Advances in High Energy Physics

Special Issue on
Implications of Gravitational Particle Creation

CALL FOR PAPERS

Leonard Parker discovered in the early sixties that the expansion of the Universe can create particles out of the vacuum. In short, he pulled together two basic pillars of physics, quantum mechanics and general relativity, and realized then that particles can be spontaneously produced by the expansion of the Universe or, in general, by a time-dependent gravitational field. The Cosmic Microwave Background (CMB) was discovered around the same time, which completely changed the view of Cosmology and put the Big-Bang Theory on a strong footing. In 1992, the COBE (Cosmic Background Explorer) satellite detected for the first time small fluctuations in the average temperature of 2.7 Kelvin. This has later been confirmed by many other experiments, including the Planck satellite. Quantum field theory in curved spacetime and, in particular, cosmological particle creation provides the mechanism driving primordial perturbations which seeded the tiny fluctuations in temperature observed in the CMB. It also helps to explain the clumping of matter that gave rise to galaxies and galactic clusters. Using Parker's formalism, Hawking realized in 1974 that black holes also create particles, in a way deeply connected with thermodynamics. Hawking's beautiful result was very influential. It revealed that the second law of thermodynamics was valid for systems that included black holes. This established a deep connection between thermodynamics and general relativity.

In recent years, gravitational particle creation is being considered as a viable alternative to Dark Energy (DE) models due to difficulties in identifying the true nature as well as the origin of DE which is considered to have exotic properties such as a huge negative pressure. The Cosmological Constant, which is supported by most observations as the driving force behind the late time cosmic acceleration, is also plagued by serious problems such as the Cosmological Constant problem and coincidence problem. At this juncture, the natural process of particle creation is speculated to explain not only the presently observed accelerated epoch of the Universe but also the inflationary phase in the early Universe as prophesied by Alan Guth in 1981.

In this special issue, we would like to focus on understanding the significance of the gravitationally induced particle creation mechanism in the context of Cosmology. We also hope to gain insights into the true nature of gravitation particle creation. In this sense, we welcome original research articles as well as review articles on theoretical advances on the following topics.

Potential topics include but are not limited to the following:

- Thermodynamic implications of gravitational particle creation
- Gravitational particle creation in modified and higher dimensional gravity theories
- Dynamical system analysis of particle creation models
- Emergent universe constructed from gravitational particle creation
- Particle creation in black holes
- Particle creation in early universe
- Other applications of gravitational particle creation in the context of Cosmology

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

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

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