The Next Truth

Where Science and Myth Meet©

Volume 2 Issue 9

July 2020

DARPA's µBRAIN is exploring the architecture, and neuronal details of small bio-systems

Dr. Michael Fiddy

New Research Shows Life Could Be Common Throughout the Multiverse

Leighton Kitson

Prof. Dr. Amal Amin founder of Women in Science Without Borders

The broken Nobel prize dream that launched a mentoring platform

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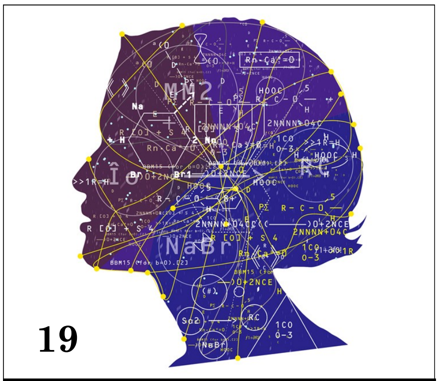

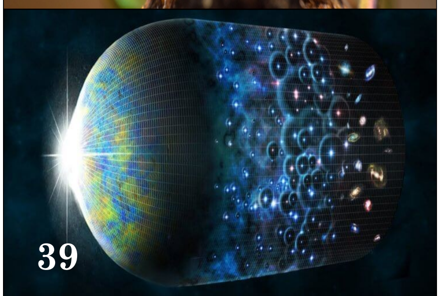

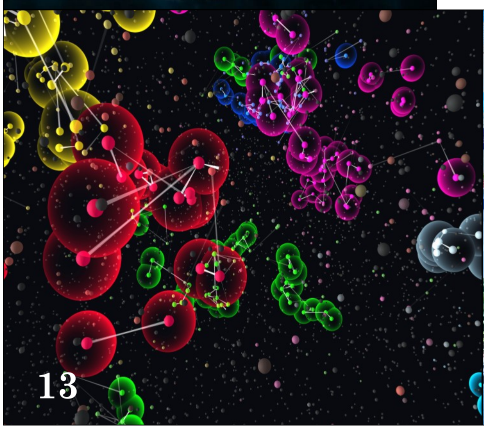

The Next Truth

The Next Truth is an energetic magazine covering both systems of acquiring knowledge that use observation, experimentation, and replication to describe and explain natural phenomena known as Science and Noetic Sciences, a multidisciplinary field that brings objective scientific tools and techniques together with subjective inner knowing. In other words … "Where Science and Myth Meet".

Our contributors are, without a doubt, tickling your indomitable curiosity and provide scientific explanations concerning topics viewed, and thought of, by the majority as myths.

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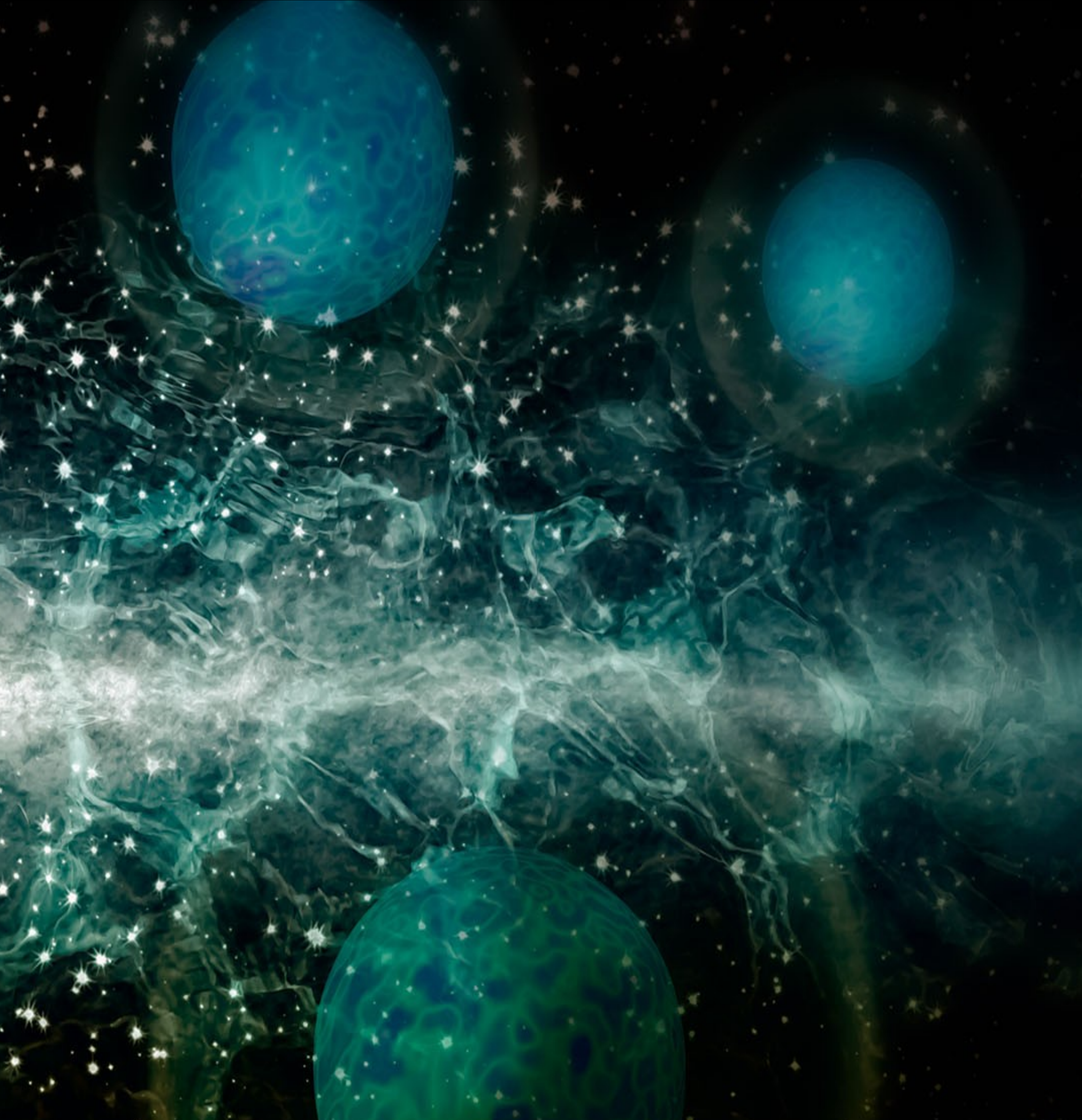
What was the kick-off for the universe we move in? That is indeed a tricky question whereby multiply but plausible answers, and theories, are directing in several directions. But regardless from which angle one is viewing this question, in some enigmatic way; many people end up with the behavior of Black Holes including the visible effects we can measure. Even there is none who can say with 100% certainty what the true purpose is; it is an almost logical line of thought that these mysterious dark areas do have a purpose. Nature seems not to create 'something' what has no meaning or cannot conserve life. *(This includes dark matter and dark energy)*



Therefore, let's think of a BH as a cosmological 'energy converter' cloaking the mouth of a Wheeler wormhole (W-WH) what should lead to its own center, a one-dimensional point which contains a huge mass in an infinitely small space, where density and gravity become infinite and space-time curves infinitely, and where the laws of physics as we know them cease to operate. The narrow throat of the W-WH can be considered as a stretched and cylindrical container in where **new matter** is expected to be created by means of rare subatomic collisions. Also, when a BH is an area what is rotating by nature, it seems to be a logical line of thought that the stretched cylindrical container of the W-WH (its narrow throat) is also rotating but in a more compressed manner.

The Next Truth

Cheryl & Chad Wilson

Welcome to the very first podcast of "The Next Truth; Where Science and Myth Meet", a weekly podcast in where scientists and citizen scientists speak about their incredible research with you to explore these awe-inspiring theories, mind dazzling paradoxes, the connections between accepted and noetic science and... everything in between.

I'm your host Maria Anna van Driel and this week I have the privilege to speak with Cheryl Knight-Wilson and Chad Wilson who are the founders and owners of Paranormal Underground magazine. **www.paranormalunderground.net**

Not only are Cheryl and Chad's magazine and podcasts your connection to the paranormal world as they are covering a wide variety of topics that are beyond the scope of normal scientific understanding... they are also the backbone of The Next Truth! Without their support, courage and energy... The Next Truth would never have been born in the first place.

www.bbsradio.com

Journalism… what is it? We tend to think that this profession speaks only of releasing the latest news on scientific research conducted, Wallstreet updates, war activities in foreign countries, among others, in written articles and/or TV-broadcasts.

Even though these news releases are a perfect information source for us to know what is happening in the world, they do contain a certain sound of distance. I mean, when we are listening to, for instance, a scientist speaking of his or her latest findings, our minds are sliding in an almost hyper-state and starts to make overtime as it is trying to wrap itself around the complex content and the myriad professional terms these conversations and explanations contain.

Now, how many of you think in that moment, "Pffft, this is beyond my understanding" find it all tremendously dull and zap to a different channel?

With all due respect for my colleague journalists, but I think this effect is spawning from writing, or presenting, these awesome and awe-inspiring theories from a point of view that is too technological, too static. Yes, the articles written by scientists and citizen scientists are important releases for sure but the author(s) of these articles are equally important. And here is where The Next Truth differs from well-known journalism.

Who are these scientists? What influenced them to step into their field of research and... where is their research going to lead for them and for us?

Stay tuned as The Next Truth is in the process of conducting interviews which will be broadcasted as podcasts and contain their personal stories.

Contributors

Amal Amin Ibrahim Shendi (Cairo, Egypt)

Dr. Amal Amin is an associate professor for nanotechnology/polymers at national research center at Cairo- Egypt with large number of publications, projects, awards and other research activities. Amal was the president and cofounder of the Egyptian society for advanced materials and nanotechnology (ESAMNT) and ex-coordinator of the Arab materials science and nanotechnology network (AMSN-ASTF). She was TWAS young affiliate and has a especial interested in e.g. science communication, increasing public awareness/literacy for science, science advice/diplomacy. https://www.researchgate.net/profile/Amal_Amin4

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The Science Mission Directorate (SMD) is an organization where discoveries in one scientific discipline have a direct route to other areas of study. SMD is taking you behind-the-scenes alongside their experts to explore the secrets of the universe. From remote locations on Earth to the depths of outer space, join the conversation live each month to interact with NASA experts and watch as they reveal the mysteries of our solar system and beyond. www.science.nasa.gov

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Josh has a Bachelor's degree in Physics, specializing in Astrophysics from Radford University. He is also a graduate student at the University of Utah studying Applied Mathematics. He enjoys writing about complex astrophysical concepts in a way that allows everyone to grasp them without desaturating the content, and also about mathematics and the role it plays in our understanding of the universe. www.spsnational.org

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Mr. Kitson is a communication officer at Durham University and a trained journalist with experience of private and public sector media relations. He also has responsibility for overseeing the University's down-the-line television broadcasting facilities, as well as contributing to media training and answering media enquiries relating to the work and reputation of the University. Currently he is responsible for promoting the research work and expertise of Durham's academics in the faculties of Science and Arts & Humanities to an international, national and regional audience. www.durham.ac.uk

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Tom is a science writer and editor in the Washington, DC, area. He writes the Context blog for Science News and is at work on a book about the history of the multiverse. Currently he is semi-retired, although he writes often for the website of Science News magazine, where he was editor in chief from 2007 to 2012 and was managing editor from 2014 to 2017. You can access Tom's articles at sciencenewsblog.org. He also contribute occasionally to Knowable Magazine. If you wish to be alerted when Tom publish something new, you can follow him on Twitter at @tom_siegfried. www.tom@sciencenoise.org

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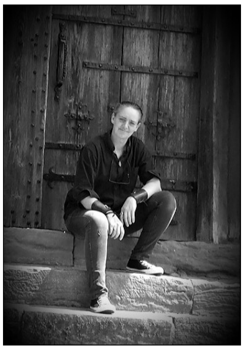
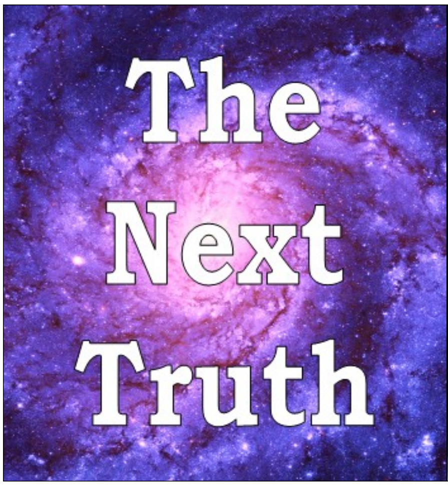
Dr. Michael Fiddy is DARPA's program manager in the Defense Sciences Office since Sept. 2016. He comes to DARPA from the University of North Carolina at Charlotte where he was the founding director of the Center for Optoelectronics and Optical Communications and director of the National Science Foundation's Industry/University Cooperative Research Center for Metamaterials. Dr. Fiddy has a B.Sc. and Ph.D. from London University and is a fellow of IOP (UK), OSA and SPIE. His current interests include fundamental studies of wave-matter interactions from RF to visible light frequencies. www.darpa.mil



Maria Anna van Driel (Germany)

Maria Anna is the owner and founder of the magazines The Next Truth; Where Science and Myth Meet and Young People Science. Maria is an investigative science journalist, columnist, foreign correspondent, ghost writer and the host of The Next Truth podcasts. Her interest includes among others Mythology, Medieval and (pre) Egyptian Symbolism, Quantum-, Optical-, Particle-, Astroparticle-, theoretical-, and experimental Physics. Maria Anna finds always the time to write new articles while having a nice chat with her (future) contributors. www.nexttruth.com



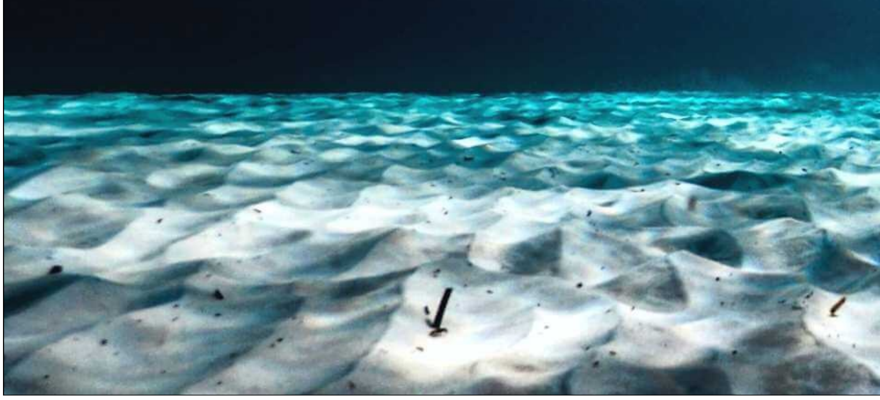
Q&A

Questions you have been walking around with for years? The Next Truth provides an answer! Email your questions to; info@nexttruth.com

- A tone always consists of a lowest "fundamental" and higher "overtones".
- The combination of fundamental and over-tones gives a tone a 'timbre'.
- A black hole in the star cluster Perseus, 300 million light-years away, produces a continuous hum.

Can humans cry underwater?

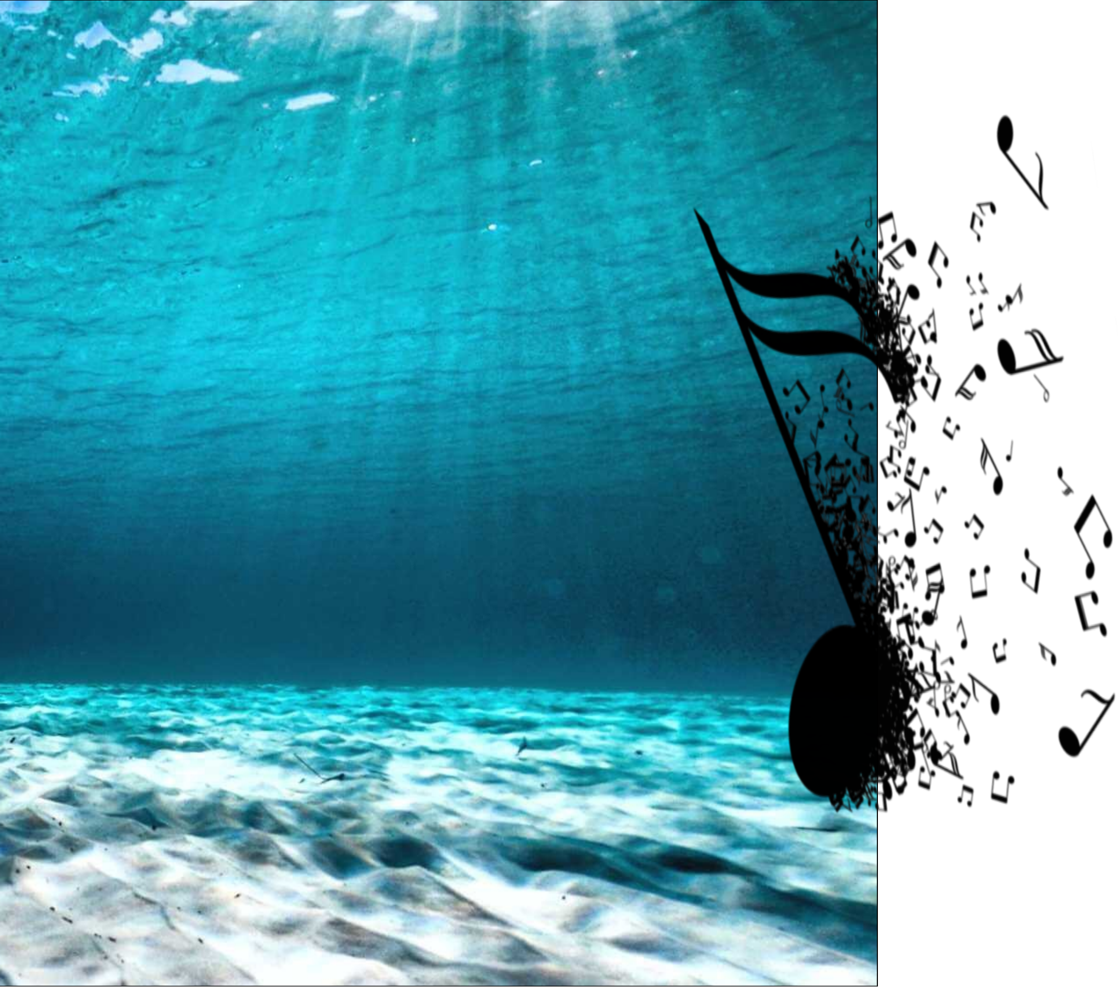
While it is possible to cry underwater, the likelihood of drowning is very high. If a person uses the correct gear that would allow them to breathe, they could do this properly while not having to worry about drowning. If goggles are worn, the tear would also be able to run down a person’s cheek. Therefore, it is possible to do it with the right gear but without it, a person will most likely drown.



Why can people hardly move their ears?

People cannot swivel their ears to point at a sound source, while many animals, like cats and dogs, can do so with ease. Humans do have weak vestigial muscles attached to the shell of the ear, called the auricle or pinna, as well as evidence of a vestigial nervous system, which could have functioned to orient the ears.

Around the human ear are tiny, weak muscles that once would have let evolutionary ancestors pivot their ears to and fro. Today, the muscles aren't capable of moving much — but their reflex action still exists. These muscles are vestigial, meaning they're remnants of evolution that once had a purpose but no longer do.



Why are songs so easy to remember?

It seems strange that, for example, learning words takes a lot of effort, while a song quickly goes into your head by itself.

One of the causes of that difference is simply repetition. You can play a song that you really like a hundred times with ease. Songs often follow predictable patterns, because music meets rules.

The text also follows a pattern. Lyrics usually rhyme and they have a certain rhythm. That gives your memory extra clues as to what the next word (or tone) in a song will be. In addition, the combination of the melody and text further enhances the memory paths.

Does the rustling of paper also have a pitch?

Sound is a sequence of vibrations. If you hit a drum, long sound waves ensure a low sound. If you blow a whistle, it will sound high.

If you let paper from a notebook rustle, it sounds higher than if you did the same with a card-board photo book. Yet you do not speak of a rustling of pitch but of a noise.

The air vibrations are not regular. Only when there is a fixed, regular wavelength, such as with a vibrating string, you speak of a pitch.

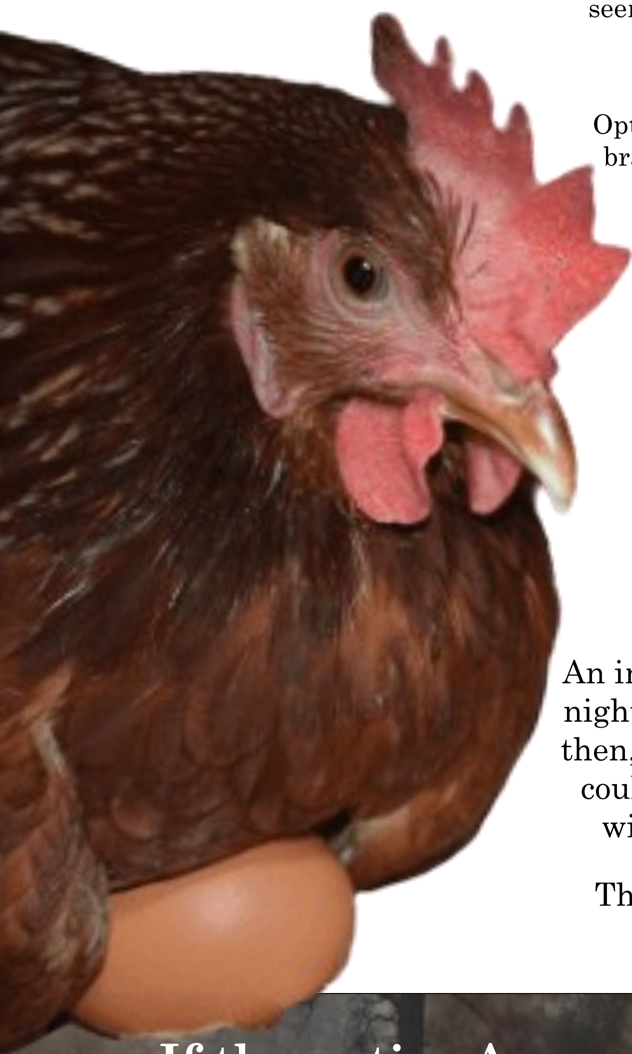
Q&A

Questions you have been walking around with for years? The Next Truth provides an answer! Email your questions to; info@nexttruth.com

How do our brains interpret impossible figures

At first glance, illusions seem logic, but on closer inspection they prove the impossible. An example of this is the staircase that goes around a building but actually seems to start at a lower starting point, even if the staircase seems to go up. The logic in the picture tells us that different lines in the house must be horizontal tells us that the stairs go up when they seem to reach the roof of the building.

Optical illusions of this kind occur when the eye, in conjunction with the brain, alternately focuses on individual parts of the image and provides an overview of what it thinks it sees. The brain cannot find a logical explanation for the phenomenon, so how illogical the image might seem, it chooses the simplest interpretation.



Can an egg break when it is still in a hen?

Even though it might sound a bit odd but, YES, this is possible.

An important cause of egg fracture is that chickens startle at night, for example because of a human or animal invader and then, in an upset state, collide with something. Another cause could be when an egg is too large to pass what is often seen with a young pullet producing eggs too large for her age.

This will eventually be fatal, because additional eggs will build up behind the blockage, unable to pass.

If the entire Amazon forest burns down, are we still able to breathe?

The Amazon is said to provide 20% of the oxygen in the air. But is that story correct? No, the Amazon fires won't deplete the Earth's oxygen supply. Most of the oxygen we are breathing in these days was produced by algae in the oceans a long time ago. The total amount of oxygen is enormous. Even if all plants disappear in one fell swoop, we still have enough stock to breathe for millions of years.

So, there is no need for you to hold your breath. Even if all organic matter on Earth were burned at once, less than 1% of the world's oxygen would be consumed.

Fraser and John Michael Godier Debate the Fermi Paradox

By Matt Williams, www.universetoday.com

As many of you are no doubt aware, our noble publisher, Fraser Cain, occasionally has the opportunity to sit down with some fellow great minds and discussion/debate issues that are relevant to space, exploration, and astronomy today. Most recently, this included an extended debate with noted author, futurists and YouTube sensation John Michael Godier.

The subject of this debate was the unresolved mystery that keeps more than a few astrophysicists awake at night. This is none other than the Fermi Paradox, the question that asks "Where are they?"

And by "they", Frasier and Godier mean the other intelligent species in our Universe, of course. You know, the ones that ought to exist and which we should have surely heard from by now! The event was hosted on Event Horizon, Godier's Youtube channel where he and special guests discuss matters relating to science, technology, space, and the future.

The debate was moderated by Skylias, the famed science communicator, computer scientist (and sometimes musician) who has routinely had Fraser on her Youtube show (Skylias Cares) as a guest speaker. Their topics of discussion have included everything from black holes and antimatter to the study of astronomy and the nature of the Universe.

In any case, Fraser and Godier had a fruitful debate under Skylias moderation. All in all, they offered some serious insight into the Fermi Paradox, its possible resolutions, and the questions that naturally arise from both.

Here are some salient points that stood out;

Where is Everybody?

To begin, the Fermi Paradox centers on a simple question that was posed by physicist Enrico Fermi in 1950. During a lunchtime conversation with his colleagues at the Los Alamos National Laboratory – and on the topic of the search for extra-terrestrial intelligence (SETI) – Fermi asked his fellow physicists, "Where is Everybody?"

In short, the question refers to the apparent contradiction between the (assumed) high probability of their being intelligent life in our galaxy and the dearth of evidence for their existence. Even today, almost 70 years after Fermi posed the question, humanity still has found no credible or verifiable evidence for the existence of an extra-terrestrial civilization.

To begin, they address the assumption that life should be plentiful in our Universe, which comes down to the sheer immensity of it and the length of time itself. Getting to the possible resolutions, Godier indicated that there are 75 that he is aware of (seriously!). And while they did not have time to get through them all, they manage to tackle the most salient ones.

The Great Filter

Many of these can be summarized as belonging to "The Great Filter" school of thought – that something is preventing intelligent species from emerging or achieving a level of technical development that would allow them to communicate with other intelligent species. There are many versions of this hypothesis that place the filter at varying points in species evolution.

For the sake of simplicity (and remaining within the parameters of the Fermi Paradox) the debate focused on those that would affect civilizations, rather than life itself. This makes sense since, using Earth as an example, the emergence of life happened shortly after the planet formed 4.5 billion years ago – estimates range from 4 to as early as 4.41 billion years ago.

Earth could also serve as an indication of how biological evolution works because, according to the best evidence we have, life remained in a single-cellular state for the next 3+ billion years. It was only after that very big space of time that complex, multi-cellular life began to emerge ››› and everything that led to human civilization occurred. This could be a possible resolution to the Fermi Paradox, where the filter exists between the emergence of life and the development of complex organisms. As Godier summarized:

"[I] actually don't mind that because it still creates a Universe where it's teeming with life and intelligence occasionally occurs, it may not interact with each other, and there you have it. It's simply a lot more complicated to have what we have than is previously thought."

Intelligent Life is Destructive

As Fraser added, the other option is that the Filter is "in our future, that the thing that stopped all civilizations from exploring the cosmos was something else that happened to them." A third possible option is the one illustrated by the current climate crisis, where technologically advanced civilizations effectively destroy their planets before they are able to become an interstellar species.

However, there is also the possibility that advanced intelligent life in our Universe is destroyed by *more* advanced intelligent life. This is a theme that has been explored extensively in science fiction (some example of which are mentioned in the debate). This could take the form an absolute alien species that emerged first in our galaxy, or the remnants of their technology – i.e. "Berserker Probes", which could also be destroying each other.

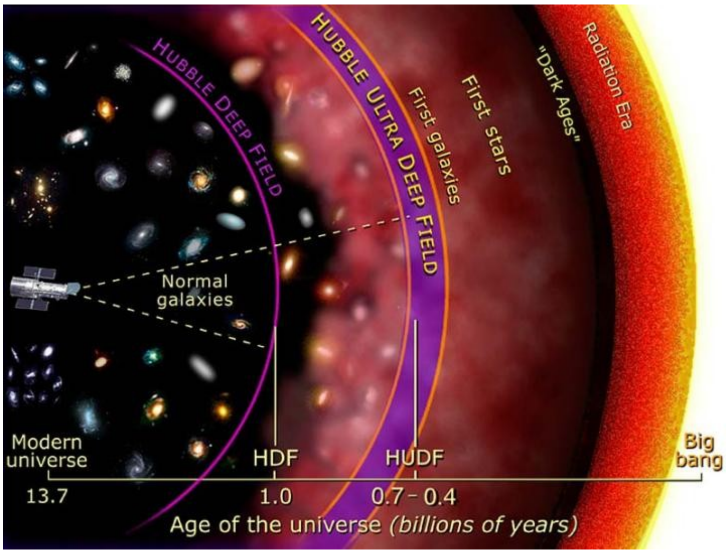


Illustration of the depth by which Hubble imaged galaxies in prior Deep Field initiatives, in units of the Age of the Universe. *Credit: NASA and A. Feild (STScI)*

The Problem of Leaving the Nest

Another theory that is tentatively raised by Godier, which is based on recent research in the emerging field of astro-virology, is the idea that colonizing new worlds – becoming an interplanetary or interstellar species – comes with some severe existential risk. Here, the example of Mars is used, since it is the most likely place humanity will colonize someday, and a planet that may have once supported life. In short, viruses are the most abundant life form on Earth and have played a major role in geological and species evolution. If we were to assume that a planet suddenly became inhospitable to life (as Mars did in the past), then it is possible that viruses would survive and become unspecialized and capable of infecting any life that comes their way.

In this respect, colonists could end up transporting a virus with a 100% infection and fatality rate. Herein lies a potential resolution to the Fermi Paradox, which Fraser referred to as "planet bombs". Basically, intelligent species end up ensuring their destruction by bringing foreign organisms home that have a devastating effect on their civilizations.

Another related issue is how species may hold *themselves* back. Skylais raised this point later in the debate (at the 29:54 mark), but is no less relevant than the idea that something is out there wiping civilizations out. Using humanity as an example, Fraser and Godier point out how we have often stood in our own way in terms of space exploration.

Rather than investing in the SLS and the Orion capsule back in the 1980s, it is something that did not begin in earnest until the mid-2000s. Instead of dedicating a big chunk of our GDP towards developing spacecraft and infrastructure in space, we've spent trillions on nuclear missiles and weapons systems. Perhaps other species are doing the same…

We Don't Know What We're Looking For

Another great possibility that Skylias raises is the problem of our own frame of reference. It is entirely possible that humanity hasn't found examples of intelligent life because we simply don't know what to look for. This is understandable considering that the only life we are familiar with and the only civilization we know of are all right here on Earth. ›››

A technologically advanced population and its planet might develop or collapse together.
Credit: University of Rochester illustration / Michael Osadciw

So if we were to encounter life that is entirely "alien", are we even sure we would recognize it if we saw it? Another issue is that and we tend to assume that futuristic civilizations will follow a similar path that we imagine for ourselves. This includes exploring and colonizing new worlds, building megastructures, harnessing the power of whole star systems, and rearranging the stars in our galaxy.

You know, the kind of things intelligent life would do as they move on up the Kardashev Scale. And it's not like we haven't gone looking for signs of such civilizations; in fact, infrared telescopes like the Spitzer Space Telescope, the Wide-field Infrared Survey Explorer (WISE), and the Hershel Space Observatory were practically built to see them!

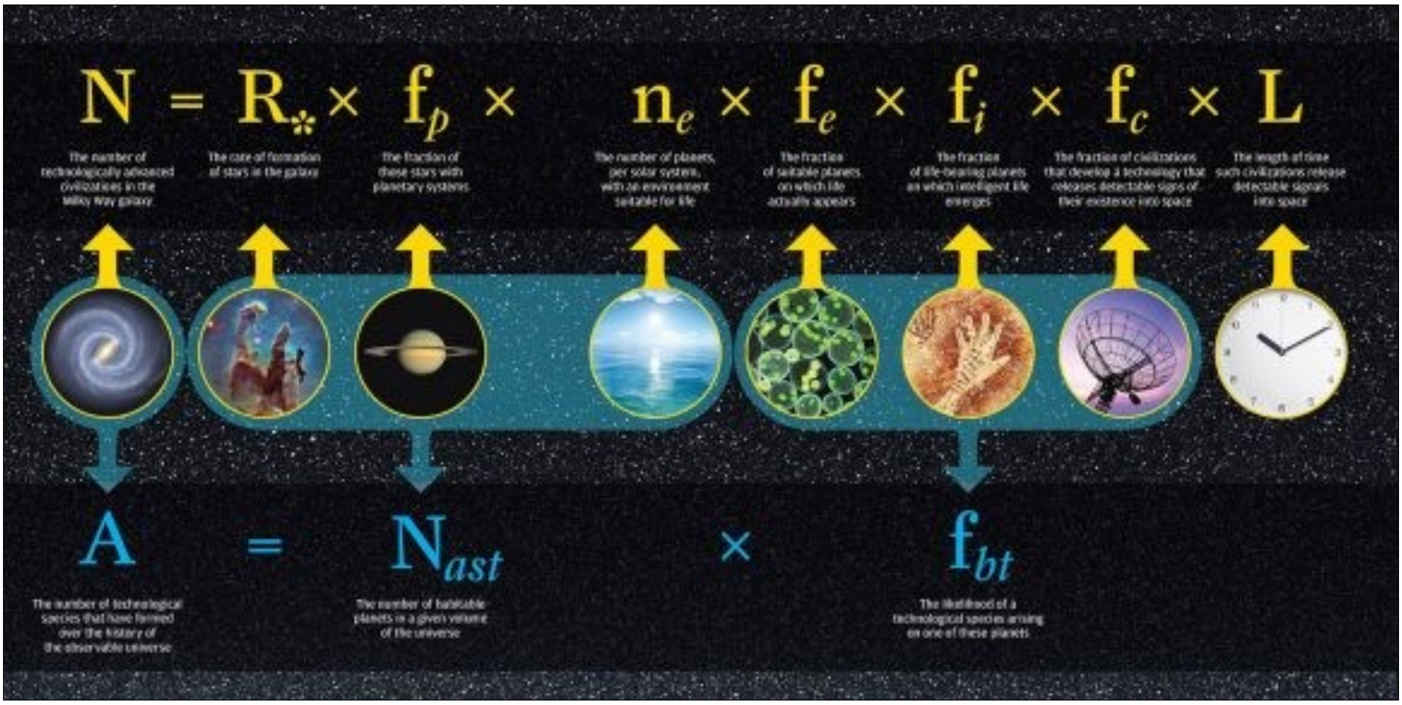
Between these instruments and the all-sky surveys that have already been conducted, something would have shown up. There's also the fact that we are only really capable of looking for signs within our cosmic neighborhood. The farther out we look, the further back in time we're also looking. Assuming that the age of the Universe is a basic timeline for species development, earlier epochs would yield less in the way of signs.

Would Aliens Want to Bother With Us?

Another important aspect of the debate (which Skylias raises around the 25:16 mark) is the question of whether or not an ETI would consider worth looking at. Assuming that there is an intelligent civilization out there (or several), is it fair to assume that they would also be looking for other examples of intelligent life? Similarly, would they want to be noticed?

As Frasier and Godier venture, that depends on what an ETI has in mind. If they are evaluating different life forms to see if they are a threat (the Berserker scenario), then seeking out intelligent life would be worth the bother. If they were curious about finding other life – as we certainly are! – then it would certainly be worth their time and energy.

Given the apparent preciousness of life, it is not at all absurd to assume that an ETI would be just as interested as we are in finding other examples of it. While we can't be certain what the motivations of another civilization would be, it does ›››



Infographic showing the famous Drake Equation. *Credit: University of Rochester*

seem like a safe assumption.

Drake Equation

Of course, no debate about the Fermi Paradox would be complete without bringing up the Drake Equation. Originally proposed in the 1960s by famed astronomer and SETI researcher Dr. Frank Drake, this equation is a thought experiment that is used to make a rough estimate at just how many civilizations could be out there at any given time.

Godier and Fraser (respectively) expressed their opinions on this equation as follows:

"I think the Drake Equation was an interesting idea when he formulated it. But I think it is forever an exercise in banging your head against a brick wall because you can't plug in enough numbers to ever find anything meaningful out."

"It provides no value to answering this question. It helps you identify what you think are variables that could be plugged into it, and those are all exciting things to look at. But it doesn't tell us in any way, shape, or form how many aliens there are in the Universe."

The Infinite Universe Argument

Here is an argument which, according to Fraser, Godier offered ahead of the official debate – to which, Fraser admitted that he had no counter-argument. The argument states simply that we do not know how big the Universe is. Because of the way the Universe is expanding, the oldest light that we can see is now 46 billion light years away.

Beyond that bubble, the entirety of space and time is immeasurable, but it is entirely possible that the Universe is infinite. In an infinite Universe, not only would you have the possibility of running into alien civilizations; you would also have the opportunity of running into another Earth.

In fact, you could find a copy of Earth and all the life that currently exists on it, where everything is identical down to the subatomic level. An infinite Universe means infinite possibilities, which could include infinite lifeforms…

Lingering Issues

A few things emerge from this debate that indicates just how difficult it is to resolve the Fermi Paradox. As with the issue of what we are looking for, it all comes down to our limited frame of reference.

For starters, when looking at all the potential scenarios that fall under the heading of The Great Filter (a point that is raised), there is the problem of applicability. Whatever reason can be suggested for the absence of observable activity ››› needs to be something that can apply 100% of the time; otherwise, species would slip through the Filter on a regular basis.

Another problem arises from the fact that if we can conceive of these existential threats ourselves, so could other intelligent life forms. And that has to mean that – given the right commitment – they would find ways around them. Third, there is the issue that all the possible signs we can come up with – be it biosignatures or technosignatures – are based on our limited frame of reference.

Fourth, as was raised towards the end, it is entirely possible that we are living in a simulation. As Godier summarized, "[I]f you have an infinite Universe and infinite time, then a Boltzmann Brain would eventually appear at random. I characterized it as a giant supercomputer appearing from nowhere and deciding that the Universe was dead and pointless, so it creates its own ancestor simulation Universe."

"In truth, it wasn't much of a debate since Fraser thinks intelligent life likely doesn't exist elsewhere," confessed Godier via email. "I merely believe it's so rare that we'll never see it."

Well, put. And here too, another problematic aspect of the Fermi Paradox emerges. We know so little and are forced to guess about so much. But that can be solved if we simply keep looking using all the means that are at our disposal.

If someday we find an example of life out there (even if it is just microbes on a rock), we will know at last that life exists beyond Earth. And in the end, all we need to do is find evidence of one ETI – be it radio chatter, ruins, or signs of a megastructure – for the Paradox to be officially resolved.

■ ■ ■

This article first appeared on the website of UniverseToday,
www.universetoday.com

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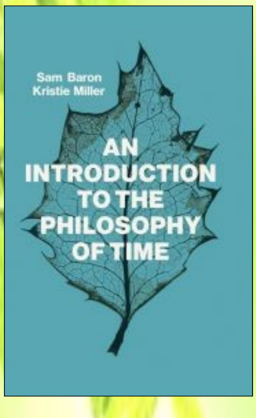

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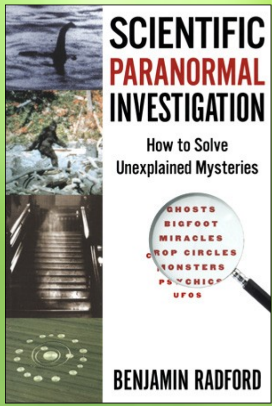

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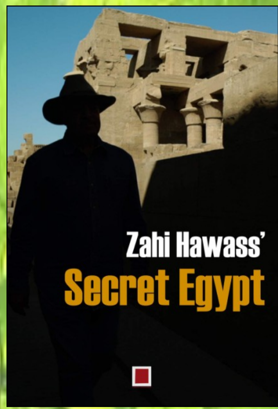

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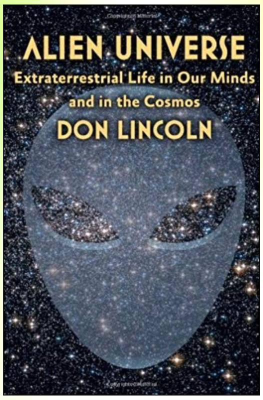

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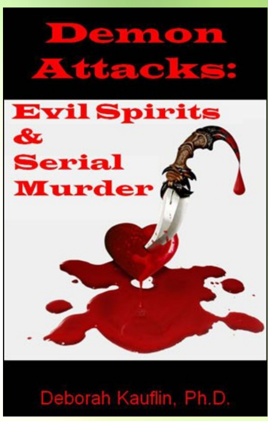

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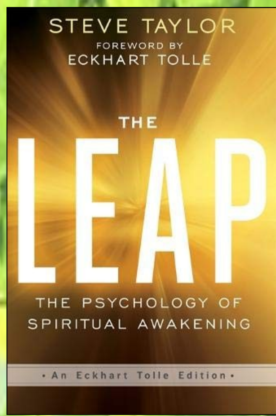

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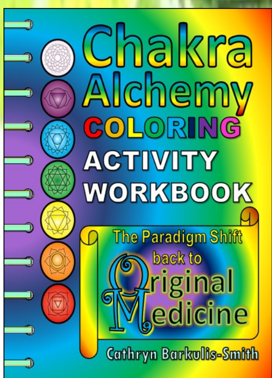
Cheryl Knight– Wilson
www.paranormalunderground.net



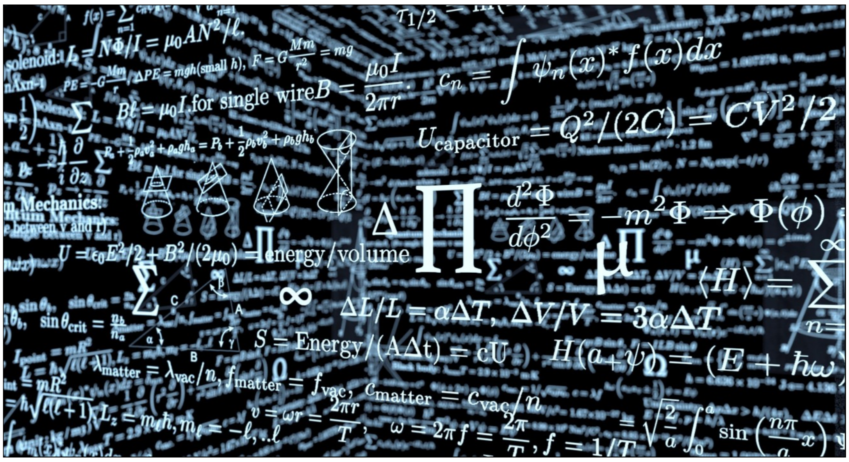
'Simply Cathryn'
www.amazon.com

Mathematics - The Language of the Universe

By Shubham Panchal, www.shubhampanchal.wixsite.com

Mathematics or simply Math. Most people began to sweat as they hear about it. But, when we study about it in depth, one can understand its true power. Mathematics is used in every possible field like economics, computer sciences, physics, chemistry, cosmology and the list goes on.

But, how do we define mathematics? According to Wikipedia; "The abstract science of number, quantity, and space, either as abstract concepts (*pure mathematics*), or as applied to other disciplines such as physics and engineering (*applied mathematics*)".



Mathematics is the most fundamental type of logic possible (in physics anyway), and therefore it is easy to reason that mathematics is the best way of expressing the universe. **www.futurism.com**

Why is it the language of the universe?

A language is nothing but a medium through which we transmit data from our brain to someone's other brain. The impulses generated in our brain are then generated in the other person's brain.

In order to create an Artificial species (Artificial Intelligence), we need to transmit our ideas and data to the computer. A computer cannot understand our language (full of words and emotions), but a language of bytes (bits). So, which language should we use to join our language and the language of the computer?

Mathematics

A language which both humans and computers can understand.

It helps us to transfer our intelligence to a computer, which can carry it further. Humans are trying to express each and every process of their brain in Mathematical equations. But still, humanity is not able to express their emotions in mathematics…

An Illustration

The language of Humans: "Hello World"
For a computer: 01001000 01100101 01101100 01101100 01101111 00100000 01110111 01101111 01110010 01101100 01100100

A language which both humans and computers can understand :
[[124 , 235]]

The above example demonstrates how the vocabulary of words in our brain could be given to a computer through the Language of Universe that's Mathematics.

Interference

If we need to develop a human-like intelligence, we need to progress in Mathematics along with Computer Sciences so that we and our AI could understand each other.

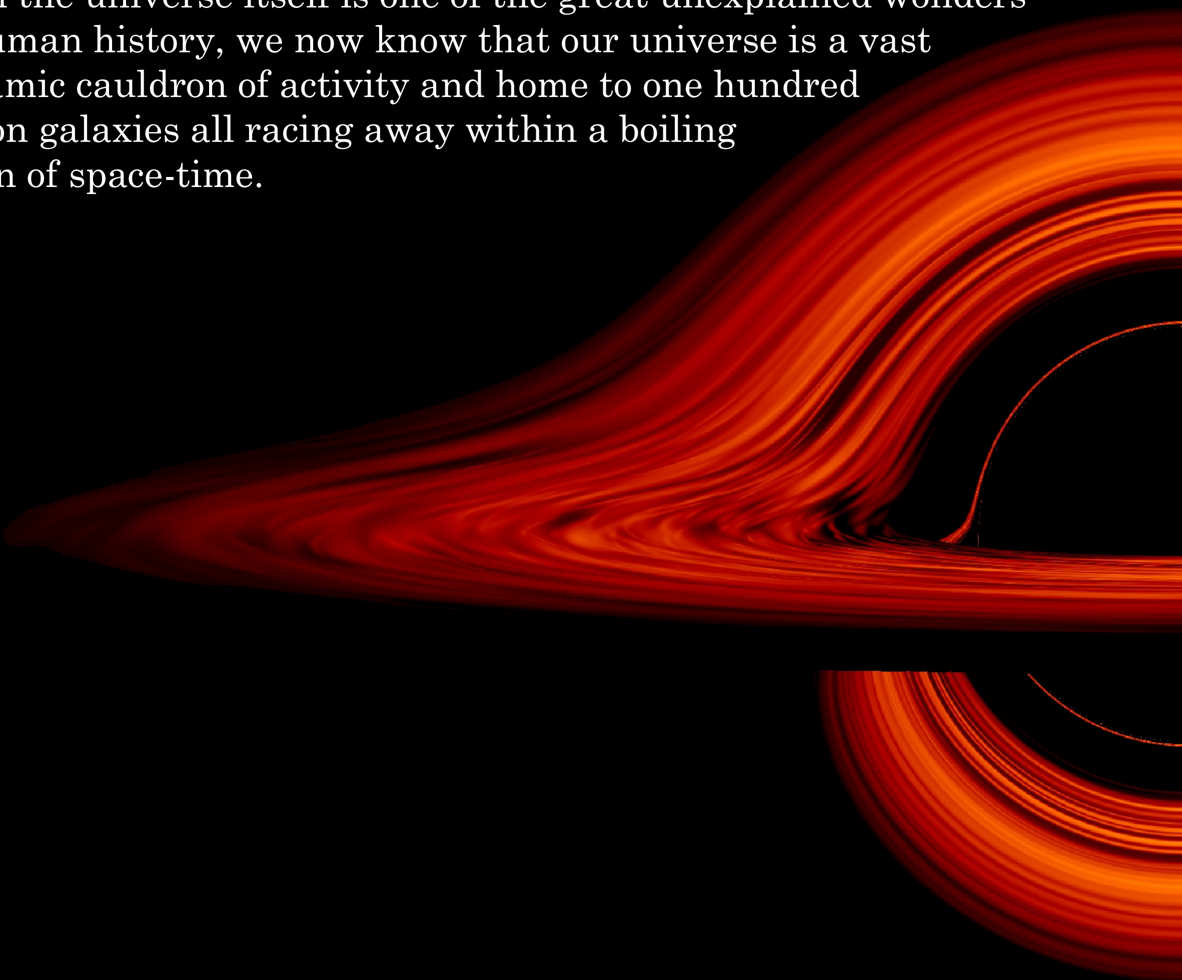
■ ■ ■

Mr. Panchal's article first appeared on the website of Medium, **www.medium.com**

SPACE

Even it is yet not fully proved, it is only a stone's throw into mankind’s history that we had no idea there were other galaxies besides our own. It was thought that humanity and the galaxy we inhabit was an island adrift in a universe of a hundred billion stars.

Even the universe itself is one of the great unexplained wonders of human history, we now know that our universe is a vast dynamic cauldron of activity and home to one hundred billion galaxies all racing away within a boiling ocean of space-time.

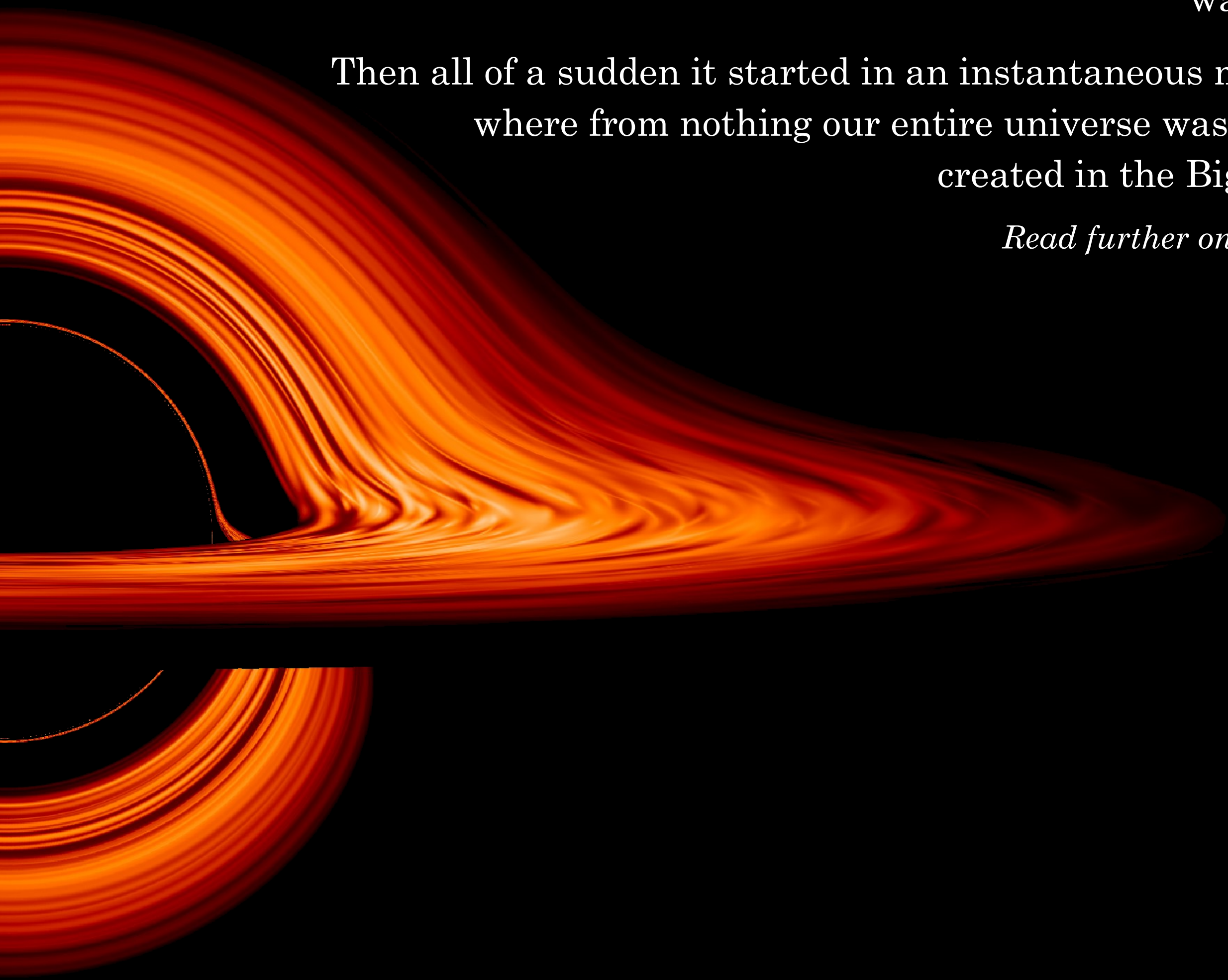


TIME

But to understand the enormousness of the universe and how it made all the raw material we see here on earth, we need to take an incredible journey and travel back through space and time to the moment our universe was born. We need to go back to the very beginning, to a time when there was nothing…no stars, no space just a time before there was time.

Then all of a sudden it started in an instantaneous moment where from nothing our entire universe was born… created in the Big Bang.

Read further on page 34



Could there be a centrifugal force out there providing the perfect conditions for space to fan out like a branch can push aside the bark of a tree due its natural perfection?

By Joshua Carroll, www.universetoday.com

Let us discuss the very nature of the cosmos. What you may find in this discussion is not what you expect. Going into a conversation about the universe as a whole, you would imagine a story full of wondrous events such as stellar collapse, galactic collisions, strange occurrences with particles, and even cataclysmic eruptions of energy.

You may be expecting a story stretching the breadth of time as we understand it, starting from the Big Bang and landing you here, your eyes soaking in the photons being emitted from your screen. Of course, the story is grand. But there is an additional side to this amazing assortment of events that oftentimes is overlooked; that is until you truly attempt to understand what is going on.

Ancient Babylonian tablet displaying early mathematics

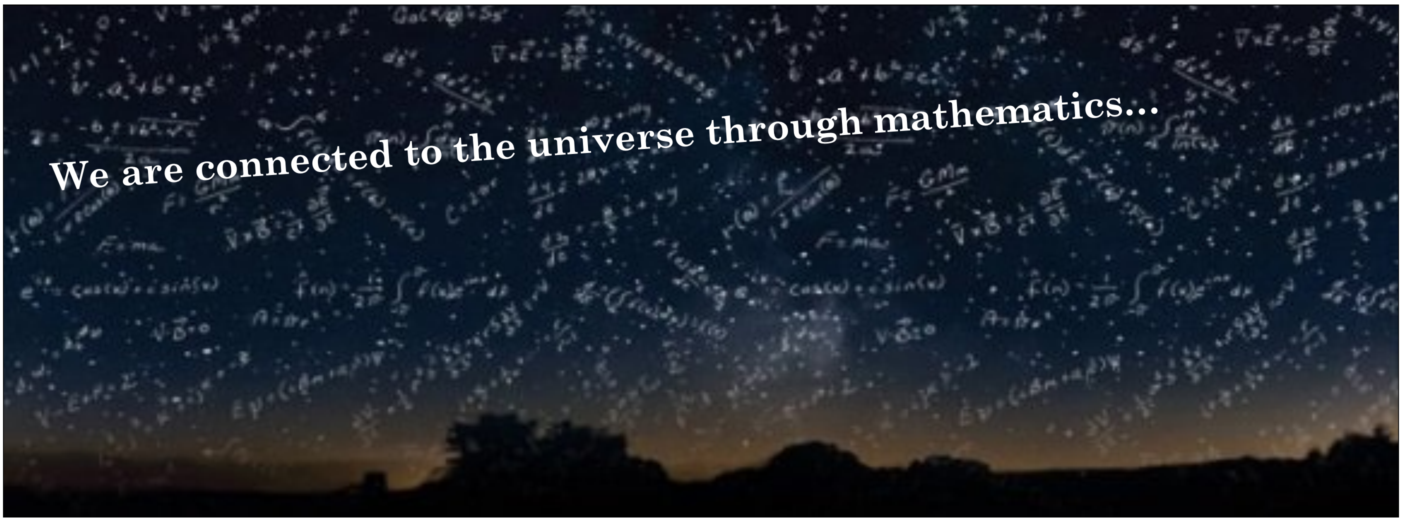
Behind all of those fantastic realizations, there is a mechanism at work that allows for us to discover all that you enjoy learning about. That mechanism is mathematics, and without it the universe would still be shrouded in darkness. In this article, I will attempt to persuade you that math isn't some arbitrary and sometimes pointless mental task that society makes it out to be, and instead show you that it is a language we use to communicate with the stars.

We are currently bound to our solar system. This statement is actually better than it sounds, as being bound to our solar system is one major step up from being bound simply to our planet, as we were before some very important minds elected to turn their geniuses toward the heavens.

Before those like Galileo, who aimed his spyglass towards the sky, or Kepler discovering that planets move about the sun in ellipses, or Newton discovering a gravitational constant, mathematics was somewhat limited, and our understanding of the universe rather ignorant. At its core, mathematics allows a species bound to its solar system to probe the depths of the cosmos from behind a desk. Now, in order to appreciate the wonder that is mathematics, we must first step back and briefly look at its beginnings and how it is integrally tied into our very existence.

Mathematics almost certainly came about from very early human tribe (predating Babylonian culture which is attributed to some of the first organized mathematics in recorded history), that may have used math as a way of keeping track of lunar or solar cycles, and keeping count of animals, food and/or people by leaders. It is as natural as when you are a young child and you can see that you have one toy plus one other toy, meaning you have more than one toy.

As you get older, you develop the ability to see that 1+1=2, and thus simple arithmetic seems to be interwoven into our very nature. Those that profess that they don't have a mind for math are sadly mistaken because just as we all have a mind for breathing, or blinking, we all have this innate ability to understand arithmetic. Mathematics is both a natural occurrence and a human designed system. It would appear that nature grants us this ability to recognize patterns in the form of arithmetic, and then we systematically ›››



construct more complex mathematical systems that aren't obvious in nature but let us further communicate with nature.

All this aside, mathematics developed alongside of human development, and carried on similarly with each culture that was developing it simultaneously. It's a wonderful observation to see that cultures that had no contact with one another were developing similar mathematical constructs without conversing. However, it wasn't until mankind decidedly turned their mathematical wonder towards the sky that math truly began to develop in an astonishing way. It is by no mere coincidence that our scientific revolution was spurred by the development of more advanced mathematics built not to tally sheep or people, but rather to further our understandings of our place within the universe.

Once Galileo began measuring the rates at which objects fell in an attempt to show mathematically that the mass of an object had little to do with the speed in which it fell, mankind's future would forever be altered.

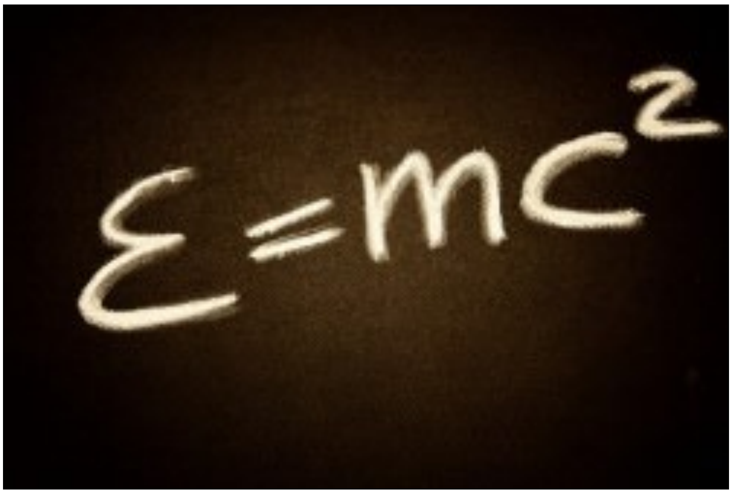
This is where the cosmic perspective ties in to our want to further our mathematical knowledge. If it were not for math, we would still think we were on one of a few planets orbiting a star amidst the backdrop of seemingly motionless lights. This is a rather bleak outlook today compared to what we now know about the awesomely large universe we reside in. This idea of the universe motivating us to understand more about mathematics can be inscribed in how Johannes Kepler used what he observed the planets doing, and then applied mathematics to it to develop a fairly accurate model (and method for predicting planetary motion) of the solar system. This is one of many demonstrations that illustrate the importance of mathematics within our history, especially within astronomy and physics.

The story of mathematics becomes even more amazing as we push forward to one of the most advanced thinkers humanity has ever known. Sir Isaac Newton, when pondering the motions of Halley's Comet, came to the realization that the math that had been used thus far to describe physical motion of massive bodies, simply would not suffice if we were to ever understand anything beyond that of our seemingly limited celestial nook. In a show of pure brilliance that lends validity to my earlier statement about how we can take what we naturally have and then construct a more complex system upon it, Newton developed the Calculus in which this way of approaching moving bodies, he was able to accurately model the motion of not only Halley's comet, but also any other heavenly body that moved across the sky.

In one instant, our entire universe opened up before us, unlocking almost unlimited abilities for us to converse with the cosmos as never before. Newton also expanded upon what Kepler started. Newton recognized that Kepler's mathematical equation for planetary motion, Kepler's 3rd Law ($P^2=A^3$), was purely based on empirical observation, and was only meant to measure what we observed within our solar system. Newton's mathematical brilliance was in realizing that this basic equation could be made universal by applying a gravitational constant to the equation, in which gave birth to perhaps one of the most important equations to ever be derived by mankind; Newton's Version of Kepler's Third Law. ›››

What Newton realized was that when things move in non-linear ways, using basic Algebra would not produce the correct answer. Herein lays one of the main differences between Algebra and Calculus. Algebra allows one to find the slope (rate of change) of straight lines (constant rate of change), whereas Calculus allows one to find the slope of curved lines (variable rate of change). There are obviously many more applications of Calculus than just this, but I am merely illustrating a fundamental difference between the two in order to show you just how revolutionary this new concept was.

All at once, the motions of planets and other objects that orbit the sun became more accurately measurable, and thus we gained the ability to understand the universe a little deeper. Referring back to Netwon's Version of Kepler's Third Law, we were now able to apply (and still do) this incredible physics equation to almost anything that is orbiting something else. From this equation, we can determine the mass of either of the objects, the distance apart they are from each other, the force of gravity that is exerted between the two, and other physical qualities built from these simple calculations.



Einstein's equation for the energy-mass equivalency, yet another incredible advancement for humanity brought forth from an ongoing mathematical dialogue. Image via Pixabay.

With his understanding of mathematics, Newton was able to derive the aforementioned gravitational constant for all objects in the universe ($G = 6.672\times10^{-11}$ N m^2 kg^{-2}). This constant allowed him to unify astronomy and physics which then permitted predictions about how things moved in the universe. We could now measure the masses of planets (and the sun) more accurately, simply according to Newtonian physics (aptly named to honor just how important Newton was within physics and mathematics). We could now apply this newfound language to the cosmos, and begin coercing it to divulge its secrets.

This was a defining moment for humanity, in that all of those things that prohibited our understandings prior to this new form of math were now at our fingertips, ready to be discovered. This is the brilliance of understanding Calculus, in that you are speaking the language of the stars.

There perhaps is no better illustration of the power that mathematics awarded us then in the, discovery of the planet Neptune. Up until its discovery in September of 1846, planets were discovered simply by observing certain "stars" that were moving against the backdrop of all the other stars in odd ways. The term planet is Greek for "wanderer", in that these peculiar stars wandered across the sky in noticeable patterns at different times of the year. Once the telescope was first turned upwards towards the sky by Galileo these wanderers resolved into other worlds that appeared to be like ours. If fact, some of these worlds appeared to be little solar systems themselves, as Galileo discovered when he began recording the moons of Jupiter as they orbited around it.

After Newton presented his physics equations to the world, mathematicians were ready and excited to begin applying them to what we had been keeping track of for years. It was as if we were thirsty for the knowledge, and finally someone turned on the faucet. We began measuring the motions of the planets and gaining more accurate models for how they behaved. We used these equations to approximate the mass of the Sun. We were able to make remarkable predictions that were validated time and again simply by observation. What we were doing was unprecedented, as we were using mathematics to make almost impossible to know predictions that you would think we could never make without actually going to these planets, and then using actual observation to prove the math correct. However, what we also did was begin to figure out some odd discrepancies with certain things. Uranus, for instance, was behaving not as it should according to Newton's laws. ›››

What makes the discovery of Neptune so wonderful was the manner in which it was discovered. What Newton had done was uncover a deeper language of the cosmos, in which the universe was able to reveal more to us. And this is exactly what happened when we applied this language to the orbit of Uranus.

The manner in which Uranus orbited was curious and did not fit what it should have if it was the only planet that far out from the sun. Looking at the numbers, there had to be something else out there perturbing its orbit. Now, before Newton's mathematical insights and laws, we would have had no reason to suspect anything was wrong in what we observed. Uranus orbited in the way Uranus orbited; it was just how it was. But, again revisiting that notion of mathematics being an ever increasing dialogue with the universe, once we asked the question in the right format, we realized that there really must be something else beyond what we couldn't see.


French mathematician who discovered the planet Neptune by using only mathematics

This is the beauty of mathematics writ large; an ongoing conversation with the universe in which more than we may expect is revealed.

It came to a French mathematician Urbain Le Verrier who sat down and painstakingly worked through the mathematical equations of the orbit of Uranus. What he was doing was using Newton's mathematical equations backwards, realizing that there must be an object out there beyond the orbit of Uranus that was also orbiting the sun, and then looking to apply the right mass and distance that this unseen object required for perturbing the orbit of Uranus in the way we were observing it was. This was phenomenal, as we were using parchment and ink to find a planet that nobody had ever actually observed.

What he found was that an object, soon to be Neptune, had to be orbiting at a specific distance from the sun, with the specific mass that would cause the irregularities in the orbital path of Uranus. Confident of his mathematical calculations, he took his numbers to the New Berlin Observatory, where the astronomer Johann Gottfried Galle looked exactly where Verrier's calculations told him to look, and there lay the 8th and final planet of our solar system, less than 1 degree off from where Verrier's calculations said for him to look. What had just happened was an incredible confirmation of Newton's gravitational theory and proved that his mathematics were correct.

These types of mathematical insights continued on long after Newton. Eventually, we began to learn much more about the universe with the advent of better technology (brought about by advances in mathematics). As we moved into the 20th century, quantum theory began to take shape, and we soon realized that Newtonian physics and mathematics seemed to hold no sway over what we observed on the quantum level.

In another momentous event in human history, yet again brought forth by the advancement in mathematics, Albert Einstein unveiled his theories of General and Special Relativity, which was a new way to look not only at gravity, but also on energy and the universe in general. What Einstein's mathematics did was allow for us to yet again uncover an even deeper dialogue with the universe, in which we began to understand its origins.

Continuing this trend of advancing our understandings, what we have realized is that now there are two sects of physics that do not entirely align. Newtonian or "classical" physics, that works extraordinarily well with the very large (motions of planets, galaxies, etc…) and quantum physics that explains the extremely small (the interactions of sub-atomic particles, light, etc…). Currently, these two areas of physics are not in alignment, much like two different dialects of a language. They are similar and they both work, but they are not easily reconcilable with one another.›››

One of the greatest challenges we face today is attempting to create a mathematical grand “theory of everything” which either unites the laws in the quantum world with that of the macroscopic world, or to work to explain everything solely in terms of quantum mechanics. This is no easy task, but we are striving forward nonetheless.

As you can see, mathematics is more than just a set of vague equations and complex rules that you are required to memorize. Mathematics is the language of the universe, and in learning this language, you are opening yourself up the core mechanisms by which the cosmos operates. It is the same as traveling to a new land, and slowly picking up on the native language so that you may begin to learn from them.

This mathematical endeavor is what allows us, a species bound to our solar system, to explore the depths of the universe. As of now, there simply is no way for us to travel to the center of our galaxy and observe the super-massive black hole there to visually confirm its existence.

There is no way for us to venture out into a Dark Nebula and watch in real time a star being born.

Yet, through mathematics, we are able to understand how these things exist and work. When you set about to learn math, you are not only expanding your mind, but you are connecting with the universe on a fundamental level. You can, from your desk, explore the awesome physics at the event horizon of a black hole, or bear witness to the destructive fury behind a supernova. All of those things that I mentioned at the beginning of this article come into focus through mathematics. The grand story of the universe is written in mathematics, and our ability to translate those numbers into the events that we all love to learn about is nothing short of amazing. So remember, when you are presented with the opportunity to learn math, accept every bit of it because math connects us to the stars.

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This article first appeared on the website of UniverseToday,
www.universetoday.com

New Research Shows; Life Could Be Common Throughout the Multiverse

By Leighton Kitson, Durham University, www.dur.ac.uk

A Multiverse – where our Universe is only one of many – might not be as inhospitable to life as previously thought, according to new research.

Questions about whether other universes might exist as part of a larger Multiverse, and if they could harbor life, are burning issues in modern cosmology. Now new research led by Durham University, UK, and Australia's University of Sydney, Western Sydney University and the University of Western Australia, has shown that life could potentially be common throughout the Multiverse, if it exists.

The key to this, the researchers say, is dark energy, a mysterious "force" that is accelerating the expansion of the Universe.

Multiverse theory

Scientists say that current theories of the origin of the Universe predict much more dark energy in our Universe than is observed. Adding larger amounts would cause such a rapid expansion that it would dilute matter before any stars, planets or life could form.

The Multiverse theory, introduced in the 1980s, can explain the "luckily small" amount of dark energy in our Universe that enabled it to host life, among many universes that could not. Using huge computer simulations of the cosmos, the new research has found that adding dark energy, up to a few hundred times the amount observed in our Universe, would actually have a modest impact upon star and planet formation. This opens up the prospect that life could be possible throughout a wider range of other universes, if they exist, the researchers said.

The findings are published in two related papers in the journal Monthly Notices of the Royal Astronomical Society. The simulations were produced under the EAGLE (Evolution and Assembly of GaLaxies and their Environments) project – one of the most realistic simulations of the observed Universe.

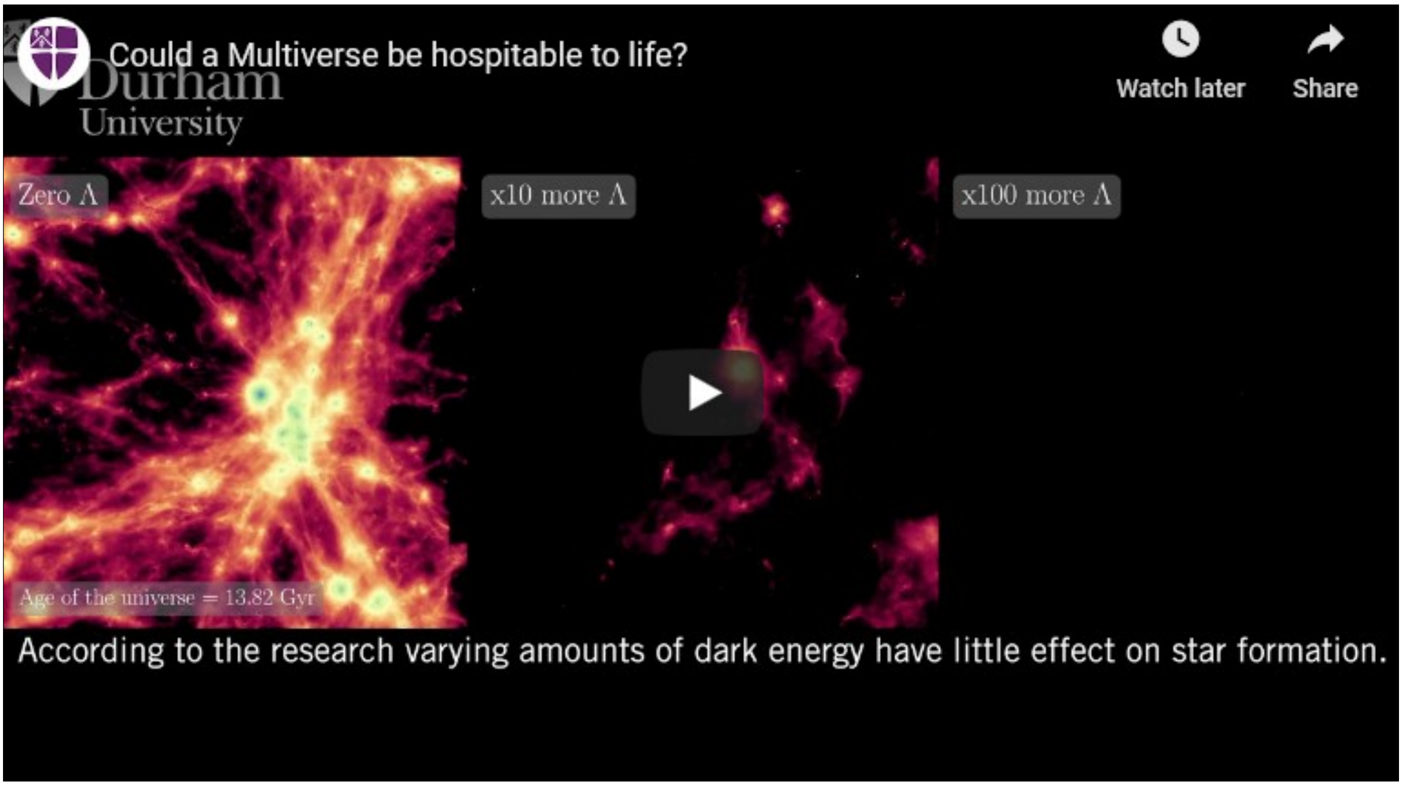
Leighton Kitson is a trained journalist with experience of private and public sector media relations. He was a media relations officer for Reg Vardy plc and Durham County Council with responsibility for commercial, corporate, media and internal communications. **www.dur.ac.uk**

Star formation

Jaime Salcido, a postgraduate student in Durham University's Institute for Computational Cosmology, said: "For many physicists, the unexplained but seemingly special amount of dark energy in our Universe is a frustrating puzzle.

"Our simulations show that even if there was much more dark energy or even very little in the Universe then it would only have a minimal effect on star and planet formation, raising the prospect that life could exist throughout the Multiverse."

Dr. Luke Barnes, a John Templeton Research Fellow at Western Sydney University, said: "The Multiverse was previously thought to explain the observed value of dark energy as a lottery – we have a lucky ticket and live in the Universe that forms beautiful galaxies which permit life as we know it. ›››



Simulations of the formation of structure in an expanding universe, featuring a universe with no cosmological constant/dark energy (left), a universe with 10 times more dark energy than in our universe (center), and a universe with a very large cosmological constant/dark energy, 100 times more than in our universe (right). In the color scheme, blue colors represent high density regions of the universe where stars are forming, and red, low density. The simulations run for approximately 14 billion years. All models use the same initial conditions after the big bang. At early times, the Universe was very hot and dense. Gravity pulls matter together to form structure, while the rapid expansion caused by dark energy dilutes all matter as the Universe ages, halting star formation. *Credit: Jaime Salcido/EAGLE*

"Our work shows that our ticket seems a little too lucky, so to speak. It's more special than it needs to be for life. This is a problem for the Multiverse; a puzzle remains."

Dark energy

Dr. Pascal Elahi, Research Fellow at the University of Western Australia, said: "We asked ourselves how much dark energy can there be before life is impossible? Our simulations showed that the accelerated expansion driven by dark energy has hardly any impact on the birth of stars, and hence places for life to arise. Even increasing dark energy many hundreds of times might not be enough to make a dead universe."

However, the researchers said their results were unexpected and could be problematic as they cast doubt on the ability of the theory of a Multiverse to explain the observed value of dark energy. According to the research, if we live in a Multiverse, we'd expect to observe much more dark energy than we do – perhaps 50 times more than we see in our Universe. Although the results do not rule out the Multiverse, it seems that the tiny amount of dark energy in our Universe would be better explained by an, as yet, undiscovered law of nature.

New law of physics

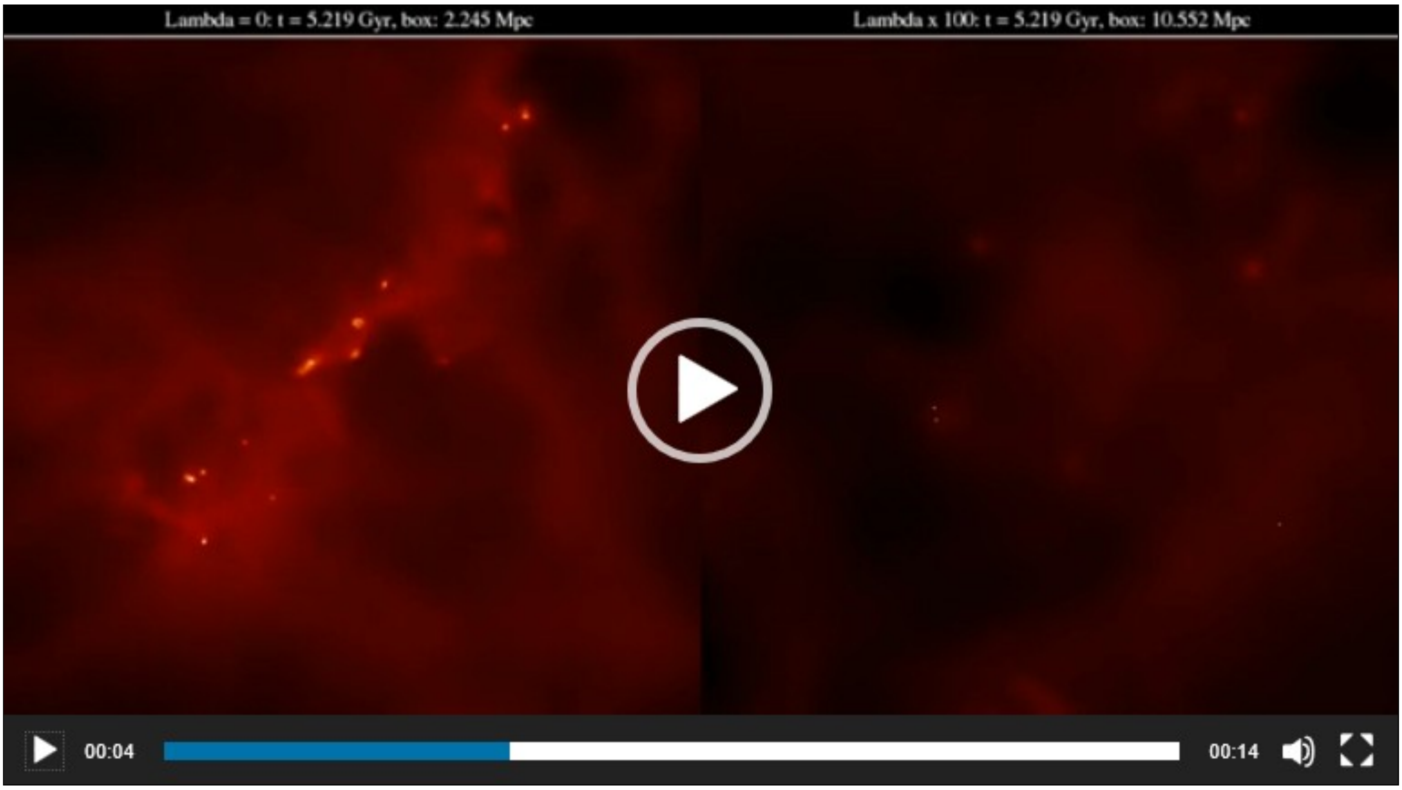
Professor Richard Bower, in Durham University's Institute for Computational Cosmology, said: "The formation of stars in a universe is a battle between the attraction of gravity, and the repulsion of dark energy.

"We have found in our simulations that universes with much more dark energy than ours can happily form stars. So why such a paltry amount of dark energy in our Universe?

"I think we should be looking for a new law of physics to explain this strange property of our Universe, and the Multiverse theory does little to rescue physicists' discomfort."

The research was conducted with Liverpool John Moores University, UK, and Leiden University, The Netherlands.

It was funded by the Science and Technology ›››



Simulations of the formation of a group of galaxies in an expanding universe, featuring no cosmological constant (left) and a very large cosmological constant (right). In the color scheme, lighter colors represent denser parts of the universe, when gravity is drawing matter together into galaxies. The simulation runs for 15 billion years. Without a cosmological constant (left), matter comes together under the attractive force of gravity into smaller galaxies, which combine into a large galaxy. With a large cosmological constant (right), the faster expansion of the universe stops matter from grouping together, and galaxies fail to form. Luke A. Barnes, Pascal J. Elahi, Jaime Salcido, Richard G. Bower, Geraint F. Lewis/EAGLE

Facilities Council, UK, the European Research Council, The Netherlands Organisation for Scientific Research, the John Templeton Foundation, the International Centre for Radio Astronomy Research, and Australian Research Council Centre of Excellence for All Sky Astrophysics in 3 Dimensions (ASTRO 3D).

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This article was first published on the Website of Durham University, **www.dur.ac.uk**

Publications:

- Jaime Salcido, et al., “The impact of dark energy on galaxy formation. What does the future of our Universe hold?,” MNRAS, 2018; **doi:10.1093/mnras/sty879**
- Luke A Barnes, et al., “Galaxy formation efficiency and the multiverse explanation of the cosmological constant with EAGLE simulations,” MNRAS, 2018; **doi:10.1093/mnras/sty846**

The Broken Nobel Prize Dream that Launched a Mentoring Platform

By Prof. Dr. Amal Amin, www.researchgate.net

I work in a region where research is grossly underfunded, and gender biases lurk in many corners. I once dreamt of winning a Nobel prize in chemistry — but that's no longer the case. Instead, I want to help young scientists in Egypt and the Arab region to overcome challenges, and maybe to achieve what has become an impossible goal for me.

Amal Amin is an associate professor of polymers and nanotechnology at Egypt's National Research Centre in Cairo and the founder of Woman In Science Without Borders WISWB)
www.facebook.com/WISWBINITIATIVE/

In my opinion, part of the problem in science, technology, engineering and maths research in this region and elsewhere is that scientists are too focused on their disciplines — to the point of isolation.

Chasing deadlines and research results while fitting in teaching and administrative work means that we don't talk to each other enough, and sometimes we don't know how to work with scientists in different fields or at other institutions.

The culture and environment in which many of us work mean that issues such as the inclusion of women and the mentoring of young minds become secondary or unimportant compared with the responsibilities we shoulder every day.

To help tackle this, I mentored some young scientist members of the Global Young Academy, an international society of young scientists that I cofounded in Berlin in 2010. In 2017, I launched Women in Science Without Borders (WISWB) as a networking and coaching platform for men and women, early-career and seasoned scientists to collaborate and support each other, and to help them to achieve what I and many members of my generation could not. Its members are drawn from 48 countries.

The idea behind WISWB came about over many years. It started in 1999–2001, during my PhD programme at Ulm University, Germany, and took shape during long hours spent in the lab and visits to the United States and France in 2008 and 2010, and while I was as an associate professor in Egypt. The idea also developed as I networked at conferences in more than 35 countries.

But the seeds for action were truly sown when I mentored my daughters after they chose to pursue science careers, and looked to me for answers. My eldest is now studying medicine, and her sister specializes in biological sciences in high school.

My aims for WISWB were six-fold:

• To empower young scientists and turn them into future leaders.

• To increase public awareness of science.

• To boost science literacy and education among the public.

• To help scientists to shape science policy.

• To help to reverse the 'brain drain' that Egypt and other countries are experiencing.

• To encourage collaboration and multidisciplinary work at the intersection of science, society and industry. ›››

The launch of WISWB in 2017 was mostly received favourably by scientists in Egypt and the general public. But I did detect some resistance to granting a 'bigger space' in the field for girls and women.

Egypt's educational system, media and society — like those in many developing countries — do not empower women to chase their dreams, leadership roles or coveted grants, or to choose challenging fields of study. Many women are barred from joining effective professional networks to further their research endeavours. And they're often expected to prioritize forming a family over building a career.

So one major challenge was lifting some of the limitations placed on female scientists, without alienating male colleagues who are deeply immersed in their own fields, chasing promotions and accolades.

Women in Science Without Borders was launched to empower women and girls to pursue scientific careers.
Photo credit: Claudia Wiens/Alamy

I reached out to peers all over the world to grow a platform that transcends gender issues, cultural misunderstandings and age differences.

Although "women" is part of the name, WISWB is not about separating genders, but helping an otherwise-marginalized group to advance, side-by-side with supportive male colleagues.

I didn't want it to be an advocacy group, or to create female-exclusive science programmes. The platform's slogan, "science for sustainable development", is about supporting and empowering the relationships between all genders.

The first WISWB conference took place in Cairo, and the following year the event was in Johannesburg, South Africa. In 2019, it returned to Cairo with a new name, World Forum for Women in Science. At this meeting, despite tensions between India and Pakistan, female scientists from the two countries forged what could possibly be lifelong alliances in the lab, as well as friendships.

In February 2020, the event was held in Rio de Janeiro, Brazil, and was supported by the Brazilian Academy of Sciences.

Our other supporters include pharmaceutical company Sanofi, cosmetics firm L'Oréal, research-funding charity Wellcome, science publisher Elsevier, the Egyptian academy of science and technology, the International Science Council and the Arab Science and Technology Foundation. Our events include public-engagement sessions at which scientists simplify science for a lay audience, and a student competition with a sustainable-development focus.

Later this year, we hope to organize a youth science forum in Egypt aimed at secondary-school students and early-career scientists. And we're planning an event for refugees in Duhok, in Iraq's Kurdistan region, at the end of the year.

I have spent most of my life trying to achieve as much as possible before turning 40 — the apex of a scientific career, after which opportunities in science in many countries narrow.

That was another personal reason behind my founding of WISWB: I wanted to mentor and guide others during the golden years of their careers — a privilege I didn't have — and to allow them a safe space to exchange expertise and success stories. I wanted to create a place where scientists of all genders, ages, nationalities and backgrounds could work together for a better shared future.

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Prof. Dr. Amal Amin article was first published on the website of Nature a place for Nature readers to share their professional experiences and advice.
www.nature.com

https://www.nature.com/articles/d41586-020-01274-z

Reality: What Exactly is it?

By Maria Anna van Driel, Editor Cheryl Knight-Wilson

The human species has seemingly always looked up into the skies seeking answers to many questions: Who am I? Is it possible that I am not “real”? Is this moment that I’m experiencing right now real? Is this consciousness and as close as I can get to reality? Reality is, by definition, a strange dimension.

What is reality?

That is a tricky question. There are many plausible answers, and theories, that go in many different directions. But regardless of how we wrestle with the question of reality, in some enigmatic way, many people end up with a form of “Platonic realism,” which states that the “visible world of particular things is a shifting exhibition, like shadows cast on a wall by the activities of their corresponding universal ideas or forms.”

These days many scientists from all over the world are trying to wrap their minds around this question of what this foggy state of the mind is. But is it really a foggy state we seem to be stuck in? Or may we think of it as a strange kind of an overlapping of different frames of space and time where a primordial energy is forming its own density and, for us, creating recognizable objects in a classical reality?

If our current understanding of physics is correct, then it is impossible to simulate the entire Universe, with its trillions and trillions of things. But we do not actually need to.

From a deep view, the vast Universe could just be a flat projection, and we would have no way of knowing it. There seems to be a possibility that we only need enough universes and high-speed rotating light particles hitting the planes with the right angle to fool the inhabitants of our simulation, or simulations, into thinking that they are real. So, who needs billions of galaxies? We only need the space to explore. Your body might feel like it is filled with bubbly things, but it might be empty, until you open it.

The minimum requirement for our simulation is only the consciousness of the “virtual human” and for humans to “think” the simulation is real. So, is our reality or our reflection (anti-matter) being simulated? Well, that is one hell of a challenging question! It is probably one of the deepest questions you have ever asked in your life. Although the answer is so radical that it cannot be communicated with (written) words, let me try to do so anyway.

A Question of Reality

Imagine a large mirror. As soon as we stand in front of it, we start making strange and funny faces … we even wave to ourselves. Why do we do so? Is this an attempt for self-recognition due to the fact we cannot see our own image (face) as often as we see the images of others? Or is it more an expression based on a slight fear/shock after the bubble of a false self image has burst and an actual self-recognition occurs? ›››

You might wonder, “Why bother? It is just a reflection. It is not even real!” But if the reflection of a dense object (including you and me) is an illusion, would it not mean that the original object (you and me in this case) is an illusion as well?

Have you ever seen the light reflecting off a complex form of superior mirage — a Fata Morgana? The reality of what you think you are without the mirror is, in this line of thought, an illusion also. Does this mean that as we are standing in front of a mirror we try to recognize what we really are? I mean, do we do this behavior, which can be considered as a natural reflex, to make it less complex for our brain to correct what it is registering as it is trying to combine this “visible image” with what it “thinks” itself to actually be? Reality as we have become so familiar with is slowly starting to be a scary realm. It seems that we are unable to experience the true nature of any object in our so-called familiar space and time (reality) in an unfiltered manner. Our senses and brains are yet not that evolved, and they can only process a fraction of the world around us. So we have to use concepts and tools to learn about the true nature of reality.

Technological progress has widened our knowledge about our reality and the Universe, as well as made us aware of unsettling possibilities in, for instance, quantum-entanglement communications.

I know that most of us are innately curious to know if there is something deeper to “reality” than what we have been told about — what our culture, science, or even what religion has explained us. There is something you are missing and you cannot quite put your finger on what it is, but you know there has to be something more.

If I would say that reality is both infinite consciousness and infinite imagination, your mind would instantly go out to wrestle the question: “What is consciousness and how could a, or any, reality be infinite imagination?” What I mean by reality being infinite consciousness is that when you were born, or in this line of thought, when you imagined that you were born, you had no idea what you were born into. You had no idea who you were, what you were, what the world was, what life was, or what the point of life was. You were a blank page! And then you quickly started learning “stuff,” and with rapid speed you started misunderstanding what “reality” is. Now you have to deal with these misunderstandings, which run very, very deep in your subconscious mind.

So, what you consider to be “reality” might not be real at all. You really might be ... simulated by your own thoughts. You might be on a small planet speeding through eternal nothingness, or you might be a simulation inside a computer or matrix. All that we can do is hope that if we actually are simulations in a supercomputer, nobody trips over the power cable!

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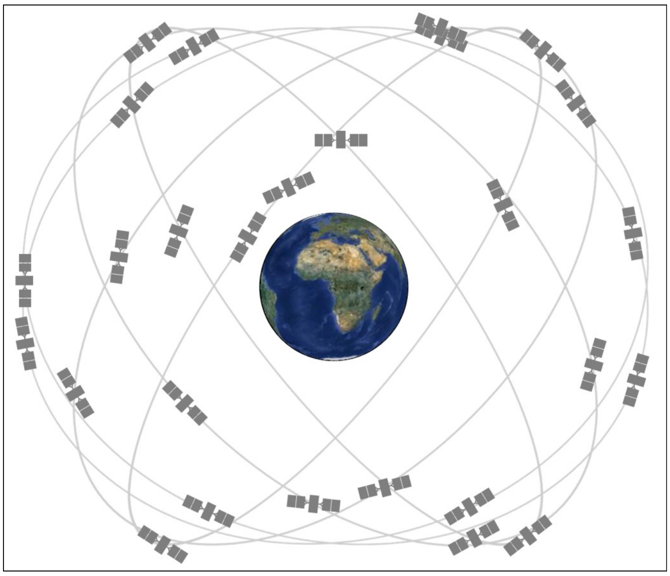
Is Time Travel Possible?

By NASA Space Place, www.spaceplace.nasa.gov

We all travel in time! We travel one year in time between birthdays, for example. And we are all traveling in time at approximately the same speed: 1 second per second.

NASA's space telescopes also give us a way to *look* back in time. Telescopes help us see stars and **galaxies that are very far away**. It takes a long time for the light from faraway galaxies to reach us. So, when we look into the sky with a telescope, we are seeing what those stars and galaxies looked like a very long time ago.

However, when we think of the phrase "time travel," we are usually thinking of traveling faster than 1 second per second. That kind of time travel sounds like something you'd only see in movies or science fiction books. Could it be real? Science says yes!



GPS satellites orbit around Earth at about 8,700 miles (14,000 kilometers) per hour. Photo credit: GPS.gov

How do we know that time travel is possible?

More than 100 years ago, a famous scientist named Albert Einstein came up with an idea about how time works. He called it relativity. This theory says that time and space are linked together. Einstein also said our universe has a speed limit: nothing can travel faster than the speed of light (186,000 miles per second).

What does this mean for time travel?

Well, according to this theory, the **faster** you travel, the **slower** you experience time. Scientists have done some experiments to show that this is true. For example, there was an experiment that used two clocks set to the exact same time. One clock stayed on Earth, while the other flew in an airplane (going in the same direction Earth rotates).

After the airplane flew around the world, scientists compared the two clocks. The clock on the fast-moving airplane was slightly behind the clock on the ground. So, the clock on the airplane was traveling slightly slower *in time* than 1 second per second.

Can we use time travel in everyday life?

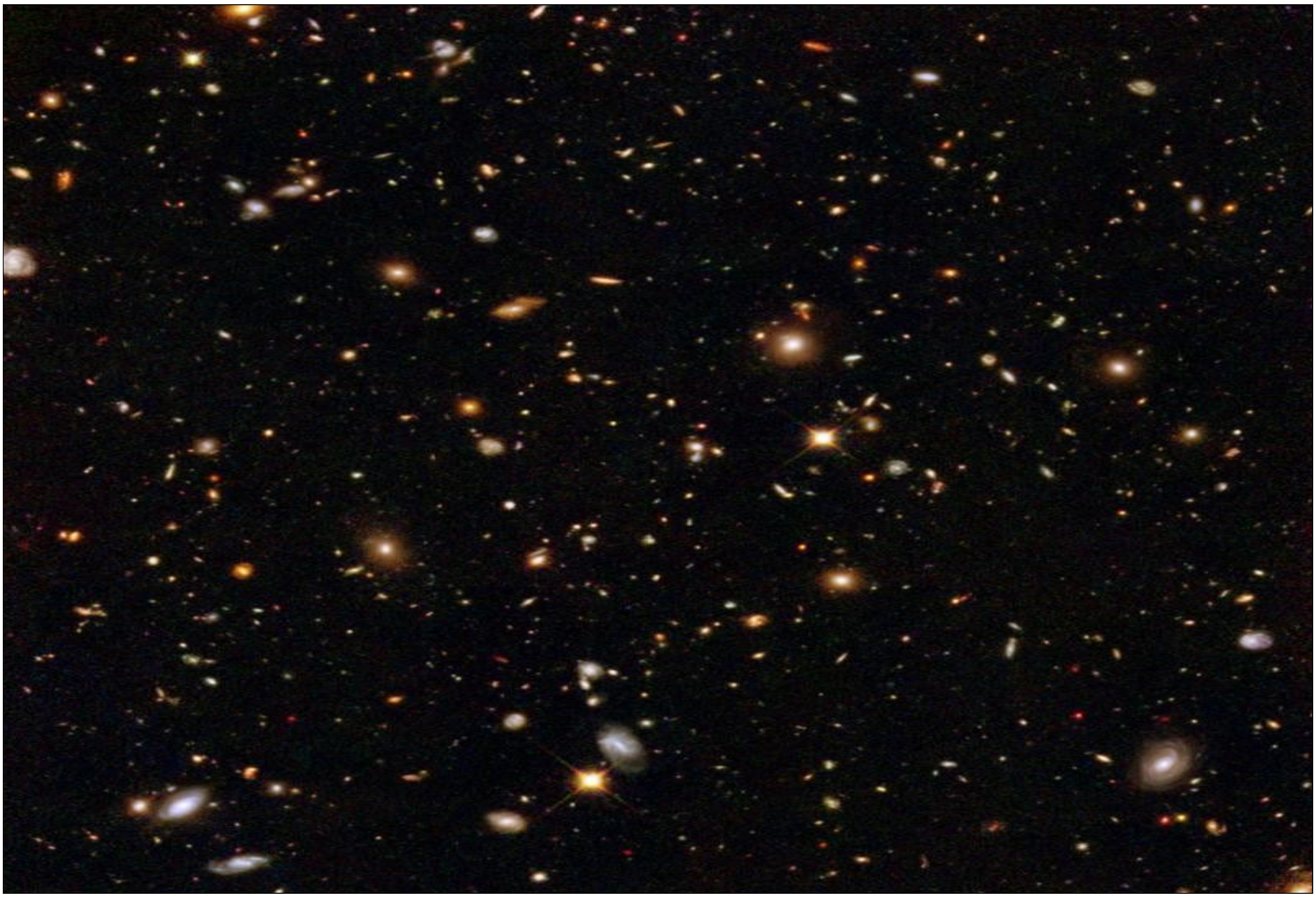
We can't use a time machine to travel hundreds of years into the past or future. That kind of time travel only happens in books and movies. But the math of time travel *does* affect the things we use every day.

For example, we use GPS satellites to help us figure out how to get to new places. (Check out our **video about how GPS satellites work**.) NASA scientists also use a high-accuracy version of GPS to keep track of where satellites are in space. But did you know that GPS relies on time-travel calculations to help you get around town?

GPS satellites orbit around Earth very quickly at about 8,700 miles (14,000 kilometers) per hour. This slows down GPS satellite clocks by a small fraction of a second (similar to the airplane example above).

However, the satellites are also orbiting Earth about 12,550 miles (20,200 km) above the surface. This actually *speeds up* GPS satellite clocks by a slighter larger fraction of a second.

Here's how: Einstein's theory also says that gravity curves space and time, causing the passage of time to slow down. High up where the satellites orbit, Earth's gravity is much weaker. This causes the clocks on GPS satellites to run *faster* than clocks on the ground. ›››



This image from the Hubble Space Telescope shows galaxies that are very far away as they existed a very long time ago.
Photo credit: NASA, ESA and R. Thompson (Univ. Arizona)

faster than 1 second per second. Luckily, scientists can use math to correct these differences in time.

If scientists didn't correct the GPS clocks, there would be big problems. GPS satellites wouldn't be able to correctly calculate their position or yours. The errors would add up to a few miles each day, which is a big deal. GPS maps might think your home is nowhere near where it actually is!

The combined result is that the clocks on GPS satellites experience time at a rate slightly

In Summary:

Yes, time travel is indeed a real thing. But it's not quite what you've probably seen in the movies. Under certain conditions, it is possible to experience time passing at a different rate than 1 second per second. And there are important reasons why we need to understand this real-world form of time travel.

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The Universe; as far as we know is all there is.

By Maria Anna van Driel, www.nexttruth.com

The very definition of the moment of the Big Bang is that space and time were created at that instant it is as far as we currently know that coming into existence of space and time itself. The infant universe; an unimaginable tiny speck of energy and space-time, what is an active player in the game of life and underpins our reality tying together all of space and time since the very beginning, materializes from nowhere.

Then, faster than the speed of light, space suddenly expands. Violently it grew from smaller than the size of an atom to the size of a baseball. In cosmic terms that is like a grain of sand growing almost to the size of the observable universe.

And even it has been around for a finite amount of time roughly 13 and 1/2 billion years; it looks pretty much the same everywhere actually. On very large scales the universe is actually a pretty simple place.

Our universe, the galaxies, the solar system, our home planet Earth, land, sea, air, life…where did they all come from?

Nevertheless, the universe is a very, very big place and it is getting bigger. But how big is the visible universe? And why does it not agree with its own age? For finding an answer to these questions I plowed through an avalanche of articles provided by the internet and came to a halt at a You Tube video from Dr. Don Lincoln, a senior scientist from Fermilab and adjunct professor of physics at the University of Notre Dame (USA). **www.drdonlincoln.com**

"There are lots of tricky ways to think about that, but let's start with perhaps the most obvious. Time and space are inextricably intertwined when we talk about how far away things are. This is especially true when we talk about large scale structures of the universe." Dr. Lincoln explains in his video **'If the universe is only 14 billion years old, how can it be 92 billion light years wide?'**

"When the universe began, Dr. Lincoln proceeds, it was filled with light which then travelled through the cosmos. And, if the universe began 13.7 billion years ago and we're just now seeing it arrive, it had to have traveled 13.7 billion light years before it hit Earth. Astronomers can actually see light from shortly after the universe began. It's called the Cosmic Microwave Background radiation (CMB) and it's the oldest thing we've ever seen."

Since space is expanding it is a natural question to ask what is it expanding into?

When we peer deep into the cosmos we cannot see a boundary and so far science has uncovered no evidence that a boundary exists. Space may extend to infinity or it may not, but in Einstein's universe things can be curved. And if things can be curved they can be curved in on themselves or around any object it is countering. Space itself might be twisting and bending its content to shape the universe and to virtually anything imaginable.

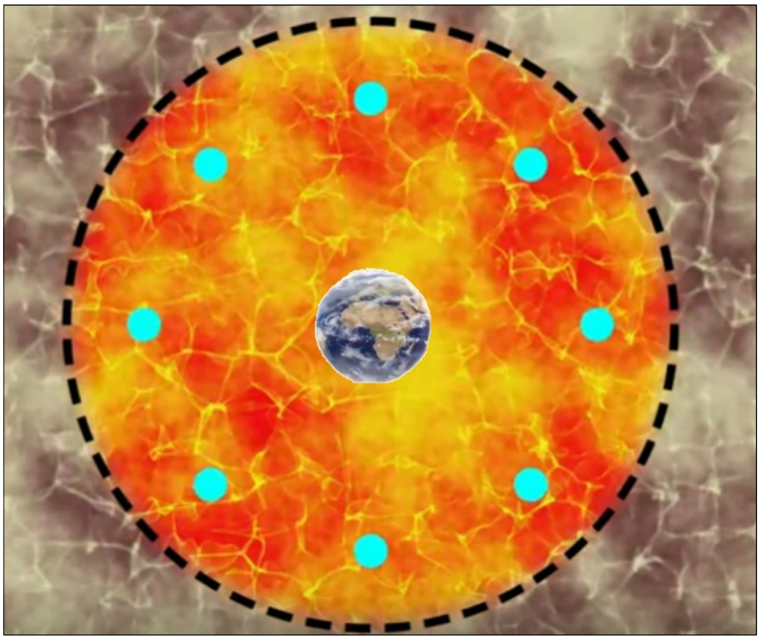
It seems that general relativity makes it possible to live in an infinite universe with no boundary at all whereby space-time is suddenly not a static entity; it is a dynamic and ever-changing fabric within which the locations of all galaxies are woven. ›››

Galaxies are not themselves moving very much, but they appear to move to us because of new cosmic real-estate continually injected increasing their distance from us. Is this creation of new space-time and the rate at which it is being created which determines how fast a galaxy appears to be moving away from us?

"One day, the expansion of the universe will make it so that almost all of the galaxies we see in our telescopes today, which I remind you now we're seeing as they were in the distant past, will slip from our view, Dr. Lincoln says. "We will one day only be able to see galaxies from our local group, meaning the Milky Way, Andromeda, and a few dozen minor galaxies in the vicinity."

There's still one big question we need to answer before we can start thinking about what the cause could be for this expansion.

How do we know space is expanding? Well, science gathered a lot of data to back up the claim of space expanding. The Planck Telescope really came through but the most famous is probably the red-shift of light.



"When you take into account the effect of dark energy, that radius of the sphere from which the microwaves were emitted has grown from 42 million, with an M, light-years to 46 billion, light-years. And this highlights the confusion that arises from expanding space." Dr. Don Lincoln

But there is another source scientist are thinking of being the cause of the universe expanding and that is Dark energy, an energy what is thought of being a repulsive form of gravity.

"It turns out that the simplest calculation isn't quite right, Dr Lincoln explains in his video, you see, about five billion years ago, an energy field that we call dark energy became important. Dark energy is a repulsive form of gravity, which means that the expansion of the universe isn't slowing down, it's accelerating.

That, of course, means that after 9 billion years of the expansion of space slowing down, it's now speeding up."

Light red-shifts as it escapes from a source of gravity what is more apparent when the gravity is strong like the light emitted by the accretion disk of a black hole.

The expansion of space can also cause a red-shift but that expansion is slow, so the light needs to be traveling a long time for us to notice. (As the universe expands, the CMB photons are red-shifted what is causing them to decrease in energy) With the light coming from 'stuff' close by, you get it mixed up with the other two sources of red-shift. The point is that cosmological red-shift is not the result of a galaxy's speeding away from us.

It is NOT the Doppler Effect! You have been misled. It is the result of the space stretching along the trip. When light travels between galaxy super-clusters, that light gets stretched as the space it's traveling through stretches. The more time that light travels, the more expansion it experiences.

So what is space expanding into when new space-time is created and into what do the edges go? The answer depends on whether or not there are edges. If we live in an infinite universe then the answer has to be **nothing** and by adding more fabric to infinity does not make more infinity. An infinite universe would have no edges that expand and the question is than meaningless. In such a universe there would be no outside.

On the other hand, if the universe is finite with a boundary that we have not yet discovered then the answer may be that we are expanding into 'something'. If that is true however, then the boundary could be so far away that we cannot see it.

With these thoughts, questions like; what is it that is creating the contra frequency creating a wall, or sphere, of where the frequencies within ›››

Could there be a centrifugal force out there providing the perfect conditions for space to fan out like a branch can push aside the bark of a tree due its natural perfection?

our universe, is bouncing back on and thus creating a boundary or edges.

A plausible idea could speak of rare photon collisions beyond the territory of the, by us, known universe. Collisions which take place in a, for us, yet undiscovered realm, whereby the acoustic shadow of the photon plopping to the Axion-like particle, could be the contra frequency what provides our universe its boundaries. If a photonic behavior as so would be possible outside our universe, would that mean that the frequency released by these collisions could be the cause for creating a kind of standing wave around all what is swirling in our universe as an invisible sphere?

However, while we may yet find our universe is just an island scientists have yet discovered that this whimsical place, containing subatomic particle showing the most bizarre behaviors when they meet, 'stuff' what is there but then is not and black holes which are consuming everything like a whale swallowing its daily portion of plankton, is much larger than is ever thought.

Still, after many centuries this rapidly expanding place remains a mystery.

And even physics has come an enormous way; it has yet not provided a real way for us to ever look anywhere, but within it. It seems we simply cannot wrap our minds around this enormous dark cosmic freezer we are swirling in as well as none have yet not found a way to state if it might have boundaries or none at all.

Every culture, every age has asked the question and tried to answer it. It's one of the greatest adventures of the human mind to find out where we came from, where we are and of course, in the end, where we're going. It seems we are captured by medusa's gaze when it comes down to unraveling the mysteries of this really, really big dark place of which its size and age seem not to agree with each other.

And so, like a young caterpillar awaiting that miraculous and magical moment of unfolding its wings, we are cocooned from understanding what is perhaps the greatest question facing the human race what is to discover; Where do we come from and what is our ultimate fate.

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What is a famous paradox?

"Russell's paradox is the most famous of the logical or set-theoretical paradoxes. Also known as the Russell-Zermelo paradox, the paradox arises within naïve set theory by considering the set of all sets that are not members of themselves."

Russell's paradox is based on examples like this: Consider a group of barbers who shave only those men who do not shave themselves. Suppose there is a barber in this collection who does not shave himself; then by the definition of the collection, he must shave himself. But no barber in the collection can shave himself. (If so, he would be a man who does shave men who shave themselves.)

Russell's paradox, which he published in Principles of Mathematics in 1903, demonstrated a fundamental limitation of such a system. In modern terms, this sort of system is best described in terms of sets, using so-called set-builder notation. For example, we can describe the collection of numbers 4, 5 and 6 by saying that x is the collection of integers, represented by n, that are greater than 3 and less than 7. We write this description of the set formally as $x = \{ n: n \text{ is an integer and } 3 < n < 7\}$. The objects in the set don't have to be numbers. We might let $y = \{x: x \text{ is a male resident of the US}\}$.

www.scientificamerican.com

Jump to a list of paradoxes!

This list collects only scenarios that have been called a paradox by at least one source and have their own article. Although considered paradoxes, some of these are simply based on fallacious reasoning (falsidical), or an unintuitive solution (veridical).

Informally, the term paradox is often used to describe a counter-intuitive result. However, some of these paradoxes qualify to fit into the mainstream perception of a paradox, which is a self-contradictory result gained even while properly applying accepted ways of reasoning. These paradoxes, often called antinomy, point out genuine problems in our understanding of the ideas of truth and description.

wikipedia.org (List of paradoxes)

A paradox, also known as an antinomy, is a logically self-contradictory statement or a statement that runs contrary to one's expectation. It is a statement that, despite apparently valid reasoning from true premises, leads to a seemingly self-contradictory or a logically unacceptable conclusion.

Self-reference

An example is the statement "This statement is false", a form of the liar paradox. The statement is referring to itself. Another example of self-reference is the question of whether the barber shaves himself in the barber paradox. Yet another example involves the question "Is the answer to this question 'No'?"

Contradiction

"This statement is false"; the statement cannot be false and true at the same time. Another example of contradiction is if a man talking to a genie wishes that wishes couldn't come true. This contradicts itself because if the genie grants his wish, he did not grant his wish, and if he refuses to grant his wish, then he did indeed grant his wish, therefore making it impossible either to grant or not grant his wish without leading to a contradiction.

Vicious circularity, or infinite regress

"This statement is false"; if the statement is true, then the statement is false, thereby making the statement true. Another example of vicious circularity is the following group of statements:

"The following sentence is true."

"The previous sentence is false."

www.wikipedia.org

Making Sense of Many Universes

By Tom Siegfried, www.sciencenoise.org

Almost anybody who has ever thought deeply about the universe sooner or later wonders if there is more than one of them. Whether a multiplicity of universes — known as a multiverse — actually exists has been a contentious issue since ancient times. Greek philosophers who believed in atoms, such as Democritus, proposed the existence of an infinite number of universes. But Aristotle disagreed, insisting that there could be only one.

Today a similar debate rages over whether multiple universes exist. In recent decades, advances in cosmology have implied (but not proved) the existence of a multiverse. In particular, a theory called inflation suggests that in the instant after the Big Bang, space inflated rapidly for a brief time and then expanded more slowly, creating the vast bubble of space in which the Earth, sun, Milky Way galaxy and billions of other galaxies reside today. If this inflationary cosmology theory is correct, similar big bangs occurred many times, creating numerous other bubbles of space like our universe.

Properties such as the mass of basic particles and the strength of fundamental forces may differ from bubble to bubble. In that case, the popular goal pursued by many physicists of finding a single theory that prescribes all of nature's properties may be in vain. Instead, a multiverse may offer various locales, some more hospitable to life than others. Our universe must be a bubble with the right combination of features to create an environment suitable for life, a requirement known as the anthropic principle.

But many scientists object to the idea of the multiverse and the anthropic reasoning it enables. Some even contend that studying the multiverse doesn't count as science. One physicist who affirms that the multiverse is a proper subject for scientific investigation is John Donoghue of the University of Massachusetts, Amherst.

As Donoghue points out in the 2016 *Annual Review of Nuclear and Particle Science*, the Standard Model of Particle Physics — the theory describing the behavior of all of nature's basic particles and forces — does not specify all of the universe's properties. Many important features of nature, such as the masses of the particles and strengths of the forces, cannot be calculated from the theory's equations. Instead they must be measured. It's possible that in other bubbles, or even in distant realms within our bubble but beyond the reach of our telescopes, those properties might be different.

Maybe some future theory will show why nature is the way it is, Donoghue says, but maybe reality does encompass multiple possibilities. The true theory describing nature might permit many stable "ground states," corresponding to the different cosmic bubbles or distant realms of space with different physical features. A multiverse of realms with different ground states would support the view that the universe's habitability can be explained by the anthropic principle — we live in the realm where conditions are suitable — and not by a single theory that specifies the same properties everywhere.

Knowable Magazine quizzed Donoghue about the meaning of the multiverse, the issues surrounding anthropic reasoning and the argument that the idea of a multiverse is not scientific. His answers have been edited for brevity and clarity.

Can you explain just what you mean by multiverse?

For me, at least, the multiverse is the idea that physically out there, beyond where we can see, there are portions of the universe that have different properties than we see locally. We know the universe is bigger than we can see. We don't know how much bigger. So the question is, is it the same everywhere as you go out or is it different?

If there is a multiverse, is the key point not just the existence of different realms, but that they differ in their properties in ›››

important ways?

If it's just the same all the way out, then the multiverse is not relevant. The standard expectation is that aside from random details — like here's a galaxy, there's a galaxy, here's empty space — that it's more or less uniform everywhere in the greater universe. And that would happen if you have a theory like the Standard Model where there's basically just one possible way that the model looks. It looks the same everywhere. It couldn't be different.

Isn't that what most physicists would hope for?

Probably literally everyone's hope is that we would someday find a theory and all of a sudden everything would become clear — there would be one unique possibility, it would be tied up, there would be no choice but this was the theory. Everyone would love that.

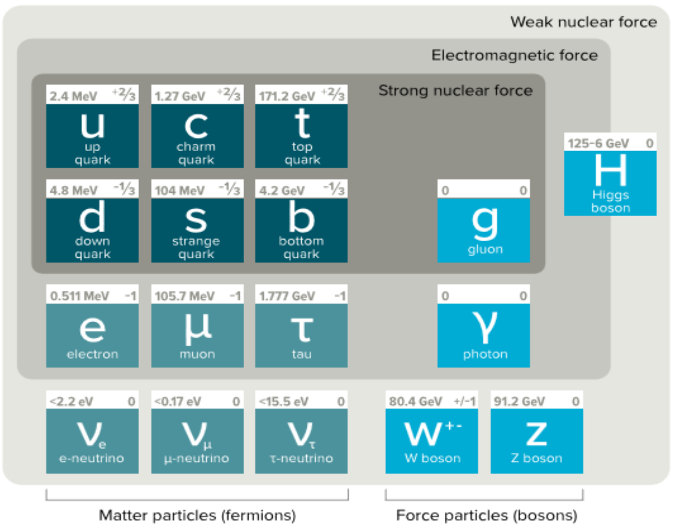
But the Standard Model does not actually specify all the numbers describing the properties of nature, right?

The structure of the Standard Model is fixed by a symmetry principle. That's the beautiful part. But within that structure there's freedom to choose various quantities like the masses of the particles and the charges, and these are the parameters of the theory. These are numbers that are not predicted by the theory. We've gone out and we've measured them. We would like eventually that those are predicted by some other theory. But that's the question, whether they are predicted or whether they are in some sense random choices in a multiverse.

The example I use in the paper is the distance from the Earth to the sun. If you were studying the solar system, you'd see various regularities and a symmetry, a spherically symmetrical force. The fact that the force goes like 1 over the radius squared is a consequence of the underlying theory. So you might say, well, I want to predict the radius of the Earth. And Kepler tried to do this and came up with a very nice geometric construction, which almost worked. But now we know that this is not something fundamental — it's an accident of the history. The same laws that give our solar system with one Earth-to-sun distance will somewhere else give a different solar system with a different distance for the planets. They're not predictable.

Standard Model

A theory called the Standard Model describes nature's basic matter particles (fermions, divvied up into quarks and leptons) and forces, transmitted by particles called bosons. Standard Model math is spectacularly successful in describing all known physical processes (excepting gravity), but that math does not specify various properties such as the masses of the particles or the strengths of the forces — those quantities must be measured by experiments. Physicists have noticed that changing some of these numbers only slightly would alter physics in such a way that atoms could not form and therefore life would not exist. Most physicists have long hoped to find a theory that would explain why those quantities must be what they are. But if our universe is just one of many — a multiverse — then the particle and force properties could vary from universe to universe. We would live in the universe where the properties allowed atoms to form and life to evolve.



SOURCE: CERN

L. MODICA / KNOWABLE

So the physics question for us then is, are the parameters like the mass of the electron something that's fundamentally predictable from some more fundamental theory, or is it the accident of history in our patch of the universe?

How does the possibility of a multiverse affect how we interpret the numbers in the Standard Model?

We've come to understand how the Standard Model produces the world. So then you could actually ask the scientific question: What if the numbers in the Standard Model were slightly different? Like the mass of the electron or the charge on the electron. One of the surprises is, if you make very modest changes in these parameters, then the world changes dramatically. Why does the electron have the mass it does? We don't know. If you make it three times bigger, then all the atoms disappear, so the world is a very, very different place.

The electrons get captured onto protons and the protons turn into neutrons, and so you end up with a very strange universe that's very different from ours. You would not have any chance of having life in such a universe. ›››

Are there other changes in the Standard Model numbers that would have such dramatic effects?

My own contribution here is about the Higgs field [the field that is responsible for the Higgs boson]. It has a much smaller value than its expected range within the Standard Model. But if you change it by a bit, then atoms don't form and nuclei don't form — again, the world changes dramatically. My collaborators and I were the ones that pointed that out.

There's some maybe six or seven of these constraints — parameters of the Standard Model that have to be just so in order to satisfy the need for atoms, the need for stars, planets, et cetera. So about six combinations of the parameters are constrained anthropically.

By "anthropically," you mean that these parameters are constrained to narrow values in order to have a universe where life can exist. That is an old idea known as the anthropic principle, which has historically been unpopular with many physicists.

Yes, I think almost anybody would prefer to have a well-developed theory that doesn't have to invoke any anthropic reasoning. But nevertheless it's possible that these types of theories occur. To not consider them would also be unscientific. So you're forced into looking at them because we have examples where it would occur.

Historically there's a lot of resistance to anthropic reasoning, because at least the popular explanations of it seem to get causality backwards. It was sort of saying that we [our existence] determine the parameters of the universe, and that didn't feel right. The modern version of it, with the multiverse, is more physical in the sense that if you do have these differing domains with different parameters, we would only find ourselves in one that allows atoms and nuclei. So the causality is right. The parameters are such that we can be here. The modern view is more physical.

If there is a multiverse, then doesn't that change some of the goals of physics, such as the search for a unified theory of everything, and require some sort of anthropic reasoning?

What we can know may depend on things that may end up being out of our reach to explore. The idea that we should be searching for a unified theory that explains all of nature may in fact be the wrong motivation. It's certainly true that multiverse theories raise the possibility that we will never be able to answer these questions. And that's disturbing.

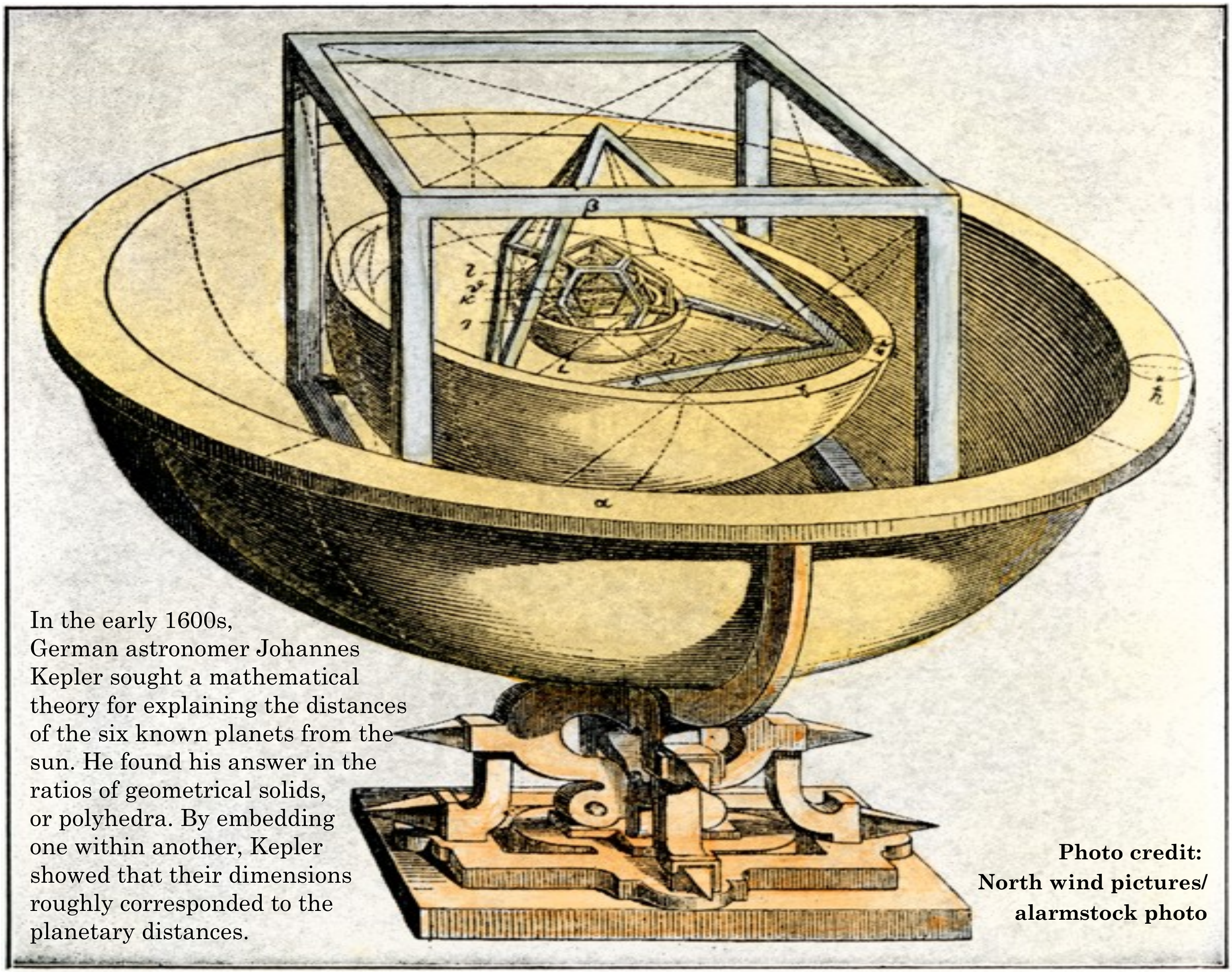
Does that mean the multiverse changes some of the questions that physicists should be asking?

We certainly still should be trying to answer "how" questions about how does the W boson decay or the Higgs boson, how does it decay, to try to get our best description of nature. And we have to realize we may not be able to get the ultimate theory because we may not be able to probe enough of the universe to answer certain questions. That's a discouraging feature. I have to admit when I first heard of anthropic reasoning in physics my stomach sank. It kills some of the things that you'd like to do.

Don't some people even argue that though a multiverse would seem to justify anthropic reasoning, that approach should still be regarded as not scientific?

It's one of the things that bothers me about the discussion. Just because you feel bad about the multiverse, and just because some aspects of it are beyond reach for testing, doesn't mean that it's wrong. So if it's worth considering, and looking within the class of multiverse theories to see what it is that we could know, how does it change our motivations? How does it change the questions that we ask? And to say that the multiverse is not science is itself not science. You're not allowing a particular physical type of theory, a possible physical theory, that you're throwing out on nonscientific grounds. But it does raise long-term issues about how much we could understand about the ultimate theory when we can just look locally. It's science, it's sometimes a frustrating bit of science, but we have to see what ideas become fruitful and what happens.

An important part of investigating the multiverse is finding a theory that includes multiple "ground states." What does that mean? ›››



In the early 1600s, German astronomer Johannes Kepler sought a mathematical theory for explaining the distances of the six known planets from the sun. He found his answer in the ratios of geometrical solids, or polyhedra. By embedding one within another, Kepler showed that their dimensions roughly corresponded to the planetary distances.

Photo credit: North wind pictures/ alarmstock photo

The ground state is the state that you get when you take all the energy out of a system. Normally if you take away all the particles, that's your ground state — all the background fields, the things that permeate space. The ground state is described by the Standard Model. Its ground state tells you exactly what particles will look like when you put them back in; they will have certain masses and certain charges.

You could imagine that there are theories which have more than one ground state, and if you put particles in this state they look one way and if you put particles in another state they look another way — they might have different masses. The multiverse corresponds to the hypothesis that there are very many ground states, lots and lots of them, and in the bigger universe they are realized in different parts of the universe.

Even if a theory of particles and forces can accommodate multiple ground states, don't you need a method of creating those ground states?

Two features have to happen. You have to have the possibility of multiple ground states, and then you have to have a mechanism to produce them. In our present theories, producing them is easier, because inflationary cosmology has the ability to do this. Finding theories that have enough ground states is a more difficult requirement. But that's a science question. Is there one, is there two, is there a lot?

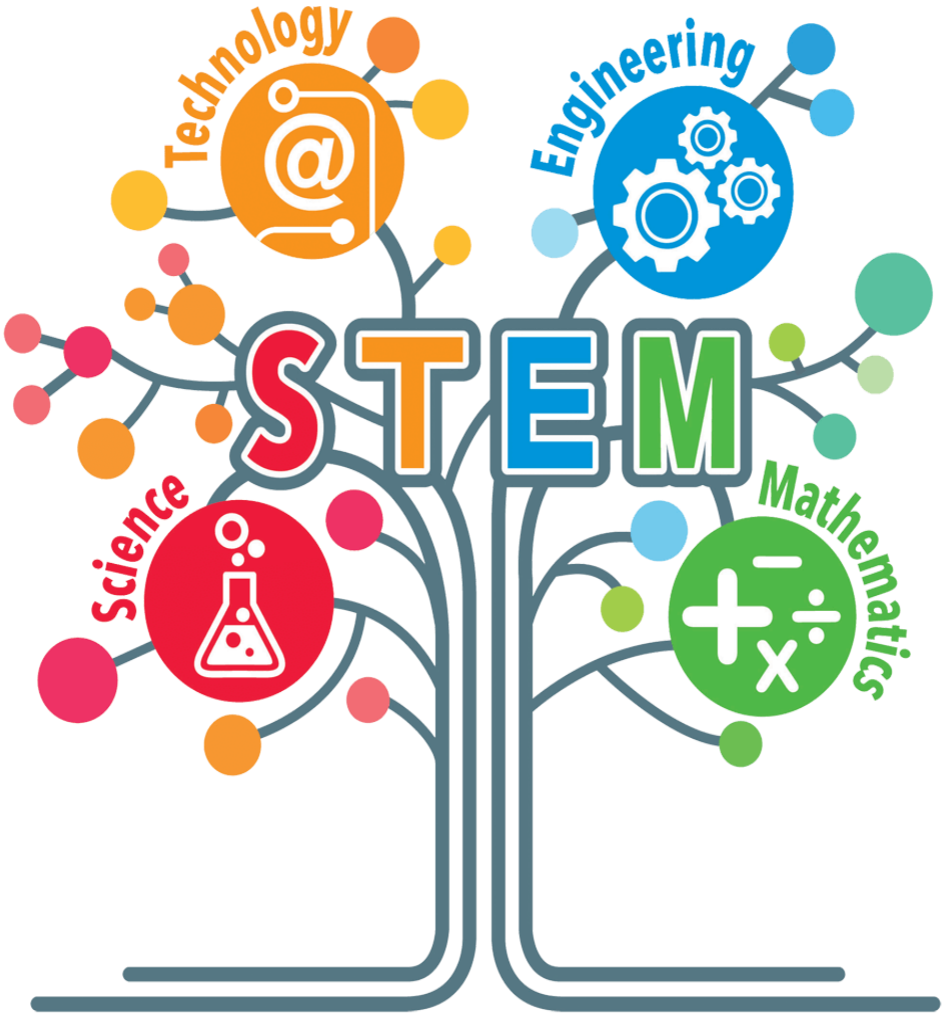
Superstring theory encompasses multiple ground states, described as the "string landscape." Is that an example of the kind of theory that might imply a multiverse?

The string landscape is one of the ways we know that this [multiple ground states] is a physical possibility. You can start counting the number of states in string theory, and you get a very ››› enormous number, 10 to the 500. So we have at least one theory that has this property of having a very large number of ground states. And there could be more. People have tried cooking up other theories that have that possibility also. So it is a physical possibility.

Don't critics say that neither string theory nor inflationary cosmology has been definitely established?

That's true of all theories beyond the Standard Model. None of them are established yet. So we can't really say with any confidence that there is a multiverse. It's a physical possibility. It may be wrong. But it still may be right.

■ ■ ■



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Source **www.ed.gov/stem**

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μBRAIN

By Dr. Michael Fiddy, www.darpa.mil

Dr. Michael Fiddy

Defense Sciences Office (DSO)
Program Manager

Dr. Michael Fiddy joined DARPA as a program manager in the Defense Sciences Office in September 2016. His current interests include fundamental studies of wave-matter interactions from RF to visible light frequencies. Advancing scattering and inverse scattering methods for multiple scattering media leads to new imaging techniques and tools to synthesize 2-D and 3-D materials and structures, including those with sub-wavelength features. These research areas can also deepen our understanding of biological systems.

Dr. Fiddy comes to DARPA from the University of North Carolina at Charlotte where he was the founding director of the Center for Optoelectronics and Optical Communications and director of the National Science Foundation's Industry/University Cooperative Research Center (I/UCRC) for Metamaterials. Prior to UNC Charlotte, he was Electrical and Computer Engineering (ECE) department head at the University of Massachusetts at Lowell and a physics faculty member at Kings College London. Dr. Fiddy has a B.Sc. and Ph.D. from London University and is a fellow of IOP(UK), OSA and SPIE.

The past decade has seen explosive growth in development and training of artificial intelligence (AI) systems. However, as AI has taken on progressively more complex problems, the amount of computation required to train the largest AI systems has been increasing tenfold annually. While AI advances are beginning to have a deep impact in digital computing processes, trade-offs between computational capability, resources and size, weight, and power consumption (SWaP) will become increasingly critical in the near future.

Current neuromorphic/neural architectures rely on the digital computing architectures that attempt to mimic the way nature computes, but not the way it functions. Actual physical interactions and mechanisms that could enable improved engineered function as observed in bio-systems, such as miniature insects, remain to be fully described.

µBRAIN will explore innovative basic research concepts aimed at understanding highly integrated sensory and nervous systems in miniature insects and developing prototype computational models that could be mapped onto suitable hardware to emulate their impressive function. Nature has forced on these small insects drastic miniaturization and energy efficiency, some having only a few hundred neurons in a compact form-factor, while maintaining basic functionality. This research could lead to capability of inference, prediction, generalization, and abstraction of problems in systematic or entirely news ways in order to find solutions to compelling problems.

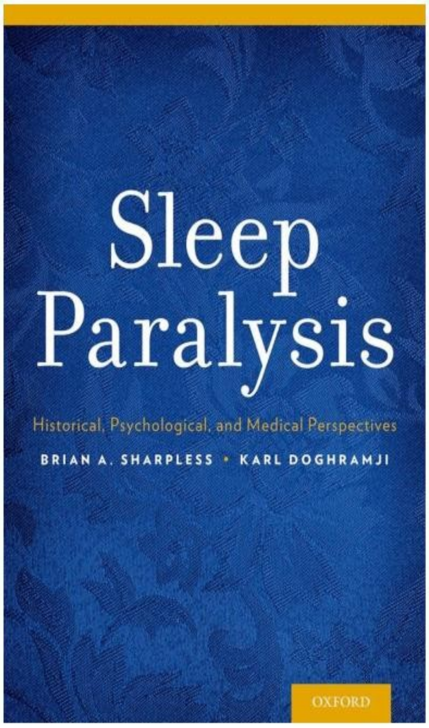
The primary goal is to understand the computational principles, architecture, and neuronal details of small bio-systems driven by extreme SWaP needs in nature. By doing so, DARPA aims to identify new computing paradigms that would enable improved AI with considerably reduced training times and power consumption.

AVAILABLE FROM OXFORD

SLEEP PARALYSIS

HISTORICAL, PSYCHOLOGICAL, AND MEDICAL PERSPECTIVES

Brian Sharpless and Karl Doghramji



Humans throughout history have described a peculiar state between wakefulness and sleep during which they are consciously aware of their surroundings, but physically paralyzed. Sleep paralysis is also commonly accompanied by high levels of fear, feelings of suffocation, and hallucinations (i.e., waking dreams). Early interpretations of this event were that it was an actual attack by malevolent and supernatural entities such as demons, ghosts, or witches. Some of these beliefs persist to the present day in the form of nocturnal visitations by extraterrestrials and shadow people.

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Karl Doghramji, MD is a Professor of Psychiatry, Neurology, and Medicine at Thomas Jefferson University; a Medical Director at Jefferson Sleep Disorders Center; and Program Director at Fellowship in Sleep Medicine.

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