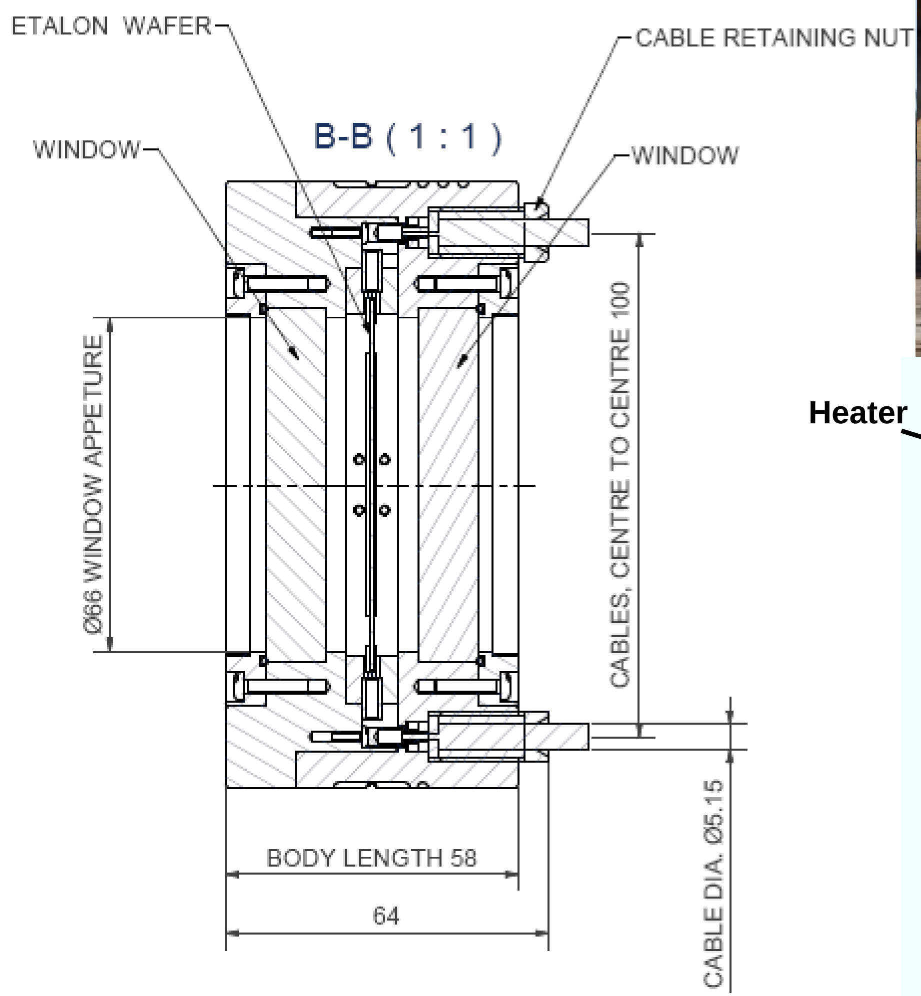


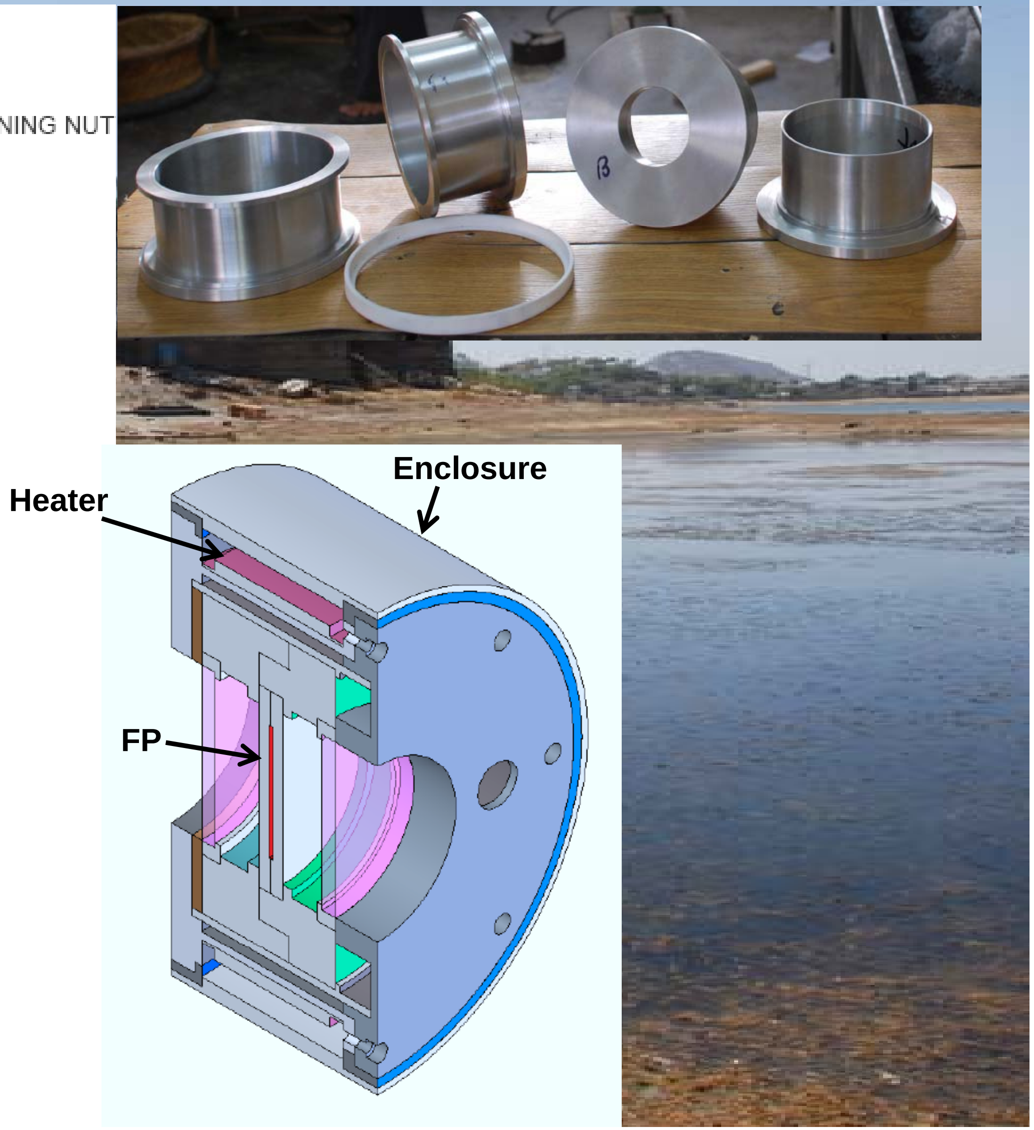




Construction of the Lithium Niobate FP

Source : CSIRO, Australia



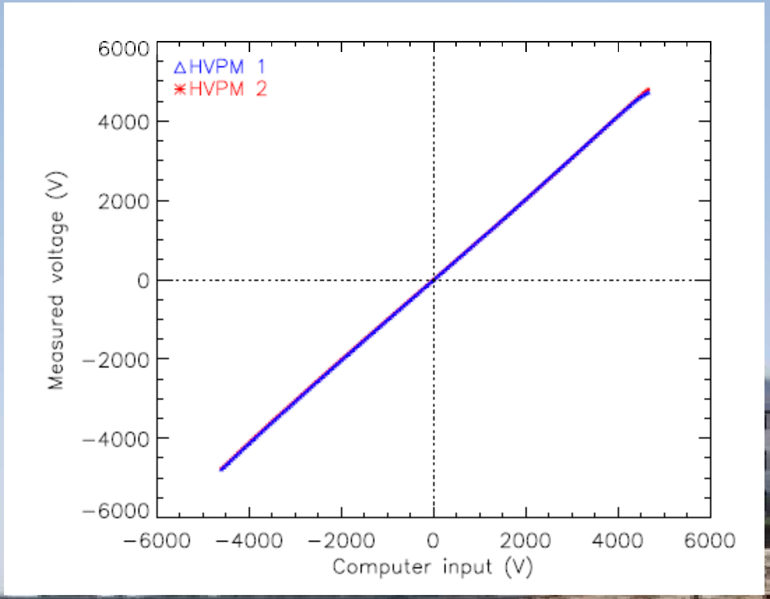


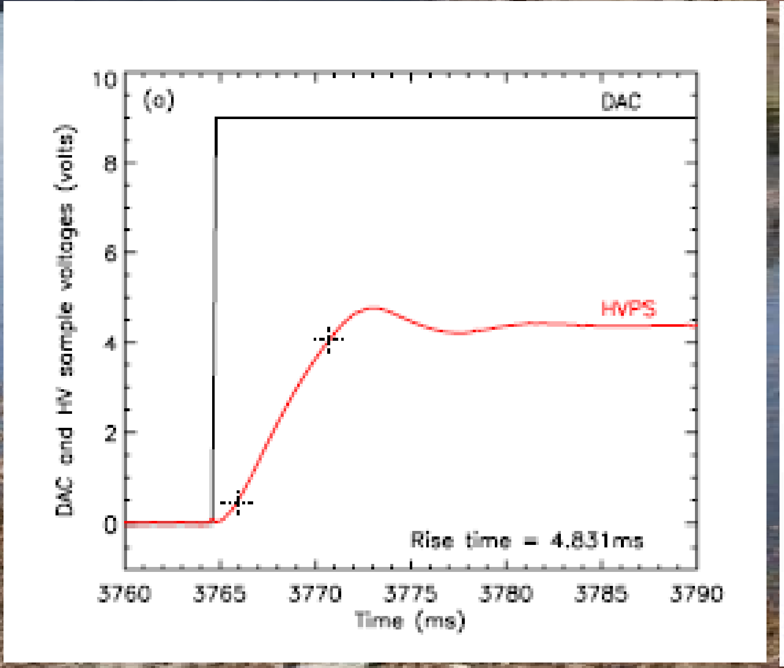
High voltage power supply for FP

Computer controlled, less than ½ V resolution

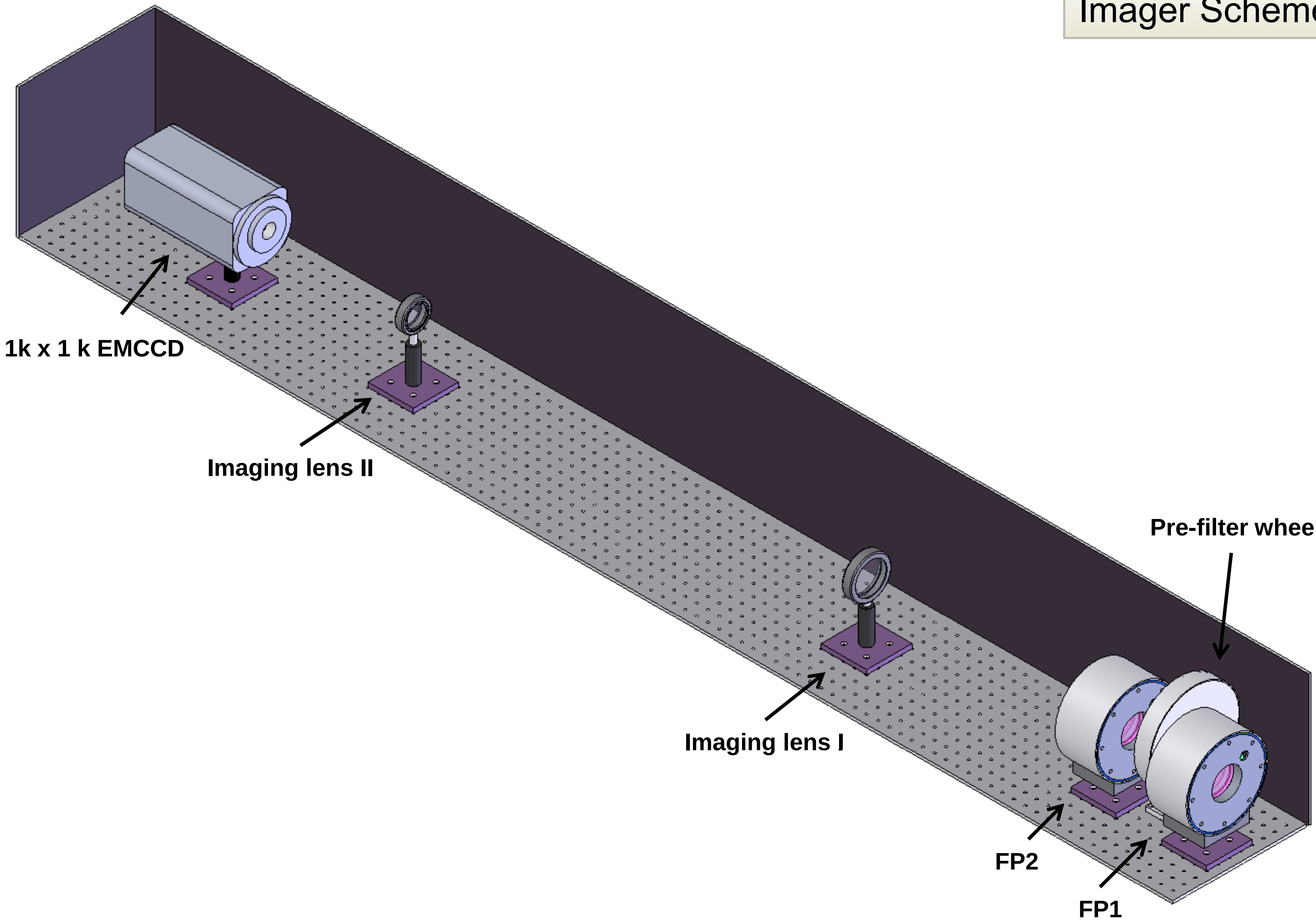
Fast response, highly stable

Driver software written in C, can easily be synchronized with image acquisition



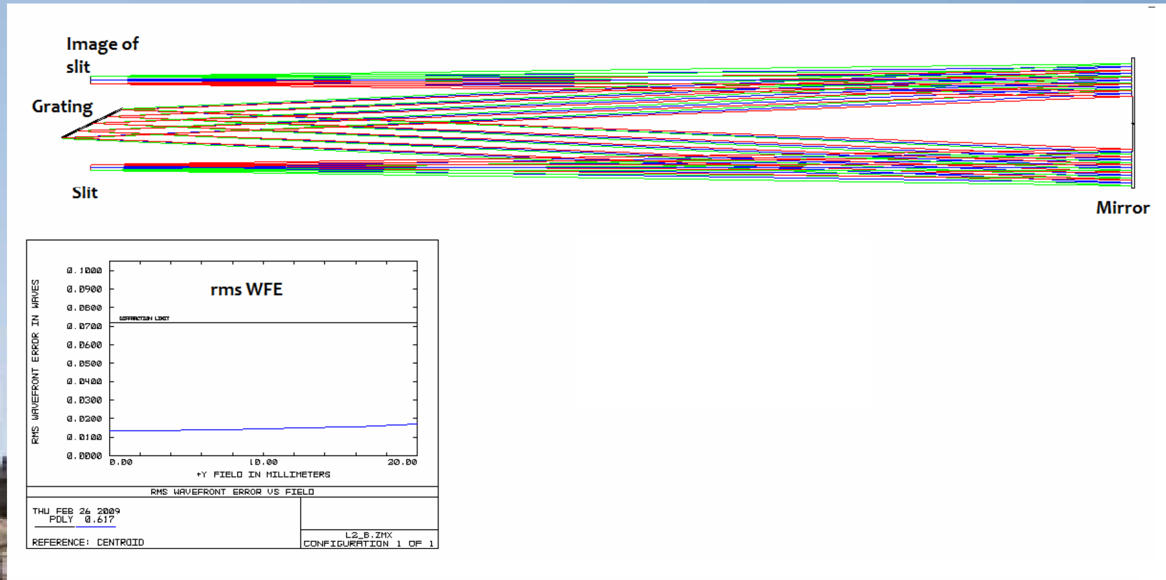


Imager Scheme



Courtesy: Mukesh, S.

Back-end instruments : Reflecting Echelle Spectrograph (RES)



Reflecting echelle Littrow spectrograph optimized for 6173 Å and 8542 Å

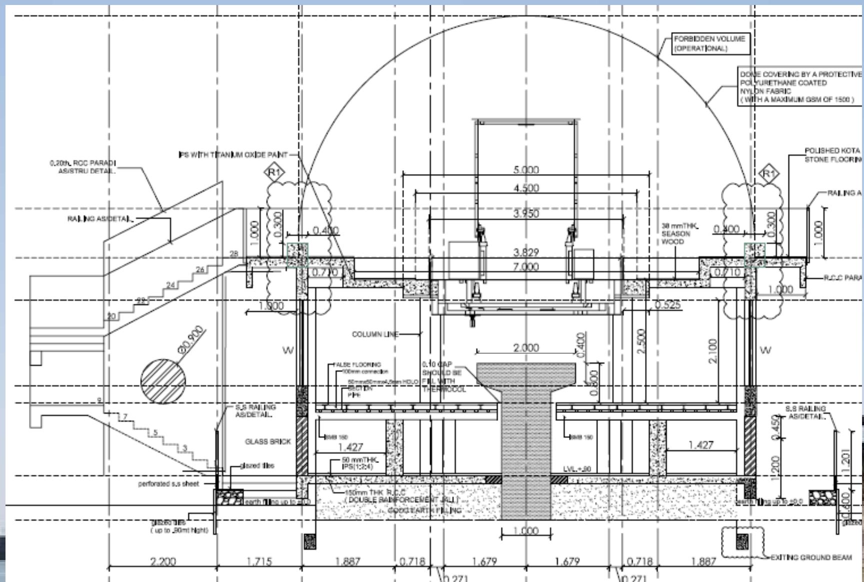
Grating constant of 79 lines/mm

Spectral resolution of 15 mÅ and 21m Å at 6173 Å and 8542 Å

Preliminary design ready, the fabrication will be taken up next year

Present status & time schedule

New building for MAST



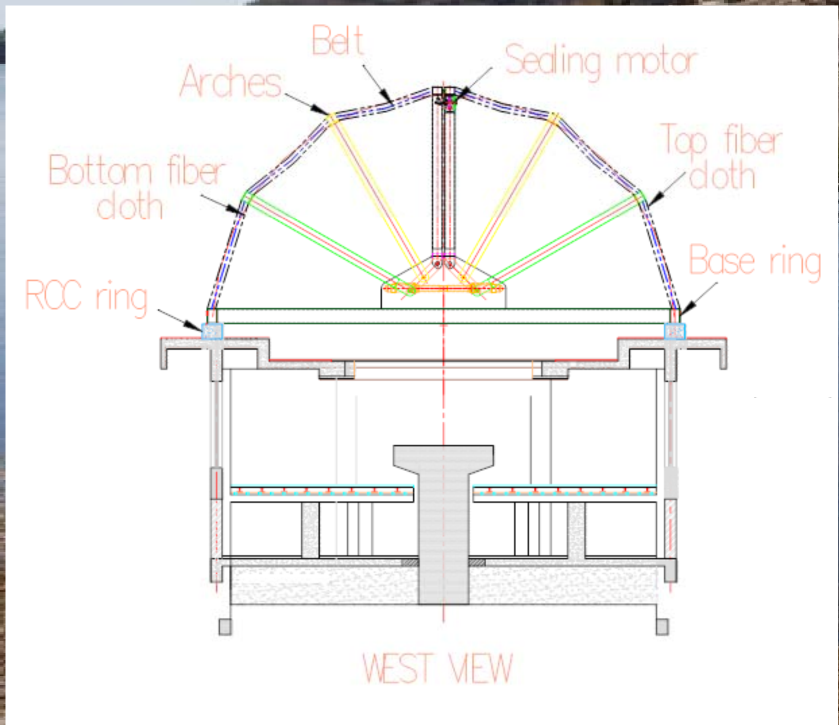
Present status & time schedule

Collapsible dome for MAST

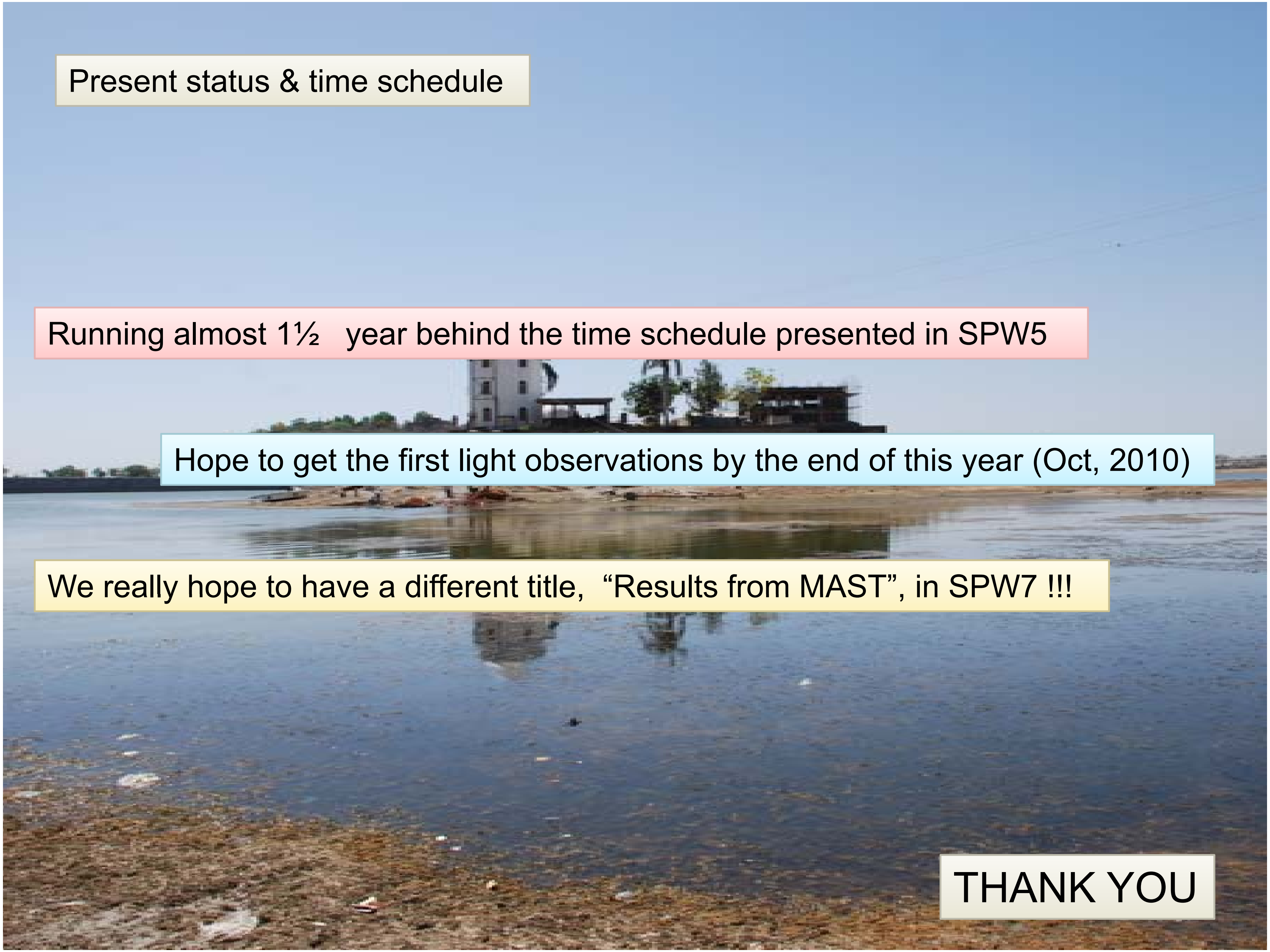
Concept: very similar to Gregor, Tenerife

Arch structures to support the cloth

Two layers of PVC coated cloth from Ferrari, Italy



Present status & time schedule



Running almost 1½ year behind the time schedule presented in SPW5

Hope to get the first light observations by the end of this year (Oct, 2010)

We really hope to have a different title, “Results from MAST”, in SPW7 !!!

THANK YOU