Apparent Positions of The Planets
ASTR 101

Jordan Ell
jordan.ell7@gmail.com
V00660306

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Supervisor: Jillian Scudder

1 Objective

This report will demonstrate the proper procedure of finding the five visible planets apparent positions in the sky. It explains how to map the planets on a polar coordinate graph and ecliptic constellation chart as well as the proper use and data collection from a planisphere.

2 Introduction

Being able to locate the planets inside our solar system is a key task during astronomical observations.

3 Equipment

The three main pieces of equipment required for this lab are as follows. First, a polar coordinate graph which is used for charting where planets are relative to the sun at any given point. This report will use the chart with measuring 1 AU as one dark black ring from the centre. Second, a constellation equatorial chart. This chart has measurements in declination, measured in degrees, and right ascension, measured in hours and minutes. Lastly, a planisphere is needed, which is a quick reference to stars given a day and time of night. Other common equipment needed for this lab includes: protractor, scissors, and coloured pencils.

4 Procedure

Given the data inside of Table 1 and Table 2, a heliocentric sketch was made of Venus', Earth's, Mars', Jupiter's, and Saturn's position at the dates of 2012-Sept-22, 2012-No-21, and 2013-Mar-20. This was accomplished by first looking up a planet in Table 2 to find its orbit radius (measured in A.U) in order to give it a distance away from the sun. We are assuming perfect circles for orbits. Next, a lookup of the planet's heliocentric longitude was preformed on Table 1. With these two coordinates, a sketch of where the planet should be located was able to be made on the polar coordinate graph given that the sun was placed at the centre and that each dark black line represented 1 A.U. This process was repeated for all five planets and all three dates listed in Table 1

Next, the visibility of each planet given the four times of day: noon, sunset, midnight, and sunrise are made. This was accomplished using a small piece of paper as a guide for East and West on the Earth placed over top of the Earth in the sketch made above. Knowing, the Earth rotates counter clockwise, if viewed from above, the paper guide was rotated to simulate a field of vision on the Earth at the four given times of day. A planet's visibility can then be determined by locating it (visible) or not locating it (not visible) in the 180° view provided by the paper guide. These results can be found in Table 3.

Now, the determination of the planet's alignment is made. By looking at sketch made above, it was determined (for the day of 2012-Sept-22) what a planet's alignment is relative to the Earth and Sun. This was done purely by observation and with approximating the planet's actual position to that of a specific alignment. The results from these observations can be found in the Configuration column of Table 3.

With the now sketched heliocentric view of planetary positions, geocentric equatorial positions of the planets were then calculated for the day of 2012-Sept-22. This was accomplished by first measuring the geocentric ecliptic longitudes of the planets. This was calculated by measuring the angle between the Earth and the planets in question, noting that the Earth is now the origin of measurement as opposed to the sun and that angles are measured from. These measurements can be found in the Ecliptic Long. column of Table 4. Next, a plot of the ecliptic longitudes was made onto the provided SC001 constellation chart. This was accomplished by simply mapping the found ecliptic longitude above with the given degrees on the ecliptic on the SC001. Finally, the right ascension (measured in hours and minutes) and declination (measured in degrees) were measured off the SC001 chart for the Sun and given planets. The results of these readings can be found in Table 4. These results are our final geocentric equatorial positions of the planets.

Lastly, minor approximate measurements were made using a Planisphere. The Planisphere was used by placing a provided circular map of the stars with labelled months and days of the year underneath an ellipse which has times of night and rotating the circular map of the stars so that your desired time and day match up. What is shown through the ellipse of the stars is what will be visible from the given latitude of the planisphere. The measurements taken can be found at the bottom of Section 6.

5 Observations

6 Tables and Measurements

Date	Venus	Earth	Mars	Jupiter	Saturn
2012-Sep-22	068	000	261	065	211
2012-Nov-21	166	060	297	070	213
2013-Mar-20	354	180	011	081	217

Table 1: Heliocentric Longitudes from Astronomical Almanac.

Planet	Orbit Radius (A.U)	Period (years)	Symbol
Sun			☉
Venus	0.72	0.62	♀
Earth	1.00	1.00	♁
Mars	1.52	1.88	♂
Jupiter	5.20	11.86	♃
Saturn	9.54	29.46	♄

Table 2: Radii and Period of Orbits.

Planet	Noon	Sunset	Midnight	Sunrise	Configuration
Venus	✓			✓	Greatest Western Elongation
Mars	✓	✓			Greatest Eastern Elongation
Jupiter			✓	✓	Quadrature
Saturn	✓	✓			Conjunction

Table 3: Planets as seen from the Earth.

Planet	Ecliptic Long.	Constellation	Right Ascension	Declination
Sun	180°	Virgo	00:00	0°.
Venus	134°	Cancer	09:02	16°.
Mars	230°	Libra	15:10	-17°.
Jupiter	73.5°	Taurus	04:41	21°.
Saturn	207°	Virgo	13:42	-11°.

Table 4: Geocentric Equatorial Position of the Planets.

References

[1] Smith, J. M. and Jones, A. B. (2012). *Chemistry*. Publisher, City, 7th edition.