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Conjecture on Cosmological Redshift: Action Instead of Velocity, No Need for Dark Energy

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Abstract

At cosmos scale, parameter "Action" would replace parameter "Velocity". Photon property "$x = ct$" is the core of special relativity. Here, it is proposed to use other photon property "$E = h\nu$". By analogy with Lorentz princeps transformation (x, ct) a so-called "Lorentz-Action" transformation ($E, h\nu$) is considered. $\begin{pmatrix} \bar{E} \\ h\bar{\nu} \end{pmatrix} = \gamma_{(A/h)} \begin{pmatrix} 1 & -A/h \\ -A/h & 1 \end{pmatrix} \begin{pmatrix} E \\ h\nu \end{pmatrix}$. Such a transformation keeps Planck constant "h" invariant and for a photon gives: $\frac{\bar{\nu}}{\nu} = \left(\frac{1 - A/h}{1 + A/h}\right)^{1/2} \Leftrightarrow \frac{A}{h} = \frac{1 - (\bar{\nu}/\nu)^2}{1 + (\bar{\nu}/\nu)^2}$. Which is similar to relativistic longitudinal redshift: $\frac{\bar{\nu}}{\nu} = \left(\frac{1 - V/c}{1 + V/c}\right)^{1/2} \Leftrightarrow \frac{V}{c} = \frac{1 - (\bar{\nu}/\nu)^2}{1 + (\bar{\nu}/\nu)^2}$. Thus, present results on V/c would apply to A/h. A/h would increase with time, which is consistent with the concept of action. By giving up the concept of velocity at cosmos scale, one gives up the concept of accelerating expansion of universe. Thus, there would be no need for dark energy.

Keywords

Cosmological Redshift, Planck Constant, Dark Energy

Forword

Foreword Conjecture on Cosmological Redshift Comparison with Present Paradigm

Present paradigm on relativistic longitudinal cosmological redshift:

- frequency of source ν is supposed known;

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- frequency received $\overline{\nu}$ is measured;
- parameter $r=\left(1-\left(\overline{\nu}/\nu\right)^2\right)/\left(1+\left(\overline{\nu}/\nu\right)^2\right)$ is calculated;
- a parameter "*V*" homogeneous to velocity is associated with each galaxy;
- according to longitudinal relativistic Doppler effect and by application of Lorentz transformation (which keeps "*c*" invariant and for a photon keeps equation "$x=ct$") the parameter r is interpreted as equal to V/c;

$$\frac{\overline{\nu}}{\nu}=\left(\frac{1-V/c}{1+V/c}\right)^{1/2}\Leftrightarrow\frac{V}{c}=\frac{1-\left(\overline{\nu}/\nu\right)^2}{1+\left(\overline{\nu}/\nu\right)^2}$$

- results show that this parameter $r=V/c$ increases along laboratory time;
- this is interpreted as an acceleration of universe expansion;
- such an acceleration is explained by an hypothetic dark energy.

Conjecture:

- frequency of source ν is supposed known;
- frequency received $\overline{\nu}$ is measured;
- parameter $r=\left(1-\left(\overline{\nu}/\nu\right)^2\right)/\left(1+\left(\overline{\nu}/\nu\right)^2\right)$ is calculated;
- a parameter "*A*" homogeneous to action is associated with each galaxy;
- by application of a so-called Lorentz-Action transformation (which keeps "*h*" invariant and for a photon keeps equation "$E=h\nu$"), the parameter "*r*" is interpreted as equal to A/h.

$$\frac{\overline{\nu}}{\nu}=\left(\frac{1-A/h}{1+A/h}\right)^{1/2}\Leftrightarrow\frac{A}{h}=\frac{1-\left(\overline{\nu}/\nu\right)^2}{1+\left(\overline{\nu}/\nu\right)^2}$$

- already collected data of $\overline{\nu}$ show that this parameter "$r=A/h$" increases along laboratory time;
- such an increase is consistent with the concept of action;
- no hypothesis on universe expansion;
- no need for dark energy.

1. Introduction

The word "redshift" was first used by Eddington [1]. The origin of cosmological redshift has been interpreted as a Doppler shift or as an expansion of space (Lewis [2], Bunn [3], Bedran [4], Harrisson [5]). Here, another explanation is conjectured: at cosmos scale, give up the concept of velocity and replace it by physical quantity "action".

Paradigm on relativistic longitudinal cosmological redshift is written:

$$\frac{\overline{\nu}}{\nu}=\left(\frac{1-V/c}{1+V/c}\right)^{1/2}\Leftrightarrow\frac{V}{c}=\frac{1-\left(\overline{\nu}/\nu\right)^2}{1+\left(\overline{\nu}/\nu\right)^2}$$

According to these equations, $\overline{\nu}$ measurements enable to calculate *V*. Present results show an increase of *V* with time. This is interpreted as an acceleration of universe expansion. Such an acceleration is supposed to be due to a hypothetical "*dark energy*".

But is it realistic to calculate instant velocities V when information $\bar{\nu}$ is collected hundreds of thousands years later? Which velocity is calculated? Velocity at instant of photon emission or velocity at instant of photon reception? Can we use at cosmic scale the same physical tools as at solar system scale?

Here, to describe cosmos dynamics, it will be suggested to use physical quantity "*Action*". Planck constant will play a central role as it is homogeneous to action.

By means of a 2-dimension transformation involving frequency and energy, and assuming invariance of Planck constant "h" through the transformation, a conjecture on cosmological redshift will be proposed.

2. Lorentz-Action Transformation

According to de Broglie "*action and entropy are major physical quantities*." Special relativity relies upon photon property "$x = ct$". Hence, the idea to use other **photon property** "$E = h\nu$". By analogy with special relativity and with princeps Lorentz transformation, a so-called "Lorentz-Action" transformation will be considered.

2.1. Frame $\mathcal{R}(E, h\nu)$

Photon property "$x = ct$" is the core of relativity.

Here, a model based upon photon property "$E = h\nu$" is proposed.

By analogy with princeps "Lorentz-Velocity" transformation which involves coordinates (x, ct), a "Lorentz-Action" transformation involving coordinates $(E, h\nu)$ is considered.

Parameter "A", homogeneous to action, will be associated with transformation between two frames $\mathcal{R}(E, h\nu)$ and $\bar{\mathcal{R}}(\bar{E}, h\bar{\nu})$. Such a transformation will be designed in order that Planck constant h be invariant through a change of frame, *i.e.* that for a photon equation "$E = h\nu$" remains valid in any frame.

2.2. Lorentz-Like Matrix

At this stage, it is convenient to define what is an "invariant". In the sense of special relativity, invariance of "c" is written: $x = ct \Rightarrow \bar{x} = c\bar{t}$.

According to this, with the terminology of special relativity, when a ratio of two coordinates is unchanged through the transformation, the value of this ratio is called "invariant".

Appendix 1 studies under which conditions the ratio of coordinates is unchanged through a 2-dimension linear transformation. A sufficient condition is that matrix be such as:

$$\begin{pmatrix} P & B \\ B & P \end{pmatrix}$$

2.3. "Lorentz-Action" Transformation ($E, h\nu$)

Lorentz princeps space-time transformation has been written in order that the speed of light "c" be invariant through any inertial change from frame $\mathcal{R}(x,ct)$ to frame $\bar{\mathcal{R}}(\bar{x},c\bar{t})$. In the sense of special relativity, invariance of "c" is written: $x = ct \Rightarrow \bar{x} = c\bar{t}$

By analogy, it is proposed a so-called "Lorentz-Action" transformation from frame $\mathcal{R}(E,h\nu)$ to frame $\bar{\mathcal{R}}(\bar{E},h\bar{\nu})$.

$$\begin{pmatrix} \bar{E} \\ h\bar{\nu} \end{pmatrix} = \begin{pmatrix} * & * \\ * & * \end{pmatrix} \begin{pmatrix} E \\ h\nu \end{pmatrix}$$

E, $\bar{E}$: total energy of physical particle within frame $\mathcal{R}$, $\bar{\mathcal{R}}$ resp.

ν, $\bar{\nu}$: frequency associated to physical particle within frame $\mathcal{R}$, $\bar{\mathcal{R}}$.

h : Planck constant.

This transformation will be designed such as Planck Constant "h" be invariant through the transformation, *i.e.* such as: $E = h\nu \Rightarrow \bar{E} = h\bar{\nu}$.

Appendix 1 shows that a sufficient condition is that matrix be such as:

$$\begin{pmatrix} P & B \\ B & P \end{pmatrix}$$

Then, searched transformation must be similar to:

$$\begin{pmatrix} \bar{E} \\ h\bar{\nu} \end{pmatrix} = P \begin{pmatrix} 1 & B/P \\ B/P & 1 \end{pmatrix} \begin{pmatrix} E \\ h\nu \end{pmatrix}$$

Coordinates (E, $h\nu$, $\bar{E}$, $h\bar{\nu}$) being homogeneous to energy, components of matrix will be dimensionless.

Let us denote: A : parameter homogeneous to action, associated with transformation between two frames $\mathcal{R}(E,h\nu)$ and $\bar{\mathcal{R}}(\bar{E},h\bar{\nu})$.

By analogy with princeps Lorentz transformation, parameter A/h would replace parameter V/c. Then, transformation becomes:

$$\begin{pmatrix} \bar{E} \\ h\bar{\nu} \end{pmatrix} = P \begin{pmatrix} 1 & -A/h \\ -A/h & 1 \end{pmatrix} \begin{pmatrix} E \\ h\nu \end{pmatrix}$$

According to princeps Lorentz transformation, Lorentz factor $\gamma_{(V/c)} = \left(1 - V^2/c^2\right)^{-1/2}$ has been calculated such as two successive transformations (V) followed by (- V) result in transformation identity (**Appendix 2**).

Here, by analogy, P will be chosen as a Lorentz-like factor $\gamma_{(A/h)} = \left(1 - A^2/h^2\right)^{-1/2}$ Then proposed Lorentz-Action transformation becomes:

$$\begin{pmatrix} \bar{E} \\ h\bar{\nu} \end{pmatrix} = \gamma_{(A/h)} \begin{pmatrix} 1 & -A/h \\ -A/h & 1 \end{pmatrix} \begin{pmatrix} E \\ h\nu \end{pmatrix}$$

2.4. Case of Photon: ($E = h\nu$)

First line of transformation is $\bar{E} = \gamma_{(A/h)} \nu (h - A)$

second line of transformation is $h\bar{\nu} = \gamma_{(A/h)} \nu (h - A)$

results are $\bar{E} = h\bar{\nu}$ (as expected) and $\bar{\nu}/\nu = \gamma_{(A/h)} (1 - A/h)$, *i.e.*:

$$\frac{\bar{\nu}}{\nu}=\left(\frac{1-A/h}{1+A/h}\right)^{1/2} \Leftrightarrow \frac{A}{h}=\frac{1-(\bar{\nu}/\nu)^2}{1+(\bar{\nu}/\nu)^2}$$

3. Conjecture

Relativistic longitudinal cosmological redshift is written as follows:

$$\frac{\bar{\nu}}{\nu}=\left(\frac{1-V/c}{1+V/c}\right)^{1/2} \Leftrightarrow \frac{V}{c}=\frac{1-(\bar{\nu}/\nu)^2}{1+(\bar{\nu}/\nu)^2}$$

Conjecture: according to present model, cosmodynamics would no longer be described by "*velocities V*" but by "*actions A*".

Parameter "*Action*" would replace parameter "*Velocity*".

Present calculations of velocities demonstrate an increase of velocities with time. These results are interpreted as an "accelerating expansion of the universe".

According to present model, "*velocities*" would be replaced by "*actions*". Due to similarity between the equations giving V/c and A/h, already calculated values of V/c would provide data of A/h.

Then, results would show an increase of parameter "*Action*" along with the laboratory time. Such an increase is consistent with the concept of action.

By giving up the concept of velocity, one gives up the concept of accelerating expansion of universe. Consequently, according to proposed conjecture, there would be no need for dark energy.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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Appendix 1: Invariants through Lorentz-Like Matrix[1]

Given a linear transformation:

$$\begin{pmatrix} \bar{z}_1 \\ \bar{z}_2 \end{pmatrix} = \begin{pmatrix} P & B \\ F & G \end{pmatrix} \begin{pmatrix} z_1 \\ z_2 \end{pmatrix}$$

Let us search when transformation satisfies condition:

$$\forall (z_1, z_2): z_2/z_1 = 1 \Rightarrow \bar{z}_2/\bar{z}_1 = 1$$

If we apply $z_2/z_1 = 1$, replacement of z_2 by z_1 gives:

$$\bar{z}_1 = (P + B) z_1$$

$$\bar{z}_2 = (F + G) z_1$$

Condition $\bar{z}_2/\bar{z}_1 = 1$ gives:

$$(P + B) z_1 = (F + G) z_1 \quad \forall z_1$$

Necessary and sufficient condition is $P + B = F + G$

A sufficient condition is $P = G$ and $B = F$

Matrix becomes: $\begin{pmatrix} P & B \\ B & P \end{pmatrix}$

Such matrix will be called Lorentz-like matrix.

Any Lorentz-like matrix ensures following property:

$$\forall (z_1, z_2): z_2/z_1 = 1 \Rightarrow \bar{z}_2/\bar{z}_1 = 1$$

Change of variables:

Let us change variables: $(z_1 = y_1, z_2 = k_2 y_2)$ and $(\bar{z}_1 = \bar{y}_1, \bar{z}_2 = k_2 \bar{y}_2)$

Then any Lorentz-like matrix

$$\begin{pmatrix} \bar{y}_1 \\ k_2 \bar{y}_2 \end{pmatrix} = \begin{pmatrix} P & B \\ B & P \end{pmatrix} \begin{pmatrix} y_1 \\ k_2 y_2 \end{pmatrix}$$

ensures following property: $\forall (y_1, y_2):\ k_2 (y_2/y_1) = 1 \Rightarrow k_2 (\bar{y}_2/y_1) = 1$

i.e. $\forall (\bar{y}_1, \bar{y}_2):\ \bar{y}_1 = k_2 \bar{y}_2 \Rightarrow y_1 = k_2 y_2$

With terminology of special relativity, k_2 is "invariant" through any linear transformation defined by a Lorentz-like matrix.

Application to transformation ($\boldsymbol{E}, \boldsymbol{h\nu}$):

$$\begin{pmatrix} \bar{E} \\ h\bar{\nu} \end{pmatrix} = \gamma_{(A/h)} \begin{pmatrix} 1 & -A/h \\ -A/h & 1 \end{pmatrix} \begin{pmatrix} E \\ h\nu \end{pmatrix}$$

Matrix is Lorentz-like and so following property is fulfilled:

$$E = h\nu \Rightarrow \bar{E} = h\bar{\nu}$$

[1]Luc R.M. Morin "h and c invariant $\Rightarrow$ ν shift" ISBN 978-2-9576694-1, January 2022.

Appendix 2: Lorentz-Like Factor $\gamma_{(\omega)}$

Given a Lorentz-like matrix:

$$\gamma_{(\omega)}\begin{pmatrix} 1 & -\omega \\ -\omega & 1 \end{pmatrix}$$

let us study under which condition a Lorentz-like transformation (ω) followed by a transformation $(-\omega)$ can result in transformation "unity".

$$\gamma_{(\omega)}\gamma_{(-\omega)}\begin{pmatrix} 1 & -\omega \\ -\omega & 1 \end{pmatrix}\begin{pmatrix} 1 & +\omega \\ +\omega & 1 \end{pmatrix}=\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\gamma_{(\omega)}\gamma_{(-\omega)}\begin{pmatrix} 1-\omega^2 & 0 \\ 0 & 1-\omega^2 \end{pmatrix}=\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

$$\gamma_{(\omega)}\gamma_{(-\omega)}=\frac{1}{1-\omega^2}$$

A solution is: $\gamma_{(\omega)}=\gamma_{(-\omega)}=\left(1-\omega^2\right)^{-1/2}$

Application:

with $\omega=V/c$, Lorentz-Velocity factor is $\gamma_{(V/c)}=\left(1-V^2/c^2\right)^{-1/2}$

with $\omega=A/h$, Lorentz-Action factor is $\gamma_{(A/h)}=\left(1-A^2/h^2\right)^{-1/2}$