Exercise set three

1 Paper and Pencil: Measuring the field of view of a telescope

Materials

lab notebook, writing implement

Instructions

The field of view (FOV) of a telescope is the angular size of the region of the sky that is visible through a telescope. For example, the moon has an angular diameter of about 1/2 a degree. If you want to be able to take a picture of the whole face of the moon, you need to make sure your telescope set up has an FOV of at least 1/2 a degree.

It is simple to measure the FOV of a telescope if you can point it at an object of a known size l at a known distance d that exactly fills the image. **Write an equation for the field of view θ in terms of l and d.** A diagram may help.

You can also use the apparent motion of stars in the sky to measure the FOV. **Describe how you might do this.** Be specific about where in the sky you would point, what you would measure, and how you would convert that measurement into the field of view.

2 Indoor: Learning to use a telescope

Materials

ruler, telescope with tripod and mount, eyepieces, (graph) paper, tape, long hallway, lab notebook, writing implement

Goals

Learn to set up, point and focus a telescope. Determine the field of view (FOV) of a telescope using various eyepieces, find the relationship between field of view and eyepiece focal length, and determine the orientation of the image produced by the telescope.

Motivation

A telescope is, of course, the basic tool of (most) observational astronomy. A telescope serves two basic purposes for an astronomer. First, it magnifies the image of the region of the sky at which it is pointed. This means the angular size of an object in the image is larger than the angular size of the object in the sky. The second (and generally more important) purpose is to gather large amounts of light. You will notice that all astronomical telescope have much larger collecting areas than your pupils. Telescopes are constructed, therefore, to bring bright, magnified images to a focus where you can view of otherwise record them.

The images produced by telescopes may be magnified, mirrored (horizontally), or flipped (vertically). The telescopes we will be using take interchangeable eye pieces, each of which produce images at different magnifications. When we look at an image in a telescope, we want to be able to understand how it maps onto the sky. In order to correctly interpret the images we will see when using the lab telescopes, we need to know two things: the field of view (FOV) of the telescope (the angular size of the region of sky visible through the eyepiece), and the orientation of the image.

Instructions

Put up a sheet of paper at the opposite end of the hallway from your telescope and draw a small letter P on it.

Make a note of what kind of telescope you are using (manufacturer and model). Learn how to set up, point, and focus the telescope by setting a telescope up at the end of the long hallway outside the library and focusing on your letter "P". Each person should practice pointing and focusing. Make sure you understand how to use all of the knobs for locking, unlocking, fine adjustments, and focusing. Feel free to take notes in your lab notebook. **Draw how the letter P appears in the telescope. Draw a horizontal arrow if the image is mirrored horizontally and a vertical arrow if it is flipped vertically (and both if both are the case).**

Now let's determine take the measurements that will allow us to determine the field of view. Put up a sheet of paper with a series of P's of increasing size. **Measure the distance between the paper and the telescope in cm.** Using several (at least three) eyepieces of different focal lengths: Determine the largest P you can fit into the image. **Record the focal-length of each eyepiece and the physical size (in cm) of the largest P you can view with that eyepiece.**

3 Indoor: Calculate the field of view of a telescope

Materials

lab notebook, writing implement, results of two preceding exercises

Instructions

Using the results of the two preceding exercise, calculate the FOV of the telescope with each eye piece. Find an equation relating the FOV to the eyepiece focal length.

4 Outdoor: Measure the field of view of a telescope

Materials

lab notebook, writing implement, watch which indicates seconds, telescope setup and eyepieces

Instructions

Using the method you described in the first exercise of this set, measure the field of view of your telescope using at least three different focal length eye pieces. **Take notes on your experimental set up (which telescope and eyepieces, what direction you point the telescope, etc.). Record you measurements, calculations, and results.**

5 Indoor: Plan an observation: stellar densities in and out of the Milky Way

Materials

lab notebook, writing implement, computer with planetarium software

Instructions

In this exercise you will plan an observation session. Since the Milky Way is a disk galaxy, we expect that most of the stars in it will be concentrated in a band in the sky.

The goal of your observations will be to qualitatively compare the densities of stars in and out of the plane of the Milky Way. This will require you to point the telescope in several different places (at least two in the plane, and two out of the plane of the Milky Way).

Since we don't know when the weather will be good, come up with a plan or plans that will work any time during the rest of the semester. Remember to take into account what parts of the sky are visible from the roof (you can go up there, if you need reminding). Your plan should also be reasonable in terms of the time it will take to carry it out (it should be doable in about an hour and a half). From your plan I need to be able to tell where you would point your telescope on any given night.

Don't worry if you feel a little lost about this. You'll have a chance to revise your methods and try a couple times.