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The paradox of the arrow of time**Roberto O Aquilano**

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The concept of arrow of time refers to the direction of time flow, uninterrupted from past to future through present. One of its most important features is irreversibility, the inability to move in the opposite direction to this arrow. However, there are those who believe that this asymmetry, where the immutable past is clearly different than the uncertain future, is just an illusion, caused by our inability to perceive certain phenomena and that the direction of this arrow could be reversed. The expression arrow of time was coined in the year 1927 by British astronomer Arthur Eddington, who used it to refer to the direction of time in a four-dimensional relativistic universe. Even though Eddington is talking about the direction of time from the point of view of physical science, our daily experience cannot escape this reasoning. We are used to a universe which, at least at the macroscopic level, tends to disorder. This is called entropy and the universe tends to distribute energy uniformly, thus maximizing entropy. In this case, the arrow of time points in the direction of entropy, so the reverse process is unlikely to happen spontaneously, even if the total amount of energy is conserved. Eddington stated that the arrow of time is vividly acknowledged by consciousness and demanded by reason for him, it indicated the direction in which randomness gradually increases, and following a thermodynamical argument; he concluded that, from the point of view of physics, the arrow of time is an exclusive property of entropy. We know an event happened because we have information (memories, physical evidence and proof) that it actually happened, the past is present there. But is it possible for the arrow of time to flow in the opposite direction? Undoubtedly, at least to the point where we can measure it and perceive it, the macroscopic universe has an arrow of time pointing towards the future. However, there may be events influenced by an arrow of time pointing in the opposite direction, but that we are just incapable of perceiving. Physicist Lorenzo Maccone has published an article [7] proposing that entropy may, besides increasing, decrease. If Maccone is correct, the second law of thermodynamics would become mere tautology- physicists are unable to study processes where entropy decreases because the information that would constitute evidence is in our future. The theory put forward here presents a series of interesting ideas. The most appealing of all is that, if there is an arrow of time pointing in the opposite direction, we could devise a way to ride it and revert the effects of the passing of time in the traditional direction. Unfortunately, not all specialists agree with this point of view and those who do agree are not sure that this direction can be reversed for just a portion of the universe, or if the whole universe's direction would have to be reversed. If we were able to build such a machine, which seems very unlikely, the reversal of the arrow of time would go totally unnoticed. However, this issue is not settled, since there have been experiments at a molecular level that would be in agreement with this position.

Biography

Roberto Oscar Aquilano has pursued his PhD in Astronomy from the School of Astronomical and Geophysical Sciences at Universidad Nacional de La Plata, Argentina. Currently, he is a Researcher at the National Scientific and Technical Research Board (Consejo Nacional de Investigaciones Científicas y Técnicas, CONICET). He is a Professor at the School of Exact Science, Engineering and Surveying at Universidad Nacional de Rosario. He is also a Member of Executive Board of the Agency of the same Ministry, Member of Federal Council for Science and Technology (COFECYT) and Member of the Advisory Committee on Astronomy and the Universe of the Ministry of Science, Technology and Productive Innovation of Argentina. He has an extensive background as a Scientist and an Administrator of science. He has acted as Director of the Astronomical Observatory, Planetarium and Experimental Science Museum Complex of Rosario, Argentina.

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