Advances in High Energy Physics

Special Issue on

Black Holes and Information Loss Problem

CALL FOR PAPERS

Black holes are arguably the most exotic objects in the Universe. They represent one of the few arenas for the interplay between the three most successful theories of modern physics: General Relativity, Quantum Mechanics, and Thermodynamics. In particular, they provide a unique window to test candidates to the long sought theory of Quantum Gravity.

Since the seminal works of Bardeen, Bekenstein, Carter, and Hawking in the seventies, combining General Relativity and Quantum Field Theory, we know that black holes behave like thermodynamical systems. While this synthesis has provided many important insights into the fundamental nature of spacetime geometry, a consistent and complete understanding of the microscopic origin of black hole thermodynamics is still out of reach. Moreover, the thermodynamical description leads inevitably to the conclusion that black holes destroy information, a feature which cannot be reconciled with the postulates of Quantum Mechanics. In relation to this, also the end of the evaporation process is still a quite debated aspect. Attempts to solve such "information loss paradox" have motivated many research programs in the last forty years, but the conundrum remains still today and it represents one of the main open problems in theoretical physics.

In the last ten years, Quantum Information theory has constantly gained importance in understanding the information loss problem from a more foundational perspective and, at the same time, in investigating the fundamental nature of space, time, and matter. The information theoretic interpretation of the notion of entanglement has provided new tools to investigate the pregeometric quantum texture of spacetime in several background independent approaches to quantum gravity. In string theory, in the context of the AdS/CFT correspondence, a holographic notion of entanglement for quantum field theories with bulk holographic duals has been used to study the emergence of the thermal properties of the dual spacetime.

This special issue is intended to collect contributions from scientists working on the fields of black hole physics and information theory, with the aim to enhance and exploit a cross-fertilization of ideas and techniques of crucial importance towards a quantum description of the gravitational field.

Potential topics include, but are not limited to:

- Black hole entropy
- Hawking radiation in classical and quantum gravity
- Information loss versus energy loss
- Remnants, firewalls, white holes
- Covariant thermodynamics and statistical mechanics
- Holography, complementarity, AdS/CFT correspondence, and nonlocality
- Quantum Information: quantum computation, correlation, quantum (error-correcting) codes, tensor network, and so forth
- Entanglement and emergent spacetime

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