**Module 03 Project: Physical Characteristics of Planets**

**Your Name:**

**School or Institution Name:**

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**Introduction:**

It is common knowledge that the Earth is not the only planet in our solar system but is a part of a collection of planets and planetoids. Terrestrial and Jovian are the two classes of planets among which all the planets are divided in our solar system (Williams, 1978). Combining all of them including the sun and the different moons, they become a part of the Milky Way System. The Milky Way System has been around for 13.51 billion years with the our sun being around for 4.603 billion years. Over time technology has evolved enough for human kind to try to get a glimpse of about the physical characteristics of other planets in our solar system. Using softwares like Stellarium (Hughes, 2008) and others we can determine several characteristics of planets of which three are as follows:

1. Orbital velocity (rotation speed)
2. Distance from the observing point (the sun in this case)
3. Equatorial diameter

This laboratory assignment is designed to get us an understanding of the interesting characteristics of the terrestrial (Mercury, Venus, Earth, Mars) and Jovian planets (Saturn, Jupiter, Uranus, Neptune). An understanding of their orbital velocity, their distance from an observing point such as the sun and their diameter would be accomplished. Also, how their surface is designed and if they have atmospheres and what constitutes their atmospheres can be learned during this exercise.

**Hypothesis:**

Also, by using this laboratory experiment and the Stellarium software a hypothesis was tested. The hypothesis being tested in this assignment is to determine if the Jovian planets such as Jupiter, Saturn, Uranus, and Neptune have a faster rotation period compared to those of the Terrestrial planets, which include Mercury, Venus, Earth and Mars.

The table below shows information supporting the hypothesis above and includes the planets (Terrestrial and Jovian), their color, their atmosphere, surface features, rotation speeds and number of moons.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Planet | Color | Atmosphere (yes/no) | Surface Features | Rotation Speed | Any Moons |
|   |   |   |   |   |   |
|  Mercury | Not visible |  Yes |  Not able to be seen |  40.929 km/s |  No moons |
| Venus  |  Not visible |  Yes |  Not able to be seen  |  34.787 km/s |  No moons |
|   |   |   |   |   |   |
|  Earth | Not visible | Yes  |  Not able to be seen |  29.634 km/s |  1 moon |
|   |   |   |   |   |   |
| Mars | Not visible | Yes | Not able to be seen  | 23.069 km/s | 2 moons |
|   |   |   |   |   |   |
|  Saturn |  Not visible | Yes  | Not able to be seen  |  9.159 km/s | 62 moons  |
|   |   |   |   |   |   |
|  Jupiter | Not visible  |  Yes | Not able to be seen  |  12.784 km/s | 67 moons  |
|  |   |   |   |   |   |
|  Uranus |  Not visible |  Yes |  Not able to be seen | 6.563 km/s |  27 moons |
|  |   |   |   |   |   |
|  Neptune |  Not visible | Yes  |  Not able to be seen |  5.462 km/s |  13 moons |
|  |  |  |  |  |  |

Q1 In your opinion, which planet had the most distinct appearance?

The appearance of the different Jovian and Terrestrial planets was more of the same. The software did not show any distinctions between the different planets in their appearance. So, the appearance of the planets using the Stellarium software could not be distinguished. Hence, the appearance of all the different planets was seen to be same.

Q2: Which group of planets (terrestrial or Jovian) appear to have the most moons?

According to the observations deduced from the Stellarium Software, Jovian planets appear to have more moons than the terrestrial planets. The Jovian Planets have a total of 109 moons. Whereas, the Terrestrial Planets have a total of 3 moons among them.

Q3: Which group of planets (terrestrial or Jovian) appear to have the fastest rotation?

According to observations from the Stellarium Software, Terrestrial Planets have the fastest rotations compared to Jovian Planets. Mercury in the Terrestrial Planets has the highest rotation speed of 40.929 km/s with Mars the lowest of 23.069 km/s. On the other hand, the Jovian Planets fastest rotating planet was Jupiter with 12.784 km/s and the slowest was Neptune with 5.462 km/s.

Q4: Did you have any problem observing the rotation of any planet? If so, why do you think this was the case?

No, no problem was encountered while observing the rotational speed of the planets. This was due to the clear representation of data in the Stellarium software.

1. We can use the small angle formula to find the physical diameter of a planet. Select one planet and record its angular size in arcseconds and distance from the observer (Distance displayed in units of millions of km). The physical size of an astronomical object is equal to the angular size times the object’s distance divided by 206265 (similar formula can be found in the textbook on page 29).

The planet chosen for this exercise is Mercury.

Angular size: 3.142 arcsecs

 Distance from the observer: 57.91 million km

$$Physical diameter [km]=(angular size arcsec)(distance km) /206265$$

Physical diameter [km] = (3.142 arcsec) (57910000 km) /206265

Physical diameter [km]= 882.133 km = 882 km

radius [km]=physical diameter km / 2

 radius [km]=882.133 km / 2

radius [km]=441.1 km = 441 km

 So physical diameter of Mercury would be: 882 km and the radius of Mercury would be 441 km. But in Chapter 6 of the textbook the radius for mercury is given as 2440 km whereas the value calculated here is 441 km. Comparing these two, the value calculated here is very less compared to the value mentioned in the textbook.

1. Continue using Stellarium to test your individual hypothesis. If you need further direction, please ask your instructor.

**Testing of individual hypothesis:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Planets | Primary rotation speed | Rotation after 1 hr | Rotation after 2 hrs | Rotation after 3 hrs | Rotation after 4 hrs | Rotation Period |
| Mercury | 41.088 km/s | 41.103 km/s | 41.118 km/s | 41.133 km/s | 41.148 km/s | 87.97 days |
| Venus | 34.787 km/s | 34.788 km/s | 34.788 km/s | 34.788 km/s | 34.788 km/s | 224.70 days |
| Earth | 29.630 km/s | 29.631 km/s | 29.630 km/s | 29.630 km/s | 29.630 km/s | 365.26 days |
| Mars | 23.060 km/s | 23.061 km/s | 23.060 km/s | 23.059 km/s | 23.059 km/s | 686.98 days |
| Jupiter  | 12.784 km/s | 12.784 km/s | 12.784 km/s | 12.785 km/s | 12.785 km/s | 4332.82 days |
| Saturn  | 9.159 km/s | 9.159 km/s | 9.159 km/s | 9.159 km/s | 9.159 km/s | 10755.70 days |
| Uranus | 6-563 km/s | 6.563 km/s | 6.563 km/s | 6.563 km/s | 6.563 km/s | 30687.15 days |
| Neptune | 5.462 km/s | 5.462 km/s | 5.462 km/s | 5.462 km/s | 5.462 km/s | 60190.03 days |

**Conclusion:**

Mercury, Venus, Earth and Mars, formerly known as the Terrestrial Planets do not have a higher rotation period (Brasser, Walsh & Nesvorný, 2013) compared to the Jovian Planets including Jupiter, Saturn, Uranus, Neptune who have a much higher rotation period (Yelle, 2004). The above table gives an illustration as to why Jovian Planets have higher rotation periods compared to Terrestrial planets. The rotation speed of the Jovian Planets is much lower when compared to the Terrestrial Planets. Take Mercury and Jupiter, the two highest rotation speed planets in their respective groups. But the difference in rotation speed between the two planets is clearly visible. With lower rotation speed a planet takes much more time to complete its orbit around the sun. So the slower the speed the higher the number of days taken for a planet to complete its orbit around the sun (Wilson, Carter & Waite, 2008). So the highest rotation period recorded above is Neptune (60190.03 days), whereas the lowest was Mercury (87.97 days).

**References:**

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5. Yelle, R. (2004). Aeronomy of extra-solar giant planets at small orbital distances. Icarus, 170(1), 167-179. doi: 10.1016/j.icarus.2004.02.008