Potential Quantum Gravitational Kick ($6\pi GM/c^2$) As Origin Of Mercury's Perihelion Precession Shift Anomaly Instead Of Spacetime Curvature

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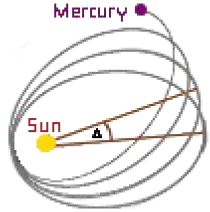
Introduction

This paper's purpose is to present a namely "Quantum gravitational kick" alternative to Einstein's spacetime gravity paradigm as the root cause of Mercury's perihelion precession shift anomaly (and other orbiting celestial objects for that matter).

What is Einstein's Spacetime Explanation For Precession Anomaly of Planetary Orbits?

Einstein's general relativity theory was validated via its calculation formula of Mercury's orbital precessions as described in the following drawing:



In the drawing, Mercury's perihelion precession shift angles are magnified in order to show its too small anomaly of 43 arcsecs per one century.

According to Einstein's general relativity theory, when a planet moves faster and faster toward its perihelion for each orbital period, the planet just gets deeper into the host star's curvature of space-time (dubbed as “gravity “well), and this orbital movement must cause the orbit's perihelion of the planet to advance. This orbital advancement is described as a sharp curve (aka “kink”) of the time shift before and after the perihelion.

Potential Discovery of Quantum Gravitational Kick [$6\pi GM/c^2$] That Triggers Perihelion Precession Effect on Orbiting Celestial Objects

Naming Conventions:

For the clarity and simplification purposes,

> A celestial object that orbits another celestial object will be called hereafter a “captive”.
>
> A celestial object that is orbited by one or many other celestial objects will be called hereafter a “captor”.

What is Quantum Gravitational Kick From My Quantum Entanglement Continuum Theory?

Based on my namely “Quantum Entanglement Continuum” theory,

> There must be a Sun-Mercury binding quantum axle that guides Mercury along its orbit around the Sun, and at the start of every planetary revolution, Mercury receives a quantum gravitational kick from the Sun via their binding quantum axle.
>
> This quantum gravitational kick is universal. It is applied equally to all captives of the same captor, like the Sun and its planets, asteroids, comets, the Earth and its moon, a black hole and its revolving stars, and so on.

Quantum Gravitational Kick's Principles

The principles of the “Quantum gravitational kick” are:

> In any gravitationally bound pair of celestial objects where one orbits the other, the orbital motion must be mechanized by a quantum axle that two celestial objects generate and share. Furthermore:
>
> > Each celestial object gives a quantum gravitational kick to the other, with the strength proportional to its mass. Therefore the quantum axle must be proportionally controlled by the more massive celestial object to force the less massive one to revolve around it in a regular quantum and classical pattern.
>
> The potential energy of the said quantum gravitational kick is materialized by its kinetic length via the following formula:
>
> > $$6\pi GM / c^2$$
> >
> > where:
> > G is Newton's gravitational constant
> > M is the mass of the captor (orbited celestial object)
> > c^2 is the square value of the speed-of-light in vacuum
>
> The potential energy of the said quantum gravitational kick is used by the captor to give the same orbital push at the start of each revolution of each orbiting celestial object.

These aforementioned principles of quantum gravitational kick appear to reveal that:

> The nature of orbital motion of celestial objects must be of quantum nature because its effect depends solely on the mass and the speed of light, where time dilation has no role in it.
>
> The formula of the said “quantum gravitational kick” should not be mistaken with the Schwarzschild radius' formula “2GM/c2”.

Quantum Gravitational Kick Values of Studied Central Celestial Objects

Quantum Gravitational Kick Value of the Sun:

Let's fill the said Quantum gravitational kick formula “$6\pi GM/c^2$” with the relevant values of the Sun (hereafter called QABOKsun):

Sun's GM $= 6.6743e\text{-}11$ (N kg^{-2} m²) x 1.9885e+30 (kg)
$= 132.7184555e{+}18$ m^3 s^{-2}

$c^2 = (299{,}792{,}458 \text{ m/s})^2 = 8.9875517873681764e{+}16 \text{ m}^2 \text{ s}^{-2}$

Then we get:

QABOKsun $= 6\pi$ x 132.7184555e+18 / 8.9875517873681764e+16

Hence the Sun's Quantum gravitational kick:

QABOKsun = 27,8349 m (or ~ 27.8349 km)

This calculated length value of the Sun's quantum gravitational kick will be used later on to compare with the orbital distance shift of each planet.

Lists of Relativistic Orbital Precession Shift Values of Solar System's Celestial Objects

My calculations of quantum gravitational kicks are based on all public data related to observed values of relativistic orbital precession shifts of moving celestial objects such as planets, moons, asteroids, satellites in the Solar system and beyond.

The relativistic orbital precession shift values ($\delta\phi$) presented in the following lists are calculated values in arcsecond units. They are obtained from Einstein's related equation on full orbital circumference reference of 1,296,000 arcsecs (or 360 degrees of 3600 arcs each), and not of 2π.

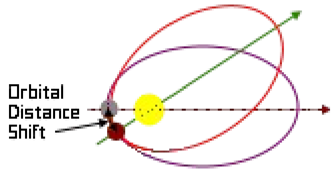
List Of Observed And Relativistic Orbital Precession Shift Values Of Solar System's Planets

The following list presents the perihelion pression shifts for each planet inside the Solar system, in the order of precession shift per orbital revolution then total thereof per century:

Perihelion Precession Shifts	**Per Revolution (in arcsecs)**	**Per Century(Total) (in arcsecs)**
Mercury	0.10338	42.9195
vs. Observed value:		43.1 ± 0.5
Venus	0.0530	8.6186
vs. Observed value:		8.4 ± 4.8
Earth	0.0383	3.8345
vs. Observed value:		5.0 ± 1.2 (D'Inverno, 198.)
Mars	0.0254	1.3502
Jupiter	0.0074	0.0623
Saturn	0.0040	0.0137
Uranus	0.0020	0.0024
Neptune	0.0013	0.0008

Calculations and Findings From Orbital Distance Shift Values Of Solar System's Planets Due to Observed Relativistic Precession Shift

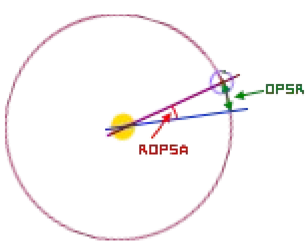
Let's first be clear about what an orbital distance shift is. An orbital distance shift defined here is the length of the distance that a planet makes along its orbit around its hosting star (i.e. the Sun) from the beginning of its orbital precession shift to the end thereof for each revolution, as shown in the following drawing:



Based on my findings, it turns out that the relativistic orbital precession shifts of all known planets of the Solar system, that were predicted by Einstein's General Relativity theory then verified by actual observations since then, hide a shared outcome. And this shared outcome is that the values of the resulting orbital distance shifts of all these planets have more or less the same length value. This shared outcome is completely opposite to the wide diverseness of observed values of these planets' originated relativistic orbital precession shift angles.

Calculation of Orbital Distance Shift Values Of Solar System's Planets Due to Observed Relativistic Precession Shift

For each planet based relativistic orbital precession shift value, we can use a common method to deduce the related orbital distance shift.



The method to calculate the orbital distance shift (ODS for short) of a planet after one full revolution consists of two steps:

1) Calculate the Orbital precession Shift Ratio (OPSR for short).

The Orbital precession Shift Ratio is the length ratio of the distance, made by the involved planet after one full revolution, with respect to the length of its entire orbital circumference.

The value of OPSR is obtained by Dividing the radian based value of a planet's relativistic orbital precession shift angle (ROPSA for short) by the radian based value of its orbital circumference (RADCIR for short), and all said values must be calculated in the same unit basis (such as arc-seconds). The calculation formula of OPSR can be defined as followed:

OPSRplanet = ROPSAplanet / RADCIRplanet

All RADCIR values are the same for all planets and their orbits are based on full circular orbit, which is 1,296,000 arcsecs (= 360 degrees x 3600 arcsecs).

2) Calculate the length value of the orbital distance shift (ODS for short).

The value of ODS is obtained by Multiplying the found Orbital precession shift ratio by the actual orbital circumference length (CIR for short). The calculation formula of ODS can be defined as followed:

ODSplanet = OPSRplanet x CIRplanet

The unit basis for this calculation must be in kilometers or meters.

Here are some relevant calculations:

Mercury's Orbital Distance Shift Due to Precession Shift:

For Mercury's precession shift angle, Mercury's orbital distance shift ratio per period (OPSR) is:

OPSRmercury = 0.10338 arcsecs / 1,296,000 arcsecs, hence:
OPSRmercury = 7.976851e-8

Mercury's Orbital Circumference = 359,922,622 km, hence:
Mercury's orbital distance shift (ODS) must be:
ODSmercury = 359,922,622 km x 7.976851e-8, hence:
ODSmercury = 28.7105 km

Because Mercury's elliptical orbit has an eccentricity as:
Emercury = 0.206 hence: $(1–\text{Emercury}^2)$ = 0.957564

So Mercury's adjusted orbital distance shift (AODS) becomes:
AODSmercury = Observed Orbital Distance Shift x $(1–e^2)$
= 28.7105 km x 0.957564, hence:

AODSmercury = 27.4921 km

Venus' Orbital Distance Shift Due to Precession Shift:

OPSRvenus = 0.0530 arcsecs / 1,296,000 arcsecs, hence:
OPSRvenus = 4.0895e-8

Venus' Orbital Circumference = 679,892,378 km, hence:
Venus' orbital distance shift (ODS) must be:
ODSvenus = 679,892,378 km x 4.0895e-8 or
ODSvenus = 27.8041 km

Venus' elliptical orbit has an eccentricity as:
Evenus = 0.00677 hence: $(1–\text{Evenus}^2)$ = 0.99995

So Venus' adjusted orbital distance shift (AODS) becomes:
AODSvenus = 27.8041 km x 0.99995 or:
AODSvenus = 27.8027 km

Earth' Orbital Distance Shift Due to Precession Shift:

OPSRearth = 0.0383 arcsecs / 1,296,000 arcsecs, hence:
OPSRearth = 2.9552e-8

Earth's Orbital Circumference = 939,951,955 km, hence:
Earth's 's orbital distance shift (ODS) must be:

ODSearth = 939,951,955 km x 2.9552e-8, hence:
ODSearth = 27.7774 km

Earth's elliptical orbit has an eccentricity as:
Eearth = 0.0167 hence: (1–Eearth^2) = 0.99972

So Earth's adjusted orbital distance shift (AODS) becomes:
AODSearth = 27.7774 km x 0.99972 hence:
AODSearth = 27.7696 km

Mars' Orbital Distance Shift Due to Precession Shift:

OPSRmars = 0.0254 arcsecs / 1,296,000 arcsecs hence:
OPSRmars = 1.9598e-8

Mars' Orbital Circumference = 1,429,085,052 km,
Mars' orbital distance shift (ODS) must be:
ODSmars = 1,429,085,052 km x 1.9598e-8 hence:
ODSmars = 28.0072 km

Mars' elliptical orbit has an eccentricity as:
Emars = 0.0934 hence: (1–Emars^2) = 0.9913

So Mars' adjusted orbital distance shift (AODS) becomes:
AODSmars = 28.0072 km x 0.9913 hence:
AODSmars = 27.7635 km

Jupiter's Orbital Distance Shift Due to Precession Shift:

OPSRjupiter = 0.0074 arcsecs / 1,296,000 arcsecs hence:
OPSRjupiter = 5.7098e-9

Jupiter's Orbital Circumference = 4,887,595,931 km
Jupiter's 's orbital distance shift (ODS) must be:
ODSjupiter = 4,887,595,931 km x 5.7098e-9 hence:
ODSjupiter = 27.9071 km

Jupiter's elliptical orbit has an eccentricity as:
Ejupiter = 0.0487 hence: (1–Ejupiter^2) = 0.9977

So Jupiter's adjusted orbital distance shift (AODS) becomes:

AODSjupiter = 27.9071 km x 0.9977 hence:
AODSjupiter = 27.8429 km

Saturn's Orbital Distance Shift Due to Precession Shift:

OPSRsaturn = 0.0040 arcsecs / 1,296,000 arcsecs hence:
OPSRsaturn = 3.0864e-9

Saturn's Orbital Circumference = 8,957,504,604 km,
Saturn's orbital distance shift (ODS) must be:

ODSsaturn = 8,957,504,604 km x 3.0864e-9 hence:
ODSsaturn = 27.6464 km

Saturn's elliptical orbit has an eccentricity as:

Esaturn = 0.0520 hence $(1–Esaturn^2)$ = 0.9973

So Saturn's adjusted orbital distance shift (AODS) becomes:

AODSsaturn = 27.6464 km x 0.9973 hence:
AODSsaturn = 27.5717 km

Uranus' Orbital Distance Shift Due to Precession Shift:

OPSRuranus = 0.0020 arcsecs / 1,296,000 arcsecs hence:
OPSRuranus = 1.5432e-9

Uranus' Orbital Circumference = 18,026,744,947 km,
Uranus' orbital distance shift (ODS) must be:

ODSuranus = 18,026,744,947 km x 1.5432e-9 hence:
ODSuranus = 27.8188 km

Uranus' elliptical orbit has an eccentricity as:

Euranus = 0.0469 hence: $(1–Euranus^2)$ = 0.9978

So Uranus' adjusted orbital distance shift (AODS) becomes:

AODSuranus = 27.8188 km x 0.9978 hence:
AODSuranus = 27.7575 km

Neptune's Orbital Distance Shift Due to Precession Shift:

OPSRneptune = 0.0013 arcsecs / 1,296,000 arcsecs hence:
OPSRneptune = 1.0030e-9

Neptune's Orbital Circumference = 28,263,782,131 km,
Neptune's orbital distance shift (ODS) must be:

$ODS_{neptune}$ = 28,263,782,131 km x 1.0030e-9 hence:
$ODS_{neptune}$ = 28.3485 km

Neptune's elliptical orbit has an eccentricity as:

$E_{neptune} = 0.00858$ hence: $(1 – E_{neptune}^2) = 0.99993$

So Neptune's adjusted orbital distance shift (AODS) becomes:

$AODS_{neptune}$ = 28.3485 km x 0.99993 hence:
$AODS_{neptune}$ = 28.3465 km

Findings Related To Orbital Distance Shift Values Of Solar System's Planetary Precession Shifts

The previous calculations of the orbital distance shift values of the Solar system's planets due to their observed orbital precession shift appear to show the following pattern:

Despite the diversity of observed precession shift values of all the planets inside the Solar system, and despite the diversity of orbital radii values of these planets, their deduced orbital distance shift values are unexpectedly close or very close to the value of:

The gravitational kick of the Sun:

(QABOKsun)	**27.8349 km**

Non adjusted Orbital distance shift values:

Mercury's orbital distance shift	28.7105 km
Venus' orbital distance shift	27.8041 km
Earth's orbital distance shift	27.7774 km
Mars' orbital distance shift	28.0072 km
Jupiter's orbital distance shift	27.9071 km
Saturn's orbital distance shift	27.6464 km
Uranus' orbital distance shift	27.8188 km

Neptune's orbital distance shift	28.3485 km

Adjusted Orbital distance shift values:

Mercury's orbital distance shift	27.4921 km
Venus' orbital distance shift	27.8027 km
Earth's orbital distance shift	27.7696 km
Mars' orbital distance shift	27.7635 km
Jupiter's orbital distance shift	27.8429 km
Saturn's orbital distance shift	27.5717 km
Uranus' orbital distance shift	27.7575 km
Neptune's orbital distance shift	28.3465 km

The adjusted orbital distance shift values appear to be overwhelmingly closer to the Sun triggered Quantum gravitational kick (QABOKsun).

Potential Confirmation of Quantum Gravitational Kick Alternative To Relativistic Orbital Precession Shift

Based on my analysis of the previous study of celestial objects with respect to their orbital distance shifts, it appears that:

The relativistic orbital precession shift of a captive, widely accepted as evidence of spacetime curvature generated by a captor, can have a quantum explanation alternative. And this alternative is a quantum kinetic energy translated into an orbital quantum gravitational kick to keep any orbiting celestial object moving endlessly one revolution after another.

The said kinetic energy that an orbited celestial object provides to each of its orbiting celestial objects, is the same regardless of the latter's sizes and radial distances.

The said quantum gravitational kick alone cannot explain why a captive stays perpetually in its orbit around its captor, but is the first evidence that it is the captor that triggers and controls the orbit of each of its captives.

My other finding related to the quantum mechanism that a captor determines and keeps a captive in its orbit will be presented in another paper.

Why Quantum Gravitational Kick And Not Space-Time Curvature?

By analyzing the embedded relativistic and non relativistic components of Einstein's equation of Mercury precession shift, one can deduce that spacetime curvature is just a geodesics-based mathematical interpretation of gravity and can be replaced by a quantum alternative paradigm.

But, through the quantum gravitational kick, gravity must be of quantum nature because the delivery of gravitational kick from captor to captive must be made by means of a quantum axle through a quantum gravitational field.

Quantum Gravitational Kick Constant

Based on my analysis, there is a constant that can be called “Orbital quantum gravitational kick constant with the symbol “O” (omicron) as:

$$\mathbf{O = 6\pi G/c^2}$$

With actual value as:

$$\mathbf{O = 1.39979823275061605442624817926 95e\text{-}26\ [m\ kg]}$$

This constant means that 1 kilogram of baryonic matter of a captor generates an orbital gravitational kick of about 1.39979e-26 meter on any of its captives.

Quantum Gravitational Kick's Formula Hidden Inside Einstein's Formula Of Perihelion Precession Shift Angle

Based on my finding, it turns out that the newly discovered quantum gravitational kick's formula ($6\pi GM/c^2$) is hidden inside Einstein's formula to calculate the angle of perihelion precession shift of captives, presented as followed:

$$\Delta\varphi = \frac{6\pi GM}{c^2(1-\varepsilon^2)R}$$

Einstein had deduced this formula from his field equations, according to his scientific paper record.

Based on my analysis, angles of perihelion precession shift of captives are just one piece of the puzzle of what gravity is, therefore not sufficient clues to make a genuine conclusion about it. By the same token, spacetime interpretation of gravity appears to be a mathematical modeling of gravity.

Conclusion

Based on my calculations, it appears that captives must be affected by quantum gravitational kicks that push them along their orbit around their host celestial object. The length of such orbital quantum gravitational kick can be obtained through the mathematical formula:

$$\mathbf{6\pi GM / c^2}$$

where:
G is Newton's gravitational constant
M is the mass of the captor (orbited celestial object)
c^2 is the square value of the speed-of-light in vacuum

Furthermore, my study has revealed that this orbital quantum gravitational kick appears to exist also between the Sun and most known asteroids, between the Earth and its moon, the Sagittarius A* black hole and its S* stars,

Combined with actual relevant astronomic data, this orbital quantum gravitational kick can be claimed as such because the mathematical formula can explain clearly how one celestial object starts and stops the orbital kick, and when and how frequently the said orbital kick is triggered, and all that with atomic clock-like precision.

I have written a book named "Quantum Gravitational Kick $6\pi GM/c^2$" with additional detailed information and calculations about all relevant celestial objects such as solar asteroids, the Moon, Earth's artificial satellite, Sagittarius A* and its stars.