Finite-length timelike paths and Kalām cosmological argument

Minseong Kim

(mkimacad@gmail.com)

ABSTRACT. Suppose one accepts the argument that past infinity is not acceptable. This does not eliminate the possibility that the beginning of time is not equivalent across objects. Along with breakdown of absolute simultaneity of events in relativity, there may even be no agreement on whether an event existed. There may be no consistent way to totally order events. In such a case, despite every object, conscious or not, having finite lifetime, there may be no single point called 'the beginning', and the universe stays as it is without requiring a cause of existence. (This manuscript is a small update to the accepted pre-publication version in Journal Sophia, doi:10.1007/s11841-021-00829-5.)

KEYWORDS: Kalām cosmological argument, singularities, relativity

1. Introduction

This manuscript is a small update to the accepted pre-publication version in Journal Sophia, doi:10.1007/s11841-021-00829-5. New updates are noted whenever they are made. I only briefly re-read them for short updates, and this is not a satisfactory and comprehensive revision, nor intended to be so. In any case, philosophical and logical claims should remain valid.

In terms of both philosophy of physics and philosophy of religion (and philosophy as whole), significant consequences can be noted.

1. Black hole singularities may not be that bad - they may even be needed to avoid logical and philosophical inconsistencies. Instead of trying to provide semiclassical pictures of the black hole interior without singularities, it may be time to simply accept singularities and consider the black hole interior reconstruction from the exterior point of view instead. This reconstruction programme has been fruitful within high-energy physics, mostly driven by mirror operator ideas and holography of information.

2. We may now sharply distinguish physical (actual and potential) infinities from mathematical and theoretical infinities. The former may not truly exist, and any physical argument based on the latter may now be deflected, without having to defend physical potential infinities.

I briefly note partially as a digression, though, that holography of information is not yet a completely satisfactory answer to the black hole information problem, and we do have to provide what happens around the event horizon. This has to do with what local observables are available to us. We expect our usual local largely non-gravitational EFT observables around and just outside the horizon to eventually confirm purification of the black hole exterior. This is what motivates replications of the Page curve today, such as islands, replica wormholes, Karch-Randall braneworld black hole constructions, et cetera. If horizon behaviors are not confirmed, then invoking holography of information for resolving the information problem is similar to invoking unitarity of AdS/CFT or quantum physics for the same purpose. Maybe there are reasons for usual EFT observables completely unable to reproduce the Page curve, but we do not have a consensus on this matter.

I am on the side that reproducing the Page curve is important, and this can satisfactorily be shown - see my ‘modified Jaynes-Cummings model of black holes’ paper. There is no conflict between this paper and the aforementioned model, and a coherent view can be put forward.

1.1. Original introduction

A review of Kalām cosmological arguments is provided in Craig and Sinclair (2009). The basic Kalām cosmological argument goes as follows:

P1) Everything that begins to exist has a cause of its existence.

P2) The universe began to exist.

> C) Therefore, the universe has a cause of its existence.
>
> from (Park, 2016)

As said in Park (2016), P2) is sometimes accepted because of Big Bang cosmology, which has a Big Bang singularity - what one can consider as the beginning. Those accepting the Big Bang singularity while denying Kalām cosmological arguments thus focus on P1).

In this paper, I discuss an alternative justification of P2) instead:

> M1) Either the universe began to exist, or there is an infinite regress into the past.
>
> M2) An infinite regress into the past is impossible. Therefore, P2).

I argue that M1) is a false dilemma. An argument based on singularities would be provided - making a counterpoint to common justifications of Kalām cosmological arguments based on singularities, such as Big Bang.

The paper proceeds as follows. I first present Newtonian physics and special-relativistic arguments against M1) and show why they are deficient. Then an explanation of why an infalling observer (relative to a black hole) and its Hawking radiations cannot be placed on the same timelike path in bit/path model abstraction is provided - implying that Hawking radiations have their own beginnings separate from the infalling observer, despite being causally related. What follows is a singularity argument against M1), the core point of this paper, which presents a plausible example that prevents global time ordering by a single observer and the genuine global beginning. This occurs despite all observers in the example having finite lifetimes or proper time.

1.2. Updates

The last paragraph of the original introduction can be simplified as follows for the singularities part. Of course we witness infalling observers not actually entering the black hole from our point of view. But we ourselves are eventual infalling observers, so 'observers at infinity seeing only black hole exteriors' arguments are non-sequitur.

2. Against the false dilemma of M1)

2.1. Newtonian argument

Let me briefly discuss a Newtonian physics argument against the dilemma posed by M1). In Newtonian physics, we may say that even if each object as an observer has a finite past, it does not follow that the whole universe does.

However, one may immediately counter that the notion of an observer is too ambiguous. Should an observer be restricted to a conscious being? If so, what does consciousness mean?

In Newtonian physics, there is nothing that prevents an admissible timelike path of infinite proper time. Then a believer in the Kalām cosmological argument may say that the dilemma of M1) is resurrected, because we now are allowing for an infinite regress into the past.

2.2. Special-relativistic argument

A special-relativistic argument makes the Newtonian argument more sharp, though sharing the same structure. The time dilation equation in special relativity is given by:

$$\Delta t' = \frac{\Delta t}{\sqrt{1-\frac{v^2}{c^2}}}$$

where Δt represents time flow of observer A at rest and $\Delta t'$ represents how observer B moving with velocity magnitude v relative to A perceives time flow of A. The equation shows that there is no upper bound to $\Delta t'$, as $v \to c$, where c is speed of light. Therefore, we may say that M1) fails because even if an infinite regress into the past is not possible for all observers, the universe may have no beginning.

However, the same counter can be made for the special-relativistic argument. What prevents an admissible timelike path of infinite proper time?

The following restatement of the Kalām cosmological argument also follows through, even if we assume that all realized timelike paths are of finite proper time:

> W0) If a realized timelike path p can be extended only by becoming an unrealized timelike path, then p is a realized inextensible

timelike path. A realized inextensible timelike path is abbreviated as a ‘part’ of the universe.

P1) Anything that begins to exist in any reference frame must have a cause.

P2*) Every part of the universe began to exist in some reference frame.

P3) No part of the universe was caused to exist by any other part.

P4) If each part of the universe has a cause, and no part is caused by any other part, then the whole universe has a cause.

C) Therefore, the universe has a cause of its existence.

In Newtonian or special-relativistic physics, P3) does stand. In quantum black hole physics, the circumstance begins to differ.

2.3. Updated: Black hole physics and causal beginning

It is typically accepted that an external distant observer sees an infalling observer (relative to a black hole) as never reaching the event horizon of a black hole due to gravitational time dilation. However, the infalling observer itself does cross the event horizon in finite proper time.

A simple picture that may initially be imagined is that there are two complementarity pictures of the world, both equally valid - called black hole complementarity (Susskind et al., 1993). One picture says that an infalling observer does fall into a black hole, while the other picture says that an infalling observer smoothly transforms into Hawking radiations outside the stretched event horizon - for sake of abstraction, one may say that an infalling observer and its corresponding Hawking radiations are in the same timelike path, eventually maintaining infinite length.

This is, of course, an artefact of qubit approximations - black hole interior-exterior quantum interactions do not happen in this ‘qubit trajectory change’ sense, and plural ‘radiations’ hint them as well. What rather happens, from an observer at infinity, is that the infalling observer enters the stretched event horizon and its information gets emitted gradually over time as new radiation quanta. These quanta together are expected to recover information about the infalling observer but they can no longer be treated as a single observer.

While Hawking radiations are about the infalling observer, they have their own beginnings, separate from the original observer. Thus, P3) falls apart.

The role of singularities in the following argument then is to provide sources that prevent some admissible timelike paths from being extended to paths of infinite proper time, addressing the issue with the Newtonian and special-relativistic arguments, with the understanding that each part of the universe can be caused to exist by other parts.

2.4. Singularity argument

Suppose that any admissible timelike path, assumed to be of finite proper time, starts from initial singularities, not necessarily from Big Bang, and ends with final singularities. I further assume that these singularities arise due to black holes.

Once the black hole example is taken, it is easy to see why 'the beginning' may not be shared across observers - in other words, there is no actual beginning moment. Assume that an object is attached to each admissible timelike path. Then this object eventually hits black hole singularities in finite proper time. However, from the point of a distant observer away from a black hole (yet), the observer views an infalling object with significant gravitational time dilation such that the object never even crosses the event horizon of a black hole. Instead, in the reference frame of the observer, the object is transformed into Hawking radiations in finite time, with the radiations obtaining their own new timelike paths, under path abstraction.

For these new objects, it makes no sense to talk of the past before their creation, just as it makes no sense to talk of the past before the Big Bang singularity. Of course, there exists an observer that watched an object almost falling into a black hole and then transforming into new objects, so the objection may be that it is still possible to think of the 'true' beginning of the universe. However, we may assert that when this observer was created, there existed another observer that watched it being created and so forth.

Furthermore, a black hole (or to be precise, black hole complementarity) twists the concept of time ordering. What would it mean for a distant observer to provide an account of time for objects inside a black hole? What would it mean for an observer inside a black hole to provide an account of time for events outside the black hole? A distant observer does not even see an infalling observer disappearing into the event horizon of a black hole. (The 'infalling observer' remains outside the event horizon according to the distant observer.) This prevents time ordering of all events by one single observer, preventing the idea of the true global beginning.

This creates a cascade of observers with finite lifetimes: each with its own beginning and end, but with no true global beginning moment across observers. Thus, we can now reject M1).

The aforementioned singularity argument does not deny the possibility that a timelike path of infinite proper time exists. As William Lane Craig has argued, it may be that God was timeless before creation of the universe as the only true observer, becoming temporal after creation of the universe, with potentially infinite proper time. (Craig, 1998) The point of this paper rather is that the Kalām cosmological argument does not necessarily follow and that M1) is a false dilemma. After all, the power of such an argument is that something necessarily follows. It does not.

3. Conclusion

The purpose of this paper is to provide a plausible example under the current understanding of physics that works against the Kalām cosmological argument - in particular, the dilemma posed by M1) is false. Even if an infinite regress into the past is impossible, it does not follow that the universe must have the global beginning. The Kalām cosmological argument does not necessarily work - though it may contingently work. This is because a black hole, treated within the quantum framework or more precisely the semiclassical gravity framework, provides an example where no global time ordering by a single observer is possible, thereby preventing existence of the genuine beginning of the universe, despite every observer having finite lifetime (or proper time, to be more specific).

As aforementioned, this does not eliminate the possibility of justifying the Kalām cosmological argument by Big Bang cosmology. Then the question becomes whether P1) is valid. If everything that begins to exist has a cause of its existence and the universe has the global beginning, then it does follow that the universe has a cause of its existence, potentially calling for existence of God. Furthermore, it is certainly possible that the real universe has some admissible timelike paths of infinite proper time. It may also be the case that potential advances in quantum gravity, such as full elimination of singularities, may restore validity of the Kalām cosmological argument.

The point then is not to settle validity of the Kalām cosmological argument once for all - rather, it is to allow sharpening of the argument for believers of the Kalām cosmological argument via thought experiments.

REFERENCES

Craig, W. L. (1998). Divine timelessness and personhood. *International Journal for Philosophy of Religion 43*(2), 109–124.

Craig, W. L. and J. D. Sinclair (2009). *The Kalam Cosmological Argument*, Chapter 3, pp. 101–201. John Wiley & Sons, Ltd.

Park, J. J. (2016, Sep). The kalām cosmological argument, the big bang, and atheism. *Acta Analytica 31*(3), 323–335.

Susskind, L., L. Thorlacius, and J. Uglum (1993, Oct). The stretched horizon and black hole complementarity. *Phys. Rev. D 48*, 3743–3761.