We've been looking at the first scientific confirmation of the second premise of the *kalam* cosmological argument that *the universe began to exist*. That confirmation comes from the expansion of the universe. We saw last time that based upon the physical evidence, space and time can be represented geometrically as a cone which shrinks as one goes back in time until one reaches an absolute beginning of the universe. The standard Big Bang model predicts a beginning of the universe. Although the standard model will need to be modified in various ways, especially to accommodate a quantum gravity theory to describe the earliest split-second of the universe, nevertheless the prediction of the standard model of a beginning of the universe has now stood for one hundred years and remains the most probable account for the origin of the universe.

I concluded last time by saying, in a sense, the history of 20th century cosmology can be seen as a series of failed attempts to avoid the absolute beginning of the universe predicted by the standard model. We've seen theories come and go, like the steady state model, oscillating models, vacuum fluctuation models, eternal inflationary models, and so on and so forth. Any model that doesn't involve an absolute beginning of the universe has proved to be untenable in some way. So when someone like Sean Carroll, in our debate on the evidence of cosmology for the existence of the God, simply gives a list of beginningless models of the universe, that says nothing about the tenability of those models. Models are a dime-a-dozen. The question is: are they tenable? Jim Sinclair in our article in the *Blackwell Companion to Natural Theology* had already discussed most of the models in Carroll's list and shown

why they were either empirically untenable or did not, in fact, avoid the absolute beginning of the universe.

In 2012 Alexander Vilenkin, a prominent cosmologist at Tufts University, at a conference at Cambridge University, surveyed the models of contemporary cosmology and concluded, "There are no models at this time that provide a satisfactory model for a universe without a beginning."

Meanwhile, a series of remarkable singularity theorems has increasingly tightened the loop around empirically tenable models by showing that under more and more generalized conditions, a beginning is inevitable. For example, in 1970 Hawking and Penrose formulated the singularity theorems which bear their name which show that any universe governed by the equations of General Relativity must shrink down to an initial singularity. In 2003 three prominent cosmologists, Arvind Borde, Alan Guth, and Alexander Vilenkin, were able to prove a theorem to the effect that any universe which is, on average, in a state of cosmic expansion over its history cannot be infinite in the past but must have a beginning. That goes for expanding multiverse scenarios, as well. In 2012 Vilenkin showed that models which do not meet this single condition of the Borde-Guth-Vilenkin theorem nevertheless fail for other reasons to avert the beginning of the universe. He concluded, "None of these scenarios can actually be past eternal."[1]

1 Audrey Mithani and Alexander Vilenkin, "Did the universe have a beginning?" arXiv:1204.4658v1 [hep-th] 20 Apr 2012, p. 5. For an accessible video, see see http://www.youtube.com/watch?v=NXCQelhKJ7A (accessed February 23, 2014), where Vilenkin concludes, "there are no models at this time that provide a satisfactory model for a universe without a beginning."

"All the evidence we have says that the universe had a beginning."[2]

That is a remarkable statement. It would be important if Vilenkin said merely that the evidence for a beginning of the universe outweighs the evidence against a beginning of the universe. But he didn't say that. He said *all* the evidence we have says that the universe had a beginning. I am not aware of any evidence that the universe is past eternal. There is simply nothing on that side of the scale. The evidence for the beginning of the universe, while not rendering this conclusion certain, certainly justifies Vilenkin's conclusion that the universe probably did begin to exist.

The Borde-Guth-Vilenkin theorem proves that under a single very general condition classical space-time (where you don't take into account quantum effects) must shrink down to a boundary at some point in the past. Now either there was something on the other side of that boundary or not. If not, then that boundary simply was the beginning of the universe. If there was something on the other side of that boundary, that will be the quantum gravity regime described by the yet-to-be-discovered quantum theory of gravity. In that case, Vilenkin says, *that* will be the beginning of the universe. So the Borde-Guth-Vilenkin theorem shows either that the universe began at this past boundary or else, if there was a quantum gravity regime, that regime is the beginning of the universe.

Vilenkin's confidence in this fact, even in the absence of a quantum theory of gravity, is based upon the fact that such a

2 A. Vilenkin, cited in "Why physicists can't avoid a creation event," by Lisa Grossman, New Scientist (January 11, 2012).

quantum regime is radically unstable, or as scientists would say, it is metastable. That is to say, it cannot endure for very long. Certainly it would be impossible for such a metastable condition to endure for infinite time doing nothing and then suddenly begin to expand about 13.8 billion years ago. Even though we may not have a description of this earliest phase of the universe, we can be confident that if such a quantum regime does exist that it was the beginning of the universe.

The prominent cosmologist Charles Misner once put it this way to me. He said it is as though there were a tiny window shade drawn across the first split-second of the universe, and we don't know what went on behind that shade, but what we do know is that the universe doesn't come out on the other side. So whether the universe began with the quantum regime or with classical space-time, the universe began to exist.

Of course, scientific results are always provisional. Science doesn't deal in certainties. It deals in probabilities. We can fully expect that new theories will be proposed, trying to avoid the universe's beginning. These proposals are to be welcomed and tested. But nevertheless I think it's pretty clear which way the evidence points. Today the proponent of the *kalam* cosmological argument stands comfortably within the scientific mainstream in holding that the universe began to exist.

In the online scientific magazine *Inference* from October 23, 2015, in an article entitled "Did the Universe Have a Beginning?"[3]

3 See http://inference-review.com/article/the-beginning-of-the-universe (accessed November 22, 2015).

Vilenkin interacts explicitly with the *kalam* cosmological argument. I want to read to you from this article. He says,

> Richard Dawkins, Lawrence Krauss and Victor Stenger have argued that modern science leaves no room for the existence of God. A series of science–religion debates has been staged, with atheists like Dawkins, Daniel Dennett, and Krauss debating theists like William Lane Craig. Both sides have appealed to the BGV theorem, both sides appealing to me—of all people!—for a better understanding.

Vilenkin is himself an agnostic. He doesn't believe in God. He is rather bemused that he should become the authority for these arguments. He goes on to say,

> The cosmological argument for the existence of God consists of two parts. The first is straightforward:
>
> 1. Everything that begins to exist has a cause;
>
> 2. The universe began to exist;
>
> 3. Therefore, the universe has a cause.
>
> The second part affirms that the cause must be God.
>
> I would now like to take issue with the first part of the argument.

So he is going to reject one of those two premises in the *kalam* cosmological argument. But he doesn't reject the second premise that the universe began to exist. Quite the contrary, he affirms it. In the article he says this:

> We have no viable models of an eternal universe. The BGV theorem gives us reason to believe that such models simply cannot be constructed.

This is the strongest statement yet that I have read from Vilenkin. Not only does he say we have no viable models today for a beginningless universe, he says that on the basis of his theorem we have reason to believe that such models simply cannot be constructed.

How, then, does Vilenkin respond as an agnostic to the *kalam* argument? He chooses to reject the first premise – that everything that begins to exist has a cause. He maintains that the universe just popped into being uncaused out of nothing. What justification does he have for such a remarkable hypothesis? Well, he says, in a closed universe (that is, one that is finite in volume), the positive energy and the negative energy in such a universe balance each other out so that the net energy is zero. There is the same amount of positive energy as negative energy, so the net energy is zero, and therefore if the universe pops into being uncaused out of nothing the conservation laws of matter and energy are not violated. Therefore the universe can simply come into being uncaused from nothing.

I have to say that I find this difficult to take seriously. Vilenkin assumes that if something doesn't violate the conservation laws, then it is metaphysically possible. But there is no reason to adopt such an assumption. Just because coming into being uncaused out of nothing wouldn't violate the conservation laws doesn't mean that it is metaphysically possible that something can come into being from nothing. It is easy to think of examples of things that are

metaphysically impossible that don't violate the laws of nature. For example, certain moral truths are metaphysically necessary. For example, it is impossible that it would be good to torture a little child for fun. But such a moral flip-flop wouldn't violate any of nature's laws, would it? That is perfectly consistent with the laws of nature. What might be another example? How about the statement that "no event precedes itself" – no event comes before itself. That, I think, is metaphysically necessary. It is impossible that an event precede itself. But no natural law would be violated by such a thing. In fact, this would be the case if time is circular. If time is circular, then event E both precedes and succeeds itself – it comes after itself, it comes before itself. There is no natural law violated in cyclical time. Indeed, scientists will often talk about closed time-like loops. But given the objectivity of temporal becoming, the nature of time, it seems to me that a circular time is metaphysically impossible. So the fact that something doesn't violate a law of nature doesn't imply that that thing is metaphysically possible, and coming into being out of nothing would certainly seem to be something that is metaphysically impossible regardless of the conservation laws of matter and energy.

Worse, when you think about it, the situation that Vilenkin imagines, that the universe can come into being uncaused if its positive energy is exactly balanced by its negative energy, just seems completely wrong-headed. It is like saying that if your financial assets and your financial debits exactly balance each other out then your net worth is zero and therefore there is no cause of your financial condition. Clearly, that would be a mistake. Christopher Isham, who is Great Britain's leading quantum

cosmologist, in his article “Cosmos and Creation,” points out that even if the positive and negative energy balance each other out, so that the net energy is zero, there still needs to be, in his words, “ontic seeding” to create the positive energy and negative energy in the first place! So even if you had the exact balance of positive and negative energy, that wouldn't eliminate the need for a cause of the origin of the universe.