The special theory of relativity:
conditions of performance of laws of preservation
impulse and energy

Kochetkov Victor Nikolayevich
chief specialist FSUE “Center for
exploitation of space ground-based
infrastructure facilities” (FSUE “TSENKI”)

vnkochetkov@gmail.com
vnkochetkov@rambler.ru
http://www.matphysics.ru

In article attempt to show becomes that use of laws of preservation of an impulse and energy of the closed mechanical system presumes to check up justice of the special theory of relativity theoretically.

PACS number: **03.30.+p**

The maintenance

1. Introduction (2).

2. The description of the closed mechanical system of bodies (2).

3. Reception of the equations of an impulse and kinetic energy of system (7).

4. Time moment t'_p (9).

5. Time moment t'_h (11).

6. Check of performance of the law of preservation of an impulse (14).

7. Check of performance of the law of conservation of energy (17).

8. The conclusion (18).

The list of references (18).

1. Introduction

As shown in [1] on an example of the closed mechanical system of the bodies which interaction has constant character, application of the special theory of relativity can lead to that in inertial system of readout the impulse and energy of the closed mechanical system become variables on time in sizes.

For the purpose of definition of conditions at which at use of the special theory of relativity laws of preservation of an impulse and energy will be carried out, it is offered:

- to consider the closed mechanical system of the bodies which interaction will have constant character;
- to choose two inertial systems of readout mobile and motionless concerning the center of weights of this closed system of bodies;
- to choose two moments of time in mobile system of readout;
- by means of Lorentz's transformation and transformation of speeds to define coordinates position of bodies of this closed system and their speed during the chosen moments of time in mobile system of readout;
- to define values of impulses and kinetic energy of bodies during the chosen moments of time in mobile system of readout, using dependences of an impulse and kinetic energy of a body on speed;
- to write down laws of preservation of an impulse and energy for this closed system of bodies for two chosen moments of time in mobile system of readout and to define conditions of their performance.

2. The description of the 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.

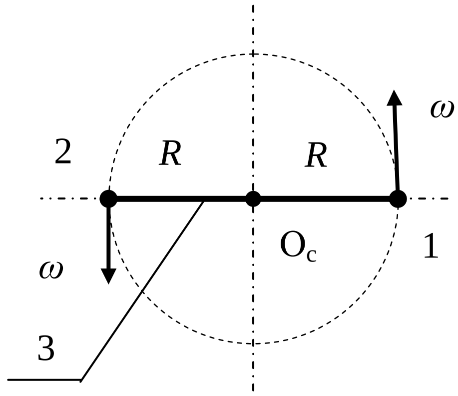

Fig. 1

Bodies 1 and 2 are connected by a thread 3 which weight because of its small size can be neglected.

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.

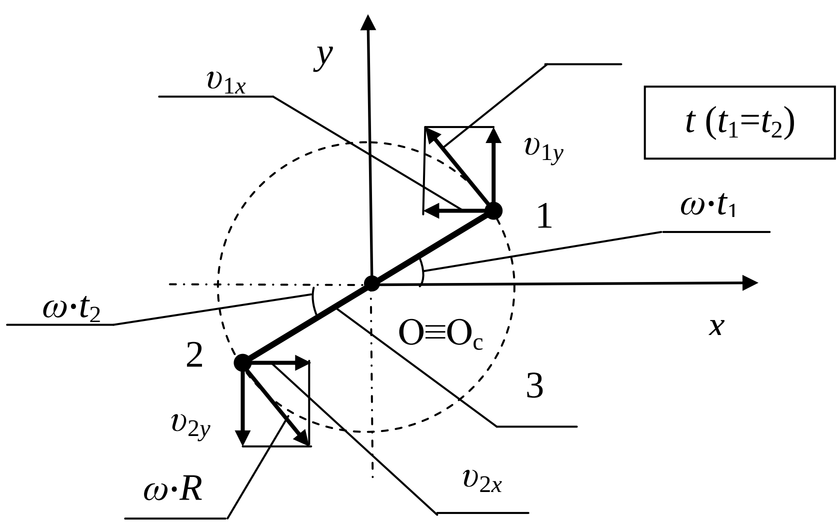

Fig. 2

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

In system of readout Oxyz:

- the body 1 has coordinates x_1 and y_1 and projections υ_{1x} and υ_{1y} of speed on axis Ox and Oy 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 Ox and Oy 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.

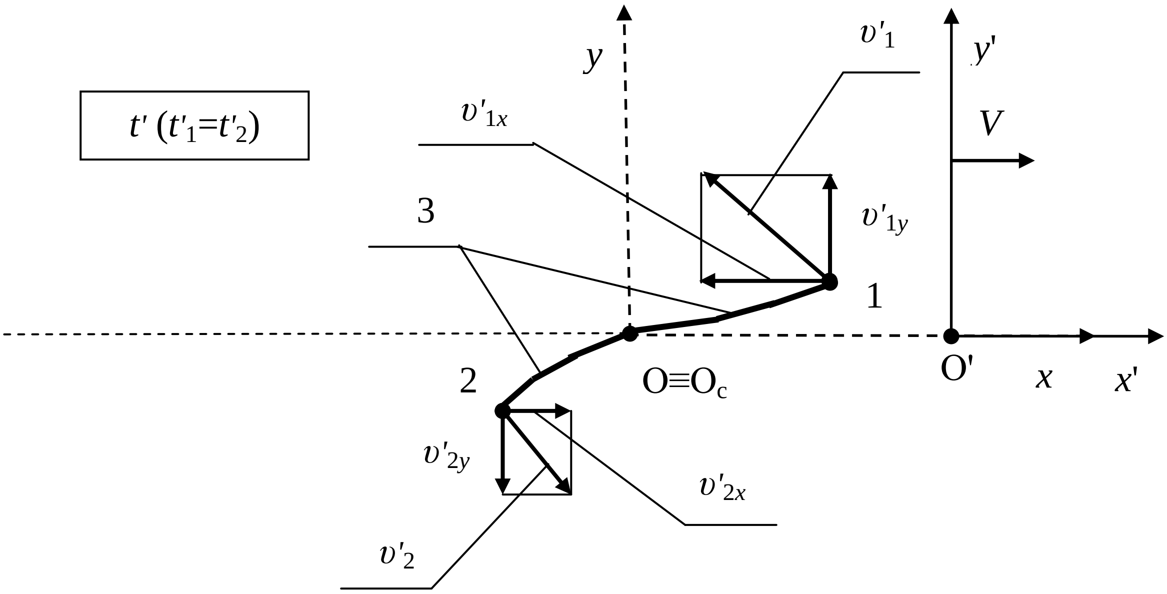

Fig. 3

Let's admit that at inertial systems of readout Oxyz 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 Oxyz with constant speed V along axis Ox;

- 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 [2] 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 Oxyz 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 the 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':

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

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

and besides:

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

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

- 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':

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

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

- 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':

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

- 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':

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

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

and besides:

$$v'^2_2 = v'^2_{x2} + v'^2_{y2} =$$
$$= \frac{\left\{1 - \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_2)}{c^2}\right\}^2 - \left[\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)\right]}{\left\{1 - \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_2)}{c^2}\right\}^2} \cdot c^2 \quad (20)$$

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

Knowing dependences of an impulse and kinetic energy of a moving body on its speed of movement [2] and using formulas (12) - (14) and (18-20), 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 O*xyz*:

$$P'_{x1} = \frac{v'_{x1} \cdot M_0}{\sqrt{1 - \frac{v'^2_1}{c^2}}} = -\frac{M_0 \cdot \{[\omega \cdot R \cdot \sin(\omega \cdot t_1)] + V\}}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \quad (21)$$

$$P'_{y1} = \frac{v'_{y1} \cdot M_0}{\sqrt{1 - \frac{v'^2_1}{c^2}}} = \frac{M_0 \cdot \omega \cdot R \cdot \cos(\omega \cdot t_1)}{\sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \quad (22)$$

$$P'^2_1 = \left(\frac{v'_1 \cdot M_0}{\sqrt{1 - \frac{v'^2_1}{c^2}}}\right)^2 = M_0^2 \cdot c^2 \cdot \left[\frac{\left\{1 + \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_1)}{c^2}\right\}^2}{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)} - 1\right] \quad (23)$$

- 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 O*xyz*:

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

$$= M_0 \cdot c^2 \cdot \left\{ \frac{\left[1 + \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_1)}{c^2} \right]}{\sqrt{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)}} - 1 \right\} \qquad (24)$$

- 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:

$$P'_{x2} = \frac{v'_{x2} \cdot M_0}{\sqrt{1 - \frac{{v'_2}^2}{c^2}}} = \frac{M_0 \cdot \{[\omega \cdot R \cdot \sin(\omega \cdot t_2)] - V\}}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \qquad (25)$$

$$P'_{y2} = \frac{v'_{y2} \cdot M_0}{\sqrt{1 - \frac{{v'_2}^2}{c^2}}} = - \frac{M_0 \cdot \omega \cdot R \cdot \cos(\omega \cdot t_2)}{\sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \qquad (26)$$

$${P'_2}^2 = \left(\frac{v'_2 \cdot M_0}{\sqrt{1 - \frac{{v'_2}^2}{c^2}}} \right)^2 = {M_0}^2 \cdot c^2 \cdot \left[\frac{\left\{ 1 - \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_2)}{c^2} \right\}^2}{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)} - \right] 1 \qquad (27)$$

- 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:

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

$$= M_0 \cdot c^2 \cdot \left\{ \frac{\left[1 - \frac{V \cdot \omega \cdot R \cdot \sin(\omega \cdot t_2)}{c^2} \right]}{\sqrt{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)}} - 1 \right\} \qquad (28)$$

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

$$t' = t'_1 = t'_2 = \frac{t_1 - \frac{V \cdot R \cdot \cos(\omega \cdot t_1)}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} = \frac{t_2 + \frac{V \cdot R \cdot \cos(\omega \cdot t_2)}{c^2}}{\sqrt{1 - \frac{V^2}{c^2}}} \quad (29)$$

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 threads 3), for time moment t' in system of readout O'$x'y'z'$:

$$P'_x = P'_{x1} + P'_{x2} \quad (30)$$

$$P'_y = P'_{y1} + P'_{y2} \quad (31)$$

$$P'^2 = P'^2_x + P'^2_y \quad (32)$$

$$E' = E'_1 + E'_2 \quad (33)$$

4. Time moment t'_p

In inertial system of readout O'$x'y'z'$ as the first moment of time it is possible to choose the moment of time t', equal t'_p.

Let's admit that to position of a body 1 in inertial system of readout O'$x'y'z'$ at the moment of time t'_1, equal t'_p, there will correspond position of a body 1 in system of readout Oxyz at the moment of time t_1, equal t_{1p}:

$$t_{1p} = \frac{\pi}{2 \cdot \omega} \quad (34)$$

Then to position of a body 2 in inertial system of readout O'$x'y'z'$ at the moment of time t'_2, equal t'_p, there will correspond position of a body 2 in system of readout Oxyz at the moment of time t_2, equal t_{2p}.

The size of the moment of time t_{2p} can be defined from the equation (29):

$$t_{1p} - \frac{V \cdot R \cdot \cos(\omega \cdot t_{1p})}{c^2} = t_{2p} + \frac{V \cdot R \cdot \cos(\omega \cdot t_{2p})}{c^2} \quad (35)$$

Taking into account the equation (34) formula (35) will become:

$$\frac{c^2 \cdot \left[\frac{\pi}{2} - (\omega \cdot t_{2p})\right]}{V \cdot R \cdot \omega} = \cos(\omega \cdot t_{2p}) \quad (36)$$

Using a graphic method of the decision of the equations [3], it is possible to receive that in the equation (36) moment of time t_{2p} is equal:

$$t_{2\mathrm{p}} = \frac{\pi}{2 \cdot \omega} \tag{37}$$

I.e., proceeding from formulas (34) and (37) in inertial system of readout O'x'y'z' at the moment of time t'_{p} a bodies 1 and 2 will be on a line parallel to axis O'y'.

Using formulas (34), (37), (12) - (14) and (18) - (20) it is possible to write down values of projections $v'_{x1\mathrm{p}}$ and $v'_{y1\mathrm{p}}$ of speed of movement $v'_{1\mathrm{p}}$ of body 1 and projections $v'_{x2\mathrm{p}}$ and $v'_{y2\mathrm{p}}$ of speed of movement $v'_{2\mathrm{p}}$ of body 2 at the moment of time t'_{p} in system of readout O'x'y'z':

$$v'_{x1\mathrm{p}} = -\frac{V + (\omega \cdot R)}{1 + \dfrac{V \cdot \omega \cdot R}{c^2}} \tag{38}$$

$$v'_{y1\mathrm{p}} = 0 \tag{39}$$

$$v'^{\,2}_{1\mathrm{p}} = \left[\frac{V + (\omega \cdot R)}{1 + \dfrac{V \cdot \omega \cdot R}{c^2}}\right]^2 \tag{40}$$

$$v'_{x2\mathrm{p}} = \frac{\omega \cdot R - V}{1 - \dfrac{V \cdot \omega \cdot R}{c^2}} \tag{41}$$

$$v'_{y2\mathrm{p}} = 0 \tag{42}$$

$$v'^{\,2}_{2\mathrm{p}} = \left[\frac{\omega \cdot R - V}{1 - \dfrac{V \cdot \omega \cdot R}{c^2}}\right]^2 \tag{43}$$

Having inserted formulas (34), (37) in the equations (21) - (23) and (25) - (27) we will receive values of projections $P'_{x1\mathrm{p}}$ and $P'_{y1\mathrm{p}}$ of impulse $P'_{1\mathrm{p}}$ of body 1 and projections $P'_{x2\mathrm{p}}$ and $P'_{y2\mathrm{p}}$ of impulse $P'_{2\mathrm{p}}$ of body 2 at the moment of time t'_{p} in system of readout O'x'y'z':

$$P'_{x1\mathrm{p}} = -\frac{M_0 \cdot \{V + [\omega \cdot R]\}}{\sqrt{1 - \dfrac{V^2}{c^2}} \cdot \sqrt{1 - \dfrac{\omega^2 \cdot R^2}{c^2}}} \tag{44}$$

$$P'_{y1\mathrm{p}} = 0 \tag{45}$$

$$P'_{1\mathrm{p}}{}^{2} = M_0{}^2 \cdot c^2 \cdot \left[\frac{\left\{1 + \frac{V \cdot \omega \cdot R}{c^2}\right\}^2}{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)} - 1 \right] \quad (46)$$

$$P'_{x2\mathrm{p}} = \frac{M_0 \cdot \{[\omega \cdot R] - V\}}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \quad (47)$$

$$P'_{y2\mathrm{p}} = 0 \quad (48)$$

$$P'_{2\mathrm{p}}{}^{2} = M_0{}^2 \cdot c^2 \cdot \left[\frac{\left\{1 - \frac{V \cdot \omega \cdot R}{c^2}\right\}^2}{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)} - 1 \right] \quad (49)$$

And having inserted formulas (34), (37) in the equations (24) and (28) it is possible to receive values of kinetic energy $E'_{1\mathrm{p}}$ of body 1 and kinetic energy $E'_{2\mathrm{p}}$ of body 2 at the moment of time t'_{p} in system of readout O'*x*'*y*'*z*':

$$E'_{1\mathrm{p}} = M_0 \cdot c^2 \cdot \left\{ \frac{\left[1 + \frac{V \cdot \omega \cdot R}{c^2}\right]}{\sqrt{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)}} - 1 \right\} \quad (50)$$

$$E'_{2\mathrm{p}} = M_0 \cdot c^2 \cdot \left\{ \frac{\left[1 - \frac{V \cdot \omega \cdot R}{c^2}\right]}{\sqrt{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)}} - 1 \right\} \quad (51)$$

5. Time moment t'_{h}

In inertial system of readout O'*x*'*y*'*z*' as the second moment of time it is possible to choose the moment of time *t*', equal t'_{h}.

Let's admit that to position of a body 1 in inertial system of readout O'*x*'*y*'*z*' at the moment of time t'_1, equal t'_{h}, there will correspond position of a body 1 in system of readout O*xyz* at the moment of time t_1, equal $t_{1\mathrm{h}}$:

$$t_{1\mathrm{h}} = 0 \quad (52)$$

Then to position of a body 2 in inertial system of readout O'*x*'*y*'*z*' at the moment of time t'_2, equal t'_{h}, there will correspond position of a body 2 in system of readout O*xyz* at the moment of time t_2, equal $t_{2\mathrm{h}}$.

The size of the moment of time $t_{2\mathrm{h}}$ can be defined from the equation (29):

$$\frac{c^2 \cdot \omega \cdot t_{2\mathrm{h}}}{V \cdot R \cdot \omega} = -1 - \cos(\omega \cdot t_{2\mathrm{h}}) \qquad (53)$$

Apparently from the equation (53), value of the moment of time $t_{2\mathrm{h}}$ should be less than 0.

I.e., proceeding from formulas (52) and (53) in inertial system of readout O'x'y'z' at the moment of time t'_{h} a body 1 will be on axis O'x', and the body 2 on axis O'x' cannot be.

Using formulas (52) and (12) - (14) it is possible to receive values of projections $v'_{x1\mathrm{h}}$ and $v'_{y1\mathrm{h}}$ of speed of movement $v'_{1\mathrm{h}}$ of body 1 at the moment of time t'_{h} in system of readout O'x'y'z':

$$v'_{x1\mathrm{h}} = -V \qquad (54)$$

$$v'_{y1\mathrm{h}} = \omega \cdot R \cdot \sqrt{1 - \frac{V^2}{c^2}} \qquad (55)$$

$$v'^{\,2}_{1\mathrm{h}} = \left\{1 - \left[\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)\right]\right\} \cdot c^2 \qquad (56)$$

Having inserted the formula (52) into the equations (21) - (23) it is possible to write down values of projections $P'_{x1\mathrm{h}}$ and $P'_{y1\mathrm{h}}$ of impulse $P'_{1\mathrm{h}}$ of body 1 at the moment of time t'_{h} in system of readout O'x'y'z':

$$P'_{x1\mathrm{h}} = -\frac{M_0 \cdot V}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \qquad (57)$$

$$P'_{y1\mathrm{h}} = \frac{M_0 \cdot \omega \cdot R}{\sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \qquad (58)$$

$$P'^{\,2}_{1\mathrm{h}} = M_0^{\,2} \cdot c^2 \cdot \left[\frac{1}{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)} - 1\right] \qquad (59)$$

Having inserted the formula (52) into the equation (24) we will receive value of kinetic energy $E'_{1\mathrm{h}}$ of body 1 at the moment of time t'_{h} in system of readout O'x'y'z':

$$E'_{1\text{h}} = M_0 \cdot c^2 \cdot \left\{ \frac{1}{\sqrt{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)}} - 1 \right\} \qquad (60)$$

Let's assume that the body 2 at the moment of time $t_{2\text{h}}$ in system of readout Oxyz has projections $v_{x2\text{h}}$ and $v_{y2\text{h}}$ of speed of movement $v_{2\text{h}}$, and as appears from formulas (7) and (8):

$$v_{2\text{h}}{}^2 = v_{2x\text{h}}{}^2 + v_{2y\text{h}}{}^2 = \omega^2 \cdot R^2 \qquad (61)$$

Then, proceeding from formulas (18) - (20), values of projections $v'_{x2\text{h}}$ and $v'_{y2\text{h}}$ of speed of movement $v'_{2\text{h}}$ of body 2 at the moment of time t'_h in system of readout O'x'y'z' will be defined as:

$$v'_{x2\text{h}} = \frac{v_{x2\text{h}} - V}{1 - \frac{V \cdot v_{x2\text{h}}}{c^2}} \qquad (62)$$

$$v'_{y2\text{h}} = \frac{v_{y2\text{h}} \cdot \sqrt{1 - \frac{V^2}{c^2}}}{1 - \frac{V \cdot v_{x2\text{h}}}{c^2}} \qquad (63)$$

$$v'_{2\text{h}}{}^2 = v'_{x2\text{h}}{}^2 + v'_{y2\text{h}}{}^2 = \frac{(v_{x2\text{h}} - V)^2 + \left[v_{y2\text{h}}{}^2 \cdot \left(1 - \frac{V^2}{c^2}\right)\right]}{\left(1 - \frac{V \cdot v_{x2\text{h}}}{c^2}\right)^2} \qquad (64)$$

Having inserted formulas (62) - (64) into the equations (25) - (27) taking into account the formula (61) it is possible to receive values of projections $P'_{x2\text{h}}$ and $P'_{y2\text{h}}$ of impulse $P'_{2\text{h}}$ of body 2 at the moment of time t'_h in system of readout O'x'y'z':

$$P'_{x2\text{h}} = \frac{v'_{x2\text{h}} \cdot M_0}{\sqrt{1 - \frac{v'_{2\text{h}}{}^2}{c^2}}} = \frac{M_0 \cdot (v_{x2\text{h}} - V)}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \qquad (65)$$

$$P'_{y2\text{h}} = \frac{v'_{y2\text{h}} \cdot M_0}{\sqrt{1 - \frac{v'_{2\text{h}}{}^2}{c^2}}} = \frac{M_0 \cdot v_{y2\text{h}}}{\sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} \qquad (66)$$

$$P'_{2\text{h}}{}^{2} = \left(\frac{v'_{2\text{h}} \cdot M_0}{\sqrt{1 - \frac{v'_{2\text{h}}{}^{2}}{c^2}}} \right)^2 = \frac{M_0{}^2 \cdot \left\{ (v_{x2\text{h}} - V)^2 + \left[v_{y2\text{h}}{}^2 \cdot \left(1 - \frac{V^2}{c^2} \right) \right] \right\}}{\left(1 - \frac{V^2}{c^2} \right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2} \right)} \quad (67)$$

Having inserted the formula (64) into the equation (28) taking into account the formula (61) it is possible to write down value of kinetic energy $E'_{2\text{h}}$ of body 2 at the moment of time t'_h in system of readout O'x'y'z':

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

$$= M_0 \cdot c^2 \cdot \left\{ \frac{\left[1 - \frac{V \cdot v_{x2\text{h}}}{c^2} \right]}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} - 1 \right\} \quad (68)$$

6. Check of performance of the law of preservation of an impulse

The law of preservation of an impulse of the closed mechanical system of the bodies, connected with property of symmetry of space – uniformity of space [2], asserts that the impulse of the closed mechanical system of bodies (on which external forces do not operate) is constant size, i.e. in any inertial system of readout for any moment of time the size of an impulse of the closed mechanical system of bodies is constant size (since there is no external influence).

Because the mechanical system of bodies 1 and 2 (and threads 3) is closed, the law of preservation of an impulse allows to write down for time moments t'_p and t'_h in system of readout O'x'y'z' following equations:

$$P'_{x1\text{p}} + P'_{x2\text{p}} = P'_{x1\text{h}} + P'_{x2\text{h}} \quad (69)$$

$$P'_{y1\text{p}} + P'_{y2\text{p}} = P'_{y1\text{h}} + P'_{y2\text{h}} \quad (70)$$

$$\left(P'_{x1\text{p}} + P'_{x2\text{p}} \right)^2 + \left(P'_{y1\text{p}} + P'_{y2\text{p}} \right)^2 =$$

$$= (P'_{x1\text{h}} + P'_{x2\text{h}})^2 + \left(P'_{y1\text{h}} + P'_{y2\text{h}} \right)^2 \quad (71)$$

Having inserted into the equation (69) formulas (44), (47), (57) and (65) we will receive:

$$-\frac{M_0 \cdot \{V+[\omega \cdot R]\}}{\sqrt{1-\frac{V^2}{c^2}}\cdot\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}}+\frac{M_0 \cdot \{[\omega \cdot R]-V\}}{\sqrt{1-\frac{V^2}{c^2}}\cdot\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}}=$$

$$=-\frac{M_0 \cdot V}{\sqrt{1-\frac{V^2}{c^2}}\cdot\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}}+\frac{M_0 \cdot (v_{x2\mathrm{h}}-V)}{\sqrt{1-\frac{V^2}{c^2}}\cdot\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}} \quad (72)$$

or:

$$-\{V+[\omega \cdot R]\}+\{[\omega \cdot R]-V\}=-V+(v_{x2\mathrm{h}}-V) \quad (73)$$

From the equation (73) follows that:

$$v_{x2\mathrm{h}}=0 \quad (74)$$

Further having inserted into the equation (70) formulas (45), (48), (58) and (66) we will receive:

$$0+0=\frac{M_0 \cdot \omega \cdot R}{\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}}+\frac{M_0 \cdot v_{y2\mathrm{h}}}{\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}} \quad (75)$$

From the equation (75) follows that:

$$v_{y2\mathrm{h}}=-(\omega \cdot R) \quad (76)$$

And if to insert into the equation (71) formulas (44), (45), (47), (48), (57), (58), (65), (66) and using (76) we will receive:

$$\left(-\frac{M_0 \cdot \{V+[\omega \cdot R]\}}{\sqrt{1-\frac{V^2}{c^2}}\cdot\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}}+\frac{M_0 \cdot \{[\omega \cdot R]-V\}}{\sqrt{1-\frac{V^2}{c^2}}\cdot\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}}\right)^2+0=$$

$$=\left(-\frac{M_0 \cdot V}{\sqrt{1-\frac{V^2}{c^2}}\cdot\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}}+\frac{M_0 \cdot (v_{x2\mathrm{h}}-V)}{\sqrt{1-\frac{V^2}{c^2}}\cdot\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}}\right)^2$$

$$+\left(\frac{M_0 \cdot \omega \cdot R}{\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}}+\frac{M_0 \cdot v_{y2\mathrm{h}}}{\sqrt{1-\frac{\omega^2 \cdot R^2}{c^2}}}\right)^2 \quad (77)$$

or:

$$[-V-(\omega\ \cdot R)+(\omega\ \cdot R)-\ V]^2=$$

$$=[-V+v_{x2\mathrm{h}}\ -\ V]^2+\left[\left(\omega\ \cdot R+v_{y2\mathrm{h}}\right)\cdot\sqrt{1-\frac{V^2}{c^2}}\right]^2 \qquad (78)$$

From the equation (78) follows that:

$$v_{y2\mathrm{h}}=\ -(\omega\ \cdot R)+\ \frac{\sqrt{4V^2-(v_{x2\mathrm{h}}\ -\ 2V)}}{\sqrt{1-\frac{V^2}{c^2}}} \qquad (79)$$

$$v_{x2\mathrm{h}}=\ 2V-\sqrt{4V^2-\left[\left(\omega\ \cdot R+v_{y2\mathrm{h}}\right)\cdot\left(1-\frac{V^2}{c^2}\right)\right]} \qquad (80)$$

The equations (74) and (76) are necessary conditions (values of projections of speed $v'_{x2\mathrm{h}}$ and $v'_{y2\mathrm{h}}$) at which in a considered example the law of preservation of an impulse in inertial system of readout O'$x'y'z'$ will be carried out.

Having substituted conditions (74) and (76) in the equations (7) and (8), we will receive:

$$t_{2\mathrm{h}}=0 \qquad (81)$$

And having substituted the equations (52) and (81) in the formula (29) or (53):

$$0\ =\frac{V\cdot R}{c^2}\ \cdot\ [1+1] \qquad (82)$$

let's have one more condition of performance of the law of preservation of an impulse in inertial system of readout O'$x'y'$z' for a considered example:

$$0\ =\frac{1}{c^2} \qquad (83)$$

But since the size of a velocity of light c is not equal to infinity, therefore the condition (83) is not feasible at use of the special theory of relativity and therefore in this case the law of preservation of an impulse is executed cannot be.

Also it is possible that the made assumption that a constant c in Lorentz's transformations is a velocity of light, not truly.

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.

7. Check of performance of the law of conservation of energy

The law of conservation of energy of the closed mechanical system of the bodies, connected with property of symmetry of space and time – uniformity of time [2], asserts that energy of the closed mechanical system of bodies (on which external forces do not operate) is constant size, i.e. in any inertial system of readout for any moment of time the size of energy of the closed mechanical system of bodies is constant size (since there is no external influence).

Prior to the beginning of consideration we will make the assumption that if in one inertial system of readout at the closed mechanical system and its components do not occur change of sizes 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 sizes of potential energy.

Taking into account the made assumption and because the mechanical system of bodies 1 and 2 (and threads 3) is closed, the law of conservation of energy allows to write down for time moments t'_{p} and t'_{h} in system of readout O'x'y'z' a following equation:

$$E'_{1\mathrm{p}} + E'_{2\mathrm{p}} = E'_{1\mathrm{h}} + P'_{x2\mathrm{h}} \qquad (84)$$

Having inserted into the equation (84) formulas (50), (51), (60) and (68) we will receive:

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

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

$$= M_0 \cdot c^2 \cdot \left\{ \frac{1}{\sqrt{\left(1 - \frac{V^2}{c^2}\right) \cdot \left(1 - \frac{\omega^2 \cdot R^2}{c^2}\right)}} - 1 \right\} +$$

$$+M_0 \cdot c^2 \cdot \left\{ \frac{\left[1 - \frac{V \cdot v_{x2h}}{c^2}\right]}{\sqrt{1 - \frac{V^2}{c^2}} \cdot \sqrt{1 - \frac{\omega^2 \cdot R^2}{c^2}}} - 1 \right\} \qquad (85)$$

or:

$$\left[1 + \frac{V \cdot \omega \cdot R}{c^2}\right] + \left[1 - \frac{V \cdot \omega \cdot R}{c^2}\right] = 1 + \left[1 - \frac{V \cdot v_{x2h}}{c^2}\right] \qquad (86)$$

From the equation (86) follows that:

$$v_{x2h} = 0 \qquad (74)$$

As a result here too, as well as at check of performance of the law of preservation of an impulse, it is possible to draw the following conclusion: 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 conservation of energy (since in inertial system of readout O'*x*'*y*'*z*' in the closed mechanical system there is only a change of sizes of kinetic energy without change of sizes of potential energy).

8. The 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.

The list of references

1. Cochetkov V.N., Special Relativity: Depending on the Definition of the Momentum of a Closed System of Bodies from Time, Journal of Vectorial Relativity (JVR) 6 (2011) 1 65-76.
2. Яворский Б.М., Детлаф А.А., Справочник по физике, Наука, Москва (1980).
3. Бронштейн И.Н., Семендяев К.А., Справочник по математике для инженеров и учащихся втузов, Наука, Москва (1986).

Author V.N. Kochetkov

E-mail: VNKochetkov@gmail.com .

E-mail: VNKochetkov@rambler.ru .

Site: http://www.matphysics.ru .