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A Novel Mathematical Model for Understanding Celestial Rotation and Vibration Dynamics

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Abstract: This study proposes a novel mathematical equation which accurately describes the relationship between rotation period, mass, radius and frequency factor of vibration for the Sun, Earth and Moon. The proposed Equation stands for spherical, oblate spheroid Celestial bodies.

It is hypothesized that the Sun's vibration contributes to its rotation about its axis. The Sun, as the central body of the solar system, exerts significant influence on vibration and rotation of other Celestial bodies Earth, Moon which also vibrates in almost same frequency as the sun vibrates.

The Sun controls the planets along with their satellites to revolve around it and also rotate about their axis. It has also been observed that due to high magnitude of earthquake, the angular rotation speed of the earth increases and gradually it retains to the original rotation speed.

The equation is validated using publicly available data and offers new insights into Celestial mechanics.

Keywords: *Celestial Bodies (E.G., Sun, Earth, Moon), Celestial Mechanics, Solar System, Rotation Period, Sun Dynamics, Radius of Celestial Bodies, Mass of Celestial Bodies, Frequency Factor of Vibration of Celestial Bodies, Frequency Factor of Vibration of the Sun, Mathematical Modelling.*

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I. INTRODUCTION

My curiosity about why and how celestial bodies continue to rotate at constant yet varying angular velocities, despite various obstructions such as hurricanes, typhoons, tornadoes, storms, and tidal effects, sparked my interest in this subject. There may be any other law based on which this is happening, the astronomical scientists are having in-depth knowledge in this regard. I have no qualification on astronomy so, I tried to find a mathematical approach based on the imagination and thought as mentioned hereunder.

It is Sun's vibration due to which the Sun also rotates and since the Sun controls all the Celestial bodies of the solar system hence all the Celestial bodies are vibrating with almost same frequency factor of vibration causing rotating about their axis with different angular velocity which depend on their individual mass and radius. To determine the frequency factor of vibration 'f', the proposed mathematical equation, f=(ω^0.147*R^2)/ M^0.7 has been established where 'M', 'R', 'ω' represents mass, radius and angular velocity of Celestial body.

The frequency factor of vibration of the Sun, Earth and Moon are found almost same and therefore equation f=(ω^0.147*R^2)/ M^0.7 satisfy for the Sun, Earth and Moon.

II. AVAILABLE DATA

The data used in this study were obtained from sources such as Cole and Connell (Vol.97, No. 4, p. 225), Deborah Scherre (Stanford Solar Center), and the Royal Museums Greenwich Solar System data.

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Table 1 (a): Data of the Sun, Earth, Moon, (b): Data of Planets other than Earth, (c): Data of Satellites of Planets other than Earth

Celestial Bodies	Rotation period	Diameter Km	Mass Kg	Acquisition source of data
Table 1a-Data of the Sun, Earth, Moon				
Sun	27Days	1391000	2.00E+30	Deborah Scherre (Stanford Solar Center), p.10
Earth	24Hrs	12742	6.00E+24	Deborah Scherre (Stanford Solar Center), p.16
Moon	27.322 Days	3476	----------	Royal Museums Greenwich Solar System data
Moon	-------	---------	7.35E+22	Cole and Connell (Vol.97, No. 4, p. 225)
Table 1b-Data of Planets other than Earth				
Mercury	59Days	4879	3.30E+23	Deborah Scherre (Stanford Solar Center), p.12
Venus	243Days	12104	4.87E+24	Deborah Scherre (Stanford Solar Center), p.14
Mars	24.7Hrs	6780	6.40E+23	Deborah Scherre (Stanford Solar Center), p.22
Jupiter	9.8Hrs	139822	1.90E+27	Deborah Scherre (Stanford Solar Center), p.26
Saturn	11Hrs	116464	5.70E+26	Deborah Scherre (Stanford Solar Center), p.30
Uranus	17.00Hrs	50724	8.68E+25	Deborah Scherre (Stanford Solar Center), p.35
Neptune	16Hrs	49244	1.02E+26	Deborah Scherre (Stanford Solar Center), p.39
Table 1c-Data of Satellites of Planets other than Earth				
Callisto	16.689Days	4800	---------	Royal Museums Greenwich Solar System data
Callisto	----------	-------	1.06E+23	Cole and Connell (Vol.97, No. 4, p. 225)
Europa	3.55 Days	-------	----------	Royal Museums Greenwich Solar System data
Europa	----------	3120	---------	Cole and Connell (Vol.97, No. 4, p. 225)
Europa	----------	-------	4.87E+22	Cole and Connell (Vol.97, No. 4, p. 225)
Ganymede	7.155Days	5262	----------	Royal Museums Greenwich Solar System data
Ganymede	----------	--------	1.49E+23	Cole and Connell (Vol.97, No. 4, p. 225)
Io	1.769Days	3652	----------	Royal Museums Greenwich Solar System data
Io	---------	--------	8.92E+22	Cole and Connell (Vol.97, No. 4, p. 225)
Enceladus	1.37Days	500	----------	Royal Museums Greenwich Solar System data
Enceladus	---------	--------	7.40E+19	Cole and Connell (Vol.97, No. 4, p. 225)
Umbriel	4.144Days	1190	----------	Royal Museums Greenwich Solar System data
Umbriel	---------	---------	1.27E+21	Cole and Connell (Vol.97, No. 4, p. 225)
Titania	8.7Days	1610	----------	Royal Museums Greenwich Solar System data
Titania	_____	_____	3.47E+21	Cole and Connell (Vol.97, No. 4, p. 225)
Tethys	1.888Days	1050	----------	Royal Museums Greenwich Solar System data
Tethys	----------	--------	6.26E+20	Cole and Connell (Vol.97, No. 4, p. 225)
Dione	2.737Days	1120	----------	Royal Museums Greenwich Solar System data
Dione	----------	--------	1.05E+21	Cole and Connell (Vol.97, No. 4, p. 225)
Rhea	2.737Days	1530	----------	Royal Museums Greenwich Solar System data
Rhea	----------	-------	2.28E+21	Cole and Connell (Vol.97, No. 4, p. 225)
Miranda	1.414Days	320	----------	Royal Museums Greenwich Solar System data
Miranda	---------	-------	7.48E+19	Cole and Connell (Vol.97, No. 4, p. 225)
Oberon	13.463Days	1550	----------	Royal Museums Greenwich Solar System data
Oberon	---------	-------	2.90E+21	Cole and Connell (Vol.97, No. 4, p. 225)
Iapetus	79.331Days	1460	----------	Royal Museums Greenwich Solar System data
Iapetus	---------	-------	1.93E+21	Cole and Connell (Vol.97, No. 4, p. 225)
Mimas	0.942Day	390	----------	Royal Museums Greenwich Solar System data
Mimas	----------	--------	4.00E+19	Cole and Connell (Vol.97, No. 4, p. 225)
Triton	5.877Days	3500	----------	Royal Museums Greenwich Solar System data
Triton	----------	--------	5.70E+22	Cole and Connell (Vol.97, No. 4, p. 225)
Titan	15.495Days	5150	----------	Royal Museums Greenwich Solar System data
Titan	---------	------	1.36E+23	Cole and Connell (Vol.97, No. 4, p. 225)

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➢ *Title of Tables:*

- Table 1a: Data of the Sun, Earth, Moon
- Table 1b: Data of Planets other than Earth
- Table 1c: Data of Satellites of Planets other than Earth
- Table 2: Frequency Factor of Vibration for the Sun, Earth and Moon
- Table 3: Frequency Factor of Vibration for Planets Other Than Earth
- Table 4: Frequency Factor of Vibration for Satellites of Planets Other Than Earth

➢ *Author's statement/ Declaration:*

- The above article is completely written by the author as per assumption and thought.
- Data as per column (3), (4) & (5) of table No. 2,3 and 4 considered from websites/ as per reference list.
- The equation is very small but it took about five years to finalise the same f=(ω^0.147*R^2)/ M^0.7
- This is an individual research work, not done through any institution and no guide has been consulted.
- Conflict of interest statement: Not applicable.

Table: In Table 2,3 &4 the mathematical equation expressed as f=(ω^0.147*R^2)/ M^0.7 Where, f, ω, R & M stands for frequency factor of vibration, Angular velocity of rotation in radian/Hr, radius in Km, and mass in Kg respectively.

Mass(M)= (Ↄ^0.147*R^2/ f) ^ (1/0.7) considering frequency factor of vibration of the Sun. Radius (R)=D/2 Km, (T)Rotation period (Hr)=Daysx24, frequency factor of vibration f=(ω^0.147xR^2)/ M^0.7**,** Frequency factor of vibration of Sun(f), Mass(M) Kg considering frequency factor of vibration of the Sun.

Considering frequency factor of Sun f = 1.506363824110E-10 in equation f=(ω^0.147xR^2)/ M^0.7,

Condition 1, if (ω) and M as per respective value as per column (4) and (5) of Celestial bodies, then,

Radius ₹ is calculated as ₹=((f*M^0.7)/Ↄ^0.147) ^ (1/2) which is mentioned in column (7).

Condition 2, if (ω) and R as per as per respective value as per column (4) and (3) of Celestial bodies, then,

Mass M is calculated as M= (Ↄ^0.147*R^2/ f) ^ (1/0.7) which is mentioned in column (8).

Table 2 Frequency Factor of Vibration for the Sun, Earth and Moon

1	2	3	4	5	6	7	8
Rotation Period of Celestial bodies	Diameter (D)Km	Radius R(Km)	(ω) Radian/Hr	Mass (M) Kg	f=(ω^0.147xR^2)/ M^0.7	Radius ₹ (Km) Condition 1	Mass (M) Kg Condition 2
Sun 27Days	1391000	695500	0.0097	2.00E+30	1.506363824110E-10	695500	2.00E+30
Earth 24Hrs	12742	6371	0.261905	6.00E+24	1.507219186458E-10	6369	6.00E+24
Moon 27.322 Days	3476	1738	0.009586	7.35E+22	1.503135564109E-10	1740	7.33E+22

In reference to Table No. (2), The specified equation satisfies for Frequency factor of vibration(f) as mentioned in column (6) and found closely equal/constant for the Sun, the Moon and the Earth. Radius ₹ mentioned in column (7) and Mass(M) mentioned in column (8) is calculated for the Sun, Moon and Earth considering frequency factor of Sun f = 1.506363824110E-10. The equation is validated using publicly available data.

Table 3 Frequency Factor of Vibration for Planets Other Than Earth

1	2	3	4	5	6	7	8
Rotation Period of Celestial bodies	Diameter (D)Km	Radius R(Km)	(ω) Radian/Hr	Mass (M) Kg	f=(ω^0.147xR^2)/ M^0.7	Radius ₹ (Km) Condition 1	Mass (M) Kg Condition 2
Mercury 59Days	4879	2439.5	0.004439	3.30E+23	9.242590682701E-11	3114	1.64E+23
Venus 243Days	12104	6052	0.001078	4.87E+24	7.021588868036E-11	8864	1.64E+24
Mars 24.7Hrs	6780	3390	0.254482	6.40E+23	2.035659301876E-10	2916	9.84E+23
Jupitar 9.8Hrs	139822	69911	0.641399	1.90E+27	3.677997301999E-10	44741	6.80E+27
Saturn 11Hrs	116464	58232	0.571429	5.70E+26	5.827528694112E-10	29606	3.94E+27

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Uranus 17.00Hrs	50724	25362	0.369748	8.68E+25	3.871554069428E-10	15820	3.34E+26
Neptune 16Hrs	49244	24622	0.392857	1.02E+26	3.288357509432E-10	16665	3.11E+26

Table 4 Frequency Factor of Vibration for Satellites of Planets Other Than Earth

1	2	3	4	5	6	7	8
Rotation Period of Celestial bodies	Diameter (D)Km	Radius R(Km)	(ω) Radian/Hr	Mass (M) Kg	f=(ω^0.147xR^2)/ M^0.7	Radius ₹ (Km) Condition 1	Mass (M) Kg Condition 2
Callisto 16.689 Days	4800	2400	0.015693	1.06E+23	2.384944079775E-10	1907	2.04E+23
Europa 3.55Days	3120	1560	0.073776	4.87E+22	2.180531852003E-10	1297	8.26E+22
Ganymede 7.155Days	5262	2640	0.036604	1.49E+23	2.575235366870E-10	2019	3.21E+23
Io 1.769Days	3652	1820	0.148052	8.92E+22	2.152476732079E-10	1523	1.49E+23
Enceladus 1.37Days	500	250	0.191171	7.40E+19	6.050440148135E-10	125	5.39E+20
Umbriel 4.144Days	1190	595	0.063201	1.27E+21	3.981784054163E-10	366	5.09E+21
Titania 8.7Days	1610	805	0.030104	3.47E+21	3.233842596256E-10	549	1.03E+22
Tethys 1.888Days	1050	525	0.138721	6.26E+20	5.709674626172E-10	270	4.20E+21
Dione 2.737Days	1120	560	0.09569	1.05E+21	4.282833869205E-10	332	4.67E+21
Rhea 2.737Days	1530	765	0.09569	2.28E+21	4.644683882434E-10	436	1.14E+22
Miranda 1.414Days	320	160	0.185223	7.48E+19	2.448273110054E-10	126	1.50E+20
Oberon 13.463Days	1550	775	0.019454	2.90E+21	3.187190587549E-10	533	8.46E+21
Iapetus 79.331Days	1460	730	0.003301	1.93E+21	2.897374092309E-10	526	4.91E+21
Mimas 0.942Day	390	195	0.278031	4.00E+19	5.982859789539E-10	98	2.87E+20
Triton 5.877Days	3500	1750	0.044564	5.70E+22	2.282258803038E-10	1422	1.03E+23
Titan 15.495Days	5150	2575	0.016903	1.36E+23	2.331235498271E-10	2070	2.54E+23

In reference to Table No. (3) and (4), The specified equation doesn't satisfy for frequency factor of vibration(f) as mentioned in column (6) for these satellites. Radius ₹ mentioned in column (7), Mass(M) mentioned in column (8) is calculated for these Planets and satellites considering frequency factor of Sun = 1.506363824110E-10 in similar condition 1 and condition 2 as specified earlier. If value of (R), (ω) and (M) are correct then the same equation is not valid for these satellites.

III. RESULTS & DISCUSSION

The Sun accounts for about 99.8% (*Sarah Frazier, 2018, www.nasa.gov*) of the total mass of the solar system. As we know that tremendous heat is generated in the Sun due to the reaction in which Hydrogen gas which is in plasma state is converting to Helium gas by fusion process. Due to the continuous reaction in fusion process not only huge amount heat is generated but the whole ball of gas i.e. the Sun vibrates with some frequency. This can't be ignored.

The proposed mathematical model satisfies the angular rotation velocity of the Sun, Moon and Earth. The earth is the planet that sustains life, the Moon is its natural Satellite, and the Sun is the primary source of energy for life on earth. The individual data of the Sun, Moon and Earth are having huge differences except rotation period of the Sun and Moon which is closely equal and still the equation satisfy and indicate nearly same frequency factor of vibration of the Sun, (f)=1.506363824110E-10 that means the relation exists and it can't be a coincidence at least for these three celestial bodies the Sun, Moon and Earth.

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IV. CONCLUSION

1)The equation f=(ω^0.147xR^2)/ M^0.7 satisfies as per the data available in the website for the Sun, Moon and Earth as mentioned in Table No. (2). The Sun & Moon is visible in the sky in big size. The Earth is the planet where we live in. Data of the Sun, Moon & Earth are more accurate than other planets and their satellites.

V. LIMITATIONS

The equation f=(ω^0.147xR^2)/ M^0.7 does not satisfy as per data available in the website for other Celestial bodies and satellites as mentioned in Table No. (3) and Table No. (4).

The equation's inability to satisfy data as available in the website for other Celestial bodies and satellites which are far away from the earth may have various reasons.

➢ *Possible Reasons:*

- It is very difficult to get 100% accurate data of these object as they look very small.
- Unique physical properties or measurement challenges.

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