The Expanding Universe, Einstein and the Big Bang

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Abstract

In 1917 Einstein developed equations that described an ever-expanding universe. It is the nature of an electromagnetic universe to continually expand, although the term “ever-dilating universe” would be more appropriate given his other work. Later on, after the expansion of the universe was actually discovered, Georges Lemaitre proposed the “Big Bang” theory to account for that expansion rather than viewing it as being in the nature of an electromagnetic universe. So we seem to have two perfectly sensible reasons for the expansion of the Universe. Why?

Einstein

Before the Universe was even known to be expanding, Einstein developed his work on Relativity. In 1917 he discovered that his equations led to an ever-expanding universe, and since the Universe was at that time believed to be static he had to add an arbitrary "Cosmological Constant" to cancel out that expansion in his equations. There was absolutely no justification for this other than to make his equations agree with the then-perceived static view of the Universe. After the expansion of the Universe was discovered Einstein regretted it, calling it the "Biggest blunder of his life".

The equations indicate that expansion (or continuous dilation) is part of the very nature of the universe, just as much as time dilation in the presence of mass and the limiting speed of light. These are all properties of electromagnetic spacetime, and do not have any originating event. In particular, there is no need for a "Big Bang" explosive start to the Universe to explain it.

The nature of the Einsteinian expansion is inherently progressive. If it takes eight billion years to double the size of the Universe, then in another eight billion years it will double again to four times the size, then double again to eight times, then sixteen times, and so on. So the rate of expansion is always increasing. Look back in time, and eight billion years ago the Universe was half its current size. Sixteen billion years ago it was a quarter. But it never becomes zero, no matter how far back in time we go. The Universe is eternal, being infinite in time forwards and backwards. And there is no spatial edge to the Universe that we have ever found – the Universe goes on beyond the limits of our most powerful instruments, so may well be infinite in size. In this case halving its size for every eight billion years we step back in time is never going to have an impact on that size. In the observable Universe – only a part of the total universe, which may be infinite - there is clearly a condensation event in progress, creating stars and galaxies.

As the Universe expands – or dilates in size – time also dilates. A putative observer outside our Universe who experiences time linearly rather than in the internal progressively dilated form would see the Universe as having a start date. In terms of time as we measure it today that would be about fifteen billion of our modern years ago. Eight billion years ago when the Universe was half its size time was only half as dilated so that in terms of time as it was measured then our observer from outside the Universe, using the years of *that* time as a measure, would see the start of the Universe as still fifteen billion years ago, because the years were only half as long as our present-day ones. The Universe is *always* fifteen billion years old in these terms.

How scientific is the theory? Scientific proof of a theory requires the theory to be testable in labs around the world, and each and every lab must be able to prove the theory. That is not possible in this case, so instead we look for correspondences and conflicts between the real world and what the theory claims. In 1998 two separate projects – The Supernova Cosmology Project and The High-Z Supernova Research Team – examined distant type 1a supernovae which have a near-standard intrinsic brightness so that the brightness we see on Earth can be used to measure their distance from us. By measuring the red shift and comparing it with that distance we can see how the Universe expands over time. The results clearly show that the rate of expansion is increasing, which correlates perfectly with Einstein's work - his theory requires this result as one of its correspondences.

The Big Bang

Upon discovering the expansion of the Universe, Georges Lemaitre proposed the Big Bang theory in 1927, which he called the "hypothesis of the primeval atom" or the "Cosmic Egg". He was probably

unaware of the weakness in Einstein's Cosmological Constant and just chose a simple explosion causing the Creation of the Universe to explain the expansion.

The only way to have a massive explosion as the start of Creation is to have a Universe which is not energy conserving – that is, it cannot follow the Principle of Conservation of mass/energy as our present-day Universe does. Hence at the point of Creation the Universe must have been creating energy out of nothing to produce all the mass and energy we see in the observable Universe. This state of affairs must have continued long enough to produce all that mass and energy before "condensing" into the energy-conserving Universe we know today. The word "condensing" is perhaps not the best choice as it suggests a simple and natural progression, whereas that change was the most dramatic and extreme in the history of the Universe, and it is not clear why such a Universe changed rather than continuing to create more and more mass and energy for all eternity.

The rate of expansion, now that the Universe is energy-conserving, should be slowing down as the original explosion is long in the past and gravitational forces between galaxies are acting to slow the expansion. In a few billion years everything must eventually collapse inwards again, back to the central site of the explosion.

How scientific is the theory? We cannot prove it in a scientific sense – theories of the Creation of the Universe are impossible to prove as we cannot create a new universe and watch it evolve in the lab. Again, we must look for correspondences between the real world and the theory. Scientists are examining the cosmic background microwave radiation looking for the electromagnetic echoes from the Creation Event to see if that also corresponds. However the fact that the rate of expansion of the universe is increasing does not sit well with this theory and work is going on to try and find a reason.

Summary

We have four possibilities:-

1. Both Einstein and Lemaitre are wrong.
2. Einstein is right and Lemaitre is wrong.
3. Einstein is wrong and Lemaitre is right.
4. Both Einstein and Lemaitre are right.

Given that we have no other working theories that fit the facts we have to eliminate (1) – it may be true but gets us nowhere. Equally, option (4) is possible but we only need one theory to explain the expansion and there is no requirement for more at this stage in our knowledge; each theory is sufficient on its own to explain the expansion of the universe. So for now we are left with a simple decision to make – which one of (2) and (3) is right.

At present the correspondences seem to prefer Einsteinian expansion. To make things work with the Big Bang theory requires work to explain what is overpowering gravitational attraction in the expansion of the universe. It does not mean that a "Big Bang" did not happen, but because of Einstein's work we know that the expansion of the Universe is not incontrovertible evidence that the Big Bang happened. Since a simpler explanation is generally more probable than a complex one, on what we know at present Einstein is more likely to be right. It leaves us without a creation event for the universe, which people as a whole are uncomfortable with, but the universe does not exist for our comfort.