The Physics of Gravity:

This is the Shape of the Universe

and the things in it (redacted til 2025)

Website: www.WhatIsTheShapeOfTheUniverse.co.uk
YouTube: **https://tinyurl.com/YouTubeMartinASCross**

The Physics of Gravity - This is the Shape of the Universe, *and the bodies therein.*
(Redacted before 2025)

Shape of the Universe Introductory Video

VOICEOVER:

“My name is Martin Cross, and I want to tell you the Shape of the Universe.

If it is before 2025, I want to tell you, but I cannot. Unless or until you attend one of my live talks.

I can, and will, tell you how Gravity works. I’ll tell you this below (See ***How Gravity Determines Shape***), but I warn you: you may be shocked at how simple it is!

I ***could*** tell you how the Milky Way gets it spiral arms

that is, I could tell you, but again, I promise not to, ‘til 2025.

This is so you can work out for yourself. Then *you* can tell *me*.

The Shape of the Milky Way is a great example of something that usually is given a really complicated answer that only a specialist would know is wrong or right. Like the one here quoted in New Scientist:

https://www.space.com/24642-spiral-galaxies-milky-way-shape-explained.html

But I included my answer to this question in my first ever 'Shape of the Universe' public talk given in 2014. It only took a few minutes to demonstrate and it is the same answer I will give now.

So that's your "homework", and this essay is my attempt to give you everything you need to work out the answer, just like I did.

Because it is just as shockingly simple.

Introduction: INFINITY

Learning at Work Day happens annually in May. Back in the late 2000s I took the opportunity to present my lecture on 'The Shape of the Universe' to a group of local small business people. I was confident I could 'market' it: who hasn't wondered what is 'outside' the Universe? I think people who run small businesses are generally pretty smart. I thought they'd be a good open-minded but sceptical group to test out my presentation, and they were my peers in the way that a more academically educated audience might not be. I started by asking them that question, "What is outside of the Universe?"

We've all, I dare say, had occasion to muse about what is beyond 'everything'. Does it all stop at the edges, to become surrounded by 'nothing'? But how then can 'nothing' be something? Or does it never end, becoming more and more and more? But if it never ends; if everything there is, goes on changing into more and more of what can be, and will be, then doesn't that make a nonsense of what 'is'?

I had a different answer, as I wanted to explain. My talk seemed to go down quite well. I felt people had been entertained, and that they had seemed to understand what I was presenting.

What was my answer? Well, using the example of Pi as infinitesimal rather than infinite, I tried to explain that the Universe does indeed have an edge, but it is an edge that extends infinitesimally, in a very specific way, the same way that Pi extends its digits forever, with no repeat.

Here and now I observe that, although surprising, there is nothing inherently worrying or upsetting in the behaviour of Pi. One does not go around looking for answers to impossible questions in the digits of Pi. One does not try using them to contact the recently deceased. Most of all, there is no temptation to worship the digits of Pi. They are wonderful, but they are not God.

As I said in my talk, figuratively speaking, you can reach the edge of the Universe very easily, but it is an edge that doesn't stop, just as there is no last or repeating digit of Pi.

~ • ~

One of the TV programmes that I fondly remember from the past was 'Tomorrow's World': Three knowledgable presenters providing viewers with a summary of what's new in the world of science and tech. I am probably prone to the passed-middle-aged malady of gilding the past, but I remember it for combining a no-nonsense delivery with a great 'feel-good' follow-up. There is always plenty of bad news, but the science magazine show presented what you could not help but feel was *good* news.

Much later on, I made myself a web page containing RSS feeds and I happened to also include the 'New Scientist' RSS feed. I quickly made the discovery that this supplied me with a similar feel- good sense that 'Tomorrow's World' once did. In 2004, it took my breath away to see the Shape I had given to the Universe appear in an item in the feed from 'New Scientist'. When I saw my shape reproduced and 'brought to life' as an image through their site, that was the turning point which prompted me on to the web in own right.

I have got some free content to give out to people who don't want to, or cannot, attend the talks or that want to prepare in advance for attendance. As well as the website I have set up, www.WhatIsTheShapeOfTheUniverse.co.uk, there are the essays which I have written and even a full-length book. All of this is free of charge at the moment * ***and will continue to be so*** *, as I make that promise, on record.

The work for this, and for the first talk had sprung specifically from a book I read in the nineties. In describing the mathematician Paul Erdos ("The Man Who Loved Only Numbers", Fourth Estate), the author had presented the work of Georg Cantor, on Infinity. Cantor was, I felt I could show, demonstrably wrong (of which more, shortly).

You'll already be familiar with my presentation of this idea if you have read the maths essay I wrote for a general readership, "Do You Like Numbers?". Not to worry if you haven't. The current essay does not assume any knowledge other than standard GCSE understanding.

Talking to my peers in business had been one thing, talking to the academic community – and specifically, physicists – would be quite another. If I were talking to a group of physicists, they would definitely understand the idea – but would they see it as a big idea? It is one thing to say to some one who has never thought of it, here is a way to look at things. It is quite

another thing to say to people who have spent their whole life looking at something to say "here is another way to look at it". I could see I might have a different problem.

I might need to do a bit more work than that, so was there another way in?

The earlier article 'Do You Like Numbers?' had been intended to engage the child or teenager by sharing a non-mathematicians enthusiasm for numbers. At the same time it had a serious experimental purpose. I hoped to pre-empt what I saw as a young person's indoctrination into a certain way of viewing infinity. But if the previous article describes how mathematicians should view Infinity, then how do physicists view infinity? Indeed, do they view infinity differently? The answer is I think, affirmative. And John Hurt explained how physicists view infinity to me – not personally, I must admit! It was in a recent BBC 'Horizon' documentary in which his magnificent voice was put to such good use.

The BBC 'Horizon' programme started by presenting the picture of a person at sea. They are in a boat and can see to the horizon all around themself. The sea appears to stop at the horizon. There is a clear, firm line where it gives way to sky. But of course, we know that this is only an illusion: the sea has no such straight edge. It continues on beyond the Horizon until it meets the land even though we cannot see it, and for all we knew in the past, it could go on forever.

It is a good analogy for a couple of reasons. First, the horizon is caused by the curvature of the Earth and physicists know that space is curved by gravity. It is easy to grasp that they are both curved. Second, the boat is on, or in, the sea, not of it. It is water that extends beyond the horizon, not the boat or the observer. This is how physicists like to understand the Universe, externally, as 'a bunch of stuff' – the water.

Physicists might even say that John Hurt's analogy caters for the nature of Pi, in a purely mathematical, one-dimensional sense; that they are about understanding infinity in three dimensions. Certainly the development of an idea of a shape for the Universe would normally be done using numbers; using maths; and I am not a mathematician. But the problem of the Universe is not logistical, it is conceptual.

Concepts like 'the Big Bang' and an 'Expanding' Universe lead us to think in terms of a center and an edge, but the Universe is a place with no centre and no outside; no edge. It *might* be 'expanding outward' but it is just as likely that it is 'contracting inward' because there is no frame of reference to make the judgement. An explosion might explain the movement of the Universe, but so does an 'implosion', and for the same reason. The cognitive dissonance this creates leads to misconceptions like Dark Matter and Dark Energy, ultimately leading to

notions which are not tenable like wormholes and multiverses. In my judgement this is because there is no objective third spatial Dimension - but we'll get to that. In summary, what is needed is not a mathematical formula; what is needed is a philosophical conception.

I had created my website, and I had seen the confirmation for my Shape of the Universe, but how could I as a non-scientist – a mere philosopher – shepherd such a view safely out onto the world 'stage'?

That was the motivation. I created a talk for general members of the public, the one I am offering to people now, and delivered this for the first time in 2014. I was able to entitle it "This is the Shape of the Universe (or your money back!)" as I do now. I was thrilled when a majority of the audience of strangers was not just open but persuaded, as shown in this Youtube video [1] taken live at the time.

I would go on to develop these ideas into a "theory of everything – and everyone!" A full-blown philosophy, if you will. But that was much later, taking us almost up to today. Back in 2014, I had not yet presented on the 'city stage', let alone nationally. Before I could take the next step, what I needed was an essay like the one I had done for 'Numbers'.

I wrote the first version of this essay in 2015. It was quite similar, but much shorter, than it is now. You may already have noticed how discursive this version is. That is because I am equally as interested in entertaining you (and myself) as I am in informing first myself, and then you. But there is another reason why Version 2 is quite different to Version 1.

I'd started writing 'Numbers' because I had read something that I knew was wrong (Cantor's proof). That hadn't happened in physics. The New Scientist picture had encouraged me because it was mostly right, not mostly wrong. I thought I just needed to persuade physicists who were mostly right that they could be completely right. I had no reason to think that physicists were wrong.

I had to wait til 2019 for that. It was the book 'What If?' by Randall Munroe from the xkcd website. Randall isn't a physicist himself, he's a science writer like the Fourth Estate biographer. That gave me a level to pitch for, and so the entertainment commenced.

Just like in my talk, which also starts with infinity, this essay proceeds by discussing Dimension; the Dimensions of space. We then proceed on to movement, and Gravity, the key part of the essay. We contrast the idea of a field against Einstein's analogy of acceleration in a

1 https://www.youtube.com/watch?v=5SrqXq8c_7A

lift to develop the principle of a lift with a 'soft floor', as the basis for visualisation. I'm also using the book 'What If?' in this essay as a first foil to my own idea; I'm then using the Internet generally, as a second adversary to my position so as to give you the basis for yourself addressing the 'homework' (you could skip straight to it and read just this if you don't need or want any background). There is the further opportunity here to develop more than could be included in the live talk and so I include discussion of the conceptualisation of Time. I come back then to concrete examples, showing my idea of Gravity as an extension of existing knowledge, and finally to the question of proof.

Let's have a closer look at the content I am offering entirely free of charge at the moment.

Of course there is the first essay, 'Do you like Numbers?' That's the title for just 10,000 words that you can download as a PDF from my website. It is a shame to have to give away the 'spoiler' for it as I have already done but I am sure you will find it entertaining even knowing the denouement, as long as the answer to the question is affirmative: you do like numbers.

http://whatistheshapeoftheuniverse.co.uk/2_Maths/Do%20You%20Like%20Numbers.htm

Also on the website as well as a number of other roughly 10,000 word essays, there is - completely free again - a full-length, full colour, illustrated PDF version of a book I wrote about the mind. This is the other part of my *theory of everything – and everyone* as alluded to earlier and on my Youtube Channel

It is a full 100,000 words, an exploration of that idea, as logically and exactly as I thought it could be done using philosophical principles and visualisation rather than the proof and maths of hard science. In a nutshell, I believe it shows the definition of the shape of the Universe is also the basis for a definition of mind.

http://www.whatistheshapeoftheuniverse.co.uk/0_Common%20Sense/Common%20Sense%20-%20The%20Philosophy%20of%20Psychology.pdf

So you might say why, if this work has any value, are you having to give it away free of charge? Why would I do that? And indeed, I'm not Facebook! I'm not grabbing "market share" so that I can make money. That's very much not the intention and I'll talk about that a bit later if you stay with me that far.

Now, what is a Dimension?

Figure 1 *The many-dimensional illustrations of Steve Ditko, for Marvel Comics 'Dr Strange'.*

Part A: SPACE

Draw a line through any two points in space. Does that represent a dimension - or a direction? In a Universe with no background and no centre, the direction you chance upon might be 'inward', or it might be 'outward' which is just the converse of 'inward'. The technical difference between a Dimension and a Direction is that Dimensions, such as those of space: height, width and breadth, are generally accepted to be orthogonal to each other. I wouldn't argue with that although as we shall see, that may not be the whole story.

Time is usually considered the fourth Dimension (see the next section), but the 'fifth dimension' of popular culture is closer to the idea of orthogonality. You can still see Rod Serling's 'The Outer Limits' on TV. As in many other stories, the 'fifth dimension' is one you can reach just as easily as by stepping through a door. Wouldn't that be great? Just as Serling's 'fifth dimension' is much more exotic than the world we know and have fully mapped, how we could conjure with, say, a ninth dimension!

The 'portal to another world' has been inspiring awe in children for generations, from C S Lewis' world of Narnia, through the wardrobe, to another Lewis: Lewis Carroll's 'Through the

Looking Glass', and on to Harry Potter. It very much helps if we can keep a strong visualization of these ideas. To describe things visually is to understand them, the way clever people understand numbers by using them through formulae. Even the simple visualisation of a boat at sea gives a useful starting point. The best visualization I can think of does come from my childhood, and I want to draw our attention to it now. It comes from the world of comics, by the artist Steve Ditko.

To digress briefly, I first started reading comics as a teenager. This medium of the imagination was to feed my sense of wonder for my whole life. As an adult, I could be left cold by Tate Modern and Damien Hirst, but I could be moved to a gasp by comics, as I was when I first saw the covers of Dave McKean, for 'Sandman'. As a teenager, my father had made me burn my collection of pornographic magazines after my mother discovered them under my bed. Some of these erotic images live fondly on in my memory today, but they are alongside the beauty of Marie Severin's images, for Marvel. This colleague of Steve Ditko showed me, for example, what it might look like if a man was strong enough to scoop up a castle by its corner (the Hulk), and teased my imagination with images I couldn't even try to describe to you now (Zom, The Living Tribunal).

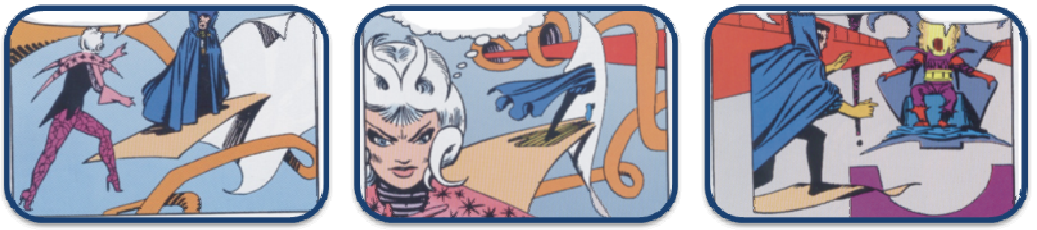
(I cannot resist adding, whilst we are talking about dimension, that of course the comic page is a 2D representation of 3D. Think about the attraction to the artist of the ease with which one can draw a stretching limb (Mr Fantastic, Plastic Man) or a man picking up a castle by its corner (Hulk) or a man shrunk to ant-size or grown to giant-size. These tasks were rendered far easier by drawing on the flat page than they could possibly be in three dimensions – at least before CGI. But then think about the challenge to pure imagination in putting these to story).

When at last I had the chance for my own essay entirely on this subject, I set out to write what I had always wanted to read: just one typical fans experience of the art-form for posterity. But of course there is a serious point to be made as well on behalf of a theory of everything and everyone about the psychological principles that perhaps underlie an extraordinary success. The resulting essay is free of charge below.

http://whatistheshapeoftheuniverse.co.uk/6_OtherResources/Art%20-%20An%20Essay.pdf

Marie Severin illustrated Dr Strange, amongst others, but it was Steve Ditko who was the co-creator and artistic force behind this character, a 'Master of the Mystic Arts'. Ditko's first stories showed Strange routinely travelling through portals he was able to open to other

worlds and dimensions. The illustration below shows Strange traveling through the portal he is able to open to a place which appears to be many-dimensional.

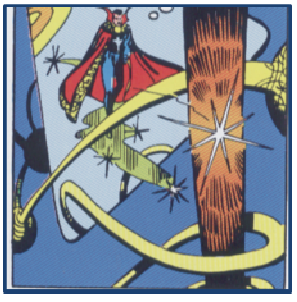


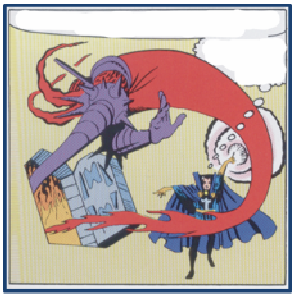
The Marvel comic-book character Dr Strange travels through what appears to be a two-dimensional shape apparently having a different third dimension, acting as a shortcut, in this 'world'.

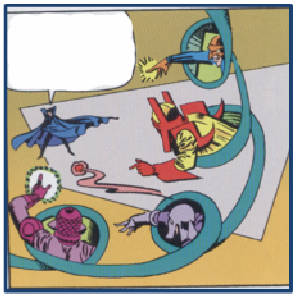
Ditko then reveals to us, in all its glory, this world? - space? area? Universe? - notice how the visualization is so strong it challenges us to find the words to match it. The creators, Stan Lee and Steve Ditko himself, came to describe this as a 'realm', or 'domain' (*the Domain of Dormammu, the Domain of Nightmare)*, recognizing that the normal terms like 'country', 'world' or even 'dimension' did not match the intuitive and logical sense of what I will be calling poly-dimensionality. But that is to come.

As the story progresses, Dr Strange is attacked by minions of the ruler of the domain he has entered.

Intriguingly, they can attack him through portals of their own devising. It is as if they can create or at least access the dimensions in which they are almost next to Strange, and have only to take a single step to be right beside him.







Dr Strange is a Master Sorcerer – a 'Master of the Mystic Arts'

In describing these sub-dimensions of course, I am imposing my verbal understanding onto a visual storytelling. Ditko might respond that it is 'just magic' (and I am overcomplicating it).

In long-established metaphysical thinking, Heaven is a place rather like 'the Fifth Dimension'. Although it is a place one can never visit physically, it exists alongside, and in addition, to the physical plane of the Universe. Even now, there is no reason that we know of that 'the Heavens', which is to say the stars, could not actually contain Heaven. You certainly cannot visit the Sun physically, as you cannot visit Heaven physically; it is 'up', being gravitationally at the centre for us, as Heaven is likewise 'upward'; and it is composed of plasma, a fourth state of matter with different properties than either solid, liquid or gas, as Heaven is a different place.

Personally, I would not argue for Hell as a place that really exists, and it is not my hope to convince you here that Heaven does either. But I have personally benefited from the principle that Heaven is not a proposition to 'reward good children' but a serious mystery that repays adult individual consideration. It turns out there is, after all, 'something to know'. As a subject, it became my first free essay.

http://whatistheshapeoftheuniverse.co.uk/3_Religion/Religion.htm

If you don't read this, what I really want now, is to draw your attention to the long-standing terminology that Heaven is 'onward' and 'upward'. Whether your view is that the corollary of 'onward and upward' is 'backward and downward', or whether you share my view that is actually 'stationary', the point is that this is a two-dimensional characterisation of the larger metaphysic.

We make use of this dimensional meta-simplification all the time. Leaders no longer speak of onward *and* upward, but of 'the way forward'. When they do, it is not in comparison to the way left or even the way backward, it is really in comparison to the way *not* forward, i.e. at a standstill. In psychological terms also – that is, in the metaphysical world of the mind – we speak of 'moving on' in the same sense.

Why does this matter? Because I say, there is a tension between what is known and what is believed. As I write these words, the New Scientist has the cover below.

Here is how the article begins:

> *"THE ONLY way is up." An earnest student of our physical realities might find room to dispute this jollying phrase. There is also down, and, for that matter, left, right, forwards and backwards. Six ways to go. Then again, the further up you go, the less down you are, and similarly for left and right, forwards and backwards. So that's three independent directions to move in – gravity and local obstacles permitting.*
>
> *It is a fact so bald that we rarely stop to ask an even balder question: why?*
>
> *Physicists have wrestled with this perplexing question of space's essential three-ness for a good while now – not, it must be said, with much success. Our best theories of nature supply no clue as to why space might have three dimensions, rather than two, four or 5.2.*

I'd like to read the rest of this article but for its notoriety rather than its implication. (The New Scientist is good news but it is not always free of ideological spin).

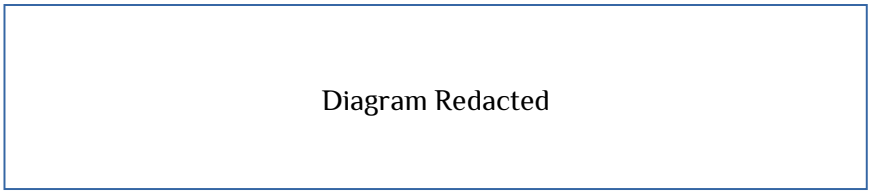
Of course physicists are the ones who have taught us that we cannot simply talk of three dimensions. They have taught us 'space-time', and that time is a dimension. We have all become reasonably comfortable with that. Although impossible it has been exotic, rather than threatening, to think of traveling backward in time. It is physicists who have pushed on to ask

if there are more than these four dimensions and in recent times some physicists have suggested there may in reality be as much as *eleven* dimensions.

What we know for sure is that the Universe is infinite, and the number of dimensions it has is infinite – or in my terminology – infinitesimal, like the digits of Pi (and for the same reason).We have not found any dimension is more important than, or even as important as, the three we usually consider: not even time. All the directions of space are a product of three dimensions in the same way all the shades of colour can be defined as some combination of a mix of red, blue and green - or another colour model.

Yes, the Universe is many dimensional but let's refer to it as no more than that. Let's refer to the Universe as poly-dimensional.

Now I can tie together the physics and the maths with a useful definition. When I was at school I was taught to use an oblong symbol for the Universal set, but I can redraw this more accurately, I think:



I use a thick perimeter to indicate that the set has an infinitesimal boundary – it goes on forever and ever getting smaller and smaller, so this more accurately describes mathematically and visually what is trans-finite, i.e. connected to infinity, like Pi, e, me, you and the Universe.

So how is the Universe *physically* infinitesimal on the largest possible scale i.e. at the edge?


Galaxy map hints at fractal universe - space - 25 June 2008 - New Scienti... http://space.newscientist.com/article/dn14200-ga

NewScientistSpace

Galaxy map hints at fractal universe

00:00 25 June 2008
NewScientist.com news service
Amanda Gefter

Is the matter in the universe arranged in a fractal pattern? A new study of nearly a million galaxies suggests it is – though there are no well-accepted theories to explain why that would be so.

Cosmologists trying to reconstruct the entire history of the universe have precious few clues from which to work. One key clue is the distribution of matter throughout space, which has been sculpted for nearly 14 billion years by the competing forces of gravity and cosmic expansion. If there is a pattern in the sky, it encodes the secrets of the universe.

A lot is at stake, and the matter distribution has become a source of impassioned debate between those who say the distribution is smooth and homogeneous and those who say it is hierarchically structured and clumpy, like a fractal.

Nearly all physicists agree that on relatively small scales the distribution is fractal-like: hundreds of billions of stars group together to form galaxies, galaxies clump together to form clusters, and clusters amass into superclusters.

The point of contention, however, is what happens at even larger scales. According to most physicists, this Russian doll-style clustering comes to an end and the universe, on large scales, becomes homogeneous.

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The New Scientist had a headline in 2008 ("Galaxy hints at fractal Universe") in which the article began with these words:

> *Is the matter in the universe arranged in a fractal pattern? A new study of nearly a million galaxies suggests it is – though there are no well-accepted theories to explain why that would be so.*

The article goes on to explain:

> *Nearly all physicists agree that on relatively small scales the distribution is fractal-like: hundreds of billions of stars grouptogether to form galaxies, galaxies clump together to formclusters, and clusters amass into superclusters.*
> *The point of contention, however, is what happens at even larger scales. According to most physicists, this Russian doll-style clustering comes to an end and the universe, on large scales, becomes homogeneous.*

Here is what Wikipedia says about fractals:

> *A fractal is a mathematical set that has a fractal dimension that usually exceeds its topological dimension and may fall between the integers.*

You're familiar with a fractal from the example of a coastline. As you know, you can 'zoom in' indefinitely on a fractal pattern and always see more detail. Mathematically, I would say, a fractal is a set with an infinitesimal perimeter. Because you have already seen it in the case of

Pi, you know how an infinitesimal number can continue indefinitely without ever repeating. You also know that Pi is a practical number with limited usage. It may be the work of God but it is not infinite; it is not God.

In exactly the same way, you can 'zoom out' on the Universe (of which we are all part), and always see more detail; but what you are looking at on these largest scales is the edge of the Universe which continues without repeat – but perhaps even meaninglessly[2] – forever, as a fractal.

It is what you might expect to see at the horizon of space.

~ • ~

Now that we are here at the edge of space ok, let's look back to our starting point (see page 7), the technical difference between a Dimension and a Direction is that Dimensions, such as height, width and breadth, are orthogonal to each other.

The easiest way to conceive of the Universe is as a sphere, so let's begin with that.

This is interesting: We can conceive of the sphere as having a radius of 13.8 billion light-years distance. That is because the Universe is 13.8 billion years old so we are told, and the speed of light is the limit. You may also know that the observable Universe is 46 billion light years from end-to-end. The conventional explanation is because space has expanded during the time being measured, but is that right?

We are told that space is expanding but because there is no centre there is no frame of reference to determine whether it is expanding or contracting. Both are equally good interpretations of the observation. And if we were to say space is contracting on the largest scale then at some point it would come into balance.

I draw no conclusion other than to say that we need a starting point we can understand and so I propose the sphere. The Internet tells me the furthest you could travel at the speed of light, allowing for 'expansion', is 14.5 billion light-years. Although they don't match exactly, I'm happy those figures are close enough to allow for experimental error (!) So my sphere would have a radius of between 13.8 billion and 14.5 billion. It gives us a basis for refinement.

2 This is an important point. For all its appeal in fiction - unlike Time-Travel, which we come on to later - 'multiple Universes' is not a meaningful idea.

Let's go back to the idea of a sea as a concept for infinity. We now understand that we are on the surface of the sea with a horizon that is between 13.8 and 14.5 bly (billion light-years) away all around us. We understand why this sea has no exact edge – because it is infinitesimal - and our position on it is entirely by chance: there is no objective centre.

In other words, our visualisation – our map – works for two out of the three Dimensions. If we want to move in space we can do so but we are moving on the surface of the sea. Unlike Dr Strange, we cannot go below or conversely, lift off from, the surface.

We've talked a lot about a fifth Dimension, enough to be fairly sure that if there was one, we would know it. It seems unlikely. I said that Time is the fourth Dimension and indeed, Time is both well understood and poorly understood, which gives me a golden opportunity to deal with it in a separate section on its own, below. An example is that, beloved as it is of fiction, nobody really thinks that time-travel is possible, and yet it is a proven aspect of physics (see Feynman's book, and below). Be that as it may, for you or me, time travel is not possible. Time is not in reality a Dimension.

But we measure our distances against speed – the speed of light. Could speed be a Dimension? (Not really, I thought. What then about a dimension of *scale*?)

In point of fact I have already pre-empted myself. I have said that there is **no** third Dimension! But I haven't justified that yet; there is a different possibility still to consider.

What about gravity? Could gravity possibly be a Dimension?

VOICEOVER

How does gravity operate at the centre of the Earth? Let's Google to get the answer!

The top link on Google right now is: https://futurism.com/what-would-happen-if-you-jumped-through-the-center-of-the-earth which is accompanied by the above graphic.

But is this the whole story?

Part B: GRAVITY

WHAT IS GRAVITY?

Let's talk about gravity from a philosophical point of view.

This isn't the place to have an introductory talk in philosophy, but see if you agree with me about one thing: I observe that philosophy seems hung up on assumption. For many philosophers, and throughout the history of philosophy, the point of it seems to have been to remove assumption; to somehow peel away the layers of reality to reveal some essential underlying truth, whether through language; through the difference between 'being' and 'knowing'; or through all sorts of other abstracts - none of which has been successful in taking us forward to a more complete philosophy.

And yet, as a would-be philosopher by avocation, the *removal* of assumption was never what concerned me: I didn't think about it either way, as good or bad. The problems that did concern me: issues of my identity, the group identity, our destiny, the things that really mattered in my view, were completely addressable on the basis of assumption. The removal of assumption is itself a false assumption. What is needed is the replacement of assumption when it is wrong.

Trying to remove assumption is, inevitably, a dead end. It's not desirable - it's not even important - to remove assumption; what's important is to check assumption, and to replace it with a better assumption when one arises, so *that* is a moving forward; *that* is a development. It's a progression because it is a way to change your mind without being inconsistent with where you started from.

So don't remove assumption because it can't be done, and it's debatable whether it's desirable, but replace assumption because you can do that at any time. We all of us constantly hold multiple contradictions in our own minds: it is a 'working understanding'. Replacing assumption however fondly one has held it, however deeply one is convicted to it, may not be easy, but it is almost certainly preferable to continuing to hold a false assumption. You can change your mind at any time. What I'm *not* saying is that it is easy. What I *am* saying is that it is evident now that it is worth it.

And if I've been successful as I believe I have, as a philosopher – for example, I am one of those saying Plato is wrong – the failure of philosophy is because it wasn't really philosophy. What it was, was a branch of science.

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I like John Hurt as we know, but I prefer Johnny Hart to Charles Schultz.

Charles Schultz of course is world-famous for writing the Peanuts comic strip. Johnny Hart may not be quite as generally known, but he is also famous for a cartoon strip, and the Wizard of Id has been serialised in Newspapers around the world.

It was B. C. by Hart which holds a special affection for me.

I recognise that Peanuts has a warmth that Hart lacks. When the 'Peanuts' strip becomes surreal, it is never silly, and Hart's 'B.C.' strip can be. But B.C. is more or less surreal all the time, with the same complexity as Peanuts. Peanuts was made into an equally sophisticated animated series which greatly impressed me but didn't quite win me over. Hart fascinated me with a world populated by characters wholly unreliant on sentiment. .

People are more likely to know Bill Watterson's 'Calvin & Hobbes'. Calvin & Hobbes mixes the reality of Peanuts with the surrealism of 'B.C.' to create something which some people find better than both, and it is a delicious mix. I didn't get the personal connection with Bill Watterson I'd felt with Hart's B.C. , but his is the example I need now.

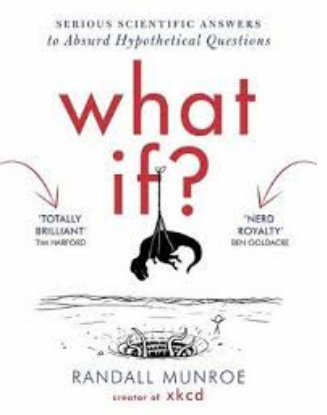
In 'Spiff the Spaceman', young Calvin finds that gravity has been reversed! 'Spiff' is the equivalent of 'talking clams' in B.C., or Snoopy as the Red Baron in Peanuts. In this particular adventure, Spiff explains matter-of-factly, 'gravity must have been reversed in my local vicinity', and then proceeds to fall toward the ceiling, walk around it, and then hang upward from the top of an outside door, in danger of falling onto a passing plane.

Anti-gravity is a mainstay of science-fiction, of course. Like jet-packs, anti-gravity seems a natural, logical step away from where we are. Like the clock that sets the time for others instead of itself, anti-gravity is sometimes easier to imagine than is the truth. It is useful to be reminded that anti-gravity might not just be imagined as the absence of gravity, it might be the reverse or inverse of gravity...

Perhaps that is how I would put into words the reason why we could not have a Dimension of speed. A thing is either moving or stopped, there is no negative of speed; no backwards. So can I apply similar reasoning to gravity as a Dimension? Even before I prove it so or reject it completely, I believe it helps to bear this question in mind as we try to investigate gravity in detail from very first principles. For gravity to be a Dimension, there would need to be a negative; a backwards. Gravity would need to not be a field.

Back to the Book.

The book I take as wrong about gravity is called 'What If?' by Randall Munroe, of the XKCD website (www.xkcd.com). It says on the cover 'serious scientific answers to absurd hypothetical questions' from the website xkcd which has presented the questions and answers which this book has collected. (It is great fun, by the way. I recommend it!)



So what sort of thing do we have in here?

We have: the periodic wall of elements! That's one of my favourites: what if each element of the periodic table composed a brick in the same wall. What else? Machine-gun jetpack, Orbital Submarine, Facebook of the Dead. I'm interested in one particular question-and-answer.

> *"If a bullet with the density of a neutron star were fired from a handgun – ignoring the 'how' – at the Earth's surface, would the Earth be destroyed?"*

And that is a question from Charlotte Ainsworth.

In the book, the answer to Charlotte begins:

> *"a bullet with the density of a neutron star would weigh about as much as the Empire State Building and the surrounding blocks of midtown Manhattan."*

So this is an object the size of a bullet that weighs part of a city; a question and answer about gravity in theory, not an experiment that anybody would ever be able to perform.

The first point that's made by the author from the book:

> "*is our bullet made from a Neutron star?"*

No. It's a bullet as dense as a neutron star not one made from actual neutron star material because of course at the centre of a neutron star the material is held together by tremendous pressure as well as tremendous heat and if that was suddenly transported out of the star then it would explode rather dramatically.

But we're imagining; we're hypothesizing - we're *assuming* (correctly so far) - that some imaginary material is both stable and ultra-dense.

Having got past his caveat the writer can start to answer the question: what would the bullet do to the Earth?

> *"You could imagine firing it from a gun but it might be more interesting to simply drop it. In either case, the bullet would accelerate downward, punch into the ground, and burrow toward the centre of the Earth. This wouldn't destroy the Earth but it would be pretty strange."*

The book goes on to say,

> *"as the bullet got within a few feet of the ground the force of its gravity would yank up a huge clump of dirt which would ripple wildly around the bullet, as it fell, spraying in all directions. As it went in, you'd feel the ground shake, and it would leave a jumbled, fractured crater with no entry hole."*

Is that exactly so?

There is a further assumption here, but if I'm honest I must first acknowledge: that's not something that would've occurred to me that the hole would close over, but I get it now. That's great visualisation! Let's just see what the rest of the description says.

> *"The bullet would fall straight through the Earth's crust. On the surface, the vibration would quickly die down, but far below the bullet would be crushing and vaporising the mantle as it fell. It would blast the material out of the way with powerful shockwaves leaving a trail of superhot plasma behind it. This would be something never before seen in the history of the Universe: an underground shooting star!"*

> *"Eventually the bullet would come to rest, lodged in the nickel-iron core at the centre of the world. The energy delivered to the Earth would be massive on a human scale but the planet would barely notice. The bullet's gravity would affect only the rock within a few dozen feet of it. While it is heavy enough to fall through the crust, it's gravity alone wouldn't be enough to crush the rock very much. The hole would close up leaving the bullet forever out of anyone's reach."*

> *"Eventually, the Earth would be consumed by the ageing, swollen Sun and the bullet would reach its final resting place at the Sun's core."*

(The Sun itself will not become a neutron star.)

OK, so now I come back to it. What I have to query, is this:

> *"as the bullet got within a few feet of the ground the force of its gravity would yank up a huge clump of dirt which would ripple wildly around the bullet, as it fell, spraying in all directions."*

Imagine the island of Manhattan ripped out of the Earth and floating over your head, waiting to fall. Now, if that started to fall towards the Earth, clearly it's not going to rip up part of the Earth and have that float around it. So, what is being suggested to us is if that weight was

collapsed into something as small as a bullet and that fell towards the ground then it **would** rip up this earth.

As I might put it, what we're saying is a reasonable assumption is that gravity is a field, so that in the same way that I don't have to be touching the Earth to be subject to it's gravity, I don't have to be touching the City's colossal mass to be subject to it, when it is condensed. When it is spread out and I'm not near enough to any heart of it, then the fact that it is colossal as a whole won't affect me.

Without saying whether this is right or wrong; without submitting an argument one way or the other, I can pose a question: And the question is, in this chain of thought and reasoning, might there be an assumption that is wrong? Is there perhaps a way to highlight that assumption and make an alternative assumption that could replace it and therefore offer a way for people to not agree with me, and not disagree with me and agree with the Author, but make up their own mind in the privacy of their own opinion until there's the opportunity to decide further.

The assumption that I'm questioning is that gravity is a field. Why shouldn't gravity be what it appears to be?

When Einstein described gravity he said, imagine you're in a lift and the lift is accelerating. For you, in the elevator, the force of gravity is indistinguishable from an applied acceleration. There's no doubt that the material in a neutron star exerts gravity, and even a small amount of the material of a neutron star, would exert gravity, however if Einstein's idea of standing in a lift is a description of gravity then we can say over the course of the time that it's been in the Universe that neutron star has been subject to 'being in a lift'.

If we move it to Earth, we move it to *a different lift*.

It retains *density*, but not necessarily *gravity*.

So let's imagine this:

We have Earth over here and a neutron star over here. Now the history throughout the Universe of these two objects is different. It's not just different because of the starting formation of the Universe, it is different because of the history of what has happened between now and all the time previously. All of the objects which collide with each other and lose momentum, and all of the objects which align with each other and gain momentum have a different history, and a different physical situation in Einsteinian terms. So this neutron star

has gravity because of something we visualise as being in a particular lift, and this Earth has gravity which could be in an entirely different lift!

If you take material out of here, the neutron star, and take it outside of the lift, are you bringing with it the constant acceleration, i.e. the implicit gravity that that mass has within the neutron star, or not? In other words, are you bringing over just density, or are you bringing over density plus gravity?

My understanding is that lead is dense but it doesn't have more gravity than iron. Drop both from the Eiffel tower and they fall at the same speed.

If you bring over the thing that makes this part of a neutron star and not just an object drifting in space, i.e. you bring over its history then that is going to be a moving object when it gets here.

We may not be able to see these lifts - there's no background to the Universe to measure the absolute movement of anything but that doesn't mean they're not there. That doesn't mean it's not a real thing that we are describing. So, when you bring it over you're going to bring it over to all intents and purposes from our point of view in trying to understand the underlying physics, you're going to bring it over *as movement*.

Finally, note the impossibility of leaving the 'gravity well' of Earth to find out whether or not density has gravity per se. Earth is in a gravity pocket due to an acceleration which in the past caused it to reach a speed now of 60,000 mph around the Sun (relative to everything else in the same gravity domain). The Sun has a speed of one million miles per hour around the Milky Way. It is both a larger mass and in a larger gravity domain due to the acceleration that caused it to reach that higher speed in the past. You really would have to escape both domains to demonstrate that density = gravity, otherwise density is just subject to existing gravity using either my assumption or our book-authors assumption.

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In fairness to Randall Munroe, the author doesn't pretend to be a scientist. He does aspire to be answering on the basis of the common sense associated with science, but it's quite possible that a physicist would say "oh no, this isn't correct; it's just not something that we physicists would shout about because it's fundamentally an entertainment, not a serious science project." So, there is every justification for some poetic license in the description.

It's another thing if it's philosophically incorrect: because at the heart of it there is an assumption and that assumption is demonstrably replaceable. Then, it ceases to become simply poetic license and it becomes something that physicists *should* correct because it is the job of science to stop us from believing what is essentially superstition.

I should comment also that against a live show, I must necessarily go more slowly and laboriously in an essay. For those that attend, my show is very much more fun, I can promise you! You don't need more than O Level physics and you can even ask questions knowing that there is a money-back guarantee if I have got wrong.

VOICEOVER:
We also have a final part of the current work to complete so that I can set you the homework for you to do outside of the Show. Let's just remind everyone what the homework is:

There are three types of Galaxy. There is the globular cluster and the irregular cluster, and ours: the spiral cluster. Using only my visualisation approach, how can we explain the formation not just of the first two, but also of the third, just using 'O' Level physics as here? How did the Milky Way get its spiral arms?

HOW GRAVITY DETERMINES SHAPE

We can see all around us that planets rotate around stars, stars rotate round Galaxies, and Galaxies interact.

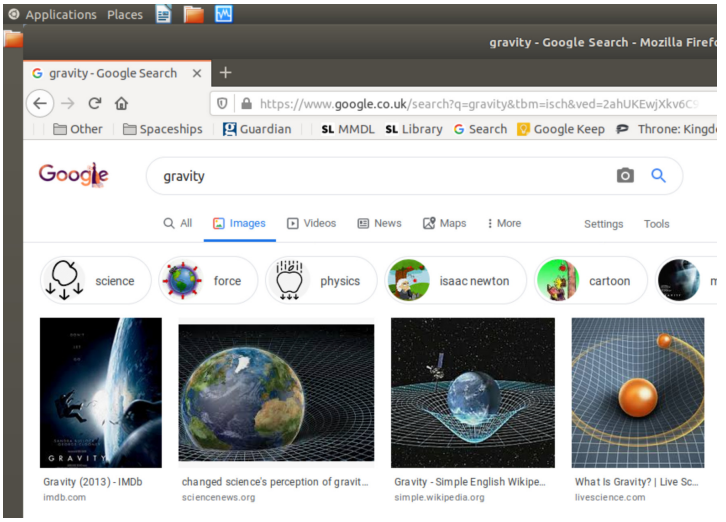
Einstein offers us two ways to understand gravity. As already mentioned, the first is the analogy of a man in a lift.

The lift is accelerating, and so they experience the acceleration as if it was gravity. Because they are in a lift, they can't see anything outside so they have got nothing to relate their movement to, and they feel that they are stationary.

In the same way, the Universe has no background and we cannot measure our acceleration in terms of a background. From our point of view, gravity feels like acceleration, and vice-versa.

So the second analogy, the second visualisation of gravity, is as a dent in space; a cup, or pocket. This visualisation imagines space as a flat, two-dimensional plane and the gravity as creating a cup, or a well; an indentation, in that plane. These are the two ways that we have got through Einstein without having to understand the maths.

(See below)



The visualisation of gravity is an important conception.

The visualisations above are not consistent with gravity as an acceleration.

They *are* consistent with gravity as a product of density, but that is missing the point if it is the other way round; if density is a by-product of gravity, rather than the gravity arising from the density, then we would re-draw these diagrams to make them accurate.

So where could gravity come from if not from density?

I have already mentioned the saying that the Universe is a sphere whose centre is everywhere. It turns out to be vitally useful to us. Blaise Pascal, the mathematician, is credited with the words, according to the Internet:

> *"Nature is an infinite* sphere whose center is everywhere *and whose circumference is nowhere."*

I came across this saying many years ago and acknowledged the truth of it. They are my italics, but Blaise Pascal would have appreciated the following use of his idea. We have seen the Universe is fractal on the largest scale, which explains how the edge can be nowhere, but what about on the smallest scale?

On the smallest possible scale things like gluons and quarks seem not to even be wholes. Physics made the discovery through the famous two-slit experiment. This, and other experiments gave not an indeterminate answer, nor even a non-answer, to the question "is light a wave or a particle?". When experimentally passed as a wave or particle through two slits, light did not fail to give an answer – the indeterminate answer, "We don't know" – nor did it give a third unanticipated answer (the different answer, or non-answer, it is X); rather, it gave something else: an *unanswer – i.e.* "this is the wrong question to ask". Light responded to an Aristotelian Yes/No experiment with a Chinese Tao, or "third way"; an unanswer, forcing physicists to "unask the question".

As a result, physicists were forced to think in a different way about the Universe. The old certainty about cause and effect gave way under a dawning realization that the observer affects the outcome. It is not that the outcome is decided by the observer, it is that the outcome is decided when the thing is observed. Schrödinger's cat stretched 'now' into an indefinite future. The moment 'now', which we thought a mechanical product of the past, became an artificial construct like the set of 'The Truman Show'. For all our billion minds, we still could not answer the question about whether a tree falls in the forest if there is no-one to hear it. If there is no one to hear it then is it falling still? Indeed does it fall at all?

The result was the brand new field of Quantum Physics, which made Uncertainty the basis of its determinacy, brilliantly negotiating the schizophrenia of paradox throughout the Twentieth Century.

And thinking in this new 'quantum' way had a definite and wonderful outcome, in entanglement. It seemed like magic, spooky "action at a distance"; the most unexpected manifestation when you thought 'physically', it turned out that two very very tiny particles could become joined - entangled – so that no matter how far apart in space they were or are, action on one instantly affects the other.

The mystics had said that the Universe was like "a sphere whose centre was everywhere". Here was, if you like, a proof of that. It was a way to understand entanglement, that the sub-atomic particles had become so small, they were, effectively *in the same place. W*hether edge or centre, who could tell?

We can think of it like this. Picture a subatomic something so small that it is not entirely in the Universe. It is, perhaps, not yet fully realised; not quite real. You can move this something. You can even move it, and leave it where it is. Then, when you make it real by say observing it, at that moment the single something is drawn into the real Universe - as two somethings.

At this point I have my exact visualization, a set which contains infinity: a Trans-finite Set. The Universal Set which has an infinitesimal edge now has an infinite centre – a singularity.

Diagram Redacted

So at the opposite end of scale from 'large' we find a particle can inhabit any two positions in space because they are 'entangled' at the centre/edge of the Universe. To put another light on it, if the Universe has a centre then that would be the place for God, and God would be in the Universe. If it is a centre that is everywhere then God can be right next to you or next to me; He can be a personal God.

But notice one other thing at this point: things are not stationary in relation to the centre. That is, everything is falling towards the centre that we imagine is everywhere - or, the centre is falling away from everything. To be exact, we do not and cannot say whether all falls towards (in an implosion) or away from (like an explosion).

The Universe is a place with no centre and no outside so it is very difficult to think about. In fact, I am going to cheat, a bit. I'm going to start with a centre/outside and then take them away.

Let's imagine a starting Universe where large and small objects are arranged randomly. So let's take a random arrangement of stationery points, and let's add a centre.

.o . . 0 . o C . o . 0 0 . 0

The objects around it are all falling towards the centre. (They could equally all be falling away).
We cannot see the movement because, at our starting point, this is like a still photo from the movie footage.

Now let's imagine the Centre moves and we are looking at another still in the movie:

.o . . 0 . o . o . 0 0 . 0

C

As the centre moves, we also see from the shifted positions the movement of the objects toward/away from the centre.

If our Universe were like this it would be obvious. It is obvious our Universe is ***not*** like this, but we can take a step closer to our Universe by hiding the Centre.

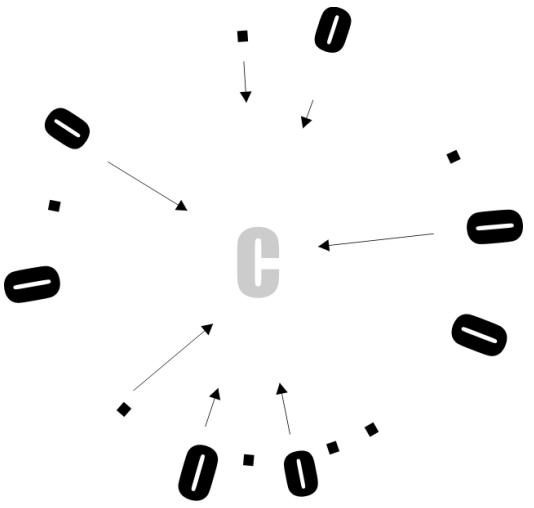
The Centre would be not taken away, but hidden, if we made the speed at which the objects move towards (away) from the centre random. Perhaps some are still, some are moving, and some are accelerating, and so all we can see is their movement relative to each other, or to an earlier position, if we know that.

Now, you're going to say well, that's not a random arrangement: look, they're all in a straight line. To which my reply could be:

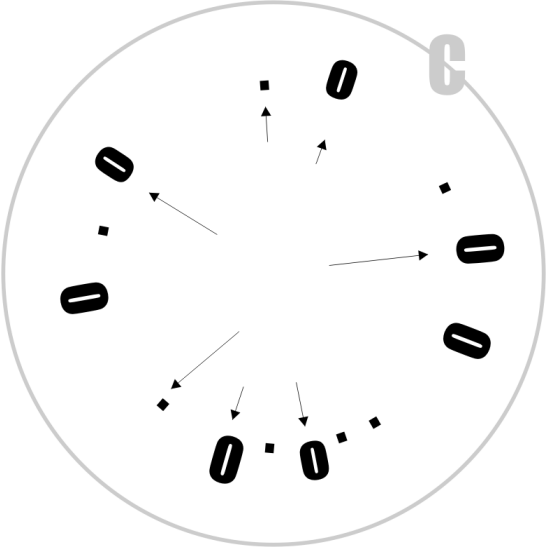
> *" That's as may be, but a random arrangement of elements includes an arrangement in a straight line. So I don't have to choose my randomness to suit you (and other people), I can choose it to suit me, if that's what I need to do, without breaking any rules.*
>
> *We can assume the centre is anywhere; we can arrange our starting conditions to allow the centre to be anywhere. What I want to do then is to take an arbitrary time, t1, (sometime between now and the start of the Universe) and then I want to take the next point in time, t2 (whenever that may be), and move the centre - and that's how I want us to start thinking about no centre: by moving the centre, rather than by taking it away. "*

I could say that to you now, but then it would be no help to you in explaining it to someone else later. I can imagine you or another saying to me "look, unless I can explain it to them without arranging things in a straight line, why would they be interested?"

Fair enough, let's compromise. So this time my starting situation is going to be a "random" arrangement of points around a centre. The Universe doesn't have a centre but for our convenience we are giving it a centre. I am also arranging the dots around in a circular rather than random manner, but that is for our mutual convenience, ready for when I come on to move the centre, next.

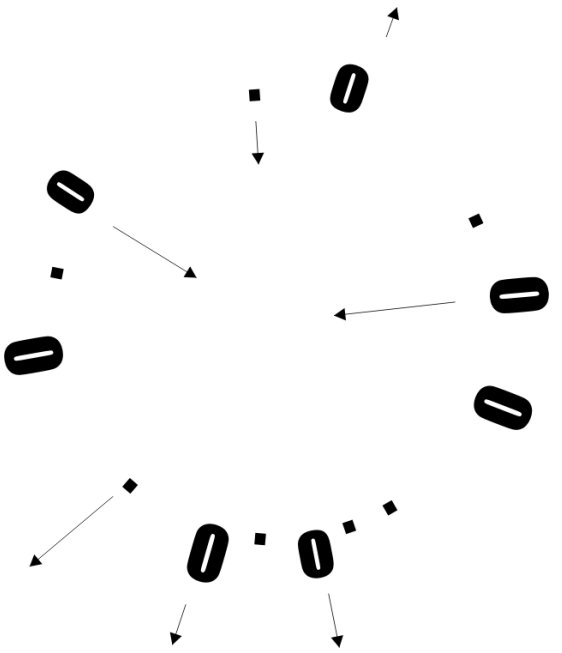


What I want to do is to move the centre by effectively taking it away. What I'm going to do first is to pretend the centre is bigger than the elements it is the centre of:



So we've still got a centre, it's just that it's so big as it drops away that everything effectively is pulled to the outside instead of to the middle. So suddenly all these flows of accelerations are reversed. (I say suddenly but I only mean, of course, suddenly in our thinking. I don't mean the Universe has somehow reversed its starting condition: whatever our starting condition is, it goes back all the way to that.)

Now, we don't know whether the Universe has a big centre or a small centre, we only know it has no centre.



Finally then, if I now take the centre away completely, we are left with an acceleration which is not in any one particular direction. Given that the Centre is hidden for us, the accelerations actually look completely random, but crucially that randomness still makes sense. The conclusion I hope is clear: it is that no centre is also a centre that is both outside and inside. Outside of what, and inside of what is irrelevant. (Notice that it is also irrelevant where in the page the centre was. I could have put a Centre in the street outside my flat and it wouldn't make any difference!)

We now have acceleration which is completely unrelated to itself in direction. And because acceleration is effectively a 'pocket' in space - Einsteins idea of a 'gravity well' as being like a dent in 3D where spacetime is effectively 2D - when something passes something, or something approaches something, it is these pockets which interact. These bodies I've drawn don't always hit each other, they don't always smash into each other, so what matters is what happens to the pockets. They are effectively soft, so we can ask obvious questions about whether the pockets flatten or deepen, as a result of the interaction.

It has been a long chain of reasoning to arrive here. I could have simply said that if the starting condition for the Universe is movement, rather than expansion, then one really has a simpler precondition, philosophically, not a more complicated one but that would hardly

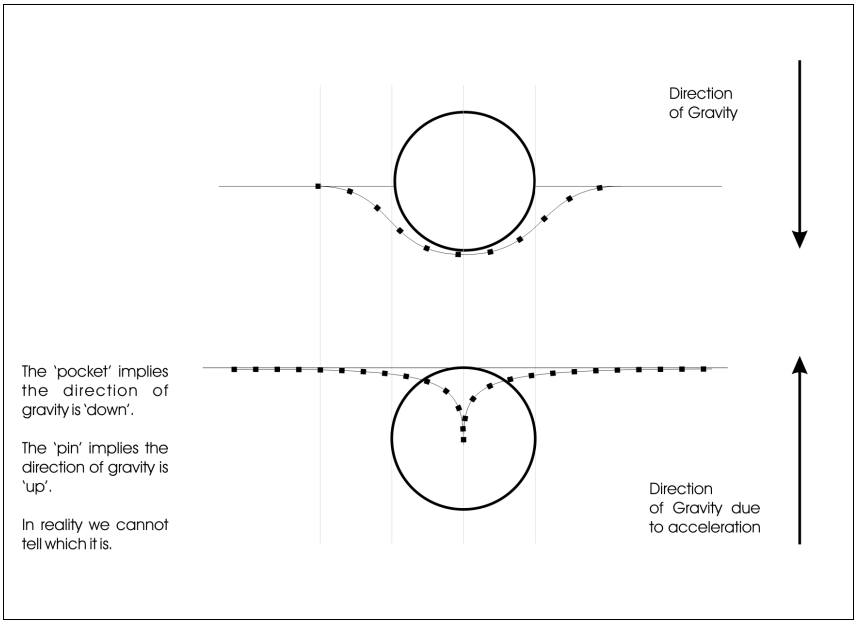
convey the impact of the change on existing thought. As the Stephen Hawking film, 'The Theory of Everything' relates, the idea of the 'Big Bang' came about as an alternative to the 'Steady State' Theory. I can now say that neither of them corresponds to this premise, which argues for a Big Bang that is ongoing yet maintains an overall steady state.

I now have the basis for a complete alternative visualisation of gravity which I build up in 3 stages, ready to apply below, in 'how gravity determines Shape'.

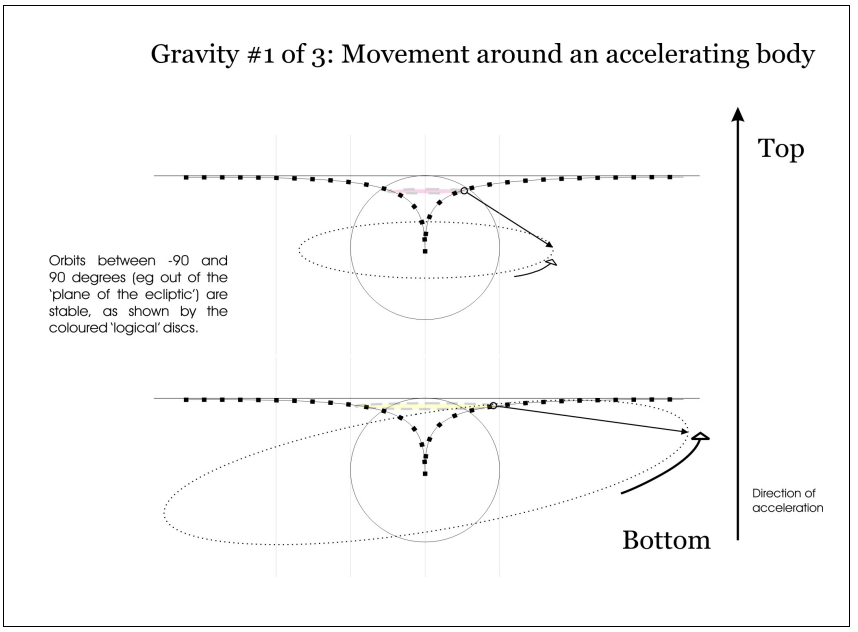
- Movement around an Accelerating Body
- Acceleration around an Accelerating Body I
- Acceleration around an Accelerating Body II

Afterwards, I will use this to explain what we see in Galaxies and Planets.

The base diagram is shown below: not a ball nestled in a dip but a ball impaled by a pin.

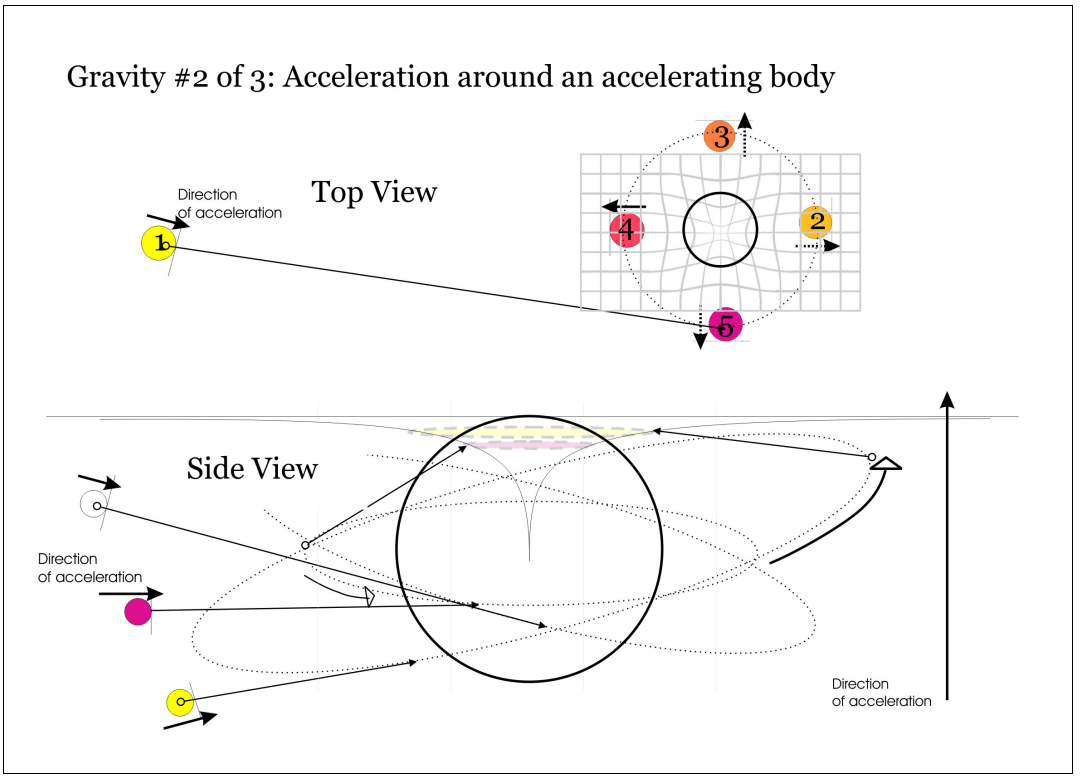


To visualise: Not a ball sitting in a pocket but a ball impaled on the head of a pin.



A moving body rotates in orbit around a gravitational centre.

We end up with a simplistic notion of a body in orbit around another body. This gets us started, so to continue, let's introduce acceleration on both sides:



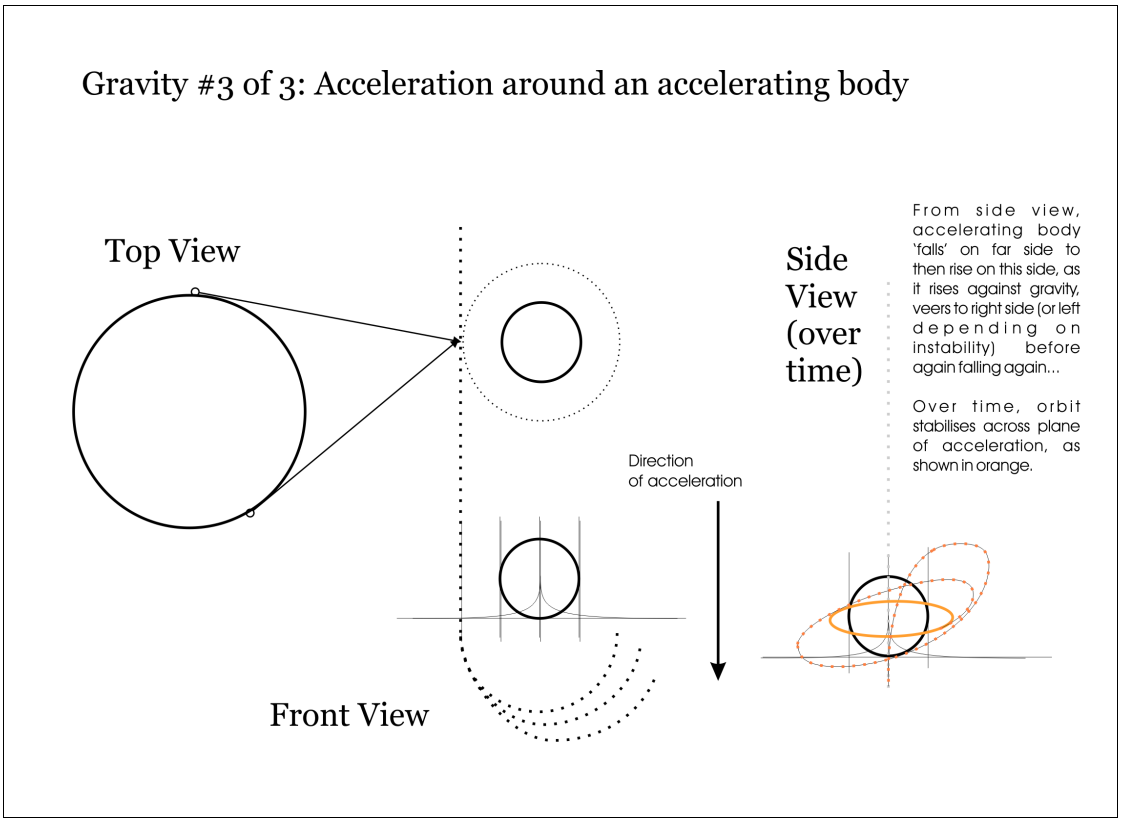
Accelerating bodies - orbit will not decay; acceleration swivels to be orthogonal, in stable orbit.

When the Orbiting body is itself accelerating, then the Orbit will not decay.

On entry into a stable Orbit, the acceleration – the pin-head – swivels to remain orthogonal to (at 90 degrees to) the acceleration of the main body (see Top View).

This happens whether or not the body is rotating.

Now, in a way this is a particular case, where the acceleration of one body is to the side of the the acceleration upwards of the other body. What about where the acceleration of both bodies is upwards (or downwards)? The last step then, is to look at this case, and describe it.



The 'Top View' shows a body 'dropped' (in fact, accelerating) into the gravitational field of a body accelerating in the same direction.

The 'Front View' shows that the body is not 'pulled' into a stable orbit now, but is partially 'pushed' into an exaggerated Orbit. The 'swivel' we saw before does not start occurring until the body passes the centre point of acceleration, the pin tip; also the lowest point. The 'pull' only occurs after this.

We see a similar effect when a jet plane pulls out of an extreme nose-dive. Only beyond the lowest point of the dive does the force of Earth's gravity get applied, as the jet pulls up to climb away, and it does so with extreme force, of multiple gravities.

I argue that the 'rise' on the other side of the Orbit is very unlikely to be an exact match to the fall. This would require a perfect sphere with an exact centre of gravity at the exact centre of the Orbit.

Much more likely is that some instability will cause the rise to veer to one side or the other so as to minimise the drag over time. Once the Orbit has become unstable in this fashion then

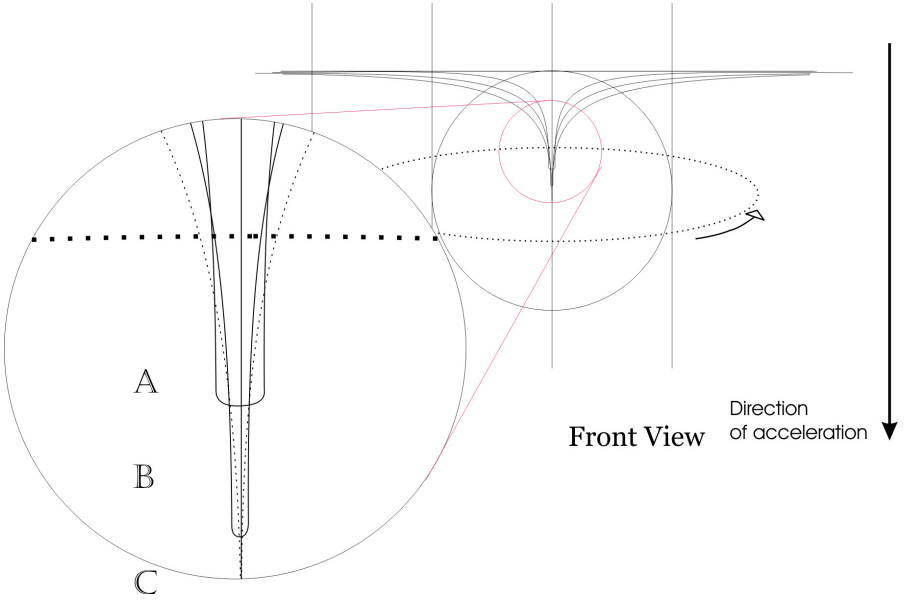
the expectation would be that it continues to change and further stabilise. The most stable Orbit is of course around the Equator and, in the case of planets orbiting stars or more likely stars orbiting stars, these orbits will develop over geological time, even millions of years.

The side-view shows the development of the exaggerated Orbit over time, graphically. Obviously there would be many, many more orbits with a much finer degree of change between them as the situation stabilises over geological eons. But the end result is clear.

In 3 Dimensional space, we can roughly apportion all Orbits to either the side view model, or the top-view model, by defining the angle of approach as either acute or obtuse. If the angle of approach is between 0 and 45 degrees, it is obtuse, if it is greater than 45 degrees, up to 90 degrees, it is acute. All obtuse approaches are characterised by the second visualisation above and all acute approaches are defined by the third diagram above.

This is important because of the difference between the second and third diagrams. In the former there is no exchange of gravitational force (acceleration). In the second case there is a loss of gravitational acceleration from the approaching body and a corresponding gain in the receiving body.

Gravity Exchange: Sharpening of the pin.



Normally, our experience of acceleration is that it is not cumulative. When one car accelerates to overtake another car, there is no circumstance where the car that is overtaken speeds up. If there were even the tiniest slipstream effect, it would not apply in the vacuum of space. And to recall the idea of the jet plane diving toward the Earth and then pulling out of the dive: clearly this has no effect on the Earth's gravitational field.

In the case of a body 'dropping', and then being 'pushed', and then being 'pulled' as described above, this **does** affect the gravitational field of both parties.

Think instead of a skydiver falling towards Earth without a parachute, then add a second powered skydiver who falls towards the first and starts to catch up. When the faster skydiver reaches the first, it does not simply overtake, like the car, instead it embraces and keeps hold of the first skydiver so that they are falling together, end over end. Now they are both faster than the first skydiver and if they are rotating, one cannot tell by looking which was the powered and which the unpowered skydiver.

In other words, a Gravitational Orbit such as the Milky Way Galaxy has does not need to be created by dark mass or dark energy, it can be created by gravity alone, if we view gravity not as *like* acceleration, but *as* acceleration.

Previously we have not been concerned with the sharpness of the pin, but let us consider that here. Clearly, it is not infinitely sharp – or rather, it is infinitely sharp only in the extreme, final case of a black hole. That might be 'C' in the diagram above. For a planet or star, which gains from the addition of acceleration/gravity, 'A' would be a more realistic starting point for visualisation purposes, and 'B' would be the outcome following stabilisation of both Orbits over time.

As hinted, an infinitely sharp pin would be a black hole; even light gets impaled on such a pin. Previously, the main method of creation for Black Holes was the gravitational collapse of an existing, sufficiently massive star. I suspect the method above shows that black holes could be created by matter alone, without the need for the lifecycle of the star to create a starting point. It would simply happen when enough matter accumulates through movement. To really convince, I think those who understand this would need to see it proven by mathematics. For the rest of us, computer simulation might prove persuasive. Both are beyond my remit and are left as future work for others.

~ • ~

At the time of this writing, there is a large lake of chilled liquid xenon in America trying to catch the particles assumed as part of dark matter. The experiment just ended and found nothing, so the scientists are recommending another, far more sensitive experiment.

It is called Big Physics, the spending of very large sums of money on the engineering to support further Quantum investigation. Is this as wasteful a search as the Alchemists in Newton's time questing for how to turn lead into gold?

Bear it in mind as we go on to look at and visualise actual examples of Galaxies and planets to answer the basic question of formation, starting with Saturn's rings.

Pausing to take stock now, have we reached the point where gravity does seem the best candidate for a third Dimension or not? Well, actually, I'm leaning wholly away from that as a conclusion. I am visualising a sort of 'folded manifold' of flat space indented with endless varieties of fat and thin, short and long 'pins'. I suspect we'd naturally lean to seeing those pins in some sort of 'pincushion sphere', where the depth of one pin at a certain measure is the same as another pin at a certain measure. It is only a short step of convenience then to see all these pins as nested along an axis of magnitude: a seductive prospect.

If we were to see gravity as a Dimension then the imagined outcome if one could somehow fall through the centre of the Earth becomes quite different. The implication would be that one could not just fall through, but somehow also fall across. Rather like Dr Strange's Portals, we'd fall in to come out the other side in a completely new place, according to an unknown or arbitrary (we may as well term it spherical) topology, and that would be the point of it all.

Looking even further afield. C S Lewis, a committed Christian of course, was one of the few writers that I have found to have tried to write about the metaphysical nature of Heaven (The Great Divorce, Macmillan). Rather than an essay like mine, he chooses to use a fictional short novel to illustrate the characteristics of Heaven. Intriguingly, one of the most significant features he gives it as a place is enhanced density. Is it coincidence or one of those intuitive insights we can pursue further?

As we are about to see next, we don't have to have a definitive answer to all aspects of the question to put the ideas above to use, which is one reason I am so comfortable flirting with possibilities. Whilst it is fun to imagine this could be somehow usable in some spiritual form, and that gravity may even be a third dimension usable by us; available for getting around in the 'Star Trek' sense. I have a serious suggestion to make, for an entirely hidden third spatial Dimension.

My conjecture will be that the third Dimension is subjective.

As I said, we dont need to understand this to apply the ideas above to the elements of the Universe. If the third Dimension is subjective, I continue to try to understand better what that means. One aspect of a Dimension that is subjective is that it does not have units. With no units, the only division possible is into two halves, but travelling the first half requires one to divide the next half again into two halves, and so on. The subjective experience of moving in such a dimension (with no 'background reference') is then that each 'step' appears to be double the size of the previous one. Earlier drafts of this essay considered an axis of scale as a possible answer to this, but it is since rejected. A more obvious candidate would be time. Although it is the traditionally acknowledged fourth dimension let us review our understanding of time before we finish.

VOICEOVER: Time and gravity and are not Dimensions, so where is the question-mark? The difficulty is with height...

Part C: TIME

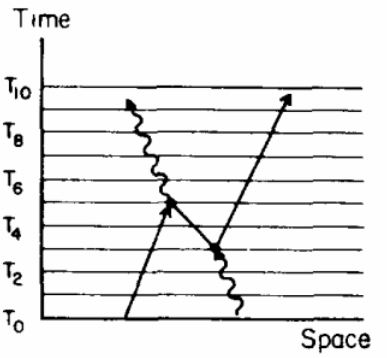
Having broached Dimension we will move on to studying the poly-dimensional whole of our subject, but let's make the effort first to consider time in its own right, as that has been the single most significant suggestion for an additional dimension made so far. I want to enlist the aid of a real physicist, Richard Feynman, in the understanding of time.

Feynman is one of the most famous physicists of the 20th Century of course, but he also wrote for the layman, as a teacher. That's how I happened to read a book of his (QED: The Strange Theory of Light and Matter) which observes that experiments made at different points of time t0, t1, t2, etc. clearly show sub-atomic particles and events reversed in time, happening at t2, then t1, then t0, etc.
The particle appears to have travelled in time, as effect *precedes* cause.

> *Extract from Richard Feynman's book'QED – The Strange Theory of Light and Matter'*

Electrons and Their Interactions 99

FIGURE 64. *Looking at example (c) from Fig. 63 going only forwards in time (as we are forced to do in the laboratory), from T_0 to T_3 we see the electron and photon moving toward each other. All of a sudden, at T_3 the photon "disintegrates" and two particles appear—an electron and a new kind of particle (called a "positron") which is an electron going backwards in time and which appears to move toward the original electron (itself!).*



*This extract is from Page 99 of the online PDF version of Feynman's book showing sub-atomic time-travel. Feynman is discussing the interaction between a photon (wavy line) and an electron (straight line). In Fig 63 he has given three possibilities and here, in Fig. 64, he identifies where, as a Positron, a sub-atomic particle moves backward in space and time – from time t3 to t5 – where it meets **itself** coming forward as an electron in space and time.*

If I look at my watch, it says the time is 1 minute past 10 on Sunday morning. It also has the date: 17th. Just imagine if, instead of changing my watch, the time on my watch changed what time it actually was!

I could wind the hands backward to set an earlier time and day, or forward to set a later one. Nowadays, it may be easier to imagine that time is a dimension than to imagine it is not. Yet, time-travel is an impossibility. It would mean I would meet myself – or my father, and accidentally kill him... How do we resolve this paradox? How can we understand time, in a way that includes this phenomenon of it being a dimension?

To come back to the watch on my wrist, it shows me the time of day, the day of the week, and the day of the month, but it does not show which month it is. For that, I'd need an electronic watch, to keep track of the day and the year. If I was on a desert island, with no battery, I could learn to tell the date from the stars. In ages past, that is how people have agreed what date it was. Knowledge of the Zodiac arose through studying the passing of time.

But the Zodiac partly repeats every year so that everyone born in August is Leo, like me. All stars visible with the naked eye from Earth are within the Milky Way galaxy. It takes about a quarter of a billion years for Earth to rotate once around the Galactic Centre – a Galactic Year – but the Zodiac of visually familiar stars repeats itself after only 27,000 years. There is no clock other than the one we make, so if we take away every external measurement of time, what tells us that time is passing? That is, can we tell that time is still passing, or might it seem as if time were repeating?

There are times when I am awake that time seems to slow down, and times when it seems to speed up. Fortunately I know logically that these are subjective sensations. I do not need a watch to tell me that time is passing at a steady rate. It is easy to tell that time is passing while I am awake.

It is much less easy to tell, while I am asleep. I have no real perception that time has passed after I awaken from sleep. The memory of dreams may be a clue, but in dreams, when I am falling asleep, I never feel that less is happening, it always feels like *more* is happening. My theory about why we do not remember dreams is not because they make no sense and are too difficult to recall, it is that too much happens too fast. Instead of cause and effect chained together, it seems like causes have multiple effects and effects have multiple causes. The dream overwhelms recall.

When you see it like that, travel into the future along a dimension of time becomes less interesting. Travelling forward in time does not need a time machine, just suspended animation.

We are all getting older. There are physical changes both outside and inside the body which show this, and eventually we will all die. Yet that is intellectual knowledge. Internally, I don't feel old. I don't feel a particular age. I don't know what dying means. The human race will go on and, I feel, so will I. But if I had no watch, I would still be accumulating experience. It is the steady accumulation not just of experiences, but of experience itself, which tells me that I have lived out a life. When I was young there were many things I did not know. Whether it was falling in love, qualifying for a degree, or starting a business from a hobby. Some of these I now know, but not all. My experience changes me permanently, without necessarily changing you, as yours does. We become defined.

A real time-machine, so to speak, would be one in which I could go back to not having had the experience I do have. I do not feel any older. I do not feel any particular age. But I do recognise the many differences that experience has made to me, and whilst going back to the

beginning would in one way be a new start, in almost all other ways, and in all the ways that matter, it would not be something I would want.

This gives me a sense of purpose to go with the sense of time passing. Although my life will end and perhaps a different life begin, the human race of which I am part is greater than death and has a greater purpose to which I contribute. The sense of purpose through experience is my proof that time is not cyclical and repeating. It matters.

I can imagine replacing the 'magic' of time-travel with a science I might call 'experience-travel'. Time-travel looks like fun and might be something I would want to do. Experience-travel is a rather different proposition. It seems much more like a one-time choice: a stark choice of whether to forge ahead for good or ill, or start again completely. If I had regrets about the way I had spent my life then I might be tempted by an offer of a completely different life. But if I am proud of the efforts I have made, and particularly if it was difficult at the time, then I'd be very reluctant to give up my hard-won experience - as indeed I am.

What is the best way to understand time? Is it indeed a solid, tangible fourth Dimension? Is it "a flowing stream that you can never step into twice"? Or is it external at all, is there such a thing as 'time'? I'd like to argue for a new understanding that embraces all of these, but replaces them with a new metaphor. One which we can recognise subjectively well enough that it makes for a useful contra-posit when we get onto an objective shape for the Universe.

If we look at time as if it were a tree, then the past might be the solid, tangible trunk at the centre of the tree, with the future the infinitesimally-spreading, but bounded canopy of leaves and twigs.

The trunk does not extend upward forever and there is not only one future. We do not believe in a future that is predetermined by the past - it is not pre-destined. Neither does the canopy extend outward infinitely. We do not believe in a future that is entirely divorced from the past. God does not play dice, and we believe in destiny, whatever name we give it. If my destiny branches in front of me like an Ash tree and your destiny were more like an Oak tree, we would not argue that one was better than the other.

It is a significant discovery that there are parts of the Universe which are further away than they should be according to the age of the Universe. The Universe is 14 billion years old, but 46 billion light-years wide, in every direction. In the tree metaphor I might understand this by understanding that the past is not a single trunk, breaking suddenly into a canopy of leaves, but one that branches first, again and again. Those parts of the Universe that are now so far away were once closer, everyone agrees. They are now not reachable in this Universe even if

one could travel indefinitely at the fastest possible speed. Time really does have all three elements that we associate with a tree: the trunk, the branches and the leaves.

We presume to think that time started at time 0, but this is just the same as thinking the Universe finishes at the edge. There is no time 0. Time did not start. From inside the Universe, the edge has infinitesimal detail – it can never finish. Although we can conceive of time Zero, for us inside the Universe, time continues back indefinitely getting infinitesimally close to zero, but only reaching it at infinity. To be glib about it, time did not start, as that would require time.

Indeed, this same thinking has led us to make the mistake of thinking that there was a 'Big Bang' - which then ended. This is a bit like looking at a tree and thinking it stops where the earth begins, simply because you cannot see the roots. We cannot see past the Cosmic Microwave Background Radiation, circa 380,000 years away from time Zero/immeasurably small, so that must be the result of the Big Bang's ending, you could say. (I don't know if you could; I'm being naughty...).

The Earth hides the roots, but it is not the roots. They are just as significant to the tree as the leaves, without which it cannot survive. We failed to see that the Big Bang never ended - it is still going on. That is *simpler* than the idea that it ended, not more complicated. I'd see that in my visualization as the roots of a tree of time.

Can I relate a tree to Feynman's experimental observations? Approaching the tree from the other direction, top down, what we see is very different: a sea of branching twigs and stems, seemingly expanding into ever thicker sticks and branches, from the very small to larger and larger. I mentioned his book, QED : The strange theory of light and matter[3], where Richard Feynman describes the series of measurements he makes on a subatomic particle. Each measurement gives a two-dimensional measure of movement (the x and y of a hypotenuse) which he then simply adds to give a final position, collapsing the dimensions (in my words). (See in particular Pages 25-27 of the online PDF).

Imagine you are an ant on a leaf trying to get to another leaf. Now, the random short branching out from the thinnest twigs and stems requires a 'dance' for you to navigate from any 3D position to any other 3D position still within the tree; a dance through many smaller Dimensions as I may choose to think of the twigs. If the ant were smaller than an electron, and the twig thinner than it, then the tree would better approximate Feynman's observations than either a river, or a path; any kind of line. (In fact, the reference to a 'dance' is Feynman

[3] A simple Google search should provide a download link

himself's preferred description for what I would describe as a movement through poly-dimensional space.)

It is so difficult to imagine the far future with any degree of credibility that I approached doing so through video rather than with an essay. Although it is a long prospect at over 90 minutes, in fact I am very serious about a way to imagine an indefinite future for Earthly Humanity by straightforward extrapolation. I thought it was worth building my case in full and so I begin by looking backwards 100 years, to then look forward the same period. I follow by doing the same for 1000 years. Of course we don't yet have a history to look back to for longer times so I am proposing an extrapolation from what we do know again to the same distance forward.

The video essay might live up to the "long" in its title, but it certainly lives up to the name: Billion!

Billion: The Long History of Time[4]

Let me return to the illustration by Steve Ditko from earlier where we see Dr Strange being attacked by the minions of Dormammu. It is not made clear in the story-telling whether the minions who command magical powers create the portals they step through to reach Strange, or whether the portals are simply an aspect of the domain of Dormammu being multi-dimensional. It doesn't matter to us in the Ditko story and I think it does not matter to us in understanding Feynman's story. We don't need to prove that at some point the three-dimensional cause-and-effect Universe becomes the multi-dimensioned, quantum Universe, since we simply observe that it does. The sub-atomic particle appears to dance because it moves through a series of pathways, each of which is a separate dimension, like the dimensions being created/discovered to reach Strange. And on the smallest scale, time turns out to be one of those dimensions; but on the smallest scale, only.

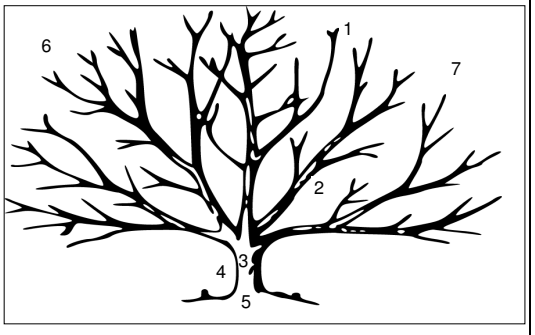
The great strength of a river or a path may be as a comparison to the flow or travel of time, but this is true of the tree as well. A tree grows outward at the same time as upward. It is, in some ways, born fully-formed, becoming more like itself with each year that passes. We are so used to thinking of time as a mechanism that it is extremely useful to be reminded it could possibly be thought of like an organism. The Universe may well be 14 billion years old, but that doesn't mean that every year has to be exactly identical with every other year, in human terms. It is, after all, always 'now'.

4 https://www.youtube.com/watch?v=vyWB377zGTI&t=176s

If the trunk of the tree is, in some way, the past, and the future is like the canopy of the tree, then 'now' is more than just the intersection between them, it is also the bark that for my purposes covers every part of the tree. As the surface, the bark separates tree from not-tree. 'Now' does not just separate the past from the future, it is also of course what gives the meaning to either.



The different types of tree are all derived from fractal mathematics underlying their different shapes.



Points of Similarity of tree with time

1	Twigs reflect Feynmans partial dimensions
2	Branches make tree wider and taller
3	Trunk corresponds to Past
4	Bark corresponds to Now
5	Roots like Big Bang
6	Shape of tree both smallest and largest scale is fractal
7	Alive, mortal

(You Physicists don't necessarily need a better visualization of time than Einstein's and even if you did, a tree might not be it. Einstein's great achievement was in showing the inverse relation between speed and time. If you are stopped, time travels forward at maximum speed. As you move, and your velocity approaches the speed of light, external time moves slower and slower, until you reach the limit of light speed, and it stops. But this is not really a fourth dimensional view of space-time as a uni-dimensional view of it – remember that earlier we talked of the current buzz-phrase 'going forward' as being the opposite of standing still? It is just a useful way to suggest everybody is moving in the same direction without having to state what direction that is.)

Trees do live a very long time, but they do not live forever. The last reason for we metaphysicists for choosing a tree to represent time is that a tree dies.

The oldest individual trees that we have found have lived for thousands of years. One can see that a tree deserves respect for the life it lives out, rather as we honour animal life to a degree. The purpose of time is not time, itself. The tree of time is not immortal because (if you choose to believe in Him) then God is obviously not here yet.

He must be coming. (Spoiler alert: please see "Where is Heaven", previously referenced.)

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Let me pause again here to take stock. At this point readers may not know whether or not what I have written is true, but it is evident I believe it to be so. Let me also pause to ask what difference does it make? There is a big difference between Einstein and me. Einstein's work led indirectly to the Atomic bomb. He was pushing the edges of physics; in fact, some argue, he was extending the 80% of classical physics described by Newton to the 99% of physics resulting in the bomb, and the observations of Feynman.

Even if time finds me accepted, there will be no great prediction, test and verification to come out of my comments as there has been repeatedly for Einstein. There will be no 'warp drive' or 'wormhole' from my work, in fact if anything, the opposite. This is a simplification, even more than an increase in knowledge, as I am arguing that we are closer to 99.99% in our understanding of physics.
There will not be any travel outside our galaxy by us in the foreseeable future. I do not think there will ever be any travel at or anywhere near the speed of light – yet that is a good thing! For those who want to go it will take the combined efforts of even the very least of us to succeed. For those who want to go to other Stars it can only ever be a one-way trip.

More on this later. For now, I want to go on to ask what is the physical shape of this Universal Transfinite Set? Can something that is infinite be meaningfully said to have a shape?

Part D: THE POLYDIMENSIONAL SHAPE OF THE UNIVERSE

To paraphrase a quote from Nikola Tesla: "The scientists of today think deeply instead of clearly. One must be sane to think clearly, but one can think deeply and be quite eccentric."

To quote myself from 2006: "To think deeply is also to think quickly. To think clearly, takes time." Here is what I also wrote then:

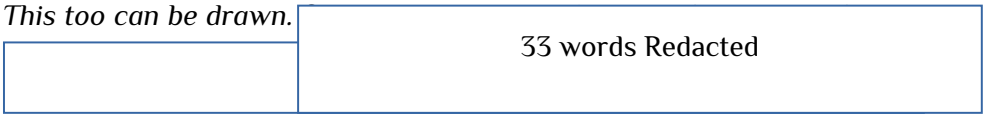
> *"The word for a shape that is finite but unbounded is 'transfinite'.*

If you draw a circle, with the area representing finity and the outside representing the infinite you have one representation of the Universe. Another is a square box, which is the mathematical symbol for the Universal Set.

How else would you draw this, or represent it in any way? Well, however it is done, one way to conceive of such a model (to use the scientist's term) is as an explosion. Since the finity is unbounded, it pushes toward or is otherwise drawn to, the infinite

Now, if this is a correct representation, is it the best representation? I would suggest not. For is it not more profound to consider a finity outside the infinite? Literally, in-finite?

This too can be drawn.



This is a shape to ponder for a long time. There is a profound difference between the centre and the edge, as well as a profound similarity. They are both infinite, but whereas the edge is unchanging and infinitely uninteresting, the centre is constantly growing ever becoming more than itself but never changing into something else ...

ii) The perimeter of the shape goes on forever, but is not infinite. If you try to examine it outwards, then you find it getting smaller, not bigger - just like Zeno's frog in reverse. What word in English is used to define something that goes on forever, getting smaller and smaller...?

iii) The pleasing and stable configuration is for infinity to be at the centre. If infinity is not at the centre, the balance is eccentric. We see eccentricity in the human mind. Furthermore (as a Church Hymn I know put it), the mind is an avatar of the Universe. The Universe of mind may be considered as three dimensional, as the universe of matter is best considered as three dimensional. The three dimensions of mind (here in the West) are those of Transactional Analysis. Is this also so in the East?

iv) Although numbers, like Pi, arguably go on forever and ever, and people, like Michelangelo, arguably live on indefinitely, in spirit; the greatest of all

> *infinities is surely the one, true God. Do we have a decent proof of the existence of God? If the most recent is St Anselm's nearly a thousand years ago, isn't it about time there was another one?"*

Although I would not write the same words today, in 2014, my choice eight years later would not be so great an improvement, I think. I was conscious of defining a shape 8 words Redacted and thus giving a definition of the Universe which anyone could use. At the same time, I was trying to give a fuller explanation so that people who did not care about the definition would also understand it.

40 words Redacted

I was in the intriguing position of being able to say that I could define the Universe's shape in 29 words; but that it would take 430 words to explain it.
It would even be possible to encrypt the definition and reveal it at some point in the future, when perhaps, someone else had come up with the same conclusion and reasoning. In this way, it could become an entertainment; a great game. There is one Universe; it has one shape; what is it? Over the course of say, a single year, the prediction of a solution to the puzzle could be made. Clues could even be given. As time passed, interest would build, making the solution more difficult, not easier. Even if I were proven suddenly wrong, or somehow inappropriate, it seemed to me an admirable enterprise: rather more worthy than 'Pop Idol'.

Well, maybe. But meanwhile, I was entertaining myself thoroughly with another new type of creative game and in a way which bears on the subject.

If 'Pop Idol' represents the zenith of mass-market entertainment then 'Tomb Raider' had marked a similar zenith in computer games. I'd played and enjoyed that, and 'Doom' and 'Age of Empires' all of which represented a new experience for the keen games-player. But now I had come across a different product entirely, a free computer program called Bryce.

It is a remarkable thing when someone is able to create a program that generates employment for other people. Microsoft had done it with their Office products, and for many others like me directly with their Visual Basic programming tool. I would realise in coming years that Bryce had done something similar in graphic design as, in the computer press in articles and adverts I would frequently see Bryce images: visually appealing illustrations that could be quickly and easily generated in Bryce – if only someone had the imagination.

Bryce is a ray-tracing program. It creates photo-realistic pictures by calculating the paths that rays of light would take through a virtual 3D world. The user can create objects and apply textures – even create a landscape picture with trees, mountains and buildings. They can then create things that only exist in imagination, like a pink sun, or purple seas. This is where I had gotten started. What does a plant look like inside a glass ball? What if you put the letters of a word into it?

It is one thing to see things that could exist, but don't. I was engaged by seeing them rendered with photographic realism, but I'd been reading comics all my life, I was used to astonishing images. What was another thing entirely was to see things rendered with photographic realism that could not exist in real life. With Bryce you don't need any wires so when you put a light inside a glass ball, it needs no power source. How do things reflect inside a perfect tube? In Bryce there is no gravity so I can suspend something in midair and have 360 degree reflection.

Of course I had been tempted by Bryce's ability to create a model of what I conceived the shape of the Universe to be. In two dimensions, you can only draw it as I have described. In four dimensions, it would look like a Klein bottle. What about in Bryce? Well, we can visualise

53 words Redacted

and that was what I was modelling in Bryce.
Until one day, I saw the same shape on the New Scientist website.

The Shape of the Cosmos

Diagrams Redacted

As modeled in the free 3D renderer, Bryce From New Scientist

125 words Redacted

Let us consider all the possibilites, which seem to boil down to three or four:

1a) The Universe is finite
2b) The Universe is infinitesimal at the edge and infinite at the centre
2c) The Universe is infinitesimal at the centre and infinite at the edge
3d) The Universe is infinitesimal at both the edge and the centre

I rule out 1 because although I have no proof, in my whole life it has been accepted wisdom that the Universe is infinite. No-one has ever seriously suggested otherwise.

I would combine c into b as 2. I do not know what difference it would make to anything if 2c were true instead of 2b.

I am left with 2b and 3d. Again I cannot choose between them, but again I do not need to make that choice for others. If God is infinite, then He is in the Universe and can only be at the centre. If God is infinite but outside of the Universe then both edge and centre are transfinite, bounded with an end that is not finite, but infinitesimal. If there is a personal God, then 2b is the Shape of the Universe. If not, then 3d is true.

144 words Redacted

as was used to say that: *the centre has moved away from the two spheres through a poly-dimensional space*.

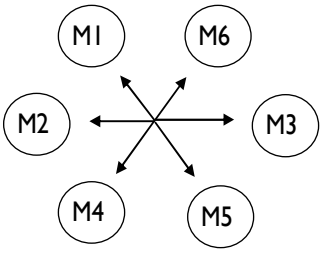
This is the point in the text, I think, where the shape of the Universe comes fully into view.

As I had to admit earlier, it is not an Einsteinian insight, such as splitting the atom. It is – at the least - a compelling interpretation of the available data, but as the makers of Betamax video learnt, the best idea does not always win out. Science, and physics more than anything, progresses by matching theoretical prediction to observed phenomenon. Modern quantum theory did this when it predicted and then observed the Higgs Boson. For many physicists, that may be just as compelling as what I have written.

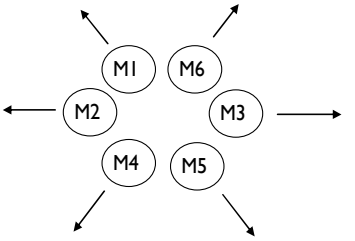
An idea is, arguably, of its time. We see this when Newton and Liebnitz simultaneously and separately discover a key building block of modern maths, in calculus. Again arguably, we see its absence when America does not instigate gun control. (With the wisdom of hindsight we might look back to the twenties and see that the prohibition of alcohol which gave rise to the mafia could also have been an era where gun control was seriously debated in the US, and decided one way or another. By the time we reach the modern era and my lifetime, it is in some ways too late for such an open debate. Gun control, as addressed by Michael Moore's 'Bowling for Columbine', has become a matter of faith, not politics.)

Although what I have done is much less than Einsteinian, it is also quite different. Einstein's information was a new discovery. He had stood on the shoulders of giants and raised the ceiling, and it would result in splitting the atom and perhaps, eventually, free energy from

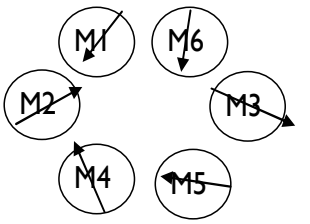
3 Ways of Viewing the Big Bang



Acceleration away from a centre could create the same gravity as 'Dark Mass'



Acceleration toward a centre could also make the Universe expand.



Acceleration without a centre is less obvious to see, but has the same effect.

fusion. Einstein could not have made an entertainment out of Relativity since, as it was said, only twelve people in the world understood it at the time. In the end, I was not courageous enough to create the Internet-based entertainment I had dreamed of. I made the best entertainment I could from taking the time to complete this writing. This shape for the Universe is not *a new complication* out of the current situation, it is a ***simplification***, I would like to think.

Part E: BODIES OF EVIDENCE

Earlier we Googled to get the answer to what happens if we could fall through the centre of the Earth. In doing so, we'd be using the gravity of the Earth. We have no extra gravity of our own so the question is not answered by the above. Let's clarify the question: there are three possibilities I can imagine for what could happen: we could come to rest smoothly at the centre, like a train arriving at a station; we could spring smartly into the hole, like a putted golf-ball; or we could overshoot and return, in an oscillation like a pendulum.

Googling "gravity at centre of Earth" reveals the statement that "At the very center, the gravitational force is zero because there's equal mass pulling on you from all sides, and it all cancels." So, in that case, we could 'arrive at the station'. Or alternatively, would the gravity pulling on us to accelerate be joined by an opposite gravity that pushes on us, and squeezes, like pressure at the bottom of the sea? In that case, we might act like the golf ball - and maybe be about the same size as well!

This particular article puts the answer this way "*You would oscillate back and forth sinusoidally; you would be a human yo-yo*". And, as I said, we have no extra gravity of our own so it is nothing to do with the interaction of Gravities. It is purely the understanding of gravity in theory when no experiment is feasible.

So which is it, and why? We'll come back to this question.

THE SHAPE OF SATURN

The latest thinking, based on data from the Cassini mission, suggests that Saturns rings were formed between 10 and 100 million years ago. (https://www.universetoday.com/141272/saturns-rings-are-only-10-to-100-million-years-old/). This same reference goes on to say "The problem of how the rings formed still remains." Were they a moon that broke up, or a comet that wandered too close, the article asks?

We, however, now have a model for how the rings could have formed.

In both of the scenarios above they don't start off as rings, that is how they end up. In the diagram above, Gravity #3 of #3, we saw how, from a particular starting position, a body that is in unstable orbit would stabilise over time by changing its orbit over many oscillations. Such an unstable orbit would not be created by a moon that broke up or by a comet passing through, I suggest. What would create rings would be a body entering Saturns Orbit at an angle to the Gravitic plane, which then broke up, I argue. The chunks of rock which want to orbit the planet cannot do it, because they can't come outside of the pocket of Saturns gravity. So, as they try to go around the planet they are going to be drawn into the only orbit they can take that is stable - across the centre. They are all going to be drawn into the same orbit (at different distances) and out of irregular orbits at different times. This is going to make the problem of smashing into each other much, much worse than it would otherwise be. Because these shortened circles are not proper Orbits, and because the large lumps of rock cannot leave (the curve of) the pocket, eventually what you will have is these rocks will pulverise each other over hundreds - thousands - millions of years into a fine dust and the fine dust will form a stable orbit, the only stable orbit being the one across the centre of the planet.

I do not think that a body entering the Solar System at an angle to the Gravitic plane is the most likely suggestion though. This is because it is hard to see where something would have come from so recently yet be outside of the plane of gravity. So few things are anywhere near us. Is there a better possibility? Well, there is one I would prefer.

Around 65 million years ago, something very big smashed into the Earth. What if, at the same time, something smashed into Saturn? All that requires is for whatever it was, there needs to be, not a single body, but more than one of them. That seems to me more likely rather than less!

Imagine something smashing into Saturn and ejecting some of the physical body of the planet out into space. (I understand the rings are mainly ice, so this might be mostly water, rather than mostly rock) It is not hard to see how this would put that mass into the same position as if it had arrived from outside the Gravitic plane – with the same end effect!

The rings of Saturn - indeed the rings of any planet with rings - could have this history as the most common historical scenario. It could be quite common, one could imagine. In my opinion the best way to illustrate the likelihood of this explanation would be through computer modelling. I think computer simulation would be a very good way to set up many different starting conditions, parameterized, and then run the simulation to see what is its outcome.

DARK ENERGY

You would think it would be impossible to know if the Universe is expanding because surely then as we are in the Universe then we would be expanding too. If the Universe expands, then "a kilometer" expands with it. My arm remains attached to my body because they are both expanding, not because they are each expanding.

I wonder if that is really what is happening? I wonder if at the same time that things are expanding on the largest possible scale, they are also contracting on the smallest possible scale?

Since there is no centre, this would not be obvious, or easily detectable. It might mean there is *not* more space between things that are joined (like my arm and my body). My arm and body are not expanding, even though the Universe is.

As diagrammed at length earlier, if everything was falling to a different degree towards a centre that is not here (!) then it would look as if everything was falling away from everything else, as indeed it does. Falling *away* from that centre would look the same though, given no background. I favour the idea that we are falling towards a centre that is not here (because it is everywhere) but I must of course acknowledge again that we really cannot tell whether we are falling towards, or falling away.

A Universe that is both expanding and contracting might not be an unstable Universe headed for a big crunch or started by a Big Bang. It is a Universe of which the final shape might be elegant in a way the current shape does not reflect. The current shape is not symmetrical being wider than it is old, but the eventual shape could be.

DARK MATTER

Galaxies which are accelerating differently from each other could be doing so because if what has or has not happened in the past. Is this the same phenomenon as seems to need explanation by Dark Matter? It does appear likely to me. Pursuing gravity through the analogy, the motor is not part of the lift where it is very much built in as part of the motor car. I have long believed that Dark Matter was simply the mis-perception of the need for a source of acceleration.

INFLATION

The easiest way to generate gravity in space is through rotation. Initially this was visualized as a large wheel as, for instance, in the film '2001'. It is more likely in reality to be done using a tether with the space station at one end since this has a number of advantages in flexibility and efficiency.

Acceleration is not velocity so, to achieve the equivalent of Earth's gravity (one gee) by accelerating in a straight line, would over the course of one year, bring the traveller close to the speed of light in velocity. There is no fundamental substance of space; what used to be called aether or quintessence, so there is no background to measure speed against. We've no way of knowing whether *underlying* acceleration is 'fast' or 'slow' by our metrics, if there is indeed underlying, original acceleration continuing from the Big Bang.

Could it even be possible that acceleration continuing from the Big Bang, where it is not mitigated by collision, could cause matter to *exceed* the speed of light? As we know, moving a torch has no effect on the speed of the light traveling away from the torch. The light is not being captured or stopped as it is in a black hole, the light would merely be red-shifted. It would be outside of the visible spectrum but if the acceleration is *later* mitigated by other matter then so would be the red shift. We might then see something which seems further away from us than it has had time to get.

There is certainly an anomaly in what scientists see. As already mentioned, the Universe is younger in years than the light-years distance it is across. The Universe is nearly 14 billion years old, we are told, but it is 46 billion light years across.

Some scientists have hypothesized that the Universe expanded very fast, very early on in its history and it is this 'inflation' which created the inconsistency we see now. But, as different physicists have noted, there is no reason given to cause the inflation. It is not part of the starting condition of the Universe; it is missing its own 'power source'.

If inflation is just the logical outcome of the interaction between unlike objects over time given their initial acceleration then there is no need for another cause. It would just be another natural part of the ongoing 'Long Bang' (see next).

THE BIG BANG

The firework is an obvious 'naive' visualisation of the Big Bang, but it creates the questions that are so difficult to solve of ‘missing’ gravity and inexplicable phenomena. As hinted at however, if we apply infinitesimality to the dimension of time on the largest scale (i.e. at the beginning) just as we have already applied it to space on the largest scale, then we must infer that the Big Bang did not 'fizzle out' or come to a stop, but is still going on. Instead of a firework, the Big Bang is more like a star which continues to shine from birth to death.

Like the impossible light in Bryce, which needs no power source, the Big Bang did not start and has not ended - as it has no power source (or the power source is hidden like the roots of the tree). For the Bryce software, they would have had to do extra programming to ‘model’ a power source – it was both simpler and cheaper to omit it. In the same way, it is logically simpler to assume the Big Bang is more like a star than a firework, even though that makes it more difficult to imagine. And when this is done, many of the biggest most recent problems in physics are explained, such as Dark Energy, Dark Matter, and Inflation.

I don't see this as a denial of reality, but an acceptance of it. For years, we have been talking of 'after the Big Bang' as in ‘a few tenths of a second after the Big Bang’. That sounds plausible until we rephrase it as 'a few tenths of a second after the start of time' which has the same problem as ‘a few tenths of a centimeter from the edge of the Universe’. These infer an edge which is infinitely hard, where the reality is it is infinitely soft.

We can no longer meaningfully conceive of infinity as per se 'big'. It is time to recapture the truth in the original idea of a Universe without end. No longer ‘the (infinitely) Big Bang’, but instead ‘the (infinitely) *Long* Bang’.

THE SHAPE OF THE GALAXY

The lesson so far, the cursory reader might think, is of movement we cannot see. But that is not the case, we *can* see the movement in that the Universe is too big; in that it is ‘expanding’; in that gravity is ‘missing’. The lesson is not of movement we cannot see; it is of movement we can see, but cannot measure.

If movement is the norm, rather than stillness, we can unpick certain behaviors in a new light. For instance, it is well known that there are three types of Galaxy, characterized by a particular shape. There is the spiral galaxy like our Milky Way, with its flat disk circling a globular centre, then there is the completely globular, spherical galaxy, and finally the irregular galaxy.

It is difficult for scientists to explain how these shapes arise from the formation of the Galaxy. They do not arise, for instance through different phases of the life of a Galaxy. They are not related to time. Those Galaxies whose shape is strongly influenced by, say, a black hole at the centre, are generally assumed to have formed that way.

But if you consider that movement is more common than stasis, then it makes more sense to assume that Galaxies form from merger rather than in situ, and in that case there are three possibilities we should consider. Let me name these as being that of 'no capture'; that of 'partial capture' and that of 'full capture'.

'No capture' is the easiest to visualize. A group of stars becomes gravitationally linked which means they are stable in relation to each others' movement. Let us consider another group of stars – or rather, let's say, a black hole, because it is more convenient to visualize one than many – which is moving. Let us imagine it moving close to, and then on past the first group of stars. They will be pulled in by its gravitational field, like a jelly is pulled if you tip the plate it is on, and they in turn, will pull on the black hole, pulling it back; but the black hole's momentum pushes it beyond the reach of the first group of stars and they are left behind, uncaptured. In this case, the Galaxy remains irregular in shape. So, the irregular Galaxy is the first of the three types, described as 'no capture'.

Now what if the black hole is much heavier this time? It may form within the group from local matter. Or approach from outside the group – some stars might be destroyed in this change – the bulk of the stars will fall into rotation around the great mass of the black hole. Gradually they should become centred upon it, even if it did not approach through the centre, that being the most stable configuration. We recognize this 'full capture' as the third type of Galaxy, the even, spherical cluster. (With no black hole present it remains an irregular shape) Most interesting of all though is the only other case possible, the in-between state of 'partial capture'.

Again, a large mass like a black hole approaches a group of stars perhaps of equally large mass. In this case, the stars begin to get pulled into the gravitational field of the moving black hole, but they are too heavy to complete an orbit across the front of the black hole. Instead they get pulled into an irregular orbit behind the black hole which gradually settles into one around the equator, so to speak.

In this case, the equator is not formed by the sun, it is the plane at 90 degrees to the axis of movement along which the black hole is moving forwards. By Einstein's theory of gravity warping space, these stars are merely behaving like the roulette ball which ricochets around the bowl of the spinning wheel until eventually falling to rest in one of the numbered slots as

it loses momentum. Some of the stars would be fully captured since the black hole ends up more massive, but the majority that are left would form a flattened rotating disc – it is the 'fried egg' shape of our own Milky Way.

MILKY WAY

103 words Redacted

Scientists do not know what causes the spiral arms of the Galaxy and have suggested complicated reasons for why it happens, as you may see from Googling for it. For that reason, we need to model this behaviour by computer to confirm that the mathematics behind it is correct. Even so, it is such a simple and clear reason to explain what is so common that it would be more surprising if we find it is wrong.

I cannot help hoping that those Galaxies that are more than about 14 billion years away are mostly Type 1 Galaxies, because they would be the ones least slowed down to sub-light accelerations. (A quick Google in June 2015 reveals that the oldest spiral Galaxy discovered to date is well within such a rule of thumb, being a relative youngster of just ten billion years).

BARRED GALAXY

The Milky Way is not just a Galaxy with Spiral Arms, it turns out, it is a barred spiral Galaxy. We knew for certain about the Spiral Arms a hundred years ago but the discovery of a bar through the middle of the disc is more recent, being only confirmed this century.

Barred Galaxies are not uncommon. It therefore ought to be possible to explain the formation of the bar through the same basic physics that is used above. Note this is a separate question (and answer) to the formation of the spiral. My theory of the spiral arms was part of my first talks about the Shape of the Universe in 2014. The barred Galaxy formation was the very final question I asked myself about in the last stages of the final version of this essay.

In principle, it is straight forward to visualise how the bar arises. Of course that does not mean it is right, but it does indicate it would be worthwhile to explore further, mathematically and if that seems possible, through simulation.

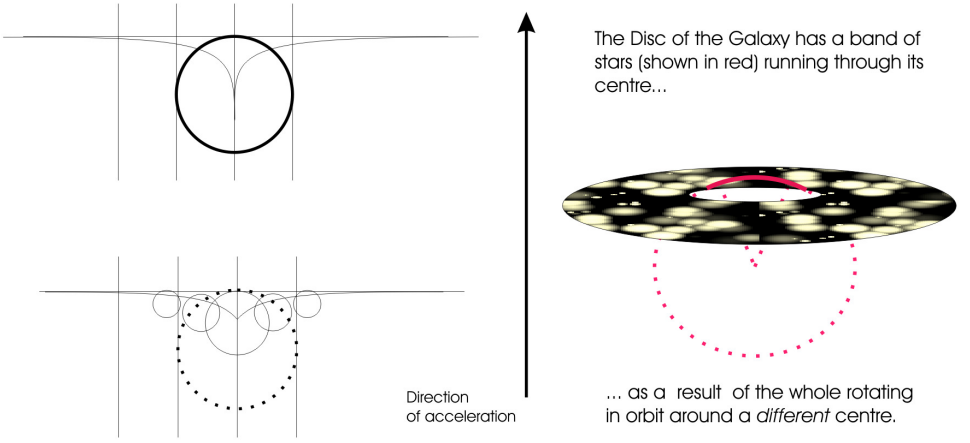
We have discussed already how one body entering into orbit around another body would 'swivel' into a stable orbit around the equator of that second body over time. If the first body were a galaxy rather than a single solid body, then the 'soft' connections between the stars would mean each of them was pulled towards the equator just as the whole was. I assume they would settle into orbit in line, thus arranging themselves around the equator into what would look like a bar from outside.

Of course this bar would be curved. It would also go across the whole galaxy, but only in the case where the gravitation of the second body were larger than that of the first, ie where acceleration makes the second pin 'sharper'. But what if the gravity is not as great? The orthogonal directions of acceleration might still keep the orbits stable, but now the bar goes across the center of the galaxy only to the extent of the weaker pull, and the rest of the galaxy is held in place by its local gravity. It still rotates but without its shape being affected, like the Earth rotates during a day within the larger rotation that makes up the year.

The 'day' of the Milky Way Galaxy is then two hundred million Earth-years (if Monty Python's 'Galaxy Song' is still correct!) but maybe its 'year' is 'only' one hundred million Earth-years long.

Of course, this would require that the Milky Way is rotating around a vast black hole that we cannot see. Let’s clarify this diagrammatically as we did earlier.

Gravity Spread: *Broader, shorter, flattening of the 'pin'.*



Stars that are gravitationally linked to a 'local' centre are described by a broader, flatter pin than a single body of the same overall gravity.

This gives rise to the characteristic 'bar' because only the stars at the very centre of the disc rotate in strict 'equatorial' Orbit, around the sharp, narrow pin of a large, single mass offset from the local centre.

The stars at the periphery of the disc are held in place by their relationship to the local centre, but the local centre - and the disc as a whole - actually holds to an offset, *regional centre*.

The effect of the gravitationally linked stars within the disc of the Milky way can be understood visually as creating a thicker 'shaft' for the pin than previously. This means that the same overall gravity can be created by two centres as we see when we consider a single centre, whilst still resulting in a disc + bar style Galaxy; and also, even when the gravitational centres themselves are equal, neither one having greater gravity than the other, we would still expect to see this resulting disc + bar structure.

I'm not sure that is a problem for me since I think that black holes can be formed other than at the centre of a galaxy. A diagrammatic confirmation means that once again we await mathematical confirmation or disabuse.

PICTURING THE GALAXY

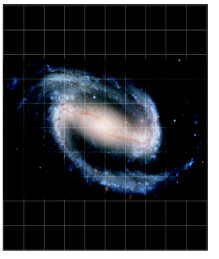
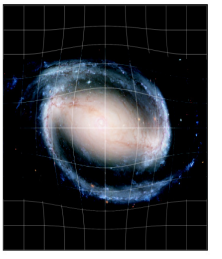
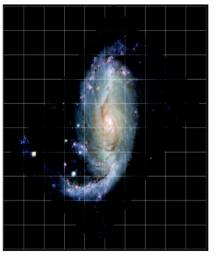
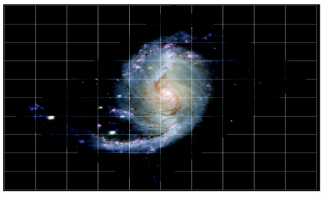
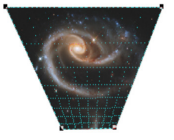
The "picture" of the Galaxy presented here cannot easily be compared with actual pictures of our Milky Way Galaxy for the obvious reason that we are inside the picture itself. This isn't true of other Galaxies. We are outside of them all. So, what do those pictures tell us? Do they have anything to say?

Let's refer back to "Top View" in the Diagram above "Galaxy #2 of #3..."

What I have done is to make my own grid so that I can graphically represent the twisting of 3D space for my own purposes similar to the superior and far more beautiful representations we have seen on the Net. I did this by applying a 3D filter in standard photo editing software. The feature is called pinch\punch in my version of Corel PhotoPaint.

The pinch\punch dialog in the software allows you to apply a geometry to an area of an image. If you "punch" then you are creating a "pocket" like that in Diagram "Galaxy #1" above. If you apply a "pinch" then you are inverting the "pocket"; creating the same pocket, but viewing it as if from below, looking up. So, a single pinch followed by a punch would reverse each other , and vice versa. The pair would cancel out to give you what you started with: a flat grid.

Can we then "un-punch" the pictures of other Galaxies? Well, let's try it.

Original Image	Assumed Geometry	3D Transformation
Galaxy NGC 1300 		
Galaxy NGC 1672 		
Rose Galaxy 	 ×	

I have been to the NASA website to download some high-quality images which they provide free of charge:

You can see from the table that there is a very nice transformation as a result of applying a "pinch" rather than a "punch" to the first image, Galaxy NGC 1300.

I would like to do the same to the next Galaxy NGC 1672 but actually it's most important feature is that it looks stretched, to me. As a result I've applied a much simpler transform, a "squeeze" in the axis that looks stretched. Now I am not sure it would be improved by a further transform.

And in the third case of the Rose Galaxy, it is a change of perspective that is the first change I wanted to apply. I have exaggerated it as much as I can but actually I would have liked to do even more. The quality of the image was simply too degraded at that extreme. At the moment, it looks like it needs a further "pinch" transform as well, but I'd want to complete the perspective shift fully, first.

What does this tell us? For example, what does it mean that we have "pinched" rather than "punched" the first image? What these pictures are clearly telling us in my judgement is that even though we are not inside these Galaxies, we are still gravitationally linked to each, in a different way.

Imagine you have a back garden. You are looking out at it from the house. You know logically that the shape is an even rectangle yet your eyes are actually seeing a trapezium because of foreshortening. The nearer part looks bigger. One way to see it better would be to 'tilt' the garden up in one axis from back to front. That is what we have done with NGC 1672. We have tilted across the diagonal, but in a single axis. It tells us something about where we are as observers, as well as something about the observed.

Imagine now you are looking along a street, outside your house. Again, logically you know that the houses are of equivalent size but because of perspective it appears they diminish to nothing. One way to see this would to 'un-apply' perspective, or apply reverse perspective by an expansion from the vanishing point. This is what we have done with the Rose Galaxy. It is just the same thing as earlier, but in two dimensions.

In both of these cases you are alongside the Garden or the Street. The third case is different. Our relationship to NGC 1300 is that we are underneath it in the overall gravitational well we both inhabit. If we are not alongside then we must be either above or beneath, and if we had

applied a “punch” then we would be above similar to my “Top View” above. (Note that “above “ or “below” are arbitrary choices – there is no objective distinction available.)

Purely by luck, I seem to have downloaded three images which represent the three possible relations one could have: gravitationally linked in one or other axis; gravitationally linked in both axes, or gravitationally linked by movement, where there is no objective third axis.

Finally, it is worth observing as well that the first Galaxy NGC 1300 would, I feel confident, have been improved still further if I had been able to apply the true geometry, of a “pin” rather than a “pocket”. The whole picture looks “magnified” from the centre outwards to me. I imagine a pin would have exactly the effect I want, of shrinking it slightly into the centre.

PICTURING THE UNIVERSE

There are a hundred billion Galaxies, it is said, which often-times themselves contain a hundred billion stars. The number of possible worlds seems to be greater than the number of grains of sand on, not just the nearest beach, but all the beaches of all the world combined, it is also said. Even if some of this multiplicity turns out to be part of a fractal illusion, the abundance is so great as to beggar the imagination. It is a sobering vista.

At sub-light speeds, we have to work out a way to travel a distance of one light year, but unluckily for us – nowhere useful is within that year. We'll need to be able to travel the next level up, around ten light years, before we can actually go anywhere. That is going to take skills and abilities we haven't even dreamed of yet. It is going to take our childrens' children's children. That is why the current focus on technological and scientific achievement - instead of, say, ecological and political problems – is, I think, somewhat beneath us. Physicists are victims of this infantilisation as much as anyone. They are encouraged to live as if we were one good experiment away from warp drive. Of course they are not.

Yet the implications should also be clear. For instance, it is very obvious why we have not been visited by aliens. How would they know where to go? If you live in, so to speak, John O Groats and I live in the equivalent of Land's End, then why would we ever visit each other? If we want to meet up, we'll do it by both going to London, or some such convenient middle. Fermat's paradox is not only resolved, it never arises.

Take the aspiration of 'Star Trek', spread the 'five year mission' over five hundred centuries and expand the cast from ten to tens of thousands, can we then start to imagine our future? It is one with apparently insoluble hurdles, yet the objective is clear, and so is what we need to do. We can only survive as a species if we look after the planet, but to thrive as a species we

must spread out from this planet, and make for the centre of the Galaxy. That is where everyone else will be going.

Whereas the 'warp drive' of space opera may appear to be a dream equivalent to the land of milk and honey – of endless sweets and treats, or an endless continuation of childhood – what seems much better to me is the prospect of an end to childhood; more specifically, an end to the infantilisation of adults. Rather than a new Einstein, I prefer to see whole new industries, of robotics; of psychology; of ecology, employing entirely new categories of worker. Rather than my own personal starship, 'Jetsons' style, I envisage a return to a much earlier era, even before it took six months to get to Australia by ship; back to when the journey was both once in a lifetime, and one way; back to the era of pilgrimage.

As is obvious to anyone, physicist or otherwise, whether they admit it or not, we are drunk on easy money, cheap sex and hard alcohol at the moment, all children to a lesser or greater degree. It will be an era longer than anyone can imagine now, when we finally meet and come to get to know the alien brothers in our family. I view that as the most interesting period of the future that I can imagine – it will be so strange and mundane both at once. It may even be that's when our adolescence begins.

That's a direction for us all, but a direction also needs a starting point. So, more interesting even than the Death Star is to know where we really are in space. Anyone who remembers the lyrics of Monty Python's 'The Galaxy Song' will know that the Earth rotates around the Sun, at about 60 thousand miles an hour, and the Sun rotates around the centre of the Galaxy, rather faster. But the Galaxy is 30,000 light years across, and we are right at the edge of it, the equivalent of at Land's End, in Cornwall. In our orders of magnitude, 10 light years might find a world, but it is less likely to find a species of our peers. We'll likely need to go to 100 light years. If 'their' timing is equivalent to ours, we might then find they have made it to the Centre from their far advantageous geographical position. We still might have our work cut out to catch up.

DARK FLOW

Wikipedia tells us that the Universe is assumed to be isotropic, which is to say that it is assumed to be the same in every direction. Without knowing the true shape experts see you and me as within a ball shape for this reason: the Universe extends out uniformly in all directions, like a ball. It is a default for something that otherwise does not have a shape.

Our address in the Universe continues beyond the Milky Way into the Local Group, then the Local Cluster and ultimately Laniakea. The table below gives the relative scales of these:

Local Cosmology

Region	*Scale*
Milky Way + satellite galaxies	100,000 light years
Local Group (includes Andromeda)	10 million light years
Local Supercluster (includes Virgo)	110 million light years
Laniakea Supercluster (focal point is Gt Attractor)	520 million light-years

There is a region in the sky, somewhere between the constellations of Centaurus and Bela, which is 'falling outward' at a rate which cannot be explained by a uniform Universe – it is too fast. This has been dubbed 'Dark Flow'. The name conjures up certain connotations, for instance could it possibly be that the 'Long Bang' has a source, not at a point in time, billions of years ago, but from a point in space, at all times? It seems unbearably exotic, but if there is such a place then our position in relation to that place may tell us more even than my shape for the Universe does.

Is it the edge or the centre? That remains to be seen.

Part F: PROOF

VOICEOVER:
Earlier we said that if we drilled a hole through the centre of the Earth there were three possibilities for what could happen: you could come to rest smoothly; you could oscillate; or you could be 'pushed' into the 'hole'. Let's now see what would happen – and let's also realise what this would feel like!

As we have said, gravity is not a function of mass per se but a function of movement per se. This means that falling towards the centre of the Earth, to reach a speed of some 1500 miles per hour (Mach 2) is conceptually like accelerating to catch a jet plane moving at some Mach 2.
Passing through the centre would feel most like diving in a jet toward the Earth's surface, and then, as you reach the centre, pulling out of the dive at the last minute. Imagine the G-force that you would pull as you level out and pull up. Now imagine that instead of levelling out, the pull is instantly, completely reversed.

There is a famous joke about the last thing that goes through a fly's mind when it hits the windshield of your car, the answer of course being that it is his feet.

Similarly, the understanding of gravity discussed here means that when you pass through the centre of the gravitational field of the Earth at 1500 miles per hour, the sensation would be akin to having your feet pushed up through your knees, pelvis, chest and head. You would not come to a dead stop at this instant, but the sensation would be unpleasantly similar!

It turns out that drilling a hole through the centre of the Earth and then falling in would certainly not cause you to come to rest smoothly at the centre. It might have an element of oscillation but primarily it would be a most unpleasant version of being putted like a golf ball.

Of course the example is fanciful. Even allowing for some kind of vacuum tube eliminating the effects of pressure, our Google source notes that the Earth is rotating. I'd end up smeared messily, not to mention fatally, along one side of the tube long before I reached the centre. The discussion assumes that we stop the Earth from spinning and also keep it from collapsing in on itself somehow. But I've emphasised this illustration of a hole through the Earth partly because it was at this point in my own thinking where I began to feel I had really proven my own theory to myself, so to speak.

I am aware there are physicists that are arguing against Einstein and that is not at all what I believe myself to be doing. There are also physicists who hope to build on the existing understanding, doing highly imaginative work but again, I don't think there is any hope for that route. The truth is that a complete understanding of gravity should explain how we went wrong, not just put us right. Such an understanding comes from replacing a wrong assumption with one that better fits the facts. Traditionally, we view three (spatial) dimensions as an (externalized) fact but what this has done for me is to present a deeper understanding of the term 'dimension'. We are not external to the three dimensions of space and one way that could be so is if there is a third subjective dimension. It would have no bearing on the current discussion of gravity but it might be part of the 'everyone' in a future Theory of Everything (and Everyone).

I am not suggesting you should immediately follow me all the way here. Let us give the cosmologists and other experts their chance to make what they will of the Shape of the Universe.

To put it another way, we have only very recently overtaken, particularly, Plato. In *The Republic*, Plato draws his famous analogy of the cave. Writing 2000 years ago, what was to prove so prescient – his description of truth-seekers as watching merely the flickering reflection of truth, like light from a fire thrown onto a cave wall seen by a person with his

back to the flame – strikes such a chord with the TV & film watching age of the Twentieth Century that it is still quoted for ultimate wisdom by gurus today.

It speaks directly to all those who have no sense of infinity. I may say that Pi is infinite, that the Universe is infinite on the smallest scale and on the largest, but there may still be no apparent shedding of light (of truth) from me by this for you. You still may not have a sense of what infinity means to you.

In *The Republic*, immediately before he introduces the cave, Plato has written of the line.
This was another representation of complete truth for Plato, what I would call a Dimension. Plato invites us to draw a line which we should divide unevenly up into four. These four sections were labeled as scientific knowledge, mathematical knowledge, opinion and intuition (in the form of poetry, drama, etc).

Plato specifically said that the line should not be divided evenly, as if he was avoiding taking these as units of a continuing line. Indeed, his line is not continuing. It does not have a measured length but it is clearly not infinite. Is it most likely this which made him move on to a fuller analogy to absolute truth with his cave?

For us, Plato's cave must be one of a limitless number of like caves, all of which are one cave away from each other, for it must have the wonder of infinity. For us, Plato's line must become infinitely long because this is more desirable than discovering warp drive.

In going so extremely against existing orthodoxy, and not even as an academic myself, I had at some point to put myself on record. I recorded 3 related videos to commit to this philosophy of metaphysics. It was important to do it at the time, before whatever failure or success was to come. Again, I definitely wouldn't put it in the same way now, but nevertheless I stand by what I said at the time in the white heat of discovery.

https://tinyurl.com/4axcksm6

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Well done for staying with this essay if you have managed to stay with it, or indeed if you've 'fast forwarded' through the earlier bits to get here, thank you; that's fine. I do hope you'll come and attend the show before 2025. I'm sure you'll find it enjoyable and I dare say not quite so demanding. It's very simple, it is no more than 'O' Level/GCSE physics.

Which final note brings me to the homework question. It is this:

The shape of the Milky Way is a distinctive 'fried egg' with a flattened 'white' of 'spiral arms. It is a typical example of a Spiral Galaxy. What simple physical process causes Spiral Galaxies to form in this way? Email me your answer before 2025 and I will respond. The easiest way is probably via my website (see front page). If your answer agrees with mine, I'll add yours to the list of names to be revealed, along with the answer, on the website in 2025

I've redacted the explanation above for the spiral arms of a spiral galaxy, so the homework is to come up with that explanation. It is very simple and has already been a part of the shows I have been giving since 2014. But bear in mind you cannot Google for it at this time.

Hence my great efforts ever since to do something both educational and entertaining with the information.

REFERENCES

Hyperlinks referenced:

First ever talk & vote	**https://www.youtube.com/watch?v=5SrqXq8c_7A**
Billion: The Long History of Time	**https://www.youtube.com/watch?v=vyWB377zGTI&t=176s**
QED : The strange theory of light and matter	**http://keychests.com/mods/filesaveas.php?dl=vhyzowlmbs**
Gravity of Earth	**https://futurism.com/what-would-happen-if-you-jumped-through-the-center-of-the-earth**
Rings of Saturn	**https://www.universetoday.com/141272/saturns-rings-are-only-10-to-100-million-years-old/**
Philosophy (Metaphysics)	**https://tinyurl.com/4axcksm6**

PDF copies available free of charge by the same author:

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Where on Earth is Heaven?	**http://whatistheshapeoftheuniverse.co.uk/3_Religion/Religion.ht**

About the book: A revolutionary and unique visualization explaining how gravity creates the shapes of the Cosmos. Accompanied by live talks, recorded videos, and further writings as part of a 'theory of everything and everyone', this long-form essay intends to educate and entertain for all readers of GCSE level understanding and above interested in the subject.
Redacted until 2025, the full explanation of the shape of the Universe requires attending the live talk ("This is the Shape of the Universe – or your money back!"). Readers of this essay not attending the talk have the chance to independently co-discover it for themselves.
After all, who has *not* wondered what is *outside* of the Universe?

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