Astronomy 112 Observing Project

The *observing project* gives you the opportunity to put classroom learning into practice as you observe and describe select objects in the sky. **Projects are worth *10%* of your final grade**.

You will need ***planetarium* software**, **skychart(s)**, a quadrant (see website under 'Info & Handouts') and **information collected during group & individual outdoor observing sessions**.

**** Projects MUST be completed on the provided pages and submitted to VIULearn as a single, reasonably sized PDF file by 6pm on Fri, Mar 15. Late projects will NOT be accepted. ****

Planetarium software

Some exercises **require** the use of *planetarium software* - either *Starry Night* (available in the computer lab located in B315-113 or available with some textbooks) or *SkySafari* (available as an inexpensive purchase for your iOS and Android phone or tablet). More information and basic tutorials for both are available on the class website on the 'Info & Handouts' page.

Location, Date & Time of Computer Observations

Unless otherwise stated set your program to ***Jan 30, 2024*** at ***9:00 pm (PST)*** in Nanaimo (approx 49° N, 124° W) ***for all computer based observations*** (MAKE SURE you 'freeze' the date/time on these settings as described in the online tutorials). ***ANY change(s) from the above date/time/location will be clearly stated***. Check your date/time/location EACH time you begin a new computer observation and (re)set values as needed. If you do NOT set the date/time/location correctly ***your observing results WILL be INCORRECT***.

Group & Indvidual Outdoor Observing Sessions

Computer observations are supplemented with **mandatory** class & individual outdoor observing as the real sky looks very different from a skychart or program! Group sessions include observing with the naked eye, binoculars, and a telescope and take about 1-2 hours. When attending outdoor observing sessions, dress **WARMLY** (hat, gloves, shoes, etc.), and bring **pen/pencil & paper**, **skychart**, and a **(red) flashlight**. There are a **limited number** of these sessions per term.

Some portions of the observing project require independent observations to be made on particular days (or within some set period). There should be enough flexibility in these dates to accommodate work, school schedules and the uncertainty of weather conditions, but even so, **DO NOT** leave it until the last moment. **The observing project CANNOT be done entirely by computer!**

Quadrant

You will need a quadrant (or equivalent); instructions to build a simple one are given on the website.

Describing Positions of Objects

When describing the location of objects in the sky, imagine helping a (non-astronomy) friend find objects while stargazing. Use* compass directions (N, SE, WSW, etc.) and *approximate* height above the horizon (near horizon, near zenith, 1/2 way in-between, etc.) *DO NOT use technical descriptions such as declination, right ascension, azimuth, etc.

Detailed Descriptions

In places throughout the observation project, you will be asked to describe objects ***in detail***. This means exactly that - imagine 'painting a picture' in words. Things to comment on include (*but are not limited to!*) elements such as size, shape, colour, brightness, and distribution of features & textures. Imagine describing what you are viewing to someone who has never seen the object themselves and who will attempt to draw it based *solely* on your description. ***Poor or incomplete descriptions will result in few or no marks on these types of questions!***

Theory

When performing any calculations, show your equation prior to entering numbers and show your steps/work. Be clear and concise, and make sure you have units on your final answers as appropriate!

1). If a nearby star experiences an *angular shift* of P relative to more distant background stars (ie. P is the measured angular separation between the star's leftmost and rightmost positions), the *parallax angle* p for the star is defined as $p = P/2$ and the distance to the star is

$$d = \frac{1}{p} \tag{1}$$

where d is the distance in *parsecs* ($1 \text{ pc} = 3.26 \text{ ly} = 3.086 \times 10^{13}$ km) if p is in arcseconds ($''$).

This apparent motion of nearby stars against a more distant background is due to the change in viewing position as the Earth orbits the Sun. To demonstrate the effect, hold your arm fully extended in front of you and make a fist, thumb up. Note distant objects in the background. Close first one eye and then the other; your thumb appears to shift position relative to the more distant objects. Of course, your thumb isn't moving; it is a change in viewing position as you switch eyes. The amount of parallax or shift relative to the background is dependent on the distance between the object & observer. Try the demo again, but this time with your thumb close to your face instead of at arms length and note the greater apparent shift of your thumb!

Astronomy 112 Observing Project

Constellations & Deep Sky

1. [***3 marks***] Determine the positions of these stars (measure heights using your quadrant; direction is compass/map direction) from a ***single, fixed OUTDOOR location*** (during an observing session or on your own) **within a few weeks** of the specified project observation date & time.

	Date	Time	Height (°)	Direction	Colour
Sirius:					
Betelgeuse:					
Capella:					

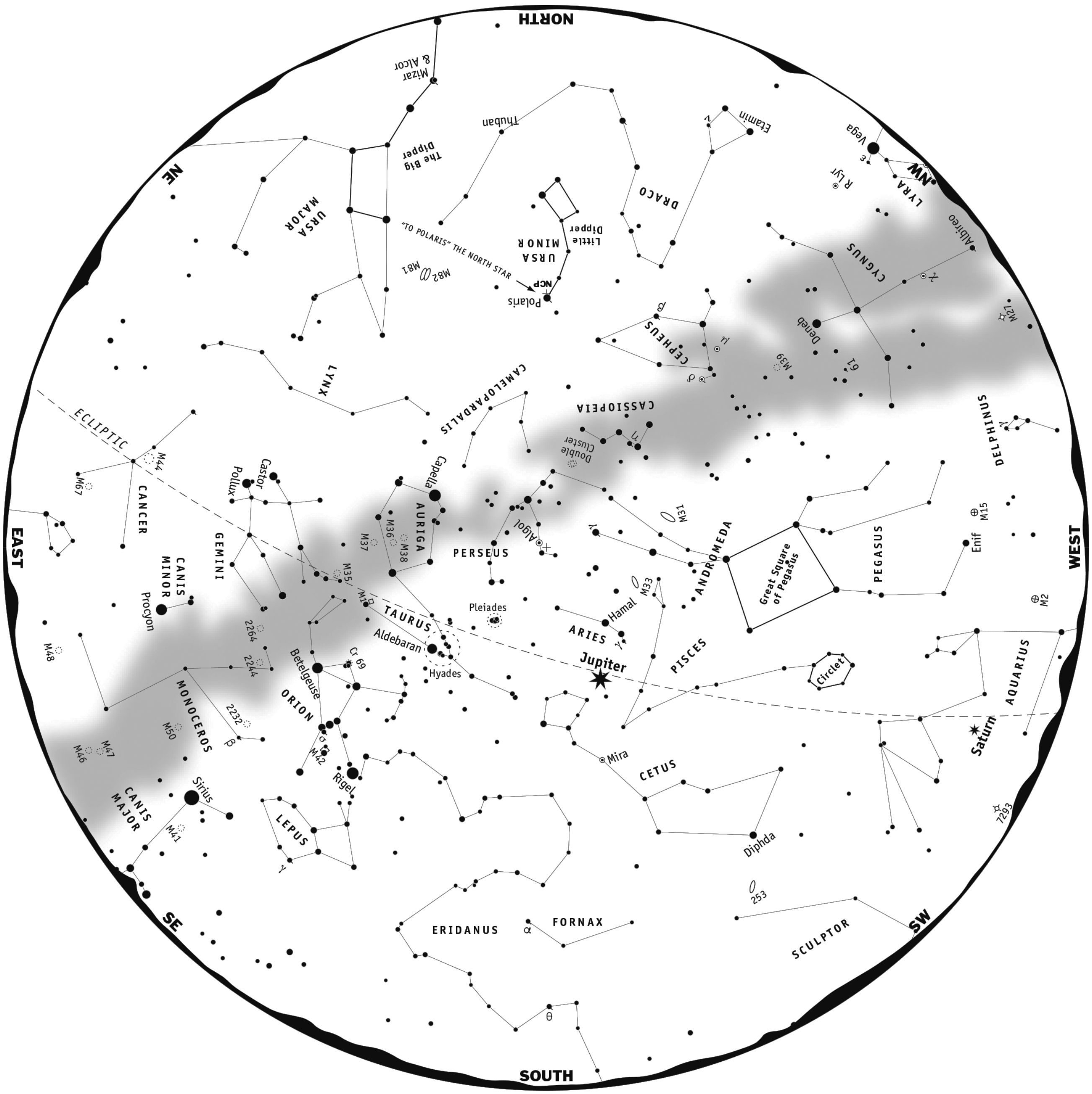
These stars vary in how *"steady"* they appear; discuss briefly, noting any trends.

Describe the change in each star's position in a few hours. Does Polaris do the same?

2. [***4 marks***] Some of the better known deep sky objects belong to a list compiled by Charles Messier and are known today as *Messier objects*. Your task is to **identify both the Messier number & common name(s) of the 4 Messier objects *in the order provided* on the *Observing Images* page on the ASTR 112 course website** (under *Info & Handouts*). Set the date & time as specified under Location, Date & Time of Observations. Display both Messier Objects and their labels (if not already enabled on your planetarium software). All objects are visible (above the horizon) on the date/time specified for the project and each has unique features & scale to allow you to identify it - observe carefully! A 30 arcmin (0.5°) field-of-view is indicated for scale in each image; *enable a 0.5° FOV in your planetarium software for easier comparison.*

Object 1	Object 2	Object 3	Object 4
M____	M____	M____	M____
____________	____________	____________	____________

3. [***5 marks***] Do the following from a ***single, fixed OUTDOOR location*** (during a class observing session or observing on your own) **within a few weeks** of the specified project observation date & time (*the skychart below will best match the real sky on the specified observation date & time but should be similar within a few weeks of that date and a couple of hours of that time*). **With a highlighter trace out the 5 most obvious ASTERISMS when viewing with the naked eye; ONLY highlight those segments of asterisms that are truly 'obvious' when viewing in 'real life'. IN ADDITION, circle AND number the 5 brightest INDIVIDUAL OBJECTS** (eg. stars, planets) **in the sky from 1 - 5** (in order of decreasing brightness).



4. [***10 marks***] **Fill in the required information in the tables below for the object *M82*.**

Observing Date	Time	Height (°)	Direction

Common name(s)	
Type of object:	
Resides in constellation:	

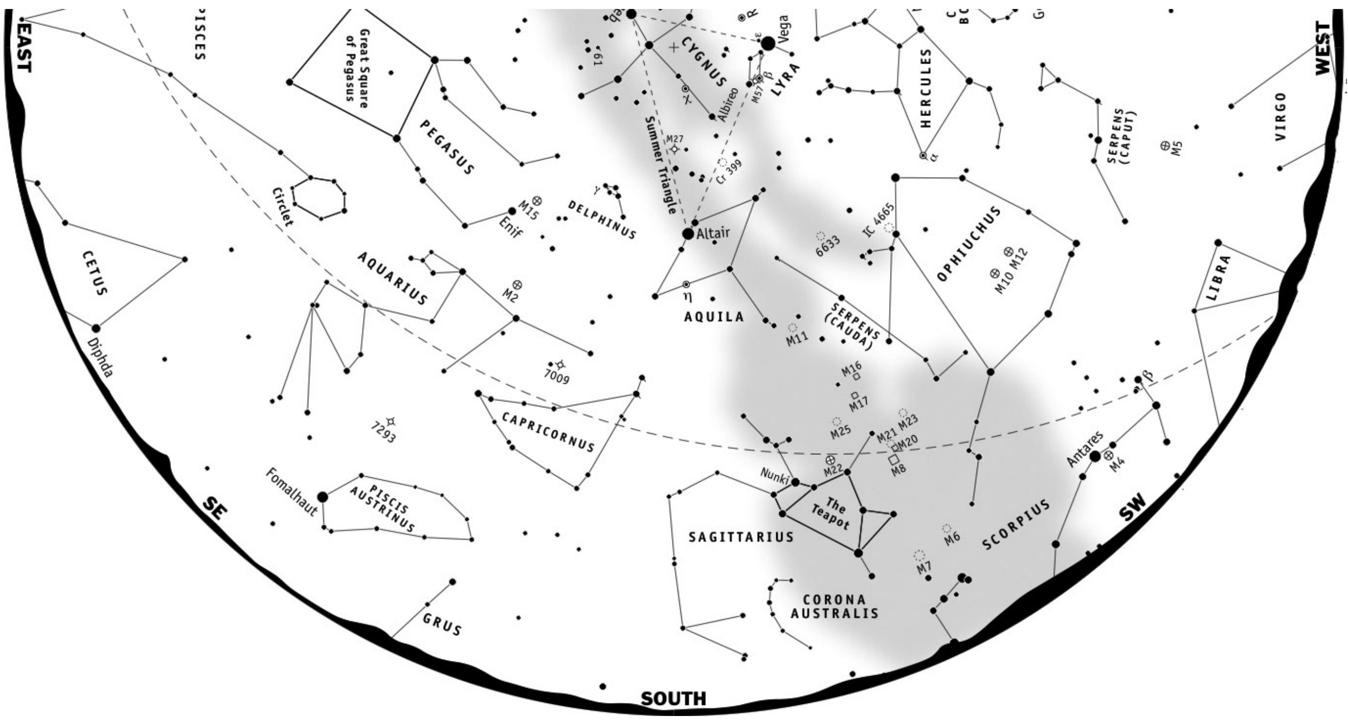
In the circular FOV on the left HAND DRAW a DETAILED view of the object as seen through a telescope at an observing session OR (if available) from its image on the VIU Rooftop Observing page (course website under Links). In the circular FOV on the right HAND DRAW a DETAILED, labeled, COLOUR view of the object as viewed on the same date using planetarium software; *ZOOM IN* so the object fills about HALF the screen.

telescope ("live") *planetarium program*

Describe the object's appearance *in detail* (as seen both during the outdoor observing session AND using *Starry Night*). **Comment on significant differences between the two views**.

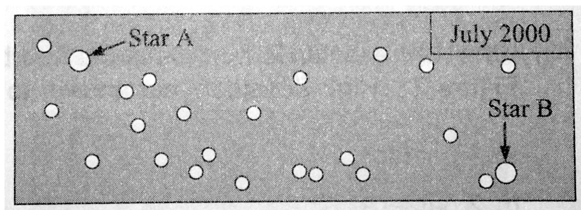
The Sun

1. [***3 marks***] Set your location to Nanaimo on Dec 1, 2022 at noon; make sure daylight savings time is OFF! Turn constellation lines/figures & constellation labels ON and daylight OFF (see tutorials online if needed). **On the skychart fragment below record the position of the Sun relative to the stars at NOON at 3 week (21 day) intervals during Dec 1, 2023 - Apr 5, 2024 (inclusive)**. **Mark the Sun's position** with a '+' and trace a dime-sized or smaller circle around that point. **Record the date next to each position. Describe how the Sun's position in the sky changes relative to the stars. Is this what we *expect*? Explain.**



Stars

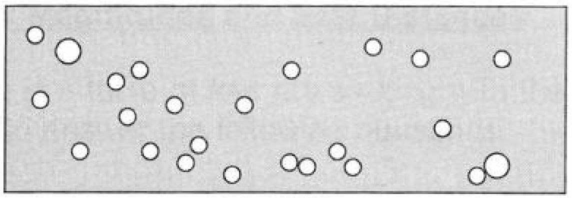
1. [***5 marks***] The figure below shows a small patch of sky containing a field of stars. The angle separating the stars A and B is just one-half of an arcsecond ($0.5''$). The same starfield is shown on the following page in one month increments over the course of more than a year. During this time period a single star moves back-and-forth against the (more distant) background stars, exhibiting what is known as *stellar parallax*. A brief summary of *parallax* can be found in the Theory section.



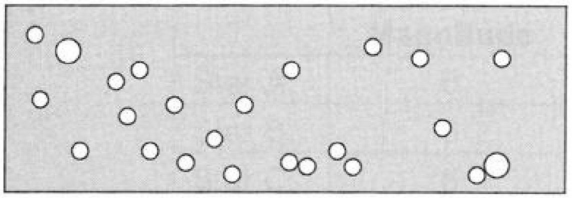
On the NEXT page **label the stars A & B on the July 2000 starfield, then using a ruler measure the (center-to-center) distance between A & B**: ________ cm. Given these stars are $0.5''$ apart, **calculate the scale of the starfield**: ____________ arcsec-per-cm. **Use a highlighter or coloured pencil to mark the ONE moving star in EACH of the starfields from July 2000 - August 2001. On the July 2000 starfield mark the TWO END-POINTS of the star's motion with $\otimes$'s. Using a ruler measure the (center-to-center) distance between these points**: ________ cm. **Use the starfield scale determined previously to convert this distance into the angular shift P of the star**: ________ arcsec **and then take half this value to find the parallax angle, p for the star**: ________ arcsec.

Use equation (1) and your value of p to calculate the distance d to this star in parsecs; convert your distance to lightyears, showing all of your work and calculations fully.

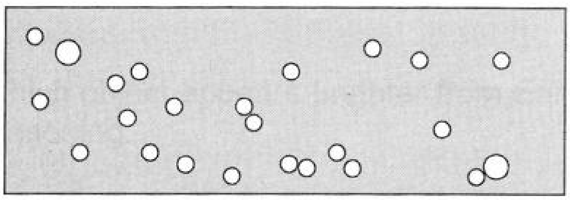
What limitation(s) does this method of distance determination have? Explain.



July 2000



August 2000



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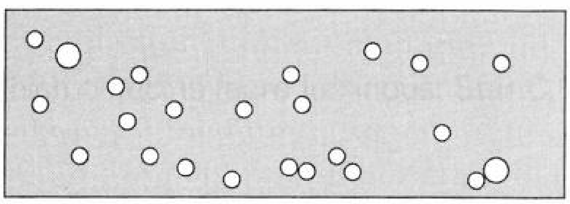

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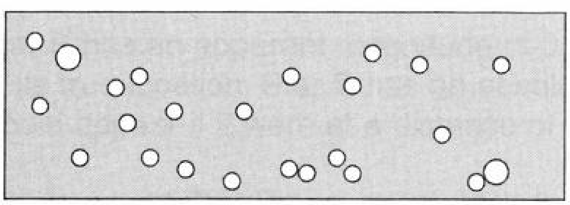

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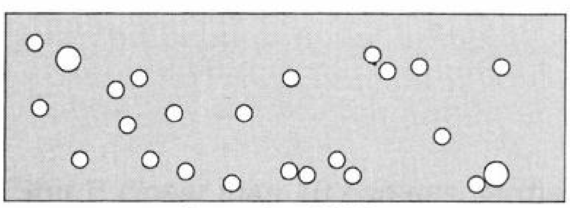

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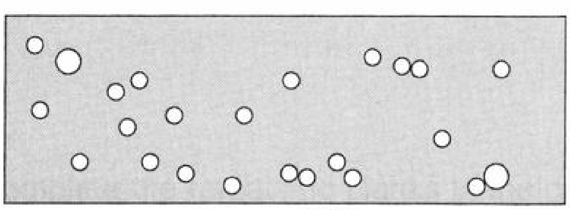

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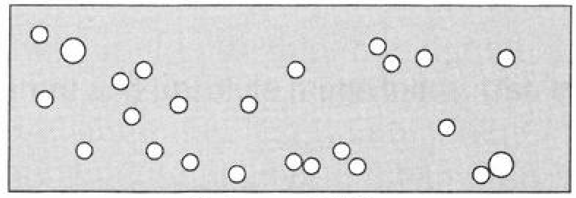

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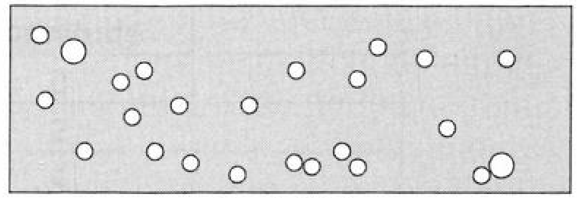

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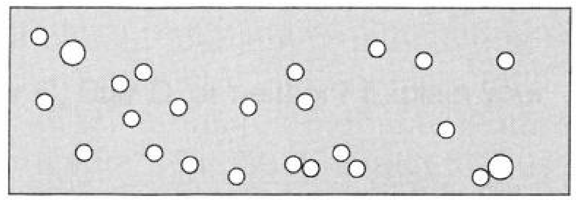
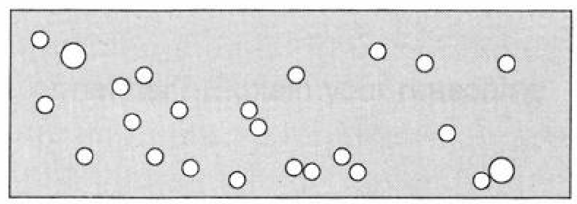
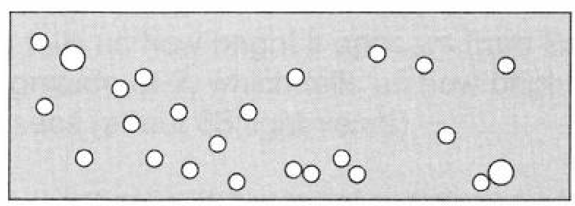


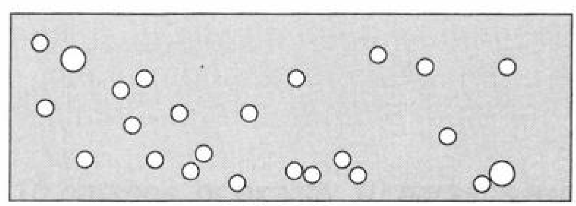
April 2001



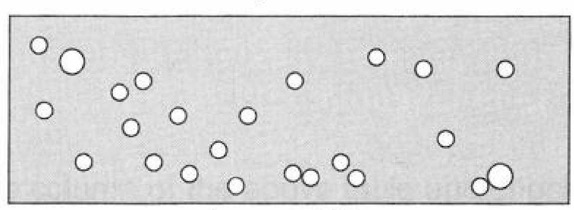
May 2001



June 2001



July 2001



August 2001