BLACK HOLES AND WORMHOLES

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Albert Einstein described black holes, in his famous work The General Theory of Relativity published in 1916, as a phenomenon that occurs when a large body of mass strays into an event horizon and a powerful gravitational pull develops sucking everything within its field and not even electromagnetic radiation, for instance, visible light, can escape it. It is a form of an endless pit in the space-time continuum. At the centre of it exists a boundless dense singularity where the fundamental laws of physics do not hold. The basic idea of the black hole was first proposed by an amateur astronomer from Britain known as John Michell in 1783. In the beginning, the concept was usually labelled as the gravitationally completely collapsed objects (Shiga, 2007). The term black hole became more synonymous in 1967 when the American physicist John Wheeler promoted the term. Some refer to the black hole, like the comedian Steven Wright, as instances where "God divided by zero". Even though a black hole cannot be observed directly, astronomers have recorded instances where matter revolves around space objects that appear to be black holes. Recently, physicists from the International University of Bremen, Germany have observed that such space objects could actually be wormholes (Discovery Channel, 2015). Wormholes are described as warps occurring in the fabric of space-time that are theoretically connected through a throat that has an entrance and exit referred to as mouths. These mouths are located in different parts of space and could potentially enable the travel of great distances, even to other universes, at light speed. The general theory of relativity describes wormholes as bridges that create short-cuts in the space-time continuum. Wormholes and black holes are virtually identical, and it would be tough to differentiate between the two (The Physics of the Universe, 2009). Some scientists predicted that the mouths of certain wormholes could be black holes. Science fiction for a long time has depicted the presence of wormholes as a means of interstellar travel. One of the earlier correct depictions of such technology in literature was in the book Singularity (Sleator, 1985) where a kid and his twin brother discover a singularity in the uncle's shack. Another noteworthy film is the Stargate (1994), which was based on the concept of an Einstein-Rosen bridge device. The device would enable fast travel from one universe to another. Other works include The Adventures of Buckaroo Banzai Across the Eighth Dimension (1984) film, and the famous franchise of Star Trek: The Next Generation, (1989). The Star Trek series, in the Price episode, the Star Trek crew hosted an interplanetary mission with the aim of stabilising a wormhole that would enable instantaneous travel between the cosmos. Another is the Star Trek movie franchise which is also filled with tales of travel from one galaxy to another. The most recent and notable film—which many critics considered scientifically accurate with very few quibbles—was the Interstellar (2014). The film was critically acclaimed, and many scientific geeks praised the accurate depiction of wormholes and black holes. The film sought the input of the Caltech astrophysicist Kip Thorne to ensure that the depictions of these cosmic phenomena were as scientifically accurate as possible.

The small community of science enthusiasts and pioneers in the field of general relativity has progressively pursued the theoretical knowledge of black holes and wormholes which led to the discovery of a

way to measure gravitational waves in the 1970's. This step is a move forward towards substantiating the existence of black holes. Although, at present, this technology is a sci-fi trope, and no one can determinately conclude the existence of wormholes. Einstein's general law of relativity equations predicts the existence of wormholes, but so far none have been able to directly observe them. Many scientists assert that a wormhole would collapse upon itself quickly and as such a stabilizing device like a negative energy matter stabilizer would be needed to prop up the wormhole. Recent papers by the famous physicist Stephen Hawking have shaken up the assumption of an event horizon with new theories supporting the firewall paradox (Kramer, 2014). These new developments pit Einstein's earlier general relativity theorem against the new study in quantum theory. This new Paradox draws its observations from thought experiments conducted by Polchinski and investigates the events that would occur if an individual fell into a wormhole. According to Einstein the individual floating into the wormhole would not recognize that fact, and would instead be in a state of no drama. At the event horizon, the individual would be pulled apart and crashed into the wormhole's dense core. For the firewall paradox, in quantum mechanics—to put it lightly, the study of small particles—the individual would not be in a state of no drama but instead would encounter a firewall where the individual would be obliterated. Nevertheless, with general relativity providing only part of the answer, string theory has come to the rescue. The new studies in string theory have tried to establish elegant mathematical equations that can explain the consequences of a black hole. In the meantime, the scientific world has to assume that singularity phenomenon is real and with the recent calculations providing proof of gravitational waves, the future for the technology looks promising.

The cosmic censorship hypothesis posits that a singularity remains invisible behind the event horizon. Thus, the singularity cannot be directly observed since the event horizon does not allow light to escape. Considering this assumption, it would not be possible to examine or understand the singularity event inside a black hole. However, the only exception to this rule is the naked singularity which is attributed to the big bang. In theory, an individual can transmit signals into the black hole, but nothing in the black hole can communicate with other things outside of it. As such, neither the black hole nor the wormhole has been observed even with the sophisticated equipment of the 21st century. Nonetheless, the recent breakthrough in gravitational wave observations, albeit considered an indirect evidence of the black holes, is a welcome discovery. Popular science fiction culture has accommodated and propagated the intriguing possibilities associated with this technology. Examples of such technologies include time travel to the future enabled by the time dilation caused by the predicted special relativity in wormholes; the provision of vast amounts of energy, since any kind of matter that spirals towards a wormhole would gain energy as was shown in the particle accelerator experiment; and lastly gravitational crystals and gravitational shielding. Even so, Wolfram (2016) insists that some technologies advertised in the sci-fi community would be impossible, especially considering the physics behind wormholes and the infeasibility of assembling and harvesting a significant quantity of black holes. So far the only number of black holes that can be indirectly observed in this universe number less than 19. Nonetheless, it does not hurt to hope that such technology would exist in the future.

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