

# Astrophotography terms and concepts



## Light pollution

- reduces contrast and visibility

- Bortle scale, a system for classifying the darkness of the night sky





## <u>Telescope</u>

- OTA: "optical tube assembly"

- aperture: diameter of lens or mirror

- focal length: distance from lens/mirror to point where light converges to form the image



- focal ratio (f-number): ratio of focal length to aperture



## Mounts - types

- Alt-azimuth: simple up/down and left/right movement
- Equatorial: aligned with earth's rotational axis
- Go-to: computerized mount that can find and track celestial objects



## Mounts - functions

- Polar alignment: aligning the axis of an equatorial mount to the celestial pole



- Tracking: The ability of a mount to follow the apparent motion of celestial objects caused by Earth's rotation.



## <u>Cameras</u>

- dSLR and mirrorless
- phone cameras
- dedicated astro cameras
  - planetary and deep sky
  - cooled and uncooled
  - one-shot colour (OSC) and mono
  - sensor size: cropped to full frame



## **Filters**

- light pollution filters; block specific wavelengths of artificial light

- broadband: luminance, red, green, blue
- narrowband: Ha, O3, S2
- multiband filters (bi, tri, quad band)
- solar filters



## Focussing

- by eye
- bahtinov mask



#### - electronic auto focusser







-coma corrector: corrects coma in Newtonian reflectors

- field flattener: corrects curvature of field, ensures sharp stars across the entire field

- focal reducer: a system of converging lenses that focusses the light into a smaller area at the focal plane, reducing the telescope's focal length and resulting in a wider field of view and a smaller f ratio (gathers more light efficiently, = shorter exposure times)

- guide camera & guide scope (autoguiding)
- dew heaters



- combining multiple exposures to create a master image.

- increases signal-to-noise ratio (SNR) and reveals fainter details

- noise:

- shot noise: randomness in the arrival of photons. Unavoidable
- read noise: noise from the camera's electronics. Constant, independent of exposure light being gathered
- dark current noise: generated by the sensor heating up during long exposures
- light pollution
- signal is constant across multiple exposures and will add up linearly
- noise is random; when combined across many images tends to cancel out Meeting 2, 14 July 2025





Single 3-minute exposure

Stacked 139 3-minute exposures



- Bias: images taken with the shortest possible exposure time with the lens cap on, used to calibrate the sensor's electronic read noise.

- Dark frames: Images taken with the same exposure time, temperature and ISO/gain as the light frames, with the lens cap on, used to calibrate thermal noise, amp glow and hot pixels.

- Flat Frames: Images taken with even illumination across the sensor, used to correct for vignetting and dust motes.



#### Bias frames







#### Dark frames

Gray 1:6 Dark\_None\_1x1\_gain\_200\_600sec\_frame10 | Dark(None)\_1x1\_gain\_200\_600sec\_frame10.... 





#### Flat frames

Master flat frame

#### Flat-corrected Master light frame





#### **Stretching**

- most of the faint, low intensity data in an image will be contained within the dark, low end of the histogram

- "stretching" the histogram remaps the data from a narrow brightness range to a wider range, allowing details to become visible



Live demo

Here are 2 clips demonstrating stretching. No matter what software you use, the principle and process is the same.

Pixinsight: https://youtu.be/zLXnxllJJtw?si=y69vT3z8GP\_AfUm4

Siril: https://youtu.be/joZvl-GMuWg?si=LowFAC7FFv3vAUc7



## **Dithering**

- a technique that involves slightly shifting the telescope's pointing between exposures by a few pixels

- By shifting the image frame, hot pixels, cosmic rays, and other noise artifacts appear in different locations in each exposure.

- When the images are stacked, the noise artifacts are distributed across the frames, and the stacking process can effectively remove them



### **Gradient reduction**

- remove the uneven brightness variations, often caused by light pollution or incorrect flat fielding, that can appear in the background of images. (see next slide for better visualization of gradient)





## **Gradient reduction**

These images are the same as on the previous slide, but over-stretched to emphasise the gradient

