

Can the Growing Block Model of the Universe Save the Objectivity of Becoming?

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In his talk "Raum und Zeit" given a hundred years ago Hermann Minkowski argued that the kinematical relativistic effects are manifestations of the four-dimensionality of the world. He called this four-dimensional world, which united space and time, the absolute world and insisted that the postulate of the absolute world described the physical phenomena more adequately than the principle of relativity. Had Minkowski lived at least ten more years (given his friendship with David Hilbert) the history of relativistic physics and the modern philosophy of space and time might have looked quite differently.

Minkowski's concept of the absolute four-dimensional world, often called the block universe view, has had a difficult fate. The majority of both physicists and philosophers do not appear to have taken it too seriously. For example, here is what M. Black wrote:

But this picture of a "block universe", composed of a timeless web of "world-lines" in a four-dimensional space, however strongly suggested by the theory of relativity, is a piece of gratuitous metaphysics. Since the concept of change, of something happening, is an inseparable component of the common-sense concept of time and a necessary component of the scientist's view of reality, it is quite out of the question that theoretical physics should require us to hold the Eleatic view that nothing happens in "the objective world." Here, as so often in the philosophy of science, a useful limitation in the form of representation is mistaken for a deficiency of the universe [1].

The obvious question which arises is: How does Black know that "the concept of change, of something happening, is ... a necessary component of the scientist's view of reality"? This cannot be taken for granted even because it is the very question: Is becoming an objective feature of the world or is the world a four-dimensional block universe?

I think anyone - a physicist or philosopher - who rejects the block universe view should do that by demonstrating that that rejection does not contradict the experiments, which confirmed the kinematical relativistic effects. For this purpose these effects should be analyzed by explicitly asking the question of the dimensionality of the physical objects involved in the effects. Take as an example length contraction. Two observers A and B measure the length of a rod that is at rest in A's reference frame. Due to relativity of simultaneity and the fact that the rod as an extended three-dimensional body is defined in terms of *simultaneity* (as all parts of the rod which exist simultaneously at a given moment) it inescapably follows that having different sets of simultaneous events A and B measure *two different three-dimensional rods*. It is evident (if existence is absolute) that three-dimensionalism is immediately ruled out – the worldtube of the rod must be a real four-dimensional object in a block universe in order that two three-dimensional rods (that are different three-dimensional cross-sections of the rod's worldtube) exist for A and B. Hence, rejecting the block universe view and assuming that the world is three-dimensional directly contradicts the relativistic effect of length contraction: the worldtube of the rod would not be a real four-dimensional object, which means that only the three-dimensional rod at rest in A's frame would exist for all observers; therefore there would be no length contraction since all observers in relative motion would measure the same length of the same three-dimensional rod (the same set of simultaneously existing parts of the rod at a given moment, which would also mean absolute simultaneity!).

However, it turns out that one should not be a three-dimensionalist to disagree with the block universe view. Some believe that the so called growing block universe view [2-5], according to which the universe is not entirely but only partly a block (containing the past and the present) not only does not contradict relativity but also provides the basis for regarding becoming as an objective attribute of the world.

The purpose of this paper is to discuss two recent versions of the growing block universe developed by Christian [6] and Sorkin [7]. Christian formulates a version of special relativity "by introducing the inverse of the Planck time at the conjunction of special relativity and Hamiltonian mechanics, which necessitates energies and momenta to be invariantly bounded from above, and lengths and durations similarly bounded from below, by their respective Planck scale values." He maintains that the resulting theory, according to which worldlines grow, "abhors any form of preferred structure, and yet captures the transience of *now* along timelike worldlines by causally necessitating a genuinely becoming universe." Sorkin's objection to the block universe view is "a concrete example – a theoretical model of causal set dynamics – that illustrates the possibility... according to which reality is more naturally seen as a "growing being" than as a "static thing". This example is based on a model of classical sequential growth dynamics for causal sets developed by Rideout and Sorkin [8].

What I will examine is whether these two versions of the growing model are viable alternatives to Minkowski's formulation of relativity. The fact emphasized by Christian and Sorkin that the two mathematical formalisms abhor any form of preferred structure may in fact turn out to be against the claim that these approaches provide the basis for objective becoming. In the same way the original formulation of special relativity given by Einstein excluded any preferred reference frame and it appeared that the concept of objective becoming was not threatened since that formulation was in the ordinary three-dimensional language. But Minkowski demonstrated that the very lack of a preferred reference frame implied that the world was four-dimensional. I will also discuss specific arguments in both papers including Christian's position that becoming and therefore existence can and should be relativized (i.e. made observer-dependent). My conclusion will be that the growing block model of the universe, including its two latest versions, have very slim chances of saving the objectivity of becoming.

References

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