

Astro 101 – Lab #3

Lab objectives

- 1) Learn about telescope magnification and the requisite magnifications to see planetary features
- 2) Learn about light gathering power and requisite size telescopes to see celestial objects

Setup

This lab will be performed in the Stellarium (version 0.14.2 or newer) planetarium program. You can access the Stellarium Planetarium program on specific computers at the following computer labs

- OC Bremerton: ST 122 Computers: 1-4
- OC Poulsbo: OCP 106 Computers: 11-13
- OC Shelton: OCS PA2 Computers: 1-2

or you can download a free copy at <http://www.stellarium.org/> (Windows, Mac OS and Linux versions of the program are available). Instructions for installing the program and system requirements can be found in the user's guide. Stellarium may not run properly on Windows Vista. If you encounter some problems, try downloading a different version of Stellarium by clicking on the "**older releases**" link. You can access the user's guide from the link on the Stellarium homepage.

1) Telescope Magnification

1a) Determine the magnifications of two telescopes with a combination of four different eyepieces. Fill out the table by calculating the magnifications with the equation given in class.

Eyepiece Focal length (mm)	Telescope-1000 Focal length 1000mm	Telescope-2000 Focal length 2000mm
40		
20		
10		
4		

1b) Start up Stellarium, set the location to **Seattle**, and set the date & time to **2017-04-12 00:00:00**. Find Jupiter and zoom in until you can clearly see the 4 Galilean Moons: Io, Europa, Ganymede & Callisto. Slowly zoom out until you can no longer distinguish all 4 moons, without difficulty.

What is the field of view (FOV): _____

1c) Approximate the magnification needed to see the 4 Galilean Moons, by using the equation: $\frac{30^\circ}{\text{FOV}}$

Calculate the approximate magnification: _____

1d) Continue zooming in on Jupiter until you can clearly see the Great Red Spot. Slowly zoom out until you can no longer distinguish it, without difficulty.

What is the field of view (FOV): _____

Calculate the approximate magnification: _____

1e) For Telescope-1000, the Galilean Moons can be seen with which of the following eyepieces?

40mm – 20mm – 10mm – 4mm (circle the correct answers)

1f) For Telescope-2000, the Great Red Spot can be seen with which of the following eyepieces?

40mm – 20mm – 10mm – 4mm (circle the correct answers)

1g) What are the advantages & disadvantages of Telescope-1000 over Telescope-2000?

2) Telescope Light Gathering Power

2a) Compare the light gathering power of various telescopes, with the human eye. Fill out the table below by calculating how many times more light, a telescope can gather, than the human eye by using the equation given in class.

	Mirror or lens diameter (inches)	Light gathering power compared to human eye	Limiting magnitude
Human Eye	0.25	-----	6
Galileo Telescope	1		9.7
Refracting Telescope	3		12.1
Cassegrain Telescope	10		14.7
Newtonian Telescope	20		16.2
Keck Telescope	400		30

The limiting magnitude, listed in column 4, is the faintest brightness detectable with an instrument or the eye. The (apparent) magnitude is a measure of the brightness of an object when viewed from the Earth. The larger the magnitude value, the dimmer the object. For example: a magnitude 2.5 star, like Polaris, is dimmer than a magnitude 0.0 star, like Alpha Centauri (see the Magnitude scale in chapter 17.2 for more information). The human eye can see objects that are brighter than magnitude 6, like Polaris and Alpha Centauri. A telescope can gather a lot more light than the human eye, so you can see much fainter objects with larger magnitudes, like Neptune with a magnitude of 8.

2b) Using Stellarium, find the Great Nebula in Orion. Click on the *Constellations* Icon, the *Constellation Names* Icon, and the *Deep-sky objects* Icon on the *Main-Toolbar* to see the constellations and to label the locations of celestial objects. Point the cursor over the Great Nebula in Orion and left-click to bring up the Magnitude information (Hint: you may need to zoom in or zoom out on the Great Nebula before left-clicking).

Is the Great Nebula in Orion bright enough to see with your unaided eyes? If not, then what is the smallest diameter telescope, from Table 2a, that will make it visible? Fill out the answers in the table for the Great Nebula in Orion and for the rest of the objects.

Object	Location Information	Magnitude	Visible to Eye (Yes/No)	Smallest diameter Telescope needed to be visible
Great Nebula	Orion			
Crab Nebula	Taurus			
Whirlpool Galaxy	Ursa Major			
Callisto	Moon of Jupiter			
Pluto	Sagittarius			