

Review of: "Philosophical Aspects of Time in Modern Physics"

Abhik Kumar Sanyal¹

¹ University of Kalyani, India

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The author has nicely reviewed the concept of time, starting from the Aristotelian view through to the theory of modern physics. For the sake of completeness, I will add some more information in this regard.

Firstly, the concept of time was nicely depicted much before Aristotle. In the great epic 'Mahabharata,' written by Vyasa, its omnipresence, which shapes society, has been depicted. Further, it is said that the king Kakudmi, while visiting Brahma's realm, experienced a different flow of time. Finally, it is also stated that: 'when everything falls, time is erect; when everything is asleep, time is awake.' In the Vagavad Gita, time has been depicted as an eternal force that governs creation. However, these facts I present merely to remind that people have been thinking about the concept of time from the very early days of human civilization.

Next, at the event horizon, time is infinitely dilated and eventually stops.

Further, the direction of time is the direction in which entropy increases.

Finally, by modern physics, the author meant the 'Special Theory of Relativity' and 'Quantum Mechanics,' while the 'General Theory of Relativity' remains untouched. However, in the absence of a complete 'quantum theory of gravity,' 'quantum cosmology' (the quantization of the cosmological field equations) is studied. The subsequent equation is known as the 'Wheeler-DeWitt equation' (WD). In the WD equation $\hat{H}|\Psi\rangle = 0$, the notion of time does not appear in the quantum domain, and so the equation is true both in the Euclidean as well as the Lorentzian space-time. This eventually means that there is no observer outside the universe, while quantum mechanics requires an external observer. This raises the fundamental conflict between gravitation and quantum mechanics. The concept of time emerges in the classical regime upon semi-classical (WKB) approximation. So, time in GTR is a classical artefact. However, going beyond Einstein's 'General Theory of Relativity' under the inclusion of higher-order curvature invariant terms, it has been noticed that a field variable, such as the proper volume of the universe, plays the role of time.

To be very true, only a viable theory of 'Quantum Gravity' might enlighten the concept of time further.