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*Editorial*

# Editorial for Feature Papers 2021–2022

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This Special issue contains top-tier physics-related and mathematical research, among other topics, written by scholars who are well-known in their field. It will undoubtedly attract the attention of researchers working in related areas.

Ref. [1] is devoted to the proposal of a non-perturbative vacuum in SU(2) gauge theory with a spinor field. This is an extremely important subject; so far, studies in quantum field theory have mainly used perturbative methods.

In ref. [2], an approach to constructing semiclassical spectral series for the generalised multidimensional stationary Gross–Pitaevskii equation with a non-local interaction term is developed. The eigenvalue problem is solved for the non-local stationary Gross–Pitaevskii equation based on the semiclassical asymptotics of the Cauchy problem of the parametric family of linear equations. These equations are associated with the time-dependent Gross–Pitaevskii equation in an extended dimension.

In ref. [3], the algebraic formulas of the symmetry operators for the Hamilton–Jacobi and Klein–Gordon–Fock equations are found for a charged test particle moving in an external electromagnetic field in a spacetime manifold with an isotropic (null) hypersurface, of which a three-parameter group of motions act transitively. The results are of considerable interest because they offer potential solutions to a number of problems, which are important for the development of the theory. Firstly, it is possible to consider a similar problem of admissible electromagnetic fields classification for the Dirac–Fock equation, since non-commutative integration is also applicable to this equation. Secondly, the resulting classification can be used to find the basic solutions to the Klein–Gordon–Fock equation and other quantum-mechanical equations of motion via non-commutative integration.

Ref. [4] is devoted to the study of the second Painleve equation. Specific transformations are given and Jordan generalisation of such equation is proposed.

In ref. [5] some wave-like symmetric models are investigated in higher derivative gravity with a scalar field. Such studies are important in relation to ongoing research on gravitational waves in the early Universe.

Ref. [6] provides explicit proof that all known holographic dark-energy models which are extensively used for the description of the late-time dark universe are examples of generalised Nojiri–Odintsov holographic dark energy introduced in ref. [7]. This offers a number of new possibilities in the construction of realistic history of our universe from the very beginning. In fact, it also permits generalisation for unification of inflation with the dark-energy era via a generalised holographic Nojiri–Odintsov cut-off model. An explicit example of such unified universe history is provided in ref. [8].

In ref. [9], Prof.Obukhov finds all external electromagnetic fields in which the Klein–Gordon–Fock equation admits the first-order symmetry operators, provided that in the space–time V4, a group of motion (G3) acts transitively on a non-null subspace of transitivity V3. The obtained results can be used as follows. First, the obtained metrics define homogeneous spaces; thus, the results are of interest in cosmology, especially for the processes which occurred in the early stages of the Universe's evolution. Second, the results can be used to obtain exact self-consistent solutions in the General Theory of Relativity, in the scalar–tensor theory of gravity, for the Vaidya problem, as well as in the integration of field equations in other gravitational theories.



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Ref. [10] is devoted to the study of symmetric solutions within SU(3) non-abelian Proca theory coupled with the Higgs scalar. Such solutions describe tubes containing the flux of a color electric field.

In ref. [11], the authors study thermodynamics of specific Barrow holographic dark energy. They also demonstrate that such a model is just one more example from the class of Nojiri–Odintsov holographic dark-energy theory. Thus, this study expands the research on the thermodynamics of modern universe.

In conclusion, the papers published in this Special Issue explore hot topics in Physics and Mathematics. Special Issue Feature Papers 2023 will continue to attract high-quality research papers.

**Conflicts of Interest:** The author declares no conflict of interest.

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