

# Standard Operating Procedure

To submit observing proposal and prepare observation plan for 3.6m DOT

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Change records		
Issue	Date	Remarks
1	30 November 2024	Draft issue

## Scope

This document provides the standard operating procedure to submit observing proposals and then prepare an observation plan for 3.6m Devasthal Optical Telescope.

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Parameter	Value
Location	Alt: $2424 \pm 4$ m; Long: $79^\circ 41' 04''\text{E}$ ; Lat: $29^\circ 21' 40''\text{N}$
Seeing (Ground level)	$1''.1$ (median); $0''.75$ (median of 10 percentile values)
Estimated Seeing	$0''.86$ for 6-12m and $0''.22$ for 12 - 18m slabs above ground level
Wind	$\leq 3$ m/s for 75 % of time
Air temperature	$21.5^\circ\text{C}$ to $-4.5^\circ\text{C}$ (variation during year), $\leq 2^\circ\text{C}$ (variation during the night)
Rain	2m (average over the year, 80 % during June-September)
Snowfall	60 cm (average; during January and February only)
Clear nights	208 spectroscopic nights, of which 175 are photometric
Sky Transparency (mag/airmass)	Average : $kU = 0.49 \pm 0.09$ ; $kB = 0.32 \pm 0.06$ ; $kV = 0.21 \pm 0.05$ ; $kR = 0.13 \pm 0.04$ ; $kI = 0.08 \pm 0.04$ Best : $kU = 0.40 \pm 0.01$ ; $kB = 0.22 \pm 0.01$ ; $kV = 0.12 \pm 0.01$ ; $kR = 0.06 \pm 0.01$
Relative humidity	$\leq 60$ % during spectroscopic nights; much higher from July to September

**Table 1:** The parameters of the Devasthal site.

## 1 Part A: Instructions for the observation proposals

- The DOT is open for observation in two cycles: Cycle 1 (C1) from February to May and Cycle 2 (C2) from October to January.
- The proposal submission periods are as follows: C1 – November 1st to December 1st, and C2 – July 1st to August 1st.
- The facility of service mode observations is available for outstation observers (other than ARIES).
- Currently, five instruments are available for observations, offering photometric and spectroscopic capabilities across the electromagnetic spectrum's optical to near-infrared (near-IR) regions: IMAGER, TANSPEC, TIRCAM2, ADFOSC, and SPIM.
- It is recommended that all PIs go through the manuals for all back-end instruments available on the website in preparation for submitting their proposals and observing plans.
- The General specification of the Devasthal site, the telescope and each instrument is given in Tables 1, 2, 3, 4, 5, 6 and 7. The available filters are tabulated in 8.
- PI can sign in and submit the proposals using the DOT Online Proposal Submission System (DOPSES) at <http://dopses.aries.res.in>.
- There are three categories of proposals: astronomers working in an Indian institution (reserved time 60 % on competition basis), astronomers from ARIES (reserved guaranteed time is 33 %), and astronomers from the Belgian Institutes (reserved guaranteed time is 7 %). The PIs have to select the category of the proposals according to their affiliation. The option for Director's Discretionary Time (reserved time 10 %) is also available with a few

Parameter	Value
Focal ratios	Primary : F/2; Effective : F/9
Plate Scale	6".366 /mm
Science Field of View	10' on side ports, 30' on axial main port, (35' for the AGU)
Operational waveband	350 nm to 3.7 micron
Optical image quality	<ul style="list-style-type: none"> <li>- Encircled Energy 50 % &lt; 0.3",</li> <li>- Encircled Energy 80% &lt; 0.45 ",</li> <li>- Encircled Energy 90% &lt; 0.6",</li> </ul> For the waveband 350 nm to 1500 nm; without a corrector for 10 arcmin FOV.
Mounting	Alt-azimuth
Sky coverage	15 to 87°.5 in elevation
Pointing accuracy	< 2"RMS
Tracking accuracy	<ul style="list-style-type: none"> <li>&lt; 0".1 RMS for 1 minute in open loop,</li> <li>&lt; 0".1 RMS for 1 hour in close loop,</li> <li>&lt; 0".5 Peak for 15 minutes in open loop.</li> </ul>
Instruments	1 axial main-port instrument: <ul style="list-style-type: none"> <li>- mass: 2000 kg</li> <li>- allocated room: 1.8 m X 3 m (Height X Diameter)</li> <li>- instrument flange: 40 cm before the focus.</li> </ul> 2 side-port instrument <ul style="list-style-type: none"> <li>- mass: 250 kg per instrument</li> <li>- allocated room: 0.5m × 0.5m × 0.7m (H × W × L)</li> <li>- instrument flanges: 10 cm before the focus.</li> </ul>

**Table 2:** Parameters of the 3.6m DOT

Parameter	Value
Type	Imaging
Mount position	Axial main port
Wavelength range	400 - 900 nm
Array size	4096 × 4096
Pixel size	15 micron
Pixel scale	0".1
Field of view	6'.5 × 6'.5
Readout noise (speed)	7-9 e <sup>-</sup> (@1 MHz) or 4-6 e <sup>-</sup> (@500 KHz) or 2-3 e <sup>-</sup> (@100 KHz)
Readout time	20s
Gain	1, 2, 3, 5, 10 e <sup>-</sup> /ADU (selectable)
Type of cooling	Liquid nitrogen cooled
Minimum exposure	10 ms
Available filters	Bessel: U, B, V, R, I SDSS: u, g, r, i, z
Limiting magnitude	24, 25.2, 24.6 mag with 10% photometric accuracy in B, g, r bands, respectively, with effective exposures of 1200s, 3600s, and 4320s.

**Table 3:** Parameters of the IMAGER mounted on the prime port of the telescope.

Parameter	Value
Type	Imaging
Mount position	Side port 1
Wavelength range	1 - 3.7 $\mu$ m
Array size	512 × 512 pixel <sup>2</sup>
Pixel size	27 $\mu$ m
Pixel scale	0".17
Field of view	86".5 X 86".5
Readout noise	30 e <sup>-</sup>
Readout time	3.3ms
Gain	10 e <sup>-</sup> /ADU
Minimum exposure	0.1 s
Available filters	Broadbands: J, H, K Narrow bands: BrG, K-cont, PAH, nbL
Limiting magnitude	19, 18.8, 18.0 mag with 10% photometric accuracy in J, H, K bands, respectively, with effective 550s, 550s, and 1000s exposures.

**Table 4:** Parameters of the TIFR IR camera 2 (TIRCAM2) mounted on side port 1 of the telescope.

Parameter	Value
Type	Imaging
Mount position	Side port 2
Wavelength range	350-1000 nm
Array size	$4096 \times 4108$ pixel <sup>2</sup>
Pixel size	15 $\mu$ m
Pixel scale	0".1
Field of view	6'.5 $\times$ 6'.5
Readout noise in electrons (speed)	3.8 (100 kHz), 8.5 (1 MHz), 12 (2 MHz ), 23 (4 MHz)
Readout time	20s
Gain	5.3, 3.4 and 1.5 e <sup>-</sup> /ADU
Minimum exposure time	1 ms
Available filters	Bessel: U, B, V, R, I SDSS: u, g, r, i, z
Limiting magnitude	23.5, 22 mag in V, I bands with an exposure time of 1 hour

**Table 5:** Parameters of the Side Port Imager (SPIM) mounted on side port 2 of the telescope.

Parameter	Value
Type	Imaging and spectroscopy
Mount position	Main axial port
Wavelength Range	350 - 1050 nm
Detector	Deep-depletion fringe-suppressed E2V CCD camera
Array Size	$4096 \times 4096$
Pixel Size	15 $\mu$ m
Pixel Scale	0.2"/pixel
Readout noise (speed)	8 e <sup>-</sup> (0.16 MHz)
Readout time	35s
Gain	1.6 e <sup>-</sup> /ADU
Field of View	Broad-band imaging: 13.6' $\times$ 13.6', Narrow band imaging: 11' diameter
Spectral resolution	< 2000
Available filters	Broadband: SDSS u,g,r,i,z Narrowband: 10.2 nm width with central wavelengths at 491.6, 660.9, 674.3, and 683.3 nm
Grism range	0.1 - 0.7 nm/pixel
Slits	Length: 8', Widths: 0".4 - 3".2
Minimum Exposure for photometry	0.9 sec
Limiting magnitude for photometry	24.5 mag in i-band for an exposure of 2 hours
Limiting magnitude for spectroscopy	g=19 mag with 10 minute exposure at 0.2 nm/px dispersion
Calibration lamp	Hg-Ar, Ne, and continuum

**Table 6:** Parameters of the ARIES Devasthal Faint Object Spectrograph (ADFOSC) mounted on the main axial port of the telescope.

Parameter	Value
Type	Imaging and spectroscopy
Mount position	Main axial port
Wavelength Range	550 - 2540 nm
Detector	Imaging: H1RG Spectroscopy: H2RG
Array Size	Imaging: $1024 \times 1024$ pixel <sup>2</sup> Spectroscopy: $2048 \times 2048$ pixel <sup>2</sup>
Pixel Size	18 $\mu$ m
Pixel Scale	Imaging: 0.25 arcsec/pixel
Readout noise (ADU)	Imaging: 3.5 Spectroscopy: 20.7 (high-gain), 5.3 (low-gain)
Readout time	Imaging: 1.89s Spectroscopy: 5.26s
Gain (e <sup>-</sup> /ADU)	Imaging: 4.3 Spectroscopy: 1.1 (high-gain), 4.5 (low-gain)
Field of View	Imaging: $1 \times 1$ arcmin <sup>2</sup>
Spectroscopy modes	Cross-dispersed mode and prism mode
Spectral resolution	Cross-dispersed mode: 2750 Prism mode: 100 - 350
Available filters	Broadband: r, i, Y, J, H, K Narrowband: H2, BrG
Slits	Widths: 0''.5 - 4''.0
Minimum Exposure for imaging	0.9 sec
Limiting magnitude for imaging	18 mag in K-band for an exposure of 1min, 19.5, 18.9, 18.4 mag in J, H, K band with an exposure of 10 minutes.
Limiting magnitude for spectroscopy	Cross dispersed mode: J=14.3 with 1-hour exposure. Prism mode: J=17.3 with 1-hour exposure
Calibration lamp	Ar, Ne, and continuum lamps
Overhead time	Imaging: 30% Spectroscopy: 50%

**Table 7:** Parameters of the TIFR ARIES Near-IR Spectrograph (TANSPEC) mounted on the main axial port of the telescope.

Filter name	Central wavelength ( $\mu\text{m}$ )	$\Delta\lambda$ ( $\mu\text{m}$ )
U	0.3663	0.065
B	0.4361	0.089
V	0.5448	0.084
R	0.6407	0.158
I	0.798	0.154
u	0.3596	0.057
g	0.4639	0.128
r	0.6122	0.115
i	0.7439	0.123
z	0.8896	0.107
Y	1.02	0.12
J	1.20	0.36
H	1.60	0.30
K	2.19	0.40
H <sub>2</sub>	2.12	0.03
Br $\gamma$	2.16	0.03
K <sub>cont</sub>	2.17	0.03
PAH	3.27	0.06
nbL	3.59	0.07

**Table 8:** Currently available filters with their wavelengths.

conditions. PIs are requested to go through the “Science observing policy” document available at [https://www.aries.res.in/dot/documents/DOT\\_Observing\\_Policy\\_Document.pdf](https://www.aries.res.in/dot/documents/DOT_Observing_Policy_Document.pdf) for detailed information.

- All the PIs submit their proposals before the submission deadlines mentioned above, and the observation time will be allotted by the Time Allocation Committee after the review.

## 2 Part B: Instructions for the observers before conducting the observations

- All PIs are requested to prepare the observation plan before the allotted observation night according to the specifications mentioned above.
- Exposure times can be calculated using the available exposure time calculators.:
  1. TANSPEC: <https://tanspectime.streamlit.app/>
  2. ADFOSC: <http://103.201.133.72:50008/etgui/>
- For the observers who will be present on-site:
  1. Arrive at Devasthal before evening and visit the control room to request the day staff to prepare the instruments according to the specified requirements.

□ For the observers who requested service mode observation:

1. Please send the complete observation plan in the prescribed format to [dot@aries.res.in](mailto:dot@aries.res.in) and [saaurabh@aries.res.in](mailto:saaurabh@aries.res.in) at least two days before the observation night. The responsible person will contact you if additional information is needed.
2. The observer should be available remotely during the observation to provide instructions to the observatory staff, if necessary.
3. The observation plan should include:
  - Name of the instrument to be used.
  - Object list.
  - Identification chart
  - Visibility plot
  - Information about slits.
  - Grating information.
  - Calibration lamp information.
  - Mention if lamp spectra are required at different positions.
  - Filter information.
  - Exposure time for objects and lamps.
  - Coordinates of the standard star, if required.
  - Pre-calculated overhead time.
  - Any other required information

The prescribed format of the observation plan can be downloaded from the DOT website ([link to prescribed format](#)).

### 3 Part C: DOT acknowledgement policy

- **To use data observed using DOT:**

Observers/Proposers/Authors are encouraged to mention 3.6m DOT in the title or abstract of the research publications and also quote inline in the body of text when first appropriate:

"Based on observations obtained at the 3.6m Devasthal Optical Telescope (DOT), which is a National Facility run and managed by Aryabhata Research Institute of Observational Sciences (ARIES), an autonomous Institute under the Department of Science and Technology, Government of India."

In addition, it is mandatory to cite the papers of the telescope and the instrument used. The papers of the telescope and several instruments are listed below:



1. **Telescope:** 3.6-m Devasthal Optical Telescope Project: Completion and first results,  
Kumar et al., 2018, Bulletin de la Société Royale des Sciences de Liège, 87, pp. 29-41, [ADS link of paper](#).
2. **IMAGER:** Photometric calibrations and characterization of the 4K ×4K CCD Imager, the first-light axial port instrument for the 3.6m DOT,  
Kumar et al., 2022, JApA, 43, 27K, [ADS link of paper](#)
3. **ADFOSC:** First-light images from low dispersion spectrograph-cum-imager on 3.6-meter Devasthal Optical Telescope,  
Omar et al., 2019, Current Science, 116, 1472-1478 [ADS link of paper](#)
4. **TANSPEC:** TANSPEC: TIFR-ARIES Near-infrared Spectrometer,  
Sharma et al., 2022, PASP, 134, 1038, id 085002, 23pp, [ADS link of paper](#)
5. **TARCAM II:** TIFR Near Infrared Imaging Camera-II on the 3.6 m Devasthal Optical Telescope  
Baug et al., 2018, Journal of Astronomical Instrumentation, 7(1):1850003–1881, [ADS link of paper](#)

- **When using data observed in service mode:**

Observers/Proposers/Authors are additionally requested to acknowledge the DOT observation staff for carrying out the observation in an Acknowledgement section as follows:

"We acknowledge the scientific and technical staff of the 3.6m Devasthal Optical Telescope (DOT), a national facility operated and managed by the Aryabhata Research Institute of Observational Sciences (ARIES), an autonomous institute under the Department of Science and Technology, Government of India, for their support in facilitating service mode observations and providing the observational data."