On Certain Theories of Physics Considered Important

September 18, 2018.

José Francisco García Juliá

jfgj1@hotmail.es

In a previous paper, I gave my opinion on some significant questions of physics. This note is to reinforce that opinion.

Key words: special and general relativity, quantum mechanics.

In a previous paper [1], I gave my opinion on some significant questions of physics. This note is to reinforce that opinion.

In 1911, Vladimir Varićak asserted that length contraction is "real" according to Lorentz, while it is "apparent or subjective" according to Einstein. To this assertion Einstein replied: The author [Varićak] unjustifiably stated a difference of Lorentz's view and that of mine concerning the physical facts. The question as to whether length contraction really exists or not is misleading. It doesn't "really" exist, in so far as it doesn't exist for a comoving observer; though it "really" exists, i.e. in such a way that it could be demonstrated in principle by physical means by a non-comoving observer.

We see in the Einstein's reply the falsehood of its special relativity (SR) theory of 1905. How is it possible that a body have different lengths depending on whether we are or not moving with it.

Or, in other words, suppose an observer at rest with a ruler of *1 m*, and other *300,000* (inertial) observers moving respectively (at constant speeds parallels to the ruler) from *1, 2, 3, ...,* to almost *300,000 km/s*, then following the SR, the length of the ruler for the observer at rest would be *1 m*, but for all the moving observers it would be less than *1 m*, going from close to *1 m* for the first ($v = 1\ km/s$) to almost *0 m* for the last ($v \approx 300{,}000\ km/s$). All of which is false. The ruler has only one length, not *300,001* different lengths. If the ruler is at rest, it has *1 m* of length, but if it moves, it contracts, but this contraction is the so-called FitzGerald-Lorentz contraction, which is real as asserted Varićak in 1911, not the Einstein contraction (that is, the SR length contraction), which is apparent or subjective in words of Varićak, that is, fictitious or false.

In 1887, Michelson and Morley carried out an experiment with a null result [2]. In this experiment there are four times to consider: T_1, T_2, T_3 and T_4. The first two are for the longitudinal displacement and the last two for the transversal one. From the experiment, it is obtained that:

$cT_1 = L + vT_1$, where c is the speed of the light in the vacuum, L the length of the arm and v its speed, that is, the speed of the Earth (around the Sun); then

$$T_1 = \frac{L}{c-v} \tag{1}$$

$cT_2 = L - vT_2$, then

$$T_2 = \frac{L}{c+v} \tag{2}$$

And the total travel time in the longitudinal displacement would be

$$T_l = T_1 + T_2 = \frac{L}{c-v} + \frac{L}{c+v} = \frac{2L}{c}\frac{1}{1-\frac{v^2}{c^2}} \tag{3}$$

$cT_3 = \sqrt{L^2 + (vT_3)^2}$, then

$$T_3 = \frac{L}{\sqrt{c^2 - v^2}} \tag{4}$$

which is the same for the backward transverse journey: $T_4 = T_3$, then the total travel time in the transversal displacement would be

$$T_t = T_3 + T_4 = 2T_3 = \frac{2L}{\sqrt{c^2-v^2}} = \frac{2L}{c}\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \tag{5}$$

From (3) and (5), we see that $T_l > T_t$ instead of being equal, which was the real result of the experiment. To obtain this equality, we use the decreased electric field.

The electrostatic field is

$$E = \frac{q}{4\pi\varepsilon_0 r^2} \tag{6}$$

E being the electric field, q the electric charge, ε_0 the electric permittivity of the vacuum and r the radial distance from the electric charge to the observation point at the present time.

But for a moving electric charge with speed v, from the retarded time $t_r = t - r_r/c$, where r_r is r at the retarded time and t the present time, [3] (pp. 244-245) and, multiplying scalarly by v, $r_r = r - \boldsymbol{r}_r \cdot \boldsymbol{v}/c = r - r_r v\cos\theta_r/c$, with $r_r = vt_r$, $r = vt$ and θ_r being the angle between the vectors $\boldsymbol{r}_r$ and $\boldsymbol{v}$, and also with $r_r \sin\theta_r = r\sin\theta$, where θ is the angle between the vectors $\boldsymbol{r}$ and $\boldsymbol{v}$, [3] (pp. 344-345); it is [3] (pp. 345-346)

$$E_r = \frac{q}{4\pi\varepsilon_0 r^2}\frac{1-\frac{v^2}{c^2}}{\left(1-\frac{v^2}{c^2}\sin^2\theta\right)^{\frac{3}{2}}} \tag{7}$$

E_r being the electric field of the moving electric charge at the present time ($E_r = E$, for $v = 0$).

(7) was obtained by Heaviside in 1888. In the longitudinal direction, $\theta = 0$ or $\theta = \pi$ (radians), it is $sin\theta = 0$. Then

$$E_r = \frac{q}{4\pi\varepsilon_0 r^2}\left(1 - \frac{v^2}{c^2}\right) \tag{8}$$

and the electric field is decreased.

The electric forces are respectively

$$F = qE = \frac{q^2}{4\pi\varepsilon_0 r^2} \tag{9}$$

and

$$F_r = qE_r = \frac{q^2}{4\pi\varepsilon_0 r^2}\left(1 - \frac{v^2}{c^2}\right) \tag{10}$$

Then

$$\frac{F_r}{F} = 1 - \frac{v^2}{c^2} \tag{11}$$

and $F_r < F$. The electric force is inversely proportional to the square of the distance, but as the lesser the force of repulsion between the clouds of electrons of the atoms, the lesser the separation distance between them, then we can put

$$\frac{L_r^2}{L^2} = \frac{F_r}{F} = 1 - \frac{v^2}{c^2} \tag{12}$$

and

$$L_r = L\sqrt{1 - \frac{v^2}{c^2}} \tag{13}$$

and the length of the longitudinal arm is contracted. (13) was proposed by FitzGerald in 1889 and obtained by Lorentz in 1892. (13) cannot correspond to the length contraction of the SR. In the SR, it would be $L_r = L$, because the observer is comoving with the arm, which implies that $v = 0$. Substituting L by L_r in (3), we have that

$$T_l = \frac{2L\sqrt{1-\frac{v^2}{c^2}}}{c}\frac{1}{1-\frac{v^2}{c^2}} = \frac{2L}{c}\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} \tag{14}$$

and $T_l = T_t$, which gives the null result.

Note that although in the transversal direction, the electric field, (7), is increased, this increase is much lesser than the decrease in the longitudinal direction, so it is ignored.

Hence, the null result of the Michelson-Morley experiment (MME) would be due to that the electric field is decreased in the direction of motion.

If we apply the SR to this experiment, as the observer is comoving with the apparatus, then the relative speed v would be zero, and we have the following:

$T_l = T_1 + T_2 = L/c + L/c = 2L/c$, $T_t = T_3 + T_4 = L/c + L/c = 2L/c$, and $T_l = T_t$.

It seems that the SR explains the null result of the MME, but this is a fallacy, because the longitudinal arm is contracted, then

$T_l = T_1 + T_2 = L_r/c + L_r/c = 2L_r/c < 2L/c = T_t$

and the SR gives a non-null result, which is false.

Therefore, the MME is an experimental proof that the SR is false. There are more problems with the SR, enough for not considering it as true [4].

The Schwarzschild's solution of the Einstein's equations for the vacuum of the general relativity (GR) theory gives the square space-time differential interval: [5] (p. 398)

$$ds^2 = \left(1 - \frac{r_g}{r}\right)c^2dt^2 - r^2\left(\sin^2\theta d\phi^2 + d\theta^2\right) - \frac{dr^2}{1 - \frac{r_g}{r}} \tag{15}$$

where

$$r_g = \frac{2GM}{c^2} \tag{16}$$

is the gravitational (or Schwarzschild) radius, M being the rest mass of the body that produces the gravitational field and G the Newton's gravitational constant, and r, θ and ϕ the spherical coordinates. We may put

$$r = \frac{2GM}{v^2} \tag{17}$$

v being like a gravitational escape speed: $E = T + V = (1/2)mv^2 - GMm/r$, where E, T and V are, respectively, the total, kinetic and gravitational potential energies of a test particle of rest mass m, and from $E = 0$, the escape velocity would be

$$v = \left(\frac{2GM}{r}\right)^{\frac{1}{2}} \tag{18}$$

and as $r_g = 2GM/c^2$, it would correspond to a gravitational escape speed of c. Substituting (16) and (17) into (15), we would have that:

$$ds^2 = \left(1 - \frac{v^2}{c^2}\right)c^2dt^2 - r^2\left(\sin^2\theta d\phi^2 + d\theta^2\right) - \frac{dr^2}{1 - \frac{v^2}{c^2}} \tag{19}$$

and for given values of θ and ϕ ($\theta = constant$, $\phi = constant$, then $d\theta = 0$ and $d\phi = 0$), it would be:

$$ds^2 = \left(1 - \frac{v^2}{c^2}\right)c^2dt^2 - \frac{dr^2}{1 - \frac{v^2}{c^2}} = c^2dt'^2 - dr'^2 = ds'^2 \tag{20}$$

which is a generalization of the SR (*ds' = ds*, then *s' = s*, [5] (p. 7)) for a radial motion in a gravitational field. From (20)

$$dr^2 = \left(1 - \frac{v^2}{c^2}\right)dr'^2 \tag{21}$$

$$dt^2 = \frac{dt'^2}{1 - \frac{v^2}{c^2}} \tag{22}$$

(21) is the length contraction of the SR and (22) the time dilation (or a time dilatation).

As the SR is false, then the GR would be false, because both coincide in the radial direction, that is, when the polar (θ) and azimuthal (ϕ) angles are constants.

But there are more problems with the GR. The mass and the energy do not curve the space (less still the time, which is only a parameter), but they polarize it [6]. When a body emits a light, its speed decreases due to the gravity [7-8]. This decrease of the speed of the light produces a gravitational refractive index that polarizes the space. Hence, the presence of a mass induces an electromagnetic polarization in the vacuum space, and the induced dipoles form the lines of force of an electromagnetic attraction force produced by the mass in question. [6] Therefore, the force of the gravity is an electromagnetic force.

As the GR is false, then the Big Bang (BB) theory, which is based on that, would be false. In effect, the universe does not expand. The so-called cosmological redshift, which is the redshift of the light of stars and galaxies, is not due to the expansion of the space but to that the light scatters the thermal radiation, which is the so-called cosmic microwave background radiation (CMBR), losing energy exponentially ("tired" light mechanism) [9-12]. The universe is static, flat and infinite [12]. It is in thermal equilibrium at *2.7 K*, which is the temperature of the CMBR [9-12]. And the radiation and the matter would be transformed into each other in an endless cycle [12].

The quantum mechanics (QM) has two version: the matrix mechanics (MM) of Heisenberg and the wave mechanics (WM) of Schrödinger. Both version are false. The

MM is based on the Fourier series expansion of the position of the (atomic) electron (of the Hydrogen atom), which is not correct. As a consequence, the Heisenberg's uncertainty principle would not be true. The WM supposes the existence of unobserved waves of matter. The explanation of the wave function in terms of probability by Born is also a supposition. Hence, the QM is false. [13]

As the quantum field theories (QFTs) are based on the QM and the SR, then they would not be true. Furthermore, the forces of the nature are applied by contact [1]. In the nuclear case: strong and weak, it is direct. In the electric and magnetic cases, the contact is obtained through the vacuum polarization [14], and also in the gravitational case [6]. The so-called force fields function in this form, by contact. They do not interchange particles. There are no carriers of the forces. But the forces in the QFTs use carriers. The Higgs boson of the standard model (SM) of fundamental particles needs a vacuum energy value of $\approx 246\ GeV$ [15]. But the vacuum has not any energy [16]. Hence, the QFTs are false.

As the Inflation theory is based on the SR, GR, BB and QFTs, then it would not be true.

Therefore, from all of the above, we conclude that instead of using the SR, use, as above in the MME, the retarded time and its related distance

$$t_r = t - r_r/c \tag{23}$$

$$r_r = r - \mathbf{r}_r \cdot \mathbf{v}/c = r - r_r v \cos\theta_r/c \tag{24}$$

with $v < c$, because for $v = c$, (13) gives $L_r = 0$, which is impossible, and for $v > c$, it gives L_r imaginary, which is also impossible. Note also that the mass-energy relation, $E = mc^2$, is previous to the SR [12]. For the (force of) gravity, instead of the GR, use the third law of Kepler and/or the Newton formula of the gravity [1]. Instead of the QM, use the quantum physics: $E = hf$, which is the Planck-Einstein equation of the energy for the photon (the quantum of light), h being the Planck constant and f the frequency (with $c = \lambda f$, where λ is the wavelength), the energy levels of the atoms, the Balmer formula for the transition between the energy levels etc. And for the measure of distances in astronomy, if it is used the redshift, then we have the problem that the redshift is a mixture of various redshifts: cosmological, intrinsic, [9-12], gravitational [7], gravitational and age of the stars [17-18], and Compton effect and age of the stars [19].

Note also [1] that from the assumption that the mass and the energy curve the space, the GR equations were obtained. These do not represent more than the trajectories of the bodies, as it does the Newtonian gravity (NG). The GR gives the NG, which functions because is based on the third law of Kepler (see the appendix below). And vice versa, from the NG we obtain the equations of the GR [20]. In effect, from the Newton's mechanics (NM), we have for any particle in the surface of the universe that [20]

$$E = T + V = \frac{1}{2} m \left(\frac{dr}{dt} \right)^2 - G \frac{Mm}{r} \tag{25}$$

where E, T and V are, as above, the total, kinetic and gravitational potential energies of the particle, respectively, m its mass, but M and r are now the mass and radius of the universe, respectively. For a homogeneous and isotropic universe

$$M = \rho \frac{4}{3}\pi r^3 \tag{26}$$

ρ being the mass density. Substituting (26) into (25), we obtain that

$$\left(\frac{dr}{rdt}\right)^2 = \frac{8\pi G\rho}{3} - \frac{k}{r^2} \tag{27}$$

$k = -2E/m$ being the curvature constant.

If $T = -V$, where $T > 0$ and $V < 0$, then $E = T + V = 0$, $k = -2E/m = 0$ (flat surface) and $\rho = \frac{3}{8\pi G}\left(\frac{dr}{rdt}\right)^2 = \rho_c$, where $\rho_c = 10^{-29}\ g/cm^3$ [5] (p. 487) is the so-called critical mass density. If $r = \infty$ (flat surface), $\rho = \frac{3}{8\pi G}\left(\frac{dr}{\infty dt}\right)^2 = 0$ (or $\rho \cong \rho_c$). [12] From (27)

$$\left(\frac{dr}{dt}\right)^2 = \frac{8\pi G\rho r^2}{3} - k \tag{28}$$

or

$$v_r^2 = v_e^2 - k \tag{29}$$

where $v_r = dr/dt$ is the supposed speed of recession and $v_e = (8\pi G\rho r^2/3)^{1/2} = (2GM/r)^{1/2}$ (using (26)) the escape velocity of the universe. And the universe might be closed ($k > 0$, $\rho > \rho_c$, $v_e > v_r$), flat ($k = 0$, $\rho = \rho_c$, $v_e = v_r$) or open ($k < 0$, $\rho < \rho_c$, $v_e < v_r$). But the universe is static, because the cosmological redshift is a tired light mechanism, then $v_r = 0$; flat, because $E = 0$, then $k = 0$, $r = \infty$, $\rho = \rho_c$ and $v_e = v_r = 0$; and infinite, then $M = \Sigma_1^\infty m = \infty$, but $\Sigma_1^\infty E = \Sigma_1^\infty 0 = 0$. [12]

But with the NM and the "mass" of the light, there is a problem: as $E = T + V$, if $V = 0$, then $E = T$. For the light, it is $E = hf$, and also, it is $E = mc^2$, and then, the so-called "effective mass" of the photon would be $m = E/c^2 = hf/c^2$, but in the NM, $T = (1/2)mv^2$, then, for the light, as $v = c$, it would be $T = (1/2)mc^2 = (1/2)hf$, so $T = (1/2)E$ and $T \neq E$. To do $T = E = mc^2 = hf$, the mass of the light or photon would be $m_{ph} = 2m = 2hf/c^2$. And the same for V. This rule would be applied in the NM to the photon as: $E_{ph} = T_{ph} + V_{ph}$, with $T_{ph} = (1/2)m_{ph}c^2$ and $V_{ph} = m_{ph}\varphi = -GMm_{ph}/r$, where $\varphi = -GM/r$ is the gravitational potential.

If we apply this rule to the escape velocity of a photon v_{eph} [6-8, 21], it would be: [7-8]

$$\frac{hv_{eph}}{\lambda} + \frac{2hc}{\lambda c^2}\varphi = 0 \tag{30}$$

$$v_{eph} = -\frac{2\varphi}{c} = \frac{2GM}{Rc} \tag{31}$$

where M and R are, respectively, the mass and the radius of the body that emits the photon, λ its wavelength and $\varphi = -\frac{GM}{R}$ the gravitational potential. And then the decrease of the speed of the light, mentioned above, would produce a gravitational refractive index n [6, 8, 21]

$$\frac{c}{n} = c - v_{eph} = c - \frac{2GM}{Rc} \tag{32}$$

$$n = \frac{1}{1-\frac{2GM}{Rc^2}} \tag{33}$$

For $M/R = c^2/2G$, it is, from (33), $n = \infty$ and $c/n = 0$, and the body is converted in a black hole (BH), and n goes from $n = 1$ (for the vacuum or free space, that is, without a gravitational field) to $n = \infty$ (BH).

If we apply this rule to the deflection of a beam of light when passing near a massive body such as the Sun, it would be: [22] (problem 13.16, pp. 489-490, 573)

$F = GMm_{ph}/r^2 = GMm_{ph}/R^2 sec^2\theta$, where F is the gravitational force, M and R the mass and the radius of the Sun, respectively, r the radial distance and θ the polar angle.

$F_t = F\ cos\theta = GMm_{ph}cos\theta/R^2 sec^2\theta$, where F_t is the transversal (or perpendicular) gravitational force.

$cdt = ds = d(R\ tan\theta)$, then $dt = Rsec^2\theta d\theta/c$, where $s = R\ tan\theta$ is a distance perpendicular to R.

$p_t = \int F_t\ dt = (GMm_{ph}/Rc) \int_{-\pi/2}^{+\pi/2} \cos\theta\ d\theta = 2GMm_{ph}/Rc$, where p_t is the transversal (or perpendicular) momentum of the photon.

$p_l = mc$, where p_l is the longitudinal (or parallel) momentum of the photon.

And, the angle of deflection would be

$$\phi \approx \tan\phi = \frac{p_t}{p_l} \tag{34}$$

Then, $\phi \approx 2 \times 2GM/Rc^2 = 2 \times 24.5 \times 10^{-5}$ *degree* $= 2 \times 0.88$ *seconds of arc*, which would be the correct value.

And, finally, it is the problem of the advance of the perihelion of Mercury: [23] (problem 3, pp. 47-48)

When it is added a little correction, δV, to the gravitational energy, then, in each revolution, the perihelion of the orbit advances a little angle, $\delta\phi$.

The gravitational potential energy would be

$$V = -\frac{\alpha}{r} + \frac{\beta}{r^2} \tag{35}$$

where $\beta/r^2 = \delta V$, and then, it is also

$$V = -\frac{\alpha}{r} + \delta V \tag{36}$$

The angular momentum is

$$L = mr^2 d\phi/dt \tag{37}$$

where $m = \frac{m_1 m_2}{m_1 + m_2}$ is the reduced mass, and m_1 and m_2 are the masses of the Sun and of the planet, respectively.

The energy is $E = (1/2)m((dr/dt)^2 + r^2(d\phi/dt)^2) + V$, and from (37), $E = (1/2)m(dr/dt)^2 + (1/2)(L^2/mr^2) + V$, and from this

$$\frac{dr}{dt} = \left(\frac{2}{m}(E - V) - \frac{L^2}{m^2 r^2}\right)^{1/2} \tag{38}$$

From (37), $d\phi = Ldt/mr^2$, and substituting into this equation, dt, from (38), and integrating, it results

$$\phi = \int \frac{Ldr/r^2}{\left(2m(E-V) - \frac{L^2}{r^2}\right)^{1/2}} + const. \tag{39}$$

When r varies from r_{max} to r_{min} and then to r_{max}, the position vector turns an angle

$$\Delta\phi = 2\int_{r_{min}}^{r_{max}} \frac{Ldr/r^2}{\left(2m(E-V) - \frac{L^2}{r^2}\right)^{1/2}} \tag{40}$$

We put (40) as

$$\Delta\phi = -2\frac{\partial}{\partial L}\int_{r_{min}}^{r_{max}} \left(2m(E - V) - \frac{L^2}{r^2}\right)^{1/2} dr \tag{41}$$

As it is $V = -\alpha/r + \delta V$, (36), developing in power series of δV, the zero order term is 2π, and the first order term is

$$\delta\phi = \frac{\partial}{\partial L}\int_{r_{min}}^{r_{max}} \frac{2m\delta V dr}{\left(2m\left(E + \frac{\alpha}{r}\right) - \frac{L^2}{r^2}\right)^{1/2}} = \frac{\partial}{\partial L}\left(\frac{2m}{L}\int_0^{\pi} r^2\, \delta V d\phi\right) \tag{42}$$

where it is obtained the last member of (42) as follows: differentiating (39), it is $d\phi = \frac{Ldr/r^2}{\left(2m(E-V) - \frac{L^2}{r^2}\right)^{1/2}}$ and $\frac{dr}{\left(2m(E-V) - \frac{L^2}{r^2}\right)^{1/2}} = \frac{r^2}{L} d\phi$ and then substituting this in the second member of (42) but with $V = -\alpha/r$. As $\delta V = \beta/r^2$, then, from (42)

$$\delta\phi = -2\pi\beta\frac{m}{L^2} \tag{43}$$

Integrating (39), for $V = -\alpha/r$, it is

$$\phi = \cos^{-1}\frac{(L/r)-(m\alpha/L)}{\left(2mE+\frac{m^2\alpha^2}{L^2}\right)^{1/2}} + const. \tag{44}$$

and taking the origin of ϕ such that the constant be zero, and doing

$$p = \frac{L^2}{m\alpha} \tag{45}$$

and

$$e = \left(1 + \frac{2EL^2}{m\alpha^2}\right)^{1/2} \tag{46}$$

the equation of the orbit is

$$\frac{p}{r} = 1 + e\cos\phi \tag{47}$$

p and *e* being, respectively, the parameter and the eccentricity of the orbit (the perihelion is the point where $\phi = 0$). From the geometry of the conics, the semi-major axis of the ellipse is

$$a = \frac{p}{1-e^2} \tag{48}$$

From (45) and (48), (43) is

$$\delta\phi = -\frac{2\pi\beta}{p\alpha} = -\frac{2\pi}{a(1-e^2)}\frac{\beta}{\alpha} = -\frac{1}{2(1-e^2)}\frac{2\beta}{a\alpha}2\pi \tag{49}$$

(in radians; *2π radians = $360 \times 60 \times 60 = 1.296 \times 10^6$ seconds of arc*).

From (35), as the force is $F = -dV/dt$, then

$$F = -\frac{\alpha}{r^2} + \frac{2\beta}{r^3} \tag{50}$$

(35) and (50) are equivalent.

From (50), if $\frac{2\beta}{a\alpha}$ is worth only 1.42×10^{-7}, then the perihelion precession of Mercury would be of *40 seconds of arc per century* (considering that the eccentricity of its orbit is *0.206*, and its period, *0.24 years*). [24] (problem 3-7, pp. 111-112)

In effect, from (49), it is

$$|\delta\phi|\frac{100}{0.24} = \frac{1}{2(1-0.206^2)} \times 1.42 \times 10^{-7} \times 1.296 \times 10^6 \times \frac{100}{0.24} = 40.04'' \text{ of arc per century.}$$

Therefore, with (35), or its equivalent (50), and the NM, it is possible to obtain a good value of the perihelion precession of Mercury relative to the Sun.

Naturally, (50) (and, hence, its equivalent (35)) is perfectly plausible, because the Newton's gravitational force, $F = -G\frac{m_1 m_2}{r^2}$ (and, hence, its equivalent, $V = -G\frac{m_1 m_2}{r}$), is deduced from the Kepler's third law (see the appendix below), which is only an approximated law.

In effect, the period of the orbit is [24] (p. 99)

$$\tau = 2\pi a^{3/2}\left(\frac{m}{\alpha}\right)^{1/2} \tag{51}$$

As $m = \frac{m_1 m_2}{m_1+m_2}$ and $\alpha = Gm_1m_2$, then

$$\tau = \frac{2\pi a^{3/2}}{\left(G(m_1+m_2)\right)^{1/2}} \tag{52}$$

And as the mass of the planet is much lesser than the mass of the Sun ($m_2 << m_1$), then

$$\tau \approx \frac{2\pi a^{3/2}}{(Gm_1)^{1/2}} \tag{53}$$

(53) is the Kepler's third law, which is only an approximated version of (52). [24] (pp. 99-100)

Appendix

A deduction of the Newton's gravitational force from the Kepler's third law

$\frac{T^2}{r^3} = C$ is the Kepler's third law, T being the orbital period, r the radius of the orbit and C a constant. We suppose that a mass m is orbiting around a mass M. As $T = \frac{2\pi r}{v}$, where $v = \omega r$ is the tangential speed and ω the angular speed, then $\frac{(2\pi)^2}{r^2(v^2/r)} = C$. As $v^2/r = a = F/m$, where a is the centripetal acceleration and F the centripetal force, then $\frac{(2\pi)^2}{r^2(F/m)} = C$ and $\frac{F}{m} = \frac{(2\pi)^2}{r^2 C}$. And doing $\frac{(2\pi)^2}{C} = GM$, where G is the Newton's gravitational constant, then $\frac{F}{m} = \frac{GM}{r^2}$ and $F = \frac{GMm}{r^2}$, which is the Newton's gravitational force.

[1] José Francisco García Juliá, An Opinion on Some Significant Questions of Physics, viXra: 1602.0119 [History and Philosophy of Physics].
http://vixra.org/abs/1602.0119

[2] José Francisco García Juliá, On the Michelson-Morley Experiment, viXra: 1706.0428 [Classical Physics].
http://vixra.org/abs/1706.0428

[3] Wolfgang K. H. Panofsky and Melba Phillips, Classical Electricity and Magnetism, second edition, Addison-Wesley, Reading, Massachusetts, 1962.

[4] José Francisco García Juliá, On the Special Relativity, viXra: 1505.0099 [Relativity and Cosmology].
http://vixra.org/abs/1505.0099

[5] L. D. Landau and E. M. Lifshitz, Teoría Clásica de los Campos, segunda edición, Reverté, Barcelona, 1992. Original edition by Nauka, Moscow, 1967.

[6] José Francisco García Juliá, On the Gravitational Force, viXra: 1602.0093 [Classical Physics].
http://vixra.org/abs/1602.0093

[7] José Francisco García Juliá, Gravitational Redshift, viXra: 0903.0001 [Relativity and Cosmology].
http://vixra.org/abs/0903.0001

[8] José Francisco García Juliá, On the Speed of the Light in a Gravitational Field, viXra: 1801.0418 [Classical Physics].
http://vixra.org/abs/1801.0418

[9] José Francisco García Juliá, A Brief and Elementary Note on Redshift, viXra: 1005.0097 [Astrophysics].
http://vixra.org/abs/1005.0097
http://cosmology.info
Newsletter 2010: June (p. 2).
Proceedings of the Natural Philosophy Alliance Vol. 7, 17th Annual Conference of the NPA, 23-26 June 2010, at California State University, Long Beach, pp. 239-240:
http://mikamar.biz/book-info/npa-a.htm
http://worldnpa.org/abstracts/abstracts_5462.pdf
Louis Marmet, On the Interpretation of Spectral Red-Shift in Astrophysics: A Survey of Red-Shift Mechanisms - II, arXiv: 1801.07582 [astro-ph.CO].
https://arxiv.org/abs/1801.07582

[10] José Francisco García Juliá, A Note of Widening on the Redshift Mechanism, viXra: 1006.0055 [Astrophysics].
http://vixra.org/abs/1006.0055

[11] José Francisco García Juliá, Cosmological and Intrinsic Redshifts, viXra: 1011.0043 [Astrophysics].
http://vixra.org/abs/1011.0043
http://cosmology.info
Newsletter 2010: December (p. 3).
Louis Marmet, On the Interpretation of Spectral Red-Shift in Astrophysics: A Survey of Red-Shift Mechanisms - II, arXiv: 1801.07582 [astro-ph.CO].
https://arxiv.org/abs/1801.07582

[12] José Francisco García Juliá, On a Static, Flat and Infinite Universe, viXra: 1702.0184 [Relativity and Cosmology].

http://vixra.org/abs/1702.0184

[13] José Francisco García Juliá, On the Quantum Mechanics, viXra: 1609.0292 [Quantum Physics].
http://vixra.org/abs/1609.0292

[14] José Francisco García Juliá, On the Electric and Magnetic Forces, viXra: 1409.0116 [Classical Physics].
http://vixra.org/abs/1409.0116

[15] S. F. Novaes, Standard Model: An Introduction, p. 47, January 27, 2000. arXiv: hep-ph/0001283v1.
http://arxiv.org/pdf/hep-ph/0001283v1.pdf

[16] José Francisco García Juliá, A Note on the Energy of the Vacuum, viXra: 1210.0128 [Quantum Physics].
http://vixra.org/abs/1210.0128

[17] José Francisco García Juliá, A Simple Note on the Light Redshift, viXra: 0902.0001 [Relativity and Cosmology].
http://vixra.org/abs/0902.0001

[18] José Francisco García Juliá, Gravitational Redshift and Age of the Stars, viXra: 0909.0046 [Relativity and Cosmology].
http://vixra.org/abs/0909.0046

[19] José Francisco García Juliá, Cosmological Redshift, Compton Effect and Age of the Stars, viXra: 0909.0061 [Astrophysics].
http://vixra.org/abs/0909.0061

[20] John W. Norbury, From Newton's Laws to the Wheeler-DeWitt Equation, arXiv: physics/9806004 [physics.ed-ph].
http://arxiv.org/abs/physics/9806004

[21] José Francisco García Juliá, On the Existence of the Black Holes, viXra: 1602.0092 [Classical Physics]
http://vixra.org/abs/1602.0092

[22] Eugene Hecht and Alfred Zajac, Óptica, Fondo Educativo Interamericano, 1977. Original edition, Optics, Addison-Wesley, Reading, Massachusetts, 1974.

[23] L. D. Landau and E. M. Lifshitz, Mecánica, segunda edición, Reverté, Barcelona, 1994. Original edition by Nauka, Moscow, 1965.

[24] Herbert Golstein, Mecánica Clásica, Aguilar, Madrid, 1972. Original edition, Classical Mechanics, Addison-Wesley, Reading, Massachusetts, 1959.