Cosmologists tell us that we now know a fair amount of detail about the conditions of the universe from the first split second, 13.7 billion years ago.

Popular writers such as physicist Paul Davies in his ‘Goldilocks Enigma’[1] eloquently describe what we know back in time to the apparent singularity from which it all began. Time itself, as a dimension of the universe, began in that moment. But what occurred before the big bang, if there was a ‘before’?

No one was there, and science seems to break down once we get to a certain boundary, nanoseconds from the beginning. There are various ideas current in the scientific community; some say the universe began from nothing (yes, nothing), a few others favour a ‘big crunch’ concept of the universe oscillating between expansion and contraction and bouncing from each contraction into a new expanding form. Some favour the idea of multiple universes spawning new ones at the edges.

So when we ask what caused the universe, we get a variety of answers but none with any, so far, scientific underpinning. When those who favour a divine cause bring this idea up then sceptics argue in a variety of ways. This article tries to look at the most common ones and to provide some philosophical and mathematical reasons why there must have been some ‘first cause’. The idea of an unmoved mover or first cause of everything that exists is ancient and philosophers such as Aristotle favoured it.[2] Now we have cosmology and general relativity, does this change things? Please read on.

Firstly, some say that to speak of some uncaused cause or first cause is wrong because we know that a singularity caused the big bang. This is easily answered. What caused the singularity? Or if you prefer, what led to the singularity? And if you say there was nothing before it, we are still entitled to ask what caused something to come out of nothing.

Secondly, some say, as has already been alluded to, that the universe has endlessly oscillated from expansion and contraction with a series of crunches forming new singularities. The question then is: what originally caused the cycle of universes in this scenario? This also leads of course to the idea that perhaps it was an infinite cycle and there was no beginning; we will later discuss whether an infinite series is actually possible.

Thirdly, we might envisage multiple universes existing which somehow spawn new ones (we are now in the realms of speculative 'brane theory'). The question then arises: what caused the multiple universes? Again we come to the real nub and sticking point: could there have been an infinite series of causes stretching back into the past with no actual first cause?

This really is the main point that we need to discuss; can there be an infinite series of causes or an 'infinite regress'? All the above scenarios boil down to this eventually. If we can show that there cannot be any such infinite series then we are back to the first cause.

William Lane Craig, the philosopher, has in the past few years revived an old argument known as 'The *Kalam* Cosmological Argument'.[3] *Kalam* is in fact an Arabic word meaning 'speech'. It is an argument about the possibility of infinite causes which was developed by medieval Islamic and Jewish theologians.

Craig sets out 3 premises as follows:

1. Whatever begins to exist has a cause.

2. The universe began to exist.

3. Therefore, the universe has a cause.

In philosophy this is known as a deductive argument. Clearly we need to examine each premise in turn. If there is some repetition it is for clarity.

Premise (1) seems to be true to anyone who examines it. It is constantly confirmed in our experience. The philosopher David Hume, known for his scepticism, wrote that he 'never asserted so absurd a proposition as that something could arise without a cause.'[4] The most important word in this premise is 'begins'. If something did not exist and then existed, there must be a cause.

Premise (2) is clearly the one that needs unpacking in some detail. We have very good data to support the fact that our universe had a beginning or, in other words, had a finite past.

The first major piece of evidence for premise (2) is the second law of thermodynamics. This is a fundamental law which states that in any system the processes always tend towards an equilibrium. Energy runs down and 'entropy' increases. Our universe is heading for what is called 'heat death'. It is what happens when your cup of hot coffee, if not drunk, reaches the same temperature as the room. Now when we observe our universe we know that it has not run down yet. Entropy is not at a maximum. This means that it is in the process of reaching that state. Such a process is time limited and had to start at some point with a state of low entropy. This means there must have been a start.

The second major piece of evidence for premise (2) is the big bang theory. We will not go into this now in any detail. Suffice it to say that this theory is held by the vast majority of cosmologists. The evidence for this comes particularly from two observations: firstly, the universe is expanding, as seen with the red shift of receding galaxies and secondly, the cosmic microwave background radiation surrounds us in every direction. The expansion can be run backwards in time and when we do that we come to a beginning. The cosmic background radiation has been very confirmatory of the afterglow from the big bang. Physicists tell us that it is at exactly the expected intensity.

So premise (2) seems to be confirmed to most people's satisfaction. But what about the other theories already touched upon; for instance of how the universe may be oscillating or has been spawned from other universes? The main issue here is that we do not know if the big bang was the real start or came from some of these other conditions.

I think it is helpful here to use the term 'universe' to mean the entire physical reality that has ever existed, be it our one known universe or the series of oscillating universes or the multiple

universes that might be spawning other universes (or indeed any of the other ideas floating around such as the ‘vacuum fluctuation universe’ or ‘quantum gravity universe’). All of these still come under the question: did such a physical reality begin to exist? This is where the Kalam argument comes in to play. The person who denies a first cause has to argue strenuously for an infinite series of causes going back into the infinite past. This is the only way in which to deny a first, uncaused cause. The question therefore comes down to whether an actual infinite series can exist.

What follows is the simplified mathematical part of the Kalam cosmological argument[5] which seeks to prove that an actual infinite series of anything is not possible. It is based on the idea that the existence of an infinite number of anything leads to logical contradictions. There are 3 mathematical arguments, which I will give in order:

First mathematical argument

There are two types of infinites, potential infinites and actual ones. Potential infinites are used all the time by mathematicians in equations. They are useful but potential. The term ‘Actual infinites’ refers to real things which are infinite; it is not enough just to conceive of this but there must actually be an infinite number of things.

The best known example to illustrate this is called the ‘Hilbert’s Hotel Paradox’ (named after the mathematician David Hilbert). Hilbert’s Hotel has an infinite number of rooms, each occupied by a guest. As there are an infinite number of rooms and an infinite number of guests, every room is occupied; the hotel cannot take any more guests. There is a ‘No Vacancies’ sign showing. There is also a ‘Guests Welcome!’ sign showing. When a new guest arrives the manager asks the guest in room no. 1 to move into no.2 and the guest in no. 2 to move to no. 3...and so on. As for any room n there is a room n + 1, every guest can be moved to a different room. This is to free up room no.1 for the new guest. Before the new guest has arrived there is no room left and yet we see that the guest can be accommodated after all. This is clearly paradoxical; it is not possible that a hotel both can and cannot accommodate a new guest. Hilbert’s Hotel is therefore impossible. David Hilbert said: ‘The infinite is nowhere to be found in reality.....The role that remains for the infinite is solely that of an idea.’[6]

Second mathematical argument

The second mathematical argument for the claim that there is no such thing as an actual infinite draws on the idea that an actual infinite cannot be created by successive addition. If you begin with a number and repeatedly add to it, you will never arrive at infinity. If you have a heap of sand and repeatedly add more to it, the heap will never become infinitely large. The past has been created by successive addition. The past continually grows as one moment after another passes from future into the present and then into the past. If actual infinites cannot be created by successive addition, and the past was created by successive addition, then the past cannot be an actual infinite. The past must be finite and the universe must have had a beginning.

Third mathematical argument

This argument draws on the idea that actual infinites cannot be traversed.

If I were to set out on a journey to an infinitely distant point in space, it would not just take me a long time to get there; rather, I would never get there. A part of the journey would always remain, no matter how long I took.

Similarly, if I were to start counting to infinity, I would never finish. Now if the past were infinite, then it would not just take a long time for the present to arrive; it would never arrive. No matter how long time had passed, we would still be working through the infinite past. It is impossible to traverse an infinite period of time. Clearly though, the present has arrived, the past has been traversed. The past, therefore, cannot be infinite, but must be finite. The universe has a beginning.

This third mathematical argument is illustrated by thinking about an infinitely deep well[7] which has a ladder with an actually infinite number of rungs. If you started at the top of the ladder and climbed down some finite number of rungs, you could climb out again one rung at a time. However, suppose you were to climb out of the well, but there were no definite, finite number of rungs above you. In this analogy, the well stands for the past, the rungs on the ladder stand for each and every past event, and the top of the well is the present. If climbing out of the actually infinite well is implausible, then so too is arriving at the present time if the past is actually infinite.

These mathematical arguments all support premise (2); ‘the universe began to exist.’

Which leads us to premise (3): ‘Therefore the universe had a cause.’ This premise depends completely on premise (2). We have confirmed premise (2) and therefore we can conclude that premise (3) is correct.

If the universe had a cause we rightly ask ourselves, what sort of cause? This is where philosophy and science come together to point to an uncaused and eternal, non physical cause.

The first cause had to be uncaused, because we have learnt that there is no actual infinite series of causes. When someone like Richard Dawkins asks, ‘who caused God?’,[8] they are confusing the issue. There simply had to be a first cause which has not been caused; otherwise we go down the infinite regress which we have dismissed.

The first cause had to be eternal, because, as we have seen, this cause could not have been caused and so never had a beginning. We may well also look to science here because cosmologists say that time itself began with the universe. So we have an uncaused cause, eternal and outside time.

The first cause must be non-physical, because everything that is physical has had a cause.

We cannot touch on the actual attributes of such a first cause in this article. However, everything about the universe, its laws, fine tuning, beauty and immensity strongly point to an intelligence of immense power, inconceivable ability and great artistry.

The knowledge we now have of cosmology, together with the insights of philosophers such as William Lane Craig and mathematicians such as David Hilbert show us that it is rational to believe in a Creator. Not just rational but inevitable.

Antony Latham.

[1] Davies, Paul. 2006. *The Goldilocks Enigma.* Penguin
[2] Aristotle. From *Physics 8.6; 260a*
[3] Craig, William Lane, 1998. *Design and the Cosmological Argument'* in Willima A.Dembski (ed.) 'Mere Creation' IVP
[4] David Hume in J.Y.T. Grieg (ed.), *The Letters of David Hume.* Garland. 1983. 1:187.
[5] http://www.philosophyofreligion.info/theistic-proofs/the-cosmological-argument/the-kalam-cosmological-argument/maths-and-the-finitude-of-the-past/
[6] David Hilbert, 'on the infinite'. Quoted by Craig in *God? A Debate Between a Christian and an Atheist.* Oxford, 2004)
[7] From Peter S. Williams. Personal communication.
[8] Dawkins Richard. 2007. *The God Delusion.* Black Swan