

GRAVITY AND THE SIZE OF THE UNIVERSE

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Abstract –

Whenever human understanding of the size of the universe is at a breakthrough point, a new idea about the nature of gravity introduces itself to the world. For thousands and thousands of years, the magnitude of the cosmos was limited to the stars that could be seen in the night sky (not that people knew what they were looking at). Just over 400 years ago, a tremendous breakthrough came. The telescope arrived, and drastically changed our view of the heavens. A mere 60 years later (a drop in the ocean of historical time), gravity was compared to the fall of an apple and Isaac Newton proposed that the moon traces out the curve of its orbit by constantly "falling" towards Earth.

Things progressed steadily for over 200 years - telescopes grew bigger, planets and stars were discovered, and the universe became as large as the Milky Way galaxy. About the same time that we were starting to wonder if there other galaxies out there (a concept that would vastly increase the universe's size again), another gravitational breakthrough came. Albert Einstein reinterpreted the moon's being constantly tugged towards Earth by our planet's gravity. He said the moon is "pushed" towards Earth by the hills and valleys of curved space-time surrounding this world.

Since then, things have – despite the inevitable dead ends science embarks on but sooner or later corrects - steadily progressed once more. Complacency seems to have arisen, because many appear to think real science never means anything except continual slow progress. There's a new idea in the world, however – that the universe may be infinite. This would drastically increase the size of the universe once more, and herald another breakthrough in comprehension of gravity.

The ideas of Newton and Einstein embrace the entire universe, and the truth in their theories has been repeatedly confirmed. It's only logical that elements of both Newtonian and relativistic gravity must be present in a new "infinite universe gravity" (IUG). The universe can't possibly be larger than infinite – even hypothetical multiverses and cyclic universes would be included in its infinity if they existed. So you might think an idea of infinite gravity would be the final breakthrough in understanding gravity. But it would be terrible if learning could reach an end – the infinite nature of gravity implies it might undergo infinite refinements over the eons.

Content –

IS THE UNIVERSE INFINITE? HOW COULD THIS BE DONE?

First, a short paragraph about this idea of the universe being infinite –

“The evidence keeps flooding in. It now truly appears that the universe is infinite” and “Many separate areas of investigation – like baryon acoustic oscillations (sound waves propagating through the denser early universe), the way type 1a supernovae compare with redshift, the Hubble constant, studies of cosmic large-scale structure, and the flat topology of space – all point the same way.” [1] Support for the article – a) after examining recent measurements by the Wilkinson Microwave Anisotropy Probe, NASA declared "We now know that the universe is flat with only a 0.4% margin of error." [2] and b) the shape of the Universe found to best fit observational data is the infinite flat model [3]

How could it be infinite?

Albert Einstein showed space-time is warped, so it's possible our own computer science (and terraforming, and biotechnology from many centuries in the future) found its way into the past. Dr Graham Phillips said “(The physicist) Paul Davies thinks the universe is indeed fine-tuned for minds like ours. And who fine-tuned it? Not God, but minds from the future, perhaps even our distant descendants, that have reached back through time ... and selected the very laws of physics

that allow for the existence of minds in the first place. Sounds bizarre, but quantum physics actually allows that kind of thing.” [4]

May I propose an alternative to the probabilistic understanding of quantum mechanics - one using hidden variables which give exact predictions, in this case by the variables being base-2 mathematics. I want to propose an alternative to the current understanding of a probabilistic universe that originated from nothingness in a Big Bang. This alternative involves binary digits, Mobius strips and figure-8 Klein bottles (in the process, a Steady State universe will be proposed).

While reading this, remember that bits are not only units of information but also pulses of energy. The information in BITS or Binary digITS is the result of electrical switching, with currents normally being either "on", usually represented by the binary digit "one" - or "off", by "zero". A binary digit can thus be viewed as a pulse of energy.

String theory says everything's composed of tiny, one-dimensional strings that vibrate as clockwise, standing, and counterclockwise currents [5]. We can visualize tiny, one dimensional binary digits of 1 and 0 (base 2 mathematics) forming currents in a two-dimensional program called a Mobius loop – or in 2 Mobius loops, clockwise currents in one loop combining with counterclockwise currents in the other to form a standing current. (The curving of what we call space-time sounds very strange, but I think it can actually be explained by modelling space-time's construction on the Mobius strip that can be represented by giving a strip of paper a half-twist of 180 degrees before joining its ends.)

Joining two Mobius strips (or Mobius bands) forms a four-dimensional Klein bottle [6]. And each Klein bottle can become an observable (or "sub") universe (figure-8 Klein bottles appear to have the most suitable shape to form subuniverses). This connection of the 2 Mobius strips can be made with the infinitely-long irrational and transcendental numbers. Such an infinite connection translates[^] into an infinite number of TANGIBLE figure-8 Klein bottles which are, in fact, "subuniverses". The infinite numbers make the cosmos as a

whole* physically infinite, the union of space and time makes it eternal, and it's in a static or steady state because it's already infinite.

^ The translation could be via photons and gravitons being ultimately composed of the binary digits of 1 and 0 encoding π , e , $\sqrt{2}$ etc.; and matter particles [and even bosons like the Higgs, W and Z particles] being given mass by photons/gravitons interacting in matter particles' "wave packets".

* (i.e. the cosmos beyond our 13.8-billion-year-old subuniverse, which is expanding and displacing parts of the universe beyond)

For the note below on the figure-8 Klein bottle, I refer to [7] [8] [9] [10] [11] –

Informally - if an object in space consists of one piece and does not have any "holes" that pass all the way through it, it is called simply-connected. A doughnut (and the figure-8 Klein bottle it resembles) is "holey" and not simply connected (it's multiply connected). The universe appears to be infinite, being flat on the largest scales and curved on local scales (from far away, a scene on Earth can appear flat, yet the curves of hills become apparent up close). A flat universe that is also simply connected implies an infinite universe [12]. So it seems the infinite universe cannot be composed of subunits called figure-8 Klein bottles (flat universes that are finite in extent include the torus and Klein bottle). But gaps in, or irregularities between, subuniverses shaped like figure-8 Klein bottles are "filled in" by binary digits in the same way that computer drawings can extrapolate a small patch of blue sky to make a sky that's blue from horizon to horizon. This makes space-time relatively smooth and continuous - and gets rid of holes, making Klein subunits feasible. The Klein bottle is a closed surface with no distinction between inside and outside (there cannot be other universes, neither a space multiverse nor a time multiverse *, outside ours – there's only one universe).

* English mathematical physicist Roger Penrose's idea of cyclic time [13] seems to be another version of the multiverse hypothesis. Space-time is an indissoluble union, and the traditional multiverse is focused on the spatial component while the Penrose version

emphasizes the temporal (time may be nothing more than the electronic display of trillions of trillions of still states each second – what is called motion of the particles in space).

Mobius Loop

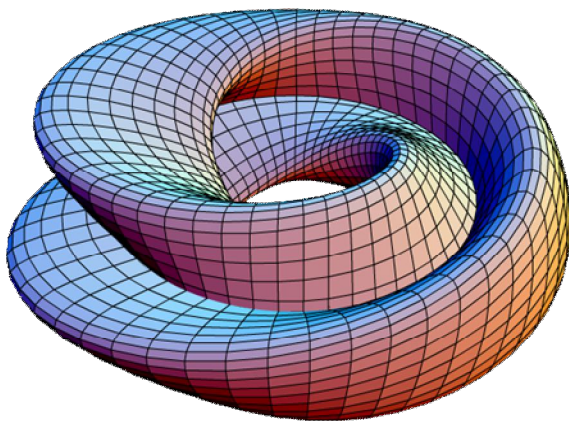
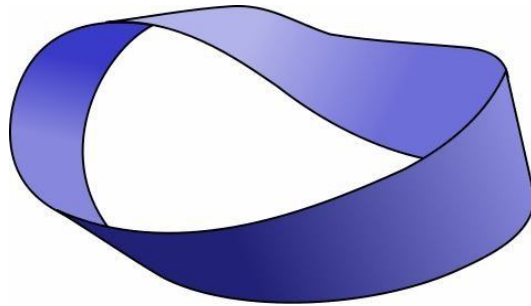


Figure-8 Klein Bottle

WAVES AND ATOMS

If space-time (whose warping is gravity) plays a role in forming matter [14], there could be "currents" of space-time flowing in the "oceans" between the galaxies. Space-time would help form the matter in the galaxies, and it would help form the Earth/objects on this planet. How? By some of the currents of space-time or gravity which pass the solar system's outer boundary being diverted towards the massive Sun's centre (just as some of the waves passing an island are refracted toward the shore by the island's mass). Along their

course, the refracted gravitational waves are concentrated in the intense warping we call matter (probably playing a role in formation of matter's forces, too). The more mass a body possesses, the more gravitation is diverted to play a part in that body's formation. Could sunward-heading gravitational waves from outside the solar system possibly explain why the Pioneer spacecraft are a few thousand miles closer to Earth than predicted? [15]

$E=mc^2$ describes how this energy (these bits) can be converted into the matter, and mass, of stars and any subatomic particle. Space-time is filled with virtual particles (energy pulses). General Relativity tells us gravity is the curvature of space-time so gravity could be made of energy pulses called gravitons. This curving of space-time allows its energy pulses or bits to push against other bits taking the form we call matter. Matter is energy that could be differentiated from space-time's energy by the interaction of two types of disturbances in fields (two types of energy pulses) viz. the electromagnetic field's photons and the gravity field's gravitons.

The nuclear strong and weak forces, along with the Higgs boson, could be produced by quantum-scale gravitational lensing in the particles of matter that already exist. Lensing could alter the path of bits/pulses called photons and gravitons - producing the sequences of bits called gluons, weak bosons (W^+ , W^- , Z), and Higgs bosons. Lensing could magnify the strength of the stream of gravitons, forming the electromagnetism * within atoms and accounting for particles' electric charges and magnetic polarities. Gravity is created by space-time so the magnification of gravity by quantum lensing alters the curvature of space-time within particles. This might explain their different quantum spins (spin cannot be explained by classical rotation).

* When Einstein penned $E=mc^2$, he used c (c^2) to convert between energy units and mass units. The conversion number is 90,000,000,000 (light's velocity of 300,000 km/s x 300,000 km/s) which approx. equals 10^{11} . First, 10^{25} - a strength achieved through quantum gravitational lensing and associated with the weak nuclear force ** - is attained. Then waves are further magnified by the matter's density - multiplied by Einstein's conversion factor of 10^{11} - to achieve electromagnetism's strength (10^{36} times gravity's

strength). This gives the illusion of the existence of electric and magnetic fields that are not a product of gravitation.

** Remember, this is only one example: the so-called weak force's "strength isn't constant" and varies with distances [16].

After absorption by atoms, the depleted remnant of the gravity waves is re-radiated from stars, interstellar gas and dust, etc. Having used up most of its energy forming particles and forces, the magnified gravity returns to its familiar strength and is radiated as a Gravity Wave Background, challenging the idea that Cosmic Inflation was necessary to generate gravitational waves. Since gravity can produce electromagnetism, it's also radiated as low-energy electromagnetic waves – possibly an infrared background whose heat output exceeds that of the stars alone, in addition to a microwave background. The latter challenges the idea that existence of the cosmic microwave background proves the universe began with a Big Bang.

EARTH'S AU AND PLANETARY PRECESSION

General Relativity (GR) treats gravity as a manifestation of space-time, and was published in 1915. Einstein published "Do gravitational fields play an essential role in the structure of elementary particles?" in 1919. So if GR had waited a handful of years, it might have also treated matter and the Sun as manifestations of space-time. Then they wouldn't be seen only as producers of gravity (the Newtonian view supported by the last paragraph in **WAVES AND ATOMS**) but also as products of gravity. I'll now speak of both roles –

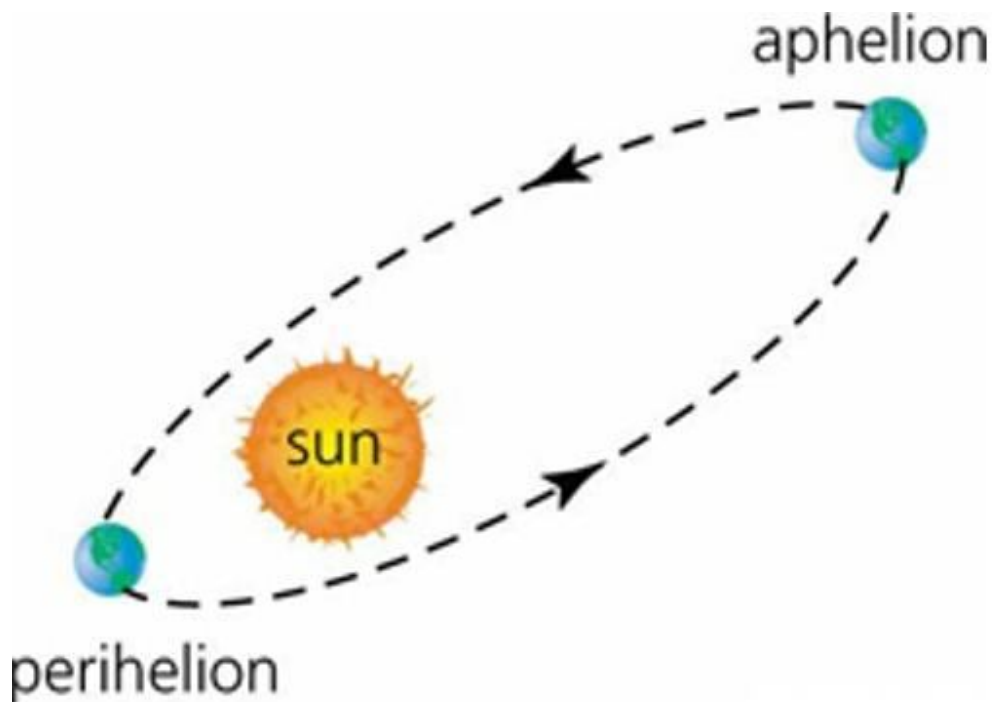
Recall the first paragraph in **WAVES AND ATOMS** – "there could be currents of space-time (and gravity) flowing in the 'oceans' between the galaxies. Space-time would help form the matter in the galaxies, and it would help form the Earth/objects on this planet."

More than 99% of the solar system's mass / gravity / gravitational waves are associated with our star, so the gravitational push on Earth from its sphere may be slightly greater than the push resulting from the waves originating in deep space (these originate from a far greater volume but are far less concentrated). In the end, the distance between Earth and the Sun – the Astronomical Unit or AU -

would be growing slowly larger. According to [17], the distance between Sun and Earth is growing by approx. 15 centimetres per century.

Avoiding jargon so my meaning is clear to anyone –

“Precession is the tendency of a gyroscope – basically a spinning wheel mounted in a moveable frame - to move at right angles to the direction of any force applied against it. Precession makes a bicycle turn a corner when you lean to one side. You also use precession to guide a rolling hoop. When you roll the hoop, it will not fall down if you push from the side against the top – it merely will turn a corner. The hoop precesses, or turns at right angles to the force you have applied against it.” [18] All the planets precess (though the effect is greatest at Mercury because it’s the closest planet to the Sun’s mass/gravity).



(The difference between perihelion and aphelion is only approx. 3% in reality – it’s greatly exaggerated in this illustration. Perihelion [closest point to Sun] is about 147.1 million kilometres [91.4 million miles] in early January – aphelion is about 152.1 million kilometres [94.5 million miles] in early July.)

When Earth is at the position of the lower arrow, the gravitational waves pushing it give it inertia that, if continued, would propel it in a straight line further and further from the Sun. But other gravitational waves from the edge of the solar system push against it and cause it to turn a corner, as if it were a bicycle whose rider had leaned to one side. It's now in the aphelion location (its farthest spot from the Sun). Throughout its orbit, Earth is pushed by different gravitational waves from deep space and keeps turning corners until it arrives back where it started. The orbit it traces out is always more-or-less centred on the Sun because all the relevant gravitational waves are being refracted towards the massive Sun's centre (just as some of the waves passing an island are refracted toward the shore by the island's mass).

If the Sun's gravitational output was absolutely constant, this trajectory would be circular. But total solar output is now measured to vary (over the last three 11-year sunspot cycles) by approximately 0.1% [19] or about 1.3 Watts per square meter (W/m^2). Sunspots form because the sun's equator rotates more quickly than its poles (24.47 days at the equator, up to 38 days as you approach the poles) [20]. Being "frozen" into its gases, the magnetic field lines of the sun stretch, twist, are drawn out into loops and erupt through the sun's surface; forming sunspots. The fact that total solar output varies with sunspot cycles may imply that all electromagnetism (infrared rays, light etc.) is the result of gravity – see **WAVES AND ATOMS**.

Without a planet's motion and inertia, inconstant gravitational output would make an orbit "wobble" because planets would move to and fro at random like corks bobbing on the ocean surface. But constant bombardment by gravitational waves would depress and deaden the irregular planetary movements, making orbits smooth (they can't be circular so they'd be elliptical).

MERCURY'S QUANTUM PRECESSION

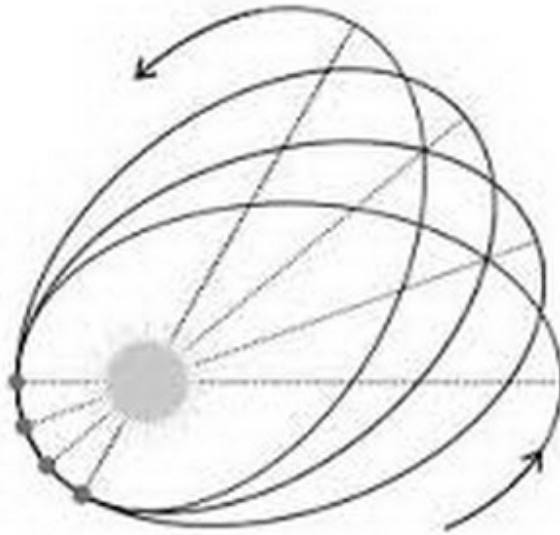
According to a website by the University of California, Riverside [21], "As seen from Earth the precession of Mercury's orbit is measured to be 5600 seconds of arc per century (one second of arc=1/3600 of a degree). Newton's equations, taking into account all the effects from the other planets as well as a very slight deformation of the sun due

to its rotation (most of Newton's effect is due to pull from the other planets) predicts a precession of 5557 seconds of arc per century. There is a discrepancy of 43 seconds of arc per century. This discrepancy cannot be accounted for using Newton's formalism. Many *ad-hoc* fixes were devised (such as assuming there was a certain amount of dust between the Sun and Mercury) but none were consistent with other observations (for example, no evidence of dust was found when the region between Mercury and the Sun was carefully scrutinized). In contrast, Einstein was able to *predict*, without any adjustments whatsoever, that the orbit of Mercury should precess by an extra 43 seconds of arc per century should the General Theory of Relativity be correct". (To be exact, Relativity's prediction is 42.98 seconds per century, plus or minus 0.04 of a second [22])

Radiation of gravitational waves from the Sun – actually, from every body or subatomic particle of matter; though the Sun is the centre of attention at present – should further correct Relativity's correction. Infinite Universe Gravity's correction needs to be truly infinitesimal since Einstein's prediction corrects Newton's so well. IUG says the new adjustment is approximately equal to the increase of the AU divided by the AU itself (both the AU and its increase are the result of the operations of gravitational waves). That's 15 centimetres / 149,597,870,700 metres [23]. Since there are 100 cm / m, that's 15 / 14,959,787,070,000 (roughly a trillionth). Figures using Mercury's distance from the Sun and the rate of increase of that distance might be more accurate, but the only thing I could find out is that computer simulations show the elongation of Mercury's orbit is increasing. Its orbit has "a roughly 1% chance (of increasing) to the point where the planet's path around the sun crosses that of Venus" [24]. However, the number 1×10^{-6} applies to Earth's precession of 3.84 [25] so Mercury's precession, being eleven times greater, might correspond to 11 trillionths.

All of the above applies if we restrict ourselves to the classical concept of spin – and that form of spin certainly does exist. But **EARTH'S AU AND PLANETARY PRECESSION** referred to the action of an orbiting planet arriving at its departure point. Of course,

this occurs in classical precession, as illustrated below by the 4 orbits of a planet sharing a common location to the star's left.



WAVES AND ATOMS spoke of space-time/gravity being “concentrated in the intense warping we call matter and probably playing a role in formation of matter's forces, too” – and of the possibility of quantum spin being explicable as the curving of space-time within particles. So the knowledge that two kinds of spin exist (classical and quantum) allows us to look at this illustration in two ways. It's accurate to interpret it classically, as representing one planet with four examples of its precessed orbit. However, believing in formation of particles and their forces by space-time / gravity allows a quantum interpretation of this astronomical event. Space-time / gravity may not only make subatomic particles but also planets (see **WAVES AND ATOMS**). So we can view the illustration as one “planetary field” incorporating the matter of the planet, forces and four pathways of space-time curvature (hypothetically achievable by modelling the distribution of the universe's fundamental energy pulses on the twisting Mobius strip).

This means precession is not only classical (with a planet's orbit being affected by other planets), but is also quantum. A planet's affecting, and being affected by, other planets can be viewed as quantum entanglement on astronomical rather than subatomic

scales. Such “astro-entanglement” must extend infinitely – the planet and its precession are affected by other planets and the Sun, these gravitationally interact with still more distant bodies, those with still others, and on and on forever. Ultimately, the entire infinite universe is quantum / astro-entangled into a unified field. Since time may merely be the motions of particles, the entire past and present and future would inevitably be parts of this cosmic entanglement – and would create an eternal present.

The electromagnetic and gravitational fields would be intimately associated thanks to their infinite-range photons and gravitons. Such intimate co-existence within infinite, eternal quantum/astro-entanglement may be called superposition. The superposition means gravitational imprints would inevitably be found in the electromagnetic field’s Cosmic Microwave Background by experiments like BICEP2 [26]. However, such detection does not necessarily confirm either the Big Bang or inflation (or the multiverse belief that has grown from them). The universe would not be unified to near-uniform temperature and curvature by the whole cosmos having once been small enough for everything to be in contact, then undergoing extremely rapid expansion from a big bang during a period called inflation. It would be unified by being quantum/astro-entangled and everything having the same origin of binary digits. The digits unite everything in time and space in the same way that 1’s and 0’s form an image on a computer screen. Even if the “image” of our universe contains many seemingly separate elements like sights and sounds and smells, it’s still a single “image”.

The suggestion of matter being composed of space-time answers a 50-year-old objection to Einstein's Unified Field Theory which was put forth by Professors Newman and Penrose [27]. His objection was that the gravitational fields, if known everywhere but only for a limited time, do not contain enough information about their electromagnetism to allow the future to be determined, so Einstein's unified theory fails. If time (referred to in **IS THE UNIVERSE INFINITE? HOW COULD THIS BE DONE?** as “motion of particles in space”) is unified with the gravitational and electromagnetic fields which this comment proposes to be the creators of particles, the gravitational fields are not known for only a limited time but do contain enough information. And

Einstein succeeded, just as John Wheeler and Charles Misner claimed [28].

REFERENCES

- [1] B. Berman - "Infinite Universe" – Astronomy Magazine (Nov. 2012)
- [2] "WMAP's Universe" - (http://map.gsfc.nasa.gov/universe/uni_shape.html)
- [3] N. G. Sánchez, Y. N. Parijskij "The Early Universe and the Cosmic Microwave Background: Theory and Observations" - Springer, (31/12/2003)
- [4] "Custom Universe – Finetuned For Us?" – Australian Broadcasting Corporation's TV program "Catalyst" (August 29 2013)
- [5] Time-Life Books - "Workings of the Universe" – 1991, p.84
- [6] K. Polthier - "Imaging maths - Inside the Klein bottle" (<http://plus.maths.org/content/os/issue26/features/mathart/index>)
- [7] Bourbaki, Nicolas (2005). Lie Groups and Lie Algebras. Springer
- [8] Conway, John (1986). Functions of One Complex Variable I. Springer
- [9] Gamelin, Theodore (January 2001). Complex Analysis. Springer
- [10] Joshi, Kapli (August 1983). Introduction to General Topology. New Age Publishers
- [11] Spanier, Edwin (December 1994). Algebraic Topology. Springer
- [12] Luminet, Jean-Pierre; Lachi`eze-Rey, Marc - "Cosmic Topology" - Physics Reports 254 (3): 135–214 (1995) [arXiv:gr-qc/9605010](https://arxiv.org/abs/gr-qc/9605010)

[13] "Cycles of Time: An Extraordinary New View of the Universe" by Roger Penrose - Bodley Head: 2010 - ISBN: 9780224080361

[14] A. Einstein, "Speilen Gravitationfelder in Aufbau der Elementarteilchen eine Wesentliche Rolle" (Do gravitational fields play an essential role in the structure of elementary particles), Sitzungsberichte der Preussischen Akademie der Wissenschaften, (Math. Phys.), 349-356 (1919) Berlin.
<http://dieumsnh.qfb.umich.mx/archivohistoricosMQ/ModernaHist/Einstein1919.pdf>

[15] Nieto, M. M.; Turyshev, S. G. (2004) - "Finding the Origin of the Pioneer Anomaly" - *Classical and Quantum Gravity* **21** (17): 4005–4024. [arXiv:gr-qc/0308017](http://arxiv.org/abs/gr-qc/0308017)

[16] M. Strassler - "The Strengths of the Known Forces" [May 31, 2013] - <http://profmattstrassler.com/articles-and-posts/particle-physics-basics/the-known-forces-of-nature/the-strength-of-the-known-forces/>

[17] G. A. Krasinsky, V. A. Brumberg - "Secular Increase of Astronomical Unit from Analysis of the Major Planet Motions, and Its Interpretation" - "Celestial Mechanics & Dynamical Astronomy", Volume 90, Issue 3-4, 2004, pp. 267-288

[18] "Gyroscope" by C.A. Frische – in "The World Book Encyclopedia" by Field Enterprises Educational Corporation (1967)

[19] Willson, Richard C.; H.S. Hudson (1991) - "The Sun's luminosity over a complete solar cycle" - *Nature* **351** (6321): 42–4

[20] "Does The Sun Rotate?"
by Fraser Cain on March 13, 2012
(<http://www.universetoday.com/60192/does-the-sun-rotate/>)

[21] "Precession of the perihelion of Mercury"
([http://physics.ucr.edu/~wudka/Physics7/Notes www/node98.html](http://physics.ucr.edu/~wudka/Physics7/Notes/www/node98.html))

{22} "PPN formalism" by Hajime Sotani - 01/07/2009 (minor changes made 21/06/2013) - <http://www.tat.physik.uni->

[tuebingen.de/~kokkotas/Teaching/Experimental Gravity files/Hajime_PPN.pdf](http://tuebingen.de/~kokkotas/Teaching/Experimental_Gravity_files/Hajime_PPN.pdf) - Perihelion shift of Mercury, page 11

[23] International Astronomical Union, ed. (31 August 2012), "RESOLUTION B2 on the re-definition of the astronomical unit of length"

[24] "Long Shot: Planet Could Hit Earth in Distant Future"
by Jeanna Bryner, Senior Writer | June 10, 2009
(<http://www.space.com/6824-long-shot-planet-hit-earth-distant-future.html>)

[25] "Anomalous Precessions" (<http://www.mathpages.com/rr/s6-02/6-02.htm>)

[26] Caltech Observational Cosmology Group - "BICEP: Robinson Gravitational Wave Background Telescope"
(<http://bicep.caltech.edu/public/>)

[27] Newman, E. T., Penrose, R. J. - Mathematical Physics 3, 566 (1962)

[28] "Classical physics as geometry" by Charles Misner and John Wheeler - the "Annals of Physics" - Volume 2, Issue 6, December 1957, Pages 525–603)
