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The Cause of Spin in a Star or Planet (Rev. 1.4)

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0. Introduction

The purpose of this paper is to answer the following questions:

1) *What causes a star or a planet to rotate on its axis?*

2) *What defines the magnitude and direction of this rotation?*

(Refer to ***Appendix 1*** *for an explanation of the terminology, mathematical symbols and units used in this document)*

Rev	Date	Reason
1.0	14/03/2017	Release
1.1	31/10/2017	Updated calculation results with correct value of 'G';
1.2	06/12/2017	Claims clarified
1.3	05/02/2018	Rewrite theory in terms of Newton's laws of motion
1.4	23/06/2018	Rewrite Appendix "The Planets"

1. Conclusions

The calculations in this paper identify the cause of spin in stars, planets and moons in terms of, and according to, Newtonian mechanics.

It accurately predicts the angular velocity in all the planets of our solar system along with the earth's and Mars' moons and our sun

The reason why Venus spins in the opposite direction to mercury, for example, is because the sun's influence is greater in Venus than it is in Mercury (neither of which have satellites) and the sun's rotational energy causes its planets to rotate in the opposite direction to their orbital direction.

Planets with satellites (moons) are forced into orbits with energies so much greater than the induced energy from the sun that this reversal would not materialise.

The author questions the density of Mars

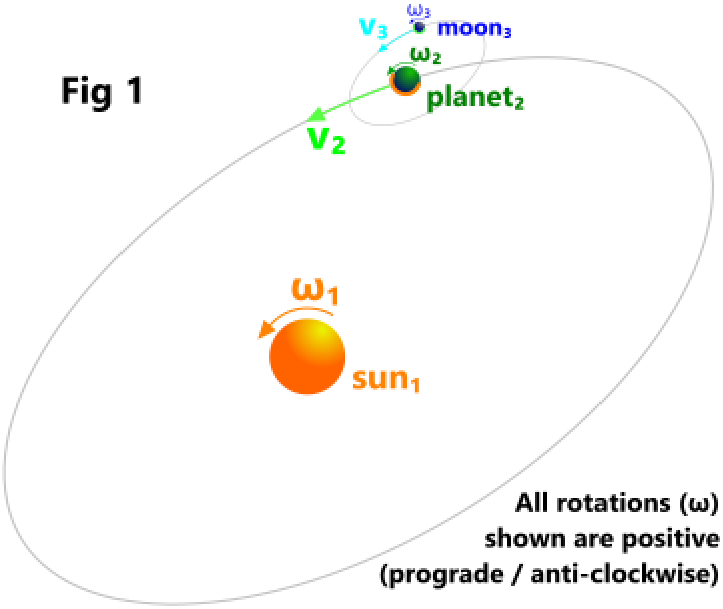
1.1 Further Work

Is Mars hollow?

2. The Basic System

The basic system (**Fig 1**) comprises;
a force-centre (e.g. a sun or star); and
an orbiting satellite (e.g. a planet); and
a secondary satellite (e.g. a moon)

Fig 1



3. Methodology

The following procedure was used to establish the controlling formulas for planetary spin using our solar system for verification:

Isolate and identify the relative angular direction(s) imposed on a planet by its force-centre and its satellite(s) and determine the energy sources responsible for their generation.

It will be assumed that only orbiting bodies and their force-centres can induce spin in each other, which is actually correct as all spin energies can be found from Newtonian mechanics.

3.1 Definitions:

The bodies are defined in Fig 1 according general understanding. In this paper, however:

1) A force-centre can be galactic, solar or planetary, any one of which may have its own satellites

2) A satellite can be solar, planetary or lunar any one of which may have its own secondary satellites

4. Calculations

The polar motion of inertia of any body may be calculated thus:

$J = \frac{2}{5} m.(\Delta.r)^2$
Refer to Appendix 2 for an explanation of 'Δ'

Spin energy may be calculated thus:

$E = \frac{1}{2}.J.\omega^2$

The relative angular velocities induced in a planet (or star) are defined below.

4.1 The Orbit

ω_o: the natural angular velocity of a lone planet (with no moons) orbiting a star rotating at the same angular velocity as its planet.

$\omega_o = 2\pi / T$

$E_o = \frac{1}{2}.J.\omega_o^2$

The gravitational energy between the core of a sun and that of its planet will induce spin (ω_o) in the planet with the same direction and period as that of its sun (e.g. Fig 1; +ve or prograde).
If a sun has only one planet with no moons, they would both have the same angular velocity ($\omega_1 = \omega_o$).
Otherwise, the sun and planets would spin at different rates.

This is the starting point for the calculation procedure.

4.2 The Force-Centre

ω_1 is the angular velocity in a satellite generated by its own orbital kinetic energy and varies with the distance between it and its force-centre according to Isaac Newton's *inverse-square* relationship

$E_1 = \delta KE . (r/\bar{R})^2$

This energy will cause a planet to rotate in the opposite direction (e.g. Fig 1; -ve or retrograde)

4.3 The Satellites

ω_3 is the angular velocity induced in a force-centre by its orbiting satellite(s)

$E_3 = \Sigma(KE^P + PE^A) . \mathrm{Sign}[\mathrm{Cos}(\theta)]$
$\Sigma(KE^P + PE^A)$ must be negative before θ is applied

Satellites induce spin throughout the mass of their force-centre in the same direction as their orbit.
If the plane of a satellite's orbit is tilted (θ) greater than 90º relative to the plane of the planet's orbit, or if it is orbiting in the opposite direction to the planet's orbit about its force centre, the energy it induces (E_3) must be multiplied by -1 {i.e. Sign[Cos(θ)] }

4.4 The Planet's Angular Velocity

The energy inducing angular velocity of a planet (E_2) may be calculated thus:
$E_2 = E_1 - E_3 - E_o$
Note: E_3 is minus in the above formula because it is a negative value in Newtonian mechanics

The angular velocity of a planet (ω_2) may be calculated thus:
$\omega_2 = \sqrt{[2.E_2 / J_2]}$

The above calculation procedure predicts all reversed spins; e.g. Venus, Uranus and Pluto

4.5 Related Mathematical Relationships

$1 + ½e^2 = \pi.\bar{R}^2 / A_o$

In which A_o is the area of satellite's orbit as calculated in *Newton's Laws of Motion*
and $\bar{R}$ is the average distance of a satellite from its force-centre as calculated in *Newton's Laws of Motion*

The orbital energy that defines the angular velocity of a force-centre may be calculated thus:

$E = m.A_o.\omega_{2\ o}^2 / 2.\pi.(1-½e^2)$

In which E is the total energy calculated in *Newton's Laws of Motion*

5. Calculation Results

	J	E_o	E_1	E_3	E_2	ω_2
	Kg.m²	J	J	J	J	c/s
Sun	3.91229E+46	1.46587E+16	5.01045E+32	-1.60100E+35	1.60602E+35	**2.86533E-06**
Mercury	5.19308E+35	1.77447E+23	5.76563E+23	0	3.99116E+23	**1.23980E-06**
Venus	3.30863E+37	1.73281E+24	2.51495E+23	0	-1.48132E+24	**-2.99237E-07**
Earth	1.08212E+37	2.14478E+23	3.20800E+23	-2.87708E+28	2.87709E+28	**7.29212E-05**
Mars	1.58326E+31	8.87109E+16	1.55612E+22	-2.42128E+22	3.97739E+22	**7.08824E-05**
Jupiter	1.92586E+39	2.71288E+23	2.52842E+26	-2.97774E+31	2.97777E+31	**1.75853E-04**
Saturn	1.52389E+38	3.48093E+21	9.19174E+24	-2.04404E+30	2.04405E+30	**1.63788E-04**
Uranus	1.38902E+37	3.90074E+19	2.80792E+22	7.11807E+28	-7.11807E+28	**-1.01238E-04**
Neptune	3.47506E+37	2.53648E+19	2.09365E+21	-2.03937E+29	2.03937E+29	**1.08338E-04**
Pluto	5.48500E+35	1.76850E+17	6.27106E+15	3.55515E+25	-3.55515E+25	**-1.13856E-05**
Moon	2.73159E+34	9.67616E+22	1.93523E+23	0	9.67616E+22	**2.66170E-06**
Phobos	4.04662E+22	1.05210E+15	2.10421E+15	0	1.05210E+15	**2.28033E-04**
Deimos	4.68802E+18	7.77805E+09	1.55566E+10	0	7.77854E+09	**5.76062E-05**

Table 5: Calculated values for planetary spin

5.1 Claims

Claim 1: The spin in any force-centre or satellite can be calculated using Newtonian mechanics

Claim 2: Only force-centres and their satellites can influence each other's angular velocity

Claim 3: The spin in a force-centre is induced by its orbiting bodies

Claim 4: A satellite's spin rate will be altered by a force centre rotating at a different angular velocity

Claim 5: Irrespective of its angular velocity, a force-centre will not induce spin in a satellite orbiting in a circular path

Appendices

Appendix 1: Mathematical Symbols & Units

Appendix 2: Chicken & Egg?

Appendix 3: Polar Moment of Inertia (Δ)

Appendix 4: The Planets

Appendix 5: Relative Densities

Appendix 1: Mathematical Symbols & Units

A mass orbiting a force-centre will generate a positive kinetic energy (KE) and a negative potential (gravitational) energy (PE) between the force-centre and the orbiting body. The sum of the two is Newton's combined energy (E). The formulas for these values can be found on CalQlata's web page; http://calqlata.com/Maths/Formulas_Laws_of_Motion.html; '**Formulas**'.

The potential energy (PE) between two or more bodies is also *gravitational* energy.

'δKE' is the difference between the kinetic energies of a satellite at its perigee and its apogee {J}
i.e. $\delta KE = KE^P - KE^A$

'KE^P' is the kinetic energy of a satellite at its perigee {J}
'KE^A' is the kinetic energy of a satellite at its apogee {J}

'PE^A' is the potential energy between a force centre and its satellite at its apogee {J}

'θ' is the angle of inclination of a satellite's orbital plane relative to its own plane orbital plane {radians}

'E_1' is the spin energy induced in a satellite by its force-centre {J}

'E_2' is the total spin energy in a satellite {kg.m²}

'E_3' is the spin energy induced in a satellite by its secondary satellite(s) {kg.m²}

'E_o' is the natural spin energy in a satellite induced by its own orbit {kg.m²}

'ω_1' is the angular velocity induced in a satellite by E_1 {J}

'ω_2' is the total angular energy in a satellite induced by E_2 {kg.m²}

'ω_3' is the total angular energy in a satellite induced by E_3 {kg.m²}

'ω_o' is the total angular energy in a satellite induced by E_o {kg.m²}

'J' is the polar moment of inertia of a body {kg.m²}

'T' is the satellite's orbital period

'r' is the satellite's radius

'$\overline{R}$' is the average orbital distance between the centre's of a satellite and its force-centre

'Δ' radial modifier (factor) for the polar moment of inertia of a rotating body

'$_1$' refers to a force-centre (star)

'$_2$' refers to a satellite (planet)

'$_3$' refers to a secondary satellite (moon)

For the purposes of this document, the terms 'rotational' and 'angular' are interchangeable; all such velocities shall be interpreted has having magnitude *and* direction.

Refer to CalQlata's **Laws of Motion** (http://calqlata.com/Maths/Formulas_Laws_of_Motion.html) for a detailed explanation of Newton's laws of planetary motion (http://calqlata.com/Maths/Formulas_Orbits.html) and for planetary orbit details

Refer to CalQlata's **Definitions** (http://calqlata.com/help_definitions.htm) for an explanation of the terms used in this paper

Appendix 2: Chicken & Egg?

It is generally believed that a sun rotates under its own steam pulling its planets around with it.

If this were the case, it would need a suitable energy source to do so, moreover, the same claim must also apply to rotating planets. Whilst this claim may (or may not) be made for our sun and even Earth itself, it cannot be made for planets such as Pluto, which is a solid lump of rock and ice with no internal energy source. Moreover, Pluto’s local orbit (**Appendix 4**) could not be explained by such an internal energy source.

It is therefore claimed (by the author) that as an orbiting body induces far greater rotational energy spin in its force centre than vice-versa and the initiation of a solar system must be due to a force-centre that was not initially rotating being caused to orbit by its orbiting bodies.

Subsequent rotational influence by a force-centre on its satellites will occur once in motion, but is insufficient to generate the energies required to maintain their orbits.

Appendix 3: Polar Moment of Inertia (Δ)

The basic formula for the polar moment of inertia (J) of a sphere is:

$J = \frac{2}{5}m.r^2$

Where 'm' is the mass of the sphere and 'r' is its radius (**Fig 2**)

However, this formula only applies to a sphere that comprises the same homogeneous material throughout its structure

Planets, however, are anything but homogeneous as gravitational energy generates very high densities at their cores (**Fig 3**)

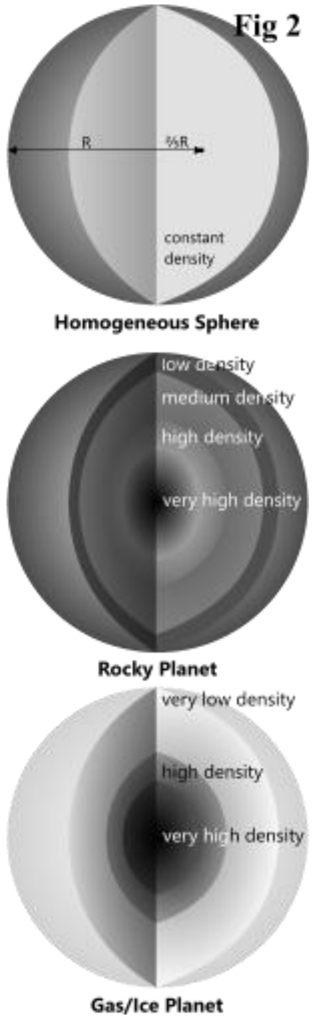
'Δ' in the above formula can provide us with an equivalent representative radius of an homogeneous sphere with the same mass and the correct polar moment of inertia (J) as follows:

$E_o = \frac{1}{2}.J.\omega_o^2$

$J = \frac{2}{5}m.(\Delta.R)^2$

The calculated variable; 'Δ' for various solar system bodies is provided in Table A3

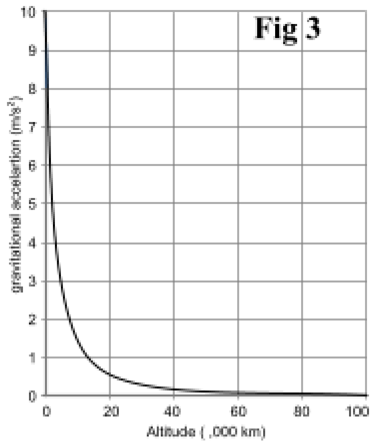
Fig 2



Body	**Δ**
Sun	0.318782372247959
Mercury	0.812862196423113
Venus	0.681180492057101
Earth	0.33428172721771
Mars	0.00231707805666362
Jupiter	0.0227806693989634
Saturn	0.014059868482105
Uranus	0.0249372276830553
Neptune	0.0374067226435373
Pluto	8.64241935542982
Moon	0.554903433736135
Phobos	0.275895222790585
Deimos	0.014346539805995
Table A3: Delta values for solar system bodies	

This value (Δ) can be used to establish the construction of a planet, star or moon, as can be found on 'http://www.calqlata.com/Maths/Formulas_Core_Pressure.html'

Fig 3



Appendix 4: The Planets

From this study, it appears unlikely that the earth, or any other planet spent its first half-billion years or so in a molten or even especially heated condition. Accretion doesn't generate heat and there is no physical evidence on earth to show that this was the case. Moreover, the fact that the earth's internal heat is not left over from its birth but constantly generated by the competing spin-related influences from its force-centre and its satellite seems to indicate otherwise.

Via 'Δ', spin theory has allowed us to estimate the internal composition of a few of the satellites in our solar system.

Venus

Venus spins the opposite way to the other planets because; a) it has no moon(s) to drive it in the other direction and; b) it is sufficiently large to resist the sun's influence on its spin direction.

Venus is, and always has been, too close to the sun to allow water to exist on its surface in liquid form. The mass of water vapour (similar to that on the surface of the earth) maintains the surface temperature of Venus. Almost all its surface heat comes from the sun and is retained by atmospheric water vapour.

Whilst Venus contains a similar percentage of iron to the earth, it has a far lower concentration at its core because it has no moon. The earth's moon is, and always has been, responsible for the differential spin-rate of the earth's core and its mantle and thereby generating its magnetic field and its internal heat, providing the mechanism for its iron to migrate towards its core. Venus has no magnetic field or internal heat because its core is not spinning at a different rate to its mantle.

Because Venus has no rotating core and no liquid surface water, it has no mantle plumes, low volcanic activity and therefore cannot generate active tectonic-plates.

The reason Venus' erupted surface material is so flat (non-effusive) is because, having no mantle plumes and little internal heat, its volcanic activity is much less aggressive than that within the earth.

Mars

Mars, on the other hand, had a short ultra-active life due to a fast-spinning core, driven by a relatively large, high-velocity moon (Phobos), which was probably responsible for its huge volcanoes. Mars' relatively low mass caused it to burn out very quickly.

Mars is referred to here as a rocky (not an iron) planet because of its perceived density. However its exceptionally low 'Δ' value along with its largest moon orbiting faster than the spin in its force-centre and the planet's red colour appear to show that it is may well be a hollow iron planet, that has at some time blown all of its ferrite-rich material from its core out onto its surface through its massive volcanoes; e.g. 'Olympus Mons'.

Mars' red surface colour may well indicate that it had accommodated oxygen emitting plant life before its core was blown out.

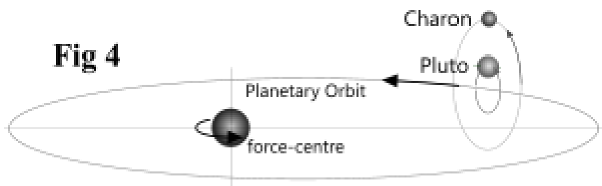
All of Mars' water will no doubt have found its way into the interior of the planet and is occasionally released only under heavy meteorite impact.

The gas planets

As can be seen in **Fig 3** the pressure/density of gas increases exponentially under gravity and inversely proportional with radius indicating that the vast majority of the mass in a gas planet must be at its centre.

Pluto

Fig 4



Pluto's principal moon; Charon, is so large (>12% of Pluto's mass) it is pulling Pluto into a local orbit (**Fig 4**) and is the reason why its effective radial modifier (Δ) is greater than 1

Pluto is the only planet in these calculations with a 'Δ' value greater than 1 and the only planet being pulled by its moon into a significant localised orbit, thereby vindicating a value of; '$\Delta>1$' and the use of this variable in these calculations.

Appendix 5: Relative Densities

As we can only guestimate the structures of our sun or the ice and gas planets, we can only guestimate their polar moments of inertia. To do this, we may use the known values for ω_o and E_o to establish a representative radial modifier 'Δ' (**Appendix 3**)

We can then use 'Δ' to estimate the expected *surface* density for each planet based upon its *average* density.

For each 'Δ' to be representative, it must reflect the structure of the planet concerned. A reasonable estimate can be made from the average densities of each planet.

By way of illustration, it is possible to estimate for most planets from their relative densities '$\rho^s = \Delta.\rho^\alpha$'
Where: ρ^α is the average density and ρ^s is the surface density

Using this argument for the planets in our solar system with moons, the surface densities of each are estimated as follows:

	Δ	**Surface Density (kg/m³)**
Earth	0.334282	1840.672632
Mars	0.00231708	9.115572455 [1]
Jupiter	0.02278067	30.21210674
Saturn	0.01405987	9.660859203
Uranus	0.02493723	31.68063158
Neptune	0.03740672	61.26999625
Pluto	8.6424194	16074.55597 [1]

Table A5
[1] ***Appendix 4***

Given their respective surface temperatures and despite the unknown nature or composition of each planet's inner material(s), with the exception of Mars and Pluto (**Appendix 4**), each is representative of its expected surface materials.