MAST update and backend instruments

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The site

Location : Udaipur, India

Latitude : 24°

Longitude : 73°

Average seeing : 3 – 4 arc-sec

(r_0 : 5 – 4 cm)

Best seeing : 2 arc-sec

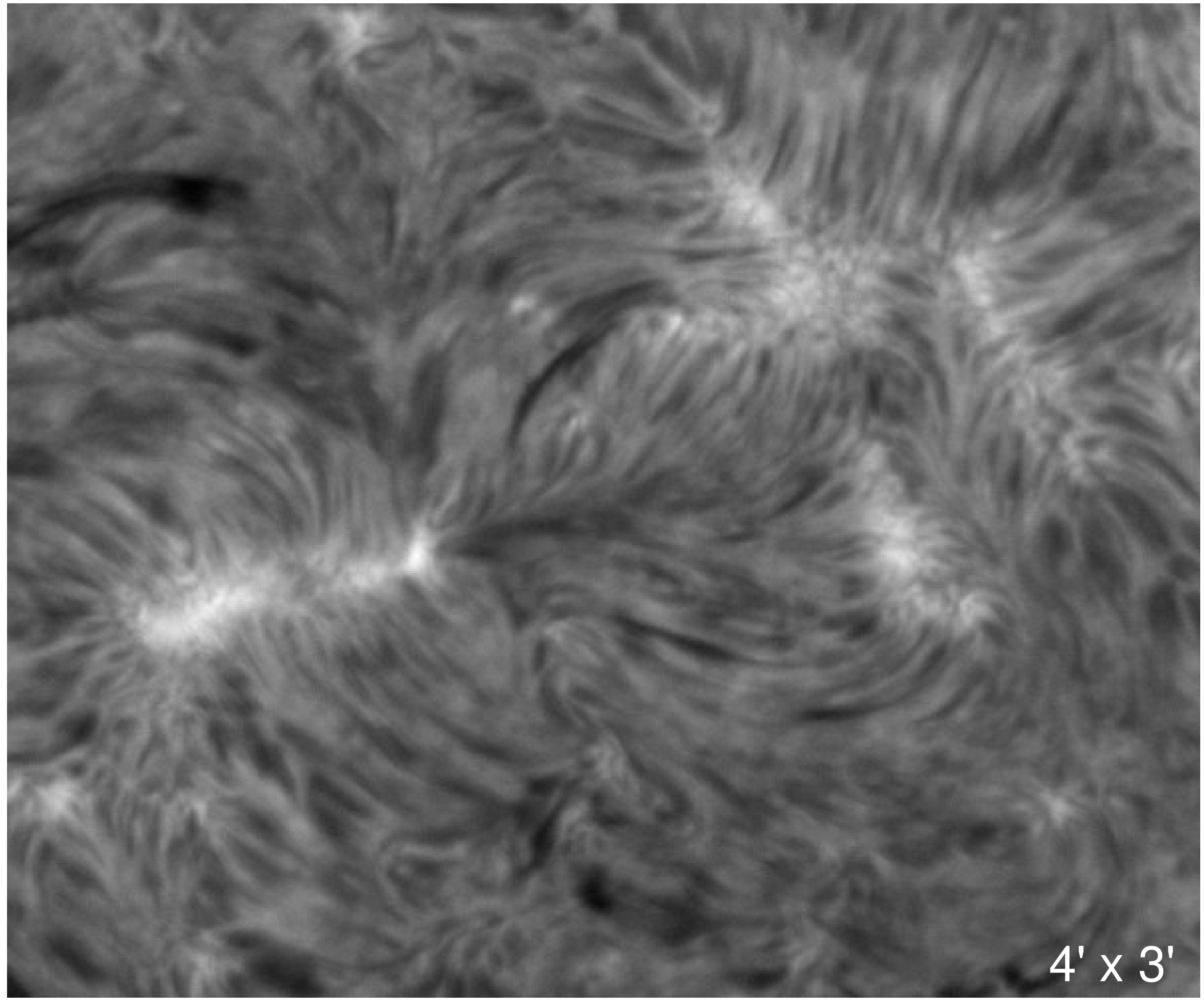
Present Capabilities

Full disk and high resolution H-alpha observations

Solar Vector Magnetograph (SVM) working at 630 nm

(Poster by Sanjay Gosain)

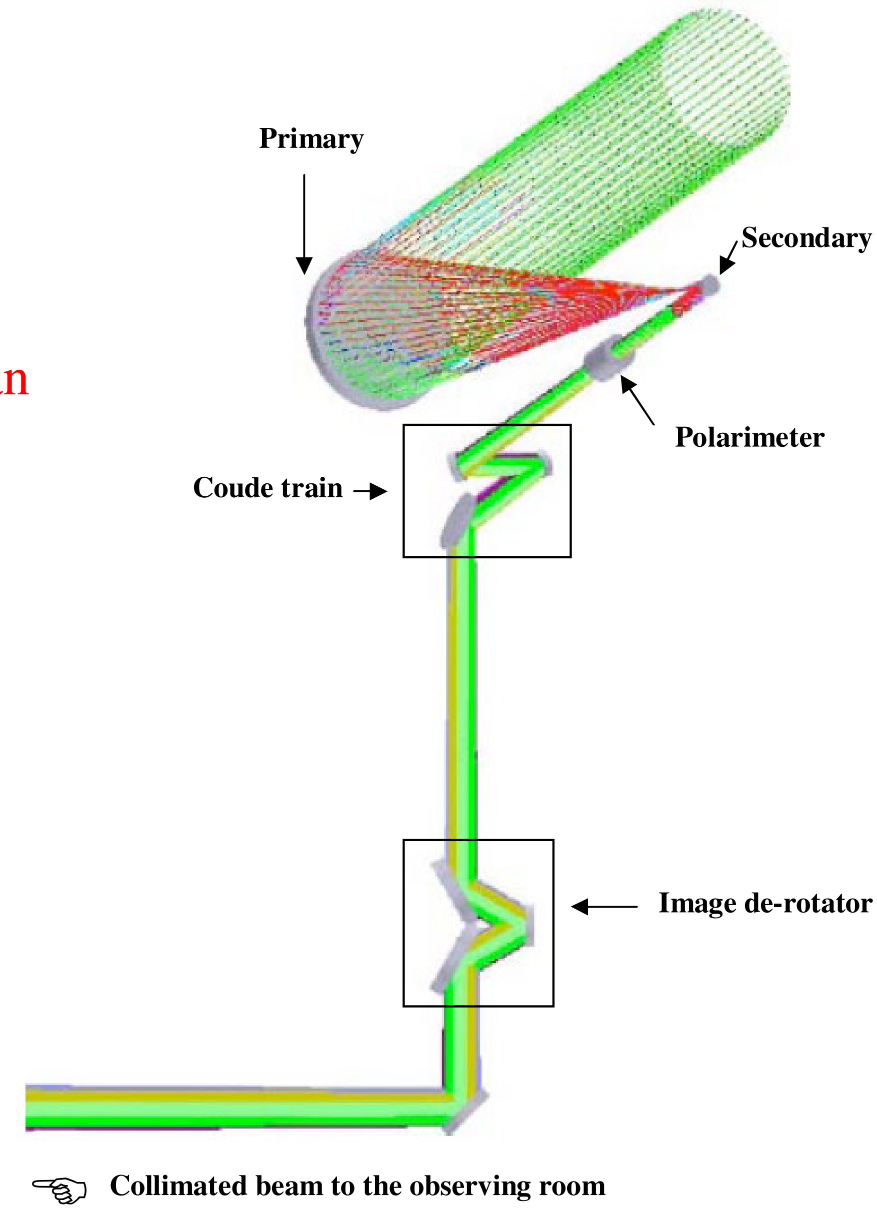
Site for GONG Instrument



MULTI APPLICATION SOLAR TELESCOPE

(MAST)

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

Scattered light	- No scattered light resulting from the secondary supporting structure, better PSF
No central obscuration	- More effective collecting area
	- full pupil plane image is available for AO wave-front sensing
polarimetry package	- polarimtery package can be conveniently placed soon after the secondary mirror
Instrumental polarization	- Resulting from the oblique reflections but can be corrected by calibrating the telescope

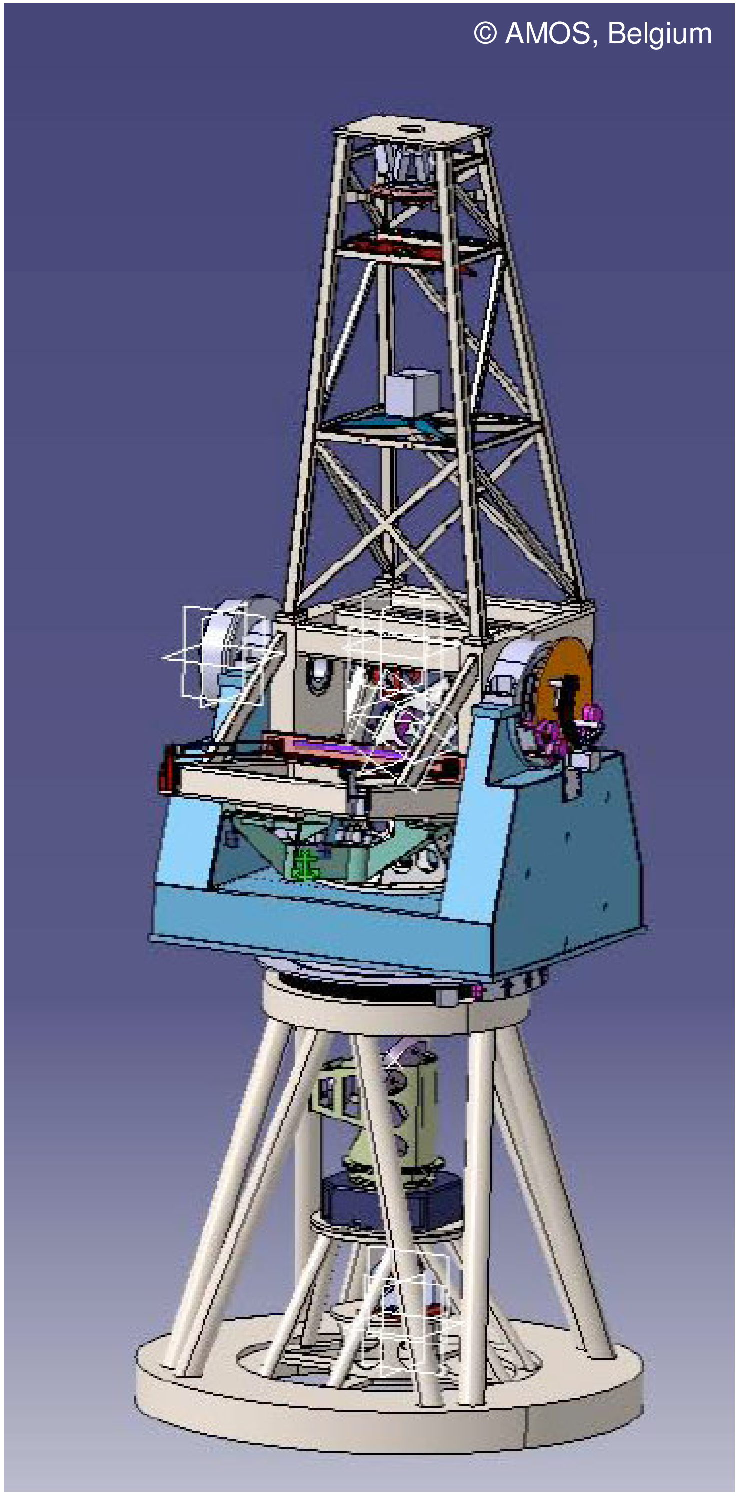
Mechanical design

A stiff central structure connecting the two altitude shafts

A reinforced strut structure to connect the central structure and M2

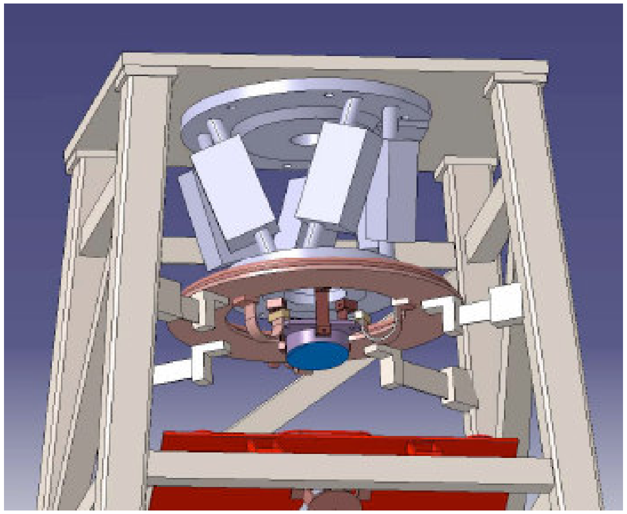
M2 is mounted on a hexapod with correction capabilities for tilt, decentring, and translation

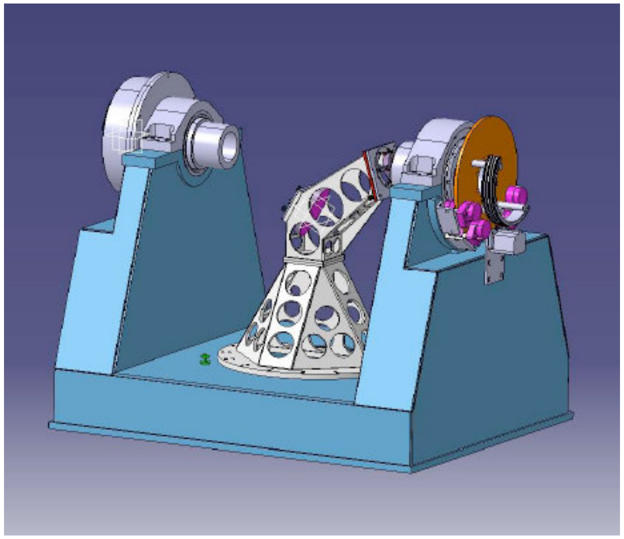
Support structure for the polarimeter package in the strut



Opto - Mechanical mounts details

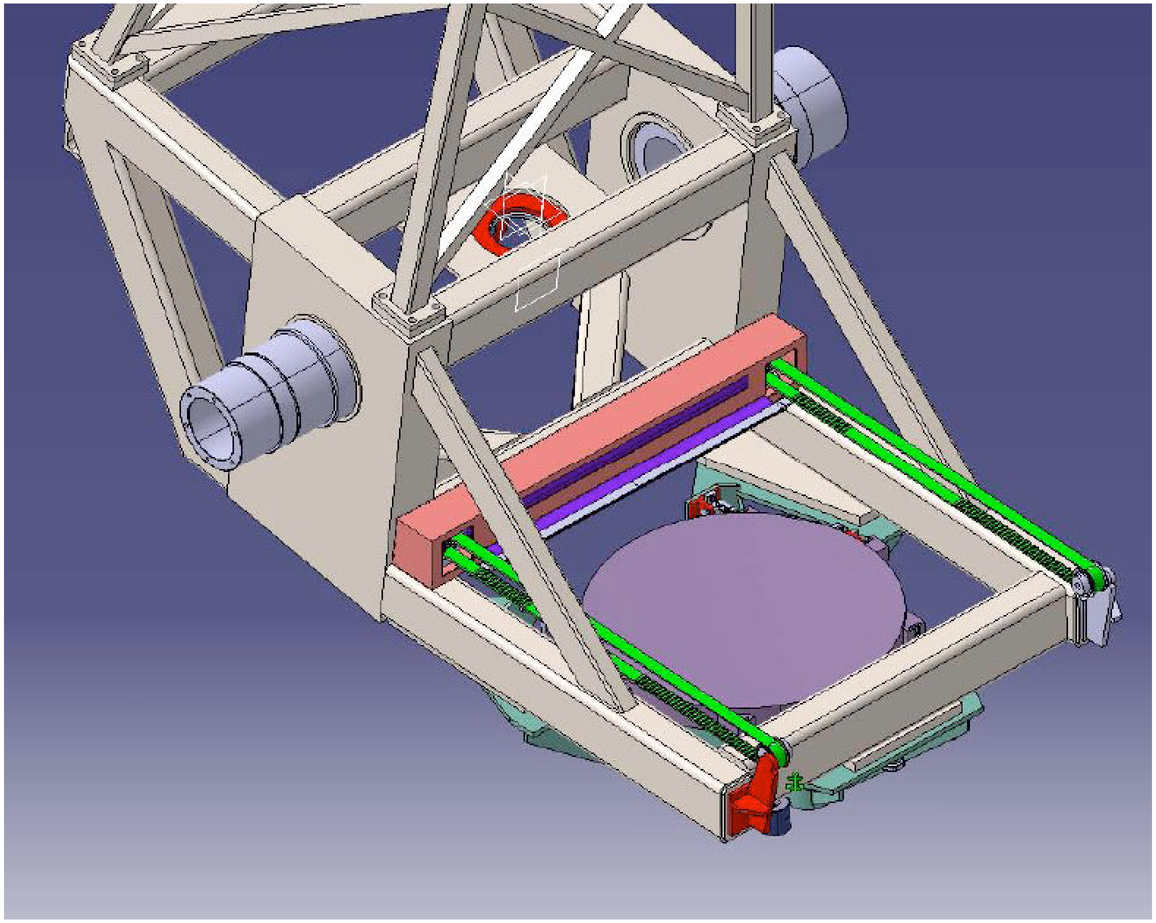
M2 mount





Coude mirrors

M1 mount



Mechanical Design : highlights

Mount	-	Alt-azimuth
Differential pointing accuracy	-	0.5 arc-sec
Open loop tracking	-	0.25 arc-sec for 10 min
Closed loop tracking	-	0.1 arc-sec for 1 Hr
M2 mechanism	-	tip-tilt system

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

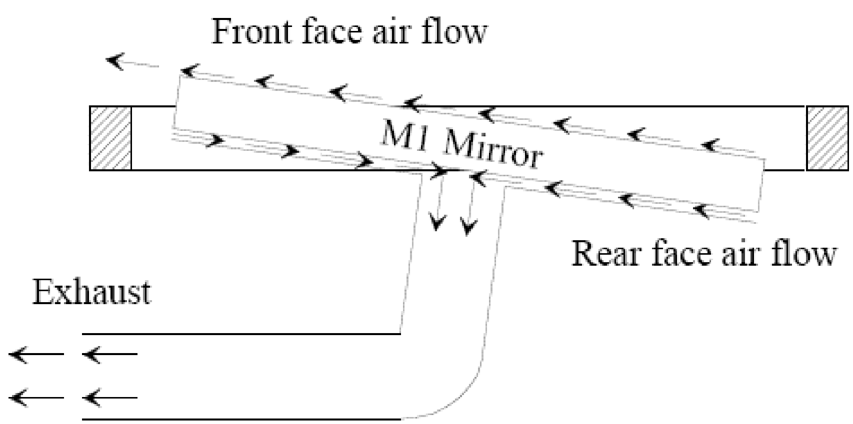
This is achieved by heating and cooling of the main telescope elements. Thermal design and control is difficult because of large variations of operating temperature and fast temperature variation

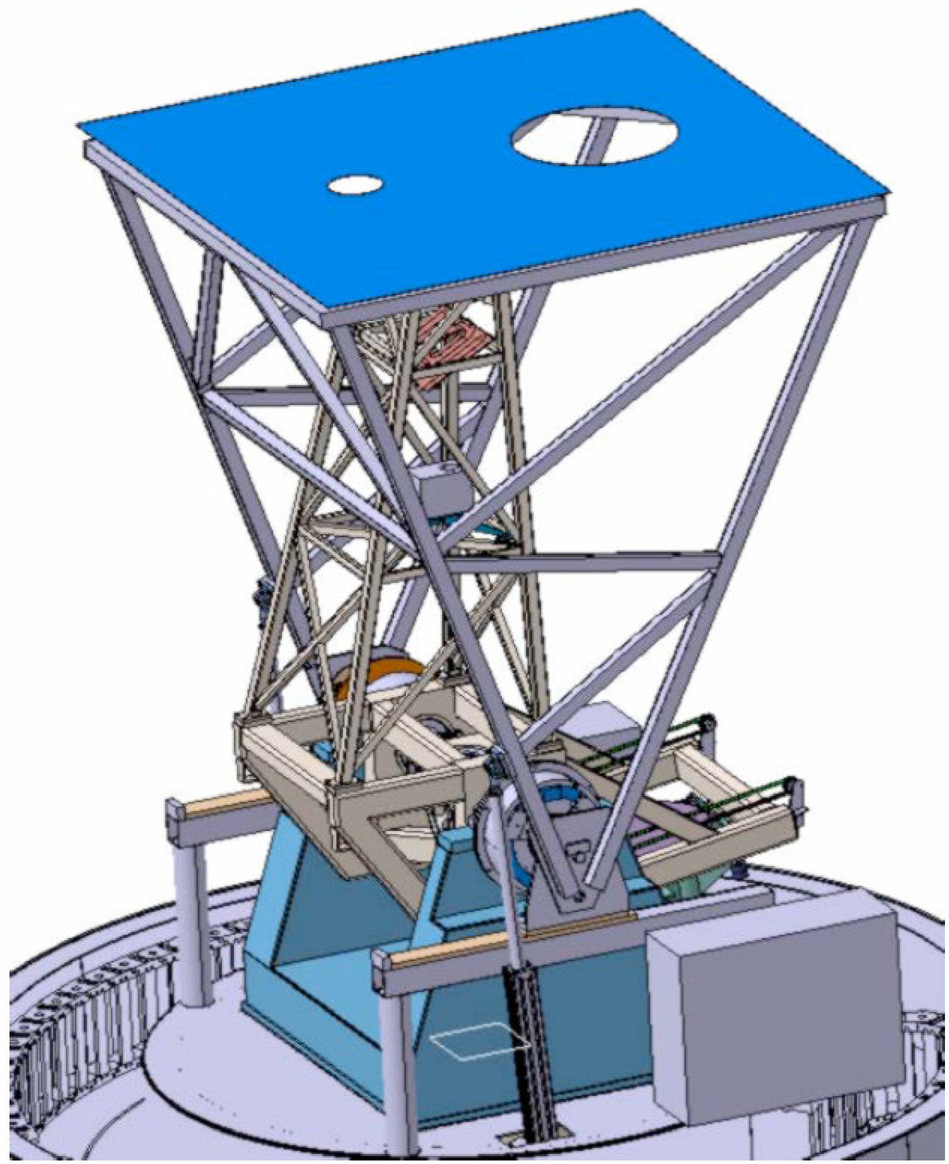
Thermal considerations (Cont...)

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 ±1°C ambient





Back-end Instruments : Science goals

“ Understanding the solar magnetic and velocity fields in small and large scale solar structures and active regions are the main science goals for the 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

Back-end Instruments

The above mentioned science goals can be realized by measuring the full vector magnetic and velocity fields in the solar photosphere and chromosphere

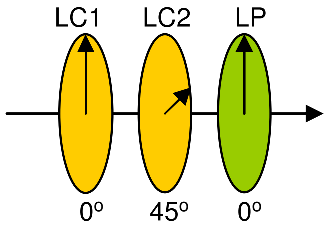
In order to achieve this we propose to have;

1) Polarimeter
2) Adaptive optics image stabilisation system
3) Narrow-band imager
4) Spectrograph

Polarimeter

Polarimeter package will be placed just after the secondary mirror

Two LCVRs and a linear polarizer will be used for the polarization measurements



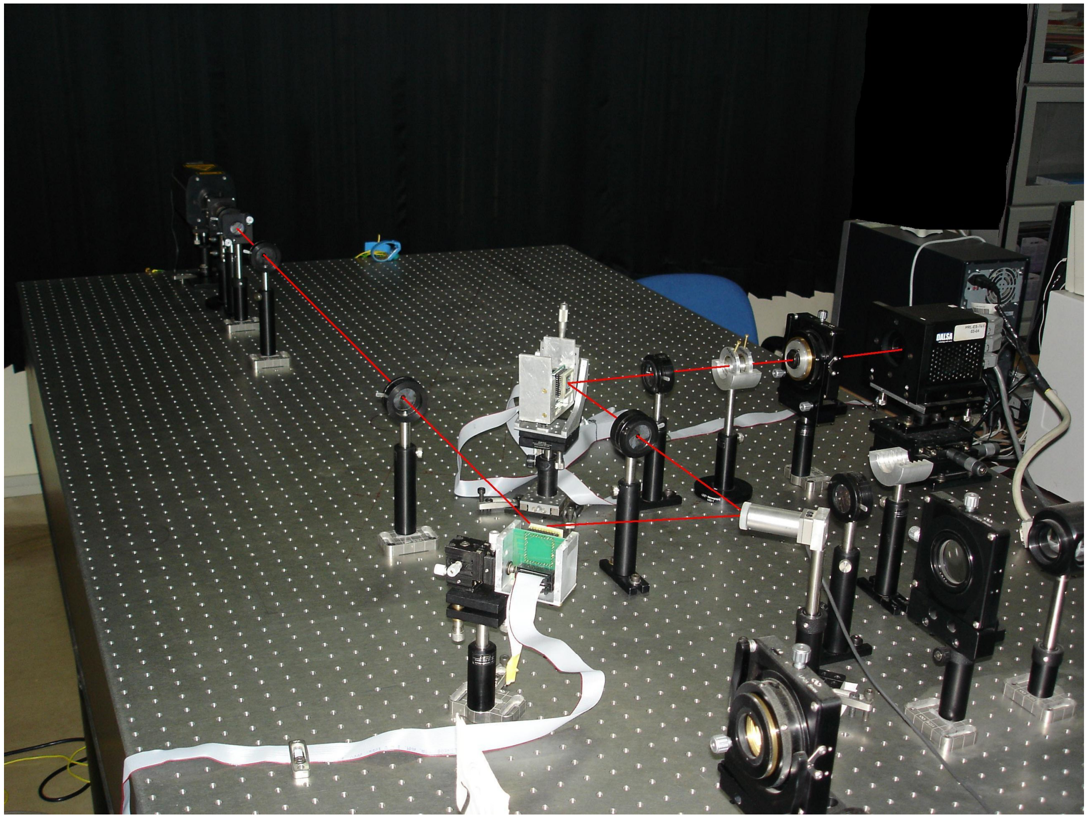
The polarimeter will cover a wavelength range of 600 – 900 nm

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, and first results with the tip-tilt mirror is obtained



Narrow band-imager

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

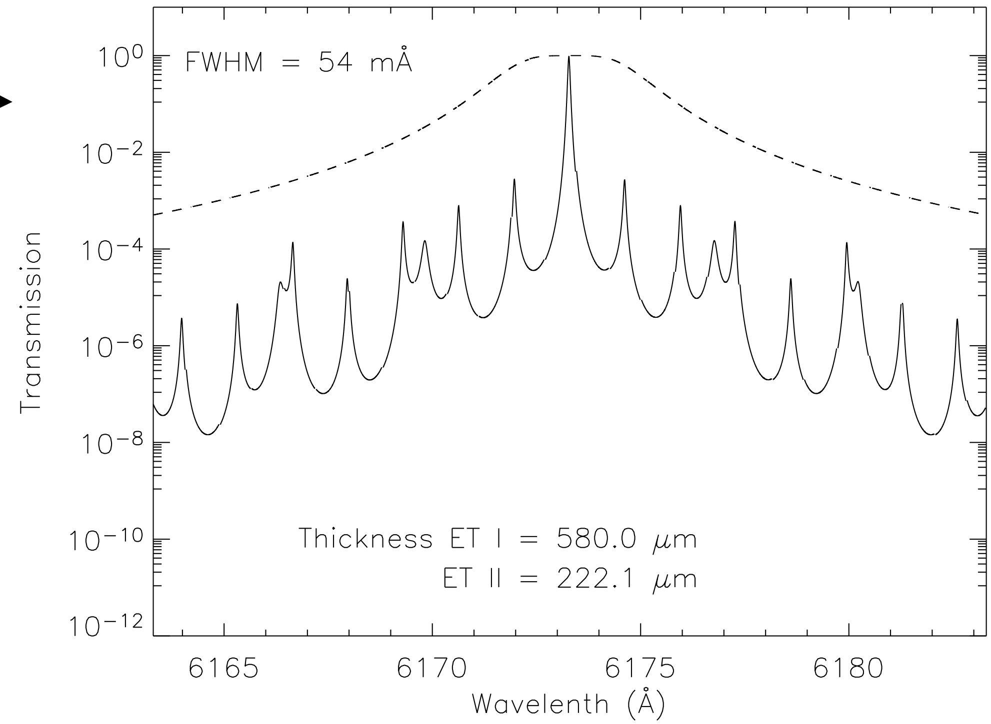
Initially for spectral lines, FeI 6173 Ǻ and Ca II 8542 Ǻ

Lithium niobate etalons with FWHM of 54 mǺ and 104 mǺ (@6173 Ǻ)

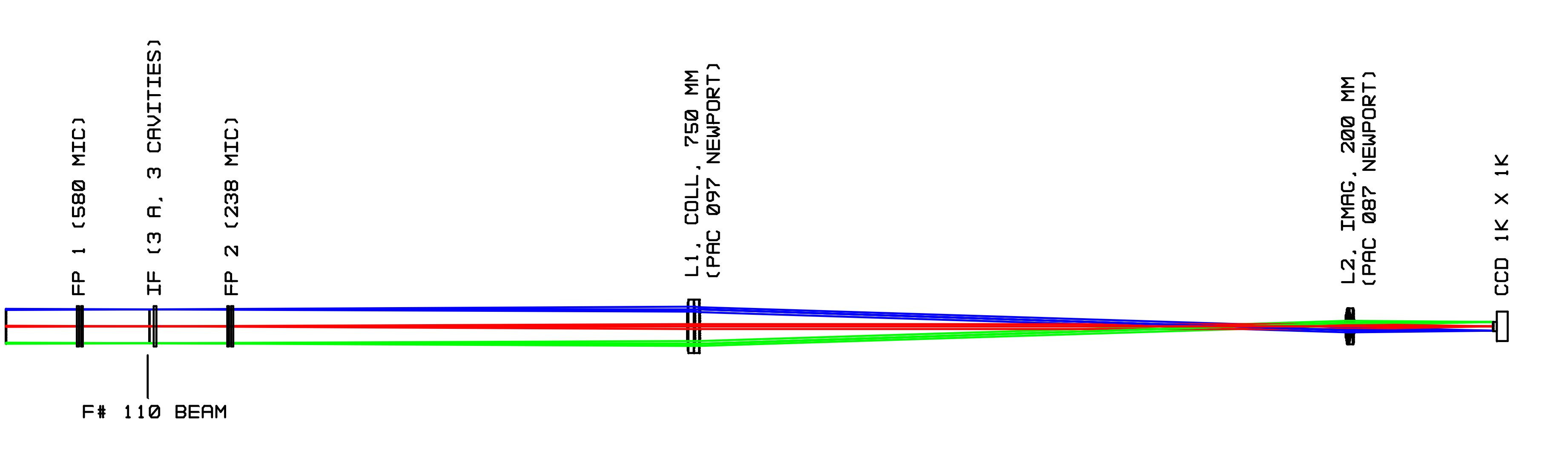
3 Ǻ blocking filter to suppress the side band from the etalon

Combined spectral resolution of 114, 000 at 6173 Ǻ

Resultant computed transmission of the narrow-band imager



Proposed Optical layout



Spectrograph

Reflecting echelle Littrow spectrograph optimzed for 6173 Å and 8542 Å

Grating constant of 79 lines/mm

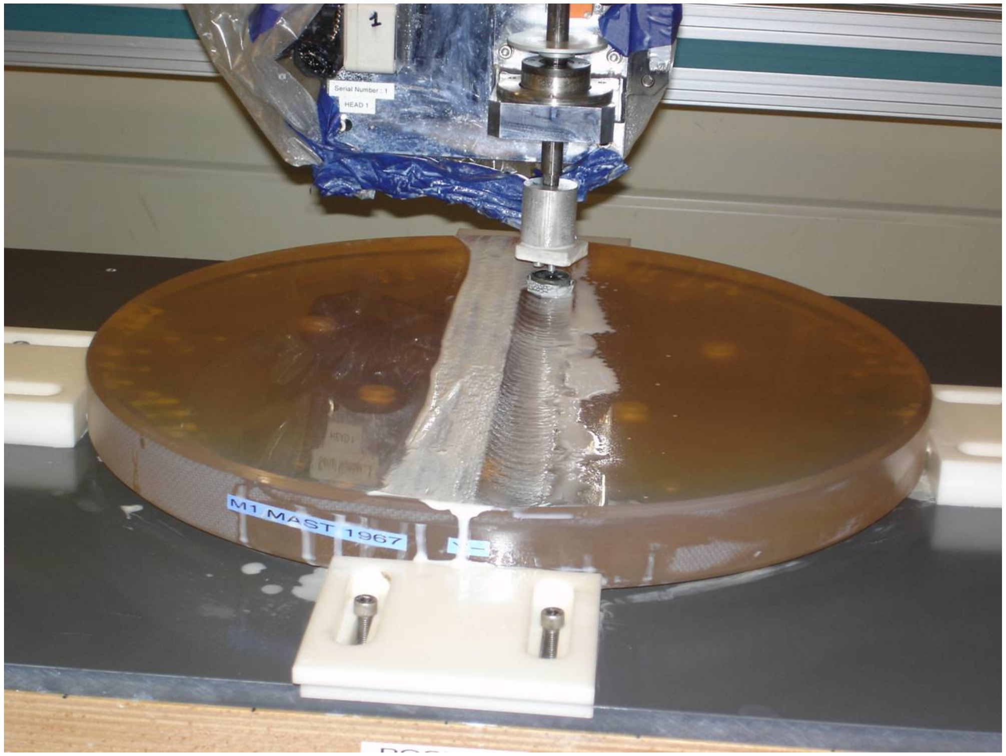
Size 408 x 204 mm

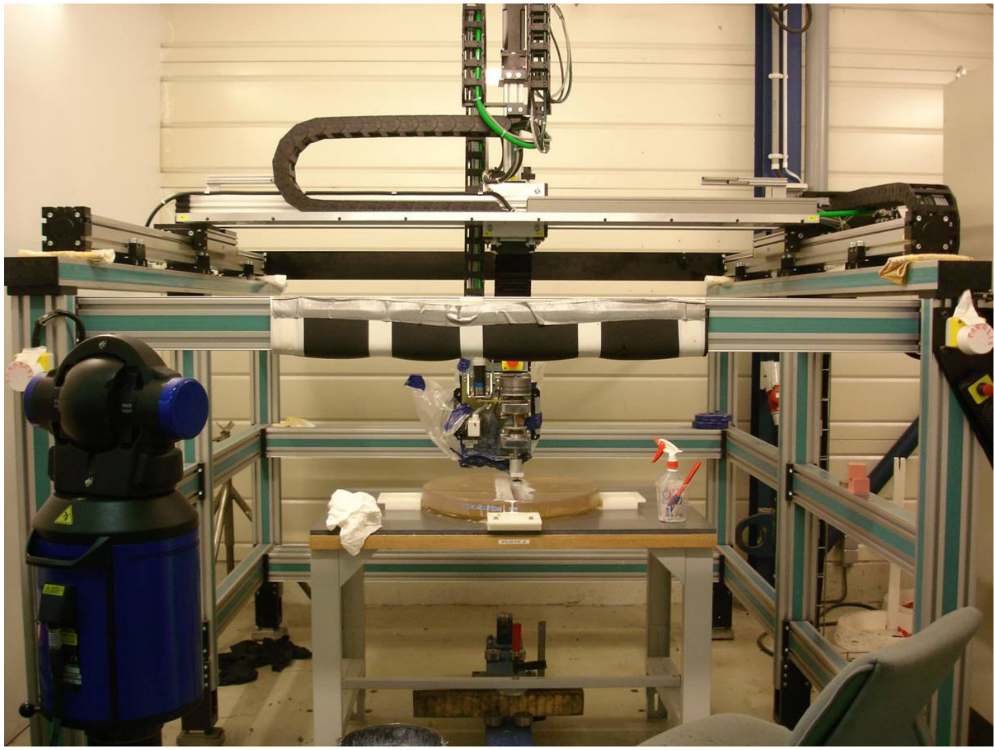
Spectral resolution of 10 mÅ and 21m Å at 6173 Å and 8542 Å

Update

The telescope → being manufactured in AMOS, Belgium

Polishing of primary mirror M1





Update (cont ....)

Secondary mirror M2 and mount (hexapod)

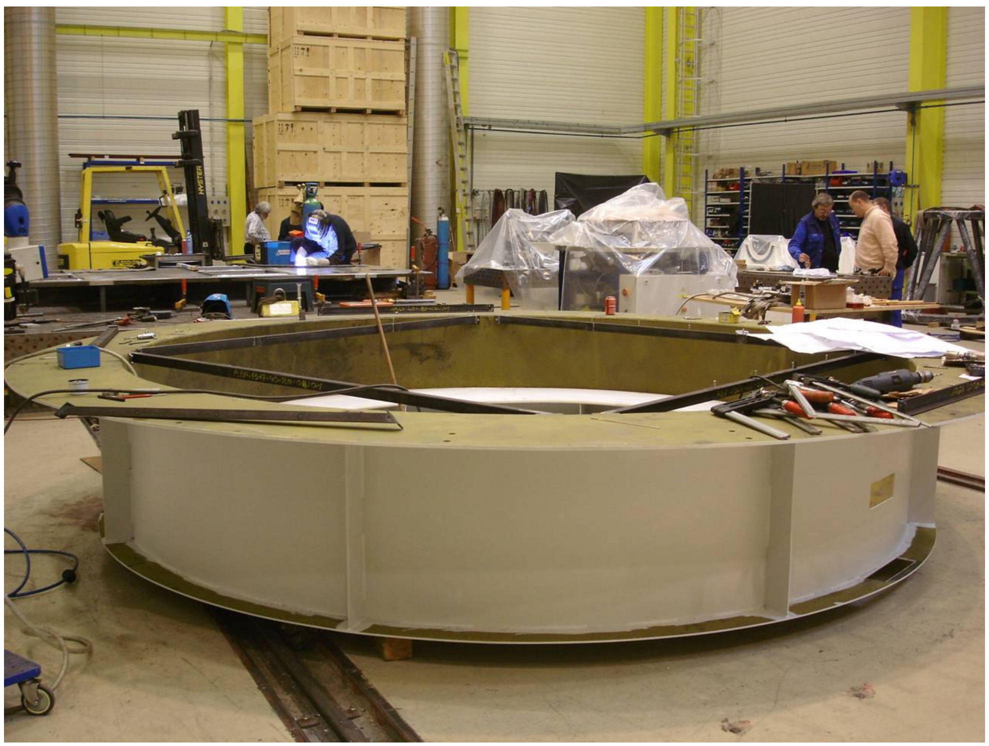
Update (cont ....)

GIS

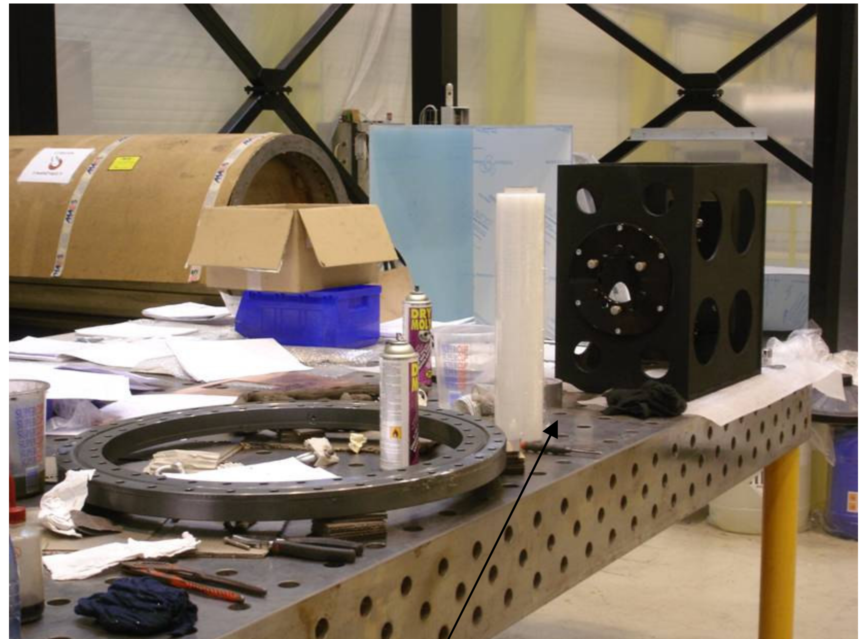
Primary mirror support

Azimuth Fork

Update (cont ….)



Cable wrap assembly



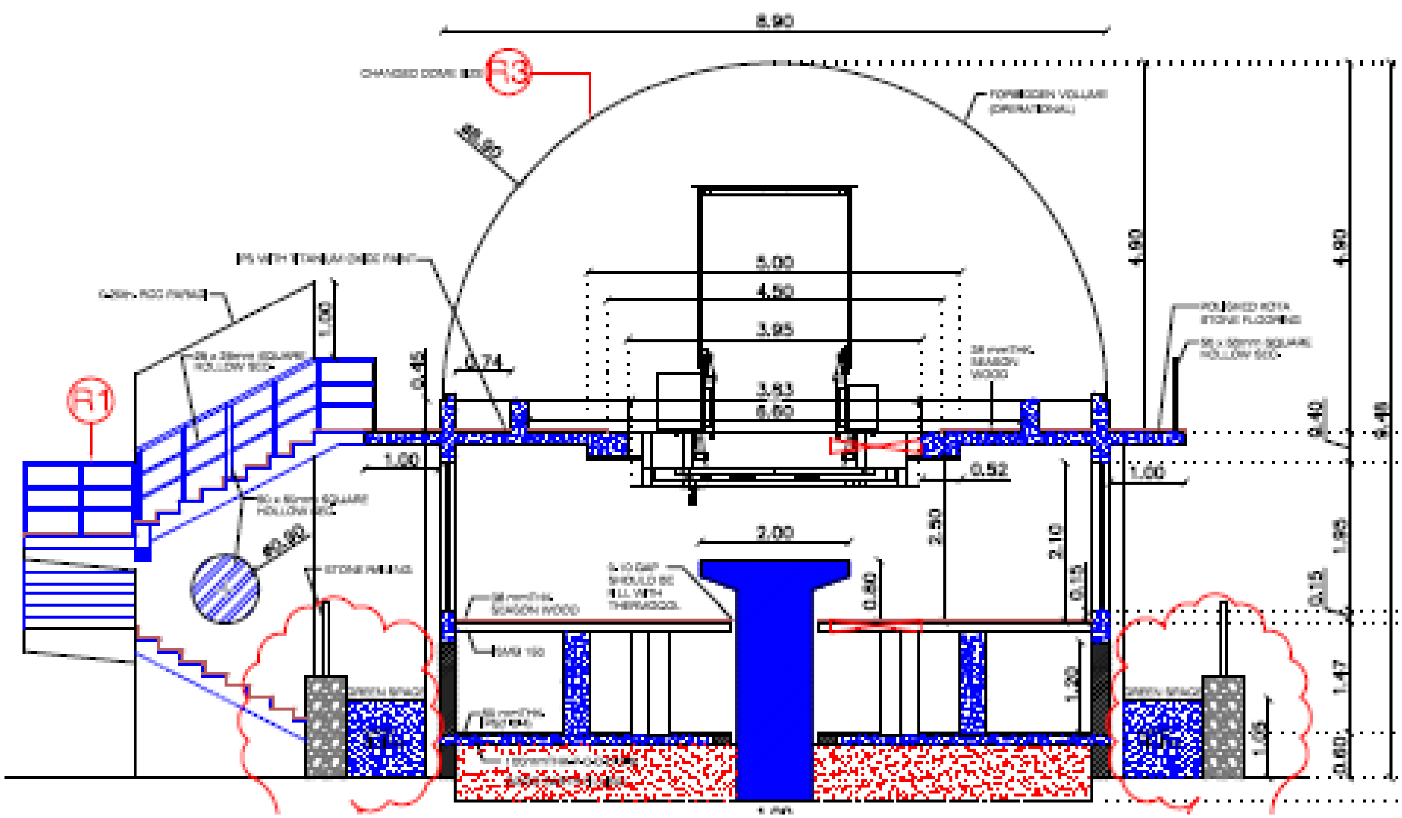
De-rotator assembly

Update (cont ….)

Telescope housing →

New telescope building is being constructed

Collapsible dome



Update - Back end instruments

Procurement of different components for the back instruments;

Narrow band Imager →

Placed order for two solid state lithium niobate etalons from CSIRO, Australia

Purchased new EMCCD camera and blocking filters for the FP

Polarimeter →

Placed order for LCVRS and other optical components

Spectrograph →

Finalizing the specifications optical layout of the instrument

MAST Telescope will be installed by the end of 2009, back-end instruments development is in progress and will be ready for the 'first light' observations