



Do We Need a Physics of 'Passage'?

10 — 14 December, 2012

Vineyard Hotel & Spa, Cape Town, South Africa

This conference is generously supported by the John Templeton Foundation, as part of the project New Agendas for the Study of Time. It is organised by Alex Holcombe, Kristie Miller, Huw Price and Dean Rickles of the Centre for Time, University of Sydney, in conjunction with Professor George Ellis, University of Capetown.

Program at a glance

Tuesday, 11 December		
Time	Speaker	Title
Break - 10:00-10:30		
10:30-12:30	Carlo Rovelli	Plenary Talk Is Time Needed to Describe Change?
Lunch – 12:30-2:00		
2:00-3:00	George Ellis	The Evolving Block Universe: A More Realistic View of Spacetime Geometry
3:00-4:00	Huw Price	Three Exits from the Block Universe
Break – 4:00-4:30		
4:30-5:30	David Albert	The Passing of Time as a Mechanical Phenomenon of Nature
Closing Discussion – 5:30-6:00		
Dinner – 7:00		
Wednesday, 12 December		
Time	Speaker	Title
9:30-10:30	Wayne C. Myrvold	Relativistic Quantum Becoming
Break – 10:30-11:00		
11:00-12:00	Avshalom Elitzur	My Future Engraved on Stone: Quantum Measurements that Seem to Undermine Becoming
12:00-1:00	Jeremy Butterfield	Growing Time? Branching Time?
Lunch – 1:00-2:30		
2:30-3:30	Teresa McCormack	Ways of Representing Time: Developmental Considerations
3:30-4:30	Chris Sinha	Developmental Time, Epigenesis, and the Reality of Time's Arrow
Break – 4:30-5:00		
5:00-6:00	Kia Nobre	Anticipating Perception in the Human Brain
Discussion – 6:00-6:30		
Dinner – 7:00		

Thursday, 13 December		
Time	Speaker	Title
9:30-10:30	Christoph Hoerl	Do We Need a Phenomenology of Passage?
Break – 10:30-11:00		
11:00-12:00	Nick Huggett	Quantum Time and Phenomenal Time
<i>Discussion – 12:00-12:30</i>		
Excursion* + Lunch – 12:30-		
Dinner – 7:00		
Friday, 14 December		
Time	Speaker	Title
9:30-10:30	Edward Anderson	The Problem of Time in Quantum Gravity
Coffee break – 10:30-11:00		
11:00-12:00	Fay Dowker	Things Happen, They just Happen in a Partial Order
Break – 12:00-12:30		
12:30-1:30	Rafael Sorkin	Solved and Unsolved “Problems of Time” in Quantum Gravity
Lunch – 1:30-3:00		
<i>Roundtables – 3:00-4:30</i>		
Coffee break – 4:30-5:00		
<i>Closing Talk/summary/loose ends – 5:00-5:30</i>		
Dinner/Reception – 6:00		

*A picnic atop Table Mountain is planned for the excursion. However, the cableway can be closed at any time due to bad weather (wind). We will notify you of an alternative arrangement should we be unable to head up the mountain.

Full Program

TUESDAY, 11 DECEMBER

10:00-10:30 *Coffee*

10:30-12:30 *Plenary Talk: Is Time Needed to Describe Change*
Carlo Rovelli, Centre de Physique Theorique de Luminy

I review the role that the notion of time plays in physics. I discuss the tension that this notion has undergone with the discoveries associated to special and general relativity and quantum theory. I discuss the form of the conceptual structure needed to describe nature, and, in particular, change, in a form compatible with what we currently know about nature.

12:30-2:00 *Lunch*

2:00-3:00 *The Evolving Block Universe: A More Realistic View of Spacetime Geometry*
George Ellis, University of Cape Town

Usual spacetimes have no representation of the present time, or the difference between past, present, and future; thus they do not represent the flow of time as experienced in macrophysics, chemistry, biology, and the mind. I propose here a more realistic spacetime model: an evolving block universe, where the future boundary of spacetime represents the present time, and changes as time evolves along timelike worldliness. This necessarily involves existence of preferred surfaces of change that form the future boundary of spacetime; I argue these do indeed exist in any realistic spacetime model (the symmetry of the theory is broken by the geometry of the solution). I show how the evolution of these models may be expressed in usual ADM terms as long as the surfaces remain spacelike, and argue that this viewpoint automatically provides chronology protection. Issues remain as to what happens if these surfaces become timelike: I argue that this can only happen in extreme circumstances associated with black hole formation.

3:00-4:00 *Three Exits from the Block Universe*
Huw Price, University of Cambridge

If something is missing from the 'block universe' conception of time, what is it, exactly? In this introductory survey I distinguish three possible answers to this question, all apparently independent of each other. Thus the first piece of news – good or bad, depending on your point of view – is that there seem to be three possible exits from the block universe, leading in different directions. The second piece of news – bad or good, respectively – is that they all seem to be dead ends.

4:00-4:30 *Coffee Break*

4:30-5:30 The Passing of Time as a Mechanical Phenomenon of Nature
David Albert, Columbia University

5:30-6:00 *Closing Discussion*

7:00 *Dinner*

Wednesday, 12 December

9:30-10:30 Relativistic Quantum Becoming
Wayne C. Myrvold, University of Western Ontario

It is a familiar fact that quantum state evolution can be expressed in two, empirically equivalent ways: the Schrödinger picture, and the Heisenberg picture. Relativistic quantum field theory is typically expressed in terms of the Heisenberg picture, which lends itself more readily to a manifestly covariant account. There is an alternative, however, which is the extension of Schrödinger-like state evolution to a relativistic context, which for some purposes is more revealing. I will discuss this picture in the context of both unitary evolution and of relativistic collapse theories. Connection will be made with the phenomenon that David Albert has dubbed “non-narratability.”

10:30-11:00 *Coffee Break*

11:00-12:00 My Future Engraved on Stone: Quantum Measurements that Seem to Undermine Becoming
Avshalom Elitzur, Bar-Ilan University

For many years I have been devising quantum mechanical experiments, such as the Quantum Liar (Elitzur & Dolev, 2005), that challenge the mainstream Block Universe model and favor Becoming. Alas, results from recent collaborations (Aharonov *et al.*, 2012a, 2012b) seem to indicate that a future choice, to be made by a human, can be encoded within outcomes of earlier weak measurements, even before the human knows what the choice will be. I demonstrate this feat with an EPR experiment where the particles are weakly measured prior to the final, strong measurements. Slicing the earlier weak outcomes reveals, by Bell's (1965) theorem, that they have somehow anticipated the choice of spin direction decided upon much later. A subtle form of censorship prevents paradoxical causal loops emerging from this anomaly. Nevertheless, I remain personally convinced that Becoming can eventually be reconciled with quantum retrocausation.

12:00-1:00 Growing Time? Branching Time?
Jeremy Butterfield, University of Cambridge

1:00-2:30 *Lunch*

2:30-3:30 Ways of Representing Time: Developmental Considerations
Teresa McCormack, Queen University Belfast

3:30-4:30 Developmental Time, Epigenesis, and the Reality of Time's Arrow
Chris Sinha, Lund University

Biology provides strong evidence for the existence of an Arrow of Time. The temporal directionality of phylogenetic evolution is disputed, with some theorists claiming that emergently increased complexity is inherent in evolution, while others view this argument as an instance of the teleological fallacy. The case of ontogenetic development is, however, much clearer. Epigenetic development is both directional (involving complexification governed by time-switched regulatory genes) and irreversible (epigenetic development, unlike learning, cannot be reversed except through catastrophic disintegration).

However, I will also argue that the search for a neurologically specified cognitive domain of Time is probably misguided. Time as an autonomous domain independent of the perception, recollection and anticipation of events is not a biological given, but a cultural and historical construction. I will back up this argument with evidence from my colleagues' and my research on the social, linguistic and cognitive organization of time in an indigenous Amazonian culture.

4:30-5:00 *Coffee Break*

5:00-6:00 Anticipating Perception in the Human Brain
Kia Nobre, University of Oxford

6:00-6:30 *Discussion*

7:00 *Dinner*

Thursday, 13 December

9:30-10:30 Do We Need A Phenomenology of Passage?
Christoph Hoerl, University of Warwick

Some philosophers believe that perceptual experience, especially in the case of the sensory perception of movement or change, (seemingly) presents us with passage. Amongst those philosophers, there is then a debate as to whether this feature of perceptual experience – call it a phenomenology of passage – lends support to the view that there is such a thing as

passage, conceived of as a feature of mind-independent reality. I examine the possibility that this debate may be predicated on a mistake, because there is in fact no such phenomenology of passage. At first sight, this might appear an odd suggestion. How could the philosophers engaged in the debate get it so wrong about what their own perceptual experiences are like? I therefore also show that there is a specific structural aspect of the phenomenology of perceptual experiences of movement and change that can explain how one might mistakenly come to the belief that such experiences involve a phenomenology of passage.

10:30-11:00 *Coffee Break*

11:00-12:00 Quantum Time and Phenomenal Time
Nick Huggett, University of Illinois at Chicago

12:00-12:30 *Discussion*

12:30- *Excursion and Lunch*
Picnic on Table Mountain

7:00 *Dinner*

Friday, 14 December

9:30-10:30 The Problem of Time in Quantum Gravity
Edward Anderson, University of Cambridge

10:30-11:00 *Coffee Break*

11:00-12:00 Things Happen, They Just Happen in a Partial Order
Fay Dowker, Imperial College London

12:00-1:00 Solved and Unsolved “Problems of Time” in Quantum Gravity
Rafael Sorkin, Perimeter Institute for Theoretical Physics

I will identify six “problems of time” that arise in connection with quantum gravity and review the extent to which some of them can be regarded as solved, highlighting the very different aspects that they assume depending on one’s starting point: Hamiltonian vs. path-integral, discrete vs. continuous.

1:00-2:30 *Lunch*

2:30-4:00 *Roundtables*

4:00-4:30 *Coffee Break*

4:30-5:30 *Closing Talk/Summary/Loose Ends*

6:00 *Reception*
