

Can there be becoming in spacetime?

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The answer to this question is straightforward – there is no becoming in spacetime because all events of spacetime exist equally, whereas becoming presupposes that *the* future does not exist (the very expression “*the* future” already presupposes absolute simultaneity in contradiction with relativity).

Despite this logical clarity there have been renewed attempts to find a way to reconcile the notions of becoming and flow of time with spacetime physics. Recently, Ellis, Christian, and Sorkin [1-4] have offered versions of C. Broad’s idea of a growing block universe proposed in 1923 [6].

The recent versions of the growing block universe claim (excluding Ellis) that they do not allow any form of preferred structure. However, I do not see how this claim can be supported if it is explicitly assumed that the existence of physical bodies is absolute.¹ The hypersurface (no matter how complex its shape may be) on the edge of the growing block universe, on which the birthing (or coming into being) of events happens, constitutes an objectively privileged hypersurface (because existence is absolute!) and therefore an objectively privileged (preferred) reference frame. Then it is evident that the growing block universe model also contradicts relativity (to avoid the misconception that modern cosmology introduces a preferred reference frame, see the explanation of the meaning of such a frame in [7], for example).

As we are now marking the 110th anniversary of the publication of Minkowski’s lecture “Space and Time” [8] in 1909, which presented the novel ideas of the four-dimensional physics of spacetime, I think any proposals for introducing notions such as becoming and flow of time in spacetime physics should *first* explain what is wrong with Minkowski’s arguments for the reality of spacetime (= block universe); as far as I am aware, for 110 years they have never been seriously challenged, let

¹To avoid the inescapable introduction of a preferred reference frame by the growing block universe, Christian insists in his paper [3] that existence should be relativized. I will show that relativized existence is incompatible with spacetime physics; moreover, it contradicts the *experiments* that confirmed the twin paradox effect.

alone refuted. I will summarize Minkowski's arguments and will show that they have in no way been weakened by quantum physics (or by any attempts to create a quantum theory of gravitation).

References

1. G.F.R. Ellis, Physics in the Real Universe: Time and Spacetime, *General Relativity and Gravitation* **38** 1797-1824, arXiv:gr-qc/0605049
2. G.F.R. Ellis, Physics in the Real Universe: Time and Space-Time. In [5] pp. 49-79
3. J. Christian, Absolute Being versus Relative Becoming. In [5] pp. 163-195, arXiv:gr-qc/0610049
4. R.D. Sorkin, Relativity Theory Does Not Imply that the Future Already Exists. In [5] pp. 153-161, arXiv:gr-qc/0703098
5. V. Petkov (Ed.), *Relativity and the Dimensionality of the World* (Springer, Berlin 2007)
6. C.D. Broad, *Scientific Thought* (Routledge and Kegan Paul, London 1923). Broad's defense of the growing block model is reprinted as Chap. 8 in P. van Inwagen and D. Zimmerman (Eds.), *Metaphysics: The Big Questions* (Blackwell, Malden 1998)
7. B. Schutz, *Gravity from the Ground Up: An Introductory Guide to Gravity and General Relativity* (Cambridge University Press, Cambridge 2004) p. 357
8. H. Minkowski, Space and Time, new translation in [9]
9. H. Minkowski, *Space and Time: Minkowski's Papers on Relativity*, edited by V. Petkov (Minkowski Institute Press, Montreal 2012).