External Cause of the Universe

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Introduction

In this paper I put forward some arguments in favor of external reason having caused the universe to exist reflecting the contemporary scientific knowledge describing the origin of the universe based on the Big Bang theory. The paper does not address theoretical, hypothetical or speculative models such as multiverse, oscillating universe, brane cosmology, or actualized many-worlds interpretation; it is solely based on the current scientifically well-confirmed and commonly accepted picture of the universe.

I have been inspired by Quentin Smith's article *A Cosmological Argument of a Self-Caused Universe*[1] published in 2008, and I use a similar approach extending the ideas mentioned in the work. As regards the causality, the core of Quentin Smith's argument for a self-caused universe is an infinite sequence of causally dependent events (states) in an open time-space interval starting from - but not including - the singularity. All states can formally be expressed in form of infinite sequence {. . . x → y → z . . .} where x causes y, y causes z, etc. Every state in the open sequence denotes an empirical event in the universe and is always preceded by another event that actually causes it to take into effect. Since the existence of each state is caused by an earlier state, and since the existence of all these states entails the universe's existence, there is an empirical explanation for each of these contingent beings.

Although the assumption of infinite sequence of causal states is a bit debatable[2], we can accept it for now. The problem is that even infinite sequence of causal states does not cover all states in the known history of the universe. The infinite sequence of causal states describes only empirical realm of the universe, that is, the phase of the universe since its empirical appearance after the big bang. The causal sequence does not reflect the existence of primordial singularity, and as such, it does not address the origin of the universe at all. If we even considered the infinite sequence of empirical states perfectly valid, it can only be applied to a specific phase of the universe already existing in its known empirical form, sidestepping the well-proved piece of scientific knowledge pointing out to the clearly recognized term of singularity.

The singularity lies beyond time and space boundaries, so we cannot simply use words such as 'before' or 'after' in terms of ordinary time notion. However, causality, as a principle, does not have to be necessarily restricted to such a frame; in fact, causality can also be applied whenever a state evolves from an earlier state. If it is possible to properly define the singularity as a state and make it different from empirical states it could also be possible to enrich the sequence by inserting it as a new state member.

[1] http://www.infidels.org/library/modern/quentin_smith/self-caused.html

[2] In commonly accepted Copenhagen interpretation of quantum mechanics, detectable physical states are limited by quantum nature of time restricted by the smallest measurable time interval; the Planck time. If we adopt this approach then the overall number of causal states of finite number of elementary particles during limited time, though incredibly large, is still finite. It is to say, however, that this view is not commonly shared by philosophers for its pragmatic positivistic nature.

1. External Cause

Widely used modern definitions of causality rely on empirical attributes such as time, space, observable states, regularity of occurrence or mutual interaction. Although external cause used in terms of primordial nonempirical cause is intuitively recognized, it does not seem to be sufficiently specified. When viewed from the perspective of standard definitions a significant difference becomes apparent - external cause is not initiated from what we could call empirical state. If it happened just once, it either does not meet the regularity-of-occurrence criterion. Furthermore, only 'resulting effect' can be observable, the 'initial state' is by definition beyond the empirical scope. Strictly spoken, external cause seems to violate most of requirements the common conception of causality should meet. Can it be considered a cause at all?

If we adopted the view that external cause is in fact not a cause, we would have to conclude that the primordial expansion of the universe from the singularity (as a possible external cause) had been uncaused. This would contradict our deep-rooted intuition about general validity of causality, which would immediately result in exclusion of the singularity from further rational deliberation. If even it was initiated by a sort of 'miracle', we would still tacitly tend to comprehend it as a yet unknown cause or a result of some agens. In addition, the empirical effect of the singularity expansion was colossal; it manifested an enormous amount of observable matter, energy and the birth of time and space. The expansion demonstrated the presence of a strong force[3] that brought fundamental physical categories to existence. The resulting effect of the force resembles similarly evolving physical processes (expansions), for which causation is naturally presupposed. In comparison to common understanding of causality, the only difference is a nonempirical initial state; the subsequent evolution of the singularity expansion is already subject to possibly fully describable causal physical process.

In order to keep causality valid also in this case, it is necessary to generalize the usual meaning of empirical cause. In order to encompass nonempirical states, we have to restrict the tight connection to empirical observability. Despite this restriction, two key attributes typical for causality will still be kept - the *state* and *ordered sequence of consequent states* representing causal state chain. If initial state can be distinguished from consequent state, we will say that initial state evolved to consequent state and the initial state constitutes a *cause*. Furthermore, if the initial state is of nonempirical nature - it cannot be described in terms of physical categories - it constitutes *external cause*[4]. (Ex)

We will use the similar notation as for usual causal states

$\{I \rightarrow e\}$

where *I* is the initial state (cause) and *e* consequent state (effect). Similarly, we can say that *I* and *e* are in causal relation, or *I* caused *e*.

This generalization keeps causality meaningfully specified also in case when both states are not necessarily empirical. The remaining question is whether such understanding of causality is sufficient for description of singularity evolution. That is, whether it is possible to describe the singularity as a state distinguished from consequent empirical state such that both states share a common property that is subject to change.

[3] The strong force mentioned here is not a force in usual physical sense. This expression denotes an initial power that launched the primordial expansion from singularity and brought forth the manifestation of physical categories.

[4] A cause linking two heterogeneous states (initial nonempirical state and consequent empirical effect) is capable of operating on nonempirical initial state prior to existence of empirical effect and cannot therefore be considered substantially empirical. Empirical cause requires both the states be empirical.

Note

There is a position held by some scientists and philosophers that the primordial singularity should be excluded from causal-oriented deliberation, or even that the origin of the universe should be claimed uncaused. This view could perhaps be plausible if none important aspect of causality was applicable. But the state-change from initial to subsequent state (provided both the states are recognized and distinguished from each other) is one of the fundamental characteristics of causality regardless of substantial nature of the states. A hypothetical but conceptually valid example would be a sudden emergence of material object in empty space. The cause-effect states can be identified either with the object itself as a virtually nonexistent object brought to existence, or as an empty space changed to nonempty space filled with the emerging object. A natural reaction would be that some unknown cause operating under yet unknown conditions has actualized the material object. If we insisted on noncausal interpretation of the event when actually 'something observable happened', we would neglect the fact of apparently observed state-change pointing to a possible cause demonstrating one of its fundamental attributes[5]. Such a standpoint would therefore be premature and unjustified. Instead, it is better to weaken the requirements attributed to causality and keep those fundamental but more general, such as recognizable states and change of states in the cause-effect relation, not requiring both states be necessarily empirically observable[6].

There are also some other situations indicating the necessity of more general comprehension of causality even in empirical realm[7].

2. The Singularity as a State

As we have already mentioned, we cannot apply usual time and space categories for description of the singularity. In fact, there is not much to say about it as it inherently lies beyond the scope of empirical evidence. In contrast, all empirical states share a well-known common property - they operate within the matter-time-space frame in the universe and are driven by natural laws. We will shortly call this significant property *empirical manifestation*. Existence of empirical manifestation is exactly the property where the singularity state differs from the empirical state - empirical events are states with the empirical manifestation property *defined*, whereas the singularity constitutes a state having this property *undefined*. In the singularity, the usual physical categories such as matter, time and space have no meaning and the natural laws do not hold. In both states, the empirical manifestation is a mutually exclusive property. The existence of the same property shared by both states being subject to change is important for linking the states into possible causal relation in the means of generalized causality described in the previous section. This definition of singularity state also implies nonempirical nature of the state.

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[5] The mentioned example is not fully representative in terms of the singularity state we are addressing for both the initial and the consequent states in the example are principally observable. However, although the singularity state cannot be observable, its existence and some important characteristics are derived from valid natural laws and supported by observation.

[6] Obviously, at least one state in the cause-effect state pair (namely, the effect) must be empirically observable otherwise such a state-change would principally be unobservable and would just be subject to hypothetical or metaphysical suppositions.

[7] A notable example is an experimentally confirmed EPR paradox. Two entangled particles with complementary states (e.g. spin) separated and localized in long distance still 'know' about each other. By randomly changing the state of one particle the state of the second one is immediately determined and actualized. This bizarre fact is known as 'nonlocal realism'. In comparison to usual understanding of empirical causality, the 'nonlocal causality' circumvents mutual interaction requirement and bypasses time and space boundaries. The nonlocal causality appears to behave similarly as two-variable relation in ideal systems - a value change of one variable in the relation yields the change of the second variable value so that the relation remains valid. Instead of interaction or transmitting the causal signal in space and time, the particles seem rather to be acting to immediately satisfy the underlying relation (e.g. Pauli Exclusion Principle). The fundamental cause-effect characteristic of causality is still retained - the initial random change of the first particle state (cause) enforces the complementary state of the second particle (effect).

Such a defined singularity state has negative delimitation; it is not known what the singularity state was like, it is just known what it was not. But we know that such a state must have existed otherwise the existence of the empirical universe would not be limited, or in other words, the fundamental attributes of the universe would not be subject to change in any aspect.

The singularity-state term is thus conceptually properly identified and distinguished from the empirical-state term. Its meaning can even be practically illustrated - if someone asks how the situation could look like twenty billion years ago, the answer would be 'There was a state where the physical categories and the laws of empirical reality were not applicable; they didn't make sense in the means of our empirical realm. As the question implicitly points out to a situation at some time, which itself is a physical category, the question has no meaning either.'

3. The Precedence of the Singularity State

The question is what a relation between the singularity state and empirical state is like. Although the singularity state cannot be directly expressed in terms of time, we can consistently say that the singularity state *preceded* empirical states. More precisely, at any instant when an empirical state existed, the singularity state (not attributed with empirical manifestation) did obviously not exist - it had already been changed to empirical state. Since this is valid for any empirical state at any given time the singularity state had preceded all empirical states. Given this, we can construct a simple ordered sequence

$$\{S, x\} \quad (1)$$

where *S* denotes the singularity state and x is an arbitrary empirical state. *S* is therefore the very first nonempirical state[8] prior to any ordered sequence of empirical states

$$\{S, \ldots x \rightarrow y \rightarrow z \ldots\} \quad (2)$$

4. The Singularity and External Causality

The sequence (1) above shows that singularity state changed to empirical state. One state changed to a different state but the singularity is the only state out of which the universe emerged - the universe is therefore a consequent effect of the initial singularity state-change. In accordance with the causality principle described earlier there must have been a cause that had the initial singularity state changed. We can therefore claim that some cause linked *S* and x in causal relation so that *S* represents the initial state condition and x the effect

$$\{S \rightarrow x\} \quad (3)$$

It is difficult to say whether any empirical state could be determined as immediate effect of the initial singularity state-change, if at all, but this is not so problematic. Because of transitivity of actual causal chain[9], virtually any consequent state in the chain can be considered an effect of initial state. For example, given the validity of sequence (2), sequence $\{x \rightarrow z\}$ is a valid causal relation too.

[8] From the metaphysical point of view, it might well be conceptualized that the singularity itself is a structured domain with similar chains of causal states applicable in this domain too. However, metaphysical issues are not subject of this article and I simplify the concept of singularity as being a single atomic state that may cause solely empirical effects.

[9] Although in general the relation between transitivity and causality is somewhat problematic, for actualized causal chain described in form of linear sequence of actually realized states such that every state is determined by the previous state, transitivity remains valid.

Without loss of generality we can therefore choose any early empirical states x, y, z in causal relation {x → y → z} and write

{*S* → x → y → z . . .} (4)

Since *S* is the first and common state to all empirical causal sequences, we will call *S* a *primary state* or *primary cause*.

But what was the primary cause like having caused such a dramatic change from a state where empirical reality had not been present towards the empirical universe? Could it be an empirical cause?

Recall the sequence (4) stating that any empirical state in the primary causal chain is an effect of the causal change starting from the initial state *S*. But *S* is a nonempirical state (the singularity state) and by (Ex), *S* denotes external cause.

Hence, we can conclude that the primary cause *S* had been an external primary cause.