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 ***Starry Night* software**, **skychart(s)** (see course website under 'Solutions/Handouts'), and **information collected during group & individual outdoor observing sessions**.

**** Projects must be submitted *in pen* (except drawings) on the pages provided and are due at start of class on Thurs, Mar 7. Late projects will NOT be accepted. ****

Starry Night planetarium software

Some exercises require the *Starry Night* software (available in the student computer lab in B315-113, textbook, etc.). A basic tutorial for *Starry Night* may be found on the website under 'Handouts'.

Location, Date & Time of *Starry Night* Observations

Unless otherwise stated, set *Starry Night* to the location of Nanaimo (approx 49° N, 124° W) on ***Mon, Jan 14, 2019*** at ***10:00 pm, PST* for all computer based observations** (pressing the 'stop' button (■) near the date & time will freeze the program at this time). ***ANY departures from the above location/date/time will be clearly stated***. If you do NOT set *Starry Night* correctly (including ensuring that Daylight Savings is OFF), your observing results **WILL BE INCORRECT**. Check your location/date/time EACH TIME you use *Starry Night*. Reset values as necessary, as some questions require different observing times, dates or locations from the above.

Group & Indvidual Outdoor Observing Sessions

Starry Night 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 using *Starry Night* alone!**

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* cardinal 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 less than full 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 pc = 3.26 ly = 3.086×10^{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

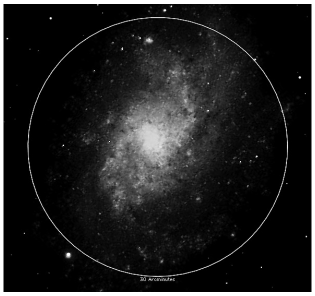
1. [***3 marks***] Perform the following outdoors from a ***single, fixed location*** during either an observing session or on your own, **as close as possible to the observation date/time specified under Location, Date & Time of Observations**. Determine the positions of the following stars (measure the heights using your quadrant; direction is compass or map direction):

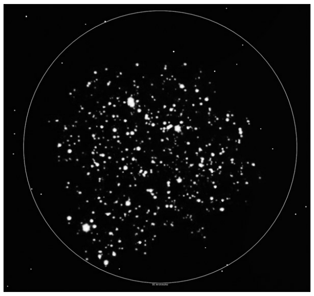
	Date	Time	Height (°)	Direction	Colour
Sirius:					
Betelgeuse:					
Capella:					

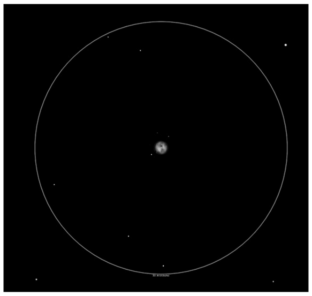
These stars vary in how *"steady"* they appear; discuss briefly, noting any trends.

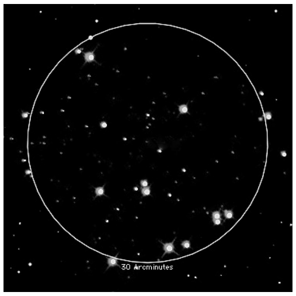
How do these stars' positions change over a few hours? Does Polaris do the same?

2. [***4 marks***] Some of the better known deep sky objects belong to the list compiled by Charles Messier and are known today as *Messier objects*. Set the date & time as specified under Location, Date & Time of Observations. Under the Options pane select Deep Space and enable both Messier Objects and their labels (if not already enabled). Your task is to **identify both the Messier number & common name of the 4 Messier objects below**. A 30 arcmin (0.5°) field-of-view is indicated for scale in each image. All the objects are visible on the date/time specified for the project, and each has unique features and scale to allow you to identify it - observe carefully!



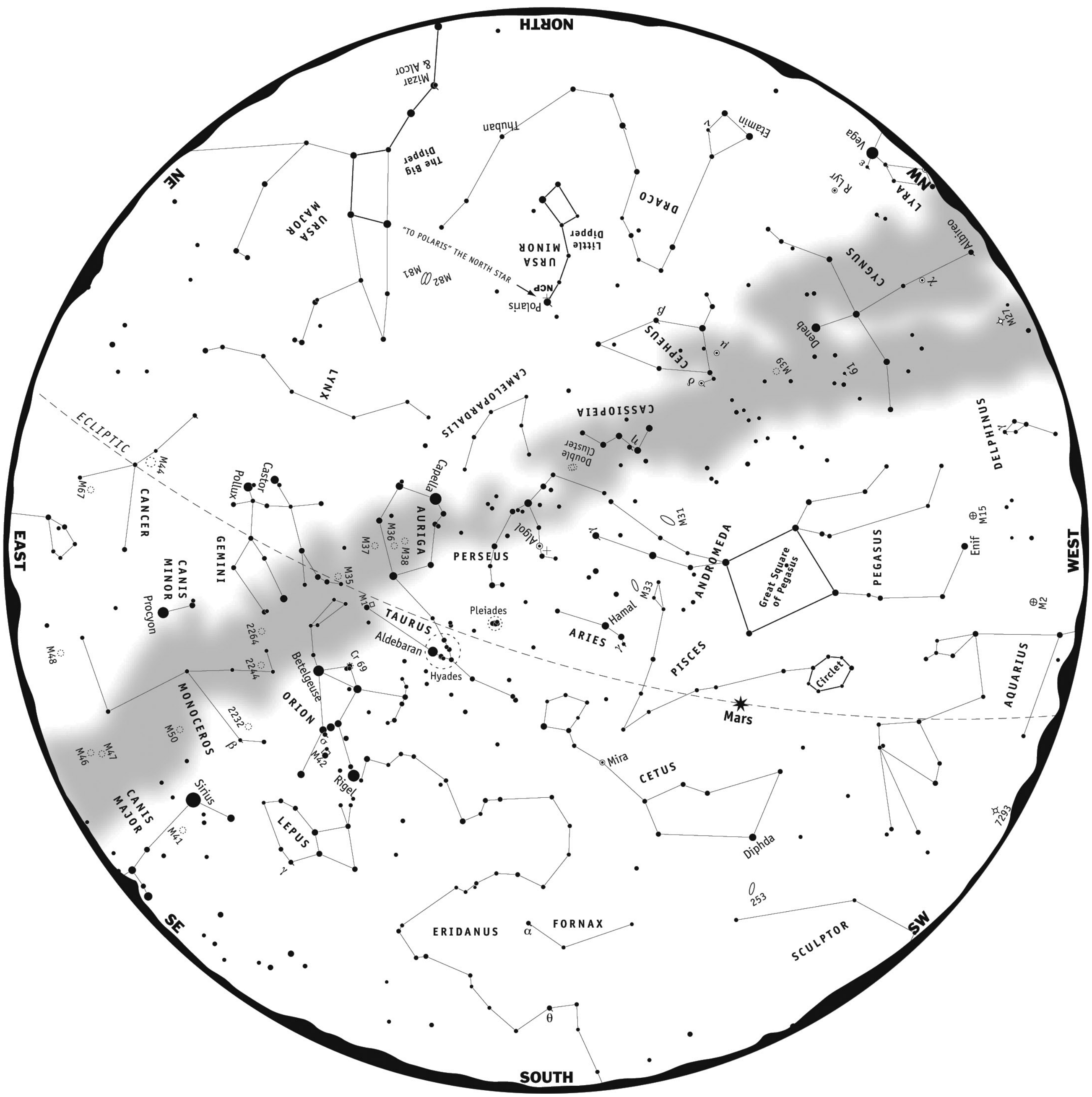






M_____ M_____ M_____ M_____

3. [***5 marks***] Perform the following outdoors from a single, fixed location either during an observing session or on your own, as close as possible to the observation date prescribed under Location, Date & Time of Observations. The skychart provided below will best match the real sky shortly around 8 pm or so on the specified observation date, and should be similar within a few hours of this time/a few weeks of this date. **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'. ALSO circle & number the 5 brightest OBJECTS visible in the sky, in order of decreasing brightness, from 1 - 5.**



4. [***10 marks***] **In the circular FOV on the left, draw a detailed view of *M1* as seen through the telescope at our observing session. Record observation specifics in the table below. Use *Starry Night* to find and zoom in on the same object at the same time, until it fills about half of the field-of-view (FOV) on the computer screen. In the circular FOV on the right, draw a detailed, fully labeled COLOUR view.**

Observing Date	Time	Height (°)	Direction

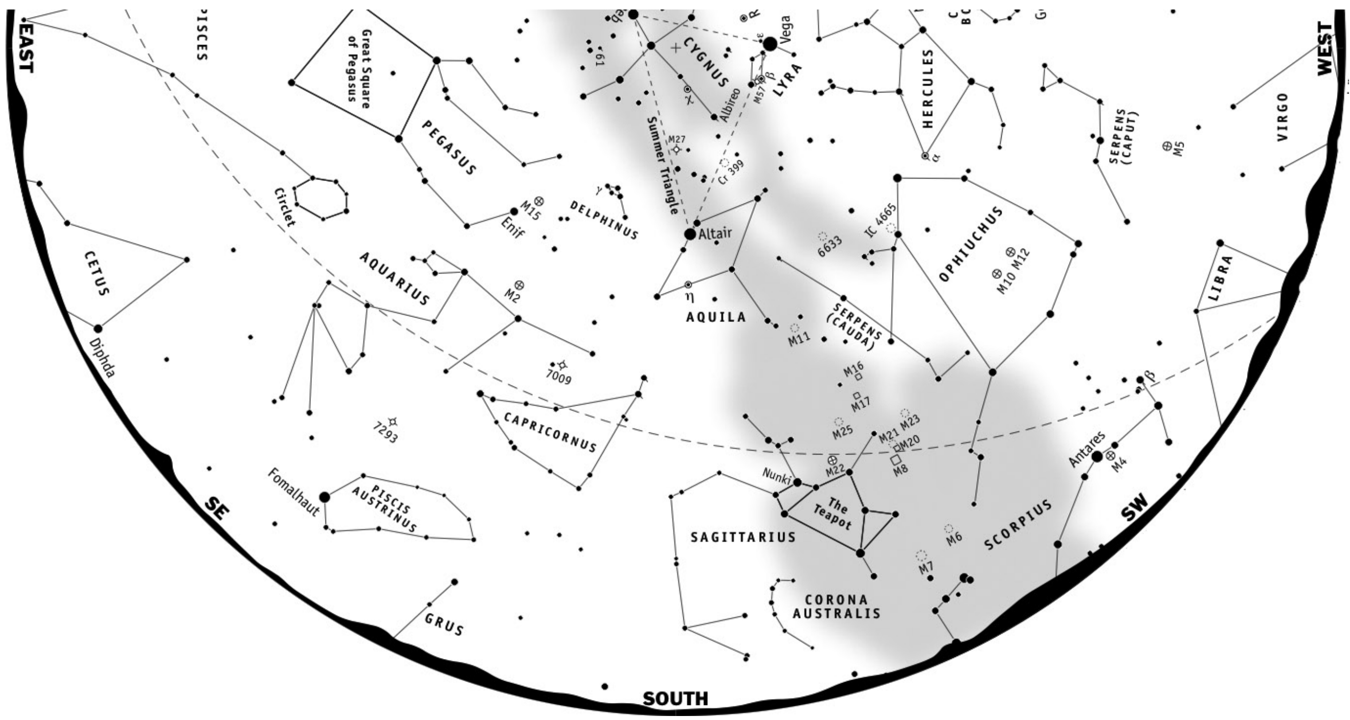
Telescope ("live")

Starry Night

Specify all commonly used name(s) for this object, what the object is, the constellation it resides in and describe its appearance *in detail* (both as seen during our outdoor observing session and using *Starry Night*). **Comment on major differences between the two views.**

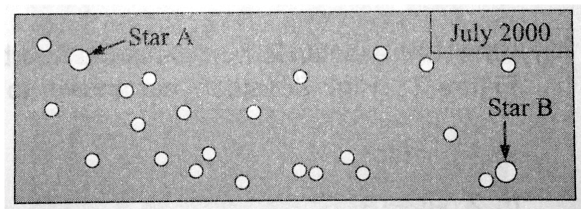
The Sun

1. [***3 marks***] Set your location to Nanaimo on Dec 1, 2018 at noon. Make sure to turn daylight savings OFF! Turn on Astronomical stick figures & Labels (see Tutorial), and Hide Daylight under the View menu. Locate the Sun. **Record the position of the Sun at noon at 3 week (21 day) intervals during Dec 1, 2018 - Apr 6, 2019 (inclusive) on the skychart below** (mark the Sun's position with a '+' and the date; trace a dime about that point). **Describe how the Sun's position in the sky changes relative to the stars. Is this what we *expect*? Explain.**



Stars

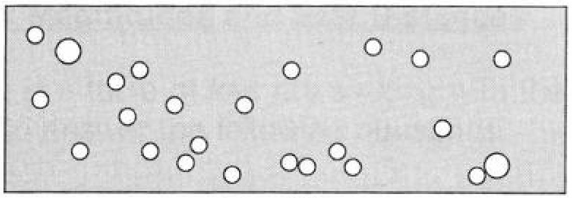
1. [***5 marks***] The figure below shows a small patch of sky containing a field of stars. The angle separating the stars A and B is just one-half of an arcsecond (0.5″). The same starfield is shown on the following page in one month increments over the course of more than a year. Over this time period,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



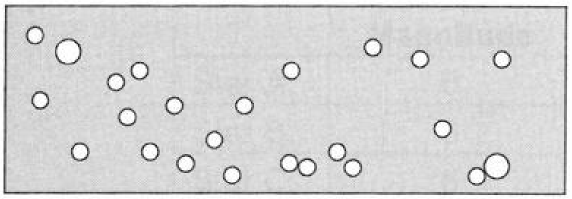
Mark the stars A & B on the July 2000 starfield *on the following page* and measure the distance between them (center-to-center) using a ruler: ______ cm. Given that these stars are 0.5″ apart, **determine the scale of the starfield:** ____________ arcsec-per-cm. **Use a highlighter or coloured pencil to colour the (single) moving star in the entire series of starfields, July 2000 - August 2001. Transfer the two (extreme) endpoints of its motion onto the July 2000 starfield using a ⊗. Measure the distance between the endpoints of its motion** (center-to-center) using a ruler: ________ cm. **Use your scale above to transform this distance into the angular shift P of the star:** ________ arcsec **and then take half this value to find the parallax angle, p of the star:**________ arcsec.

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

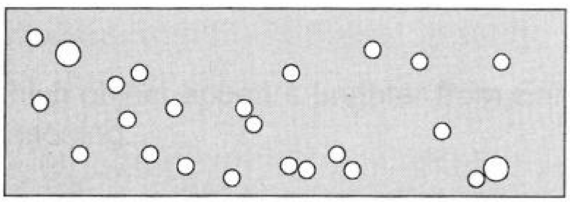
What limitation(s) does this method of distance determination have? Explain.



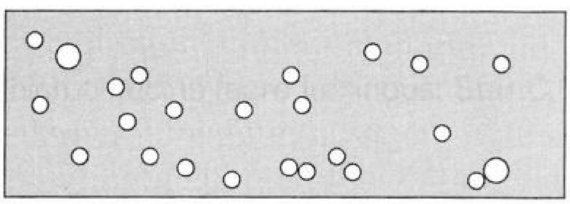
July 2000



August 2000



September 2000



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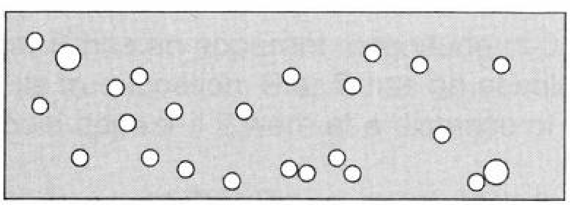

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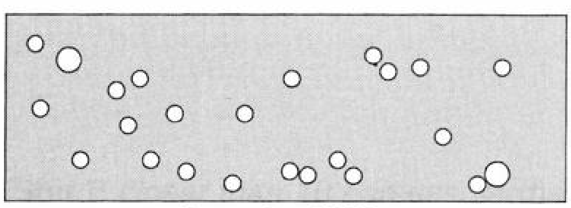

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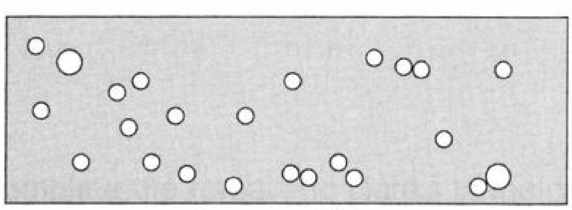
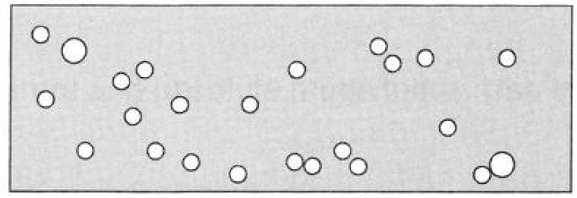


January 2001



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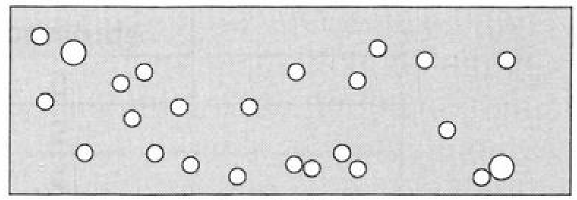

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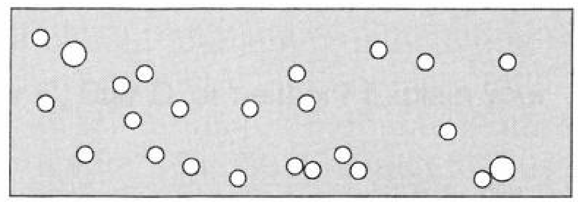
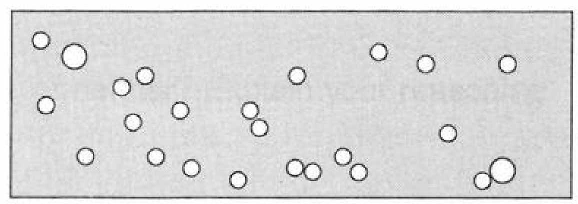


April 2001



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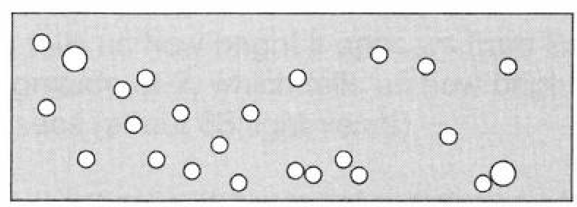

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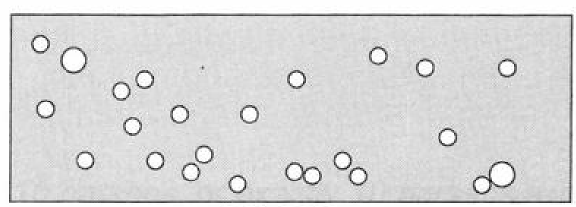
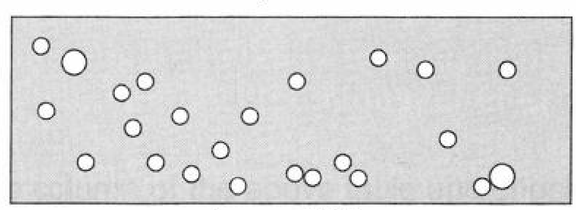


July 2001



August 2001