Unity of Physics

Branko Mišković

Independent Author, Novi Sad, Serbia

Abstract   With respect to separate developments of various physical disciplines, this synthesis relies on their common principles and touching points. The two classical systematic theories, mechanics and electrodynamics, are here especially mutually compared and related. The convenient extension of their distinct mathematical treatments to each other results in their equivalence. The forces and laws expressing them are classified into the static, kinetic and dynamic types, being dependent on the positions, motions and accelerations, respectively, of interacting objects. Reducing the mechanical and electromagnetic (EM) forces of each kinematical state to the same essences, these three states are also mutually related. The formal procedures are further followed by the mutual relation of various substances, as the scalar physical quantities. Mass is reduced to the field energy, but electricity – to the structural formal relations. A general natural law, merely here introduced and supported by the structural stratification, implies the other physical laws. The exposition is finally terminated by reduction to only one physical quantity, operating by the natural units.

Keywords   Empirical, Formal, Rational, Intuitive

1. Introduction

The development of physics consists of the numerous partial contributions, more or less mutually related. The two classical scientific systems, mechanics and electrodynamics, have been applied in the technical practice before their sufficient theoretical elaboration. The other classical disciplines (acoustics, optics and thermodynamics), reducible to the two systems, are more oriented to practice. Owing to their distinct foundations, the two systems were difficult to be essentially related. The formal similarities of their static, kinetic or dynamic phenomena, as well as of the equations of fluid mechanics and EM field theory, are not reduced to the same essences. The investigation of material structure is given up to the provisory modern theories, mainly speculatively founded. Apart from the deep gulf towards the classical physics, the new theories are also mutually independent, incompatible or even colliding with each other.

Though not being clearly declared, the four aspect of the unification are understood at least tacitly. The *empirical* aspect mutually relates physical forces, as the evident interactive quantities, looking for the unique essence of their phenomenal forms. The *formal* aspect compares and relates respective laws expressing the forces, tending to as less as possible their number, in the simplest mathematical forms [1]. The *rational* aspect relates the physical substances or respective particles, interacting   by the forces. The *intuitive* aspect   has in view

physical quantities or natural categories, also tending to their mutual relation. Apart from the incomplete classical theories, far away from the idea of unification, the modern ones are speculatively oriented. Instead of the reduction of the mentioned concepts (of the forces, laws, substances and quantities), they are further multiplied, with respective complication of their relations.

In particular, the force action law formally unifies longitudinal and transverse inertias. The former of them, dependent on respective acceleration, transfers the energy, but latter one tends to the rectilinear path, without any energy transfer. The static and dynamic electric fields, dependent on the object position or acceleration, respectively, are related by the common objects. Their relation with the magnetic field is founded on the causal loop of the equations [1]. Some nuclear forces of the unknown natures, keeping the nucleons together, have been also predicted. The initial idea of the principal unity of all the natural forces had been understood already by R. J. Bošković (1711-78). Taking over this idea, Faraday expected their reduction to the same essence. The mentioned principal unity Einstein restricted to the force pair: gravitation and inertia. In Faraday's sense, we are looking for the essential unity.

Bošković also mentioned a unique natural law. In fact, with the understood common nature of all physical forces, he considered their structural relations. Though in principle confirmed by the later science, his diagram of the summary force stayed out of the mainstream development, without a serious role or influence. The further development was partial and insufficiently systematic. For instance, though being a special case of force action, the law of inertia is still kept in the basic set. Moreover, the force action will be here reduced

to the force balance, as the third law. So far unknown and unexpected, respective proof is mediated by EM forces, equivalent with mechanical ones.

The typical pair of unrelated laws is the force balance and energy conservation. Though the former equation multiplied by some object displacement equals the invested and accepted energies, this fact cannot be found in any textbook. The relation of various substances is not better at all. Mass and electricity are treated as the two independent concepts, of the vague essences and origins. Failing in the convincing interpretation, their mutual relation via electrical inertia has not been accepted. Irrespective of modern speculative theories, expected to give a unique natural law, we are going to start from the known classical relations.

2. Static Relations

The central form of the two static laws, announcing their similar formal frames at least, is not sufficient for their essential unification. The main distinction consists in the unipolar mass with exclusively attracting gravitation, against bipolar electricity and respective forces. However, the radial integration of Coulomb's law (1) mutually relates the two substances. The factor n simplifies the procedures and enables the transparent comparison and relation of the quantities. The radial force integral – from the particle surface – up to infinity, gives the field energy, in the form of Einstein's equation (2). The factor n is thus turned into $m = nr$, expressing the electrical inertia.

$$f = nc^2 \qquad n = \mu qQ/4\pi r^2 \qquad (1)$$

$$w = mc^2 \qquad m\ (=)\ \mu q^2/4\pi r \qquad (2)$$

The last conditional equality concerns the particle interaction with its own field, where r_o is the distance of the surface charge – as the object, from the particle center – as the formal field carrier. Amongst various particle models, a surface charged balloon is the simplest one for calculation at least, irrespective of the particle structure. Owing to the external integration, mass is inversely proportional with the particle radius, and thus the smaller particles show greater masses. With the known mass and charge, so called classical electron radius had been predicted.

This result was further checked by the electrons passing through certain apertures. Not only that they passed trough mach narrower fissure from the predicted diameter, but one electron passed through two near apertures, keeping its own identity, thus calling in question the radius at least. However, if we understand some medium disturbance – instead of the hard particle, the classical radius may be accepted. Empirical results also depend on their interpretations.

Moreover, the mass equivalence with the field energy is the best interpretation of Einstein's equation. The relation of mass and electricity (2b) is the additional crucial step of the unification. If we replace the radius to the left side, its product with mass determines the square of charge, irrespective of its polarity. Expressed by the product of the two inversely

related quantities, the elementary charge does not depend on the particle radius and mass. Unlike this formal relation concerning a single particle, their multiplicity gives the impression of respective substances.

3. Kinetic Relations

Long time after Aristotle, being confused by the matter resistance, Galileo simplified the laws of mechanics by restriction to the empty space. The longitudinal resistive reaction was thus temporarily neglected. However, this crucial U-turn followed into the opposite wander. Neglecting the matter, kinetic effects were overlooked. The motion through fluids, diminishing transverse pressures, may influence the path in return. A moving body axially symmetric, without a transverse spin, keeps the straight path.

The asymmetric body or its spin would disturb the balance, curving the path. The smaller pressure on the external path side just opposes the cause of the curvature. This relation can be applied to the transverse inertia at the vacuum medium being super-fluidic. Affecting the particles, such forces are independent of the body shape.

Figures 1 and 2 illustrate the typical kinetic forces. Two parallel flows attract each other by the lower transverse pressures, but opposite ones repel by the vortices in between. For the same reasons, two opposite vortices mutually attract, but similar ones repel each other.
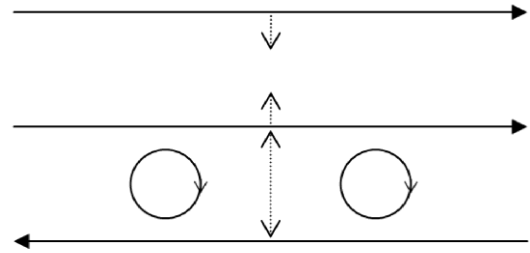

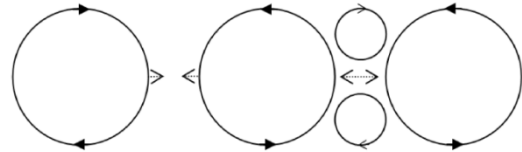**Figure 1.**   Kinetics of parallel flows

Figure 2.   Kinetics of coplanar vortices

The two static forces (gravitational and electric) can be thus essentially mutually distinguished. Unlike the gravitational attraction of the parallel flows of matter from the past into future, the bipolar electric forces point to the vortices of the medium, as the essence of electricity. With respect to the triplet of spatial axes being arbitrarily oriented, the polarity is referred to the given temporal axis, also implying the different radii and masses [2].

The kinetic forces are known from EM theory [1]. Ampere's law (3) in principle explains the above cases. Here **v** is the speed of the object charge (q) moving through the

magnetic field (**B**) of a carrying current (**J** = VQ).

$$\mathbf{f}_k = q\mathbf{v} \times \mathbf{B} \qquad \mathbf{B} = \mu\mathbf{J} \times \mathbf{r}_o/4\pi r^2 \qquad (3)$$

Treating the object-field motion [1], this law is reduced to (4) – in the scalar or vector form. Coulomb's law (1) looks alike a special case of this one, at the two equal imaginary speeds: $v = V = ic$. According to the fluidic essense, magnetic forces act between currents, but electric ones between vortices, distinct by the factor i.

$$qvB = f = -nvV \qquad q\mathbf{v} \times \mathbf{B} = \mathbf{f} = -\mathbf{n}(\mathbf{v}\cdot\mathbf{V}) \qquad (4)$$

The sum of the static (1) and kinetic (4a) forces gives the chain (5). Owing to the same electric flux through each embracing sphere, the spherical field integral does not depend on the particle radius. According to (2b), the summary force difference implies the sequence (6).

$$n(c^2 - v^2) = nc^2(1 - v^2/c^2) = nc^2g^2 = n_o c^2 \qquad (5)$$

$$n = n_o/g^2 \qquad r = r_o g \qquad m = m_o/g \qquad (6)$$

As the particle radius cannot loss below naught, the motion is restricted by the speed of light. This derivation further confirms the mass essence. Introduced as the substance, it just accords with the field energy. The energy itself, not reducible to anything else, may be formally taken as a basic substance. Apart from such derivation of the mass function (6c) by H. A. Lorentz, its cosmological confirmation has already been presented in [3].

4. Dynamic Relations

Radial integral of Ampere's law (4b) turns the field into potential and force into energy (7a), thus relating the kinetic potential with linear momentum (7b). Their temporal derivatives give the laws of induction (8a) and force action (8b), further relating the two classical systems.

$$q\mathbf{v}\cdot\mathbf{A} = w = m\,\mathbf{v}\cdot\mathbf{V} \qquad q\mathbf{A} = m\mathbf{V} \qquad (7)$$

$$\mathbf{E} = -\partial\mathbf{A}/\partial t \qquad q\mathbf{E} = \mathbf{f}_i = -\partial(m\mathbf{V})/\partial t \qquad (8)$$

At a single moving particle (**V** = **v**), the inertia is resolved into its *kinetic* and *dynamic* components:

$$\mathbf{f}_i = -\mathbf{r}_o mv^2/r - \mathbf{v}_o\partial(mv)/\partial t \qquad (9)$$

Here $r\mathbf{r}_o$ is the path curvature radius. The two forces are expressed by the common law. The former force component, as the ratio of the energy and radius, depends on the speed and tends to the rectilinear motion, keeping the constant energy. The latter force component, determined by the object acceleration – irrespective of the speed value, transfers the energy between the opposite forces.

Owing to the variable mass (6c), the dynamic force is further resolved (10). Substituting the mass derivative (11), there follows the full dynamic force (12).

$$\partial(mv)/\partial t = m\partial v/\partial t + v\partial m/\partial t \qquad (10)$$

$$\partial m/\partial v = mv/(c^2 - v^2) \qquad (11)$$

$$f_d = m\partial v/\partial t + v(\partial m/\partial v)(\partial v/\partial t) = (m/g^2)(\partial v/\partial t) \qquad (12)$$

The chain (13) gives the energy transfer, where the last

equality follows from (11). The integral of the external equality gives the known result (14). It has been also interpreted in the cosmological sense [3].

$$\partial w = p\partial t = vf\partial t = v\partial(mv) = v^2\partial m + mv\partial v = c^2\partial m \quad (13)$$

$$w - w_o = (m - m_o)c^2 \qquad (14)$$

On the other hand, the static and dynamic EM forces are understood as unique. Despite their distinct forms, respective fields affect all the present electricity, as the basis of the effective unity. This is also formally affirmed by addition of their two definitions via the potentials:

$$\mathbf{E} = -\nabla\varPhi - \partial\mathbf{A}/\partial t = (\partial A_t/\partial r - \partial A_r/\partial t)\mathbf{i}_r \qquad (15)$$

The electric forces are reduced to the left super-toroidal vortex. The needed condition, $\varPhi = -A_t$, will be explained in [2]. This vortex at each **r**t-plane, in the right form, is defined in 4D space. Unlike the axial vector of the magnetic field [1], perpendicular to respective vortex, this one is a polar vector, situated in the vortex plane. Electric and magnetic forces thus distinguish in practice.

5. General Natural Law

The two energies, complementary in the ballistics or celestial mechanics, applied to the air molecules relate the atmospheric *gravitational* and *thermal* energies, with the decreasing temperature by the height. The wind energy has been added by Bernoulli. Without external influences, the sum of the three volume densities is kept:

$$W_g + W_t + W_k = \text{const.} \qquad W_i = \partial w_i/\partial o \qquad (16)$$

Irrespective of its strict theoretical explanation, this equation has been practically confirmed, accepted and applied. Apart from the two mechanical components, the middle (thermal) energy density – as the atmospheric pressure (17) – is strictly determined by the particle concentration (N) and local temperature (T), including the kinetic and potential particle energies. The constant (k) here accommodates the thermal with mechanical units. In the presence of wind, as the air current, the same energy at a height implies respective loss of the transverse pressure.

$$W_t = P = kNT \qquad N = \partial n/\partial o \qquad T = mv^2 \qquad (17)$$

With respect to the energy investing (18a), the reactive force is determined by gradient of the accumulated energy (18b). Applied to (16), this equality gives the equivalent force balance (19). Owing to its validity for all forces, the law (16) may be generalized to all the energies throughout the cosmic space, as the closed domain. The zero power of a closed composition further generalizes this law to the temporal axis. The partial tendency to the homogeneous thermal energy is known as entropy.

$$\partial w = \mathbf{f}\cdot\partial\mathbf{r} \qquad \mathbf{F} = -\nabla W \qquad (18)$$

$$\nabla\Sigma W = \Sigma\nabla W = -\Sigma\mathbf{F} = \mathbf{0} \qquad (19)$$

The energy homogeneity implies all the other classical laws at least. If we consider the two electric polarities as the

opposite energetic disturbances of the medium, the energy homogeneity demands the neutrality of each spatial location (20), as the sum of the charge densities of various structural strata. Coulomb's law between two charges thus expresses such tendency in matter, with the linking electric field as the opposite medium disturbance.

$$\Sigma Q = Q_1 + Q_2 + Q_3 + ... = 0 \qquad Q_i = \partial q_i/\partial o \qquad (20)$$

The total electrical neutrality – including the matter and vacuum medium, has been shown already by Faraday. Some electric charge, inserted into a metallic sphere, causes the surrounding radial polarization, including vacuum and the conducting spherical walls. Discharging the external surface charge, Faraday established its equality with the inserted amount. The neutrality is thus confirmed.

Keeping the media neutrality, an accelerated charge demands the opposite set in motion of all the present electricity. This medium reaction, known as the dynamic induction, also affects the initial charge, against its own acceleration. The sum of such forces affecting structural particles is manifest by the inertia. Unlike the surrounding induction, it is restricted in space to the body volume.

In the fluidic interpretation of EM quantities [1], the longitudinal kinetic potential, axially symmetric around the particle, keeps the rectilinear motion. Such summary effect influences moving bodies, irrespective of their shapes. The two kinetic forces are thus unified, including static ones, projected from the temporal domain.

6. Structural Strata

Owing to the expected free space, there is difficult to accept the same energy densities inside stars and throughout interstellar space. Unlike the evident – explicit matter, the implicit medium has been ignored or denied [1]. The quantitative structural stratification is formerly announced by the summary force of R. J. Bošković [4].

Instead of his detour confirmation, founded on the continuity principle applied to the colliding bodies or particles, we here rely on the balances in the pairs of various forces. The typical diagram (Fig. 3) is similar for the planetary orbits or diatomic molecules. The positive forces predominate on the smaller, but negative ones – on greater distances, with the balances at their mutual equalities. A sequence of such diagrams along the structural axis [3] announces the full summary force (Fig. 4).

The sum of eight assumed forces is here presented. Their projection on the distance, in the role of the structural axis, is expressed by the arrows. Amongst the seven sections of the diagram with abscissa, these four at the colliding arrows represent stable, but the three ones between them – unstable distances. The force integral would give the similar diagram of the energy displaced along the abscissa, so that the more rear energies accord with the stable, and denser – with unstable states. Tending to the less energies, the particles fulfill the stable states, but unstable ones stay empty. In this manner, matter is structurally stratified.
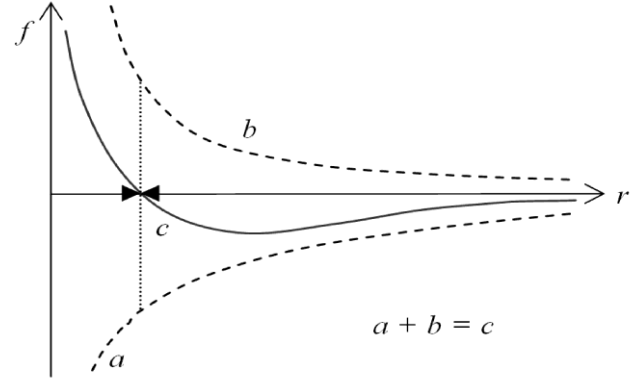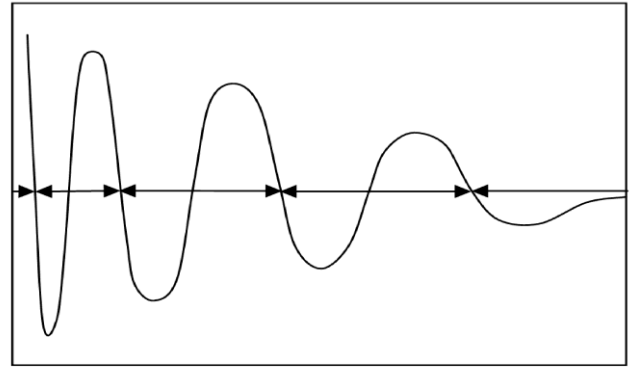

Figure 3. A force balance

Figure 4. The sumary force

Owing to the great ratios of the successive strata, both axes of this diagram are nonlinear. Some differences between the successive forces and their domains are still visible. Going from the right of the abscissa, the forces are as stronger as their domains are narrower. The strongest forces Bošković expected between the bodiless particles on the absolute level. The next forces, still unknown in physics, he ascribed to the assumed spiritual strata. He also not excluded some unknown forces on the greater scales, after gravitation. Really, the alleged galaxy distribution about a spherical surface cannot be explained by the orbital forces, such as in a planetary system or galaxy.

Electric processes emphasize three structural strata: vacuum, dielectric and conducting ones. Apart from the distinct vacuum and matter, each of them can be further stratified. Present fields also stratify the medium. Magnetic materials may be treated as a separate stratum.

The continuity equations substitute charge densities (20) by respective electric fields (21), thus closed into each other. Though located at various strata, the components continue each other, making a unique closed field.

$$Q_i = -\nabla \cdot \mathbf{D}_i \qquad \nabla \cdot \mathbf{D} = \nabla \cdot (\mathbf{D}_1 + \mathbf{D}_2 + \mathbf{D}_3) = 0 \qquad (21)$$

This neutrality thus relates the vacuum ($_0$) with material structural strata: dielectric ($_1$) and conducting ($_2$) ones:

$$\nabla \cdot (\mathbf{D}_0 + \mathbf{D}_1) = -\nabla \cdot \mathbf{D}_2 = Q_2 \qquad (22)$$

$$\nabla \cdot \mathbf{D}_0 = -\nabla \cdot (\mathbf{D}_1 + \mathbf{D}_2) = Q_1 + Q_2 \qquad (23)$$

These two equivalent results represent static Maxwell's equation. The total electric field is terminated by free electricity only (22), unlike the vacuum component terminated by the bound and free material electricity (23).

7. Quantity Reduction

Physical quantities are the scientific notions of physics. A number of them apparently mutually independent, introduced intuitively from the experience, represents the basic set. By the rational algebraic relations, all the other quantities and their measuring units are derived from this set. Owing to their rational relations still indistinct, the basic quantities have been related empirically, by the basic laws, with physical constants for their dimensional reconciliation. An open scientific system of n basic quantities demands $n - 1$ basic laws. A system of the less law number is undetermined, but that of greater one – predetermined. The former case demands additional laws, but latter one – the elimination of excessive laws by their mutual relation. The explanation of a basic law turns it into the rational relation, thus diminishing the basic sets. Therefore, this can be made in advance, by elimination of the constants.

The presented relation of some basic quantities or laws has reduced them to the frame of four metrical axes, so that 4D space and energy remain as the two natural categories. The scientific system is thus closed by the energy homogeneity (16), equivalent with the force balance (19). Before these relations, the quantity reduction had been made conditionally, substituting the constants by numerical units, up to Natural System of the quantities and units. The elimination of the two constants (24a) dimensionally equals electric and magnetic fields. Owing to (24b), the speed of light (c) also equals to unit [1], with the metrical temporal axis: $x_4 = t$. This solution had been preceded by a few incomplete rationalizations. Apart from the practical system (SI), special relativity used that of Heaviside (24c), also obeying (24b). The metrical fourth axis was there obtained as the product with the cosmic process speed [3]: $x_4 = ct$.

$$\varepsilon_o = 1 = \mu_o \quad \varepsilon_o\mu_oc_o{}^2 = 1 \quad \varepsilon_o = 1/c_o = \mu_o \qquad (24)$$

The incomplete rationality of mechanics thus demands the subsequent elimination of gravitational constant. Really, its unit value finally mutually equals all the basic quantities: *length*, *time*, *mass*, *electricity* and even *energy*. Owing to the huge authority of this constant, gained by the long time, such solution has not been even noticed, let alone applied. Instead, the unit Plank's constant, relating the energy and frequency of a photon, is proposed. The gravitational constant thus turns into surface dimensions, so as the Plank's constant – in the former solution. This fact implies a surface in one of the two laws, not so far taken into account nor noticed in practice. This is unbelievable in the law of gravitation at least. However, if we substitute the photon frequency by the proportional sector speed, both of the two mentioned physical constants will be equally reduced to units. The explanation of this procedure will be supported by the convenient photon model [2].

8. Conclusions

Physical forces are explained by variable pressures of the media, as the structural strata. Kinetic and dynamic forces react on the object motion or acceleration. The static forces are reduced to kinetic ones, from the cosmic process. The forces arisen in various structural strata oppose each other, obeying the balance at each point of space.

This balance is expressed by the third Newtonian law. The forces oppose the gradients of respective energies, so that the force balance accords with the homogeneous summary energy, in the General Natural Law. Bernoulli's equation is its particular case, applied to the three energies and respective forces at fluidic media.

Kinetic forces between the flows or vortices, as the polar or axial vectors, may be distinguished by the imaginary unit. The real exponent in Laplace's transformation concerns the energy transfer between two strata, but imaginary one – its barter at cyclic processes. The double number of the axes in the string-theory may be thus understood.

The static potentials are reduced to the opposite energetic disturbances, and so the energy homogeneity implies electrical neutrality of each spatial location, as the sum of various polarities from respective strata. This law implies the other laws of EM theory. Applied to elementary particles, they explain the known laws of mechanics.

Amongst the three natural categories (space, time & matter), time is included into 4D, as the additional metrical axis [3]. Determining the direction of the cosmic process, it is privileged in relation to the spatial axes. The relation of 4D space and energy, as the two remaining natural categories, is expressed by the General Natural Law.

The related natural laws mutually relate mass, electricity and energy, as the substances. Mass is reduced to the energy around the particles, but electricity – to structural relations. A plenty of particles gives the impression of the substances. As the union of the open disciplines, the unique physical science is closed by the cosmic process.

The fifth axis is illustrated by the human senses, operating on various structural levels. Unlike the molecular motion manifest by the temperature, the wind affects touch, with respective transfer of the thermal energy. Unlike the macro-kinetic forces, dependent on the body shapes, respective micro-forces – affecting elementary particles, are symmetric at least statistically.

The denser energies and stronger forces determine less compressible media and greater speeds of signal propagations. Such infinite speed may be expected through the dotted structure on the absolute level. An event from a point would be immediately present in the whole cosmos, thus exceeding the apparent notions of space and time.

REFERENCES

[1]   B. V. Mišković: Foundation of Electrodynamics, Int J Phys Stud Res 2023; 4(1): 98-103. Doi: 10.18689/ijpsr-1000115.

[2]   B. V. Mišković: Essence of Matter (still unpublished).

[3]   B. V. Mišković: Curvilinear Cosmology. Int J Cosmol Astron Astrophysics 2023; 5(2): 231-231. Doi: 10.18689/ijcaa-1000143.

[4]   R. J. Bošković: A Theory of Natural Philosophy, Any edition.

[5]   The references of [1] & [3] may be also taken into account.