Why Spacetime is Real

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Abstract

Publications, which explicitly or implicitly reject the reality of spacetime, have been hampering the advancement of our understanding of the physical world for years. The reason is that they all inexplicably ignore Hermann Minkowski's arguments for the reality of spacetime in his 1908 lecture "Space and Time" whose unprecedented strength is that experiments would be *impossible* if the arguments were wrong, i.e., if spacetime were not real (Minkowski's lecture is included as an Appendix). This is inexplicable because we all know well that science does not work in this way – arguments, especially those firmly based on the experimental evidence (such as Minkowski's arguments), are faced and addressed. That is why any discussions of the nature of spacetime or of time (which unavoidably involve the nature of spacetime as well) must explicitly address Minkowski's arguments for the reality of spacetime. Otherwise, such discussions would be nothing more than insignificant unscientific chats or, at best, exercises in the philosophy of language. Although Minkowski's arguments taken alone unambiguously demonstrate that it does appear to be an experimental fact that the world at the macroscopic level is four-dimensional, i.e., that spacetime is real, I will expand them to other kinematic relativistic effects to make it even more clear why the strength of the arguments is indeed unprecedented.

1 Introduction

For more than 10 years I have hoped that I would not have to write such an abstract. Unfortunately, things have been getting from bad to worse. There has been an increase in the publication of views, which directly contradict the relativistic experimental evidence, such as versions of objective becoming and even much worse – reviving presentism.

I am not alone to think that such a situation should not be tolerated any more. If Hermann Minkowski were alive he would quite probably express his protest in even stronger terms. It is science that determines our views of the physical world, not philosophy where contradicting views coexist democratically because, unlike in science, experiment is not rigorously (if at all) regarded as the ultimate judge in philosophy (but it should be if philosophers want their views of the external world to be taken seriously). I always started the philosophy of science classes by telling students that there is no democracy in science – there is no room in science not only for proposed theories which contradict the experimental evidence, but also for views about the physical world (such as presentism, for example) which are in direct contradiction with experiment.

Here I will first restate Minkowski's arguments for the reality of spacetime which make it exceedingly clear why presentism is unquestionably wrong and why no objective becoming is possible in spacetime. In Section 2 I will analyze Minkowski's more general argument, which on the basis of experiments quoted by Minkowski states that the (macroscopic) world is four-dimensional. In Section 3 I will present Minkowski's specific argument based on the relativistic length contraction. Then in Section 4 I will expand Minkowski's arguments to time dilation and the twin paradox.