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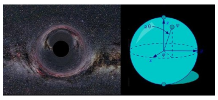
By: Gabriel Gache, Science News Editor

Black Holes and Qubits Appear to Have Quite A Lot in Common

New discovery mathematically links qubits to branes



In the left image there is a simulated black hole, while in the right, there is a simple representation of a qubit
Ute Kraus/Imperial College London

At first glance, black holes and qubits seem to be two completely different entities and indeed they are, although they seem to share a great deal of resemblances. For example, last year, Michael Duff from the Imperial College London first demonstrated a connection between the entropy of a black hole and the ways three qubits can be entangled. And apparently it doesn't stop here, as more and more connections between the two sprung up ever since Duff made his discovery.The latest was found by Duff in collaboration with his colleagues from the Imperial College London and from the Institute of Research in Fundamental Sciences in Iran, and suggest a possible mathematical connection between qubits and branes."These relations between black holes and qubits are still mysterious. The significance of this recent paper is that, by invoking branes wrapping around the extra dimensions, it resolved the puzzle of why black holes should display any kind of two-valuedness: 'To wrap or not to wrap; that is the qubit,'" Duff said. A brane is an extended object derived from the string theory. According to the string theory, our universe is contained in only one of the branes existing in the higher dimensional universe. Four D3-branes intersecting at a certain angle can be used to describe a black hole, for example, but they can also describe an entangled three-qubit state if the branes are wrapped around an extra dimension of space.A D3-brane can wrap around a dimension in two ways, thus describing the two different states of a qubit. Extending the analogy to M2-branes reveals that there are mathematical connections to qutrits as well, which have three possible states. "When two very different areas of physics share the same mathematics, one can learn new things about each field by borrowing techniques from the other. This has been a two-way pay-off and we are certain that yet more correlations will be discovered," Duff said.The new discovery is indeed very exciting, albeit whether or not there is an analogy between the mathematics and the physics of the two systems remains to be seen. And even if they don't, it is almost certain to have some applications in the field of quantum information theory."The weird kind of numbers known as octonions have fascinated both mathematicians and physicists for decades. But in their recent books, both Roger Penrose and Ray Streater have written them off as 'lost causes in physics' because they have so far failed to find any application. However, we believe that the tripartite entanglement of seven qubits (inspired by stringy black holes) provides a way of testing octonions in the laboratory, and this might find applications in QI, for example, in cryptography," concluded Duff.