Topological invariants and microscopic quantum description

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Quantum gravity in the framework of string theory provides a microscopic quantum description of charged black holes using D-brane-soliton objects in string theory [1]. Such a D-brane is represented in the form of a brane-antibranch configuration characterized by a magnetic charge, taking on a value in the Hilbert space. Thus, the singularities of black holes are described by the vacuum space-time, which is identified with the physical Hilbert space [2]. According to Rosenberg, the principal bundles over a locally compact space, X, with fibers isomorphic to compact operators on an infinite-dimensional Hilbert space, K, define sections that represent the C^* algebra of sections of the principal bundle. A characteristic class associated with such an algebra is called the Dixmier-Douady invariant corresponding to the Neveu-Schwartz field, H. For an oriented three-dimensional manifold, according to the Rosenberg theorem, there is a classifying element - a Dixmier-Dudi invariant and the morphism, $\beta : H^2(X, Z_2) \to H^3(X, Z)$, which is connected with the Bockstein homomorphism [3]

$$0 \to Z \to Z \to Z_2 \to 0 \ .$$

This relation allows us to associate the bundles of C^* algebras, associated with principal bundles, with the observed states of Hilbert spaces, which corresponds to the phase transition from one soliton state of the D-brane to another. These phase transitions for N large are characterized by K-theory.

References

[1] Juan M. Maldacena. Black Holes and D-branes. *Nucl.Phys.Proc.Suppl.*, 61A: 111-123, 1998.
[2] Rodolfo Gambini, Javier Olmedo, Jorge Pullin. Quantum black holes in Loop Quantum Gravity. *Class. Quant. Grav.*, 31: 095009, 2014.
[3] Allen Hatcher. *Algebraic Topology.* Cambridge University Press, 2001.