Advances in High Energy Physics

Hindawi

Special Issue on
Non-Minimal Coupling and Fractional Gravity 2023

CALL FOR PAPERS

The foundation of general relativity (GR) lies in extending the conservation of energy-momentum tensor from flat to curved spacetime. Previous studies have examined this principle in Earth labs, where spacetime is flat. The success of GR suggests that this principle also holds in curved spacetime. Consequently, any limitations or inconsistencies in GR could be indicative of a need to reconsider the energy-momentum conservation law (EMCL) in curved spacetime. As a result, one possible approach is to expand upon GR by allowing for the divergence of the energy-momentum tensor to be connected with curvature tensors, such as the divergence of the Ricci scalar.

Therefore, an initial result of this line of thought is the potential to extract energy (spacetime) from the fabric of spacetime (the source of energy momentum). These modifications to the theory of GR, which involve a coupling between geometry and matter fields that is not minimal, were first explored by P. Rastall. The concept of unimodular gravity (originally introduced by Einstein), the uncertainty principle, and the process of particle production during the evolution of the universe may also strengthen the notion of departing from the Equivalence Principle in curved spacetime, thereby leading physicists to take the non-minimal couplings more seriously. Additionally, there is an intriguing approach based on fractional calculus to redefine gravity. This perspective proves useful in modeling and comprehending fractal behavior and appears to have the potential to shed light on the mysterious aspects of the cosmos. On the other hand, these systems are also believed to be explained using generalized statistics. In this context, there is also a link between quantum aspects of gravity and deviations from the usual extensive and additive statistics. Naturally, the long-range nature of gravity serves as a further motivation to consider generalized statistics as a means to justify gravity and related phenomena.

This Special Issue focuses on the implications of considering non-minimal couplings, generalized statistics, and utilizing fractional calculus to describe gravity, high energy physics, and the corresponding cosmological and astrophysical consequences. We welcome original research articles as well as review articles that tackle the current challenges in these fields, including dark energy and dark matter problems, fine-tuning and cosmological coincidence puzzles, inflation physics, H0 tension, the physics of black holes, the Sun and other compact objects, structure formation and its characteristics such as the Jeans criterion, Chandrasekhar limit, and Chandrasekhar stability, the nature of holographic screen and spacetime, and more.

Potential topics include but are not limited to the following:

- The effects of non-minimal coupling on the structure formation in various scales
- The effects of fractional calculus, generalized statistics, and non-minimal coupling on symmetry and cosmic evolution
- Various motivations and origins for the existence of non-minimal coupling and fractional calculus
- The effects of (fractional calculus) non-minimal coupling on the quantum features of gravitational systems
- The astrophysical implications of the existence of non-minimal coupling, fractional calculus, and generalized statistics, such as their effects on MHD equations
- Physical and mathematical properties of compact objects in the presence of non-minimal coupling
- Various properties of black holes, wormholes, and other objects in the formalism of fractional calculus
- The implications of (fractional calculus) non-minimal coupling on the predictions of quantum field theory in curved spacetime
- The quality and properties of gravitational waves in these viewpoints

Authors can submit their manuscripts through the Manuscript Tracking System at https://review.wiley.com/submit?specialIssue=361165.

Papers are published upon acceptance, regardless of the Special Issue publication date.

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