Advances in High Energy Physics

Special Issue on
Classical Extensions and Alternative Theories of Gravity

CALL FOR PAPERS

In Einstein's formulation of general relativity, matter and energy shape a smooth universe, and it is always possible to describe in a continuous process, progressively smaller portions of spacetime. General relativity presupposes a universe in which, as we trace its evolution backward in time, the hotter and denser it was, the faster the universe was expanding. With matter or energy bending the space and time around it, and nearby objects following those curved paths, gravity corresponds to the geometric shaping of spacetime itself. According to the theory of general relativity, around 13.7 billion years ago, at absolutely extremal physical conditions, the universe originated from a singularity in the spacetime fabric, with immeasurable density. These extreme conditions in the initial state of the universe, where the laws of physics break down, are outside of our experimental capabilities. This limits profoundly our understanding of the cosmos and gravity, implying the loss of logic, formal consistency, and descriptive predictability of its evolutionary process.

Currently, classical theoretical models only allow speculations about how to avoid physical singularities or about the physical conditions that may have prevented this drastic consequence of general relativity. Accepting this image of singularities of infinite density in the spacetime fabric, we must ask ourselves whether this scenario corresponds or not to a realistic representation of a primitive dense universe. This prediction may undoubtedly represent a limitation of general relativity, leaving room for the development of classical alternative theories that might overcome these restrictions. The fundamental dilemma of extended and alternative classical theories of gravity is that they have to comply with general relativity in the limits of weak gravitational elds. On the other hand, astrophysical observations indicate that enormous amounts of dark matter and dark energy are needed to explain the observed large-scale structure of the universe and cosmic dynamics. The image that emerges from the standard model is of a homogeneous, spatially flat universe, which in its evolutionary process goes through an accelerated phase, triggered by the dark energy sector. However, the nature and origin of dark energy and dark matter, which must make up the bulk of the energy of cosmological matter, are still unknown. Accordingly, these theories have to explain the large-scale structure of the universe without taking into account the puzzling effects of dark matter and dark energy.

The aim of this Special Issue is to collate original research articles, as well as review articles, on theoretical advances about classical extensions, and alternative theories of gravity that do not necessarily involve either quantum mechanics or the unification of forces. This Special Issue can make exceptions for submissions focussing on classical theories that may potentially provide some insight into the quantisation of gravity.

Potential topics include but are not limited to the following:

- Alternative field theories, and extensions to general relativity
- Algebraic extensions of the theory of general relativity
- Pseudo-complex general relativity
- Scalar field theories
- Quasilinear theories
- Tensor field theories
- Scalar-tensor field theories
- Vector-tensor field theories
- Non-metric theories
- MOND (Modified Newtonian Dynamics)
- Quintessence
- Tests of general relativity, extensions and alternative theories
- Cosmological constant problem

Authors can submit their manuscripts through the Manuscript Tracking System at https://mts.hindawi.com/submit/journals/ahep/catg/.

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

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