Part 4 of "Cosmic Membrane Theory"

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# 8 Analysis and Conclusions (First version 05/1995, last update 11/2011)

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The **4-dimensional relativistic Cosmic Membrane Theory** is based on the imagination of an ether-filled 4-dimensional **hyperspace** Σ (or bulk space, as sometimes called). In this hyperspace a 3-dimensional cosmic membrane expands with high speed $V_E$ in the same manner as a balloon is blown up. This membrane is our cosmos.

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The author sees the **fourth spatial coordinate** not as a trick to simlify mathematics. It is reality, and we can measure the curvature of our 3D subspace.

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The author thinks the membrane consisting of tiny torus-shaped curls (German **korn**s, grains) with diameters of Planck length. The membrane is of tiny thickness in the fourth dimension and has a **strong tension**, but the fourth spatial dimension of Σ is of the same kind as our common three spatial dimensions x, y, z. Only the scale factor is unknown. The motor of the expansion of our cosmos is the momentum of the mass of the membrane

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**Gravitation** is not a direct force between masses. The membrane has nearly no resistance in the etherwind of expansion, but matter inside the membrane is some disturbance and causes resistance. The membrane deformes to a gravitational funnel. Another (smaller) mass at the walls of the gravitational funnel is driven by the ether force to the center of the funnel. That is what we call gravitation.

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In the case of a single central load the memrane deformes with radial symmetry. The ordinary differential equation (ODE) of the deviation w(r) from its zero position is

$$w''(r) = -\frac{2w'(r)(1+w'^2(r))}{r} \qquad (2.12)$$

Here w(r) is the **depth of space** in the fourth dimension. Positive w-direction is the direction of the expansion of the cosmos. In all cases of weak curvature we may neglect the small term $w'^2$ and furthermore we may neglect the fine difference between r and the true arc length inside the membrane. So we get the simplified equation of curvature

$$w''(r) = -2w'(r)/r. \qquad (2.12 \text{ simplified})$$

Each Newton's potential like function $w(r)=W_o+C/r$ is a solution of the simplified equation 2.12 . Since we often have to handle problems with spherical symmetry (e.g. in our solar system), we write the solution of the simplified equation 2.12 in the form of Eq 2.13a. R is the radius of the Sun, $W_o$ the depth of space at the edge of the Sun. We define the mass-acceleration by the ether wind (force for the unity of mass) just as $A_e=g_s/W'_o$, where $g_s$ is the gravitational acceleration at the edge of Sun, $W'_o$ the slope of the membrane at the edge of Sun, $\gamma$ the gravitational constant.

$$w(r) = -\frac{W_o R}{r}, \qquad (2.13\text{ a})$$

$$w'(r) = \frac{W_o R}{r^2} \qquad (2.13\text{ b})$$

$$A_e = \frac{g_s}{W'_o} = \frac{M\gamma}{W_o R} \qquad (2.14)$$

If we do not have a central load, but a mass distribution of radial symmetry, we get the differential equation (ODE)

$$w''(r) = -\frac{2w'}{r} + A\rho(r)\,. \qquad (3.5)$$

The first term of the right-hand terms of the ODE 3.5 yields Newton's gravitational potential. The second term gives the influence of the ordinary matter.

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**Graviton:** The Cosmic Membrane Theory does not use the concept *graviton* to transport gravitational forces, and does not use this term, but the change of the position of a massive body relatively to the membrane changes the curvature of the membrane. This change propagates from *korn* to *korn* of the membrane, so as an acoustic sound wave propagates from molecule to molecule of a gas. This mechanism of propagation one can surely describe by the action of a graviton (gravitational wave).

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**First estimation of the Depth of Space $W_o$ at the edge of the Sun:**

To calculate the exterior geometrical path lengthening $dS_E$ we solve the integral eq. 3.6.

$$dS_E = \int_R^\infty \frac{1}{2} w'^2(r)dr = \int_R^\infty \frac{W_o^2 R^2}{2 \cdot r^4} dr = \frac{W_o^2}{6R} \qquad (3.6)$$

With Feynman's value $r_{EX}=dS_E=491$ [m] and radius of sun $R=6.958\times10^8$[m] we find a value of $W_o= 1.432\times10^6$[m] or 1432 [km]. That is the depth of space at the edge of Sun. The constants $A_e$ , $F_o$ und the ODE coefficient A we can calculate now from the depth of space $W_o$:

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|---|---|
| Ether acceleration | $A_e=g_s/W'_o = g_sR/W_o =1.361\times10^5$[m/s$^2$] |
| Membrane tension | $F_o=Mg_s/(4\pi W_o^2)= 2.164\times10^{19}$[N/m$^2$] |
| ODE-coefficient A | $A=Ae/F_o= 6.289\times10^{-15}$[m$^2$/kg]. |

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**Numerical calculations to curvature of space:**

The author performed in 1995-1996 numerical calculations of the curvature of space to prove the correctness of the deduced formulas. The first proof was done by a spatial grid made from regular tetrahedras. Twenty regular tetrahedra form a regular icosahedra. The load of the central point was directed in the fourth dimension. An improvement of the icosahedra result was given by an enlarging of the number of points in the grid and a better spherical shape. So the author used another grid forming a sphere. The results showed convincing well the correctness of the formulas. The calculated curvature of the grid yielded very exactly the 1/r-potential of Newton's law of gravitation.

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**Speed of Gravity and gravitational waves:**

Th. Van Flandern (1998) supposes the propagation velocity of gravitation to be much higher than the speed of light. The reason is the fact that the Earth accelerates not towards the visible position of the Sun, but to its real position. Inside the Cosmic Membrane Theory this contradiction is solvable. Both directions - acceleration and path of light - are on one line. The reason is the aberration that we do not see the Sun at its real place. The gravitation has no aberration. It must not propagate, since it is already there in the form of the gravitational funnel. *Therefore, we do not have any reason to suppose the propagation velocity of gravitation to be higher than the speed of light* ***c****.*

Gravitational waves may exist both, transversal and longitudinal gravitational waves, comparable with gravity water waves and water sound waves otherwise. The amplitude of transversal gravitational waves is directed parallel to w-direction. Here the membrane accelerates in w-direction, and we had to use the unknown W-mass $m_W$ or the W-density $\rho_W$. The only fact we can assume is that $\rho_W$ is much larger than the transversal inert density $\rho$ of

the membrane. So, the transversal waves are assumed to propagate much slower than longitudinal gravitational waves. As final result for the total gravitational energy flow of the system Sun-Earth we find

$$\Phi_T = \frac{\gamma \cdot M_E^2 R_E^4 c}{10 \cdot R_B^6}. \qquad (6.2.14)$$

This formula is equivalent to that given by Weinberg (1972) for the GT.

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**Momentum, Mass and Energy:**

The 4-dimensional hyperspace Σ seems to be Newton's absolute space. The confirmation of momentum is relative to this space, and not relative to the other masses of the Universe, as Mach assumed, and also not relative to the membrane. Heavy or gravitational mass is caused by the ether wind force, and is proportional to the disturbance of the membrane by the matter. Energy is the virial energy of the movement in the 4-dimensional hyperspace as addition of the expansion speed $V_E$ and speed v inside the membrane, and of the cyclic movement of the bricks of matter inside the particles.

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**Special Relativity:**

The indroduction of a space filling resting stuff leads necessarily to a special relativity, either based on the Lorentz transformation or on an equivalent new transformation with cross and length contraction. With both transformations one can explanate the change of mass and time and the whole set of experiments, e.g. Thomas precession, the interferometer experiments of Michelson-Morley, Fizeau (Fresnel's drag coefficient), aberration and Airy's water experiment, the Trouton-Noble condensor experiment, the Sagnac experiment with rotating interferometer, the Kennedy-Thorndike long-time interferometer experiment.. The experiment of Haefele and Keating needs additionally Einstein's Principle of Equivalence. The conservation laws of energy and momentum and Maxwell's equations are valid. Only the measured constancy of speed of light is better to explanate with the new transformation.

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**Transformation with cross anf length contraction:**

The Lorentz transformation can not explanate exactly the constancy of speed of light, as the SR and a lot of experiments demands. This fact is leading to the new transformation with cross and length transformation. Some equations for coordinates and time of points resting in a moved frame σ' are (speed v directed in x-direction)

$$x' = \frac{x - vt}{1 - v^2/c^2} \qquad (4.2.8\ a)$$

$$t' = t\sqrt{1 - v^2/c^2} \qquad (4.2.8\ b)$$

The addition theorem for velocities is

$$u' = \frac{u - v}{\sqrt{1-\beta^2}\left(1 - \frac{uv}{c^2}\right)}\ , \qquad (4.2.18\ b)$$

a result, which is similar to the addition theorem of velocities in the special theory of relativity.

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**Tidal and frequency effects:**

The advance of time is a property of the space, but no a dimension.

*Kinematic Time-Dilation* arises from any motion of a clock relative to CBR frame (Cosmic Background Radiation). A moving clock runs more slowly. The formula is the same as given by Lorentz or by Einstein

$$t' = t\sqrt{1 - v^2/c^2} \qquad (4.7.1)$$

*Gravitational Time-Dilation of Clocks* is an effect which is caused by a gravitational field acting on the clock. The author has no objections to use the explanation given by Einstein's GT for the gravitational time-dilation.

*Gravitational Time Dilation of Photons*: Photons moving in a strong gravitational field need more time than photons moving in field free space. In a week gravitational field we find $c(r)=c_o(1-2a/r)$ with 'a' the half Schwarzschild radius of the central mass.

*Doppler Effect* is an effect of first order in v/c. Since the light source or the receiver or both are moving relative to the membrane (CBR frame) this effect is always connected with the kinematic time dilation effect. For speeds v<<c we find the same formulas as given in the case of the doppler effect of acoustic sound waves.

*Gravitational Red Shift* is an effect which is merged into the *gravitational time dilation of clocks* sometimes. This effects are difficult to separate. The Cosmic Membrane Theory says: The frequency ν does not change if the photon climbs upward, but the speed of light changes with $c(r)=c_o(1-r_g/r)$ and causes so a change of the wave length. Here $c_o$ is the speed of light outside of all gravitational fields. But what does energy and momentum? If we use further the equation e=hν, we have to assume that **Planck's constant *h* depends on the gravitational field.**

*Red Shift caused by the expansion of the Universe*: The space stretches with the expanding Universe, and stretches so a propagating photon. The effect is an enlarging of the wave length.

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**Proofs of the Cosmic Membrane Theory:**

The central assumption is the **decrease of speed of light** in the gravitational funnel with

$$c(r)=c_o(1-2a/r) \qquad (5.1.1)$$

The ***Shapiro effect*** of signal retardation by solar gravity is

$$d\tau = \frac{2a}{c}\ln\left(\frac{(Xe+\mathrm{Re})(Xr+Rr)}{y^2}\right) \qquad (5.1.2)$$

The result agrees with the General Relativity. The effect of higher order of the *sun-near acceleration of speed of light* $c_r(r)=c_o(1+w'^2/2)$ leads to a shortening of the classical time dilation according to Eq. 5.1.4.

$$d\tau_C = -\int_{-\infty}^{\infty}\frac{W_o^2R^2}{2cr^4}dx = -\frac{W_o^2R^2\pi}{4cy^3}. \qquad (5.1.4)$$

Together with the effect of the geometrical lengthening of the path both effects yield a shortening of time $d\tau=3\pi W_o^2R^2/(16cy^3)$, contrary to signal retardation caused by the effect of first order. A regression analysis of the 17 sun-near trajectory data of Shapiro, Reasenberg et al. (1977) yields a value $W_o=(1.204 \pm 0{,}869)\times10^6$ [m] for the depth of space at the edge of Sun.

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The main effect of the ***solar gravitational deflection of light*** or ***light bending*** is caused by the common gravitation together with the effect of a decrease of the speed of light described above. The formula $\phi(y)=-4a/y$ is the same as in the General Relativity. Additionally we find three effects of the order $1/y^4$. Two of the three additional effects of higher order cancel one

another. The only remaining effect is the lateral effect $\phi_C = -3\pi W_o^2 R^2/(16y^4)$ of the centrifugal acceleration. The data of the eclipses of Sobral 1919 ($\phi$=1.98±0.18“), Principe 1919 ($\phi$=1.61±0.45“), Takegon 1929 ($\phi$=2.24±0.10“) and Timbuktu 1959 ($\phi$=2.17±0.34“) yield the mean deflection angle $\Delta\phi$= 2.093±0.193’’. The GR predicts $\phi$=4a/R=1.75“ for trajectories grazing the Sun. We take the difference (2.093±0.193)’’-1,75’’=(0.342±0.193)’’ and compare it with the lateral effect $\phi_C$. Thus, we get with y=R another estimate of the depth of space $W_o=(1.168 \pm 0.659)\times 10^6$ [m]. The light deflection data quoted by Steven Weinberg (1972) deliver a weighted average of $\Delta\phi$= 1.92±0.18’’ and $W_o=(0.823 \pm 0.871)\times 10^6$ [m].

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***Perihelion Advance of Mercury:*** The perihelion Advance of elliptical orbits of planets is caused by an additional relativistic term of Newton's potential. The direct integration of the equations of motion of a planet including the additional acceleration term $-6\gamma Ma/r^3$ was done numerically for one revolution with sufficient accuracy. The author got a value of 42.5“ per century and confirms so sufficiently well the factor k=6 of the additional acceleration term. The hitherto best experimental value is 43.20±0.20“.

An explanation of the factor k=6 and and therewith of the additional relativistic acceleration $-6\gamma M/r^3$ within the membrane theory we get from the relativistic expression for the square of energy $e^2$:

$$e^2 = (m_{oo}c_o^2)^2 + (pc)^2, \qquad (5.2.3)$$

and from this the change of mass in the gravitational funnel,

$$m(r)=m_{oo}(1+3a/r). \qquad (5.2.6)\ \text{(Formula revised 11/2004)}$$

The term 3a/r contains the kinematic dependence of the mass on the speed, i.e. a/r, and the dependence of the mass on the gravitational field, i.e. 2a/r.

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If the NASA has neglected this acceleration, as the author supposes, the parameter fit of the solar system parameters will be only hold inside the planetary belt. As the spacecrafts Pioneer 10 and 11 leaved our solar system, the fit failed, and the implicitely added acceleration of $a_A = (8 \pm 1) \times 10^{-10}$ [m/s$^2$] became visible. The author has written a small program in C, Pioneer.cpp. This program is calculating the error made by the neglection of the Gerber-Einstein acceleration. By addition of a "correction constant" of $C_C = -10.5 \times 10^{-10}$ [m/s$^2$] the sum of error squares is minimized inside the planetary belt (from Mercury to Uranus, or a distance until 20 astronomical units). If one sums the errors until a distance of about 100 AU with additional measuring points, we had to reduce the correction constant to a value of $C_C = -3.2 \times 10^{-10}$ [m/s$^2$]. We see, leaving the solar system we had to diminish the falsely introduced correction. Between 20 AU and 100 AU by the amount of **$7.3 \times 10^{-10}$ [m/s$^2$]** getting a new value of $C_C = -3.2 \times 10^{-10}$ [m/s$^2$]. The Gerber-Einstein acceleration does not influence the rotation curves of the galaxies. Calculations with the program Darksim9.pas show that the coefficient of the ODE term of curvature, $C*w'^2$ with $C=2.601\times 10^{-11}$ [1/m], is to small. This value arises from the comparision of the integral of the term $C*w'^2$ multiplied by the ether acceleration $A_E$ compared with the Gerber-Einstein acceleration. A value of $C=2.26\times 10^{-6}$ [1/m] is needed to yield a flat rotation curve with speed 245 km/s in its flat part.

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**Particles:**

The basic brick of our world is a torus-shaped whirlpool (eye, in German Auge). The finite extension of its inner channel causes a finite total ammount of the outer flow. That means the flow decreases with a higher exponent of (1/r) than 3 and the force between two auges decreases with $(1/r)^6$ at least.

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*The electron model:* The basic idea is that the kinetic energy of the drilling space surrounding a charge (a rotating pair of Auges) is identically with the energy of the electric field. The membrane theory yields the density of space. From this density and some assumptions about the angular speed of the rotation we may calculate the energy. This energy depends on the inner radius, where we are stopping the integration. If we compare the integrated energy with the energy of the electric field of an electron, than the stop radius of integration must be somewhat as the radius of the electron. The calculation yields the results of the model in the first column. The known values of literature are given in the second column:

$J=5.269\times10^{-35}$ [Js], $J_E=5.273\times10^{-35}$ [Js], error=0.08%
$\mu=9.307\times10^{-24}$ [Am$^2$], $\mu_B=9.285\times10^{-24}$ [Am$^2$], error=0.24%
$\lambda=2.362\times10^{-12}$ [m], $\lambda_C=2.426\times10^{-12}$ [m], error=2.71%
$R_G=7.183\times10^{-13}$ [m], $R_E=7.078\times10^{-13}$ [m], error=1.48%

Model parameters of the electron model are:

Great half axis $a=1.1210\times10^{-13}$ [m],
Small half axis $b=0.6647\times10^{-14}$ [m],
Radius of auge $R_A=0.906\cdot b$
Ratio of speeds $V_A/c=1.860$
Angular frequency $\omega=\omega^{(Z)}/2$

with angular frequency $\omega^{(Z)}=1.5527\times10^{21}$ [1/s] of the *zitterbewegung* of the electron, the spin angular momentum $J_E=5.273\times10^{-35}$[Js], the Bohr's magneton of the electron $\mu_B=9.285\times10^{-24}$ [Am$^2$] and the Compton wave length $\lambda_C=2.426\times10^{-12}$ [m].

**Cosmology:**

There is a significant difference between GR based cosmology and membrane Theory. In all GR based models, e.g. the Einstein-Friedmann models or the Friedmann-Lemaitre models, the expansion of space depends on mass or energy parameters. The Friedmann equations suggest that baryonic mass, dark matter or a cosmological constant (vacuum energy) can influence the expansion rate of our universe. The Membrane Theory denies this imagination. The mass and the speed of the membrane is so overwhelmingly greater than all baryonic mass, dark matter and other forms of matter or energy inside our three spatial dimensions that this forms of matter can not influence the speed of expansion in any way. The Friedmann equations describe a three-dimensional cosmos, Membrane Theory a four-dimensional one. In this context questions became obsolete concerning the critical mass, Ω, e.g., or the signature of the metric. The metric of our universe is spherical, but nearly flat in the visible part because of the vast radius.

*The cosmological constant Λ* is dominating the expansion rate (Hubble constant) since 10 Billions of years (Blome and Priester 1991, Priester 1995). This authors use the following numbers: Standardized cosmological constant $\lambda_o=\Lambda c^2/3H_o^2=1.08$, Hubble constant $H_o=90$ [km/sMpc]= $2.912\,10^{-18}$[1/s], radius of the universe $R=36\,10^9$[ly], $=3.408\,10^{26}$[m]. Using the Friedman equation 7.1.1 we get the real cosmological acceleration $a_\Lambda$ by eq. 7.1.3.

$$a_\Lambda=-\ddot{R}c^2=-\frac{c^2\Lambda R}{3}=-\lambda_o H_o^2 R \qquad (7.1.3)$$

With the above value $R=3.408\,10^{26}$[m] we find the value $a_\Lambda=-3.12\,10^{-9}$[m/s$^2$]. The cosmic membrane model deals with two forces: The tensile force $Fo=2.114\times10^{19}$[N/m$^2$] of the membrane and derivated from it and from the radius of the universe the pressure $p_\Lambda$. From this we find

$$a_M = -\frac{p_{4d}}{\rho_M} = -\frac{3F_o c^2}{RF_o} = -\frac{3c^2}{R} \qquad (7.1.5)$$

with a valueof $a_M$=-0.792$10^{-9}$[m/s$^2$]. There is the factor 4 between the both estimations of the acceleration. One should not over-evaluate the difference between the two results, since one is calculated by Priester and Blome from astronomical observations, the other from physical constants. But the values of both accelerations are to high. Calculating the age $T_U$ of the universe starting with an initial speed of expansion c=3×$10^8$[m/s], we get not more than a value of $T_U$=3×$10^{17}$ [s] or $10^{10}$ years. This estimation is to short. The membrane model allows a higher speed $V_E$ of the cosmic expansion than the speed of light c, since c holds only inside the 3-d membrane. From this follows a much higher longitudinal inert mass $\rho_M=\rho_W$ and additionally a higher speed. That means, the radius R of the universe could be of another order of magnitude, and the life-time of our universe may be much greater.

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***Dark Matter*** denominates the phenomenon that the outer stars of galaxies rotate with speeds which are too high and, therefore, not explanable from the gravitational forces of the visible matter. Theory divides Dark Matter in Cold and Hot Dark Matter.

The cosmic membrane theory says that dark matter is not really existent, but it is an anomaly of the gravitational law. It is caused by effects of the ether wind on a perturbated membrane. Two imaginable effects (two of some) the author had selected. As seen in chapter 3, the *korns* (torus shaped curls) of the membrane experience a lateral force $F_{ec}$ if the axes of the curls are not directed exactly parallel to the ether wind, similarly to the buoyancy of a wing profile. This buoyancy causes two other forces, $F_a$ and $F_{e\rho}$. $F_a$ is a direct component of the lateral force $F_{ec}$, and $F_{e\rho}$ is caused by a thickening of the membrane stuff in the funnel by the hydrostatic pressure. We get a new ODE for the curvature of space,

$$w''(r) = -\frac{2w'}{r} + A\rho(r) - Cw'^2 - Dw|w'|. \qquad (7.2.7)$$

The third term is caused by the new force $F_a$ and the fourth term by the new force $F_{e\rho}$. With the depth of space $W_o$=1.432×$10^6$ [m] we get ODE-coefficient A with a value of A= 6.289×$10^{-15}$[m$^2$/kg]. With this number, the ODE 7.2.7 has been solved numerically, seeking well performing values for C and D. Values of C=1.909×$10^{-18}$[1/m] and D=1.596×$10^{-26}$[1/m$^2$] yield a reasonable result (good looking rotation curve) with a dark-matter coefficient of d=3 at a distance r=$R_G$ (radius of galaxy).

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Although the Cosmic Membrane Theory does not know the original frame dragging effect in the sense of Lense and Thirring, a similar effect is thinkable. The membrane stuff is not a rigid body, not crystal like, but is more a liquid with strong adhesion between the korns and nearly frictionless. The word 'nearly' is essential here. If a heavy mass is spinning over billions of years, one can imagine that it transmits a part of its rotational energy to the surrounding membrane and makes it rotate too.Since membrane stuff has a density, and following inertial mass, we should await a centrifugal force, because the trajectory of the membane particles is curved in the 4-dimensional bulk space. This force is acting on the membrane, and causes a change of curvature similarly to an additional load with dark matter.

The rotation curve v(r) has not an even course for radii>0.3 Rg, as the example of Begeman has, but v(r) is decreasing from 300 km/s to a value of about 220 km/s at radius Rg. That means that space drilling can not be the only source of the dark matter effect.

The choice of function $\omega(r)= \omega_o(R_o/r)$ modelling the decrease of angular speed of rotation with increasing radius was controled by the aim to get the ideal rotation. Other curve models, e.g., $\omega(r)= \omega_o(R_o/r)^K$ with K>1 gave worse results, so that K=1 was used. This function $\omega(r)= \omega_o(R_o/r)$ is adequate to a cylindrical flow with infinite rotational axis. That is another weak

point of the model. A spherical spinning body as source for a pipe shaped flow pattern is difficulty to imagine. We had to assume some decrease of angular rotational speed propagating in direction of the rotational axis. But so we lose the nice property of a curl free flow pattern.

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***Expansion of the Universe**:* An actual question of astrophysical relevance is the discussed deceleration versus acceleration of the expansion of the Universe. The Cosmic Membrane Theory yields here a "third way": The real speed of expansion is constant or slows moderately, but because of an acceleration of the velocity of light we get the impression of an accelerating expansion of the Universe. One effect is that far light sources seem to be fainter as expected from their redshift z.

The modelling of the stretching membrane includes: A stretching membrane thins, membrane tension F grows, membrane density ρ shrinks. This changes must have some influence on the physical constants. We assume the total mass of the membrane to be nearly constant and get the changing membrane load (load per volume unit)

$$L_A(R) = L_{AO}\left(\frac{R_o}{R}\right)^3 . \qquad (7.3.3)$$

Otherwise, membrane tension F should linearly increase with an expanding balloon. That follows from the assumed elastic behaviour. We find::

$$F(R) = F_o\left(\frac{R}{R_o}\right), \qquad (7.3.4)$$

and from the wave equation $c^2=F/\rho$ we deduce the changing speed of light

$$c(R) = c_o\left(\frac{R}{R_o}\right)^P . \qquad (7.3.5)$$

Power exponent P we had to find in the range P=0.5 (constant density ρ) to P=2 (case $\rho=\rho_o(R/R_o)^3$ ). The author has no physical argument to chose the best value, but a good fit with the supernovae results we will find with a value of P=0.5 only. Because of the direct equivalence of time ticks and frequency, we find $\nu(r)=\nu_o$ (1-a/r). Frequency $\nu_o$ is the undisturbed frequency of the source far away from each gravitational field. We suppose that both changes, the change of c and ν, respectively, follow from a change of the properties of the membrane surrounding the Sun. We get from this assumptions the changing time (frequency)

$$\nu(R) = \nu_o\left(\frac{R}{R_o}\right)^{1/4} . \qquad (7.3.10)$$

Going back in time the speed of light and the frequency of light sources decrease. In the tough soup of the early Universe all things went slowly. What does our length scale s? Our length scale, e.g. the *meter*, is defined by a fixed number of wavelengths of a certain type of light. We find

$$s(R) = \frac{c(R)}{\nu(R)} = \frac{c_o}{\nu_o}\left(\frac{R}{R_o}\right)^{1/4} = \lambda_o\left(\frac{R}{R_o}\right)^{1/4} . \qquad (7.3.11)$$

Our length scale s grows with the growing Universe. In the literature (e.g. Blome et al. 2002) we find statements of the form "*the distance between the galaxies grows with the expanding Universe*". The question, whether the galaxies grow too, is much more difficult. The author thinks they do so, and eq. 7.3.11 is helpful here.

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But wat happens with a photon at his long travel through space and time? The common assumption is that the photon is stretched as a drawing of an wave at the skin of a balloon,

which we blow up. The membrane model yields a second contibution of stretching: If speed of light grows, the wavelength grows too So, for the membrane model redshift $z_m$ we find from the there-speed-and-frequency transformation, back-speed transformation and back-stretching transformation

$$z_m(R) = \left(\frac{R}{R_o}\right)^{1/4}\left(\frac{R_o}{R}\right)^{1/2}\left(\frac{R_o}{R}\right) - 1 = \left(\frac{R_o}{R}\right)^{5/4} - 1. \qquad (7.3.12)$$

Eq. 7.3.12 differs somewhat from the common redshift $z_F$ given by Friedman, i.e., $z_F=(R_o/R)-1$. In the membrane model a given redshift $z_m$ yields a greater radius R than Friedman's redshift $z_F$ does.

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In opposite to Friedman's model with constant speed of light the horizon grows more slowly here. We will never see the whole Universe. We should remark two important points:

- The Universe seems to be flat for us, because of the vast radius R. Expansion speed $V_E$ is assumed to be much higher as speed of light.
- The inflation of the Universe at the first milliseconds after the Big Bang or Big Bounce (cf. Guth 1981) is not in contradiction to Cosmic Membrane Theory. The first milliseconds of the eigentime t had been very long compared with the milliseconds of an outer observer with a recent time tick. In a short eigentime the radius R(t) grew with nearly infinite speed. But that is relative. All processes went very slowly during the real radius of the Universe was growing stadily with constant speed.

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Now back to the sopernavae candles. A calculation shows that using the above model a far galaxy seems to glow fainter indeed than the distance calculated from redshift prescribes.

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**The *geodesic precession*** is a mathematical effect with no physical relevance. Astronomers are using different reference frames. The GCRS (geocentric reference system) is a non rotating reference system connected with the Earth. The BCRS (barycentric reference system) is a non rotating reference system connected with the Sun. If one goes from one system to the other, one had to consider the different time flow influenced by Special and General Relativity.

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**The *Lense-Thirring* effect** or *frame dragging* effect is an effect of gravitational models using the *graviton*. The graviton is thought to be a particle or wave transmitting the gravitational force between distant masses with speed of light. The Cosmic Membrane Theory does not know the point to point connection of particles by gravitons, and, consequently, it does not know the Lense-Thirring effect in this form.

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**The geodetic precession** is the rotation of the spin axis of a gyroscope in an isotropic gravitational field of a static mass distribution. "Gravity Probe B - the 'gyroscope experiment' - was a NASA space experiment in 2007 designed to measure the general relativistic effect known as the dragging of inertial frames. In Everitt (1991) we find the following formula of the geodetic precession:

$$\dot{\Omega}_G = \frac{3GM}{r^3}\vec{r}\times\vec{v}\ . \qquad (7.4.4)$$

The main effect causing the Geodetic Precession is the decrease of speed in the gravitational funnel. The equation is $c(r) = c_0\,(1-2a/r)$. From this equation we find by a conclusion by analogy the eq. 7.4.6.

.

$$v(r) = v_o\,(1 - 2a/r) \qquad (7.4.6)$$

The gradient of the speed is $dv/dr = v_o\, 2a / r^2$ , and has the dimension of an angular speed. An integration over one year results in the revolution angle $\Omega_1$ :

.

$$\Omega_1 = \frac{v_0\, 2aT}{r^2} = 4.291\times 10^{-5} \qquad (7.4.7)$$

This angle is equivalent to 8.8 arcseconds. This is some more as the value of 6.6 arcseconds the General Relativity is giving. The second effect of the membrane considered now will give the correction. Both effects together yield the exact value of 6.6 arcseconds. Eq. 5.2.15 from section 5.2, $m(r) = m_{oo}\,(1 + 3a/r) = m_{oo}\,(1 + a/r + 2a/r)$ , says that mass will change with its distance r from the gravitational center. Here is only the term 2a/r of interest. It describes the change of mass caused by the changing properties of the membrane in the gravitational funnel. In a position 1 a volume element of the gyroscope moves away from the Earth on that side of the spinning top which is seen by the viewer. On the backward side the volume elements are moving in the direction towards the Earth. Supposing constant speed v, the rate of change of mass, dm/dt, causes a change of the momentum $v\cdot dm/dt$ with the dimension of a force. On the other side of the spinning top the rate of change of mass has the opposite sign, and also the force. This pair of forces together with the lever arms L will produce a torque. The torque does only depend on the angle $\theta$ now.

.

$$D = \frac{\pi \cdot 4 \cdot v \cdot \rho \cdot \delta \cdot r_G^4 \cdot a \cdot \omega}{2 \cdot 4 \cdot r^2} \cdot \cos^2(\theta)\,. \qquad (7.4.11)$$

The precession per year is

.

$$\Omega_2 = \frac{v \cdot a \cdot T}{2 \cdot r^2} = 1.0729\times 10^{-5}. \qquad (7.4.13)$$

.

This value is equivalent to 2.2 arcseconds. The total geodetic precession of one year is the difference of $\Omega_1$ and $\Omega_2$ .

.

$$\Omega_G = \Omega_1 - \Omega_2 = \frac{3\cdot v \cdot a \cdot T}{2 \cdot r^2}\,. \qquad (7.4.14)$$

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Equation 7.4.14 is equivalent to Everitt's equation 7.4.4. This is the same value which is also given by the GR, about 6.6 arcseconds.

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**Change of constants:**

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Mass changes with the speed of the reference frame and with the gravitational field: $m(r)=m_{oo}(1+3a/r)$.

Velocity of light changes with the gravitational field: $c(r)=(1-2a/r)$. $c_o$ is the speed of light in a vacuum for $r\rightarrow\infty$, 2a is the Schwarzschild radius of the Sun. The membrane gives a hypothetical explanation for this effect using the hydrostatic pressure and the dispersion equation $n=1+4\pi N(e^2/h)\Sigma a^2_{nk}(\nu_{nk}/(\nu^2_{nk}-\nu^2))$

.

Velocity of light and with it the wave length, frequency of the source and with it the emitted wave length change during expansion of the Universe: $c(R)=c_o(R/R_o)^{0.5}$

.

Time changes with the speed of the reference frame, with the gravitational field and with expansion of the Universe

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Planck's constant changes with the gravitational field.

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Length scale changes with speed of a reference frame and with expansion of the Universe

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**Further conclusions:**

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Spontaneous creation of matter seems to be possible, because the resistance of the existing matter inside the membrane is producing a great amount of energy  This energy cames from the virial energy of the expanding membrane.

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The radius of the universe may be much larger than $10^{26}$ [m] (assumed by different authors), and the Universe is closed, i.e. there does not exist any border and therefore no distance R. But there exists a radius R of the balloon.

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The kinetic energy of the membrane stuff (sometimes quintessence) is it what decreases during expansion. Most of this energy will be stored in the tension of the membrane.

The existence of black holes is not in contradiction to the cosmic membrane paradigm. On the contrary, the existence is well imaginable using the membrane paradigm.

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Cosmic membrane theory includes the possibility of a membrane rupture comparable with the burst of a soap bubble. That will be the end of  this Universe, and mankind has to seek a neighboured Universe to live in.

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