Physics 155: Lecture 3

Announcements

Proof of "Altitude of NCP = observer's latitude", with example of visibility of stars.

One recipe to tell if a star is visible from latitude L:
Take 90 - L = angle *. For an observer at latitude L,
Stars with declinations from * to +* rise and set
greater than +* never set
less than -* never rise

The sun appears to move among the stars by 360° in 365 days or
about 10°/day (due to earth's annual revolution) along the path
named the ecliptic, which is inclined by +23.5° to the
celestial equator. Some consequences are:
1) earth has seasons, due to this inclination--e.g. summer
in the northern hemisphere is when the latter is tipped
towards the sun and we have more direct illumination for
longer hours
2) earth's daily motion causes seasonal drift of constel-
lations (Orion is seen in winter, Scorpius in summer)
3) solar and sidereal time differ

We keep solar time on our watches, putting the sun due south
each noon (for the center of each time zone). But because earth
moves 10°/day in its orbit, we move to meet the stars and the
stars therefore rise 4 minutes earlier each night, adding up to
a whole hour earlier every two weeks, or 2 hours earlier/month.
(One degree corresponds to 1/15 of the hour angle spacing on the
star globe or 4 minutes of time, recalling the earth turns 15°
each hour.) Thus a solar day (noon to noon) is 4 minutes longer
than a sidereal day (given star transit to succeeding transit).

Sample problem on handout:
A star transits at 9:00pm tonight, when will it transit to-

tomorrow night? Ans. 4 minutes earlier or 8:56pm.

In two weeks? Ans. an hour earlier or 8:00 pm.

Star designations and brief overview of constellations.

Origin of name "Right Ascension". Ancient astronomical tools:
the gnomon and lines of sight to horizon.

Use of Big Dipper as compass, clock and calendar.
Other circumpolar constellations for Storrs, Ct.
Origins of constellation names.
The two legends which block our much of our sky:
Andromeda (with Casseopia, Cephus, Perseus, Pegasus, Cetus)
Orion (with Canis Major and Minor, Lepus, Taurus, and
Scorpius in opposition)
and the bright stars in these constellations:

Orion: Betelgeuse and Rigel  
Canis Major: Sirius  
Canis Minor: Procyon  
Scorpius: Antares  
Taurus: Aldebaran  

and the Zodiac, the "Zone of Life" through which the sun, moon and planets move along or near the ecliptic:

Aries  
Taurus (Aldebaran)  
Gemini (Castor & Pollux)  
Cancer  
Leo (Regulus)  
Virgo (Spica)  
Libra  
Scorpius (Antares)  
Sagittarius  
Capricorn  
Aquarius  
Pisces (V.E.)

Note that the sun actually spends 12 days in Ophiuchus as well. Approximate locations on blank globe.

Star designations:  
Individual names for brighter ones, usually from Arabic. In 1603 designated according to brightness, using the Greek alphabet: alpha, beta, gamma, delta, epsilon, zeta, etc. although there are exceptions (give examples). In general then we have:

Sirius  
Capella  
Polaris  
Vega  
Betelgeuse  
Rigel  
α Canis Majoris  
ω Aurigae  
ω Ursae Minoris  
ω Lyrae  
α Orionis  
β Orionis  

We also use magnitudes:  
First magnitude are the Navigation stars (listed on star finder) whose magnitudes vary from Sirius (-1.6) to Castor (1.6)

Second magnitude stars are the general magnitude defining the brighter constellations (Orion, Sagittarius, Big Dipper)

Third magnitude stars fill out the brighter constellations and define the dimmer ones (Pisces, Cancer, Capricornus)

Fourth magnitude fill out the dimmer constellations

Fifth magnitude are barely visible here most nights

Sixth is the dimmest the eye can see under best conditions.

There is a factor of 2.5 between magnitudes and it is the magnitude difference which is important. See table below.

Example: Comparing a fourth magnitude star with 0 magnitude
Vega, how many of the dim star all together unresolved would equal the brightness of Vega?

Ans. the magnitude difference is 4, therefore it would take 40 of the dimmer stars all together to equal Vega's brightness.

<table>
<thead>
<tr>
<th>Magnitude Difference</th>
<th>Brightness Ratio</th>
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<tbody>
<tr>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>2</td>
<td>$2.5 \times 2.5$ or 6</td>
</tr>
<tr>
<td>3</td>
<td>$(2.5)^3$ or 16</td>
</tr>
<tr>
<td>4</td>
<td>$(2.5)^4$ or 40</td>
</tr>
<tr>
<td>5</td>
<td>$(2.5)^5 = 100$</td>
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</tbody>
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We need to generalize this:
we need negative magnitudes for the brightest objects
we need to interpolate between whole numbers using decimals, i.e. use magnitudes of 1.6, 26.3, etc.

Examples of various magnitude objects: Sun (-26), full moon(-12), Venus (-4), Jupiter(-2), Saturn (0), Sirius (-1.6), dimmest visible star (6), dimmest binocular star (10), limit of 200 inch Hale telescope visually (20), photographic limit (23.5)

Today's objects:
Venus -3.9 in Virgo
Jupiter -1.7 in Leo
Saturn 0.3 in Capricorn (it was also there 500 years ago for Columbus)
Mars 0.6 in Gemini and brightening
Mercury -1.2 in Leo near Venus