Tapio Kulmala, LFS 4.9.2012 esitelmä

TYHJIÖN OLEMUS

1. Maailmankaikkeuden (avaruuden) rakenne:

a) rakenteellinen aine: alkeishiukkaset, niistä koostuvat atomit, molekyylit ja vielä massiivisemmat kappaleet
b) rakenteelliselta aineelta vapaaksi jäävä avaruuden tila eli ns. **”tyhjiö”** .

2. Miksi avaruuden ”tyhjiö” ei voi olla tyhjä ?

a) Luonnonfilosofiset perusteet:

- ”Tyhjässä” ei voi olla pituusasteikkoa; ei siis etäisyyksiä, ei tilaa eikä sen ”kaareutumista”, ei liikettä, ei aikaa eikä energiaa !
- ”Tyhjiölle” on fysiikassa määritelty sähköinen permittiivisyys (epsilon) ja magneettinen permeabiliteetti (myy) ja edellleen niistä riippuva valon nopeus c. Periaatteellisesti mitattavissa olevien fysikaalisten suureiden määrittely ”tyhjälle” ei ole johdonmukaista, koska ”tyhjällä” ei voi olla ominaisuuksia.

b) Kokeelliset perusteet; esimerkkejä:

- **Gravity Probe A -koe** (1976): atomikellojen taajuuden (sini) siirtymä gravitaatiokentässä, Einsteinin suppean suhteellisuusteorian ennusteen mukaisesti.
- **Gravity Probe B -koe** (2004 -2011): geodeettinen ja ”frame dragging” -ilmiö gyroskoopeissa maapalloa kiertävällä radalla, Eisteinin yleisen suhteellisuusteorian ennusteen mukaisesti .

3. Johtopäätöksiä, skenaarioita, ennusteita, viittauksia tulevaan ...

a) ”Kenttien” ja niiden aiheuttamien voimavaikutusten synty avaruuden täyttävässä väliaineessa, eli ns. ”tyhjiössä”:

- **sähkökenttä ja gravitaatiokenttä** (+inertia)
- mitä muuta avaruuden ”tyhjiö” voisi pitää sisällään ja saada aikaan ?? (jatkoa tarvittaessa kohdassa b) alla)

b) **Keskustelua** esitelmän aiheen pohjalta...

Tapio Kulmala, 5.3.2012 (Ether)

Exploring the existence of ether itself

For the present, the existence of ”ether” as a concept throughout this study has been a hypothesis without referring to a specific experimental evidence. Hence, its time to present known relativity related experiments made in the vicinity of earth using atomic clocks and gyroscopes in a spacecraft.

A. Gravity Probe A (GP-A) experiment; gravitational blueshift of atomic clocks

Albert Einstein predicted in his special relativity theory that fractional frequency shift of an oscillator is

$$\Delta f/f = (\Phi_2 - \Phi_1)/c^2 \qquad (1)$$

where Φ_1 and Φ_2 are gravitational potential ($\Phi = -GM/r$) in location 1 and 2 respectively, M is mass of earth, G is gravitational constant and r is distance from the center of earth.
Sometimes the formula above is written in an approximate form

$$\Delta f/f \approx gh/c^2 \qquad (2)$$

where g is gravitational acceleration ($g = GM/r^2$) and h is the vertical distance concerned. Especially, if we are interested in local variation of speed of light in this context, we can write [23]:

$$\Delta c/c \approx gh/c^2 \qquad (3)$$

Comparison of formulas (2) and (3) reveals that the frequency of an oscillator is connected to the local speed of light: Atomic oscillators are composed of electronic / optical circuits whose resonance frequency depends on the local propagation speed of electromagnetic waves (inc. light) that, on the other hand, shall be determined by the local ”density of space medium” concerned.

One objective of Probe A experiment (NASA, 1976) was to confirm Einstein's prediction for oscillator's ”blueshift”, as given in formula (1). The principle of the experimental system is shown in Fig.31. [23], [34]. A Hydrogen maser oscillator (atomic clock) was sent in a spacecraft by a rocket to an altitude of h = 10 000km along a nearly vertical trajectory. The frequency of the oscillator onboard was sent via a radio signal to the Earth station where a similar Hydrogen maser was used as a reference for frequency comparison. To compensate for the Doppler effect in the radio signal above, an additional two-way radio signal path was used between the Earth station and the spacecraft. The flight of the Probe A lasted about two hours. The experiment confirmed Einstein's prediction in formula (1) with an uncertainty of 0.01%. The maximum fractional frequency (blue)shift obtained in that experiment was about 5×10^{-10} . It shall be mentioned herein that Hydrogen maser was one of the most accurate (fractional frequency error is about 10^{-14} , or less) and stable frequency standards (clocks) at that time (1976).

On the basis of the experiment above, I conclude that there exists in space a ”medium” that can alter the propagation speed of electromagnetic waves (inc. light) depending on the location and, hence, on the local ”density” of that medium. If we try to measure the local speed of light we need a clock whose frequency, on the other hand, depends also on the density of the medium concerned. Thats why we may come to a conclusion: ”The speed of light is a constant as a measured quantity !”
By this end, I propose to use the magnitude of gravitational potential (Φ) as a measure for the local density of space medium that I call ”ether”.

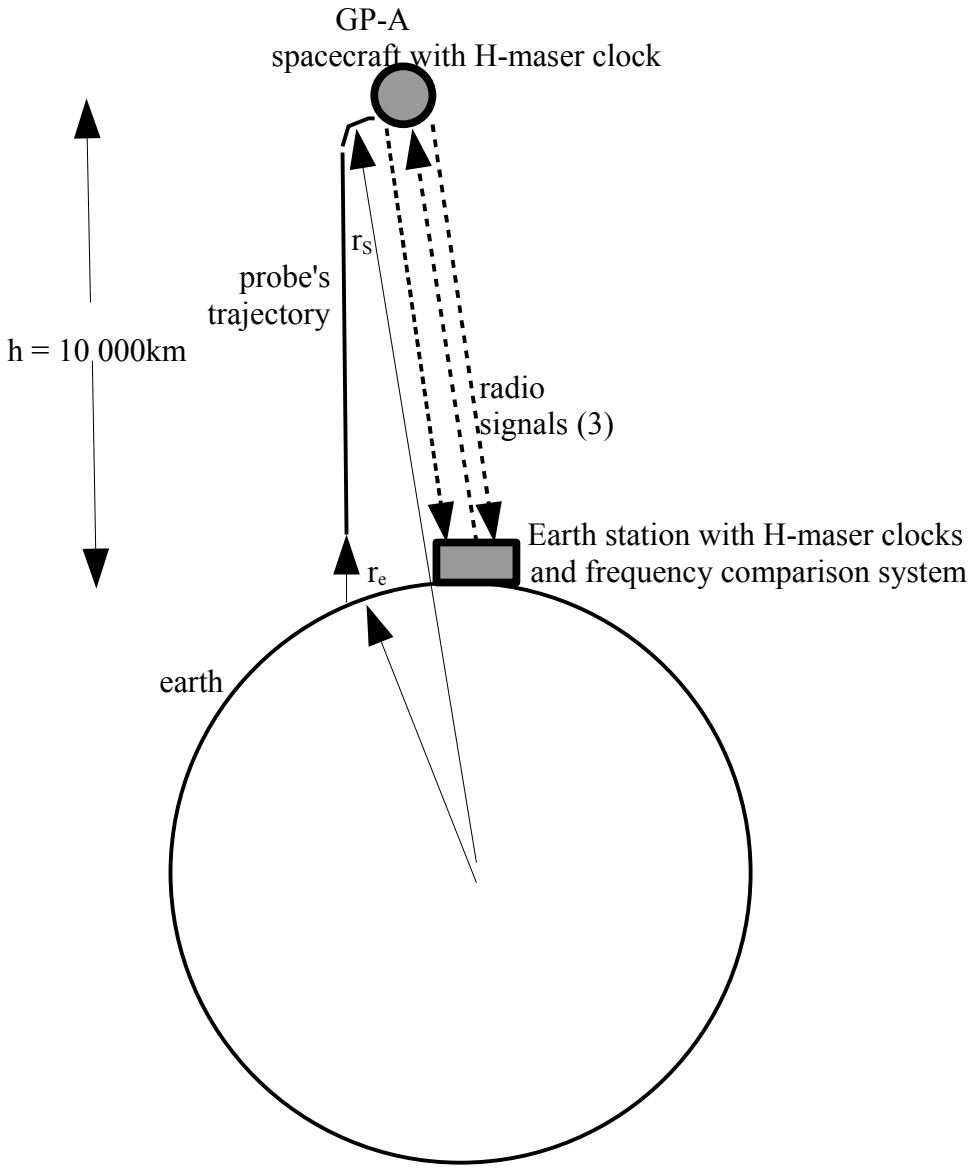

Fig.31: Experimental system (GP-A) for measuring gravitational blueshift of H-maser clock

B. Gravity Probe B (GP-B) experiment; geodetic and frame dragging effects around earth

GP-B experiment's mission (2004 – 2011) was to investigate two gravitational effects predicted by Albert Einstein (1916) in his general relativity theory:

a) The geodetic effect; the amount by which the earth warps the local spacetime in which it resides.
b) The frame dragging effect; the amount by which the rotating earth drags (”twists”) its local spacetime around with it.

The objective of GP-B experiment carried out by NASA and Stanford University was to test those two effects by measuring the deflection angles (precession) of the spin axes of the four gyroscopes (”gyros”) housed in a satellite orbiting 642km above the earth (Fig.32). A telescope placed in the

satellite enabled to align the satellite towards the ”Guide Star” of Im Pegasi. The experimental results over a period of one year were compared to predictions given by Schiff's formula that was derived from Einstein's theory [35]:

$$\text{total precession of gyro } \Omega = 3GM\,(\mathbf{R} \times \mathbf{v}) / (2c^2 R^3) + GI/(c^2 R^3)\,[\,3\mathbf{R}\,(\boldsymbol{\omega} \cdot \mathbf{R})/R^2 - \boldsymbol{\omega}\,] \quad (4)$$

(geodetic precession) (frame dragging precession)

where G= gravitational constant, M = mass of earth, I = earth's moment of inertia ($I = (2/5)\,Mr^2$), ω = earth's angular velocity, R = instanteneous distance of the gyroscope (from earth's center) and v = velocity of the gyroscope while orbiting the earth.

Before going into numerical results of the GP-B experiment, it is interesting to interprete the formula (4) in terms of the ”ether” concept as adopted previously in the context of GP-A experiment above.

Geodetic precession:

- The first term of formula (4) indicates that geodetic precession is proportional to $1/R^2$ (and to $g = GM/R^2$ accordingly), ie. to ”density gradient” of the space medium called ”ether” herein. This result is obvous as the satellite moves at the velocity **v** through the ”ether” that tends to tilt (slighly) the axis of the gyroscope due to the (small) vertical density gradient of the ”ether”.

Frame dragging precession:

- The second term of formula (4) exhibits two simultaneous activities: the one associated with distance (radius) vector **R**, and the other associated with earth's rotation velocity **ω** that is a vector too. The resulting ”force” that tends to tilt the axis of the gyroscope is a combination of those two factors. Anyway, its seems that frame dragging precession is proportional to 1/R and $1/R^2$ at the same time. This implicates that the local density (1/R) of ether will push the gyroscope in the direction of earth's rotation, and the density gradient ($1/R^2$) tries to tilt the axis of the gyroscope. This kind of behavior seems to be obvious if we think that the gyroscope is moving in the ether having vertical density gradient and rotating with earth at the same time. Anyway, the magnitude of frame dragging precession is predicted to be very small compared to geodetic one (that is quite small too).

For the polar-orbiting GP-B satellite the following experimental results were obtained in the course of one year and 5000 orbits around the earth:

For geodetic precession: 0.0018 degrees with an uncertainty of 0.5%.
For frame dragging precession: 0.000 011 degrees with an uncertainty of 19%.

The results above were consistent with Einstein's theory by taking into account the experimental uncertainties given. It shall be noted that in case of frame dragging effect the reported uncertainty of 19% is quite large. On the other hand, this is the first time scientists could measure the frame dragging effect in a way that confirms the theory at a reasonable level of confidence. The gravitational effects confirmed above leads to a conclusion that mechanical oscillators (eg. a pendulum) experience a blueshift similar to that of electric/optical oscillators (eg. an atomic clock), as oscillation rate is a bit higher in low density ether (!).
As the ether – or the”spacetime” - existing in the near space of earth rotates with the earth, it is obvious that there is no noticeable ”ether wind” on earth's surface. This feature of earth's near space is to explain (on its part) why Michelson and Morley failed with their interferometer experiments

(since 1887) while attempting to measure such a ”wind”. On the other hand, a ”null result” was expectable anyway, as both the ”measuring arm” and the ”reference arm” of the interferometer were immersed in the same local ”ether” and, hence, with the similar wave propagation properties.

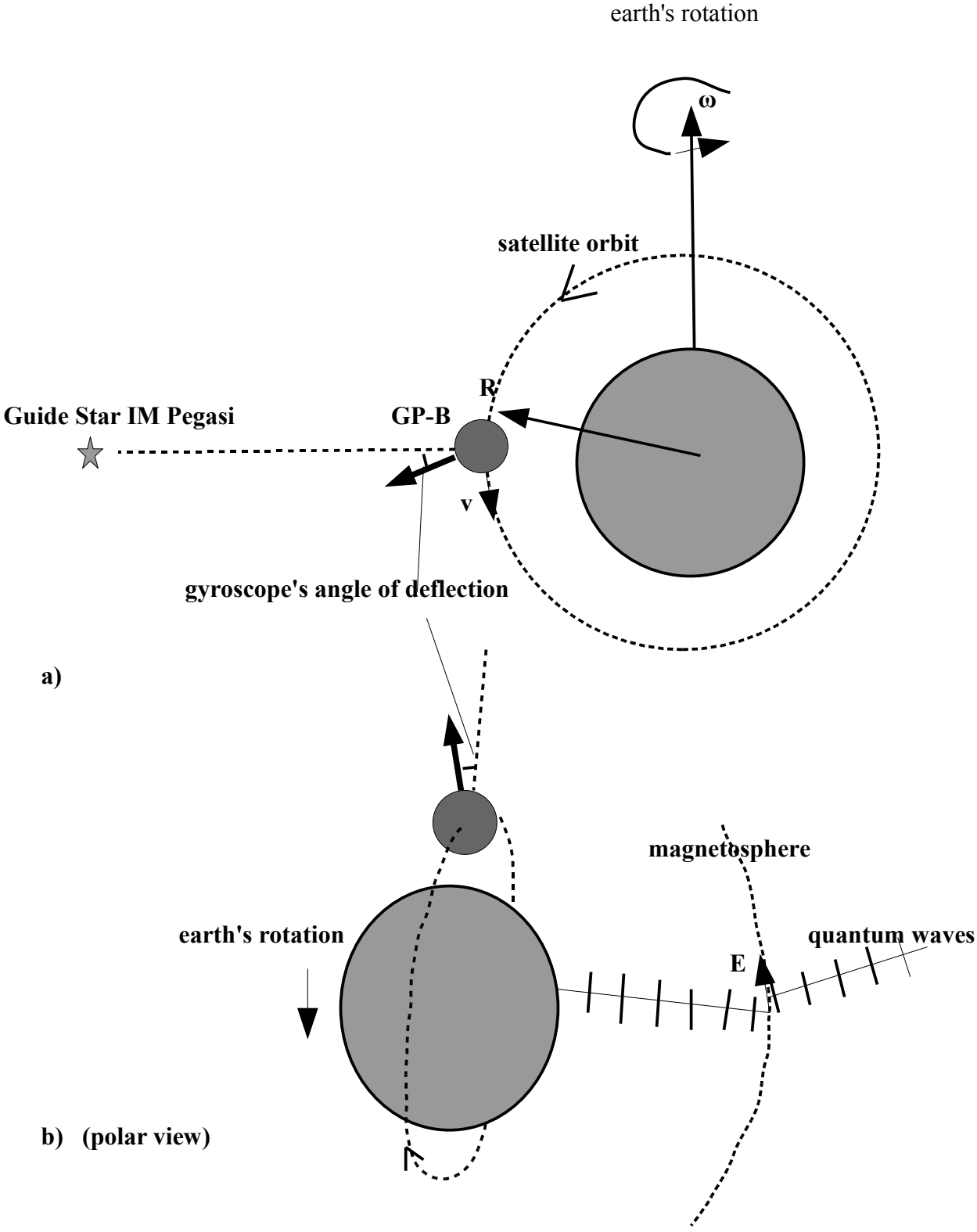

Fig.32: GP-B experiment; observing a) geodetic and b) frame dragging effect around earth

Frame dragging is sometimes renamed as ”gravitoelectromagnetic” effect, as it behaves like electromagnetic (Faraday) induction. The ”wave based” concept adopted in the present study gives grounds to think that the physical mechanism illustrated in Fig.32 b) may be capable to produce also ”real” electromagnetic effects:
Quantum waves emitted by the earth travel first trough the ”frame dragged ether” surrounding the earth and penetrade then the ”non-dragged ether” of outer space. At the boundary between those two zones of space ether quantum waves will experience some ”slips”, ie. they are transversally modulated and, hence, tends to induce a (horizontal) electric field E there. Furthermore, a properly calibrated electronic instrument (eg. magnetometer) could indicate here some vertical ”magnetic field H” too. Given the scenario above, we could imagine a new potential mechanism for generating a magnetic field within earth's ”magnetosphere” – in addition to the traditional ”Dynamo” model we have used during the last century (?).

C. Concluding remarks on the existence of ether

The experiments above have proven that at least in the near space of the earth there exist a medium with a slighly variable density that can support wave propagation and alter the speed of electromagnetic waves (inc. light) accordingly. Secondly, around the earth there exist a medium that is capable to cause some small gravitational forces to the bodies moving in the near space of the earth. It shall be noted, that the conventional ”Newtonian” gravity force between two bodies is due to (g-) accelerated quantum waves that, of course, propagate also in that medium, as already predicted in section 17 (Part II) of this study. For simplicity and to be reasonable, I assume that those electromagnetic and gravitational effects are due to the same space medium, called ”ether” herein. Furthermore, I suggest that the same ether-like medium exists also in other parts of the universe, and it's local ”density” is determined by the local gravitational potential. In this context it is good to recall also Arthur Eddington's experiment 1919 in order to verify the bending of light passing close to the sun, as predicted by Albert Einstein 1915. In those ”gravito-lensing” cases we are dealing with the density gradient of ”ether”, and that seems to be the best way to reveal the existence of an ether-like medium. Otherwise we may be facing with a ”null result”, as did Michelson and Morley 100 years ago. One fundamental property of the ”ether” is that all bodies in our universe seem to be ”immersed” in it, and the density of the ”ether” is highest close to the massive bodies, such as earth and sun. As a consequence, we can state (a bit ”paradoxially”) that ”although the speed of light is not absolutely constant in space, it is a constant as a measured quantity”.

Although the existence of an ether-like medium is obvious in space, we don't know all the properties and the detailed structure of that medium. Hence, the ”ether” as a whole is still in some degree a hypothetical concept, and is therefore for further studies, as we can see in Ref. [29], eg..
In the meantime, we can consider the ”ether” as an extension of ”vacuum” concept where vacuum's traditional properties, such as electric permittivity (ε), magnetic permeability (μ) and speed of light (c) may alter slighly depending on the location in space.

References:

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[34] R.F.C. Vessot et al (1980): ”Test of Relativistic Gravitation with a Space-Borne Hydrogen Maser”, Physical Review Letters 45 (26): 2018 -2084.
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Tapio Kulmala 30.8.2012 (EtherFields)

How a cyclic motion of electron generates sinusoidal electromagnetic field and wave

The scenario below (Fig.12) illustrates em waves, ie. electric (E) and magnetic (H) components , as generated by a radio transmitter. On the other hand, it can be applied also for cases of electrons bound by an atom while photons are emitted, respectively.

Electric component E(t) is a quantity measurable by an observer antenna. Hence, Faraday induction is the mechanism that will establish electric /electromagnetic interaction between the source and an observer. On the controversy, magnetic component H(t) may be interpreted as a measure of accumulated phase of electron's wave function in a unit time that is not directly measurable by electronic means [18].

(Fig 33)

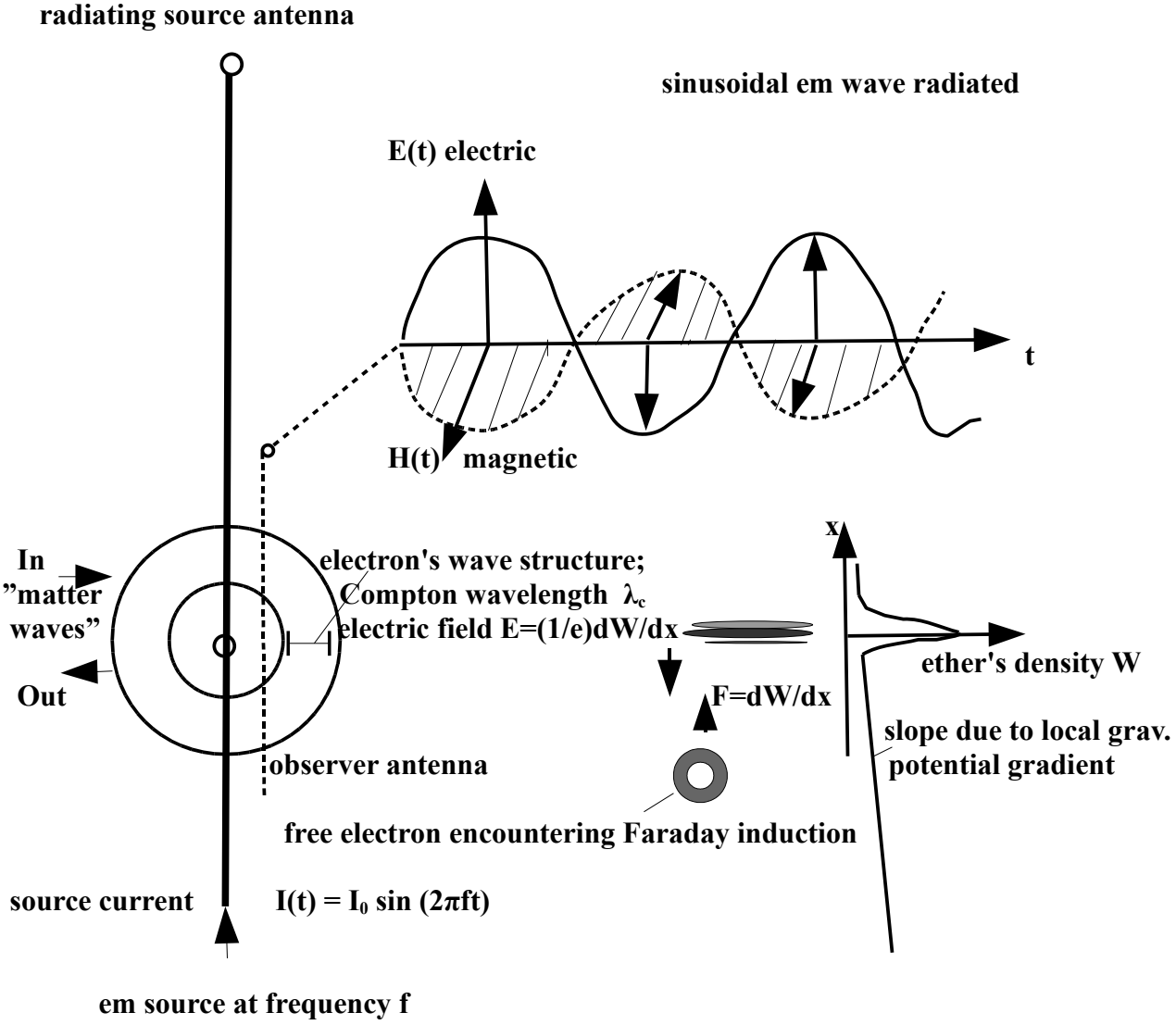

Fig.33: Electric field concept in ether with local gravitational potential gradient