

***The present as an empirically testable hypothesis:  
a case study in reading physics as a part of the history of philosophy***

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In his comments on Putnam's (1967) paper on special relativity, Stein (1968) suggests that adopting both

(P1) All and only things that exist *now* are real (a standard expression of "presentism"),  
and

(P2) Special relativity is a complete account of spatiotemporal structure leads to "the interesting result that special relativity implies a peculiarly extreme (but pluralistic) form of solipsism."

The argument is simple, and one that is familiar from the literature on space and time. It runs as follows. Given an event  $e_1$  in spacetime,  $e_1$  is "now" relative to itself, but there is nothing within the structure of special relativistic spacetime that determines which events spatiotemporally distant from  $e_1$  are also "now" relative to  $e_1$ . Why is that? Well, you can either conclude this *directly* from conventionality of simultaneity, in which case any "joining of the dots" in planes of simultaneity is an addition, going beyond the content of special relativity. Or you can get there via relativity of simultaneity: adopt the Einstein synchrony convention, note that different planes of simultaneity make different determinations of which events are "now" relative to  $e_1$  and which are not, note that picking *one* of these – a *preferred* plane of simultaneity – goes beyond the content of special relativity, and so conclude that no other events are determinately "now" with respect to  $e_1$ . If we focus our attention on (P2), and ignore (P1), this argument typically leads to endorsing the block universe. But if we want to have (P1) as well as (P2), we get a different conclusion: If no other events are determinately "now" with respect to  $e_1$ , then, by (P1), no other events are determinately "real" with respect to  $e_1$ . Add to that the claim that everything that is real must be determinately so, and we get our conclusion: nothing is real with respect to  $e_1$  except  $e_1$  itself (hence the extreme solipsism), although each event is real with respect to itself (hence the pluralism). So that's Stein's pluralistic extreme solipsism.

The core of presentism is the thesis that my present is real, whereas my past and my future are not, and this core is preserved in "pluralistic solipsism". Nevertheless, the position has not (so far as I know) attracted many adherents. Rather, the standard moves in the interpretation of special relativity are to adopt the "block universe" (via denying P1) or to reject P2 (perhaps staying as close as possible to special relativity but adding a preferred foliation of spacetime). One thing I do in this paper is to offer an alternative that preserves the core of the "presentist" thesis whilst also endorsing P2, but what makes this paper suitable for *HPS* is the means by which I get there.

The underlying reason *why* "pluralistic solipsism" follows from adopting both P1 and P2 is that we are trying to use spatiotemporal structure to tie events together: to tie "that which is real" together via simultaneity. In other words, we take spatiotemporal structure to be our principle of ontological unity. We make this commitment when we endorse P1. I argue that spatiotemporal structure is better understood as a principle of *epistemic* unity, with the work of ontological unity being done by another principle altogether.

The case for this begins from Newton's physics, which I argue contains three principles of unity: (i) spatiotemporal, (ii) dynamical (with no appeal to specific force laws), and (iii)

making use of specified forces. I spend some time making the case for this, and then argue for the superiority of the dynamical approach as a principle of ontological unity in the context of Newton's physics. Next, I argue that if, in Newton's physics, we ground ontological unity in the dynamical laws, the core thesis of presentism survives the transition to Minkowski spacetime *without* entailing "pluralistic solipsism", and without requiring that we reject P2. Moreover, once unity is grounded in dynamics, the spatiotemporal extent of the present becomes an *empirical* matter. Making the case for this constitutes the core of my paper. The transformation of presentism versus eternalism into an empirical matter follows the general methodological line found in Newton's work, in which more and more questions previously taken to be a priori metaphysical questions are transformed into empirical ones.

What makes this appropriate for an &HPS conference is that it is by situating Newton's physics within history of philosophy, with philosophical questions at the forefront, we find a philosophical richness in his work that is interesting not only in and of itself but also because it uncovers a wholly new and surprising approach to a contemporary issue.

Very often, philosophers of physics work on "interpretations" of theories in physics, and work their way back from these towards philosophical questions. Here is an example of a philosopher of physics describing this work:<sup>1</sup>

Physics provides theories which typically consist of a mathematical formalism and some procedures for applying that formalism to particular concrete situations. But both the formalism and the procedures may admit of alternative ontological interpretations. It may not be clear, for example, which part of the mathematics corresponds to real physical magnitudes and which is an artefact of arbitrary choices of units of gauges. It may not be clear which mathematical models represent real physical possibilities, and which do not. And it may not be clear which pairs of mathematical models represent the same physical situation. All of these problems confront even the philosopher who tries to take, for example, the Theory of Relativity 'at face value'.

This is one possible approach, of course, and there is important conceptual work to be done here, but I do not think it is the most profound philosophically. An alternative is to begin with the deepest of our philosophical questions, and to use the historical development of physics *read as a contribution to philosophy* to explore how these questions are transformed, re-worked, addressed, and sometimes rendered non-questions. One does not "help oneself" to a philosophically shallow formalism, and then attempt to do philosophy: *one sees physics as a part of the history of philosophy*, and engages it on those terms. I take this to be one way of doing integrated history and philosophy of science, and it is what I try to do in this paper.

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<sup>1</sup>From Loux and Zimmerman (eds.), 2003, pp. 461-2.