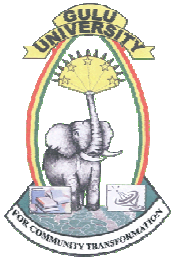
Course of General Astronomy



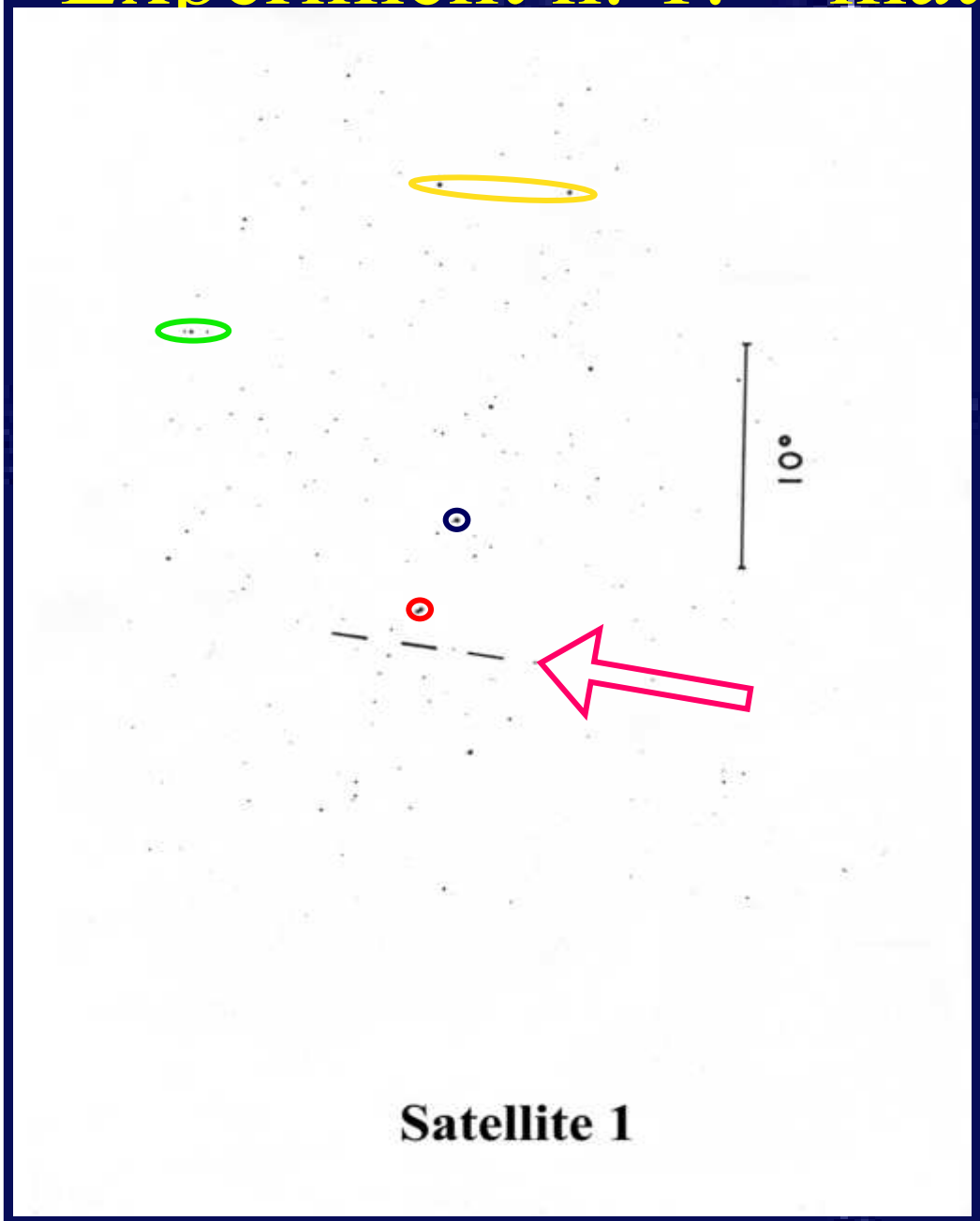
Gulu University

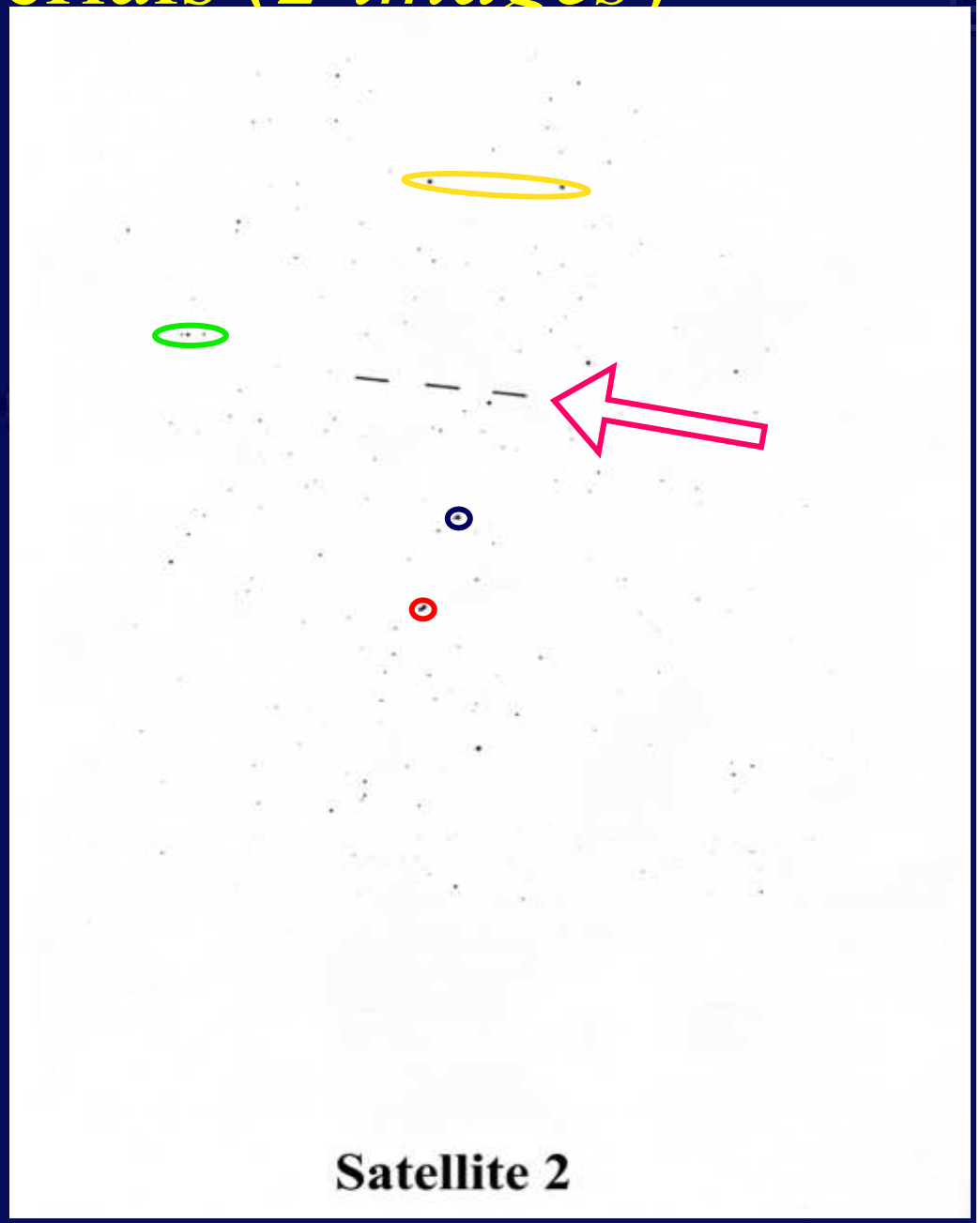
Naples FEDERICO II University

1

Distances, Images & Estimate of Earth's Mass

Experiment n. 1: materials (*2 images*)





The images "Satellite1" and "Satellite2" are simultaneous pictures of trails of an artificial satellite, acquired nighttime from two separated locations 228 Km apart.

(negative images, the dark sky is white while the stars are the black dots, the dashed trails are those of the satellite)

During both the exposures, the camera objective has been alternatively covered and uncovered for periods of 4 seconds.

Determine the mass of the Earth.

The *thin* … triangle !
Simplified mathematics

AB= r*2 sin (β/2)

CD≈ l = rα ≈ dα

(for small angles

sin α ≈ α)

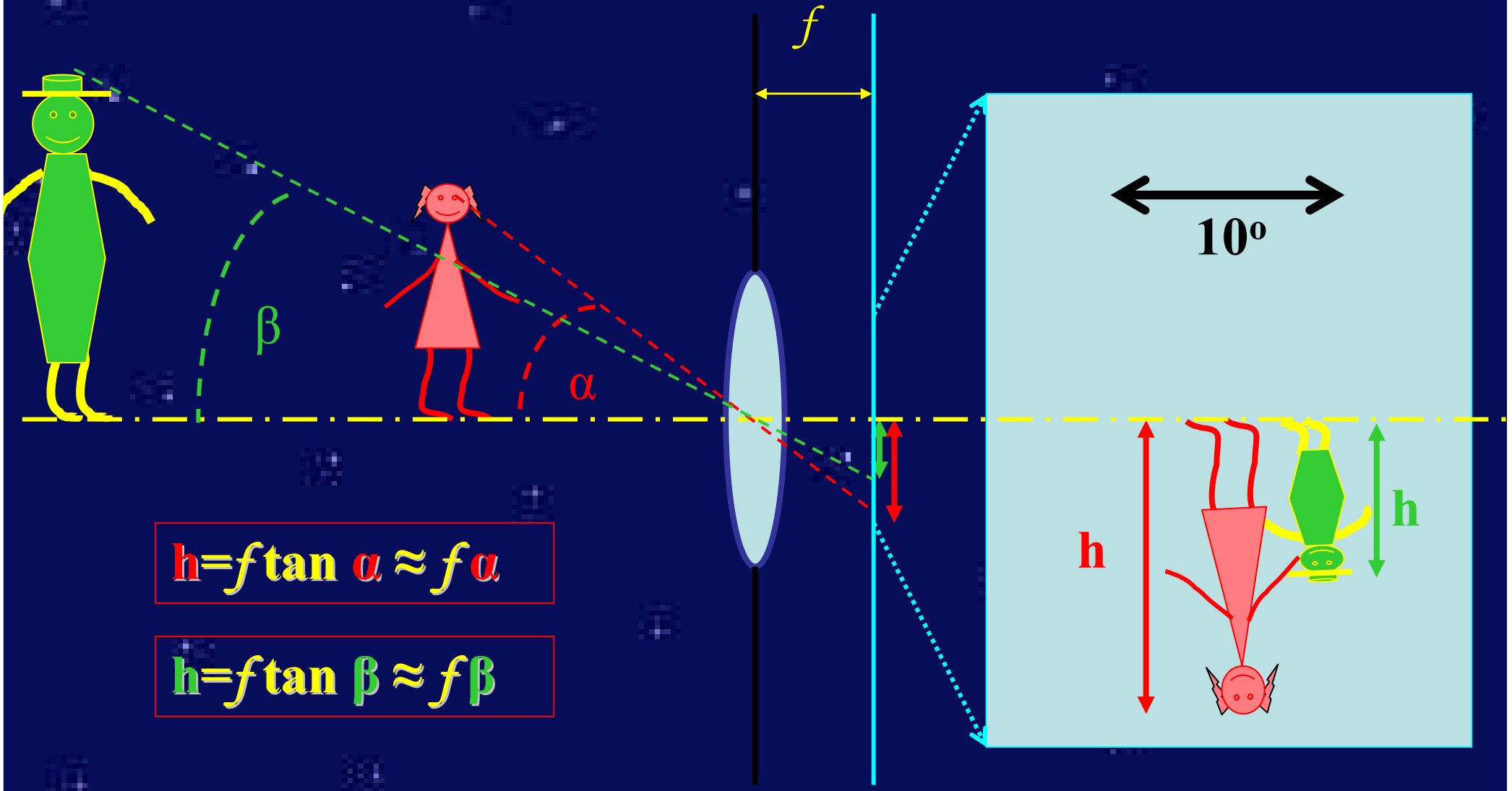
degr.	rad.	sinα	err. in sinα=α
57,30	1	0,8415	18,8%
28,65	0,5	0,4794	4,3%
14,32	0,25	0,2474	1,0%
7,16	0,125	0,1247	0,24%
3,58	0,0625	0,0624	0,064%

d=CD/α

1 2=1/206265 radians

Meaning of images

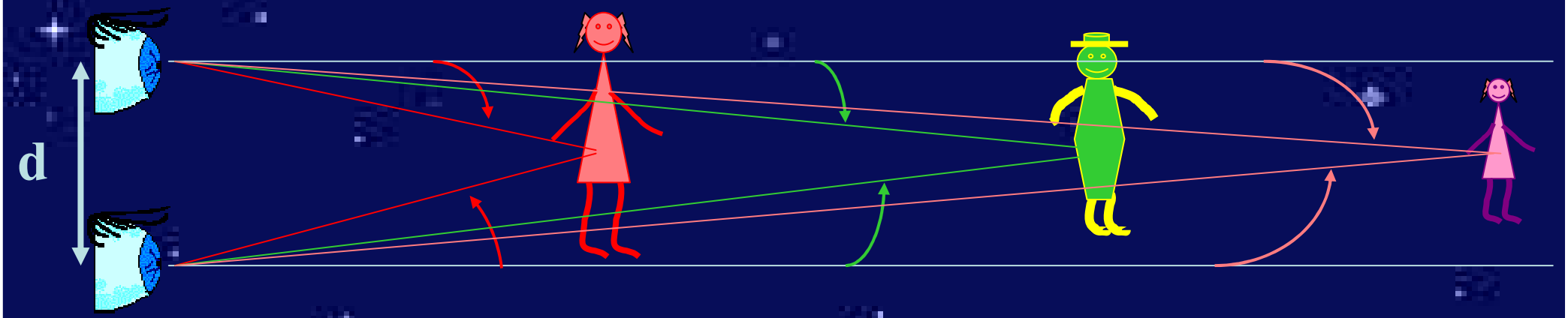
… more on meaning of images



$h = f \tan \alpha \approx f \alpha$

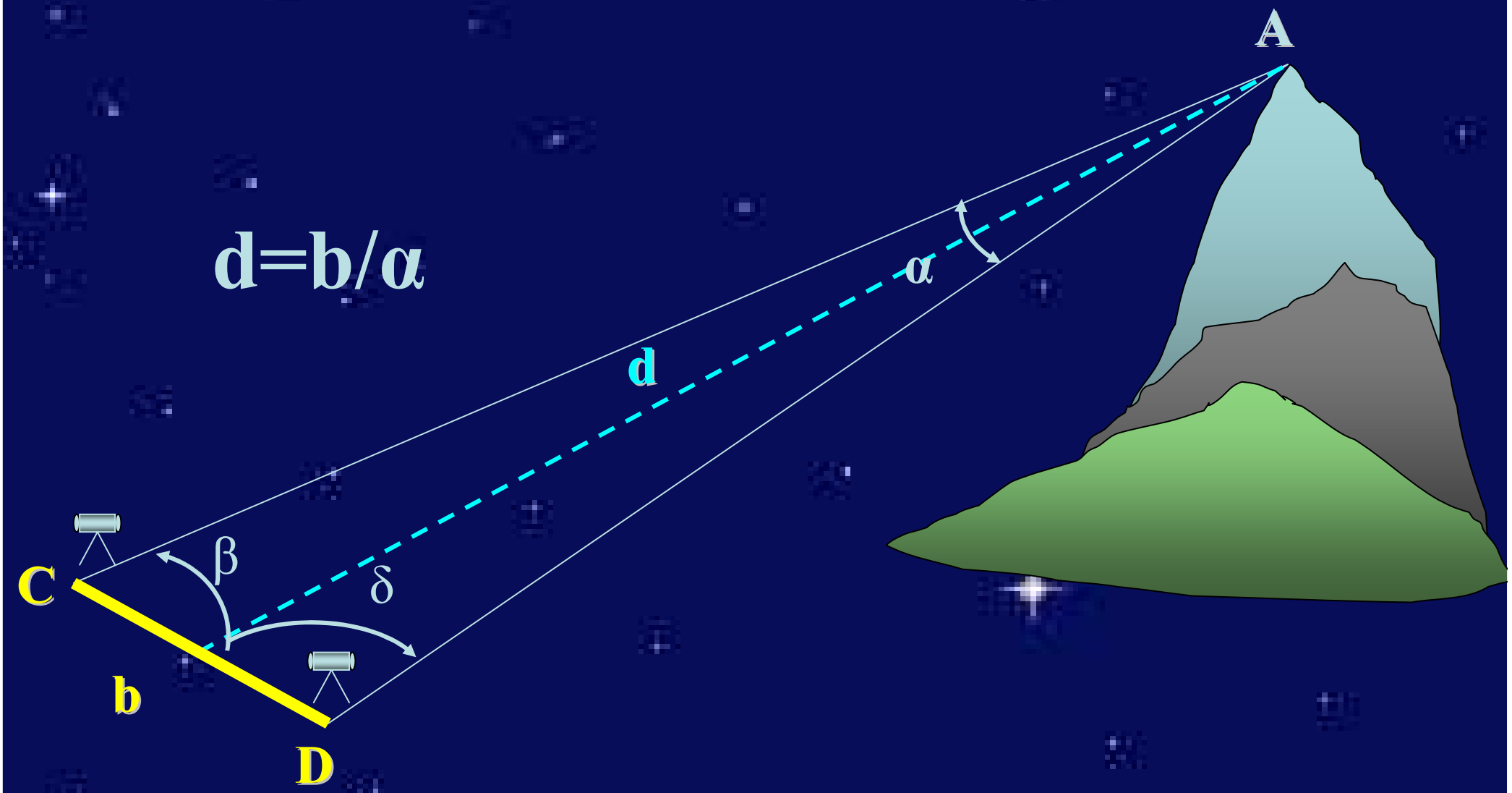
$h = f \tan \beta \approx f \beta$

Binocular vision

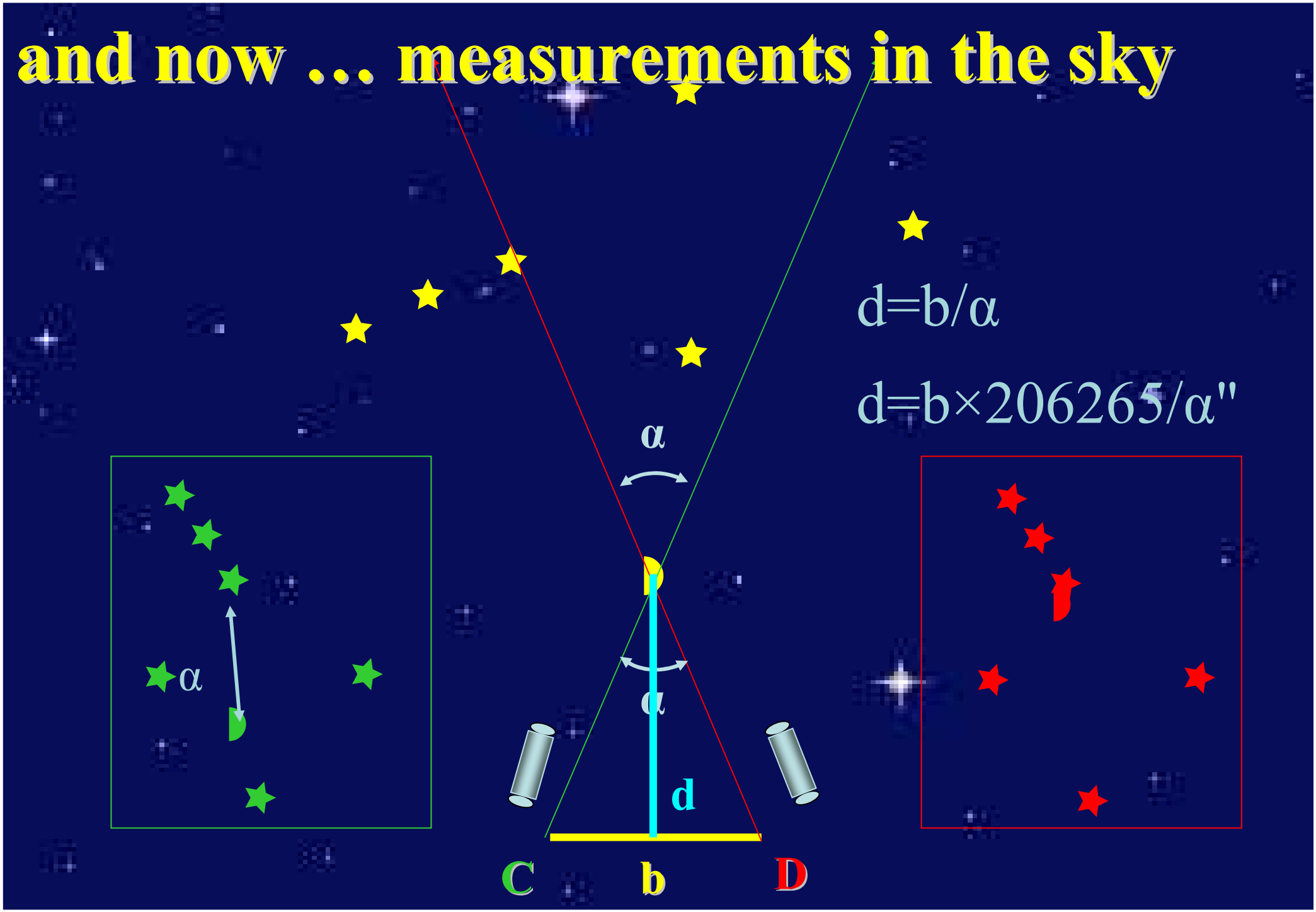


Distance to an inaccessible mountain

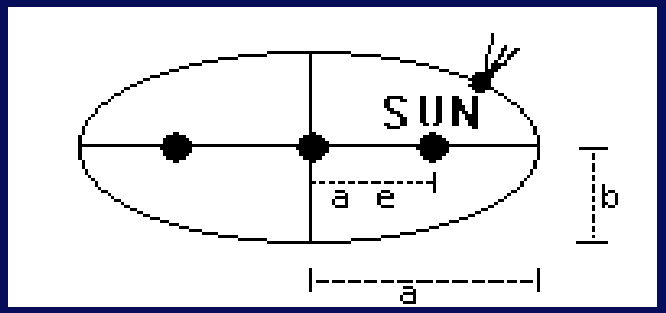
$d = b/\alpha$



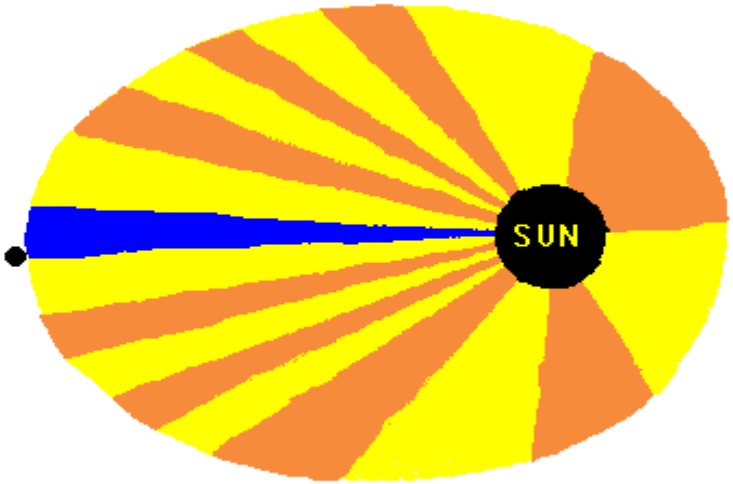
and now … measurements in the sky



The Kepler's Laws

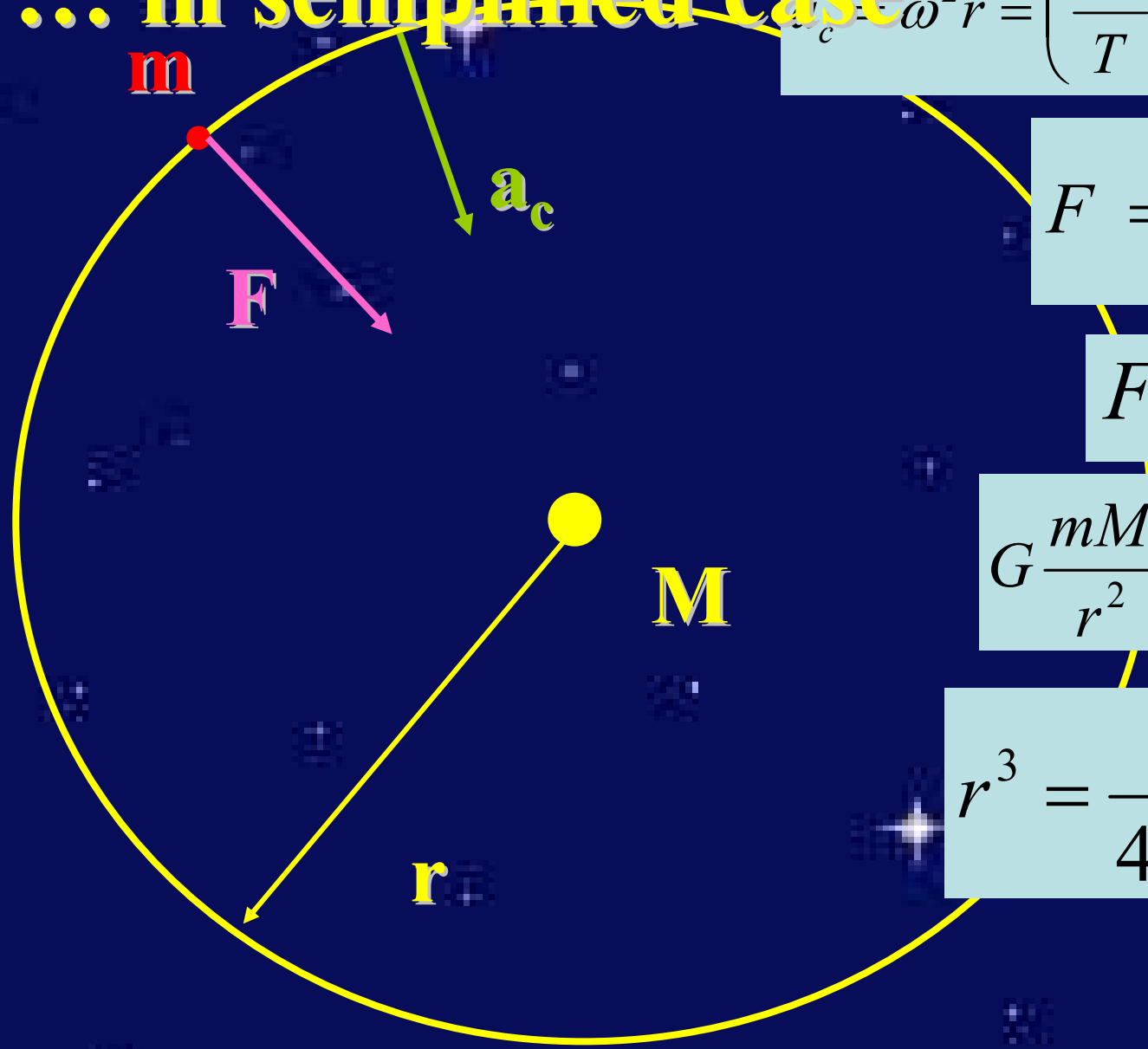


1. The orbit of a planet about the Sun is an ellipse with the Sun at one focus.
2. A line joining a planet the Sun (radius vector) sweeps out equal areas in equal intervals of time.
3. The squares of the periods of the planets are proportional to the cubes of their semi-major axes.



$$r^3 = \frac{G}{4\pi^2}(m+M)T^2$$

Derive … in semplified case



$$a_c = \omega^2 r = \left(\frac{2\pi}{T}\right)^2 r = \frac{4\pi^2 r}{T^2}$$

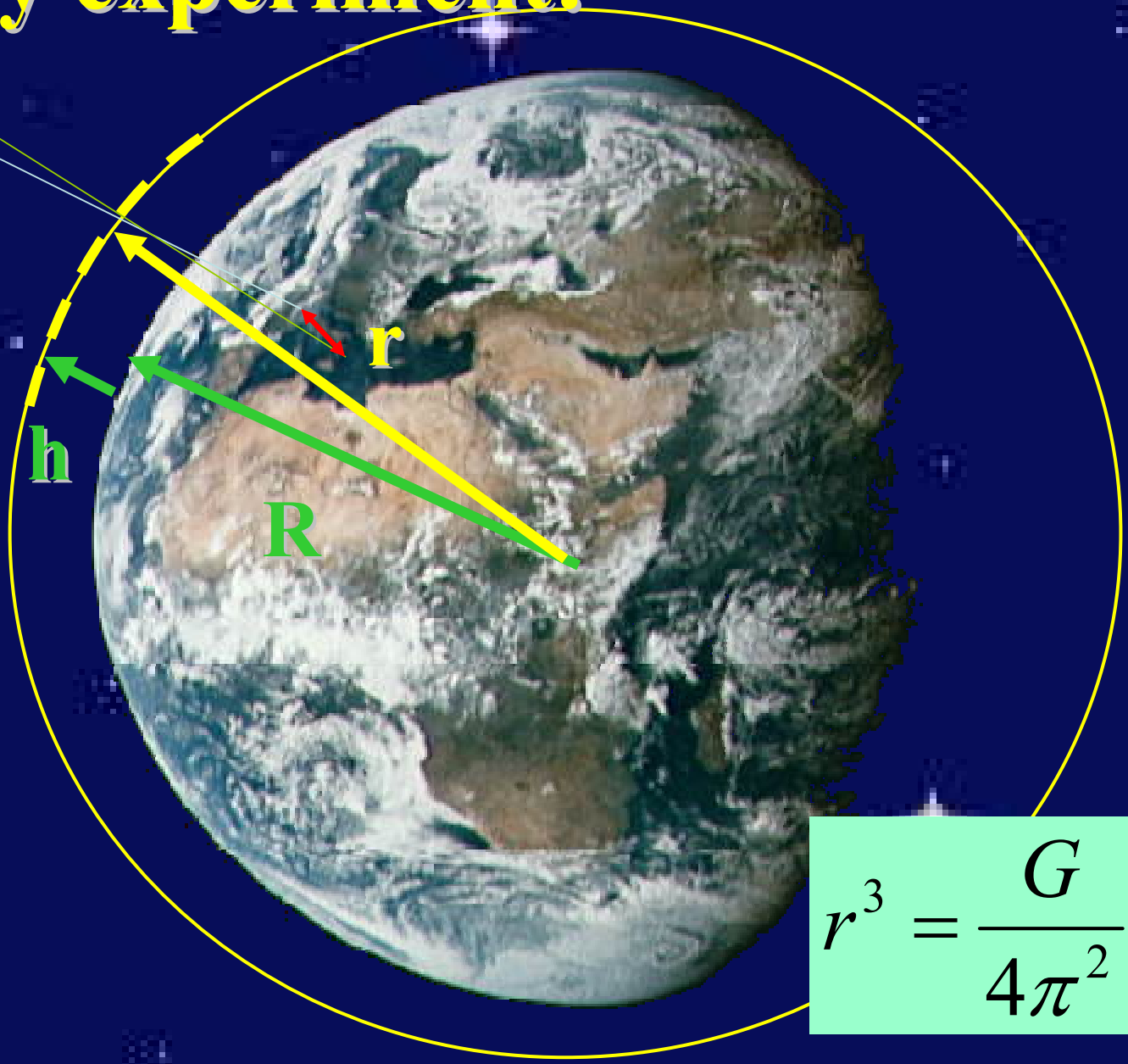
$$F = G\frac{mM}{r^2}$$

$$F = ma_c$$

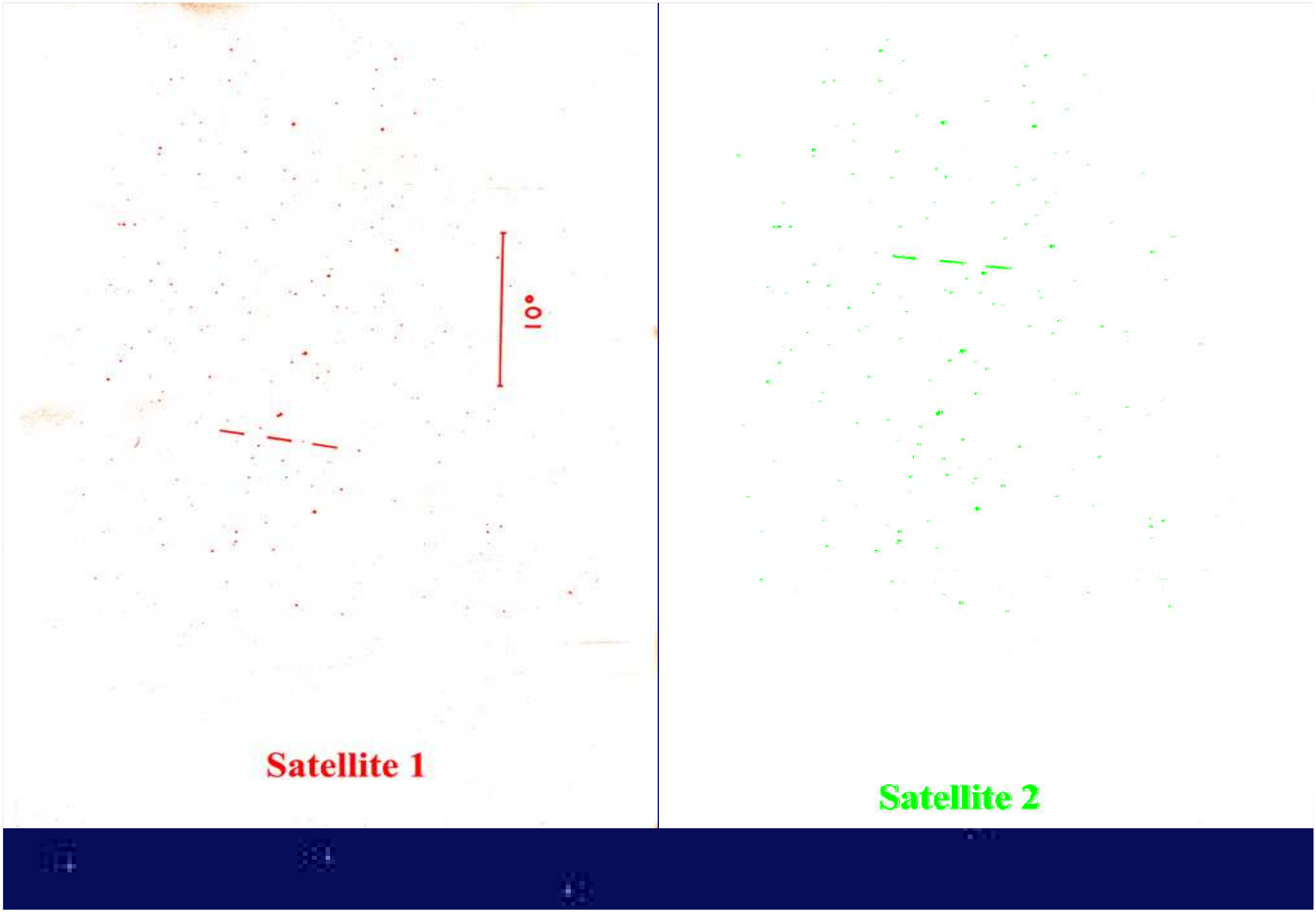
$$G\frac{mM}{r^2} = m\frac{4\pi^2 r}{T^2}$$

$$r^3 = \frac{G}{4\pi^2}MT^2$$

Today experiment:



$$r^3 = \frac{G}{4\pi^2} M_{Earth} T^2$$


10°
Satellite 1
Satellite 2

Steps

1. Determine the satellite height
2. Determine the satellite period
3. Estimate of Earth's mass
4. Explain *(shortly)* the used methods

Home work:

1. Study from pag 1 to pag 9 Lab. Activ.
2. Students who got a wrong T repeat the measure
3. Read pg 1-7 of Star Light