



The 3.6m Devasthal Optical Telescope Project : Current Status

Brijesh Kumar* †

*Aryabhata Research Institute of Observational Sciences (ARIES),
Manora Peak, Nainital 263 002, Uttarakhand, India*

Abstract. A 3.6m aperture optical telescope with active optics technology is being established at Devasthal, Nainital. This telescope will have instruments providing spectral and seeing-limited imaging capabilities at visible and near-infrared bands. A brief update on this 3.6m telescope facility is presented.

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1. Introduction

The Devasthal (Longitude : $79^{\circ}41'04''\text{E}$, Latitude : $29^{\circ}21'40''\text{N}$) is located at an altitude of about 2420 m, in the foothills of central Himalayas. It is about 50 km east of Nainital by road. The 3.6m Devasthal Optical Telescope (DOT) is being established at Devasthal, which is a field station of the Aryabhata Research Institute of Observational Sciences (acronym ARIES). The scientific objectives and technical description of the 3.6m DOT project are described elsewhere (Sagar et al. 2012, and references therein).

2. The telescope enclosure

The telescope enclosure is designed to house a pier, a telescope and a mirror coating unit. As the site of the telescope is surrounded by steep gradients from three sides and considering the limited available space, a very compact telescope enclosure was

*email: brij@aries.res.in

†On behalf of the entire 3.6m DOT Project Team



Figure 1. The enclosure of 3.6m DOT facility at Devasthal. The wind screen is seen in blue color.

designed (Pandey et al. 2012). The dome of the telescope is off-centred from the telescope pier and the enclosure is designed to house overhead cranes so that the integration of entire telescope could be made from within the enclosure.

The telescope is mounted on a pier which is a hollow cylinder made up of M25 grade concrete. The pier is 8.26m above the ground and its foundation is completely isolated from the dome building. The as-designed natural frequency of the pier is 25.44 Hz. The horizontal natural frequency of as-built pier has been measured using 3C geophones and piezoelectric sensors (Gatkine and Kumar 2014). A mean value of 22 ± 2 Hz is obtained, which is consistent with the as-designed value. The telescope is designed to have natural frequency of 7.4 Hz.

The telescope enclosure building is designed in three parts viz. the rotating dome, the stationary dome-support structure and an auxiliary building. The entire building is made up of steel. The dome is a cylindrical insulated structure with pitched roof having diameter of 16.5m and height of 13m. The dome has a 4.2m wide opening slits and a wind screen. The telescope floor level is at 11m level and a total of 12 ventilation fans are installed on the dome support structure for thermalisation of the telescope building at the start of observations. The ventilation duct has also been provided to flush the hot air of technical room. The auxiliary building is equipped with coating plant unit. The construction of the telescope enclosure was completed in 22 months and the enclosure was put into regular use in June 2014. The as-built picture of the 3.6m telescope enclosure building is shown in Fig. 1.



Figure 2. A picture of 3.6m Alt-az telescope from inside the dome. The height of telescope is about 11m. The forks are seen in blue color.

3. Installation of telescope

The integration of the telescope was accomplished during October 2014 to February 2015. The mechanical integration of the telescope was achieved using two 10 Ton capacity overhead cranes installed each in the auxiliary building and the rotation dome. These cranes can lift the telescope parts with hoist speed as slow as 3mm s^{-1} and they also have provision to move in tandems. The telescope come in parts and the maximum weight of single part was 14 Ton. The whole telescope of 150 Ton was installed successfully on top of pier using these overhead cranes.

The primary mirror of telescope was coated with Aluminum using the coating plant installed in the auxiliary building. This was the most critical operation. The mirror coating was successfully performed in the first week of February 2015. A reflectivity of 86 percent was measured at optical wavelengths. The Aluminum coating thickness accuracy is about 2nm. A set of about 75 tests were performed during mechanical, electrical and optical integration of telescope. The on-sky tests were also performed during March to May 2015. The synchronization of dome motion with the telescope has also been successfully achieved. The preliminary analysis of these tests are in conformity with that achieved at the factory. The test and commissioning phase of the telescope is yet to be concluded. The picture of as-built telescope is shown in Fig. 2.

4. The instruments

The first generations focal plane instruments are a 4k CCD imager and a faint object spectrograph cum camera for visible region, and a medium resolution spectrograph for visible-infrared region. For update on instruments visit <http://www.aries.res.in/dot/>.

An optical imager with a 15 micron pixel, 4kx4k back-illuminated CCD detector, liquid nitrogen cooling, full frame window mode operation, and the associated control electronics has been proposed as first light instrument. This imager will primarily be used to verify the performance of telescope during the commissioning phase. The imager will cover a square area of about 6x6 arcmin on the sky. This instrument will have broadband Johnson-Cousins *UBVRI* and *ugriz* SDSS filters, as well as a few narrow-band filters. The performance of imager has been tested at 1.3m telescope at Devasthal and it is ready for use with 3.6m DOT.

A Faint Object Spectrograph and Camera is being developed for the wavelength range 350 - 900 nm and with suitable choices of grisms and slits, it would be possible to get resolution in the range 250-4000. The imaging mode will cover sky of 14x14 arcmin. A computer simulation indicate that we can detect a 25 mag star in V band with an hour of exposure time in typical observing conditions at Devasthal. Technical description of instrument can be found elsewhere (Omar et al. 2012). The instrument like FOSC are very versatile and it can be used to explore a broad range of the parameter space defined by wavelength coverage, field of view, spatial and spectral resolution. The celestial sources include point and extended objects of galactic and extragalactic origins, such as star clusters, supernovae, and active galactic nuclei. This instrument is likely to be ready by early 2016.

A visible-NIR medium resolution spectrograph and imager is being developed for the wavelength range of 0.6 to 2.5 μm and having prism mode $R \sim 100$ and cross-dispersed mode $R \sim 2000$ optimised for 1 arcsec seeing at J-band. Imaging for 1x1 arcmin field of view would be possible. The spectrograph will be mounted at f/9 Cassegrain focus of 3.6m telescope and its primary science goal would be to investigate the large populations of cool and dust embedded stellar atmospheres. In addition, it could also be used to study extragalactic transient sources in optical wavelengths. This instrument is likely to be ready by the end of 2017.

References

- Gatkine P., Kumar B., 2014, IJSCER, 3, 1
Omar A., Yadav R. K. S., Shukla V., Mondal S., Pant J., 2012, SPIE, 8446, 844614
Pandey A. K., Shukla V., Bangia T., Raskar R. D., Kulkarni R. R., Ghanti A. S., 2012, SPIE, 8444, 844441
Sagar R., Kumar B., Omar A., Pandey A. K., 2012, SPIE, 8444, 84441T