CLASSIFICATION OF THE REFERENCE SYSTEMS IN PHYSICS

A. F. Potjekhin
Odessa National Maritime University
34 Mechnikova St., 65029, Odessa, Ukraine

Abstract

It is revealed that attribution in contemporary physics of all non-accelerated reference systems to inertial, and all accelerated in relation to them to the non-inertial reference systems is incorrect. The concept of dynamical and kinematical reference systems is introduced. It is shown, that inertial and non-inertial reference systems can be only dynamic ones. The basic equation of dynamics of a material particle in the dynamical non-inertial reference systems in mechanics and Maxwell electrodynamical equations in the kinematical non-accelerated (in relation to the inertial) reference systems in electrodynamics, missing in the modern physics, are derived. Problems of dynamics of moving bodies that cannot be solved without these missing equations of physics, are considered.

Key words: dynamical and kinematical reference systems; non-inertial and inertial reference systems; non-accelerated and accelerated reference systems.

Newtonian Absolute space

At the beginning of XX century Newton's concepts of absolute space and absolute time in physics were disclaimed and, as a result, that stable foundation, on which the classical physics have been based up to the end of XIX century, was left. This has led to the far-reaching consequences, up to impossibility to solve elementary problems of dynamics of moving bodies. Let us limit ourselves by two examples.

Example first. According to the contemporary relativistic notions, the field of electric charge, resting in a physical laboratory, is described in the frame of reference of a tram, driving with constant speed, by the same Maxwell's equations, as a field of the same charge resting in this tram, relatively to the frame of reference of the laboratory. The experiment refutes this, registering a magnetic field only in the second case.

Example second. In agreement with the contemporary relativistic notions, oscillation of a mathematical pendulum with a fixed point of suspension in physical laboratory is described in the reference frame of a tram, driving with acceleration, by that very equation of dynamics of the relative motion of a particle, as oscillation of the same mathematical pendulum with fixed point of suspension in this tram relative to the frame of reference of tram. The experiment refutes this, registering deviation of a local vertical only in the second case.

In the conceptual apparatus, laid down by Newton in the foundation of classic physics, the concepts of absolute or fixed space and absolute or universal time play the special role. By introducing of these concepts Newton, at first, eliminated influence of selection of the relative spaces (bodies of reference) and relative time (approximately uniform motion) on the description of motion of bodies. Secondly, he took into account availability in the nature of the dynamically allocated frame of reference, rotation relative to which is accompanied by the tendency of particles to move away from the axis of rotation (experiment of Newton with the rotated bucket with water).

As the fact of rotation of the Earth relative to a sphere of remote stars was known to Newton, he practically used a heliocentric frame of reference as an absolute one. However Newton, despite of what was assigned to him, perceived all the conditionality of selection of an absolutely unmovable frame of reference: "*For it may be that there is no body really at rest to which the places and motions of others* *may be referred*" [1]. One can speak only about the hierarchy of the "fixed" or "absolute", enclosed one into another like a nest-doll, frames of reference: for the propagating ship the fixed frame of reference is that one bound with a surface of the Earth; for the surface of the Earth the fixed frame of reference is that one, the beginning of which coincides with the center of the Earth, and axes are directed to remote stars; for this, in turn, the fixed is the heliocentric frame of reference, and so on. Thus, the concept of an absolute frame of reference (AFR) is a relative concept. In the process of globalization of the "fixed" frames of reference, we come nearer to the absolute space of Newton only as a limit. To criticize Newtonian absolute space and absolute time is as senseless as to criticize other scientific abstractions, for example, concept of perfect fluid or gas, of absolute solid or material point.

On the frames of reference classification in the contemporary physics

The concept a frame of reference is fundamental in the theoretical physics. Generally accepted [2], [3] end others, is the following kinematical definition: coordinate system, bound with a body of reference and serving for indicating of a position of particles in space, together with clocks, bound with this system and serving for indicating of time, is deemed as a frame of reference. The modern physics is based on the following kinematical procedure of subdivision of reference systems into two classes [2], [3] end others. One of the reference systems relative to which the material particle is moving uniformly and rectilinearly is fixed. Further, by means of Galilee kinematical transformations, the theorem is proved: if the geometrical point moves uniformly and rectilinearly relative to one of the reference systems there are also an infinite number of reference systems relative to which the same geometrical point will also move uniformly and rectilinearly. All such reference systems, moving one relative to other translational, uniformly and rectilinearly, are named inertial. Reference systems moving with acceleration in relation to the inertial reference systems defined in this way are named non-inertial.

Such kinematical allocation of a class of inertial and non-inertial reference systems in the modern physics is incorrect. The dynamic aspect (movement of a material particle by inertia relative to its body of reference at simultaneous involvement of this particle into the transport motion of the given body of reference) of the inertial reference systems introduced in such a way is missed. Only in dynamics where such property of bodies as their inertness becomes apparent the concept of inertial and non-inertial reference systems can be correctly introduced. Therefore it is reasonable to name the kinematical reference systems, introduced in the way specified above, as the kinematical non-accelerated and kinematical accelerated reference system, or, for the reduction, simply non-accelerated and accelerated reference systems.

Dynamical and kinematical, inertial and non-inertial frames of reference according to Newton.

In accordance with dynamical [4] relativity principle of Galileo-Newton, the mutual motion of the system of material particles, interacting with each other, will be independent of their common movement with the same transport velocity. This statement is formulated by Newton in Corollary V after explanation of his laws: "*Relative motions of the bodies, contained in any space, one relative to another, are equal, irrespective of whether this space is at rest or moves uniformly and straight without rotation*". In this connection, this statement of Newton is worth mentioning: "*The body, moving in space, participates also in the movement of this space; that is why the body, moving away from the moving place, participates in the movement of this place*". In Corollary V Newton concludes with the comment: "*This is confirmed by abundant experiments. All motions within the ship occur in the same way, independent of whether she is at rest or moving uniformly and rectilinearly*" [1].

In accordance with Newton all frames of reference must be divided first of all into two classes – dynamical and kinematical. If the considered system of material particles is moving together with a frame of reference $\sum$, which, in turn, is moving relative to the absolute frame of reference $\sum^0$, then $\sum$

is called a dynamical frame of reference for the given process. If the considered system of material particles does not participate in the transport motion together with a frame of reference $\sum'$, then the latter is called kinematical frame of reference for the given process. It is necessary to point out the relativity of these concepts: the same frame of reference for one process can be dynamical, while for other – the kinematical.

The dynamical frames of reference, in turn, are subdivided into two classes - inertial and non-inertial one. Just in dynamics a concept of inertial frames of reference appears. According to the experimentally established dynamical [4] relativity principle of Galileo-Newton, dynamical frames of reference which move translational, uniformly and rectilinearly concerning the sphere of remote stars, therefore, concerning each other as well, are called the inertial dynamical frames of reference. In each of such dynamical frames of reference, according to experiment, physical laws of not mechanics only, but also of the electrodynamics, are stated and written down equally to within notation of coordinates. Equations of motion of physical processes in dynamical inertial frames of reference never include speed of their motion relative to the other frames of reference. The dynamical frames of reference, which move with acceleration with respect to the inertial dynamical frames of reference, are called the non-inertial dynamical frames of reference.

The reference systems introduced just in such dynamic way should be named dynamical inertial and dynamical non-inertial reference systems or, briefly, simply inertial and non-inertial reference systems.

In connection with the wrong classification of reference systems in modern physics, there was not noticed a) an absence of the basic equation of dynamics of a material particle in dynamical non-inertial reference systems in mechanics and b) an absence of Maxwell electrodynamical equations in the kinematical non-accelerated reference systems in electrodynamics. Below the derivation of these missing equations of physics is given and the fore cited examples are solved.

Fundamental law of dynamics for the relative motion of a particle in dynamical non-inertial frames of reference

Generally accepted in the contemporary physics is the following conclusion of the fundamental dynamics equation for the relative motion of a particle in accelerated systems of reference. Basic equation of motion of a particle is written down in unaccelerated system of reference $\sum$, which is taken as a fixed one

$$m\overline{a} = \sum \overline{F}_k . \qquad (1)$$

The motion of the same mass point is esteemed relative to another, arbitrarily moving kinematical frame of reference $\sum'$. Applying known kinematical transforms of reference systems

$$\overline{r} = \overline{r}_{0'} + \overline{r}', \qquad t = t', \qquad (2)$$

from (1) the basic equation of dynamics of the particle in a frame of reference $\sum'$ is obtained

$$m\overline{a}' = \sum \overline{F}_k + \overline{J}^{tr} + \overline{J}^{Cor}, \qquad (3)$$

where

$$\overline{J}^{tr} = -m\overline{a}^{tr}, \qquad (4)$$

$$\vec{J}^{Cor} = -m\overline{a}^{Cor}. \qquad (5)$$

Equation (3) is only the other form of a record of equation (1). Appearance in equation (3) of the transport $\overline{J}^{tr}$ and Coriolis $\vec{J}^{Cor}$ forces of inertia is a result of pure mathematical manipulation. Therefore these “forces of inertia”, not being the results of dynamical interaction, are fictive forces, appearing owing to mutual motion of systems of reference.

Let us consider now the case of a dynamical non-inertial frame of reference $\sum'$. The fundamental dynamics law for the relative motion of a particle can not be in this case obtained by kinematical transformation (2) of frames of reference, as that body of reference, with which one the frame of reference $\sum'$ is n now connected, dynamically interacts with the given mass point. This law should be obtained directly with the aid of initial principles of Newton.

Let relatively to the dynamical inertial frame of reference $\sum$ esteemed as a fixed one (for example frame of reference of the Earth surface), another dynamical inertial frame of reference $\sum'$ is moving (for example the frame of reference of the ship), which is dynamical for the considered mass point (for example the mathematical pendulum with a fixed point in the ship). Then motion of this point in $\sum'$ is described by the Newton law

$$m\bar{a}' = \sum \bar{F}_k . \tag{6}$$

Let us now give this dynamical stroked system of reference $\sum'$ arbitrary motion relative to $\sum$. The material particle (mathematical pendulum with a fixed point in the ship), moving relative to the stroked system of reference $\sum'$, participates in accelerated motion of this frame of reference with respect to $\sum$. In this case, in a direction of transport and Coriolis accelerations the material particle interacts with that body, to which one the system of reference $\sum'$ is connected. Then in a direction of transport acceleration acts force of reaction $\bar{N}^{tr}$, and in a direction of Coriolis acceleration acts force of reaction $\bar{N}^{Cor}$. According to the second Newton's law,

$$m\bar{a}^{tr} = \bar{N}^{tr}, \tag{7}$$

$$m\bar{a}^{Cor} = \bar{N}^{Cor}. \tag{8}$$

Adding left-hand and right parts of equations (6), (7), (8), i. e. applying a principle of independence of operating of forces in classic mechanics of Newton, we shall obtain

$$m\bar{a}' = \sum \bar{F}_k + \bar{N}^{tr} + \bar{N}^{Cor} + \bar{F}^{tr} + \bar{F}^{Cor}, \tag{9}$$

where

$$\bar{F}^{tr} = -m\bar{a}^{tr}, \tag{10}$$

$$\bar{F}^{Cor} = -m\bar{a}^{Cor}. \tag{11}$$

The equation (3) of motion of a material particle in a kinematical accelerated frame of reference differs essentially from the law of motion (9) in a dynamical non-inertial frame of reference. Firstly, the equation (3) is obtained as a result of formally mathematical transformation of systems of reference, while the law (9) is proved on the basis of initial principles of Newtonian mechanics. Secondly, in (3) transport and Coriolis forces of inertia are kinematical or fictive, whereas in (9) transport and Coriolis forces of inertia are dynamical or real, conditioned by the relevant reaction forces $\bar{N}^{tr}$ and $\bar{N}^{Cor}$.

Let's notice, that, despite of implementation of mathematical equalities (7), (8), mutually opposite physical forces N^{tr} and $\bar{F}^{tr}$, and $\bar{N}^{Cor}$ and $\bar{F}^{Cor}$ in equation (9) are not compensated, as reaction forces N^{tr} and $\bar{N}^{Cor}$ are surface forces, while inertial forces $\bar{F}^{tr}$ and $\bar{F}^{Cor}$ are volume forces.

Example 1. Consider damping linear oscillations of a mathematical pendulum in the reference system $O'x'y'$ (carriage), moving translational relative to the stationary reference system Oxy of the Earth surface (laboratory) with acceleration $\bar{q}$. The point of pendulum suspension and the medium of resistance are motionless in the laboratory reference system.

Solution.

With the known accuracy, the laboratory reference system is taken as the stationary inertial one. We consider, that at the initial moment of time origins of the stationary and mobile primed reference systems coincide with the pendulum suspension point, and their axes are parallel. Movement of the primed reference system occurs in a positive direction of the x - axis. In this case the pendulum does not participate in the movement of the primed reference system; therefore this reference system is a kinematical for it. Then the basic equation of dynamics (3) of the pendulum load becomes

$$m\bar{a}' = \bar{P} + \bar{T} + \bar{R} + \bar{J}^{tr}, \qquad (12)$$

where $\bar{P}, \bar{T}, \bar{R}, \bar{J}^{tr}$ - a load gravity force, string reaction force, resistance force of medium and transport fictitious force of inertia of a load correspondingly.

By virtue of kinematical transformation

$$\bar{r} = \frac{1}{2}\bar{q}t^2 + \bar{r}', \qquad t = t' \qquad (13)$$

we get

$$\bar{R} = -\mu\bar{v} = -\mu(\bar{q}t + \bar{v}'), \qquad \bar{J}^{tr} = -m\bar{q}. \qquad (14)$$

Projecting (12) onto direction of a tangent to the trajectory of a load of a pendulum in the stationary reference system, with account of relations $v'_\tau = v_\tau - q_\tau t$, $a'_\tau = a_\tau - q_\tau$ and taking into consideration, that by virtue of transformation (13) $\varphi = \varphi'$, we get equation of oscillations of a pendulum in the primed reference system.

$$\ddot{\varphi}' + 2n\dot{\varphi}' + k_1{}^2\varphi' = 0. \qquad (15)$$

Then

$$\varphi' = e^{-nt}\left(C_1 \cos k_1 t + C_2 \sin k_1 t\right), \qquad (16)$$

$$x' = l\sin\varphi' - \frac{qt^2}{2}, \quad y' = l\cos\varphi', \qquad (17)$$

$$T = ml\dot{\varphi}'^2 + P\cos\varphi'. \qquad (18)$$

Thus, from the primed reference system the same oscillations of a pendulum are seen, as from the stationary reference system, but moving away with acceleration q in the negative direction of the x - axis.

Example 2. Consider damping linear oscillations of a mathematical pendulum in the reference system $O'x'y'$ (carriage), moving translational relative to the stationary reference system Oxy of the Earth surface (laboratory) with acceleration $\bar{q}$. The pendulum suspension point and the medium of resistance are fixed in the reference system $O'x'y'$ of the carriage.

Solution.

The reference system $O'x'y'$ is a dynamical non-inertial for the pendulum. The basic equation of dynamics of a particle (9) in this case becomes

$$m\bar{a}' = \bar{P} + \bar{T} + \bar{R} + \bar{T}' + \bar{F}^{tr} \qquad (19)$$

here $\bar{T}'$ – that part of force of reaction of a string which provides moving of a load of a pendulum together with the carriage with acceleration $\bar{q}$ and on that ground the real, physical transport force of inertia is appeared

$$\bar{F}^{tr} = -mq. \qquad (20)$$

Introducing full force of reaction of a string of a pendulum

$$\bar{T}^* = \bar{T} + \bar{T}' \qquad (21)$$

let us re-write equation (19) as follows

$$m\bar{a}' = \bar{P} + \bar{T}^* + \bar{R} + \bar{F}^{tr}. \qquad (22)$$

Projecting (22) onto the direction tangent to the trajectory of the pendulum load in the primed reference system, we get the differential equation of oscillations of the pendulum

$$\ddot{\varphi}' + 2n\dot{\varphi}' + k_1^2\varphi' = -ql^{-1}, \qquad (23)$$

solving which we find

$$\varphi' = e^{-nt}\left(C_1 \cos k_1 t + C_2 \sin k_1 t\right) - \frac{q}{lk_1^2}, \qquad (24)$$

$$x' = l \sin\varphi'; \quad y' = l\cos\varphi', \qquad (25)$$

$$T^* = ml\dot{\varphi}'^2 + P\cos\varphi' - mq\sin\varphi'. \qquad (26)$$

Comparison of solution of two presented problems of oscillations of the pendulum in the kinematical accelerated and dynamical non-inertial reference systems reveals their principal distinction. Firstly, in dynamical non-inertial reference system there appeared an additional force of reaction of a string T', applied to the pendulum load. Secondly, in dynamical non-inertial reference system the transport force of inertia $\bar{F}^{tr}$ is a physical, or real, this leading to the deviation of a local vertical of the carriage by the angle $\varphi_0 = -\frac{q}{lk_1^2}$ and it exhibits as a force of counteraction from the string of a pendulum on its point of suspension.

Maxwell equations in kinemical unaccelerated frames of reference

Maxwell equations in vacuum for electric charge of density ρ_e^0, moving with velocity v^0 relative to the absolute frame of reference $\sum^0$, have the following appearance

$$div\,\bar{E}^0 = \frac{1}{\varepsilon_0}\rho_e^0, \qquad (27)$$

$$rot\,\bar{E}^0 = -\frac{\partial \bar{B}^0}{\partial t^0}, \qquad (28)$$

$$div\,\bar{B}^0 = 0, \qquad (29)$$

$$rot\,\bar{B}^0 = \mu_0\rho_e^0\bar{v}^0 + \frac{1}{c^2}\frac{\partial \bar{E}^0}{\partial t^0}, \qquad (30)$$

where ε_0, μ_0 - electric and magnetic constants, i.e.

$$\varepsilon_0 = const, \quad \mu_0 = const, \quad c = (\varepsilon_0\mu_0)^{-1/2} = const \qquad (31)$$

c - rate of propagation of front of an electromagnetic wave (light velocity) in $\sum^0$.

Let the charge ρ_e move with some inertial frame of reference $\sum$ and, simultaneously, relative to this reference system with velocity $\bar{v}$, i.e., in relation to the considered process $\sum$ is dynamic IFR. In this case, in accordance with the dynamic relativity principle of Galileo, Maxwell equations in IFR $\sum$ has the same appearance as in AFR $\sum^0$

$$div\,\overline{E} = \frac{1}{\varepsilon_0}\rho_e, \tag{32}$$

$$rot\,\overline{E} = -\frac{\partial \overline{B}}{\partial t}, \tag{33}$$

$$div\,\overline{B} = 0, \tag{34}$$

$$rot\,\overline{B} = \mu_0 \rho_e \overline{v} + \frac{1}{c^2}\frac{\partial \overline{E}}{\partial t} \tag{35}$$

with the same constants values pursuant to (31). The physical meaning of the c constant thus remains the same – this is light velocity relative to $\sum^0$, which, pursuant to the experiment, is irrelevant from whether the source of light is in rest or moving relative to $\sum^0$. It is a consequent of that fact, that the photon has no rest-mass, therefore first Newton's law, law of inertia, is not applicable to it. The photon, contrary to the material particle, does not preserve a running velocity of its source.

In the theory of moving charges also another problem has arisen: it is necessary to describe in kinematical unaccelerated frame of reference $\sum'$ a field of a charge ρ_e, the motion of which is preset in dynamic IFR $\sum$. At this, $\sum'$ is moving relative to IFR $\sum$ with velocity $\overline{u} = const$. To describe in $\sum'$ process, taking place in IFR $\sum$, let’s apply kinematical transformation of Galileo

$$\overline{r} = \overline{r}' + \overline{u}t, \qquad t = t' \tag{36}$$

to the set of equations (32-35).

Let’s derive some auxiliary relations. Applying Galileo transformation (36) to the function $f(\overline{r}, t)$, we obtain

$$f(\overline{r}, t) = f(\overline{r}' + \overline{u}t', t') = f'(r', t'). \tag{37}$$

Further we find

$$\frac{\partial f}{\partial t} = \frac{\partial f'}{\partial t'}\frac{\partial t'}{\partial t} + \frac{\partial f'}{\partial \overline{r}'}\frac{\partial \overline{r}'}{\partial t}, \tag{38}$$

$$\frac{\partial f}{\partial \overline{r}} = \frac{\partial f'}{\partial \overline{r}'}\frac{\partial \overline{r}'}{\partial \overline{r}}. \tag{39}$$

Taking into account, that

$$\frac{\partial t'}{\partial t} = 1, \quad \frac{\partial r'}{\partial t} = -\overline{u}, \quad \frac{\partial \overline{r}'}{\partial \overline{r}} = \delta (\ \delta_{ij} = 1, i = j; \ \ \delta_{ij} = 0, i \neq j) \tag{40}$$

from (38) and (39) we get the following relations between the operators in dashed and non-dashed reference systems

$$\frac{\partial}{\partial t} = \frac{\partial}{\partial t'} - \overline{u}\overline{\nabla}', \qquad \overline{\nabla} = \overline{\nabla}'. \tag{41}$$

With account of (41), Maxwell equations (32-35), upon application of Galileo transformation to them, take the following appearance in the unaccelerated frame of reference $\sum'$

$$div\bar{E}' = \frac{1}{\varepsilon_0}\rho_e, \quad (42)$$

$$rot\,\bar{E}' == -(\frac{\partial}{\partial t'} - \bar{u}\bar{\nabla}')\bar{B}', \quad (43)$$

$$div\,\bar{B}' = 0, \quad (44)$$

$$rot\,\bar{B}' = \mu_0\rho_e(\bar{u} + \bar{v}') + \frac{1}{c^2}(\frac{\partial}{\partial t'} - \bar{u}\bar{\nabla}')\bar{E}'. \quad (45)$$

again, with the same values of constants pursuant to (31). Let's select in the last set of equations the members, conditioning non-covariance of Maxwell equations concerning Galileo transformation

$$div\bar{E}' = \frac{1}{\varepsilon_0}\rho_e, \quad (46)$$

$$rot\,\bar{E}' == -\frac{\partial}{\partial t'}\bar{B}' + \left[(\bar{u}\bar{\nabla}')\bar{B}'\right], \quad (47)$$

$$div\,\bar{B}' = 0, \quad (48)$$

$$rot\,\bar{B}' = \mu_0\rho_e\bar{v}' + \frac{1}{c^2}\frac{\partial}{\partial t'}\bar{E}' + \left[\mu_0\rho_e\bar{u} - \frac{1}{c^2}(\bar{u}\bar{\nabla}')\bar{E}'\right]. \quad (49)$$

As should to expect, the non-covariance is conditioned by the convective current and convective derivative of field vectors - members in square brackets.

Example. Electrical charge q' is rest in the origin of the dashed IFR $\sum'(x', y', z', t)$ of moving tram, while the charge q is rest at the origin of non-dashed IFR $\sum(x, y, z, t)$ of orbiting Earth. Thus the dashed reference system is moving together with the non-dashed one and at the same time relative to it with the velocity $\bar{u}$ in positive direction of x-axis. Find fields of these charges in each of these reference systems.

a) The field of the charge q' in IFR $\sum'$. The $\sum'$ is the dynamical IFR for the charge q', therefore it's necessary to apply Maxwell set of equations (32-35). As a result, we find scalar and vector potentials

$$\phi' = \frac{1}{4\pi\varepsilon_0}\frac{q'}{r'}, \qquad \bar{A}' = 0. \quad (50)$$

b) The field of the charge q in IFR $\sum$. This case is analogous to the previous one, i.e. $\sum$ is a dynamical IFR for charge q, and for this reason one should apply Maxwell set of equations (32-35). In the issue we get scalar and vector potentials

$$\phi = \frac{1}{4\pi\varepsilon_0}\frac{q}{r}, \qquad \bar{A} = 0. \quad (51)$$

c) The field of the charge q' in IFR Σ. The charge q' moves with the reference system $\sum$ and at the same time relative to it with the velocity $\bar{v} = \bar{u}$. Therefore, $\sum$ is a dynamical IFR for the charge q', and that's why it is necessary to apply Maxwell set of equations (32-35). Applying the method of retarded integrals, offered by Heaviside [5] and potently advanced by Prof. O.Jefimenko [6] to solve this set of equations, we find out

$$\phi = \frac{1}{4\pi\varepsilon_0}\frac{q'}{\left[(x-ut)^2+(1-\frac{u^2}{c^2})(y^2+z^2)\right]^{1/2}}, \qquad (52)$$

$$\bar{A} = \frac{1}{4\pi\varepsilon_0}\frac{q'\bar{v}}{c^2\left[(x-ut)^2+(1-\frac{u^2}{c^2})(y^2+z^2)\right]^{1/2}} \qquad (53)$$

d). The field of the charge q in $\sum'$. The charge q does not move with the reference system $\sum'$, but is moving relative to it with the velocity $\bar{v}' = -\bar{u}$. Hence, $\sum'$ is the kinematical for the charge q, and therefore it's necessary to apply the set of equations (42-45), which in this case takes the form

$$div\bar{E}' = \frac{1}{\varepsilon_0}\,\delta(x'-ut), \qquad (54)$$

$$rot\bar{E}' = 0, \qquad (55)$$

$$div\bar{B}' = 0, \qquad (56)$$

$$rot\bar{B}' = 0. \qquad (57)$$

Here is considered, that as well as the field of charge q in the $\sum$ system is stationary, then

$$\frac{\partial}{\partial t} = \frac{\partial}{\partial t'} - \bar{u}\bar{\nabla}' = 0 \qquad (58)$$

and, besides this, $\bar{u}' + \bar{v} = 0$. From the set of equations (54-57) we find

$$\phi' = \frac{1}{4\pi\varepsilon_0}\frac{q}{\left[(x'+ut)^2+y'^2+z'^2\right]^{1/2}}, \qquad \bar{A}' = 0 \qquad (59)$$

It follows from (59): a) equipotential surfaces

$$\left[(x'+ut)^2+y'^2+z'^2\right] = const \qquad (60)$$

of the charge q in kinematical frame of reference $\sum'$ are spherical surfaces moving together with this charge in the negative direction of x'-axis; b) convective current, conditioned by the movement of kinematical frame of reference $\sum'$, does not produce magnetic field. Both these conclusions are in accordance with the experiment and Wilhelm's theory. It is necessary to mark a substantial contribution of Prof. H. Wilhelm ([7] and others), into creation of the Galileo-covariant theory of electrodynamics of moving bodies in absolute space-time.

Conclusion

1. All frames of reference, moving one respect to another, are divided into two classes - dynamical and kinematical one. If the considered system of material particles is moving together with the frame of reference $\sum$, which in turn is moving relative to the AFR $\sum^0$, then $\sum$ is called the dynamical frame of reference for the given process. If the considered system of material particles does not participate in transport motion together with the frame of reference $\sum$, the last is called kinematical for the given process.
2. The dynamical frames of reference, in turn, are subdivided into two classes - inertial and non-inertial. Dynamical frames of reference which moves translational, uniformly and rectilinearly concerning the sphere of remote stars (AFR), therefore, concerning each other as well, are called the inertial frames of reference. In each of such inertial frame of reference, according to experimental principle

Galileo-Newton, physical laws are stated and written down equally to within notation of coordinates. Equation of motion of physical process in inertial frames of reference never includes speed of their motion relative to the other frame of reference. The dynamical frames of reference, which moves with acceleration with respect to the inertial frames of reference, are called the non-inertial frames of reference. So all non-inertial frames of reference move with acceleration concerning of the sphere of remote stars (AFR).

3. The subdivision of kinematical reference systems into non-accelerated and accelerated is conditional (relative) as all of them are equal in rights and any of them can be taken as a stationary one. If the equation of movement of some process relative to one of the reference systems, taken as a stationary, is known, the equation of movement of this process relative to any other kinematical (for the given process) reference systems can be obtained by kinematical transformation of these reference systems, for example, by Galileo transformation. Equation of motion of physical process in kinematical frame of reference always includes speed of their motion relative to the other frame of reference, so in different kinematical frames of reference one and same physical laws are stated and written down not equally.

1. I. Newton, Mathematical Principles of Natural Philosophy. (In Russ.). (Nauka Publishing, Moscow, 1989).
2. L. D. Landau, E. M. Lifshitz, Course of Theoretical Physics V. I. Mechanics. (In Russ.). (Nauka Publishing, Moscow, 1973).
3. C. Kittel, W. Knight, M. Ruderman. Berkeley Physics Course. V. I. Mechanics. (In Russ.). (Nauka Publishing, Moscow, 1975).
4. A. F. Potjekhin, Hadronic Journal Supplement, (14, 297-313, 1999).
5. O.Heavicide, The Electrician, (31, 281-282, 1893).
6. O. D. Jefimenko, Electromagnetic Retardation and Theory Relativity. (Star City, West Virginia, 1997).
7. H. E. Wilhelm, Hadronic Journal (19, 1-39, 1996).

****

The journal “Annalen der Physik”

From: Anatoliy Potjekhin [mailto:a_potjekhin@osmu.odessa.ua]
Sent: Mittwoch, 30. Januar 2008 12:18
To: Kramer
Cc: eckern@physik.uni-augsburg.de
Subject: Re[4]: Potjekhin A.F, Odessa, Ukraine

Hello Kramer,

Dear Editor, Prof. Dr. Bernhard Kramer,
(Cc: 'eckern@physik.uni-augsburg.de)

You teach all standard lectures in theoretical physics including
" Theoretical Mechanics
" Electrodynamics
" Theoretical Physics for teachers

So, You can understand the great Meaning of this my article CLASSIFICATION OF THE REFERENCE SYSTEMS IN PHYSICS.

I suppose, you recommend to publish this article in the Journal "Annalen der Physik"
Please, tell me that you had received and well opened this article.

Best wishes,
Prof. Potjekhin A.F.
****

From: Kramer <B.Kramer@jacobs-university.de>
To: 'Anatoliy Potjekhin' <a_potjekhin@osmu.odessa.ua>
Date: Monday, February 4, 2008, 4:21:48 PM
Subject: Potjekhin A.F, Odessa, Ukraine
Files: <none>
--====----====----====----====----====----====----====----====----====----===--
Dear Dr. Potjekhin,
I received your article which has now the ref number kr200801.
Best wishes
Bernhard Kramer

****

From: Kramer <B.Kramer@jacobs-university.de>
To: 'Anatoliy Potjekhin' <a_potjekhin@osmu.odessa.ua>
Date: Tuesday, March 4, 2008, 2:39:25 PM
Subject: Potjekhin A.F, Odessa, Ukraine
Files: <none>
--====----====----====----====----====----====----====----====----====----===--
Dear Dr. Potjekhin,

Thank you for sending your article on "Classification of the reference systems in physics" for publication in the Annalen der Physik.

Unfortunately, we cannot accept the paper. Its contents should much better fit the scope of other - possibly much more pedagogically oriented Journals. Therefore, we suggest that you send the paper to a more suitable journal for publication.

Best wishes
Bernhard Kramer

****