BEYOND THE DYNAMICAL UNIVERSE

MICHAEL SILBERSTEIN, W. M. STUCKEY, AND TIMOTHY MCDEVITT

Reviewed by Karen Crowther

Beyond the Dynamical Universe: Unifying Block Universe Physics and Time as Experienced
Michael Silberstein, W. M. Stuckey, and Timothy McDevitt
Oxford: Oxford University Press, 2018, £55
ISBN 9780198807087

Many of the greatest problems in fundamental physics, cosmology, and the philosophy of mind are the result of our taking a biased perspective on the world, and of our seeking a particular type of explanation. These problems could be solved if we were to adopt a different viewpoint and accept an alternative form of explanation. This is the contention of Silberstein, Stuckey, and McDevitt (SSM) in *Beyond the Dynamical Universe.*

The long list of problems that SSM argue can be clarified in this way include the 'paradoxes' of general relativity (closed time-like curves) and those of quantum mechanics (the measurement problem, quantum non-locality), as well as the challenge of unifying these two frameworks in a theory of quantum gravity and associated issues like the black hole firewall paradox. Additionally, there are the usual suspects of cosmology: dark matter, the 'Big Bang', the flatness problem, the horizon problem, and the initial low-entropy problem (the 'past hypothesis'). Finally, there is the 'hard problem of consciousness' (which SSM argue is even harder than typically thought), and the problem of reconciling our experience of time and change with the metaphysical picture of time best supported by relativity theory (a static 'block universe', where past, present, and future are all equally real).

order to bring about certain outcomes, where the outcomes are either simultaneous with, or come after, our actions. We grow older, never younger. Our conscious experience of the external world at any given moment is constructed from a selection of sense impressions collected only over a small window of time and space. These sense-impressions all precede our experience. And this experience keeps changing. We thus possess what SSM call a 'dynamical bias', which we build in to our science.

The physics that results from this bias describes mechanistic processes: interacting, (typically) three-dimensional entities, which move in space as a function of time. It utilizes the 'Newtonian schema' or Hamiltonian formalism: differentiable equations plus initial conditions. Also, this physics relies on, and produces, dynamical explanations: it explains a given outcome as being the result of the initial conditions plus the dynamical laws, and thus reflects our natural tendency to explain later events as 'caused by' earlier ones. This combination of ontology, formalism, and explanation is what SSM call the Newtonian schema universe (NSU), following Wharton ([2015]). Our continued adherence to it, they argue, is the source of the above-mentioned problems. Additionally, SSM state, we may have been misled by the NSU picture. In many cases (that is, as applied to particular problems), it is strained, incomplete, or even seemingly inconsistent—in these cases, at least, SSM claim that the NSU is neither fundamental nor the correct framework to use.

One might immediately wonder if we haven't already moved past the mechanical purview; isn't that what field theory and relativity—some of the cornerstones of modern physics—are all about? Actually, the answer is that we haven't pushed this lesson far enough: We are so ensconced in dynamical explanation and mechanistic physics that we have trouble recognizing it or letting go. SSM point out that even in field theory, for instance, we describe fields as dynamical entities mediating forces or as harmonic oscillators at each point in space, exchanging energy-momentum (although one might object that this picture is inaccurate, it still appears in textbooks and SSM themselves appeal to it in introducing standard quantum field theory for their readers).

Instead, SSM urge, we need to move completely 'beyond the dynamical universe'. The appropriate framework to adopt is the Lagrangian schema universe (LSU)—again, following Wharton ([2015]). This framework is based on the Lagrangian formalism, which utilizes the initial and final states of a system, plus an 'adynamical global constraint' such as the least action principle. The ontology is of four-dimensional entities that do not move or change but simply exist in the block universe. And the associated mode of explanation is 'adynamical': it uses the initial and final states of the system, plus the adynamical global constraint, to explain the spatiotemporal arrangement of the four-dimensional entities in the block universe that are involved in the system of interest.

The NSU is presented as the 'ant's eye view', trapped in the world of dynamical appearances, of 'things happening' and time passing. The LSU is described as the 'God's eye view' (inspired by Wilczek [2016]), which sees the block universe painted with static worldlines, unchanging. SSM argue that the LSU is the way to go, but they recognize that there are different possible theories that could be formulated within the LSU framework. In the book, SSM develop only one of these, which they call 'relational blockworld' (RBW). SSM hope that this is the correct theory but readily admit that it may not be. One of their broader goals is to inspire a new perspective for exploration and promote the general LSU framework as the way to progress in physics, even if their particular version of it (the RBW) is found wanting upon further development and study.

The RBW takes some work to appreciate: rather than devote a chapter to explaining this theory, SSM instead attempt to illustrate it through its application in particular cases—relativity, quantum mechanics, quantum field theory, and quantum gravity—each of which has its own chapter. As such, the RBW is developed throughout the book and the only way of grasping the theory is by reading the whole thing. Unfortunately, even then, the RBW remains obscure. Nevertheless, I attempt to summarize its main traits: The RBW has an ontology of spacetimesource elements, which are 'of spacetime, rather than in spacetime' and possess no intrinsic properties nor individual autonomy ('primitive thisness' or haecceity).

instance, the adynamical global constraint is the Einstein equations; for a quantum system, it is the Feynman path integral; and so on.

The characteristic feature of the RBW is 'spatiotemporal ontological contextuality': a sort of multi-level relationalism, where phenomena apparently 'outside' of a system (by occurring at different length- or time-scales than the phenomenon of interest) can 'act as contexts' for phenomena at another level, constraining their behaviour and being responsible for the particular properties exhibited by the system of interest. These properties exist thanks to 'ontological contextual emergence', which is contrasted with its nearest metaphysical neighbours: monism, dispositionalism, and ontic structural realism. The view is opposed to ontological reductionism: the spacetimesource elements occupy different scales at once and there is no privileging as more fundamental the physics at one scale or another. Similarly, the quantum realm is not more fundamental than the classical: everything within a given system co-exists in accordance with the self-consistency condition of the adynamical global constraint. As SSM (p. 166) put it:

> According to RBW, the whole enterprise of physics is one giant program based on self-referentiality, contextuality, and self-consistency [...] So, clearly classical behavior does not emerge from quantum reality. The snake eats its own tail, where the head of the snake is the so-called classical and the tail of the snake is the so-called QM.

Ontological contextual emergence means that even the God's eye view is contextual: there is no 'view from nowhere'. Instead, 'it is relations and contexts all the way down, up and side-to-side; there need be no universe above and beyond these' (p. 177). So, while everything is connected and the relations determine the whole block universe, there is not a single 'whole universe' to speak of (this is the main feature that distinguishes the view from monism, for instance).

Later, the book goes further, arguing that the conscious subject is also part of spatiotemporal contextuality. The mental realm and the material realm are not dual; the psychological does not emerge from the physical. Instead, 'physics is psychology': consciousness and matter are two aspects of the 'same stuff', where 'stuff' is not physical but rather a neutral basis that comprises both (a view known as neutral monism).

Most of the book is dedicated to showing how the LSU could solve each of the big problems mentioned above, using the RBW as a concrete example of an LSU approach. In many of the cases, however, the details of the RBW are not required; one could easily imagine solutions of the same flavour being provided by generic features of the LSU framework (and this certainly demonstrates the power of the adynamical perspective). In these cases, SSM show that the problems are due to our seeking dynamical explanations—such explanations compel us to explain 'why everything is the way it is' in terms of how it was before, plus the dynamical laws. From this NSU perspective, even if we discover some fundamental laws, or a 'theory of everything', not only would we be left asking, 'why these laws rather than some other ones?', but we would also be beleaguered by the initial conditions of the universe at the Big Bang, defying dynamical explanation in terms of any 'prior state'. Instead, from the LSU perspective, 'there is nothing particularly mysterious or sacred about the initial conditions at the Big Bang [...] because the conditions at any point in spacetime globally constrain the conditions at the other points of spacetime' (p. 102). The character of the explanation thus shifts and can be captured by the slogan 'everything is the way it is because everything is the way it is', in accordance with the adynamical global constraint (note: slogan coined by me, not SSM).

Beyond the Dynamical Universe was written collaboratively, an admirable joint effort between a philosopher, a physicist, and a mathematician. Like SSM, I hope that this exemplary strategy will catch on, encouraging people not only to look for collaborations beyond their own disciplines in attempting to answer questions that we are all interested in, but also to try to solve many problems at once, particularly those that are apparently unrelated and might otherwise be considered as within the dominion of different disciplines.

perception of time, or the problem of consciousness more generally, and (4) any and all interested graduate students and advanced undergraduates in philosophy, cognitive science, and physics. In Parts I and II of the book, the chapters are triparted, comprising (i) a main thread, meant to be accessible to advanced undergraduates, (ii) a thread devoted to the philosophy of physics, meant to engage philosophers who have more questions about the topics raised in the main thread, and (iii) a thread on the foundational physics, which is supposed to satisfy anyone who craves more formalism than the minimum that's provided in the main thread. Part III of the book blends analytic and continental philosophy in explaining the relationship between the RBW and our experience of time.

SSM try to make the book as clear and accessible as possible and there are a number of nice details that help here: as well as the triparted chapters, there are full-colour figures and many illustrative references to works of literature and science fiction throughout. There are reassuring and helpful footnotes for the undergraduate and non-specialist audience, and suggestions for reading-patterns based on interest. Additionally, the authors make unashamedly liberal use of quotations from a great range of different sources, serving not only to acknowledge their various inspirations (and that other authors recognize similar problems and have hit upon different aspects of the solution) but to help clarify the ideas by providing alternative depictions. Even the book's striking cover illuminates its written contents: a kaleidoscope of emerald green eyeballs, each seeing a different perspective, connected and contextual. The image is static from our 'God's eye view', but conveys the motion of the kaleidoscope turning, with the eyes morphing and merging. Nevertheless, given the scope and complexity of the subject-matter (not to mention all the acronyms!), as well as the diversity of the intended audience, some more could have been done on this front: a glossary of jargon, for instance, would have been particularly useful.

My main criticism of the book is that I often found its presentation frustratingly imprecise—as stated above, the description of the RBW is spread over the entire book as the RBW is applied in different contexts, and so the RBW itself is apparently only able to be grasped contextually. More than this, though, it feels as though the view is only ever described, rather than fully laid out, step-by-step, as a textbook would. This, however, is excusable given it is explicitly not supposed to be a textbook and the view is still being developed (in academic journal articles, for instance). *Beyond the Dynamical Universe* has the ambitious goal of introducing a complete world-view and demonstrating how it could potentially solve many of the biggest problems across a range of disciplines, while remaining accessible even to advanced undergraduates. It does an impressive job of achieving this. Yet, what makes the work exceptionally valuable is its openness—it offers a stimulating perspective on the world and encourages the reader to be involved in exploring it.

Karen Crowther
Department of Philosophy
University of Geneva
karen.crowther@unige.ch

References

Wharton, K. [2015]: 'The Universe Is Not a Computer', in A. Aguirre, B. Foster and Z. Merali (*eds*), *Questioning the Foundations of Physics*, Basel: Springer, pp. 177–90.

Wilczek, F. [2016]: 'Physics in 100 Years', *Physics Today*, **69**, pp. 32–9.