

The Black Hole War: My Battle with Stephen Hawking to Make the World Safe for Quantum Mechanics (Hardcover) , by Leonard Susskind (Author)

This is the review I wrote on amazon.com:

Black Holes, November 16, 2008

By Sanford Aranoff (NJ)

The book discusses a problem. According to Hawking, when an object falls down a black hole (BH), all information is lost. The problem is that this violates a principle of physics that information is never lost. The future cannot lose track of the past, for then the past would cease to exist, as the only meaning to the past is present observations and records. Susskind proposes a solution that took him a decade to resolve, and he discusses this in the book. The solution is the Holographic Principle, which is that all the information inside the 3-dimensional sphere of the BH resides on the 2-dimensional surface. An object falling down a BH never crosses the surface, and so the information is not lost. There is a "dual description" that does not refer to the inside.

Susskind makes heavy use of String Theory to establish the theory. Actually, one can arrive at the same conclusion without the use of String Theory or quantum mechanics, by simply focusing on basic principles of physics and general relativity (GR). According to GR, it takes an object forever to reach the BH, and so it never gets inside. We therefore cannot speak about the inside. Everything falling down a BH is eternally falling, and so the information is not lost. We cannot speak about the inside of the BH. This then is exactly Susskind's Holographic Principle, where all information is outside the BH.

Science, and in particular physics, is a collection of theories. A theory is a mathematical system along with observational and experimental agreement. If it is impossible in principle to perform an observation, the theory cannot speak about that situation. Science also includes guesses, research proposals, and hypotheses, not all of which are theories.

The confusion arises from the formal existence of a solution of GR that from the viewpoint of the falling object, the object crosses the event horizon in finite time. However, since it is impossible in principle to observe an object "entering" the BH, this formal solution does not exist in reality.

If we accept the argument that something that a falling observer (someone who cannot return nor communicate with the rest of the world) can observe is considered as a valid scientific observation, we then lose our ability to criticize people for believing that the dead go to Heaven. The dead person (one who cannot return nor communicate with the rest of the world) observes Heaven. We scientists must be very careful about our scientific reasoning, and not give others the opportunity to twist it to make it sound as if we support religion, as is, unfortunately, often the case.

In summary, the principle of objective observation implies that no object can enter a BH.

Another point is that the formal solution of GR from the viewpoint of the falling observer is not a valid solution of GR. This is due to the proven existence of a singularity at the center. Since the object reaches the singularity in finite time, this solution is not valid. If we insist on accepting this formal solution, we get into paradoxes, as is usually the case when one accepts formal invalid solutions.

According to the Holographic Principle, no future theory can discuss the inside of a BH.

I gave four stars. The book makes excellent reading. It helps clarify some aspects of String Theory. For this, I give it three stars. His points about information residing outside the BH give it another star. I do not give it five stars, as his main point about where the information is can be proven by understanding and applying basic principles of science. We scientists and teachers must never lose sight of basic principles.

Susskind makes the common error of defining a BH as a place where light cannot escape, implying that the idea of an inside of a BH is a meaningful concept, contradicting his own Holographic Principle. A correct definition of a BH is a mass so large that objects falling towards it are time-dilated and red-shifted out of existence.

Another error in the book is mentioning "the 3-dimensional space inside the BH". The geometry is very much non-Euclidean. Approaching a BH is geometrically similar to moving eternally outwards to the "end" of the universe. Speaking about the inside of a BH is geometrically similar to speaking about space outside the universe, i.e., not meaningful.