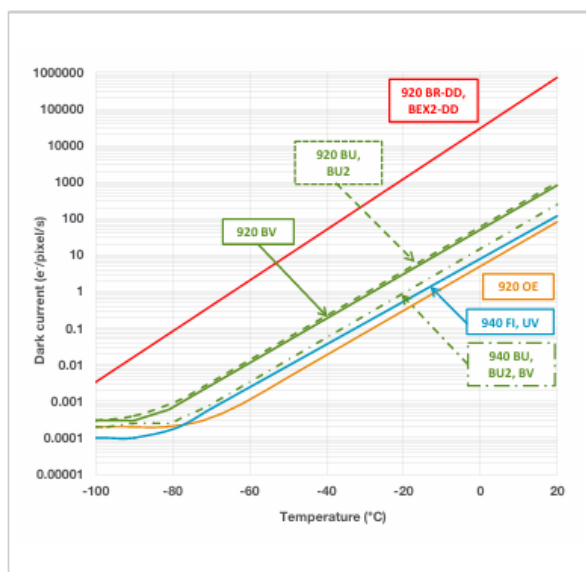


LRS Proposal Cycle14 Specification

Low Resolution Spectrograph Mark IV Specification

- Spectrum domain: 400 - 800 nm
- Observation mode: Slitless and Long slit
- Spectrum Resolution: $R \sim 300\text{-}750$ at 600 nm
- Dispersion: 4 Angstrom per pixel; usable coverage 4000 - 8092 Angstrom (1024 spectral pixels)
- Resolution by slit at 600 nm: Slit A (1.8") $R \sim 750$, Slit B (2.7") $R \sim 500$, Slit C (4.5") $R \sim 300$
- Only the central 3 arcmin of the slit is illuminated (vignetting); detector rows beyond appear as overscan-like dark bands
- Slit size:
 1. Slit A: mechanical width 200 micron, mechanical length 20.0 mm unobstructed. On-sky angular width 1.8 arcsec, On-sky angular length 3 arcmin
 2. Slit B: mechanical width 300 micron, mechanical length 20.0 mm unobstructed. On-sky angular width 2.7 arcsec, On-sky angular length 3 arcmin
 3. Slit C: mechanical width 500 micron, mechanical length 20.0 mm unobstructed. On-sky angular width 4.5 arcsec, On-sky angular length 3 arcmin
- Plate scale 0.9 arcsec per pixel (unbinned)
- Main Detector specification:
 1. Model: Newton Andor DU920 BEX2-DD
 2. Array size: 1024x 256
 3. Pixel size: 25.5 x 25.5 microns
 4. Gain: 4 e-/ADU; 16-bit digitisation (full well 65,535 ADU); bias level ~ 300 ADU; response linear to 95% of full well
 5. Dark current: 0.08 e-/pix/s at -80 C; 0.003 e-/pix/s at -100 C
 6. Readout modes: slow 50 kHz / medium 1 MHz / fast 3 MHz with read noise 4 / 12 / 15 e- and readout time 7 / 3 / 1 s per frame; slow recommended for faint targets

Dark Current ⁺⁹



Quantum Efficiency Curves ⁺¹⁰ 25°C

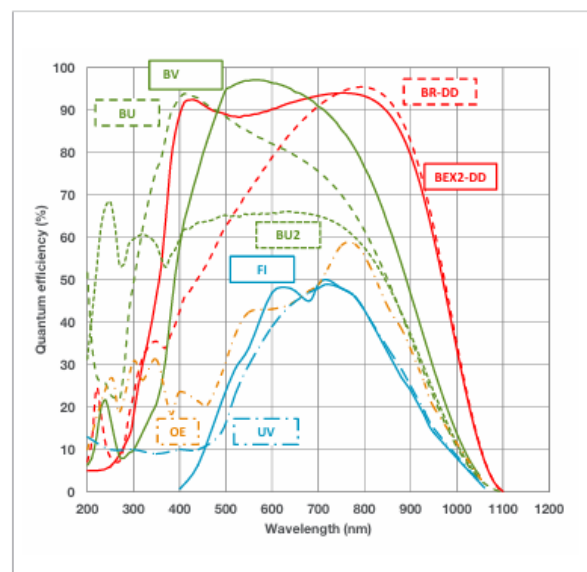


Figure 1: LRS' main CCD characteristic dark current and quantum efficiency

LRS @ 2.4-m TNT — point source S/N vs integration time
1.8" slit · seeing 1.1" · altitude 60° · photometric · slow readout · -80 °C

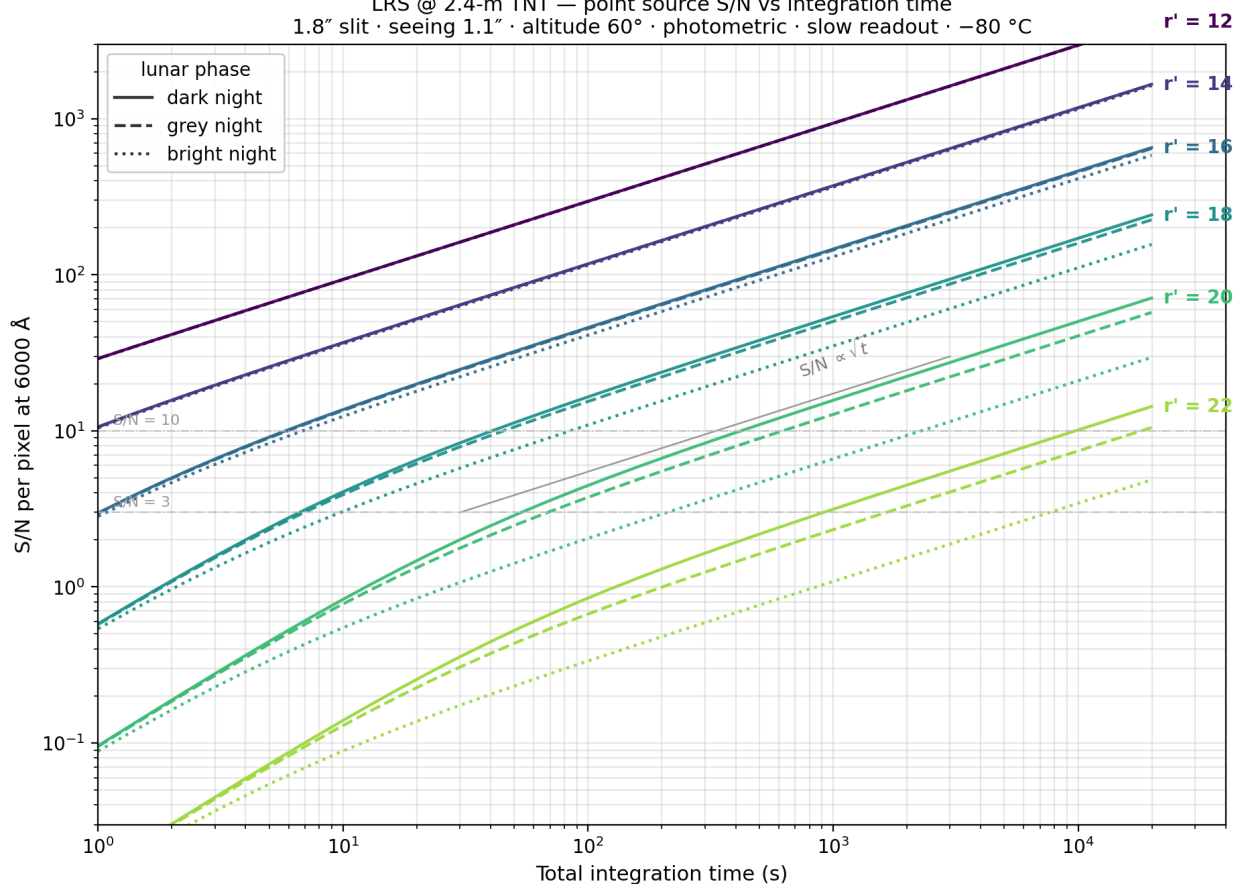
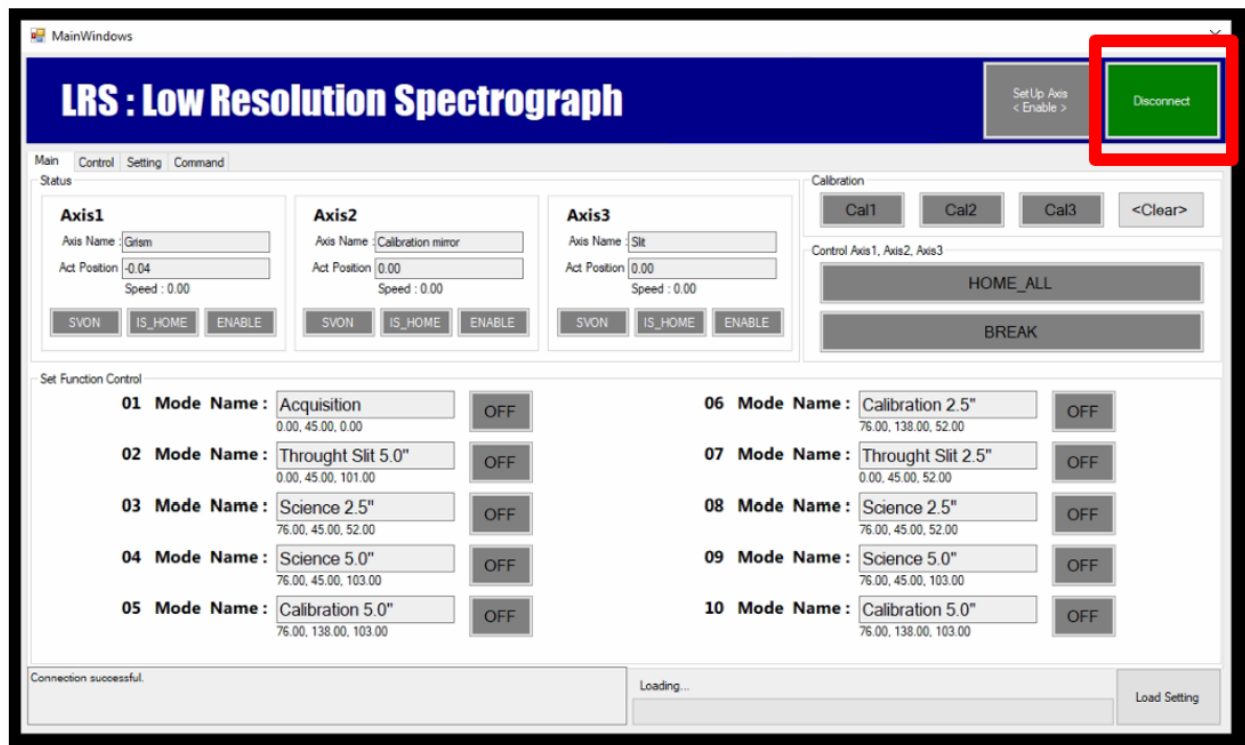


Figure 2: SNR as a function of time for a point source in various observing conditions with LRS at the TNT

- Exposure-Time Calculator and proposal planning
 1. Plan observations with the NARIT LRS Exposure-Time Calculator (LRS_ETC.ipynb; contact krittapas@narit.or.th or be on the lookout at <https://github.com/krc2020>). It provides a research-grade template library (Pickles stars; Kinney-Calzetti, SDSS, and Brown+2014 galaxies; AGN/QSO composites), Galactic extinction, redshifting to $z = 9$, point/extended-source normalisation, observing conditions (moon, clouds, seeing, airmass), and saturation/noise warnings. Output: S/N vs wavelength for a given $N \times t$, or the required time for a target S/N . Figure 2 summarises point-source performance.
 2. Target visibility: targets must culminate above 30 deg altitude at the TNO (declination -41 to +79 deg); above 50 deg (declination -21 to +59 deg) is recommended (airmass < 1.3).
 3. Requested time = (on-source + overheads) / 0.65, i.e. a 35% weather/mechanical margin. Overheads per target: slew 120 s; 3 rounds of offset + acquisition (~120 s); thru-slit check 30 s; readout per frame; operator communication up to 5 min per 1-h block; one standard-star round (up to 10 x 30 s) every 2 h. The ETC computes the recommended request automatically.
 4. Calibration: daytime bias/dark/flat/arc (~1 h per half night) is not charged. Night-time calibration, if required, is charged at a fixed 1 h per half night (outside the weather margin) - state the need in the proposal.
- Guiding Unit specification
 1. Pickoff mirror
 2. Model: ZWO ASI6200MM Pro (mono)
 3. Full frame 36 x 24 mm
 4. CMOS Sensor IMX455
 5. Pixel Size: 3.76 micron
 6. Read noise 1.2e-3.5e
 7. Resolution 9576 x 6388
 8. FOV of 4'x2.33'
- Mechanical shutter with the quickest interval of 1 ms
- Liquid cooling down to -100 C and dark current of 0.003e-/s/pix
- Slit position drifting at $x=530 \pm 1$ with different PA
- Unified autoguiding and robotic-operation software (new for Cycle 14): one modular platform now integrates guider control, science-camera acquisition, plate solving (astrometry.net), drift estimation, and telescope communication. After an initial plate solve, offsets (dRA, dDec, dPA) are estimated continuously from groups of three guider frames by sub-pixel centroid matching and fed back to the TCS in closed loop; science exposures start automatically once guiding is stable. The same framework operates CoLoRS on the Thai Robotic Telescope network (Chomchuen et al., Proc. SPIE, 2026).
- Panda controller: specification and software interface
 1. Calibration source: Cal3: Tungsten, Cal2: HgAr and Cal1: Neon (Spectral technology instrument company)
 2. Sliding rail control: Grism position, Slit mode, and Calibration mode

- a. Software interface (will be updated before the start of Cycle 14):



- Interface MaximDL and ASI studio
- MaximDL / ASI Studio remain available as fallback interfaces; routine Cycle 14 operations use the unified platform above.