ASTC02 - LECTURE 3 - PROF. HANNO REIN

PRACTICAL 1 & 2
COORDINATE SYSTEMS

PRACTICAL 1

Celestial Objects

- Get familiar with Stellarium
- Get familiar with the telescope
- Observe as many different objects as possible within a short amount of time
- Understand what you’re looking at

PRACTICAL 1

Asteroid

PRACTICAL 1

Comet

PRACTICAL 1

Moon

PRACTICAL 1

Planet

PRACTICAL 1

Star

PRACTICAL 1

Binary star

PRACTICAL 1

Planetary nebula

PRACTICAL 1

Star forming nebula

PRACTICAL 1

Open cluster

PRACTICAL 1

Globular cluster

PRACTICAL 1

Galaxy

PRACTICAL 1

For the report:

- Submit by noon, Thursday next week. No late submissions.
- E-mail or paper submissions (slide it under my door if I'm not in).
- If you work together, be very clear about who did what.
- I want to see that you understand what you did/saw.
- Describe what you **see** in the images. If the object of interest is not obvious to see, highlight with an arrow. Provide evidence that the object is the right one (stellarium screenshot, astrometry.net).
- Not just the content counts. Polish the report. Make it look nice.

PRACTICAL 2

Stellar Magnitudes

- Very different practical!
- Not just taking picture. You need to think about what pictures you need to take beforehand.
- Pay close attention to the settings you use for the camera. If they are not right, then the pictures are useless.
- Manual settings for exposure time and gain.
- No “magic” button for long term exposures.
- Manual dark frame subtraction.

PRACTICAL 2

Photometry

- Measure the amount of light (number of photons/energy) we receive from a given object.
- Depends on:
  - Object
  - Atmosphere / Light pollution
  - Telescope (size, transmission)
  - Camera properties (pixel size, temperature)

Calibration
Dark frame
Flat field

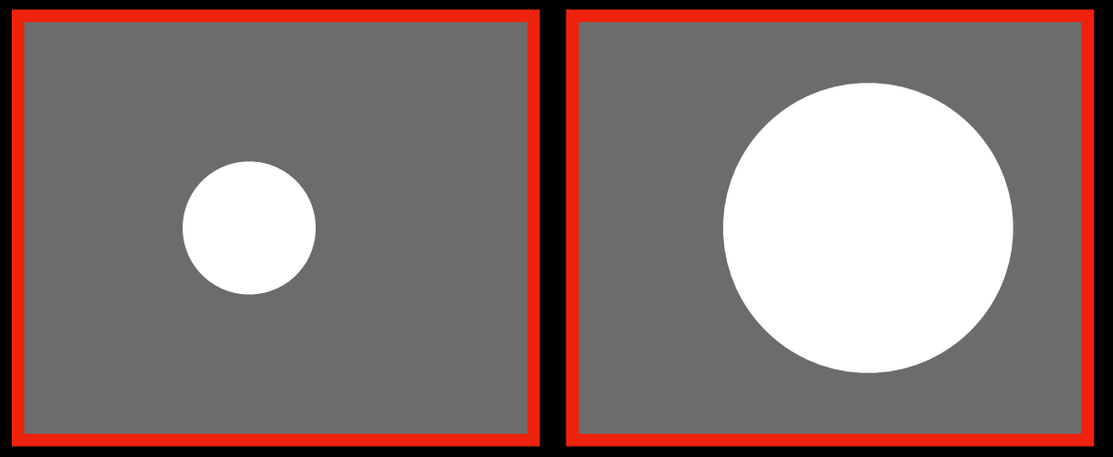
  - Camera settings
    - Exposure time
    - Gain / amplification

Keep fixed!

PRACTICAL 2

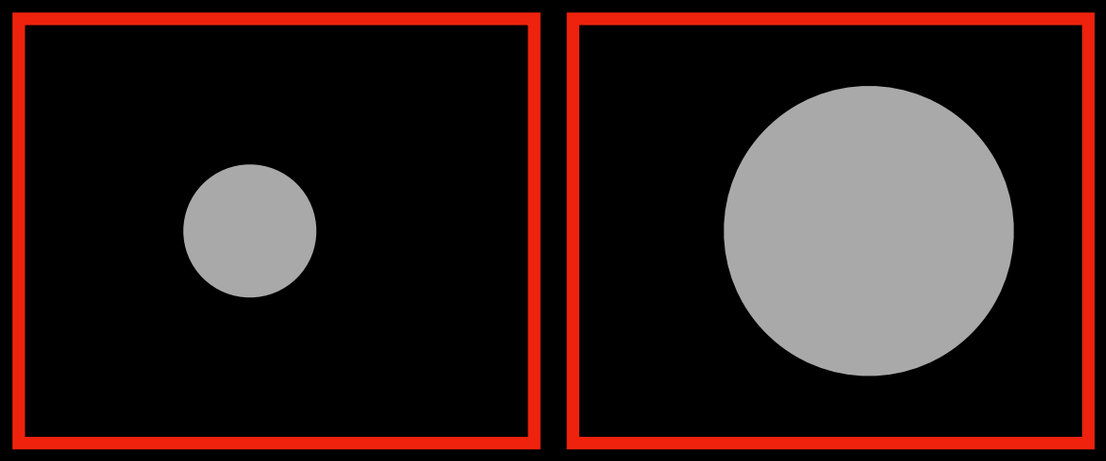
Photometry pipeline

1. Take an image of the stars (same settings!)



2. Take a dark frame with the lid on (same settings!)

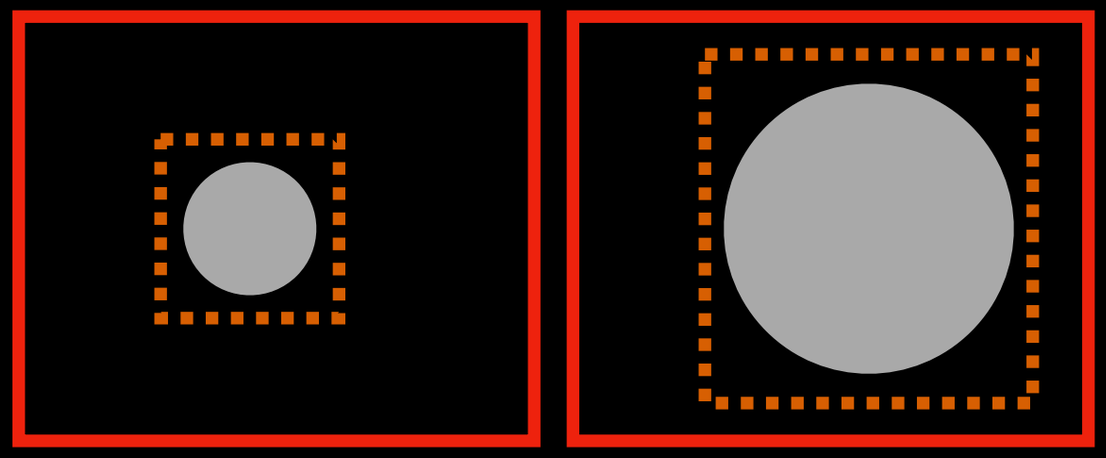
3. Subtract dark frame from images



PRACTICAL 2

Photometry pipeline

1. Sum up pixel values in an area around the star to get the flux F.



2. You can now calculate the ratio of fluxes. Knowing the apparent magnitude of one star, you can calculate the apparent magnitude of the other.

$$m_i = -2.512 \log_{10}(F_i) + z_p$$

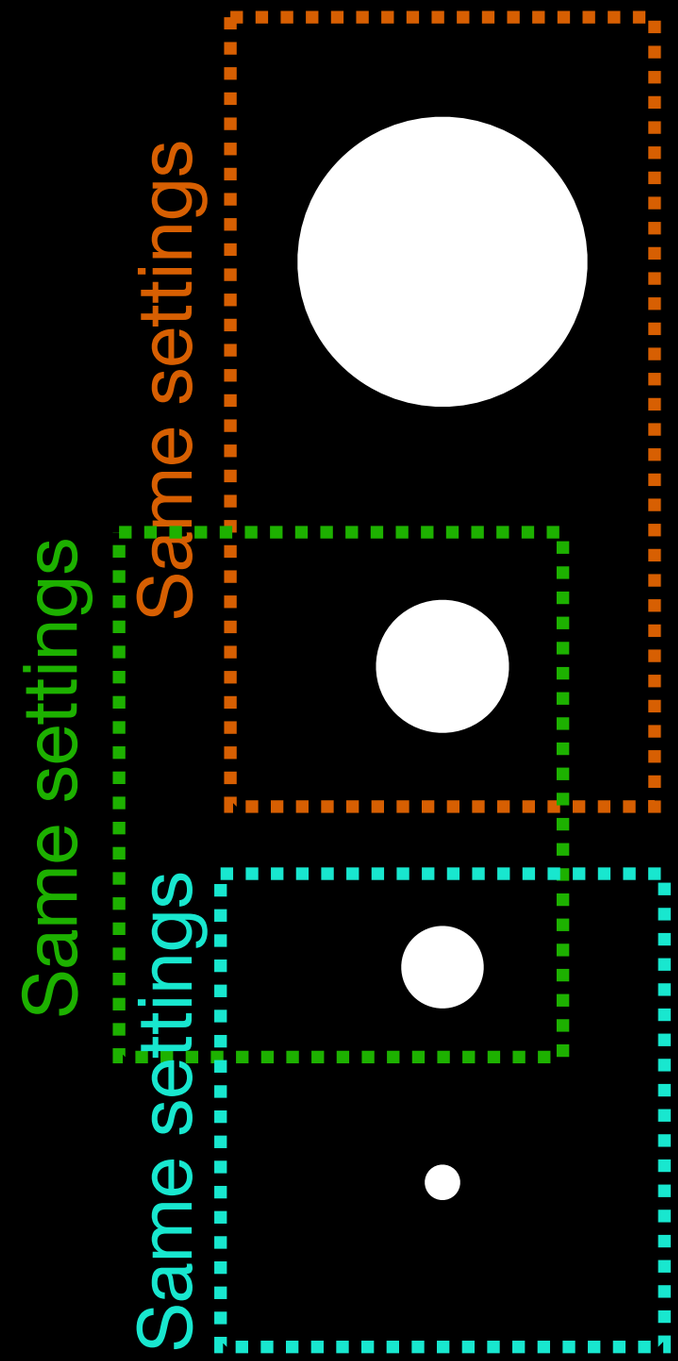
3. If you know the distance to the object, you can calculate the absolute magnitude.

$$M = m + 5 - 5 \log_{10}(d)$$

PRACTICAL 2

Observation plan

- Brightness between objects varies a lot (logarithmic scale)
- Can not use same settings to get images of all objects
- Need to do it in steps. You need to plan your observations accordingly.



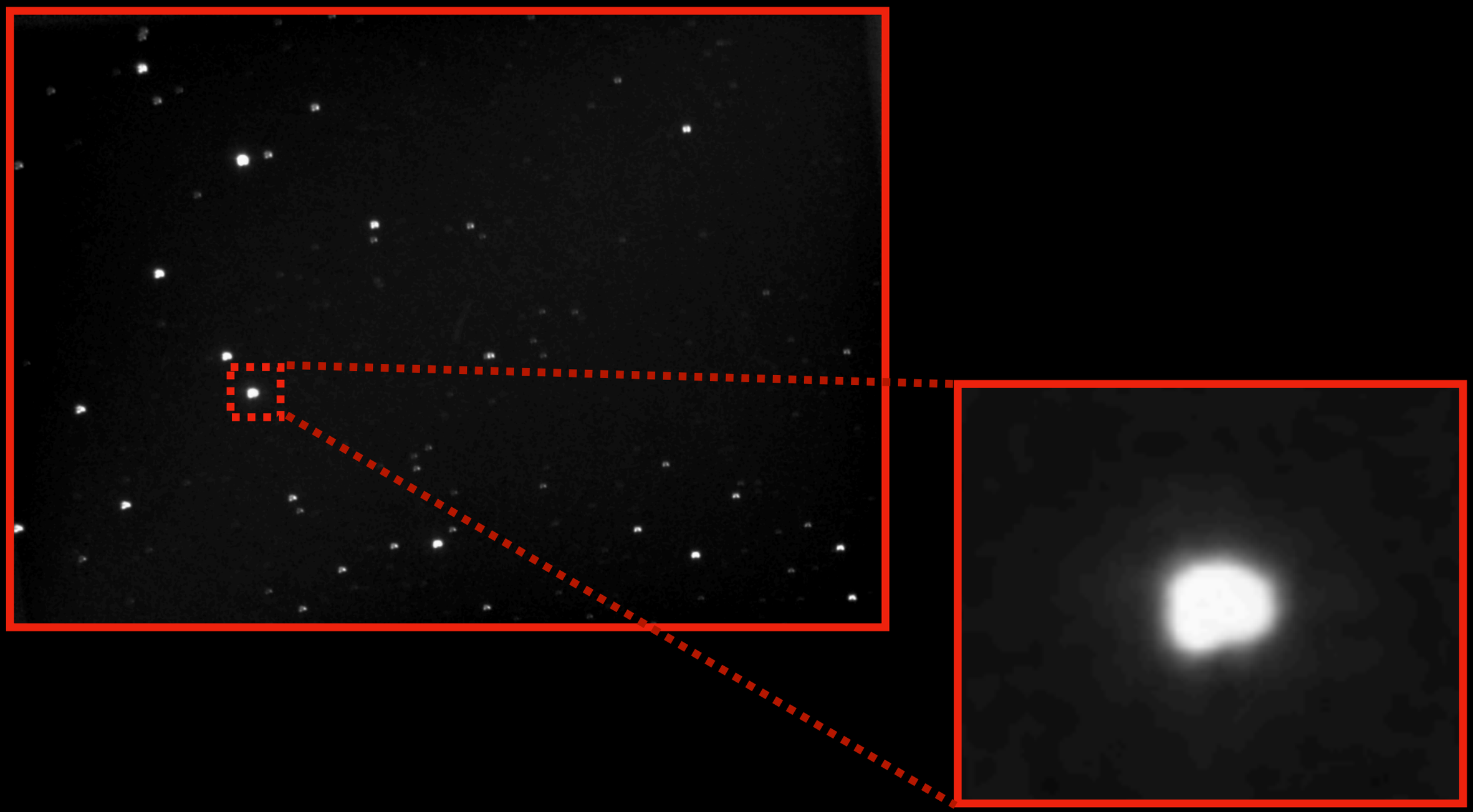
PRACTICAL 2

No saturated images

- The camera is collecting light for a fixed amount of time (exposure time)
- There is a maximum amount of light it can collect. Then it reaches saturation.
- If any additional light comes it, it will not be recorded.

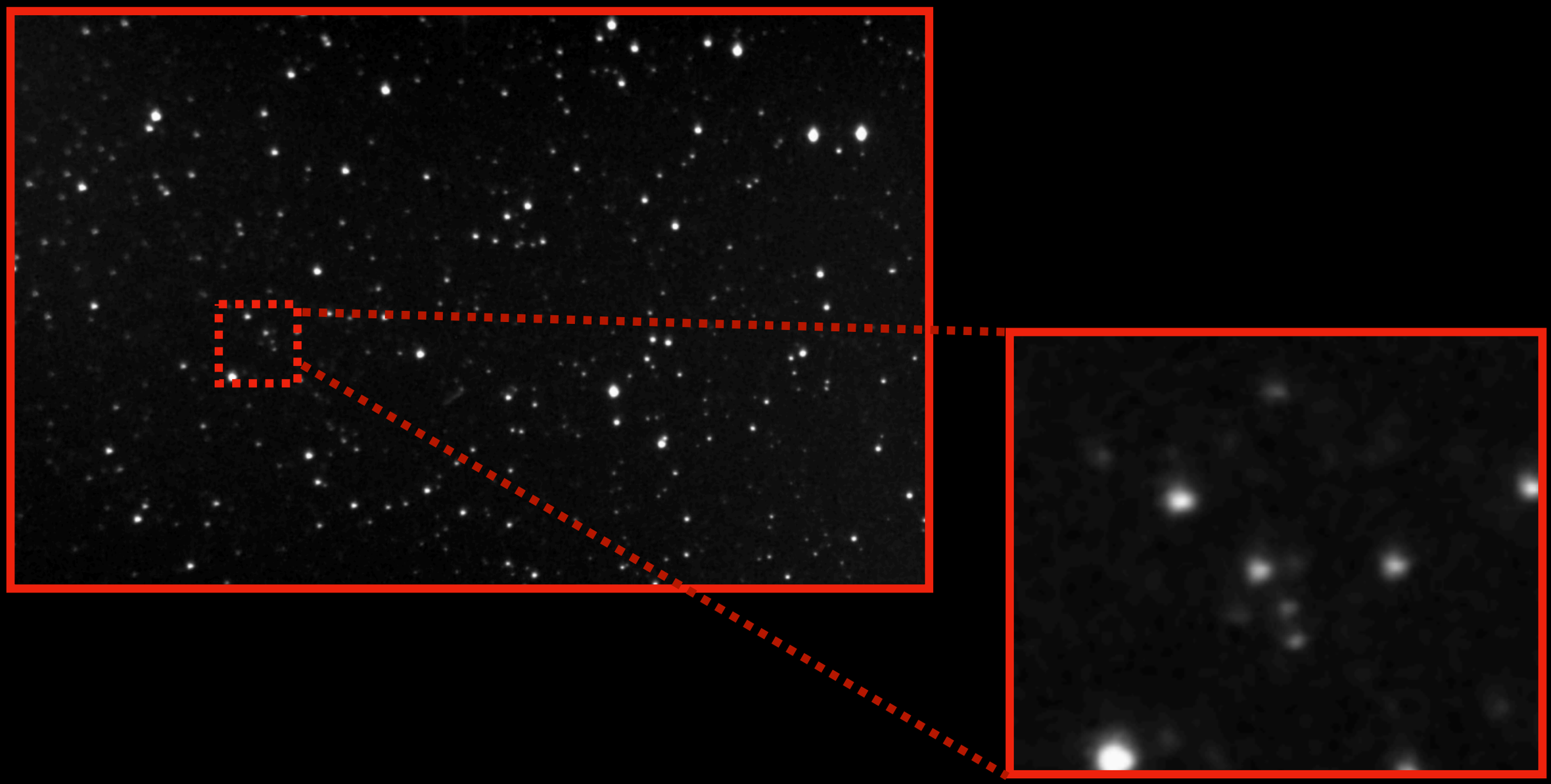
PRACTICAL 2

Example of a saturated image



PRACTICAL 2

Example of an unsaturated image



PRACTICAL 2

Tip: Defocus

- You can slightly defocus the telescope to spread the light of a star over more pixels.
- Center pixels less saturated.
- Don’t defocus too much otherwise you can’t separate one star from another. Also telescope will not orient itself properly.

PRACTICAL 2

Tip: Stacking

- If an object is too dim to see in one image, take multiple ones with the same settings, add them up.
- Increases signal to noise.
- Can be tricky. Need alignment, etc.
- Software: Python (by hand), Nebulosity, CDCciel

PRACTICAL 2

A lot of things to get right. What to focus on?

1. Get some data to work with for all stars.
2. Same settings for relative measurements.
3. Unsaturated images.
4. Dark frames.
5. Defocus.
6. Stacking.

Celestial Spheres

CELESTIAL SPHERES PRACTICE

Problem 1

Is Beetlejuice visible at 9pm tonight in Toronto?

CELESTIAL SPHERES PRACTICE

Answer 1

Is Beetlejuice visible at 9pm tonight in Toronto?

CELESTIAL SPHERES PRACTICE

Problem 3

What is the local sidereal time in Toronto right now?

CELESTIAL SPHERES PRACTICE

Answer 3

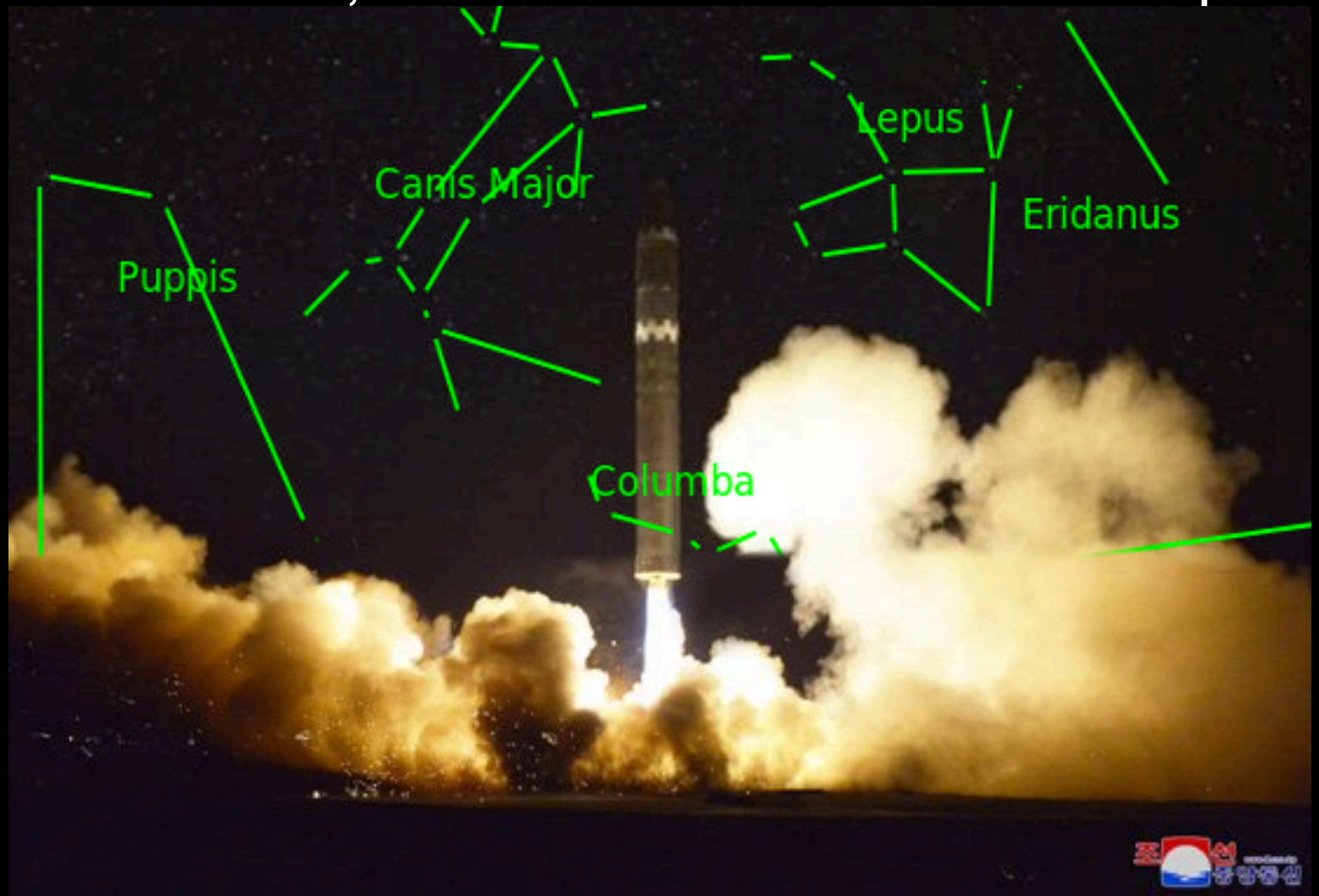
What is the local sidereal time in Toronto right now?

~ 18 h

CELESTIAL SPHERES PRACTICE

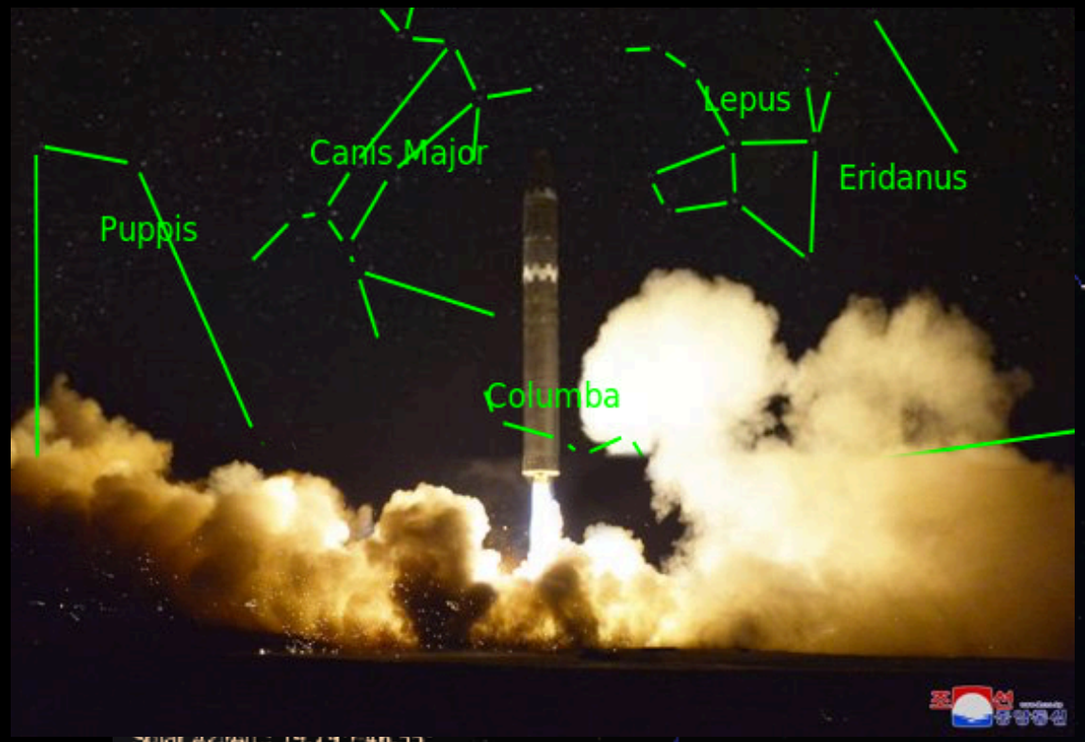
Problem 4

On November 28, 2017, 3am PYT (Pyongyang Time), North Korea launched an intercontinental ballistic missile. Is this image fake? If not, what azimuth is the camera pointing.



CELESTIAL SPHERES PRACTICE

Answer 4



CELESTIAL SPHERES PRACTICE

Problem 5

You're on a ship somewhere. You see Sirius rising for a very short time just above the southern horizon before setting again. Where are you? What is the date and time?

CELESTIAL SPHERES PRACTICE

Answer 5

You’re on a ship. You see Sirius rising for a very short time just above the southern horizon before setting again. Where are you? What is the date and time?

73 degrees north