What kind of bang was the big bang?

- 02 July 2012 by **Amanda Gefter**
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There's trouble at the start of time: the theory of cosmic inflation has got way out of control. Can quantum theory and holograms tame it?

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"YOU know how sometimes you meet somebody and they're really nice, so you invite them over to your house and you keep talking with them and they keep telling you more and more cool stuff? But then at some point you're like, maybe we should we call it a day, but they just won't leave and they keep talking and as more stuff comes up it becomes more and more disturbing and you're like, just stop already? That's kind of what happened with inflation."

Max Tegmark's voice is animated as he talks about the idea underpinning our story of the universe's origins. The theory of cosmic inflation states that in the first fraction of a second after the big bang, the universe's fabric expanded faster than light. Without a trick like that, we have difficulty squaring some crucial features of today's cosmos with a universe that began as a hot, dense soup and has been growing and cooling since.

Yet Tegmark, a cosmologist at the Massachusetts Institute of Technology, is not the only person asking whether inflation has outstayed its welcome. For all its attractions, the theory has unpalatable consequences - so unpalatable that they threaten to undermine our entire understanding of the cosmos. Debate has been reopened on a question many thought had been settled: what kind of a bang was the big bang?

When inflation was proposed in 1980 by Alan Guth, then a young postdoc at Cornell University in Ithaca, New York, it was a godsend. Studies of the cosmic microwave background radiation were causing serious headaches among proponents of the big bang.

This radiation seems in itself to be a spectacular confirmation of the big bang theory. Some 380,000 years after the universe's origin in a "singularity" of unimaginable density and temperature, the cosmos had expanded and cooled enough for the first atoms to form. Photons of light pinged off these atoms and have been travelling in all directions through the cosmos ever since. Sitting in our particular spot some 14 billion years later, we see them as a background radiation that suffuses the sky at an almost uniform temperature of 2.7 kelvin.

But that success hides some problematic details. One is that you can measure the cosmic background 10 billion light years away in one direction and 10 billion light years in the other and still observe that pleasing uniformity. Run a simple story of a steadily expanding cosmos backwards, however, and it would take 20 billion years for these patches of space to meet - more than the age of the universe. In a simple big-bang universe, they were never close enough to equalise their temperatures, and that uniformity is a highly improbable coincidence.

Then there is the universe's geometry. Information encoded in the cosmic background shows space is extremely "flat": Euclidean geometry reigns supreme and parallel lines never meet. This flatness is also highly unlikely, given what we know about gravity and its compulsion to warp space. Again, a simple big bang cannot explain it.

Inflationary pressure

An inflationary big bang can. At the beginning of time, so the idea goes, all that existed was a quantum field called the inflaton. It found itself in a "false vacuum" - a state that is temporarily stable, but not the lowest, true-vacuum energy state. It is as if the inflaton were poised on a small plateau on a steep mountainside. All things being equal, it could rest there undisturbed, but the slightest jiggle would send it careering down towards the true vacuum below.

In the universe's first fraction of a second, all things were not equal. Random quantum fluctuations in energy provided just the jiggle to set the inflaton on its way. As it fell towards the true vacuum, it generated a kind of repulsive gravity that pushed the space out around it. The further it fell, the more it pushed until space was ballooning outward at a speed far greater than that of light.

This is physically all above board. Einstein's relativity forbids objects from travelling faster than light through space, but places no constraints on what space itself can do. And when the inflaton hit rock bottom, all the kinetic energy it acquired in its headlong descent poured into the universe, creating the matter and radiation that went on to form stars, planets and, eventually, us. All this happened in considerably less than the blink of an eye: in just 10^{-33} seconds, the observable universe ballooned over 20 orders of magnitude in size, from a diameter about a billionth that of an atomic nucleus to a mini-cosmos about a centimetre across (see diagram).

Unwanted universes

In one fell swoop, inflation solved the big bang's problems. Those patches of sky no longer need a 20-billion-year rewind to have met and mingled: inflation gave them the shove-off they needed to ensure they arrived far faster at the far reaches of the cosmos. And that absurdly unlikely flatness is nothing of the sort: inflation makes the universe so large that any measurable region must look flat, the same way the ground at your feet looks flat even though Earth's surface is curved.

Inflation's munificence didn't stop there. By inflating tiny quantum fluctuations in the density of the cosmos to astronomical proportions, it produced a blueprint for how stuff clumped into ever-larger agglomerations of matter such as the galaxies we see today.

"That would have been the perfect point for inflation to bow, wait for applause and exit stage left," says Tegmark. But that didn't happen. Instead, inflation kept on predicting still more things - things that nobody wanted.

Things like other universes.

The problem is that once inflation starts, it is nearly impossible to stop. Even in the tiny pre-inflation cosmos, quantum fluctuations ensured that the inflaton field had different energies in different places - a bit like a mountain having many balls balanced precariously at different heights. As each one starts rolling, it kicks off the inflation of a different region of space, which races away from the others at speeds above that of light. Because no influence may travel faster than light, these mini-universes become completely detached from one another. As the inflaton continues its headlong descent in each one, more and more bits of space begin to bud off to independent existences: an infinite "multiverse" of universes is formed (see diagram).

This is not good news for our hopes for cosmic enlightenment. In a single universe, an underlying theory of physics might offer a prediction for how flat the universe should be, say, or for the value of dark energy, the mysterious entity that seems to be driving an accelerated expansion of the universe. Astronomers could then go out and test that prediction against observations.

That's not possible in an infinite multiverse: there are no definite predictions, only probabilities. Every conceivable value of dark energy or anything else will exist an infinite number of times among the infinite number of universes, and any universal theory of physics valid throughout the multiverse must reproduce all those values. That makes the odds of observing any particular value infinity divided by infinity: a nonsense that mathematicians call "undefined".

At first, cosmologists hoped to make sense of these infinities by taking a finite snapshot of the multiverse at some particular time, and then extrapolating the relative probabilities of various observations out to later and later times and an ever larger number of universes. Einstein stymied that approach. His relativity means there is no single clock ticking away the seconds of the multiverse, and there is an infinite number of ways to take snapshots of it, each giving a different set of probabilities. This "measure problem" destroys inflation's ability to make predictions about anything at all, including the smoothness of the cosmic background, the curvature of space, or anything else that made us believe in the theory in the first place.

"We thought that inflation predicted a smooth, flat universe," says Paul Steinhardt of Princeton University, a pioneer of inflation who has become a vocal detractor. "Instead, it predicts every possibility an infinite number of times. We're back to square one." Tegmark agrees: "Inflation has destroyed itself. It logically self-destructed."

Sean Carroll, a cosmologist at the California Institute of Technology in Pasadena, is more circumspect. "Inflation is still the dominant paradigm," he says. "But we've become a lot less convinced that it's obviously true." That's not just because of the measure problem, he says. More basically, we don't know what an inflaton field is, why it was in a false vacuum and where it and its energy came from. Having an inflaton field perched so perfectly and precariously atop that mountainside seems no more likely than the flukes the idea was intended to explain. "If you pick a universe out of a hat, it's not going to be one that starts with inflation," says Carroll.

So if it isn't inflation that made the universe as we see it today, what did? Are there other sorts of big bang whose predictions square with our observations, but don't have inflation's unwanted side effects?

Perhaps. In 2001, Steinhardt was one of the first to suggest an alternative, together with his colleagues Justin Khoury, Burt Ovrut and Neil Turok. Their idea was to revisit our interpretation of the big bang. Rather than marking a singularity at the absolute beginning of space and time, it was just a recent event in a much longer history. The inspiration for this idea came from string theory, the most widespread approach to get Einstein's general theory of relativity, which best describes space and time, to play nicely with quantum mechanics, which best describes everything else.

String theory proposes that the various particles that make up matter and transmit forces are vibrations of tiny quantum-mechanical strings, including one that produces a "graviton", an as-yet-undetected particle that transmits gravity. It also predicts the existence of extra dimensions beyond the four of space and time we see.

Brane drain

This leads to the possibility that our 4D cosmos is situated on a "brane", a lower-dimensional object floating in a higher-dimensional space. In this picture, ours is not necessarily the only brane: two branes floating a microscopic distance away from each other can form the boundaries to a five-dimensional space in between, like two slices of bread bounding a sandwich. Steinhardt and his colleagues' idea was that every few trillion years or so neighbouring branes float together and touch, resulting in an explosive exchange of energy as the fifth dimension briefly disappears into a singularity, reappearing as the branes move apart again (see diagram). Our 4D brane receives a huge injection of energy in this collision, something we interpret as a big bang. It doesn't represent the absolute beginning of our space and time, however, but a reinvigoration of a cosmos with an eternal existence (*Physical Review D*, vol 64, p 123522).

This "cyclic model" of the big bang does much of what the inflationary big bang was invented to do. "You can solve problems that would have been intractable without inflation given only 14 billion years," says Steinhardt. The branes are essentially flat to begin with, so the flatness problem disappears. When the branes clash, they hit at almost the same time everywhere, so the energy that will form matter and radiation pours in almost uniformly, creating a nearly homogeneous cosmos. Small quantum energy fluctuations are all that are needed to give enough density variation to eventually seed galaxies. And because the idea needs no multiverse, the measure problem disappears.

If nothing else, the cyclic model introduced some competition into the big bang market. "It shows that you're not stuck with inflation - other ideas are possible," says Steinhardt. "But whether or not you like this particular alternative is a matter of taste."

Not everyone did. Models of the big bang that involve a singularity in our space-time, including the inflationary big bang, neatly excuse us from explaining what happened at the universe's beginning: the singularity is a place where the universe falls off the cliff of existence and the laws of physics break down. But in the cyclic model, we must explain how the fifth dimension survives its momentary lapse into a singularity. "To me, it doesn't seem to work," says Thomas Hertog of the Catholic University of Leuven (KUL) in Belgium, who worked on the idea for a couple of years. "The calculations suggest that the transition through the singularity is very unlikely."

The many clashes between branes that the model implies just compound the problem, says Carroll. "If you follow the cyclic universe backward in time, the conditions that you need become more and more special, or unlikely." The way to solve that problem is to postulate some kind of beginning that provided a special set of conditions - but that seems to defeat the object of the theory.

Many histories

So if neither inflation nor the cyclic universe can deliver a plausible beginning to the cosmos, what can? Carroll suggests a middle way. Steinhardt might have had the right idea in seeking an answer to the big-bang conundrum in the unification of general relativity and quantum mechanics, he says. But the answer could lie in using those ideas not to replace inflation, but to make it better.

"We use a half-assed version of quantum mechanics when we do cosmology," Carroll says. Inflation is a theory about space-time and gravity, so it is anchored in general relativity. It incorporates a few aspects of quantum physics, such as the uncertainty fluctuations that push the inflaton off the mountain ledge, but as we lack a sure-fire way of connecting relativity and quantum theory it remains a "semiclassical" theory. "Maybe that's not good enough," says Carroll.

But how can we put the quantum into cosmology? Three decades ago, just after inflation had burst on to the scene, physicists Stephen Hawking of the University of Cambridge and James Hartle of the University of California, Santa Barbara, made a stab at it. In quantum physics, when a particle travels from A to B it doesn't take a single path but can pass along two or more paths simultaneously, interfering with itself at the other end as if it were a wave. To find out which path we are most likely to observe, we must add together the quantum-mechanical "wave functions" encoding each possible path, working out how their individual peaks and troughs cancel and amplify each other. Encoded within this total wave function is everything we need to know about the quantum particle at B, including the probabilities for the outcomes of any measurement we choose to make.

Hawking and Hartle argued that a similar approach could be applied to the universe as a whole. Point B is the universe we see today. Looking back towards its origin, we can trace many valid histories of its expansion back towards a point - point A - where semiclassical physics breaks down and quantum space and time become so gnarled that the two cease to be clearly distinguished. This point is no longer a beginning of time in a singularity as in the standard inflationary cosmology, but a timeless point where the universe - or rather a superposition of all possible historical universes - pops into existence from nothing with all its laws of physics intact. Because of this lack of a clear beginning, Hawking and Hartle called it the no-boundary proposal.

Following the rules of quantum mechanics, they added up all the possible histories that began in a universe with no boundary and ended in the universe we see today. The idea is a kind of multiverse in reverse: a single universe with multiple histories (see diagram). The resulting wave function gets rid of the measure problem, as it encodes a unique set of probabilities for anything we might observe. And because the admissibility of the histories is determined by what we see in the cosmos today, problems such as the flatness of space-time or the homogeneity of the cosmic microwave background cease to be problems: instead, they are the inputs to the theory.

The no-boundary universe had its attractions for many physicists. "If it turns out the universe has to have an origin, I find this initial state to be a very plausible one," says Guth. And as far as Guth's theory of inflation is concerned, the no-boundary proposal turned up a pleasant surprise. As Hartle, Hawking and Hertog showed in 2008, although the theory was not dreamed up with inflation in mind, it crops up naturally along many paths the universe could have taken to get here (*Physical Review Letters*, vol 100, p 201301). "You can calculate the probability that inflation occurred, and it turns out that probability is very high," says Hertog.

That all sounds very neat, but there was still no reason to believe the no-boundary proposal was true. It was difficult to see where it fitted in to the sort of unifying theoretical constructs, such as string theory, which are needed to explain events in the early, high-energy days of the universe.

That might just have changed, thanks to one of the most profound ideas to come out of string theory in recent years: the holographic principle. This states that the physics of a 4D universe such as ours, including gravity, is mathematically equivalent to the physics on its 3D boundary without gravity. The implication is that the world we see around us is nothing but a holographic projection of information from the edge of reality. It sounds implausible, but the principle pops up not just in string theory, but in almost any approach to unifying relativity and quantum theory dreamed up so far.

Although the no-boundary proposal says that the universe has no boundary in the far past, it does give a boundary in the infinitely far future. By calculating the physics on this boundary, Hertog extracted the probabilities of all the possible universes that can emerge as its holographic projections. Remarkably, the probabilities for things like the homogeneity of the cosmic background or the amount of dark energy are the same as those that you get from the no-boundary wave function. This supplies a direct connection between string theory, the most popular route towards a theory of everything, and the no-boundary proposal, which produces inflation naturally.

"Originally the no-boundary wave function was sort of picked out of thin air," says Hertog. "But now we see that it lies at the heart of the holographic principle. This is very encouraging for inflation." Together with Hawking and Hartle, he set out the thinking in a paper posted online last month (arxiv.org/abs/1205.3807).

Cosmologists are still digesting the new proposal, with some questioning whether the assumptions it makes are justified. Guth says that as yet no one is sure about the validity of the specific holographic correspondence Hertog, Hawking and Hartle have employed. "It's certainly a worthwhile line of research, but what they are trying to establish is a very difficult thing," he says.

We are not yet there, at the true story of the beginning of the universe. But it seems undeniable now that working out whether inflation is the imposter doubters such as Tegmark believe it is will depend on finding some way to consistently apply quantum theory to the fabric of the universe. Only then will we truly know what kind of a bang the big bang was.

Testing, testing

Theorising about the big bang can only take us so far: we need observations and experiments to determine the true story of the universe's beginnings. Fortunately, a number are in progress that might help us discriminate between rival theories (see main story).

One is the European Space Agency's Planck satellite. This telescope blasted off in May 2009 to make the most detailed measurements yet of the cosmic microwave background from an orbit 1.5 million kilometres above Earth, and its first cosmological dataset is scheduled to be released next year. If the extraordinarily powerful burst of early expansion implied by the theory of cosmic inflation really did occur after the big bang, it would have sent ripples through the fabric of space-time. These gravity waves would have had subtle effects on the polarisation of the microwave radiation that makes up the background - and Planck should be capable of spotting them. "That would be very exciting," says Alan Guth, the physicist who originally proposed the theory of inflation.

Meanwhile, Celine Boehm of the University of Durham, UK, and her colleagues proposed last month that the high-energy collisions at the Large Hadron Collider at CERN near Geneva, Switzerland, could be used to test whether the inflaton field and its associated particle, the inflaton, existed and if so what it looked like. The particle itself is far too massive to be made at the LHC, but its existence might influence the decay of other, less weighty, particles - and that could be tested (arxiv.org/abs/1205.2815).

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Corrections And A Question

Thu Jun 28 19:41:43 BST 2012 by **Eric Kvaalen**

"Run a simple story of a steadily expanding cosmos backwards, however, and it would take 20 billion years for these patches of space to meet - more than the age of the universe."

That's not correct. They would meet at at time 1/H in the past, where H is Hubble's "constant", equal to about 70 km/s/Mpc. Given that a Mpc is about 31 tetrillion km and there are about 31.6 million seconds, 1/H is about 14 milliard years, not 20 milliard. Coincidentally this is quite close to the age of the universe. ("Coincidentally" because in the simplest model the age of the universe should be 2/3 of 1/H.)

So that is not the reason that astronomers claim the two areas were never close enough to equalize their temperatures.

"The further it fell, the more it pushed until space was ballooning outward at a speed far greater than that of light."

How can you possibly define the speed of the expansion of the universe? The expansion is measured in units of inverse time (like H), not distance per time, because there are no two special points to measure between. The universe has no known radius whose rate of growth we can talk about. (The "observable universe" whose diameter is said to have been a centimetre after inflation is, for all we know, only a tiny part of the universe.)

"The way to solve that problem is to postulate some kind of beginning that provided a special set of conditions - but that seems to defeat the object of the theory."

What's the point of finding a theory with no beginning of time? That doesn't really solve anything. It doesn't tell us why there is a universe, which in this theory has been around from everlasting.

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Corrections And A Question

Mon Jul 02 09:49:48 BST 2012 by **Mark Bridger**
http://www.wix.com/markbridger48/artist

Eric "What's the point of finding a theory with no beginning of time? That doesn't really solve anything. It doesn't tell us why there is a universe, which in this theory has been around from everlasting."

Well in my understanding the Big bang/ our cosmos points to the beginning of it's own time. But one can't in principle say something came out of nothing, which is to say that there has to be some original context - which could mean infinite 'siblings'.

Here's some links to my explanations of the whole theory.

Re: More problems for inflation theory in the cosmic microwave background radiation

(long URL - click here)

The theory that predicted the accelerating expansion obsevation (and another dark matter effect) on the basis of an infinite universe.

(long URL - click here)

Matter generation / the start of a big bang (within a surrounding already existent infinite universe)

(long URL - click here)

(long URL - click here)

(long URL - click here)

An important revision of (ultra) black hole theory (for an infinite, eternal, multi-bang universe.)

(long URL - click here)

(long URL - click here)

Explanation of gravity in an infinite universe (concerning multiverse theory, quantum physics and dark matter(s))

(long URL - click here)

Not an infinite repetition of universes!

http://postbiota.org/pipermail/tt/2010-April/007171.html

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Not Impressed!

Sat Jun 30 17:15:46 BST 2012 by **Michel Cartier**

20 billions years? The universe couldn't scale back on one side for 10 billion years than another ten billion years on the other side. It would all happen at the same time.

Not impressed!

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Not Impressed!

Sat Jun 30 20:30:02 BST 2012 by **Eric Kvaalen**

Anyway, the length of time you have to back to find when they "hit" has nothing to do with how far away they are, because the further away they are the faster they move away from us. So all galaxies (except ones quite close to us), if you trace them back hit one another at the same time, namely about 14 milliard years ago.

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Not Impressed!

Mon Jul 02 15:57:16 BST 2012 by **Mips**
http://www.brunel-design.co.uk

Putting another view to this concept; clearly we are not near the origin of the big bang yet we can see for approximately 14bn years in all directions. For an observer at the far end of our visible range (of course bearing in mind that they were there 14bn years ago) they would be able to see us and substantially further out in the opposite direction. The point I am making is that the universe is substantially bigger than we can see; we are searching for the dark matter and the like, it is out there but you just cannot see it because it is too far away.

The second issue is the assumption of the nature of a singularity. Clearly it is very small and has extraordinary mass and temperature. However this means that space and time has no meaning in a singularity. Note I did not say that they did not exist but that without distance there can be no velocity and without velocity time is meaningless. The outcome of this is that it is not possible to say how big the singularity was. How big would it have to be before time became relevant? Supposing that it was 1bn light years or more across before the threshold was reached then there might be no need to invoke inflation and non-relativistic motion.

I believe that a singularity might represent the suspension of time and nothing more.

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Not Impressed!

Mon Jul 02 17:34:02 BST 2012 by **Mark Bridger**

I agree that the notions of space and time, and the laws of physics, break down in the assumed singulaity. But that's a reason to suppose the Bang Bang must have started in another way - from a single energetic particle that generated other particles - so the matter was not generated all in one go. This approach would also explain the asymmetry - as the original particle would have to be matter (or anti matter) alone.

More on that theory I've linked above.

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Not Impressed!

Mon Jul 02 20:40:35 BST 2012 by **Eric Kvaalen**

@Mips: Actually, someone whom we could see about 14 milliard light-years away would not be able to see us or much beyond him. This is because he would be living when the universe was very, very young, so he would only be able to see things a small distance from himself.

By the way, I think you misunderstand the word singularity. A singularity is a point where a mathematical function is not well behaved. Any point arbitrarily close to it is not part of the singularity, and is not a singularity itself. So there's no such thing as the size of a singularity. The singularity at the beginning of the Big Bang (if there was one) had no real mass or temperature. The temperature was infinite, and so was the density.

There is no threshold. Time was relevant immediately after the singularity.

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This Is All Still A Dodge Of The Reality - Part 1/2

Sat Jun 30 19:58:13 BST 2012 by **Richard Moore**

Both quantum theory and relativity require consciousness to make sense - albeit with a debate about what that is. Rosenblum & Kuttner discuss this in "Quantum Enigma: Physics Encounters Consiousness". All forms of standard physics, however, attempt to 'produce' consciousness as something emergent, as they are predicated on some paradigm of a random, meaningless universe some how born of Accident and deus ex machine producing a 'miracle' of Emergence from which self-organizing phenomena are somehow possible; and, voila, life appears. That seems as clearly absurd as Tertullians dictum in theology that 'it must be believed because it is absurd'. In this sense, scientistic atheism and conventional miraculous theism is logically equivalent.

There is, however, an alternative. The mathematician Luigi Fantappiè in 1941 observed that the equations which produced Einstein's famous E=mc^2 were actually truncated so that the problem of 'reversed time' was dropped out of the solution. As he contemplated the implications of what that meant, he came up with a radically different idea - the 'positive time' solution of energy and entropy is complemented by a 'negative time' solution of what he called syntropy. Positive time, characterized as causality in which cause precedes effect is thus complemented by negative time, in which effect precedes cause. This initially seems baffling, until one focuses on the question of what time is.

If, as some suggest, time is the flow of events, causality is defined by a flow from higher order toward disorder, which is entropy. Conversely, what has been called retrocausality is the flow of events from disorder to organization - or what is exactly what life exhibits.

Stuart Kauffman, has recently focused on the possibility of Actuality and Possibility being two different quantum realizations (my characterization, but consistent with his description) - see (long URL - click here). This is in fact what has been proposed by the theory of syntropy. But let us consider a simple way to understand what it is saying:

Think of a house or other system that can be built from some set of materials. The same set of materials can be used to build a different house or other system. So the builder must have in mind a particular idea or image of which design the materials are to be arranged in so as to achieve the intention of the process of building. That 'image' is a 'cause' in the future - which is simply a way of saying that the process will produce a particular organization in which the random pattern of the materials right now will become less random. This 'less random' however is not arbitrary or accident - it is intentional. The system of its construction produces something within the bounded range of an idea - not 'exactly', but precisely enough to distinguish one system 'design' from another and to then say 'after the fact' that effect (the particular pattern intended by its construction) preceded the cause (the image of what was intended). This is not what would be predicted by the energy-entropy postulate of the Second Law of Thermodynamics, and is unexplained by any conventional physics, but is as common as virtually any process which is identified as 'living' - whether biological or sociological.

Now, this is not to say that energy-entropy is absent, but that its processes are 'exploited' by what might be called synergy-syntropy - the production of whole effects and a higher degree of organization in a system which cannot be predicted by its initial state conditions. One must actually 'know' what the image or intent of the process of organization is to see how the 'probabilities' will 'actually' unfold - in other words, actuality is produced by the 'choice' of action in the present moment, a never-ending process of change (which is also, by the way, the only meaningful definition of what 'energy' is in terms of the First Law of Thermodynamics: energy is neither created nor destroyed in the cosmos as a whole, which technically is not a system, hence there is no loss of energy to it).

Now, according to Henry Stapp, the quantum physics of consciousness actually makes this possible - a quantum theory which, incidentally, has withstood the thermodynamic objections to other quantum theories of consciousness (e.g., see http://www-physics.lbl.gov/~stapp/stappfiles.html and http://www-physics.lbl.gov/~stapp/PTRS.pdf).

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This Is All Still A Dodge Of The Reality - Part 1/2

Mon Jul 02 10:09:46 BST 2012 by **Mark Bridger**
http://.

"Both quantum theory and relativity require consciousness to make sense - albeit with a debate about what that is."

I agree with that - indeed I say that an infinite eternal universe (links in my comment above)provides the key to an explanation of all physics (as well as the possibility of things outside of physics), but only with the unavoidable implication that consciousness / intent is inherent in the existence of (any) formal reality.

This is a final step in understanding that many scientists are loathe to take.

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This Is All Still A Dodge Of The Reality - Part 1/2

Mon Jul 02 10:32:35 BST 2012 by **Tony Coleby**
http://tonycoleby.com

I enjoy these articles immensely and the comments also to a certain degree. But the ability to hide certain people's posts (usually the first poster on EVERY article, hint, hint) would 'inflate' that enjoyment exponentially...

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This Is All Still A Dodge Of The Reality - Part 1/2

Mon Jul 02 14:11:47 BST 2012 by **Mark Bridger**

Are you saying ignorance of certain commenters would be (exponential) bliss?

Given Eric's knowledge I think it appropriate that he's a frequent first commenter.

But with regard to my claim to a or 'the only' realistic theory of the expansion that also predicted the observation of an acceleration....

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Big bang 1: Inflationary cosmology

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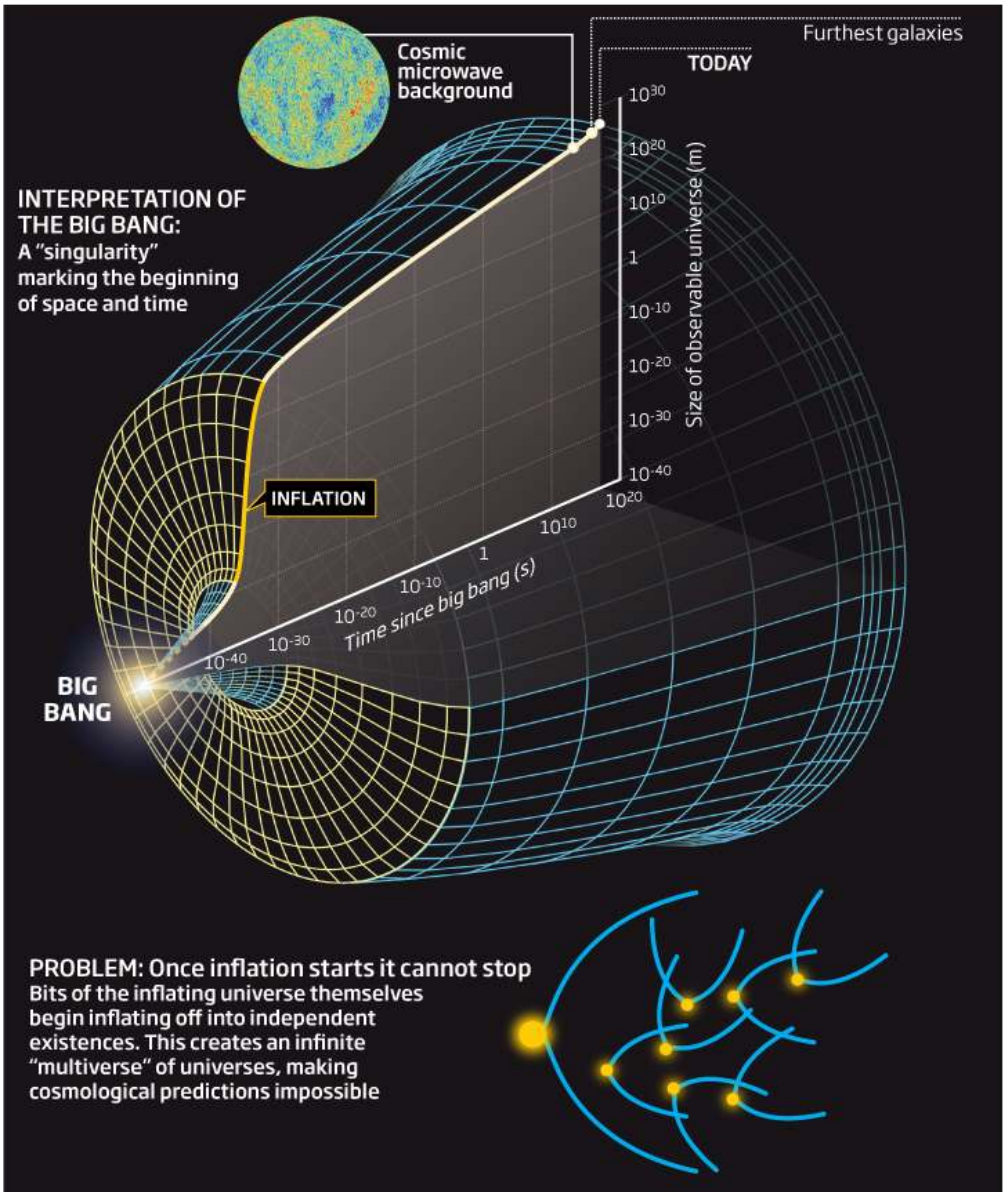
By rapidly pushing apart the early universe, a period of inflation can explain why distant parts of the cosmic microwave background look like they came from the same place

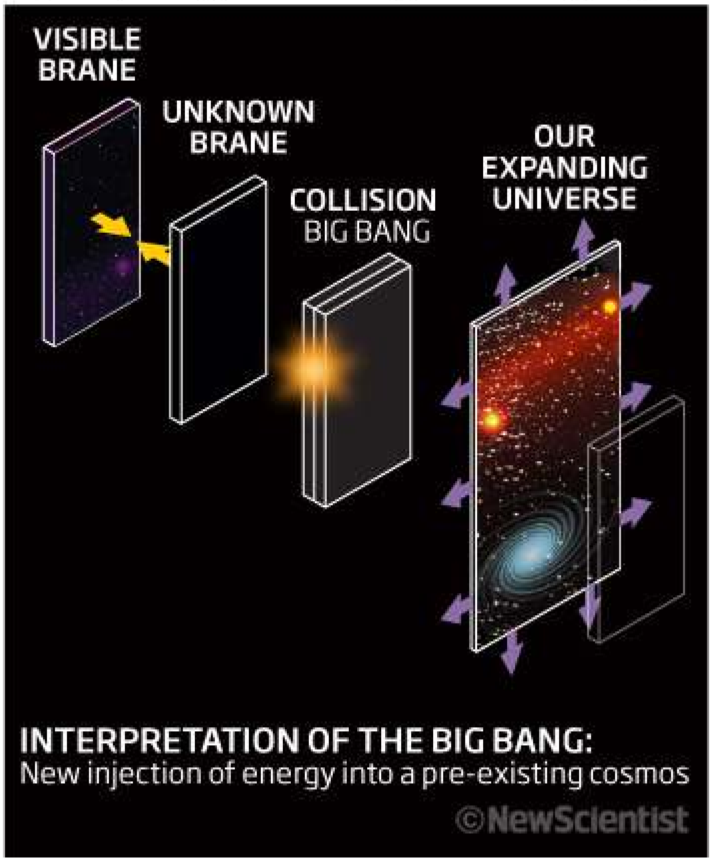


INTERPRETATION OF THE BIG BANG:
A "singularity" marking the beginning of space and time

PROBLEM: Once inflation starts it cannot stop
Bits of the inflating universe themselves begin inflating off into independent existences. This creates an infinite "multiverse" of universes, making cosmological predictions impossible

Big bang 2: Colliding worlds

If our universe is a 4D "brane" floating in a higher-dimensional space, it might collide with other branes, acquiring energy that we interpret as the big bang



INTERPRETATION OF THE BIG BANG:
New injection of energy into a pre-existing cosmos

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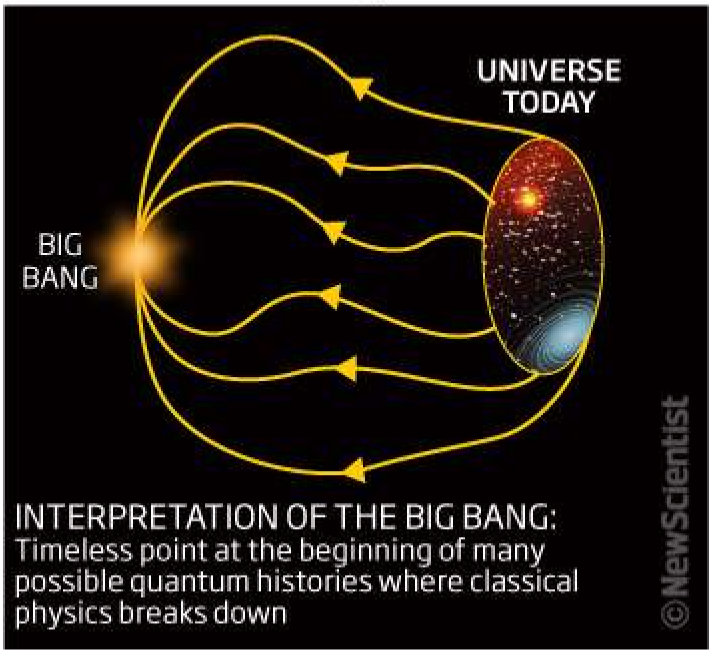
Big bang 3: Uncertain history

By adding the possible quantum histories of the universe together, we can work back from today's cosmos to the universe's origin



INTERPRETATION OF THE BIG BANG:
Timeless point at the beginning of many possible quantum histories where classical physics breaks down

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