Indoor Lab 2 - The Starry Sky

Objectives: To tour the sky and explore the way in which it moves, using the sky simulation program Starry Night Pro. Check out the information sheet on SN first, and try some of the controls. The ability to visit sites and to run the sky clock is helpful in learning how the sky moves.

1 Finding your way around the shy.

Launch SN and check that it is set up for NY at the present time, pointing South. Explore the horizon by pressing the N, S, E and W buttons, and look around more generally by dragging with the mouse (holding left button down). The stars can be identified by pointing at them with the mouse cursor. Compare the view with the Field Guide, sky map 12 (in the sections after page 53), and the Mag 5 atlas (which maps ?). The 88 official constellation boundaries, their names, and illustrations can be shown by using the pull down View menu, clicking Constellations and Boundaries etc. Within each constellation the brightest stars are called α, β, and so on through the Greek alphabet (usually in order of decreasing brightness), followed by the constellation name in Latin (in the genitive case) or its abbreviation. Bright stars also have proper names, e.g., Betelgeuse and Sirius, and these are usually given by the SN pointer. Most of the constellation figures are based on Johannes Bayers 1603 star atlas *Uranometria*. As you look around the sky you will see it is pretty full of heroes, heroines, animals, and so on.

2 Measuring angles in Starry Night

We shall frequently be measuring angles with SN, and we start here with the angles between stars which we have seen before with the celestial globe. Locate the pairs of stars below and measure the distance between them, to the nearest degree (see SN information sheet on how to do this). The first pairs are to the South, the others to the North. Merak and Dubhe are the "pointers" at the end of the familiar Big Dipper, which is part of the constellation Ursa Major, the Great Bear. γ Cas is the middle star of the W shape in Cassiopeia. Knowing the rough distance of these stars from Polaris is useful for locating Polaris when you are outside.

Pair	Separation
The ends of Orion's belt	
Betelgeuse - Sirius	
Merak - Dubhe	
Dubhe - Polaris	
γ Cas - Polaris	

3 Sky Motion

We shall now see how the sky moves. Return to looking S, set the time moving forward at a rate so that you can see the stars move (see SN information sheet). During the night in NY, new stars come into view, and as morning approaches the sky brightens and the sun rises. To examine the motion in more detail, hide the sunlight to keep the sky dark all the time (see SN information sheet). Focus on single stars and examine how they move close to the horizon. Each box below is 10° on a side and sits on the horizon at the compass points given. In each box draw a line with arrows to show how the stars move at these positions in the sky. In the North also look farther up in the sky to see the motion around Polaris.

(a) N (b) E (c) S (d) W

Now set the location of the observer (using the Viewing Location display) to a latitude of +90° , the North Pole, and examine the sky motion there. Fill out the boxes.

(e) N (f) E (g) S (h) W

Change the location of the observer to the equator (latitude 0°) and repeat the operation.

(i) N (j) E (k) S (l) W

The overall picture should (hopefully) be clear: you appear to live under a large, rotating, celestial sphere that carries the stars around. Note too that as you go South, new stars never seen in the NY sky came into view.

4 Polaris

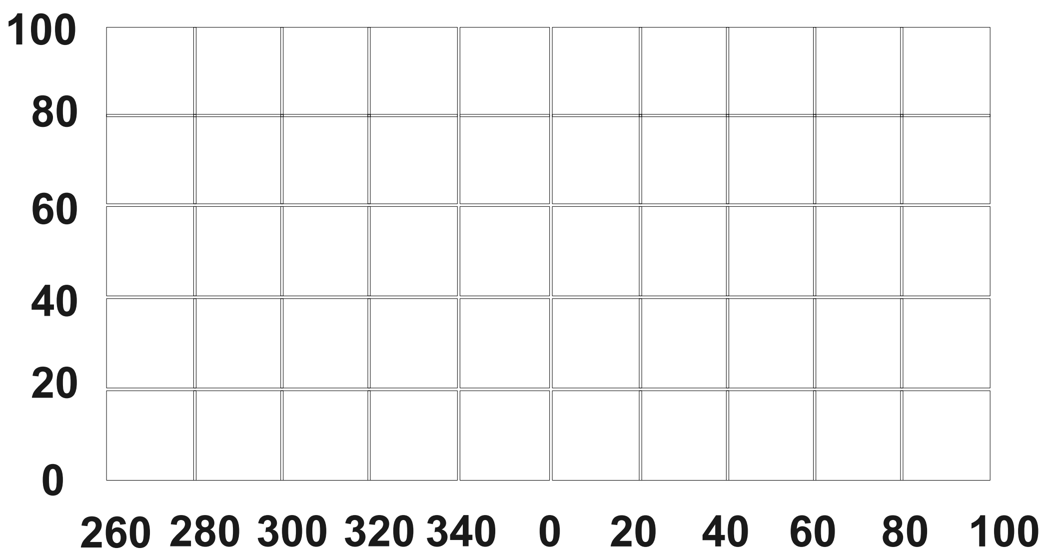
Return to NY, at the current time, and create an Az-Alt grid in the sky (see SN Information Sheet). You will see that Alt increases from the horizon up, and Az increases Eastwards from the North horizon point. The vertical lines converge in the zenith (Alt = 90°). Check this by looking up with the Z (for Zenith) button at the top of the screen. If you start the clock, you will see that the Az-Alt grid lines stay in exactly the same place all the time, but the stars move. However, there is one special place, the North Celestial Pole (NCP), that keeps the same Az and Alt all the time in NY. This is close to Polaris (and we will often use the two names interchangeably, although this is not exactly correct). A key question in understanding star motion is where this special point is when you go to different places on the Earth? We have already seen the rule in class: the altitude of Polaris (or more exactly the NCP) is equal to the latitude (when you are in the northern hemisphere). Check this in NY by estimating the altitude and azimuth of Polaris from the grid lines:

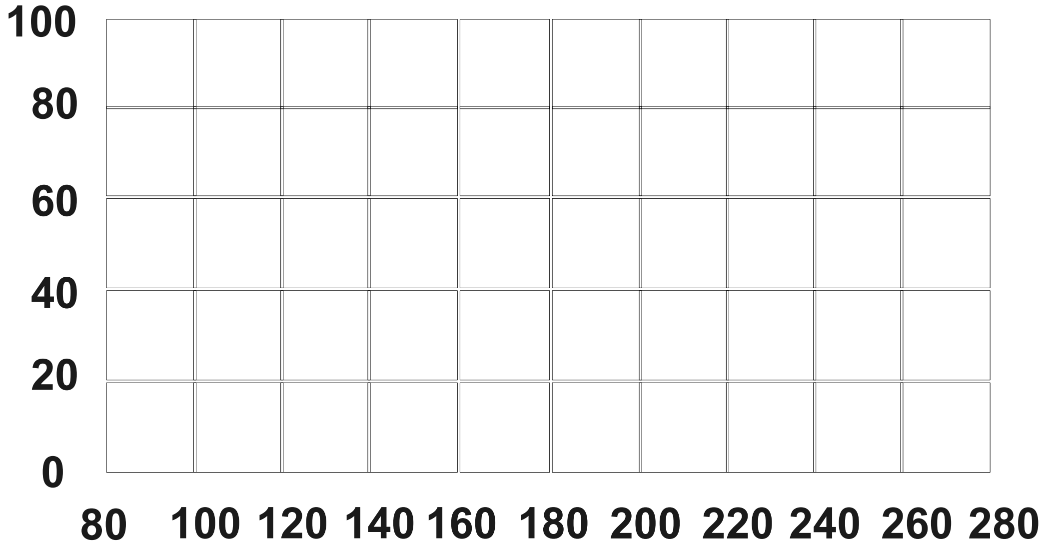
Polaris: Alt =____________________ Az =____________________

You will also have verified the rule for latitude = 0 in your drawing of the N horizon picture in section 3.

5 Motion in Alt-Az

It will be clear from the previous sections that not all stars as seen from NY do the same thing. We will examine 2 examples here: Merek (at the tip of the Big Dipper) and Mintaka (the highest star in Orion's belt). The latter is of special interest since it lies almost exactly on the celestial Equator, midway between the NCP and the SCP. For each star, estimate the Az and Alt at 10 or more roughly evenly spaced positions in its motion (e.g., by stopping the clock and changing the time in steps of 2 hr by typing over in the display window. Plot the points on the grids below, and join them with smooth curves with arrows to show the motion.





Stars move (clockwise/counter-clockwise) around Polaris:____________________

For stars that rise in the east, they move up and to the (left/right):____________________

For stars that set in the west, they move down and to the (left/right):____________________

At what two Az values do stars reach their highest in the sky ?____________________

6 Motion in RA-Dec

Replace the Alt-Az grid with an RA-Dec grid and the celestial equator (see SN information Sheet). Set the sky turning, and you will see the moving graph paper in which the stars are fixed. There are some basic aspects of the RA-Dec system that follow from the geometry of the celestial sphere we have explored above. You can probably figure them out directly from our discussion in class (e.g., using the center, bottom diagram inside the cover of the Mag 5 Atlas assuming NY is at lat = 40°): but you should also check them on the screen:

What Dec is at the zenith?____________________

What is the lowest Dec of stars visible in NY?____________________

What is the minimum Dec of stars that are circumpolar in NY (i.e., never set)?____________________

What is the difference in RA between the N and S horizon points?____________________

At what compass points does the CE meet the horizon:____________________

What is the difference in RA between the points where the CE meets the horizon?____________________