

## Creation in Metaphysical Time with the No-Boundary Proposal

This note argues that it is possible for the universe to be created by God even with the Hartle-Hawking no-boundary proposal, if creation is in metaphysical time.

### The no-boundary proposal

The no-boundary proposal [1] is a neat way of doing one form of quantum cosmology for the earliest universe, without any initial singularity. The proposal involves ‘imaginary time’; a mathematical move which does not make any physical quantities imaginary. Imaginary time turns the Lorentzian kind of relativistic metric into a real Euclidean metric. The appropriate part of such a Euclidean manifold is called an *instanton*. An instanton is bounded and has no singularity or edge. An article on the Web from Stephen Hawking's Department [2] says that the creation of the universe does not involve ‘the concept of time’, and that the instanton appears spontaneously ‘from literally nothing’.

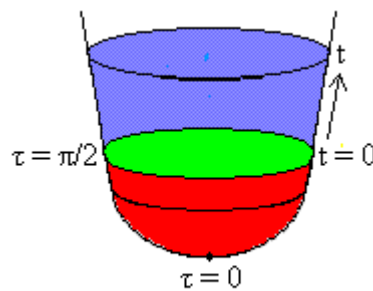


Figure 1. No boundary

This may be illustrated by the simple example [3] of a Euclidean instanton with metric

$$ds^2 = d\tau^2 + \sin^2\tau d\Omega_3^2$$

where  $d\Omega_3^2$  is the line element on the surface of a 4-dimensional sphere, and the units have been adjusted for maximum simplicity. The instanton is the half sphere  $0 \leq \tau \leq \pi/2$ . The manifold is then continued by the transformation  $\tau = \pi/2 + it$ , yielding a Lorentzian metric for  $t > 0$ :

$$ds^2 = -dt^2 + \cosh^2t d\Omega_3^2$$

The surface in Figure 1 is a diagrammatic representation of the manifold. Butterfield and Isham [4] point out various interpretive problems with this approach, including the fact that a sum over various manifolds is involved.

### Basics of a model of metaphysical time [5]

In this model, metaphysical time will drive the advance of the present, so the nature of a present in space-time is discussed first. Any geometrical manifold representing the universe, such as shown in Figure 1, does not itself undergo any change. Hence ‘becoming’, the happening of events in sequence, is missing. It is possible to introduce a family of presents into space-time, if each present is a space-like hypersurface dividing space-time into two regions representing past and future. Such a present is objective and universal. Accepting this idea requires mentally separating ‘the present’ from ‘simultaneous events’ (which is all that is required by the relativity of simultaneity). Space-time with a particular present as ‘now’ is different from space-time with some other ‘now’. Hence the sequence of happenings in the world may be represented by a sequence of space-time manifolds, each with one member of the family of presents marked as ‘now’.

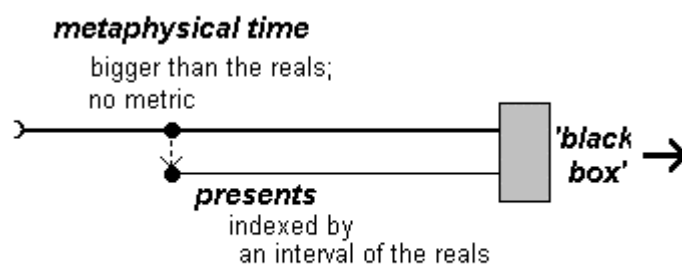


Figure 2. Simplified program for becoming

The relationship between physical time and metaphysical time is shown diagrammatically in Figure 2. *Metaphysical time* is a dense, ordered class larger than the real numbers and without a metric, i.e. it has order but no measure. It also has no first element. It is an essential feature of this model that metaphysical time is advancing. It is postulated that change of present is part of what it means in classical theism for God to sustain the world. In other words, the advance of metaphysical time, and the dynamic of physical happening, derives from the dynamic of God's life. The actualisation of each present is represented by a 'black box' to avoid making a choice between the large variety of possible philosophical and theological positions [6]. There is no such thing as the 'rate of change of the present', because physical time is an independent variable in mathematical descriptions of the world. Although a linearly ordered set of presents only needs linearly ordered metaphysical time, metaphysical time may be partially ordered if necessary. It is convenient to restrict the use of the terms 'before/after' to metaphysical time.

### Creation in metaphysical time

The first point is simply that in this model it is possible for God to create the world at an instant of metaphysical time, whatever the resulting physics (cf. the large dots in Figure 2). Quentin Smith [7] has argued that the Hartle-Hawking unconditional probability for the existence of a quantum state of the universe eliminates the need for a Creator. If, however, it is postulated that physical laws do not apply before creation, then there is no time at which this unconditional probability has a physical application.

Secondly, if it is permissible to consider the manifold of highest probability as the actual world, it allows a sequence of presents. There is a continuous set of real 3-dimensional surfaces  $\tau = \text{const}$ , ( $0 \leq \tau \leq \pi/2$ ), and then  $t = \text{const}$ , ( $t > 0$ ), in Figure 1. Each surface divides the manifold into two parts. The fact that they occur in manifolds of different signatures does not prevent them from being a possible choice for a family of presents. This allows a non-singular beginning of the universe at an instant of metaphysical time, with the initial present being, e.g., the single point  $\tau = 0$ . Deformations of the other surfaces are also possible presents. Ordinary physical time begins at  $t=0$ .

Another possibility is that the initial present is the whole of the 4-dimensional Euclidean instanton.

The advance of the present is independent of whatever manipulations are performed with time measurements and time coordinates.

Postulating metaphysical time provides a different perspective on temporal questions. The statement [2], 'Universe creation is not something that takes place inside some bigger spacetime arena', is not contested, but creation in metaphysical time involves a bigger arena of a different sort. Again, Butterfield and Isham [4] have pointed out that in physical time there is no

earlier/later relation between an instanton and the Lorentzian part of the manifold. The sequence of presents based on metaphysical time overcomes this difficulty.

### Notes and References

[1] J.B. Hartle and S.W. Hawking, 'Wave Function of the Universe', *Phys. Rev.* **D28** (1983) 2960-2975

[2] 'Quantum Cosmology', in Web pages Cambridge Relativity: Quantum Gravity

[3] Based on A.O.Barvinsky, A.Yu.Kamenshchik and I.V.Mishakov, 'Quantum Origin of the Early Inflationary Universe', *Nucl. Phys.* **B491** (1997) 387-426; arXiv:gr-qc/9612004 v1, 2 Dec 1996

[4] J. Butterfield & C.J. Isham, 'On the Emergence of Time in Quantum Gravity', in J. Butterfield (ed.), *The Arguments of Time*, OUP (1999),111-168; arXiv:gr-qc/9901024 v1, 8 Jan 1999. (Sec. 5.5)

[5] Under development; but many details are found in two papers by the present writer: 'A Program Model of Becoming', *Physics Essays* **10**, 150-163 (1997); 'TIME AS CHRONOS AND KAIROS - Physical and metaphysical time', paper given at PIRT-IX Conference, September 2004. There are also other papers at <http://homepage.ntlworld.com/stone-catend/time.htm>. The terms 'kairos' for metaphysical time and 'chronos' for physical time are avoided in this note because their usage is still fluid.

[6] W. Wildman, 'The Divine Action Project, 1988-2003', *Theology and Science* **2** (2004) 31-73

[7] Quentin Smith, 'Why Steven Hawking's Cosmology Precludes a Creator', *Philo* Vol 1, No 1 (Spring-Summer 1998)

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