

What happened before the Big Bang? – *The untold part of our origin story*

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It is common knowledge that the universe began with a cataclysmic blowout, which we call the Big Bang. But did you know that in the last few decades, science has started to figure out what may have caused this primordial explosion! This amazing new revelation about our origin story has so far been cloaked in the esoteric physics of quantum field theory, but the wisdom it holds is as deep and profound as any that the cosmos has to offer. What follows is a recounting of this new chapter of the creation story in a language that all can understand.

This part of our origin story has gained credence only in the 21st century even though its roots go back to 1980 when a physicist by the name of Alan Guth conjectured that the cosmic bang could have been caused by a sudden emergence of pure energy uniformly permeating all of space. He called his idea **cosmic inflation** because his calculations, using Einstein's equations of gravity, showed that such energy would make the cosmos grow in size by a factor of a trillion times trillion; starting from a billionth of the size of a proton and ending up with a universe the size of a grapefruit. And all of this would happen in a trillionth of a trillionth of a trillionth of a second, making the growth rate faster than the speed of light.

And here is the real kicker: the energy in the universe also grows in proportion to its size. Guth's theory predicts that at the end of cosmic inflation the universe will end up with a huge amount of energy; and after that it would continue to expand at the gentler pace that we observe today.

Cosmic inflation is now accepted as a more descriptive name for the big bang. It is interesting to note that the term "big bang" was introduced by Fred Hoyle, one of the greatest detractors of the new creation story. He came up with the term in a BBC interview as a way to dismiss those who thought the universe could have begun with a mighty bang.



Artist's visualization of Cosmic Inflation

One of the stunning discoveries of physics is that empty space is not empty. It is filled with an invisible field we call the quantum vacuum. A bizarre consequence of the Quantum Uncertainty Principle, first enunciated by Werner Heisenberg, is that a little bit of energy can appear spontaneously in a tiny region of space without any cause and without a specific source. Heisenberg's principle requires that such energy must disappear quickly back into nothingness. However during the tiny moment of its existence the energy can transform into a particle of matter and a particle of antimatter, which must quickly annihilate each other to become nothing again. These so called quantum fluctuations are happening at every moment and in every corner of space. Their presence has been verified beyond any doubt by special instruments that can measure their effect!

The particles of matter and antimatter that emerge from the vacuum are called virtual particles since they cannot be detected directly. However, under very special conditions these virtual particles can bypass the requirement of needing to disappear instantly and can become real particles that can endure. Such a condition can be shown to exist at the moment that inflation ends. (The only other place where this condition exists is at the edge of a black hole.) As inflation comes to a screeching halt the huge amount of energy present in the universe transforms into all of the radiation and matter that we see today. The hot broth of particles cools to form atoms of hydrogen and helium, which later coalesce into stars and galaxies.

A remarkable conclusion of inflation theory is that the quantum vacuum is the ultimate source of every single piece of matter and light that exists in the universe today. And all of it appeared in a singular act of creation at the moment that the inflationary phase of the universe came to an end. Our universe may have emerged from what we generally regard as NOTHING. *The amazing truth being revealed by science is that we could be here simply because of the strange nature of nothingness uncovered by quantum physics.*

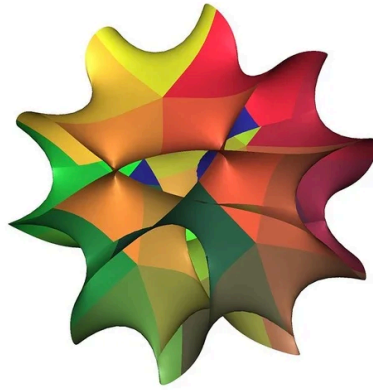
*Buddhism scriptures have long described reality as a manifestation of **Sunyata**, which literally means the void. Buddhist wisdom maintains that form and emptiness are two aspects of the same reality.* How such truths could have been intuited many millennia ago is a source of wonder and marvel that deserves deeper thought.

The quantum vacuum has an amazing power to transform nothingness to “everythingness”, and to also change matter back to nothing through annihilation. Based on this quality Brian Swimme, an astrophysicist and a great visionary, has named this vacuum the **all-nourishing abyss**. *The all-nourishing abyss appears to be the ultimate source of the whole cosmos!*

One can still ask the question: *where does the energy that caused inflation to start come from?* Guth’s theory provides an answer to this mystery as well! The latest advances in quantum field theory tell us that the sudden appearance of pure energy permeating all of space could have resulted from the breakdown of a “symmetry” embedded in the physical laws that govern the nature of the primordial quantum nothingness that existed before inflation.

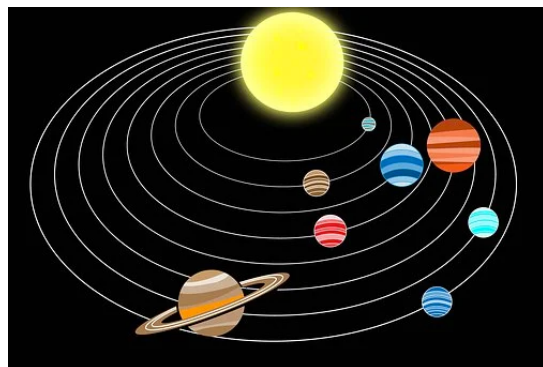
In the 1970s particle physicists started surmising on the possibility of a grand unified theory that suggests that the universe started in a state that can best be described as an indivisible union of quantum fields that are aligned with each other in total perfection. The oneness refers to the presence of a single all-encompassing law (the Theory Of Everything) that governs the behavior of

these fields and the perfection comes from an arrangement of the fields in a beautifully symmetric internal structure inside of the grand law. *One could think of this state as the metaphorical cosmic egg from which the cosmos is born.*



Artist’s visualization of a cosmic egg’s symmetry
(Image credit: Wikimedia Commons)

Symmetry has long been used in art, architecture, and poetry to express beauty and balance. It was the Greeks who first brought it into science by enunciating a sacred principle that says that all heavenly objects must move in the most perfect geometric shape – that of a circle. Interestingly, it was their unshakable belief in this perfection that kept us stuck in an earth-centered cosmology for more than two thousand years.



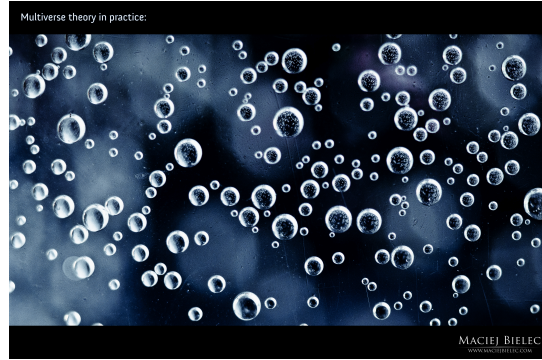
Artist’s impression of Solar System at its birth

We now know that the Greeks were not entirely wrong. Each planet in the solar system was born moving in a perfect circle with its axis of rotation perfectly aligned with

its orbit. But random collisions with left over debris made their paths slightly non-circular and their axes a little bit tilted. The amazing truth is that without the axis tilt there would be no seasonal rhythms on Earth to apply the gentle evolutionary pressure that allowed life to adapt and diversify. *Complex life may never have emerged without Earth's original fall from perfection.*

About 50 years ago physicists began to figure out the mechanism through which symmetries embedded in physical laws can be broken. Another quantum phenomenon called tunneling can enable the perfect symmetry of the laws governing the quantum vacuum to break spontaneously *without any external provocation*. The current leading hypothesis is that this is what happened to the primordial egg. *Nothingness is inherently unstable* and so it transmutes on its own to a new state where the symmetry of the fields, articulated in the original grand unified law, is no longer honored. Only in this broken state is the law that governs nature capable of giving rise to the universe that we all know and love. *In a remarkable parallel to the biblical story of Adam and Eve, the perfection inherent in eternal nothingness fell from grace and in doing so gave rise to the imperfect but rich fullness of our stupendous cosmos.*

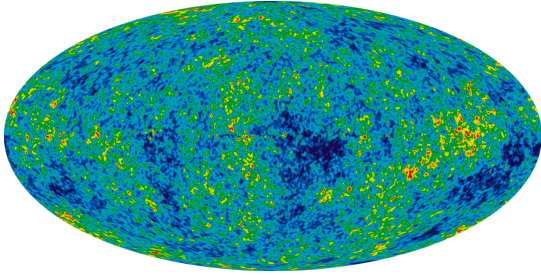
To create a visualization of this amazing creation story think of the cosmic egg as balanced delicately on a knife's edge, much like a pencil balanced on its tip, which sooner or later must topple towards one side. The direction in which the egg will fall is as random and uncertain as the next fluctuation in the quantum vacuum. Each direction of fall will result in a completely different kind of universe, run by a different set of laws. The physical properties of each of the millions of possible universes can be computed using well-known equations. Most of them turn out to be ones in which stars and galaxies can never emerge and therefore life, as we know it, could never happen. *We are here because the cosmic fall from total perfection happened in just the right way for the broken laws to result in the creation of stars, galaxies and eventually us.*



Each bubble is a universe with its own laws
(Image credit: Haiku Deck)

Since the perfection of nothingness can keep breaking again and again in all different directions, this theory opens the possibility of multiple universes each run by a different set of broken laws. The existence of the multiverse is a stunning prediction of Guth's theory but one that may be very difficult to verify, since we have no direct way to observe the contents of other universes.

Guth's calculations showed that a breakdown in the symmetry inherent in a law must be accompanied by the release of energy filling every corner of space. It is this energy that starts the process of cosmic inflation resulting in the so-called big bang, and at the same time creates everything in our universe. Another very significant consequence of inflation is that it instantly magnifies the tiny energy fluctuations that are always present in a quantum vacuum. These fluctuations manifest themselves as slight variations in the density of matter that fills the constantly expanding universe. The spots where matter is a little denser become the seeds around which gravity can pull in gas to assemble stars and galaxies. These spots of higher density were first observed in the intensity map of the cosmic microwave background (*the "sonogram" of the embryonic universe*) in 1998, when measurements of the radiation became accurate enough to reveal these tiny variations. *This discovery was a compelling shot-in-the-arm for Guth's cosmic inflation theory, making it a widely accepted and credible theory of cosmic origin.*



Cosmic Microwave Background Intensity Map

In Greek mythology **cosmos**, which means order, emerges from chaos, which in the old Greek language also means the void. In our new creation story chaos (void) and cosmos (perfection) are merely two aspects of the primordial egg. Cosmos turns into the other meaning of chaos (broken symmetry), which finally gives birth to our familiar cosmos (the universe)! *What an amazing twist on the Greek myth!*

The analogy with Hindu mythology is even more striking. **Brahman**, the Hindu version of Godly perfection, does NOT create the world; **Brahman** turns into the world. The act of becoming the world is called **Lila**, which means a play or a drama. Hindus see the world as a stage for the enactment of a divine play. *The end goal of the players in the drama is to attain oneness with **Brahman** whose essence is ever-present in all objects of the world.*

The new physics tells us that the duality that results from the disintegration of the primordial oneness contains within it the essence of its primal symmetry. The broken laws of nature that run the universe today can be mathematically transformed to reveal their original unity and perfection. In fact, it was the uncovering of the hidden symmetry that led us to the possibility of a grand unified theory in the first place. Thus the essence of the original oneness is still manifest in our current broken reality. It is the attraction inherent in symmetry that continues to bring the piece parts, created by the breakdown of symmetry, back into communion to create new levels of cosmic wholeness. *All acts of differentiation in the cosmos turn out to be nothing but prequels to future allurements and increased unity.*

The cycles of differentiation, subjectivity and community, first identified by Thomas Berry, are evident throughout cosmic evolution. From quarks to protons to atoms to molecules to chains of hydrocarbons to single cells to multicellular organisms to complex creatures like us. *The truth is we are all here because of a cascade of cosmic events that always start with the diversification of uniformity followed by an allurements back into communion. Our urge to keep aspiring for what is our essence, the original oneness from which we emerged, is what gives a direction and meaning to our lives. Perfect symmetry may have beauty, elegance, and even truth hidden in it, but creativity, aspiration and evolution emerge only when there is difference, conflict and reconciliation.*

The parallels of our scientific creation story to eastern mysticism continue to be a source of amazement. Hindu philosophy says that when we fail to recognize worldly reality as myriad forms of the divine in a state of **Lila**, we miss the essence of **Brahman** hidden in the world. We are then under the spell of **Maya**, the deceptive power of illusion. Our **Karma** or actions must be such that they move us towards a conscious experience of the underlying oneness whose essence each one of us carries within. **Aum**, the “vibration” that the Hindus regard as emanating from the original nothingness (**Shunya**) is a vehicle that can carry us to that sacred goal.

Religion, music, art, and poetry have always helped us align ourselves with the gentle rhythms of nature that connect us back to our source, the oneness from which we initially emerged. *It is my fervent hope that the new creation story can serve as an additional source of inspiration to move humanity towards peace, harmony and oneness.*