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A surprising potential connection between Newton's fundamental principles and the dynamical aether of pushing gravity

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Abstract

Newton's second law, sometimes called the fundamental principle of dynamics, although considered as an irreducible axiom of mechanics based on and validated by experience, might paradoxically depend on the energetic content of our cosmos, through the existence of a dynamical form of aether appearing, in the ancient theory of Fatio de Duillier and Lesage, as an explanation of gravitational forces. In such a framework, Newton's theory is an approximation valid for small velocities as it was the case in special relativity theory.

Key words: gravitation, dynamics, aether

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1 Introduction

The existence of aether has been a major source of discordances between various schools of Physics even before Newton gave the starting impulse to rational mechanics with his three fundamental laws, followed some time later by his law of universal gravitation. Precisely at that time appeared (Fatio de Duillier, then Lesage, cf .e.g.[1, 2]) the idea that gravity might be the result of interaction of matter with tiny unseen very fast moving particles, coming from all directions and called"ultra-mundane", pushing, as a consequence of a mutual 3D shield effect, any pair of massive objects towards each other. The"ultra-mundane corpuscles" (called gravitons below) can be thought as forming a gas of immaterial particles (like photons) possessing however a linear momentum which can be transferred partially to material particles after a shock. Then the gravitational force can be thought as a pressure, the difference with usual gases that we meet in physics being that the graviton gas can cross the matter and the force is proportional to the volume of matter struck by gravitons rather than any kind of surface. And actually this is only approximative (cf. e.g.[2]) since, among other complicated phenomena, successive layers of matter reduce the number of incoming particles by a small proportion. In this model, the gravitational constant G can be seen as representing a local pressure per volume of space. And the final formula for the gravitational force will coincide sharply with Newton's law only when a large number of nuclei are involved and the distances are not large enough to imply a (possible and not excluded a priori) big variation of the gravitational pressure, which is usual in our macroscopic but not extra galactic familiar world.

In the last 3 centuries, many extremely qualified experts tended to disqualify Lesage's theory. Among the many objections, some of which are recalled in [7], one was raised by Maxwell who invoked the existence of a drag for moving objects, leading for instance to instability of planetary orbits. It is a bit strange that Maxwell used this argument to invalidate the pushing gravity concept, since Maxwell himself believed in the existence of aether, and he should also have been informed on Euler's work (cf.[5]) concerning gravitational collapse of our solar system in a very distant future.

The existence of that drag, which has been studied very thoroughly by R. Ortega and his coauthors in (cf. [14, 15]) was in fact the starting point leading to the ideas of this short communication.

Our main point is that under Newton's second law, might be hidden a mechanism which explains why we need some energy (in the form of a the mechanical work of a force) to move a massive object in the absence of any visible exterior force.

2 Newton's second law, energy and resistance to motion.

Newton's second law stipulates that, in the absence of any surrounding source of energy, the change of velocity of a moving punctual or quasi-ponctual body requires the action of a force. In more precise terms, to obtain an acceleration γ, we need to apply to the body a force

$$F = m\gamma \tag{1}$$

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where m stands for the mass. For a motion $y(t)$ on some interval of time, the equation of the motion is therefore

$$F(t) = my''(t) \tag{2}$$

The most striking aspect of this equation is that is seems to be very intrinsic in character: there is no numerical multiplicative constant in the RHS, and in a sense this formula, assuming that the mass is already a clearly understood concept, can even be considered as a definition of forces. But as soon as we try to understand this formula in depth, very difficult although simple-looking questions appear.

2.1 Moving in the vacuum.

Following an expression often used by Einstein, let us try the following thought experiment: imagine a solid object alone in the empty outer space, supposed to be the only object with no force field acting on it. Assume that we decide it does not move in some spatial reference system, and that we want to give it an impulse to produce a motion. There is no matter or anything of this kind in the surrounding which would prevent us to do that. Moreover, the position of the object in the reference system is somehow indifferent, since changing the position has no effect on any other object which would react on it following Newton's third law. So a naive argument would lead us to the conclusion that moving that object is free and no force whatsoever is needed to change either position or even velocity. However, Newton's second law requires that even in that situation of a sole isolated object, to produce an acceleration γ, we need a force $F = m\gamma$.

2.2 What does the mass do here?

It is rather easy to conceive that if we combine two small objects of masses m_1, m_2 to form an object of mass $m = m_1 + m_2$, in order to get a acceleration γ, the necessary force will be the sum of the two forces required to move each of the partial objects with the same acceleration γ. So that multiplication by m in the formula is natural. It is also natural for the force to be colinear with the acceleration. And, as we said previously, the formula can be a definition of forces for people who prefer to study mechanics from the point of view of energy. We understand that big mass implies large force. But are we really sure that Newton's law is valid in the vacuum? The law is in fact of experimental origin, and it might be that the supposedly empty outer space is in fact full of some invisible material, such as the aether of ancient physical theories. It would be much easier to understand Newton's law if the necessity of exerting an effort to move an object was due to the resistance of some surrounding material. The question is now: how is it possible that nobody tried to *explain* why we need a force to change the velocity of objects?

2.3 Kinetic energy

From Newton's second law, a very important principle has been deduced: the work-kinetic energy theorem states that a force acting on a massive pointwise object changes its kinetic energy $\frac{1}{2}mv^2$ from time t_1 to time t_2 by the exact value of the mechanical work of the total force acting on it (which may be positive or negative). This result, basically equivalent to Newton's second law, is so satisfactory that after it nobody is inclined to look for the *reason explaining* the necessity of using forces to move massive objects in the outer space.

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3 Interplay of a mass with incoming corpuscles.

When we plunge deeper in our "thought experiment", it appears that in the absence of external constraints, the position of an object in the absolute vacuum is somewhat undefined. Worse than that, we could say that, since moving does not constitute a change, since nothing happens, time itself is meaningless. If we think this way, the appearance of everywhere distributed fast incoming corpuscules is a sort of benediction. First of all, it stabilizes the position of our "fixed" punctual mass, and then, it explains immediately why moving requires energy or forces. What is the meaning of kinetic energy when the position of our object is undetectable and there is nothing for our object to interact with?

3.1 A provisional model.

We suggest to change Newton's law slightly to the form

$$F(t) = m[y''(t) + \delta y'(t)] \tag{3}$$

since in the pushing gravity model the presence of the dynamical aether results in a very weak linear damping force proportional to the number of nucleons, hence the mass. We may also write this variant of the second newton's law in the time independent form

$$F = m[\gamma + \delta v] \tag{4}$$

where v represents the velocity and γ the acceleration.

But we should keep in mind that the normalization of the term $my''(t)$ might be in question if we study the motion of the object far away from our solar system. In such a surrounding, the equation will take the form

$$F(t) = \frac{G}{G_0} m[y''(t) + \delta y'(t)] \tag{5}$$

where G_0 is the gravitational constant in our close surrounding and G is the gravitational constant at the distant location. This is because the Fatio de Duillier-Lesage framework allows the possibility of variable local gravitational coefficients, related to the local intensity of the flux of "gravitons". We note that in this formula, in the new region with local gravitational constant G, the role of the mass m is replaced by rm with $r = \frac{G}{G_0}$. In particular the gravitational field created by a mass M in the sense of our local masses on earth will become r^2 times greater because the gravitational constant is $G = rG_0$, and the mass in the new surrounding become rM, therefore the conservative part of the acceleration

$$y'' = -\delta y' - \frac{GrM}{|y|^3} y = -\delta y' - \frac{r^2 G_0 M}{|y|^3} y$$

will be multiplied by r^2 compared with what it would be in our neighborhood, at the same distance from the central mass, with the same material source (star, galaxy, etc). This remark reinforces the impact of our previous observation made in [7].

4 The equivalence principle.

The equivalence principle of dynamical (inertial) and gravitational masses remains intact in the new paradigm suggested by the above formulas. It suffices to replace, in the formula, F by the gravitational field when no other force is present, to see that the dynamical mass then plays the role of the heavy mass.

5 Relativity.

The proposed new paradigm is in no way incompatible with either special or general relativity theories and might probably be “relativised”, with the small difference that we could have to admit a large scale variability of the gravitational coefficient and the speed of light. Another difference might be that all points of observations become not equivalent, and the structure of the dynamical aether could force us to consider some kind of (possibly time dependent) spatial center or local centers. It would be very interesting if the formulas of relativity theory could appear as a consequence of the structure of aether, in which case the theory would be closed (until the next counter-experiments producing one more revolution in physics...)

6 Conclusion.

The reader will understand, in connection with our remark on motion in the absolute vacuum that, although he was during a long time convinced by the mainstream concept of a totally empty (up to some few wandering particles) interstellar space, the author has now been pushed to advocate for the existence of a form of dynamical aether to explain several independent findings (the missing mass enigma, the fundamental principle of dynamics, and even a possible atomic contraction, cf. [8, 9]). As a matter of fact, the concept of aether has been admitted or conjectured by many scientists in various forms during the last 3 centuries, among which Descartes, Leibniz, Maxwell and even Einstein. It reappears in a different form in quantum theory to explain the emergence of matter and energy. The (initial) origin of energy might be the ultimate problem that physical science will never be able to solve. The final axiom of natural philosophy, and the “supreme being” of physicists!

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