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PROPOSAL TO MEASURE A POSSIBLE SUN LIGHT REDSHIFT CAUSED BY THE INHOMOGENUITY AND ANYSOTROPY OF EARTH'S ATMOSPHERE

Ruggero Maria Santilli
The Institute for Basic Research, Box 1577, Palm Harbor, FL 34682 USA

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Abstract

In a preceding paper, the author predicted that light experiences a redshift when propagating within inhomogeneous and anisotropic atmospheres as a manifestation of the deformation of the original geometry in vacuum caused by the physical medium. By using recent numerical data reached via quasars's redshifts, this note provides a first numerical estimate of the expected redshift for our atmosphere which results to be fully within the current experimental capabilities. We therefore propose the comparative measures of the sun light frequencies-wavelengths at the zenit and at the horizon to verify whether or not a redshift exists. Other experiments are indicated too.

The homogenuity and isotropy of empty space are fundamental geometric conditions of Einstein's special and general relativities. In fact, they are embodied in the structure of the underlying carrier spaces, the Minkowski space [1,3] and the Riemannian space [2,3], respectively, and they manifest themselves in relativistic laws, such as the Einsteinian redshift law [3], whose validity for light propagating in vacuum is now established by vast esperimental evidence.

In papers [4,5,6] we studied the possibility that the propagation of light within inhomogeneous and anisotropic (transparent) media implies deviations from the Einsteinian redshift laws caused precisely by the deviations from the homogenuity and isotropy of empty space. In particular, we identified [6] a generalized redshift law for the broader conditions considered, called *isodoppler's law*, and proposed the measure of the possible redshift of light in our atmosphere in the transition from the zenit to the horizon, although without any numerical prediction. Additional experimental proposals consisted in the measure of light from a distant star before and after passing through other sufficiently dense atmospheres of our Solar system, such as Jupiter or the Sun.

Mignani [7] applied these techniques to the problem of quasars' redshift by identifying for the first time upper numerical values for the possible deviations from the Einsteinian redshift expected from the quasars' hyperdense, inhomogeneous and anisotropic atmospheres.

In this paper we shall use the techniques of ref.s [4,5,6] and the numerical values of ref. [7] to identify a first order of magnitude of the possible redshift of the sun light when propagating within Earth's atmosphere, which is indeed manifestly inhomogeneous (because of the variation of the density with the distance) and anisotropic (because of the Earth's rotation which creates a preferred direction in our atmosphere).

The problem of the physical laws applicable within inhomogeneous and anisotropic media has been lingering for considerable time, but became quantitatively treatable only recently thanks to the appearance of the so-called *isotopies of contemporary algebras, geometries and mechanics* [4,5,6]. In particular, these studies have identified new geometries, known under the name of *isosymplectic, isoaffine and isoriemannian geometries*, which provide a direct characterization of inhomogeneous and anisotropic media. The main idea is the generalization of the trivial unit I = diag. (1, 1, ...,1) of contemporary algebras, geometries and mechanics into the most general conceivable nonlinear and nonlocal (integral) units $\hat{1}$, called *isounits*, which represent precisely the impact of the physical media in the motion of (extended) particles and waves [for recent detailed studies see the mathematical memoirs [8,9], and the review monographs [10,11]). In this letter we can evidently review only the most rudimentary elements, and refer the interested reader to the quoted literature for details.

Let $M(x,\eta,\Re)$ be the conventional Minkowski space in (3+1) space-time dimension over the reals $\Re$, with local coordinates $x = (x^\mu) = (x^k, x^4)$, $\mu = 1, 2, 3, 4$, $x^4 = c_o t$, where c_o denotes hereon the speed of light in vacuum, metric $\eta = \text{diag.}(1, 1, 1, -1)$ and familiar separation on $\Re$

$$x^2 = x^\mu \eta_{\mu\nu} x^\nu = x^1x^1 + x^2x^2 + x^3x^3 - x^4x^4. \qquad (1)$$

The *isominkowski spaces*, first introduced in ref. [5], are given by the infinitely possible isotopes $\hat{M}(x,\hat{\eta},\hat{\Re})$ of $M(x,\eta,\Re)$ characterized by the same local coordinates x of $M(x,\eta,\Re)$, by a new metrics $\hat{\eta}$ called *isometrics* and new fields $\hat{\Re}$ called *isofields*, with the follwing structures and inter-relations.

The isometrics can always be written in the form $\hat{\eta} = T\eta$, where T, called *isotopic element*, represents nowhere degenerate 4×4 matrices of generally nonlinear and nonlocal-integral elements on all possibler local variables and quantities, including coordinates x, their derivatives of arbitrary order, the local density μ of the media, their local temperature τ, their index of refraction n, etc., and it is assumed for all physical applications to be positive definite, $T = T(x, \dot{x}, \ddot{x}, \eta, \tau, n, ...) > 0$.

The isofields possess the structure $\hat{\Re} = \Re\, \hat{1}$ where $\hat{1}$ is the isounit of the theory; its elements are the *isonumbers* $\hat{N} = N\, \hat{1}$, and the trivial product of numbers N_1N_2 is now lifted into the *isoproduct* $\hat{N}_1 * \hat{N}_2 = \hat{N}_1\, T\, \hat{N}_2 = (N_1N_2)\, \hat{1}$ (as a result the "numbers" of the isotopic theories remain the conventional ones, because their sum is conventional and their isoproduct with any quantity Q coincides with the conventional product, $\hat{N} * Q \equiv NQ$).

The spaces $\hat{M}(x,\hat{\eta},\hat{\Re})$ become mathematically consistent when $\hat{1} = T^{-1}$, in which case, all deviations T from the original metric η, called *mutations*, are embedded in the isounit of the theory [5]. This novel geometric structure has a number of intriguing mathematical and physical implications.

On mathematical grounds, the spaces $\hat{M}(x,\hat{\eta},\hat{\Re})$ and $M(x,\eta,\Re)$ coincide, by construction, at the abstract, realization-free level because, under the condition $T > 0$, $\hat{\Re}$ is a field, and the signature of η is preserved for $\hat{\eta}$. Also, by recalling that all geometries are insensitive to the topology of their unit, the isotopies $M(x,\eta,\Re) \Rightarrow \hat{M}(x,\hat{\eta},\hat{\Re})$ permit the preservation of the original local-differential topology of the Minkowski space (e.g., the Zeeman topology) essentially unchanged because all nonlinear and nonlocal terms are embedded in the isounit of the theory.

On physical gounds, the primary function of the isotopies $M(x,\eta,\Re) \Rightarrow \hat{M}(x,\hat{\eta},\hat{\Re})$ is to represent the transition from the homogeneous and isotropic vacuum, represented by η, to generally inhomogeneous and anisotropic physical media, represented by $\hat{\eta} = T\eta$. In fact, the inhomogenuity can be directly represented, e.g., by the explicit dependence of the isometric $\hat{\eta}$ on the local density; the anisotropy can be represented, e.g., via a Finslerian factorization of a preferred direction in space; and finally, the combination of such inhomogenuity and anisotropy generally result in a space-time anisotropy (see below)

Note that the isotopies $M(x,\eta,\Re) \Rightarrow \hat{M}(x,\hat{\eta},\hat{\Re})$ constitute the most general possible nonlinear and nonlocal, axioms preserving generalizations of the original Minkowski space. Note also that, while the Minkowski space is unique, there exist an infinite variety of mathematically equivalent, but physically different isominkowski spaces represented by the corresponding variety of isotopic elements T, evidently because there exist an infinite variety of physical media in the universe.

Since the isotopic elements T are assumed to be positive definite, they can be diagonalized. Without any loss of generality, we can therefore assume hereon the following particular isominkowski spaces [5]

$$\hat{M}(x,\hat{\eta},\hat{\Re}): \quad x^{\hat{2}} = x^{\mu}\,\hat{\eta}_{\mu\nu}\,x^{\nu} = x^1 \hat{b}_1^2 x^1 + x^2 \hat{b}_2^2 x^2 + x^3 \hat{b}_3^2 x^3 - x^4 \hat{b}_4^2 x^2, \qquad (2a)$$

$$\hat{\eta} = T\eta, \quad T = \text{diag.}\,(\hat{b}_1^2, \hat{b}_2^2, \hat{b}_3^2, \hat{b}_4^2) > 0, \quad \hat{b}_\mu = \hat{b}_\mu(x, \dot{x}, \ddot{x}, \mu, \tau, n, \ldots) > 0. \qquad (2b)$$

where the $\hat{b}$'s are called the *characteristic functions* of the medium considered.Their explicit nonlinear and integral dependence is needed for the *local behaviour* , e.g., for the representation of relativistic drag effects experienced by a (classical, extended) particle in the neighborood of a given point x of the medium considered [6].

In this paper we study instead a *global behaviour*, that is, the possible refdshift of light when passing through our entire atmosphere. Under these conditions the characteristic $\hat{b}$-functions can be effectively averaged into the so-called *characteritic b-constants*, via any suitable averaging procedure

$$< | \hat{b}_\mu(x, \dot{x}, \ddot{x}, \mu, \tau,' \ldots) | > = b_\mu = \text{constants} > 0, \qquad \mu = 1, 2, 3, 4. \qquad (3)$$

A first illustration of the representational capabilities of isominkowski spaces (2) can be done via their use to treat the *isorelativistic kinematics* [6] in water. This is the simplest conceivable case represented via the isotopy of the conventional invariant

$$x^{\hat{2}} = b^2 x^2, \quad b_\mu = 1/n, \quad \hat{\eta} = \eta / n^2, \quad \mu = 1, 2, 3, 4. \qquad (4)$$

which illustrates the reason for the assumptions $b_\mu > 0$ in Eq.s (2b).

In this case the isominkowski space can properly represent: 1) the familiar speed of light $c = c_\circ b_4 = c_\circ / n < c_\circ$; 2) the maximal causal speed of massive particles (e.g. electrons) $| dr / dt |_{max} = c_\circ$ which is bigger than the local speed of light, as established by the Cherekov light; and 3) the homogenuity and isotropy of the medium considered, as manifest in the factorization (4) (see ref.s [6,11,12] for details). This case will soon be useful to clarify that light experiences a decrease of its speed but no redshift in all homogeneous and isotropic media.

Our fundamental assumption is therefore that *a space-time representation of the inhomogenuity and anisotropy of our atmosphere is provided by the isominkowski space* $\hat{M}(x,\hat{\eta},\hat{\Re})$ *where the isometric* $\hat{\eta} = T\eta$ *has the structure (2b) with constants values (3), which are not factorizable into forms of type (4) (i.e.,* $b_k \neq b_4$, $k = 1,2,3$*)* All subsequent steps can be proved to be uniquely derivable from the above assumption.

To begin, it has been proved that the isotopies $M(x,\eta,\Re) \Rightarrow \hat{M}(x,\hat{\eta},\hat{\Re})$ imply the necessary abandonment of the conventional Lorentz symmetry O(3.1) in favor of the covering *isolorentz* *symmetries* $\hat{O}(3.1)$ [5,6]. The isotopies $O(3.1) \Rightarrow \hat{O}(3.1)$ are necessary on a number of counts, e.g., the fact that the conventional Lorentz transformations $x' = \Lambda x$ no longer leave invariant isoseparations (2a) and, if applied to $\hat{M}(x,\hat{\eta},\hat{\mathfrak{R}})$, would imply the violation of the conditions of isolinearity, isotransitivity, etc. As a result, they must be generalized into the so-called isotransformations $x' = \hat{\Lambda} * x = \hat{\Lambda} T x$, T fixed, resulting in nontrivial generalizations of Lorentz's transformations of the type

$$x'^1 = x^1, \quad x'^2 = x^2, \quad x'^3 = \hat{\gamma}\,(x^3 - \beta x^4), \quad x'^4 = \hat{\gamma}\,(x^4 - \hat{\beta} x^3), \tag{5}$$

holding under the expressions

$$\beta^2 = v^2 / c_o^2, \quad \hat{\beta}^2 = v^k b_k^2 v^k \,/\, c_o b_4^2 c_o \;, \quad \hat{\gamma} = (1 - \hat{\beta}^2)^{-\frac{1}{2}}. \tag{6}$$

which are valid also for nonlinear and nonlocal realizations of the $\hat{b}$-quantities [6,8,9].

In particular, for $T > 0$, $\hat{O}(3.1)$ results to be locally isomorphic to $O(3.1)$ [5]. Thus, *our model of isoredshift of light within our atmosphere implies the necessary loss of the conventional Lorentz transformations*, evidently because of their direct incompatibility with the inhomogenuity and anisotropy of the medium considered, and their replacement with the covering isolorentz transformations (the proof that isotransformations (5) do leave invariant isoseparation (2a) is instructive). However, *the fundamental Lorentz symmetry is not lost, but remains exact at the abstract level*.

Next, it is possible to show that the isotopies $M(x,\eta,\mathfrak{R}) \Rightarrow \hat{M}(x,\hat{\eta},\hat{\mathfrak{R}})$ imply the necessary generalization of the conventional planewaves representation of light into the covering notion of *isoplanewaves* [6]

$$\Psi(x) = \hat{N} * e^{k^\mu \hat{\eta}_{\mu\nu} x^\nu} \equiv N\, e^{k^\mu \hat{\eta}_{\mu\nu} x^\nu} \tag{7}$$

where the isoexponent is evidently invariant under $\hat{O}(3.1)$.

It has been finally proved that the repetition of the familiar derivation of the relativistic Doppler's law [3] uniquely leads to the *isodoppler's law* [6]

$$\hat{\omega}' = \omega \hat{\gamma} (1 - \hat{\beta} \cos\alpha), \tag{8}$$

with *isotopic aberration*

$$\cos \hat{\alpha}' = \frac{\cos \alpha - \hat{\beta}}{1 - \hat{\beta} \cos \alpha}, \tag{9}$$

where one can assume values (6) for motion along the third axis.

We can now illustrate the statement made earlier to the effect that there is no isoredshif for homogeneous and isotropic media. In fact, for factorizable isoseparations (4), $\hat{\beta} \equiv \beta$, $\hat{\gamma} \equiv \gamma$ and the isodoppler's law coincides with the conventional laws even for propagation of light within physical media. Also, one can see from law (8) and values (6) that the isodoppler's redshift is not due to the inhomogenuity and anisotropy of the physical media per se, but more precisely to the space-time anisotropy $b_3 \neq b_4$ that they generally imply (see ref.s [6,11,12] for details).

The reader should be aware that the isominkowski spaces $\hat{M}(x,\hat{\eta},\hat{\mathfrak{R}})$ are *"directly universal"*, that is, capable of representing all possible signature preserving mutations of the Minkowski space (universality), directly in the frame of the experimenter (direct universality). The same property is then shared by all derived quantities. In fact, the isolorentz symmetries $\hat{O}(3.1)$ have been proved to admit as particular case all possible generalizations of the Lorentz symmetry preserving the values sign. $\eta = (+1, +1, +1, -1)$, such as those of ref.s [12,13] [if such signature is not preserved, the existing generalizations of the Lorentz symmetry are still particular cases of the isolorentz symmetry by relaxing the condition $T > 0$).

In particular, Aringazin [14] proved that isodoppler's law (8) admits as particular cases all existing generalizations of the Doppler's law via one of several, possible, different power series expansions and truncations. The reader not familiar with the unifying power of the isogeometries [8,9] should therefore be aware that there is no need to consider simpler, approximate laws by risking incomplete results, but one can consider instead isolaw (8) because of its uniqueness, direct universality, and covering nature over all possible particular cases, evidently including the Einsteinian case.

It is intriguing to note that the isodoppler's law coincides with the conventional Einsteinian law at the abstract, realization-free level. This mathematical property has nontrivial physical implications inasmuch as it establishes that the prediction of redshift caused by the inhomogenuity and anisotropy of the medium ultimately originates from the very axiomatic structure of the Einstein's Doppler's law, only realized in its most general possible way.

We pointed out in ref. [6] that isodoppler's law (8) offers genuine possibilities of resolving a vexing problem of contemporary physics, the speed of quasars which, as currently deduced from measured redshifts, has reached such high value to admit (portions of) quasars traveling at speeds higher than c_o, up to speeds of the order of $10c_o$ or more. But the quasars travel in empty space. Thus, their center-of-mass trajectories must be strictly Einsteinian in our views. *The assumption that their speeds is bigger than c_o therefore constitutes a violation of Einstenian laws under Einsteinian conditions, which is strictly prohibited for isotopic theories*.

We therefore suggested [6] that the quasars redshift could be due in part to the propagation of light within their hypersense, inhomogeneous and anisotropic atmosphes. This could reduce the relative speed between the quasars and the associated galaxy down to such values to avoid speeds higher than c_o, without affecting the current views on the expansions of the universe, whose primary contribution remains that of the galaxies.

More explicitly, we submitted the hypothesis that the currently measured quasars' redshift may be due to the following three contributions:

1) a primary contribution due to the expansion of the universe according to the Einsteinian Doppler's law;

2) a first quantitatively smaller correction caused by propagation of light within the quasars' hyperdense, inhomogeneous and anisotropic atmospheres as per the isotopic law which decreases the speed of the quasars as measured in 1); and

3) a second, very small correction expected from the fact that space is perfectly homogeneous and isotropic at distances, say, of the order of our Solar system, but at large intergalactic distances it may well result to be a physical medium being filled up with radiations, particles, dust, etc., thus potentially activating the isodoppler's law.

This study was explicitly conducted by Mignani [7], who assumed, fopr simplixcity, that $b_1 = b_2 = b_3 = b$ and that, as a first upper approximation, quasars are at rest with respect to the associated galaxy. Mignani then identified the following expression for the ratio b/b_4

$$B = \frac{b}{b_4} = \frac{(\omega'_1 + 1)^2 - 1}{(\omega'_1 + 1)^2 + 1} \times \frac{(\hat{\omega}'_2 + 1)^2 - 1}{(\hat{\omega}'_2 + 1)^2 + 1}, \qquad (10)$$

where ω'_1 represents the measured Einstenian redshift for galaxies and $\hat{\omega}'_2$ represents the isoredshift for quasars. From known astrophysical data, Mignani [loc. cit.] then reached the following first numerical values of the characteristic constants of inhomogeneous and anisotropic media [7]

GAL.	ω'_1	QUASAR	B	$\hat{\omega}'_2$
NGC	0.018	UB1	31.91	0.91
		BSOI	20.25	1.46
NGC 470	0.009	68	87.98	1.88
		68D	67.21	1.53
NGC 1073	0.004	BSO1	198.94	1.94
		BSO2	109.98	0.60
		RSO	176.73	1.40
NGC 3842	0.020	QSO1	14.51	0.34
		QSO2	29.75	0.95
		QSO3	41.85	2.20
NGC 4319	0.0056	MARK205	12.14	0.07
NGC 3067	0.0049	3C232	82.17	0.53

(11)

Intriguingly, all Mignani's values of the characteristic B-quantity are positive, they are all bigger than one, and all cases imply a shift toward the red. These results are nontrivial inasmuch as the underlying geometries are so broad that, in principle, there is no general way to predict whether light is red- or blue-shifted in an arbitrary medium (see the geometrization of physical media in ref. [6]).

Needless to say, the above numbers are upper values under the indicated assumption that the quasars are at rest with respect to the associated galaxies. However, the main idea of the isodoppler's redshift is that of avoiding the violation of Einstein's relativities under Einsteinian conditions [6]. Thus, smaller values of the characteristic B-quantities still permitting an expulsion of the quasars from the associated galaxies remain possible [7].

Despite these unsettled aspects, Mignani's results (11) provide the first numerical values for the characteristic B-quantity of interior physical media. As such, they have particular comparative value for other atmospheres.

By keeping in mind that possible corrections to MignaniUs values can at best be of decimal character, in this paper we assume numerical values (11) as characterizing the inhomogeneous and anisotropic atmospheres of the quasars. Their average value is

$$<|B|> \approx 72.78 \qquad (12)$$

with corresponding average isoredshift of the quasars

$$<|\hat{\omega}'_2|> \approx 1.15 \qquad (13)$$

while the average redshift of the associated galaxies is

$$<|\omega'_1|> \approx 0.01 \tag{14}$$

The isodoppler's redshift law, under the indicated limit assumption, therefore implies the following average value of the redshift due to the inhomogenuity and anisotropy of the quasars' atmospheres

$$<|\hat{\omega}'_2|> - <|\omega'_1|> \approx 1.14 \tag{15}$$

We now use the above numerical values to obtain a first order of magnitude of the possible redshift of light due to our atmosphere, for the primary purpose of seeing whether it is within current experimental capabilities.

From astrophysical information on quasars' masses as compared to the mass of our Earth, we can assume that the quasars' atmospheres are of the order of 10^4 densier than our atmosphere. If, in first approximation, the isotopic deviation from the conventional redshift is assumed to be proportional to the density of the atmosphere (and in fact it is null for null densities), we reach the following isotopic redshift expectedly due to the inhomogenuity and anisotropy of our atmosphere

$$<|\hat{\omega}'_{|\,\mathrm{Earth}}|> \approx 1.14 \times 10^{-4}, \tag{16}$$

which is fully within current experimental capabilities.

The above values confirm the validity of the proposal of ref. [6], that is, measure the possible isoredshift of the sun light in the transition from the zenit to the horizon.

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