Principle of inertia of the cosmic distance (or age) : Einstein-Hubble Law as a law of constant passion [1] = Le principle d'inertie de la distance (ou âge) cosmique : la loi de Einstein-Hubble comme loi de passion constante

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PRINCIPLE OF INERTIA OF THE COSMIC DISTANCE (OR AGE): EINSTEIN-HUBBLE LAW AS A LAW OF CONSTANT PASSION [1]

LE PRINCIPE D'INERTIE DE LA DISTANCE (OU ÂGE) COSMIQUE: LA LOI DE EINSTEIN-HUBBLE COMME LOI DE PASSION CONSTANTE

BY

Paul B. SCHEURER *

This short preliminary note aims at a first presentation of an amazing and rather deep discovery about an equivalence of inertia and cosmic distance. A law of constant passion (= time/mass) is proposed: $t = \kappa m$ for structural reasons, in parallelism with Einstein-Planck law of constant action $ET = p\lambda = h$. When the value of κ is taken as G/c^3 (G: Newton's constant of gravitation and c: the velocity of light in vacuo), this law amounts easily to Hubble law of the recession of the galaxies ($V_r = Hr$, H: Hubble's constant), and a scalar form of Einstein's equation of General Relativity (*GR*) associable with the cosmological constant Λ. Inertia appears as the work of Planck's constant force along the distance r ($F_P = c/\kappa = c^4/G$).

Structural derevolution

There are now almost twenty years that I have shown that Newton's First Law of inertia can be easily transfered to Special Relativity (*SR*) when it is written in a local version as

(1) $$dx/p_x = dy/p_y = dz/p_z = dt/m = d\tau/\mathrm{m}_0 = dP$$

(p: linear momentum, τ: proper time, m_0: rest mass, P : passion).

* Université de Genève, Département de philosophie, 1211 Genève.

By an elementary calculus of proportions, the differential system (1) is made equivalent to

$$dP = E_0 d\tau / p_0^2 = p_\mu dx^\mu / p_\mu p^\mu = dA / p_0^2 \tag{2}$$

(A: Hamilton's action, $\mu \in [1, 2, 3, 4]$, dA one-form of action on space-time, for one particle).

If action A is considered as a product of proper time and rest mass (multiplied by c^2), i.e. $A = E_0\tau$, then

$$dA = E_0 d\tau + \tau dE_0 \tag{3}$$

Usual mechanics deals only with the first part of this differential, assuming that rest mass is a constant. But now if this mass is let to be variable, the second part could be associated with something analogous to entropy.

Simililarily passion P has been introduced as the quotient of (proper) time by (rest) mass: $P = \tau/m_0 = t/m$. By analogy with the relation of division to multiplication, P has been given the name of *passion* relatively to *action,* no less no more. It happens now that proper time τ is considered as a composite grandeur, the product $\tau = m_0 P$ [3], and consequently:

$$d\tau = m_0 dP + P dm_0 \ . \tag{4}$$

In *SR,* such a situation is not new for the coordinates of space and time. It is sufficient for the discussion to consider the restricted space-time TANTRA [4], i.e. the unfolding of the unidimensional world-line into the two-dimensional manifold TANTRA, easily obtained as

$$s^2 = c^2\tau^2 = c^2\tau^2(ch^2\vartheta - sh^2\vartheta) =_d c^2t^2 - r^2 \ , \tag{5}$$

with the definitions of t and r as

$$t = \tau ch\vartheta \quad \text{and} \quad r = c\tau sh\vartheta \ . \tag{6}$$

Consequently,

$$dt = d\tau ch\vartheta + \tau sh\vartheta d\vartheta \quad \text{and} \quad dr = cd\tau sh\vartheta + c\tau ch\vartheta d\vartheta \ . \tag{7}$$

In *SR,* the motion is uniform, and ϑ taken constant. Then, as usual, $v = dr/dt = cth\vartheta$.

If now we consider τ fixed, and ϑ variable (motion of the frame!), then $V = dr/dt = cth^{-1}\vartheta$: this amounts to considering V as a phase velocity ($V = c^2/v$) and associating this motion to some wave!

More generally, with both τ and ϑ variable, the velocity takes a more complex form:

(8) $$v' = dr/dt = (r/\tau d\tau + ctd\vartheta)/(t/\tau d\tau + r/cd\vartheta)$$

which can be attributed to a combinatory motion of particle and wave!

Similarily, coming back to proper time, the part m_0dP of $d\tau$ gives the usual treatment of the dynamics of a particle, associated with usual *action,* whilst the part Pdm_0 gives way to a new branch of mechanics, called *passics* [5]. Here we are particularly interested with the case of constant passion or pure passics, i.e.

(9) $$d\tau = \kappa m_0 \quad (\kappa \text{ is a constant of passion})$$

and even more with the integral case

(10) $$\tau = \kappa m_0 \quad (\text{and then } t = \kappa m \text{ and } r = \kappa p\text{: there exists a vector } x^\mu = \kappa p^\mu!)$$

This is in perfect structural analogy with the case of Einstein-Planck law of constant action

(11) $$E_0\tau = ET = p\lambda = h \ .$$

Now a physically relevant determination of κ gives way to a deep change.

Discursive revolution.

Select $\kappa = G/c^3$, where G is Newton's constant of gravitation. This selection entails very amazing relationships.

(i) PLANCK'S RELATIONS AND GRANDEURS

Consider what happens when both laws of constant action (11) and passion (10) are simultaneously obeyed. It is clear that the product κh has the dimension of length squared, and the quotient h/κ that one of momentum squared. This determines Planck's length and mass as:

(12) $$l_P^2 = Gh/c^3 \quad \text{and} \quad m_P^2 = hc/G \quad [6] \ .$$

Planck'time $t_P = l_P/c$, that means that the distance is taken on the light cone, with velocity c. In the same way, Planck's acceleration a_P and force F_P can be defined as:

(13) $$a_P = c^2/l_P \ [7] \quad \text{and} \quad F_P =_d m_P a_P = c/\kappa = c^4/G \ .$$

Two remarks are relevant here:

a) $t_P/m_P = \kappa$: at its minimal known values, the Universe obeys the law of constant passion.

b) G takes a more concrete meaning: it is a slightly disguised form of Planck's constant force, i.e. there exists a purely passic relation (no relation to h):

(14) $$c^4 = GF_P \ .$$

Then the law of passion takes the very remarkable form (with $r = ct$):

(15) $$E = mc^2 = F_P r \ :$$

Planck's force works along the distance r for the amount $E = mc^2$, i.e. inertia is associated with distance r from a given origin, or with the age t.

(ii) HUBBLE'S LAW

This intrusion into cosmology is not fortuitous. The law of constant passion is also valid for the Hubble Universe. With the at this moment accepted values for Hubble's time $t_H = H^{-1} = 5.10^{17}\ s$ and Hubble's mass $M_H = 10^{53}\ k$, the ratio $t_H/M_H = 5.10^{-36} \cong \kappa$.

Let assume that Hubble's universe obeys also this law. One defines the corresponding (to Planck's) Hubble's grandeurs

(16) $$r_H = ct_H = c/H \ ; \quad a_H = c^2/r_H = cH \ , \quad \text{as yet ascertained} \ .$$

Remarkably, for the force:

(17) $$F_H =_d M_H a_H = c^4/G = F_P \ :$$

Hubble's force is equal to Planck's force

One can then assume that the expansion of the Universe from Planck to Hubble has been made generally at constant passion, that means it is due to the permanence of Planck's force [10]:

(18) $$\kappa = t_P/m_P = t/m = t_H/M_H \quad [11] \ .$$

This assumption gives immediately Hubble's rule for the velocity of recession V_r:

(19) $$r/t_H = ct/t_H = c\kappa m/\kappa M_H = Hr =_d V_r$$

In other words:

(20) $$r = ct = V_r t_H$$

The recession appears as a projective geometric effect. The distance r is taken on the light cone (visible past!), and then projected onto the spacelike plane t_H = constant, hence this universally observed regularity of such a pattern.

(iii) EINSTEIN'S SCALAR LAW OF *GR* AND THE COSMOLOGICAL CONSTANT

From the form $r = \kappa mc$ of the law of constant passion (this is the Schwarzschild radius form!), dividing simply by r^3, one gets immediately

(21) $$r^{-2} = (\kappa/c)\, mc^2 r^{-3} =_d \Lambda_r \quad (= G/c^4 \cdot \text{density of energy}) ,$$

a scalar form of Einstein's equation for *GR* [12]. Tentatively one proposes an association with a "cosmologic constant" at distance r. It is indeed the case that for the Hubble values $\Lambda_H = r_H^{-2} = 10^{-52}\, m^{-2}$, which is a numerical value very close to the accepted limit $\Lambda_H \leqslant 10^{-54}$, always up to 8π.

(iv) MISSING MASS

There is no missing mass. The problem is solved automatically by the law of constant passion, that provides this "mysterious conspiracy" of mass growing uniformly with distance. For a confirmation, refer to the following relation: from (14) $c^4 = GF_P = M_H a_H G$, one gets that

(22) $$(m/M_H)\, c^4 = a_H G m = v^4 \quad [13]$$

which is constant for a given mass m. For example, a typical spiral galaxy has a mass $m = 10^{41}\, k$, and then $m/M_H = 10^{-12}$, and then $v = 10^{-3}\, c = 300$ km/s, a value very close to the measured values.

(v) TOWARD NEWTON'S LAW OF GRAVITATION F_N

As a final item of this note, put together the purely kinematic relation of Minkowski's acceleration $a_\rho = c^2/\rho$ (with ρ the radius of the hyperbola of curvature) under the convenient form:

(23) $$c^4 = a_\rho^2 \rho^2$$

and the passic relation (14) $c^4 = GF_P$. Then

(24) $$G/\rho^2 = a_\rho^2/F_P \,.$$

A Minkowski-Newton law F_{MN} of gravitational attraction between two masses m_1 and m_2 is easily obtained as:

(25) $$F_{MN} = Gm_1 m_2/\rho^2 = F_P^{-1} E_1/\rho\, E_2/\rho :$$

This form is typically intermediary between pure Newton's law F_N (formally the distance r between the masses is substituted to the curvature radius ρ) and the passic law:

(26) $$\text{from} \quad F_P^2 = E_1/r_1 \,.\, E_2/r_2 \quad \text{then} \quad F_P = Gm_1 m_2/r_1 r_2$$

(formally, in F_N the same distance r is substituted to the "cosmic" distances r_1 and r_2).

Furthermore, F_N can be approached by some kind of cosmic force F_{cosmic} [14]:

$$F_N = r^{-2}(G/c^3)m_1 c m_2 c^2 =_d \Lambda_r c^2 m_2 r_1 \tag{27}$$

(instead of $F_{\text{cosmic}} = \Lambda_H c^2 mr$).

CONCLUSION

It is clear that we stand before a multiplicity of possible scenarios or theories [15] for the interpretation of all those factual relations, and that the extraordinary insight of a new Minkowski should be required in order to obtain the needed geometric clarification.

Nevertheless, the law of constant passion opens a large domain of new relationships between the quantum (h) and the cosmic (G or F_P) worlds. The introduction of the grandeur passion offers the basis for a deep and revolutionary change in the accepted fundamental grandeurs and dimensions. Instead of taking length, time, and mass as fundamental dimensions, one can now elect action, passion, and velocity as the fundamental triad. Each of them is indeed endowed with a natural constant (h, κ, and c) that are measurable and have been measured more or less precisely (whilst it is not the case for Planck's length, very too small, and for Planck's mass, refering to what?) From these three basic grandeurs, length and mass are derived as the (squared) norm of dual vectors, the "vectorness" being given by the spacetime unfolding due to the existence of velocity. But this is properly matter for a study in physical ontology. We stop here this note, with the last remark that now we are standing in front of a deep revolution in our vision of the physical world: we must admit that the two dual manifolds spacetime and momentumenergy have a dynamical origin.

NOTES AND REFERENCES

[1] The main contents of this note have been presented in my lecture at the last meeting of the Swiss Society of Logic and Philosophy of Science, Lugano, 27.3.1988.

[2] First t/m has been named "reduced time"; now it is identified as the new grandeur passion P. Cf. P.B. Scheurer: *Helv. Phys. Acta 42* (1969) 619; *43* (1970) 739; *Arch. Sc. Genève 35* (1982) 197-216; *37* (1984) 229-264.

[3] And then the interval $s = p_0 P$ and the action $A = p_0^2 P$!

[4] Time t – trajectory r, in French *temps-tra*jectoire !

[5] Finally the name passics (in French: passique) has prevailed over pathics, as used in Lugano, other forms as pathematics or pathetics being eliminated of themselves!

[6] And then $Gm_P^2/hc =_d \alpha_P = 1$!

[7] A la Minkowski thus, with l_P in the role of the radius of the hyperbola of curvature $\rho = l_P$. Cf. H. Minkowski: "Raum und Zeit" (1908), "Space and time" in *The Principle of Relativity,* Dover, from 1923 on, p. 86-90.

[8] Here is a useful table:

Grandeur	Constant	Dimension	Value (in *SI* units)
Gravitation (Newton)	G	$M^{-1}L^3T^{-2}$	$6{,}67 . 10^{-11}$
» (Einstein)	$\kappa_E = G/c^2$	$M^{-1}L$	$6 . 10^{-28}$
Passion	$\kappa = G/c^3$	$M^{-1}T$	$2 . 10^{-36}$
Planck's force	$F_P = c^4/G$	MLT^{-2}	$1.21 . 10^{-44}$

[9] P.C.W. Davies: *The Accidental Universe,* Cambridge U.P., Cambridge 1982. In his table 4, p. 45, Davies gives the values for Planck's and Hubble's universe, but fails to recognize the equality of the ratios length over mass.

[10] The inflatory episode would be an exception to this rule.

[11] The ratio $t_H/t_P = 5 . 10^{17}/5{,}31 . 10^{-44} = 10^{61}$ is also the ratios r_H/l_P and M_H/m_P. But the action is extensive, and as $A_P = m_P c^2 t_P = h$, the actual value of A_H must be $10^{122}h$.

[12] Up to a factor 8π. The geometric factors 2π, 4π, and 8π are neglected in this study. Remember also the existence of a vector $x^\mu = \kappa p^\mu$. It is possible to pass from this vector to Einstein's tensor? A question let to the geometers!

[13] This relation is given by Milgrom, but here without his assumption of the modification of the law of inertia (the so-called MOND theory). Cf. M. Milgrom: *Astrophys. J. 270* (1983) 365, 371, 384, and *La Recherche 196* (1988) 182-190.

[14] Up to now, this discussion has not taken account of the sign of attraction for F_N and of repulsion for F_{cosmic}.

[15] *Note added on the galleys:* e.g. a new basis for Mach's principle.

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