The special theory of relativity: definition of an impulse and kinetic energy of the closed system of constantly cooperating bodies

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In article attempt to show on a concrete example becomes that application of the special theory of relativity by consideration of movement of the closed mechanical system of bodies in inertial systems of readout can lead to that the impulse and kinetic energy of the closed system will be time functions.

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Content

1. The introduction

In the special theory of relativity of dependence of an impulse and kinetic energy of a dot body from speed of its movement are defined from a condition of compulsion of performance of laws of preservation of an impulse and energy for the closed system of the bodies which interaction has short-term character.

In article it is offered to consider the closed mechanical system of the bodies which interaction has constant character, for acknowledgement of applicability of laws of preservation of an impulse and energy in case of use of the special theory of relativity as an example.

2. Description of a closed mechanical system of bodies

For consideration we take the elementary closed mechanical system of the bodies having constant interaction.

Let's assume that there is the closed mechanical system of bodies shown on fig. 1 and consisting of dot bodies 1 and 2, having equal weight M_0 at rest, and thread 3.

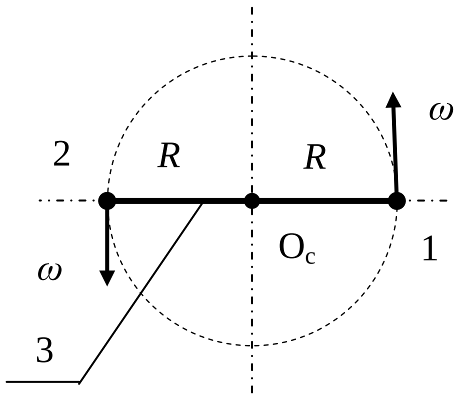

Fig. 1

Bodies 1 and 2 are connected by a thread 3 which at rest has weight m_0 in regular intervals distributed on length.

Bodies 1 and 2 (and a thread 3) rotate with angular speed ω round the general center of weights - point O_c.

The distance from a dot body 1 (body 2) to point O_c is equal R.

Let's place the considered closed mechanical system of bodies 1 and 2 with a thread 3 in inertial system of readout O*xyz* so that point O_c would be motionless in this system of readout and coincided with the beginning of coordinates O, and rotation of bodies 1 and 2 round it would occur against an hour hand in plane O*xy*, as is shown in fig. 2.

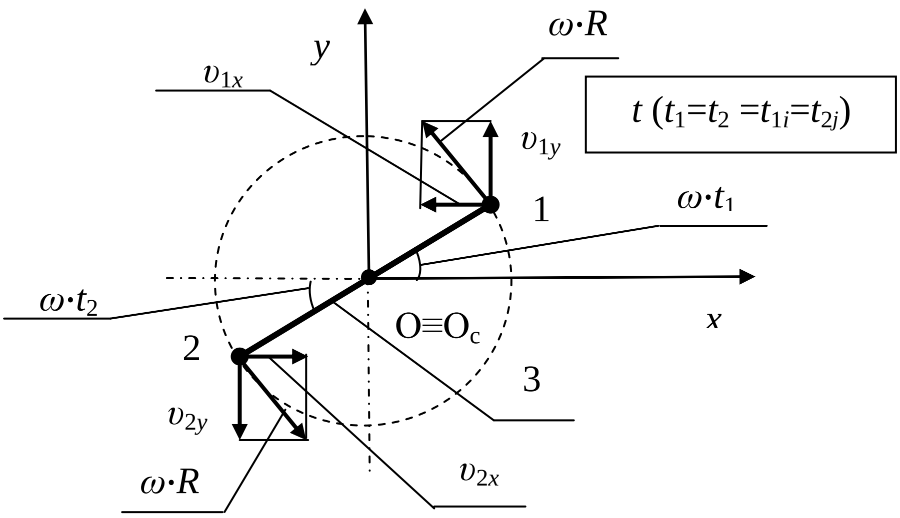

Fig. 2

Also we will admit that at the moment of time reference mark (t=0) in system of readout O*xyz* a bodies 1 and 2 were on axes O*x*, and a body 1 had positive coordinate, and a body 2 – negative.

In system of readout O*xyz*:

- the body 1 has coordinates x_1 and y_1 and projections υ_{1x} and υ_{1y} of speed on axis O*x* and O*y* accordingly depending on time moment t, equal t_1:

$$x_1 = R \cdot \cos(\omega \cdot t_1) \quad (1)$$

$$y_1 = R \cdot \sin(\omega \cdot t_1) \quad (2)$$

$$v_{1x} = -[\omega \cdot R \cdot \sin(\omega \cdot t_1)] \quad (3)$$

$$v_{1y} = [\omega \cdot R \cdot \cos(\omega \cdot t_1)] \quad (4)$$

- the body 2 has coordinates x_2 and y_2 and projections υ_{2x} and υ_{2y} of speed on axis O*x* and O*y* accordingly depending on time moment t, equal t_2:

$$x_2 = -[R \cdot \cos(\omega \cdot t_2)] \quad (5)$$

$$y_2 = -[R \cdot \sin(\omega \cdot t_2)] \quad (6)$$

$$v_{2x} = \omega \cdot R \cdot \sin(\omega \cdot t_2) \quad (7)$$

$$v_{2y} = -[\omega \cdot R \cdot \cos(\omega \cdot t_2)] \quad (8)$$

Let's enter one more inertial systems of readout O'*x*'*y*'z', shown on fig. 3.

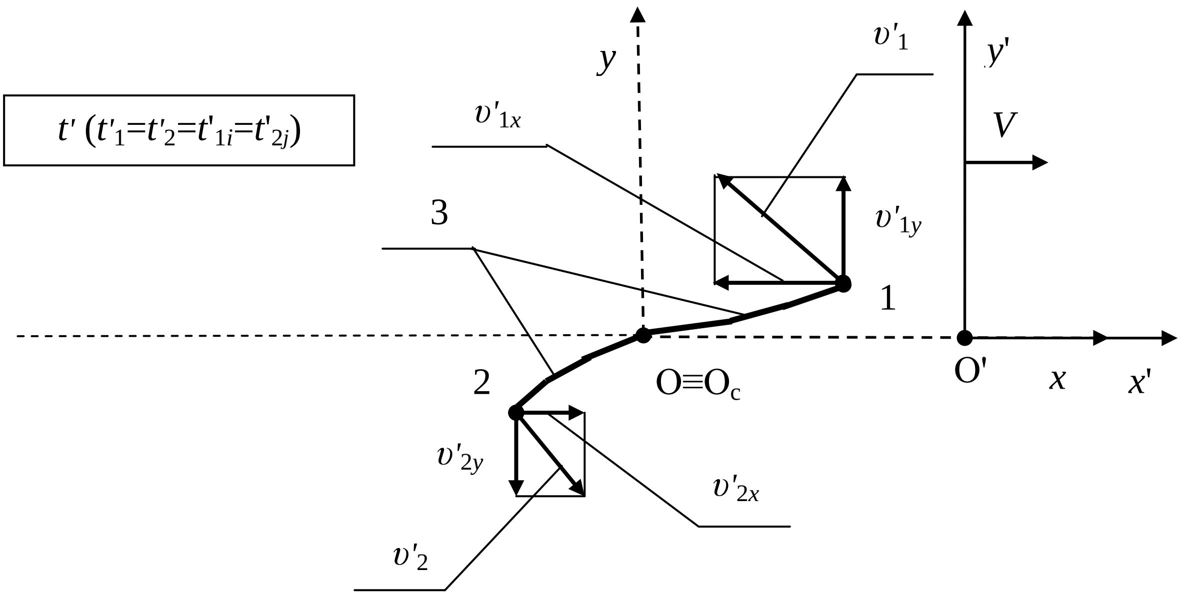

Fig. 3

Let's admit that at inertial systems of readout O*xyz* and O'*x*'*y*'z':

- similar axes of the Cartesian coordinates are in pairs parallel and equally directed;

- system O'*x*'*y*'z' moves concerning system O*xyz* with constant speed *V* along axis O*x*;

- as time reference mark (t=0 and t'=0) in both systems that moment when the beginnings of coordinates O and O' these systems coincided is chosen.

Leaning against Lorentz's transformations and transformations of speeds [1] it is possible to write down:

- communication between coordinates x'_1 and y'_1 of body 1 at the moment of time t', equal t'_1, in system of readout O'*x*'*y*'z' and coordinates x_1 and y_1 of body 1 in system of readout O*xyz* at the moment of time t_1, corresponding to time moment t'_1 in system of readout O'*x*'*y*'z':

$$x'_1 = \frac{x_1 - (V \cdot t_1)}{\sqrt{1 - \frac{V^2}{c^2}}} \qquad (9)$$

$$y'_1 = y_1 \qquad (10)$$

where: c - a constant in Lorentz's transformations (according to assumption

c it is equal to a velocity of light in vacuum),

- communication between time moment t'_1 (event with a body 1) in system of readout O'$x'y'z'$ and time moment t_1 (the same event with a body 1) in system of readout Oxyz, corresponding to time moment t'_1 in system of readout O'$x'y'z'$:

$$t'_1 = \frac{t_1 - \frac{V \cdot x_1}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} = \frac{t_1 - \frac{V \cdot R \cdot \cos(\omega \cdot t_1)}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} \qquad (11)$$

- communication between projections v'_{x1} and v'_{y1} on axis O'x' and O'y' of speed of movement v'_1 of body 1 at the moment of time t'_1 in system of readout O'$x'y'z'$ and projections v_{x1} and v_{y1} on axis Ox and Oy of speed of movement v_1 of body 1 in system of readout Oxyz at the moment of time t_1, corresponding to time moment t'_1 in system of readout O'$x'y'z'$:

$$v'_{x1} = \frac{v_{x1} - V}{1 - \frac{V \cdot v_{x1}}{c^2}} = -\frac{[\omega \cdot R \cdot \sin(\omega \cdot t_1)] + V}{1 + \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_1)}{c^2}} \qquad (12)$$

$$v'_{y1} = \frac{v_{y1} \cdot \sqrt{1 - \frac{V^2}{c^2}}}{1 - \frac{V \cdot v_{x1}}{c^2}} = \frac{\omega \cdot R \cdot \cos(\omega \cdot t_1) \cdot \sqrt{1 - \frac{V^2}{c^2}}}{1 + \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_1)}{c^2}} \qquad (13)$$

and besides:

$$v'^{\,2}_1 = v'^{\,2}_{x1} + v'^{\,2}_{y1} =$$

$$= \frac{\left\{1 + \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_1)}{c^2}\right\}^2 - \left[\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)\right]}{\left\{1 + \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_1)}{c^2}\right\}^2} \cdot c^2 \qquad (14)$$

- communication between coordinates x'_2 and y'_2 of body 2 at the moment of time t', equal t'_2, in system of readout O'$x'y'z'$ and coordinates x_2 and y_2 of body 2 in system of readout Oxyz at the moment of time t_2, corresponding to time moment t'_2 in system of readout O'$x'y'z'$:

$$x'_2 = \frac{x_2 - (V \cdot t_2)}{\sqrt{1 - \frac{V^2}{c^2}}} \qquad (15)$$

$$y'_2 = y_2 \qquad (16)$$

- communication between time moment t'_2 (event with a body 2) in system of readout O'x'y'z' and time moment t_2 (the same event with a body 2) in system of readout Oxyz, corresponding to time moment t'_2 in system of readout O'x'y'z':

$$t'_2 = \frac{t_2 - \frac{V \cdot x_2}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} = \frac{t_2 + \frac{V \cdot R \cdot \cos(\omega \cdot t_2)}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} \qquad (17)$$

- communication between projections v'_{x2} and v'_{y2} on axis O'x' and O'y' of speed of movement v'_2 of body 2 at the moment of time t'_2 in system of readout O'x'y'z' and projections v_{x2} and v_{y2} on axis Ox and Oy of speed of movement v_2 of body 2 in system of readout Oxyz at the moment of time t_2, corresponding to time moment t'_2 in system of readout O'x'y'z':

$$v'_{x2} = \frac{v_{x2} - V}{1 - \frac{V \cdot v_{x2}}{c^2}} = \frac{[\omega \cdot R \cdot \sin(\omega \cdot t_2)] - V}{1 - \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_2)}{c^2}} \qquad (18)$$

$$v'_{y2} = \frac{v_{y2} \cdot \sqrt{1 - \frac{V^2}{c^2}}}{1 - \frac{V \cdot v_{x2}}{c^2}} = - \frac{\omega \cdot R \cdot \cos(\omega \cdot t_2) \cdot \sqrt{1 - \frac{V^2}{c^2}}}{1 - \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_2)}{c^2}} \qquad (19)$$

and besides:

$$v'^{2}_{2} = v'^{2}_{x2} + v'^{2}_{y2} =$$

$$= \frac{\left\{1 - \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_2)}{c^2}\right\}^2 - \left[\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)\right]}{\left\{1 - \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_2)}{c^2}\right\}^2} \cdot c^2 \qquad (20)$$

For consideration a thread 3 at rest we will conditionally divide on 2·n equal parts with placing in the center of each part of a dot body with weight of rest $m_{0\mathrm{n}}$, equal:

$$m_{0\mathrm{n}} = \frac{m_0}{2 \cdot \mathrm{n}} \qquad (21)$$

The points of a thread 3 which are on a piece from point O_c to a body 1, we will designate as i-points (i = 0, 1, 2, 3, … n), and the points of a thread 3 located on a piece from point O_c to a body 2, we will designate as j points (j = 0, 1, 2, 3, … n).

Thus distance R_i from point O_c to i-points of a thread 3 is equal:

$$R_i = R \cdot \left(\frac{1}{2 \cdot n} + \frac{i-1}{n}\right) \qquad (22)$$

And distance R_j from point O_c to j-points of a thread 3 will be defined as:

$$R_j = R \cdot \left(\frac{1}{2 \cdot n} + \frac{j-1}{n}\right) \qquad (23)$$

In system of readout Oxyz:

- i-point of a thread 3 has coordinates x_{1i} and y_{1i} and projections υ_{1xi} and υ_{1yi} of speed on axis Ox and Oy accordingly depending on time moment t, equal t_{1i}:

$$x_{1i} = R_i \cdot \cos(\omega \cdot t_{1i}) \qquad (24)$$

$$y_{1i} = R_i \cdot \sin(\omega \cdot t_{1i}) \qquad (25)$$

$$v_{1xi} = -[\omega \cdot R_i \cdot \sin(\omega \cdot t_{1i})] \qquad (26)$$

$$v_{1yi} = [\omega \cdot R_i \cdot \cos(\omega \cdot t_{1i})] \qquad (27)$$

- j-point of a thread 3 has coordinates x_{2j} and y_{2j} and projections υ_{2xj} and υ_{2yj} of speed on axis Ox and Oy accordingly depending on time moment t, equal t_{2j}:

$$x_{2j} = -R_j \cdot \cos\left(\omega \cdot t_{2j}\right) \qquad (28)$$

$$y_{2j} = -R_j \cdot \sin\left(\omega \cdot t_{2j}\right) \qquad (29)$$

$$v_{2xj} = \omega \cdot R_j \cdot \sin\left(\omega \cdot t_{2j}\right) \qquad (30)$$

$$v_{2yj} = -\left[\omega \cdot R_j \cdot \cos\left(\omega \cdot t_{2j}\right)\right] \qquad (31)$$

Similarly using Lorentz's transformations and transformation of speeds [1] it is possible to write down:

- communication between coordinates x'_{1i} and y'_{1i} of i-point of a thread 3 at the moment of time t', equal t'_{1i}, in system of readout O'$x'y'z'$ and coordinates x_{1i} and y_{1i} of i-point of a thread 3 in system of readout Oxy at the moment of time t_{1i}, corresponding to time moment t'_{1i} in system of readout O'$x'y'$z':

$$x'_{1i} = \frac{x_{1i} - (V \cdot t_{1i})}{\sqrt{1 - \frac{V^2}{c^2}}} \qquad (32)$$

$$y'_{1i} = y_{1i} \qquad (33)$$

- communication between time moment t'_{1i} (event from i-point of a thread

3) in system of readout O'x'y'z' and time moment t_{1i} (the same event from i-point of a thread 3) in system of readout Oxyz, corresponding to time moment t'_{1i} in system of readout O'x'y'z':

$$t'_{1i} = \frac{t_{1i} - \dfrac{V \cdot x_{1i}}{c^2}}{\sqrt{1 - \dfrac{V^2}{c^2}}} = \frac{t_{1i} - \dfrac{V \cdot R_i \cdot \cos(\omega \cdot t_{1i})}{c^2}}{\sqrt{1 - \dfrac{V^2}{c^2}}} \qquad (34)$$

- communication between projections v'_{x1i} and v'_{y1i} on axis O'x' and O'y' of speed of movement v'_{1i} of i-point of a thread 3 at the moment of time t'_{1i} in system of readout O'x'y'z' and projections v_{x1i} and v_{y1i} on axis Ox and Oy of speed of movement v_{1i} of i-point of a thread 3 in system of readout Oxyz at the moment of time t_{1i}, corresponding to time moment t'_{1i} in system of readout O'x'y'z':

$$v'_{x1i} = \frac{v_{x1i} - V}{1 - \dfrac{V \cdot v_{x1i}}{c^2}} = -\frac{[\omega \cdot R_i \cdot \sin(\omega \cdot t_{1i})] + V}{1 + \dfrac{V \cdot \omega \cdot R_i \cdot \sin(\omega \cdot t_{1i})}{c^2}} \qquad (35)$$

$$v'_{y1i} = \frac{v_{y1i} \cdot \sqrt{1 - \dfrac{V^2}{c^2}}}{1 - \dfrac{V \cdot v_{x1i}}{c^2}} = \frac{\omega \cdot R_i \cdot \cos(\omega \cdot t_{1i}) \cdot \sqrt{1 - \dfrac{V^2}{c^2}}}{1 + \dfrac{V \cdot \omega \cdot R_i \cdot \sin(\omega \cdot t_{1i})}{c^2}} \qquad (36)$$

and besides:

$$v'^{\,2}_{1i} = v'^{\,2}_{x1i} + v'^{\,2}_{y1i} =$$

$$= \frac{\left\{1 + \dfrac{V \cdot \omega \cdot R_i \cdot \sin(\omega \cdot t_{1i})}{c^2}\right\}^2 - \left[\left(1 - \dfrac{V^2}{c^2}\right) \cdot \left(1 - \dfrac{\omega^2 \cdot R_i^{\,2}}{c^2}\right)\right]}{\left\{1 + \dfrac{V \cdot \omega \cdot R_i \cdot \sin(\omega \cdot t_{1i})}{c^2}\right\}^2} \cdot c^2 \qquad (37)$$

- communication between coordinates x'_{2j} and y'_{2j} of j-point of a thread 3 at the moment of time t', equal t'_{2j}, in system of readout O'x'y'z' and coordinates x_{2j} and y_{2j} of j-point of a thread 3 in system of readout Oxy at the moment of time t_{2j}, corresponding to time moment t'_{2j} in system of readout O'x'y'z':

$$x'_{2j} = \frac{x_{2j} - (V \cdot t_{2j})}{\sqrt{1 - \dfrac{V^2}{c^2}}} \qquad (38)$$

$$y'_{2j} = y_{2j} \qquad (39)$$

- communication between time moment t'_{2j} (event from j-point of a thread 3) in system of readout O'x'y'z' and time moment t_{2j} (the same event from j-point of a thread 3) in system of readout Oxyz, corresponding to time moment t'_{2j} in system of readout O'x'y'z':

$$t'_{2j} = \frac{t_{2j} - \frac{V \cdot x_{2j}}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} = \frac{t_{2j} + \frac{V \cdot R_j \cdot \cos(\omega \cdot t_{2j})}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} \quad (40)$$

- communication between projections v'_{x2j} and v'_{y2j} on axis O'x' and O'y' of speed of movement v'_{2j} of j-point of a thread 3 at the moment of time t'_{2j} in system of readout O'x'y'z' and projections v_{x2j} and v_{y2j} on axis Ox and Oy of speed of movement v_{2j} of j-point of a thread 3 in system of readout Oxyz at the moment of time t_{2j}, corresponding to time moment t'_{2j} in system of readout O'x'y'z':

$$v'_{x2j} = \frac{v_{x2j} - V}{1 - \frac{V \cdot v_{x2j}}{c^2}} = \frac{[\omega \cdot R_j \cdot \sin(\omega \cdot t_{2j})] - V}{1 - \frac{V \cdot \omega \cdot R_j \cdot \sin(\omega \cdot t_{2j})}{c^2}} \quad (41)$$

$$v'_{y2j} = \frac{v_{y2j} \cdot \sqrt{1 - \frac{V^2}{c^2}}}{1 - \frac{V \cdot v_{x2j}}{c^2}} = - \frac{\omega \cdot R_j \cdot \cos(\omega \cdot t_{2j}) \cdot \sqrt{1 - \frac{V^2}{c^2}}}{1 - \frac{V \cdot \omega \cdot R_j \cdot \sin(\omega \cdot t_{2j})}{c^2}} \quad (42)$$

and besides:

$$v'^{\,2}_{2j} = v'^{\,2}_{x2j} + v'^{\,2}_{y2j} =$$

$$= \frac{\left\{1 - \frac{V \cdot \omega \cdot R_j \cdot \sin(\omega \cdot t_{2j})}{c^2}\right\}^2 - \left[\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R_j^{\,2}}{c^2}\right)\right]}{\left\{1 - \frac{V \cdot \omega \cdot R_j \cdot \sin(\omega \cdot t_{2j})}{c^2}\right\}^2} \cdot c^2 \quad (43)$$

3. Reception of the equations of an impulse and kinetic energy of system

Using dependences of an impulse and kinetic energy of a moving body on its speed of movement [1], we can write down following formulas:

- formulas for impulse P'_1 of body 1 and its projections P'_{x1} and P'_{y1} on axis O'x' and O'y' in system of readout O'x'y'z' at the moment of time t'_1, corresponding to time moment t_1 in system of readout Oxyz (using formulas (12)

- (14)):

$$P'_{x1} = \frac{v'_{x1} \cdot M_0}{\sqrt{1 - \frac{{v'_1}^2}{c^2}}} = -\frac{M_0 \cdot \{[\omega \cdot R \cdot \sin(\omega \cdot t_1)] + V\}}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \qquad (44)$$

$$P'_{y1} = \frac{v'_{y1} \cdot M_0}{\sqrt{1 - \frac{{v'_1}^2}{c^2}}} = \frac{M_0 \cdot \omega \cdot R \cdot \cos(\omega \cdot t_1)}{\sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \qquad (45)$$

$$P'_1 = \frac{v'_1 \cdot M_0}{\sqrt{1 - \frac{{v'_1}^2}{c^2}}} = M_0 \cdot c \cdot \sqrt{\frac{\left\{1 + \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_1)}{c^2}\right\}^2}{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)} - 1} \qquad (46)$$

- formula for kinetic energy E'_1 of body 1 in system of readout O'$x'y'z'$ at the moment of time t'_1, corresponding to time moment t_1 in system of readout Oxyz (using the formula (14)):

$$E'_1 = M_0 \cdot c^2 \cdot \left(\frac{1}{\sqrt{1 - \frac{{v'_1}^2}{c^2}}} - 1 \right) =$$

$$= M_0 \cdot c^2 \cdot \left\{ \frac{\left[1 + \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_1)}{c^2}\right]}{\sqrt{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)}} - 1 \right\} \qquad (47)$$

- formulas for impulse P'_2 of body 2 and its projections P'_{x2} and P'_{y2} on axis O'x' and O'y' in system of readout O'$x'y'z'$ at the moment of time t'_2, corresponding to time moment t_2 in system of readout Oxyz (using formulas (18) - (20)):

$$P'_{x2} = \frac{v'_{x2} \cdot M_0}{\sqrt{1 - \frac{{v'_2}^2}{c^2}}} = \frac{M_0 \cdot \{[\omega \cdot R \cdot \sin(\omega \cdot t_2)] - V\}}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \qquad (48)$$

$$P'_{y2} = \frac{v'_{y2} \cdot M_0}{\sqrt{1 - \frac{{v'_2}^2}{c^2}}} = -\frac{M_0 \cdot \omega \cdot R \cdot \cos(\omega \cdot t_2)}{\sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \qquad (49)$$

$$P'_2 = \frac{v'_2 \cdot M_0}{\sqrt{1 - \frac{{v'_2}^2}{c^2}}} = M_0 \cdot c \cdot \sqrt{\frac{\left\{1 - \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_2)}{c^2}\right\}^2}{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)} - 1} \qquad (50)$$

- formula for kinetic energy E'_2 of body 2 in system of readout O'$x'y'z'$ at the moment of time t'_2, corresponding to time moment t_2 in system of readout Oxyz (using the formula (20)):

$$E'_2 = M_0 \cdot c^2 \cdot \left(\frac{1}{\sqrt{1 - \frac{{v'_2}^2}{c^2}}} - 1\right) =$$

$$= M_0 \cdot c^2 \cdot \left\{\frac{\left[1 - \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_2)}{c^2}\right]}{\sqrt{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)}} - 1\right\} \qquad (51)$$

- formulas for impulse P'_{1i} of i-point of a thread 3 and its projections P'_{x1i} and P'_{y1i} on axis O'x' and O'y' in system of readout O'$x'y'z'$ at the moment of time t'_{1i}, corresponding to time moment t_{1i} in system of readout Oxyz (using formulas (35) - (37)):

$$P'_{x1i} = \frac{v'_{x1i} \cdot m_{0n}}{\sqrt{1 - \frac{{v'_{1i}}^2}{c^2}}} = -\frac{m_{0n} \cdot \{[\omega \cdot R_i \cdot \sin(\omega \cdot t_{1i})] + V\}}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot {R_i}^2}{c^2}}} \qquad (52)$$

$$P'_{y1i} = \frac{v'_{y1i} \cdot m_{0n}}{\sqrt{1 - \frac{{v'_{1i}}^2}{c^2}}} = \frac{m_{0n} \cdot \omega \cdot R_i \cdot \cos(\omega \cdot t_{1i})}{\sqrt{1 - \frac{\omega^2 \cdot {R_i}^2}{c^2}}} \qquad (53)$$

$$P'_{1i} = \frac{v'_{1i} \cdot m_{0n}}{\sqrt{1 - \frac{{v'_{1i}}^2}{c^2}}} = m_{0n} \cdot c \cdot \sqrt{\frac{\left\{1 + \frac{V \cdot \omega R_i \cdot \sin(\omega \cdot t_{1i})}{c^2}\right\}^2}{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot {R_i}^2}{c^2}\right)} - 1} \qquad (54)$$

- formula for kinetic energy E'_{1i} of i-point of a thread 3 in system of readout O'$x'y'z'$ at the moment of time t'_{1i}, corresponding to time moment t_{1i} in system of readout Oxyz (using the formula (37)):

$$E'_{1i} = m_{0n} \cdot c^2 \cdot \left(\frac{1}{\sqrt{1 - \frac{{v'_{1i}}^2}{c^2}}} - 1 \right) =$$

$$= m_{0n} \cdot c^2 \cdot \left\{ \frac{\left[1 + \frac{V \cdot \omega \cdot R_i \cdot \sin(\omega \cdot t_{1i})}{c^2} \right]}{\sqrt{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot {R_i}^2}{c^2}\right)}} - 1 \right\} \qquad (55)$$

- formulas for impulse P'_{2j} of j-point of a thread 3 and its projections P'_{x2j} and P'_{y2j} on axis O'x' and O'y' in system of readout O'x'y'z' at the moment of time t'_{2j}, corresponding to time moment t_{2j} in system of readout Oxyz (using formulas (41) - (43)):

$$P'_{x2j} = \frac{v'_{x2j} \cdot m_{0n}}{\sqrt{1 - \frac{{v'_{2j}}^2}{c^2}}} = \frac{m_{0n} \cdot \{[\omega \cdot R_j \cdot \sin(\omega \cdot t_{2j})] - V\}}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot {R_j}^2}{c^2}}} \qquad (56)$$

$$P'_{y2j} = \frac{v'_{y2j} \cdot m_{0n}}{\sqrt{1 - \frac{{v'_{2j}}^2}{c^2}}} = -\frac{m_{0n} \cdot \omega \cdot R_j \cdot \cos(\omega \cdot t_{2j})}{\sqrt{1 - \frac{\omega^2 \cdot {R_j}^2}{c^2}}} \qquad (57)$$

$$P'_{2j} = \frac{v'_{2j} \cdot m_{0n}}{\sqrt{1 - \frac{{v'_{2j}}^2}{c^2}}} = m_{0n} \cdot c \cdot \sqrt{\frac{\left\{1 - \frac{V \cdot \omega \cdot R_j \cdot \sin(\omega \cdot t_{2j})}{c^2}\right\}^2}{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot {R_j}^2}{c^2}\right)} - 1} \qquad (58)$$

- formula for kinetic energy E'_{2j} of j-point of a thread 3 in system of readout O'x'y'z' at the moment of time t'_{2j}, corresponding to time moment t_{2j} in system of readout Oxyz (using the formula (43)):

$$E'_{2j} = m_{0n} \cdot c^2 \cdot \left(\frac{1}{\sqrt{1 - \frac{{v'_{2j}}^2}{c^2}}} - 1 \right) =$$

$$= m_{0n} \cdot c^2 \cdot \left\{ \frac{\left[1 - \frac{V \cdot \omega \cdot R_j \cdot \sin(\omega \cdot t_{2j})}{c^2} \right]}{\sqrt{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot {R_j}^2}{c^2}\right)}} - 1 \right\} \qquad (59)$$

For definition of sizes of an impulse and kinetic energy of system of bodies 1 and 2 and thread 3 in system of readout O'*x*'*y*'z' at the moment of time *t*' it is necessary, that time moments t'_1, t'_2, t'_{1i}, and t'_{2j} (formulas (11), (17), (34) and (40)) were equal among themselves and equal *t*', i.e.:

$$t' = t'_1 = t'_2 = t'_{1i} = t'_{2j} = \frac{t_1 - \frac{V \cdot R \cdot \cos(\omega \cdot t_1)}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} =$$

$$= \frac{t_2 + \frac{V \cdot R \cdot \cos(\omega \cdot t_2)}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} = \frac{t_{1i} - \frac{V \cdot R_i \cdot \cos(\omega \cdot t_{1i})}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} =$$

$$= \frac{t_{2j} + \frac{V \cdot R_j \cdot \cos(\omega \cdot t_{2j})}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} \qquad (60)$$

Considering that the system of readout O'*x*'*y*'z' is inertial, it is possible to write down following formulas for kinetic energy *E*' and projections P'_x and P'_y on axis O'*x*' and O'*y*' of impulse *P*' of the closed mechanical system consisting of bodies 1 and 2 and thread 3, for time moment *t*' in system of readout O'*x*'*y*'z':

$$P'_x = P'_{x1} + P'_{x2} + \sum_{1}^{i=n} P'_{x1i} + \sum_{1}^{j=n} P'_{x2j} \qquad (61)$$

$$P'_y = P'_{y1} + P'_{y2} + \sum_{1}^{i=n} P'_{y1i} + \sum_{1}^{j=n} P'_{y2j} \qquad (62)$$

$$P' = \sqrt{{P'_x}^2 + {P'_y}^2} \qquad (63)$$

$$E' = E'_1 + E'_2 + \sum_{1}^{i=n} E'_{1i} + \sum_{1}^{j=n} E'_{2j} \qquad (64)$$

4. The results of the calculation of the numerical example

For reception of the evident image of dependence of impulse *P*' and kinetic energy *E*' of the closed mechanical system consisting of bodies 1 and 2 and thread 3, from time *t*' in inertial system of readout O'*x*'*y*'*z*' it is possible to consider a numerical example, having entered the following any way chosen initial data:

$$\frac{V}{c} = 0{,}9 \qquad (65)$$

$$\frac{\omega \cdot R}{c} = 0{,}8 \qquad (66)$$

$$\frac{m_0}{M_0} = 0{,}1 \qquad (67)$$

$$n = 10 \qquad (68)$$

Calculation can be spent under the following scheme:

- setting values of the moment of time *t*' (we will admit that *t*' has values: -2*R*/*c*, -*R*/*c*, 0, *R*/*c* … 21*R*/*c*) and using the formula (60), we define values of the moments of time t_1, t_2, t_{1i} and t_{2j};

- further we define values of kinetic energy E'_1 and projections P'_{x1} and P'_{y1} impulse P'_1 of body 1 (formulas (44), (45) and (47)), kinetic energy E'_2 and projections P'_{x2} and P'_{y2} of impulse P'_2 of body 2 (formulas (48), (49) and (51)), kinetic energies E'_{1i} and projections P'_{x1i} and P'_{y1i} of impulses P'_{1i} of *i*-points of a thread 3 (formulas (52), (53) and (55)), kinetic energies E'_{2j} and projections P'_{x2j} and P'_{y2j} of impulses P'_{2j} of *j*-points of a thread 3 (formulas (56), (57) and (59)) for the various moments of time *t*' in inertial system of readout O'*x*'*y*'*z*';

- then for the various moments of time *t*' in inertial system of readout O'*x*'*y*'*z*' we define values of kinetic energy *E*' (the formula (64)), projections P'_x

and P'_y of impulse P' of system of bodies 1 and 2 and thread 3 (formulas (61) and (62)), absolute size $|P'|$ of impulse P', using the formula (63), and also values of a corner α' between a direction of a vector of impulse P' and axis O'x', defined under the formula:

$$\alpha' = arctg\left(\frac{P'_y}{P'_x}\right) \qquad (69)$$

Results of calculation are resulted in schedules:

- the schedule of dependence of absolute size $|P'|$ of impulse P' of system of bodies 1 and 2 and thread 3 from time size t' (with the account and without weight of a thread 3), represented on fig. 4;

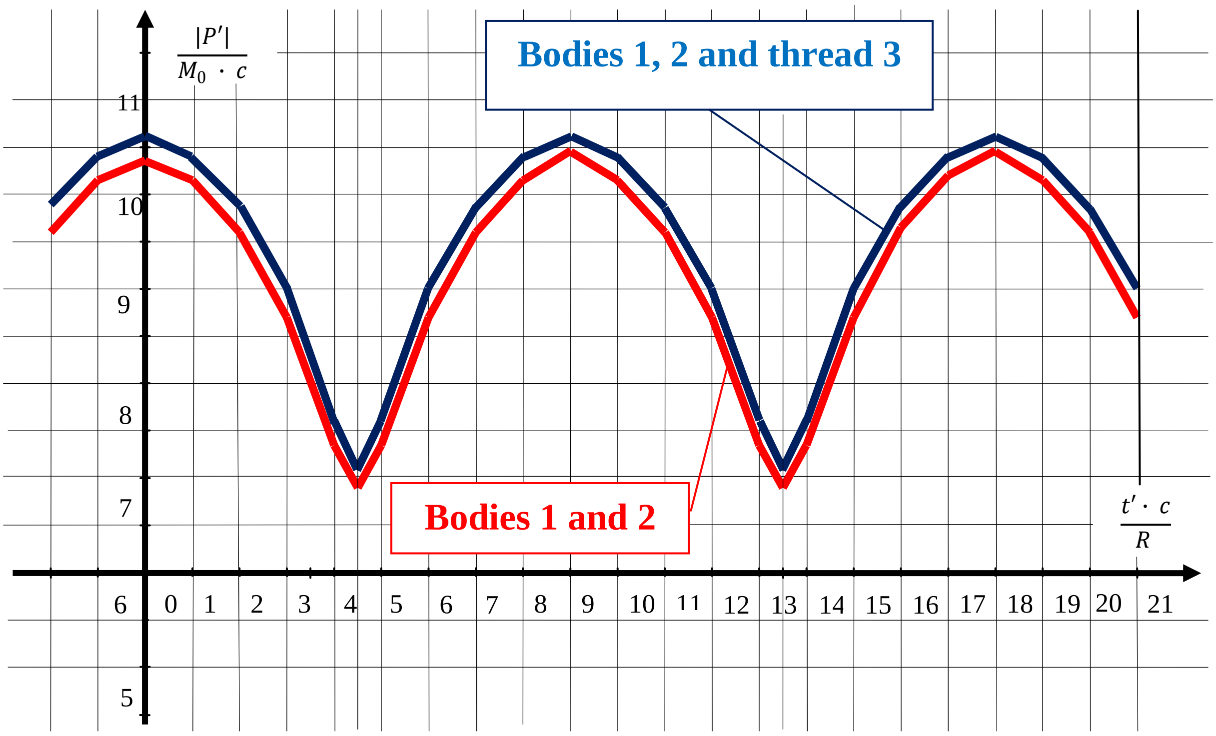

Fig. 4

- the schedule of dependence of size of a corner α' between a direction of a vector of impulse P' of system of bodies 1 and 2 and thread 3 and axis O'x' from time size t' (with the account and without weight of a thread 3), represented on fig. 5;

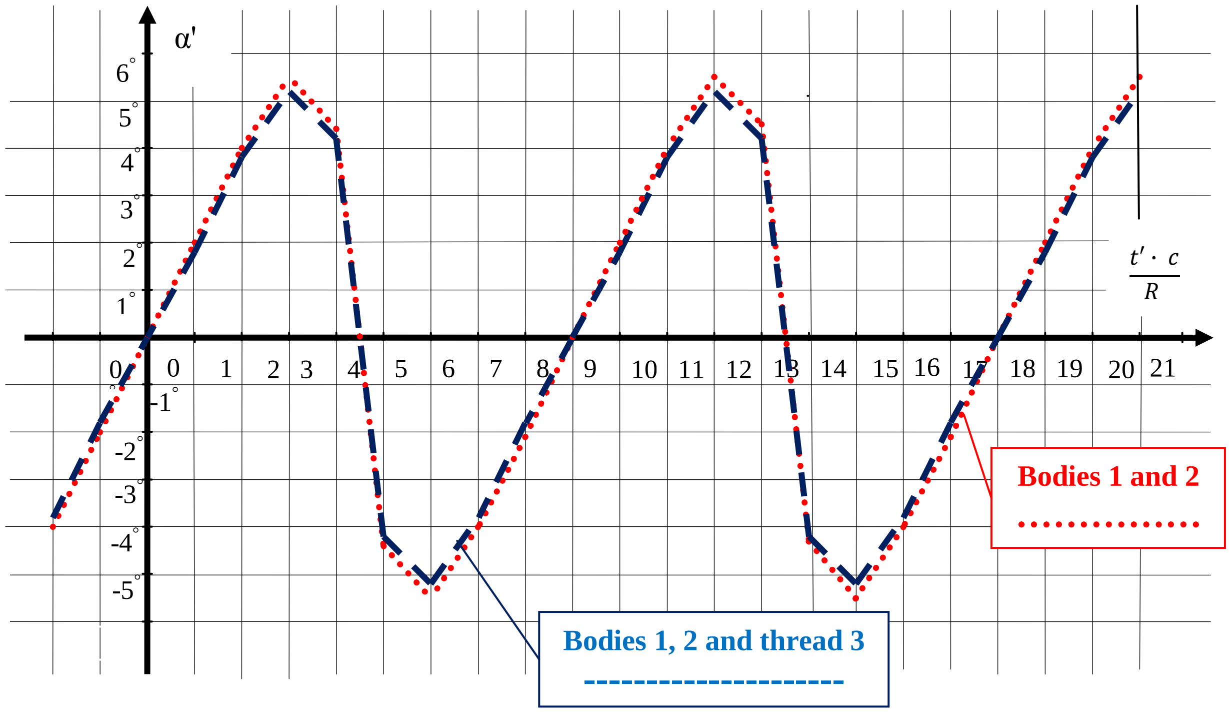

Рис.5

- the schedule of dependence of kinetic energy *E*' of system of bodies 1 and 2 and thread 3 from time size *t*' (with the account and without weight of a thread 3), represented on fig. 6;

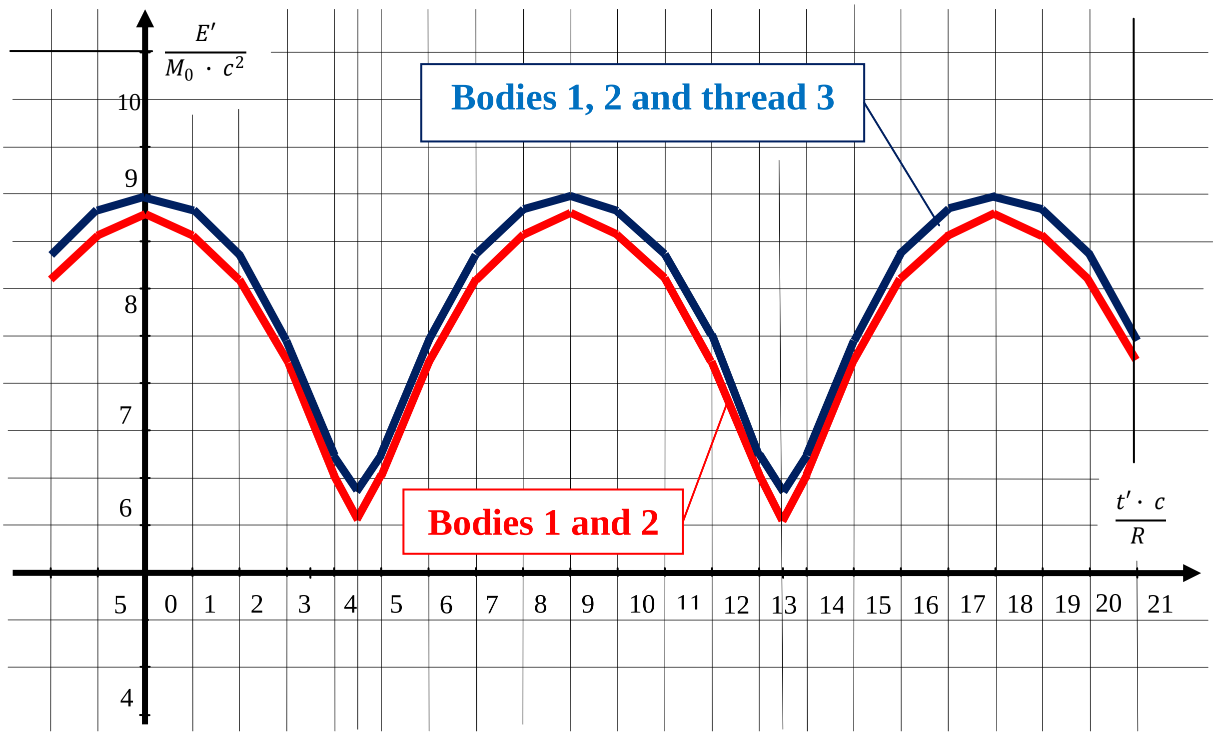

Fig. 6

In article [2] doctor Michael H. Brill dependences of kinetic energy *E*' and projections of impulse *P*' on an axis of coordinates *x* and *y* systems of bodies 1 and 2 from time size *t*' are represented.

As a result of calculation it has been received that use of the special theory of relativity leads to that in inertial system of readout O'*x*'*y*'*z*' the closed mechanical system of bodies 1 and 2 and thread 3 has variable in time *t*' on absolute size and a direction a vector of impulse *P*' and variable in time *t*' value of kinetic energy *E*' (i.e. kinetic energy *E*' and impulse *P*' this closed system are time functions of time *t*') that contradicts the law of preservation of an impulse and the law of conservation of energy (if the assumption is true that if in one inertial system of readout at the closed mechanical system and its components do not occur change of size of potential energy and in any other inertial system of readout at the same closed mechanical system and its components will not occur change of size of potential energy).

As a result it is possible to draw a conclusion that in inertial system of readout O'*x*'*y*'*z*' application of the special theory of relativity at the description of movement of the closed mechanical system of the bodies considered in the given example, leads to default of the law of preservation of an impulse and the law of conservation of energy (since in the closed mechanical system there is a change of size of kinetic energy without change of size of potential energy).

5. Conclusion

In summary it is possible to notice that use of the special theory of relativity by consideration of separate examples can lead to default of laws of preservation of an impulse and energy of the closed mechanical system in inertial systems of readout.

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