29:50 Astronomy Lab
Stars, Galaxies, and the Universe
Fall 2007

Using Star Charts

Name:…………………………………………………

Date:………………………………

Introduction

Star charts are literally maps of the sky. We use them for a number of purposes, such as telling us what time of night certain stars and constellations will be visible, plotting the positions of the Sun, Moon, and planets against the background stars, and locating non-stellar objects such as nebulae and galaxies in the sky. In this lab exercise, we will use star charts for all of these purposes.

In this week's activity, we will become familiar with star charts and how to use them. Next week, will use them in a nighttime observing exercise to help us learn the sky.

In this class, we will use three types of star charts, all available from the Sky Publishing Corporation Sky and Telescope Web Site

- Sky and Telescope Star Wheel
- The SC1 Constellation Chart
- The Pocket Sky Atlas

In what follows, each of these charts or maps is explained. We will use each of them to answer a set of astronomical questions.

Students may keep the SC1 chart for use throughout the semester. The star wheels and Pocket Sky Atlases should be returned to your teaching assistant at the end of the lab period or observing period.

A Digression on Star Names

We will be spending a lot of time this semester finding stars and using them as points of reference. It is worthwhile to learn about their names.
- The brightest stars have commonly used names which come from Greek (Antares), Latin (Regulus, Castor, Pollux), and (most commonly) Arabic (Betelgeuse, Deneb, Algol)
- Second-ranked stars usually have Arabic names (Algenib, Na'ir al Saif, etc), but these don't usually appear in scientific use.

- The most common way of naming reasonably bright stars (even the brightest ones) is by a Greek letter, followed by the name of the constellation. Examples are Alpha Lyrae, Delta Scorpii, Beta Cygni. You might notice that the names of the constellations have changed a little, i.e. Lyra goes to Lyrae, Scorpius to Scorpii, and Cygnus to Cygni. Those who have studied Latin will recognize the latter forms as the genitive, or possessive of the first form. Don't worry about the Latin grammar, just write them down as best you can.

(1) The Star Wheel

The Star Wheel is an analog computer for calculating the horizon system positions of stars, based on their celestial coordinates, the date, and the time of day. Star wheels are specific to the latitude at which observations are made. Rotate the wheel until the date of interest lines up with the time of day you want. Notice that you can choose either Daylight Savings Time or Standard Time. The oval region shows you the stars that are above the horizon, and also shows the different directions. This oval region is a reasonably accurate picture of the sky above the horizon. It allows a good estimate of the azimuth and altitude angles of any star at the specified date and time.

If you flip the star wheel over, you have an alternative (and in some ways superior) representation of the stars close to the horizon in the south and southwest.

Exercises
- Dial up 9PM CDT for tonight; this is about the time it begins to get dark. What bright red star is close to the horizon in the southwest. Write its name here. **Do it!** ……………………………………………………………..
- In what part of the sky would I find the constellation of Pegasus ("The Great Square of Pegasus")?**..**
- What bright star is close to the meridian, and about halfway up the sky from due south? ……………………………………………………………..
- The planet Mars is very close to the star Aldebaran, the brightest star in the constellation of Taurus the bull. What time of the night will Aldebaran (and Mars) rise? ……………………………………………………………….
- The brightest star in the sky is Sirius, in the constellation of Canis Major (the big dog). On approximately what date will it be rising just before dawn? For purposes of this question, let "just before dawn" mean 5 AM standard time. …………………………………………………………………… *(This corresponded to the time of year when the Nile river flooded; the ancient Egyptians made a supernatural connection between the rising of this bright star, and the annual flood which brought life to Egyptian civilization.)*

(2) The SC1 Constellation Chart
The SC1 chart is a flat, long strip of paper that resembles maps of the world. Instead of the surface of the Earth, however, the SC1 shows the celestial sphere. The two coordinates on the SC1 are the celestial coordinates of *Right Ascension* and *Declination*.

The SC1 is useful for showing the coordinates and names of a large number of stars. It can be used by itself in learning the constellations, although it is not quite as convenient as the star wheel.

The SC1 shows the *magnitudes* of stars by the size of the dot representing the star. The correspondence between the magnitude of a star and the size of its plotted symbol is shown in the scale on the lower right edge of the chart. Note that the brightest stars like Arcturus and Vega have magnitude 0, while the faintest ones visible to the eye have magnitudes of about 5-6. The stars in the Big Dipper are *second magnitude,* meaning magnitudes between 1 and 2.

The SC1 Chart can be used to tell which stars are up at any time of the day or night, although it is not as easy as with the star wheel. Along the bottom edge of the chart, just below the numbers corresponding to the Right Ascension, are dates. A ruler placed vertically at that point shows the location of the *meridian* at 8PM standard time on that date. The location of the meridian at later times on that date can be found simply by moving the ruler 1 hour of Right Ascension to the left for each hour of time.

The heavy double line running horizontally through the middle of the chart shows the *Celestial Equator.* This is the line that defines a value of 0d for the Declination. The curved line that looks like the sine function from trigonometry represents the *ecliptic*, which is an extremely important imaginary line in astronomy. This is the path along which the Sun, Moon, and planets move.

The dates along the ecliptic show you the location of the Sun on that date. From this chart, you can see that the Sun reaches its highest declination on about June 21.

Exercises
- The celestial coordinates for Jupiter in the middle part of this month are Right Ascension (RA) = 16h40m, Declination (Dec) = -22d. What constellation is it in, and what is the nearest bright star? **……………………………………………..**
- What bright star has the following coordinates: RA = 19h51m, Dec = +8d51m?**...**
- Find the location of the meridian at 8PM Central Standard Time (= 9PM Daylight Time) for tonight. Is the star you found above east of the meridian, on the meridian, or to the west of the meridian? **………………………………………**
- At 9PM Central Daylight Time tonight, where in the sky would you look to find the constellation Capricornus? **………………………………………………….**
- The celestial coordinates of Mars in the middle of September, 2007, are RA = 5h32m, Dec = +22d51m. Find its position , and write down the constellation in which it is and the bright star nearby. **………………………………………….**

(3) Sky and Telescope Pocket Sky Atlas

The Pocket Sky Atlas is a detailed map of the sky in which each page shows a region about the size of a constellation, and which plots stars as faint as 7th magnitude. This is considerably fainter than can be seen with the unaided eye, but easily visible with binoculars. The Pocket Sky Atlas is useful for finding fainter stars, locating planets and asteroids that cannot be seen with the naked eye, and observing non-stellar objects such as nebulae and galaxies. We will use the Pocket Sky Atlas for this last purpose later in the semester.

An analogy can make the function of the Pocket Sky Atlas clearer. The star wheel and SC1 Chart are similar in function to a map of the entire world. The Pocket Sky Atlas is more like an atlas which has a map of each state on a single page, with similar detail for the rest of the world.

The legend for the atlas is given just before Map 1, and shows the scale for the magnitudes of stars, the symbols used for star clusters and galaxies, etc. The maps are organized in sets of 10, with 10 maps being used to cover 3 hours of Right Ascension. For example, maps 1-10 cover the Right Ascension range 0h – 3h, charts 31-40 cover the range 9h – 12h, etc.

Each map shows the grid of celestial coordinates, allowing measurement of a position to fraction of a degree, the outline of constellations in that part of the sky, and the locations of galaxies, nebulae, and star clusters. Note that the smaller dots represent fainter stars. The location of the ecliptic is also indicated.

The Pocket Sky Atlas is a powerful aid to the sky, but it is best used together with the Star Wheel or SC1 to get oriented.

Exercises

- The coordinates of the planet Uranus in September, 2007 are RA = 23h11m, Dec = -6d05m. What constellation is it in? **……………………………………..**
- Give the names of two stars within a degree or two of Uranus which would help you find it…**…………………………………………………………………………..**
- On the facing page, or in the margins of this document, draw a map that would help you find Uranus from observations at the eyepiece of a telescope. This sort of map is called a *finding chart*.
- An object of great interest in astronomy, which we will discuss later in the semester, has the following coordinates: RA = 0h43m, Dec = +41d16m. What is the name of this object?**...** What kind of astronomical object is it?**...**
- In September, the constellation Hercules is visible in the western sky. Here are the coordinates of a famous object that we will observe later, perhaps next week: RA = 16h42m, Dec= 36d28m. What is the name of this object, and what kind of object is it? **…………………………………………………………………..**