

Plotting the Moon – Altitude and Azimuth

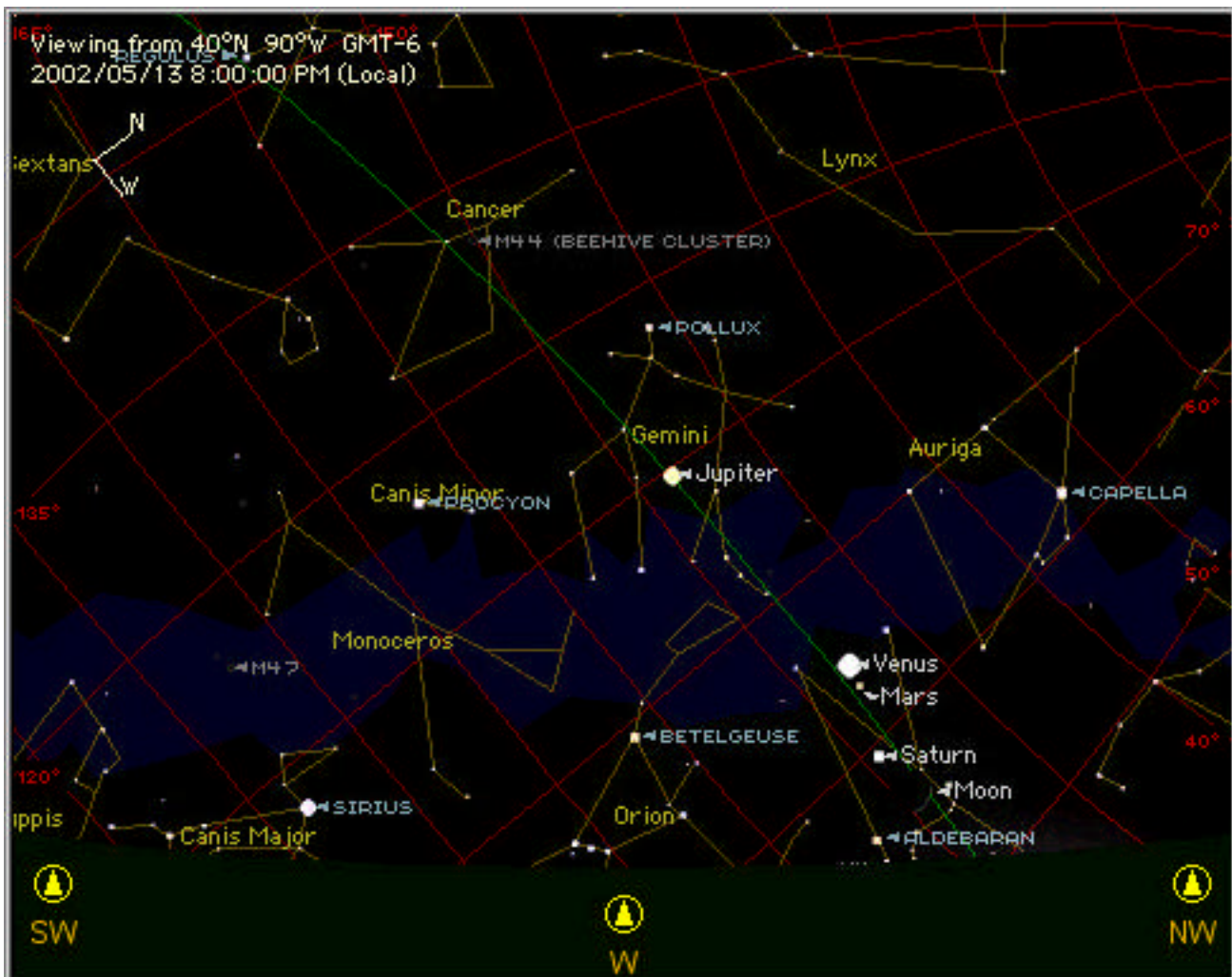


Your Challenge:

The Moon's position changes in both altitude and azimuth from day to day. You will take data on the position of the Moon, plot it and see what kind of relationship the data has - is it linear?

Discovering:

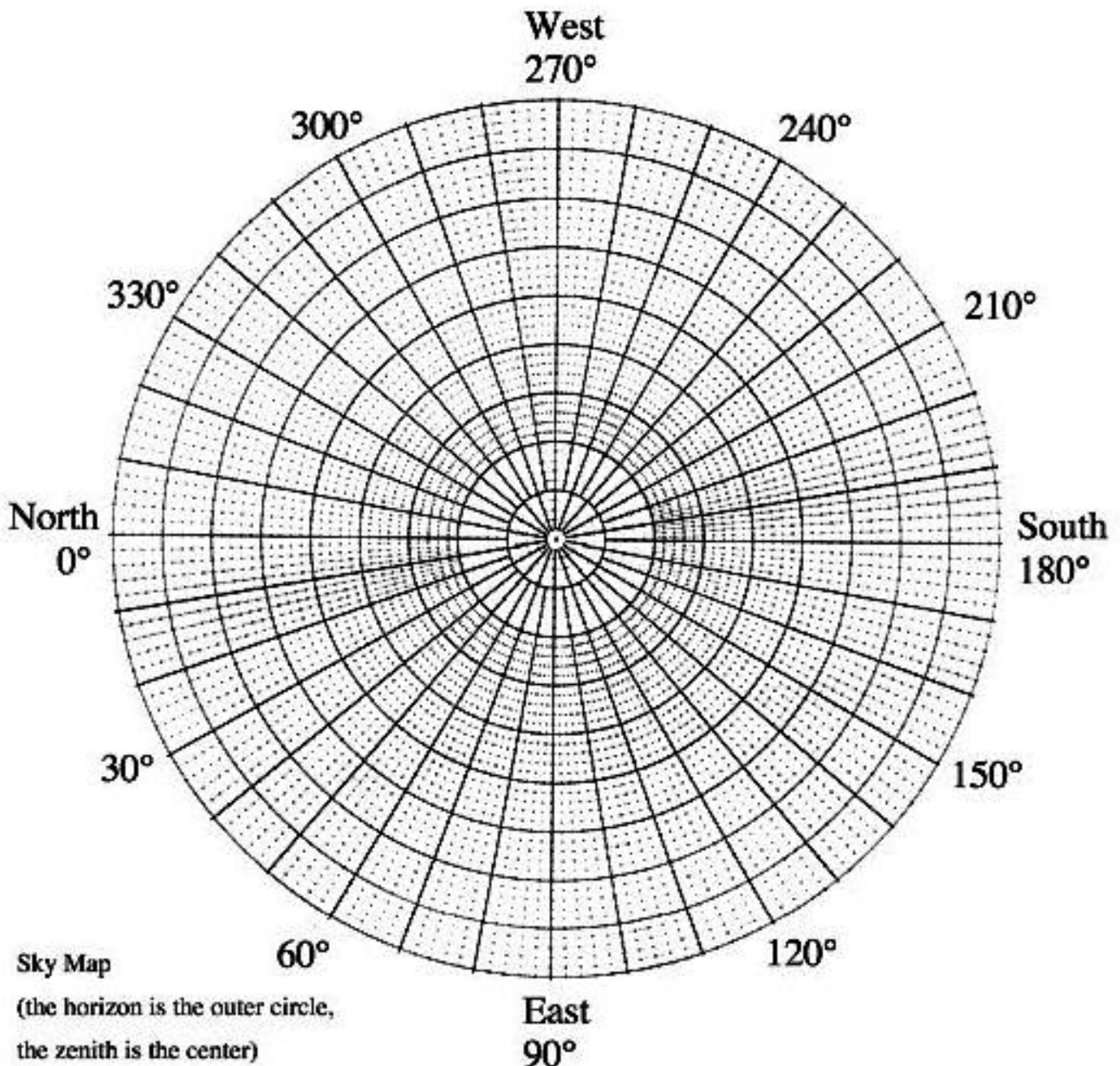
First do the activity "A Month of Moons" to discover the Moon's changing location in the sky over the course of a month. Now, let's go back and get the altitude and azimuth for the Moon for each day from the crescent new moon to the full moon. Find the day of the earliest crescent you can see in the western sky: _____. (Any month is OK; the images here show the month starting May 2002). Now, look at the bottom of the chart to see the direction in the sky. You'll see a "W" in the middle, for West, a "NW" at the right for "Northwest", and a "SW" on the left, for "Southwest". These are the directions you would look to see the horizon on this chart. We use "azimuth" to make a measurement of just how East or West the stars (or in this case, the Moon) is, measured along the horizon. Imagine yourself standing outside and facing North. How many degrees do you have to turn clockwise (towards your right) until you face East? Answer: 90° (degrees), or a right angle. We define the term "azimuth" to be the number of degrees of rotation around the horizon, measured clockwise from North. So, the direction East is an azimuth of $+90^\circ$ degrees. You need to turn another fourth of a circle



Make a Plot:

Now, use the data which you have collected and make an **x-y plot**, using the azimuth as the x-axis and the altitude as the y-axis. Does the plot make a straight line? If not, what kind of curve does it look like? (You may use graphing calculators or printed regular rectangular graph paper). (Advanced: use the fitting function of your graphing calculator to fit the data to a quadratic curve. What do you get? Would you get the same fit for October Moons as you would for January Moons? Try it!)

We can also plot the data on a **polar plot**. Polar graph paper is where one coordinate (in this case, azimuth) is measured in concentric circles. To use this kind of plot, put 90° altitude in the center (for the zenith), and 0° altitude in the outside edge (for the horizon). Put the Moon on its proper location for each day. (Hint: turn the paper upside down to plot the West views - note the 10° azimuth spacing in this graph paper, which is different from the azimuth spacing in the Sky Tonight movies)



Celestial Coordinates

Notice that through the month, the Moon is always close to the **green** line. That line is the **ecliptic**, and the Sun is always found *exactly* on that line. The Moon and planets are always found *near* that line (May 2002 is an especially pretty lineup of planets in the evening sky). The ecliptic is the plane of the Earth's orbit projected onto the sky.

On the sky maps are also faint **red** lines. These are the celestial coordinates of the stars and planets. The red lines all come to a point at the North Celestial Pole (NCP), which is near Polaris, the North Star. That location is 90° North celestial latitude. The circles are lines of celestial latitude, which we call "**Declination**", marked in 10-degree steps. The scale of declination is labeled on the right edge.

The coordinate of the stars which is most similar to a longitude is called "**Right Ascension**". It's easiest to see those coordinates if you look at the "North" view. Hit the "play" button and watch the stars rotate around the NCP through the year (they also rotate around the NCP through the night). (Of course, this apparent motion is caused by the Earth's rotation – the stars don't really move!) Note that the Big Dipper (Ursa Major) and Cassiopeia are on opposite sides of the North Celestial Pole. So they have different Right Ascensions, although their declinations are similar. The lines of Right Ascension (RA) all meet at the North Celestial Pole. How many lines come out from the North Pole? ____ This makes their spacing ____ degrees, which is equal to the number of degrees which the Earth rotates in an hour. This plot has Right Ascension marked in degrees (on the top and right edge), but it is often labeled in hours (1 hour = 15 degrees). The zero of RA is where the green ecliptic crosses the celestial equator heading North (the location of the Sun at the spring equinox). This is not shown on this plot (find it!). Zero RA on this plot is the red line which is nearly horizontal, marked "meridian", just over the top of Cassiopeia. What RA is the line nearly through Dubhe (one of the "pointer stars" in the bowl of the Big Dipper)? _____. How many "hours" is that? _____

