Chapter 38

2D Equatorial Lensing

In the late 1990s, two teams of astronomers[a] gathering data on Type Ia supernovae independently discovered phenomena which led them to conclude that the universe's expansion rate has changed over time. Cosmologist Adam Riess, who led one of the teams, says of this change which occurred over a period roughly 5 to 7.5 billion years ago, *"…the Universe stopped slowing down and began to accelerate, experiencing a cosmic jerk."*[b] However, two decades and three Nobel prizes on, we are no nearer an explanation in terms of the Standard Model. In a 2012 article on the popular *Space.com*, Clara Moskowitz, reflecting science's frustration with the issue, talks about *'The pesky reality that the universe's expansion is accelerating…'* She continues,

> *'Scientists still don't have much of an idea why the universe is not only expanding [but] doing so ever-faster. The gravity of all the mass in the universe would be expected to pull everything back inward, so scientists call whatever force is counteracting gravity "dark energy."'* [c]

So, with dark energy still a major player on today's cosmological scene, how exactly did the teams come to conclude that the expansion rate is accelerating in the first place? In their original 1998 paper which appeared in the *Astronomical Journal*, the High-Z Supernova Search Team led by Riess state in their opening Abstract that,

> *'A universe closed by ordinary matter* (i.e. $\Omega_M = 1$) *is formally ruled out…'*

Several models of the universe exist, hence it was important that they clarify this at the outset, laying down the open universe of the Standard Model as the basis for their interpretation of the data. This is of course a very severe limitation, if it's wrong, because in essence what they are saying is that they only assessed their data in terms of the Standard Model, with their conclusions dependent on it being correct.

Before we go on to consider the scenario in terms of the twin demisphere model (which incidentally provides a straightforward alternative explanation), let's first take a closer look at what they found.

Standard Candles

A supernova occurs when the white dwarf star in a binary system, drawing plasma from its more active neighbour, reaches the maximum stable limit of its mass, known as the Chandrasekhar limit – about 1.4 times the mass of our sun[d]. It collapses and explodes with such unimaginable power that it can shine for about two weeks with a brightness far exceeding that of its entire host galaxy.

Peter A Milne, astronomer at the University of Arizona, tells us,

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[a] The High-Z Supernova Search Team led by Adam Riess of the Space Telescope Science Institute and Brian Schmidt of Mount Stromlo Observatory, and the Supernova Cosmology Project led by Saul Perlmutter of Lawrence Berkeley National Laboratory.

[b] http://www.newscientist.com/article/dn4264-astronomers-date-universes-cosmic-jerk.html#.VYptzPkUVhF - Accessed 4th Dec 2016

[c] http://www.space.com/15247-universe-acceleration-dark-energy-quasars.html - Accessed 27th Sept 2015

[d] Although supernovae have since been discovered which appear to exceed this limit, beginning with the 'Champagne Supernova' of 2003.

'Supernovae… are cosmic mileposts for astronomers, in particular a class of such phenomena known as Type Ia Supernovae. Their consistent brightness makes it possible to gauge distance in the cosmos.' [a]

Type Ia supernovae (SNe Ia) are referred to by astronomers as 'standard candles' because, although they might happen anywhere in the universe, their properties may be calibrated as consistent. Unfortunately these tiny super-distant blinks in space occur on average at the rate of just one per galaxy/per century – and our telescopes have to catch them going off! Until methods of observation were developed in the mid-1990s involving the simultaneous monitoring of thousands of galaxies by scanning the sky with a co-ordinated host of committed enthusiasts with smaller telescopes, then bringing in the Hubble whenever one was found, statistical analysis was not possible due to the extreme rarity of the event.

Astronomers measure cosmological redshift (*Z*) in the spectra of distant objects; this is the extent to which light waves have been stretched into the red (low frequency) by the expanding universe through which they have passed and gives a figure for how long after the Big Bang they were released. Armed with knowledge of the consistent properties of supernovae, the teams plotted redshift against apparent magnitude (i.e. how bright objects appear). Writing for *New Scientist*, Sharmila Kamat summarises the independently obtained findings of both teams,

'Because the Universe is expanding, the light from the supernovae shifts towards the red end of the spectrum. The 1998 observations revealed that light from such supernovae appeared dimmer than their red shifts predicted…' [b]

After the extensive survey and analysis of 16 distant and 34 nearby supernovae, the High-Z team explain that, by a process of *'comparing the apparent magnitudes of low-redshift SNe Ia with those of their high-redshift cousins'* an unexpected discrepancy was found between the brightness and redshift of the more distant supernovae, which implied that *'The distances of the high-redshift SNe Ia are, on average, 10% to 15% farther than expected…'*

Put simply, if a supernova is dimmer than it ought to be for its redshift, both teams conclude that it must be farther away, therefore the universe's expansion rate must have changed over the light's journey, expanding differently at different times by passing somewhere around the middle of its lifespan from deceleration to acceleration. John Barrow tells us,

'They found that at large enough distances the expansion of the universe slowly changes gear from a state of deceleration, governed by an attractive gravitational force into one of acceleration driven by universal repulsion. This is exactly the behaviour expected of a cosmological constant.' [c]

One month before results were announced, team leader Robert Kirschner expressed serious misgivings, emailing Riess with the words, *"In your heart, you know that this is wrong"*. The reply advised, *"Approach these results not with your heart or head, but with your eyes, we are observers after all"*[d]. Good advice for the observed dimming, but does it apply to the interpretation? An interpretation which has gone

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[a] http://tucson.com/news/blogs/scientific-bent/arizona-prof-nobel-prize-supernova-finding-needs-tweak/article_1cfbd7a6-f28e-56fa-b72d-ad55f42d40c4.html - Accessed 25th Nov 2015

[b] http://www.newscientist.com/article/dn4264-astronomers-date-universes-cosmic-jerk.html#.VYptzPkUVhF - Accessed 6th Oct 2015

[c] John D Barrow, *New Theories of Everything*, Oxford University Press 2008, P131

[d] Michael Brooks, *13 Things That Don't Make Sense*, Profile Books 2010, P24-25

on to electrify the scientific world with the 'certainty' of recent acceleration. Nobel Prizes were distributed in 2011 (Kirschner missed out), and this interpretation now stands as the orthodox view. [a]

To explain this inferred phenomenon dark energy was introduced, with physicists Andreas Albrecht and Constantinos Skordis of UC Davis describing in a 2000 paper how *'All attempts to account for acceleration introduce a new type of matter (the "dark energy" or "quintessence").'* [b] [c]

Victoria Jaggard of *National Geographic* explains that the idea behind dark energy,

> *'…is tied to quantum mechanics, which predicts that even in the vacuum of space, particles are constantly winking in and out of existence, generating energy.'* [d]

'Quintessence', in which dark energy may change over time to be either attractive or repulsive, is one of a number of models that include 'dark fluid', a model in which dark energy and dark matter are combined in a single framework. More recent proposals explore alternatives, such as cosmologist Syksy Räsänen's theory of 'walls and bubbles', of which *Wikipedia* maintains, *'The benefit is that it does not require any new physics such as dark energy.'*[e]

Alas, even Räsänen himself does not consider the model likely. When all is said and done, science writer Stuart Clark summarises the real status of dark energy when he writes in 2014 that *'There is no natural explanation for it in any current theory in physics.'*[f]

No explanation, for something that no-one can find.

Hetdex, a collaboration between eight of the world's leading institutions dedicated to nailing dark energy including Oxford University and the Max Planck Institute, quote Nobel laureate physicist Steven Weinberg on their index page as saying,

> *"Dark energy is not only terribly important for astronomy, it's the central problem for physics. It's been the bone in our throat for a long time."* [g]

The website continues,

> *'Since scientists don't know what dark energy is,.. they aren't searching for it directly – at least not yet. Instead, they will study its effect: the accelerating expansion of the universe, which has provided much of the evidence of dark energy's existence.'* [h]

The project is using the world's third largest telescope to put together a breathtaking 3D map of one million galaxies located between 9 and 11 billion light years away. From this they understandably have high expectations. However, many professionals still have their doubts… US science writer and astrophysicist Ethan Siegel asks,

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[a] Although the prize is often described in the media as having been awarded for the discovery of the accelerating universe, or even dark energy, I believe the Nobel Committee were careful only to mention the light anomaly. Having said that, the long-running refusal to award the prize to Vera Rubin for her 1970s discovery of the galaxy rotation problem – following on from Fritz Zwicky's 1933 observation of 'dark matter' – is said to be because she did not supply an interpretation.

[b] http://arxiv.org/pdf/astro-ph/9908085.pdf - Accessed 8th Jan 2017

[c] The term 'dark energy' was introduced to describe a universe-wide negative pressure overwhelming gravitation as the density of mass throughout the universe reduces with expansion. There are other indicators to the existence of dark energy, implied from the CMB and acoustic baryon oscillations, but it remains theoretical.

[d] Victoria Jaggard, *Physics Nobel Explainer: Why Is Expanding Universe Accelerating? National Geographic News*, 4th Oct 2011. http://news.nationalgeographic.com/news/2011/10/111004-nobel-prize-physics-universe-expansion-what-is-dark-energy-science - Accessed 6th Oct 2015

[e] https://en.wikipedia.org/wiki/Accelerating_universe - Accessed 6th Oct 2015

[f] Stuart Clark, *The 20 Big Universe Questions*, Quercus 2014, P161

[g] http://hetdex.org/ - Accessed 2nd Dec 2015

[h] http://hetdex.org/dark_energy/how_find_it - Accessed 27th Sept 2016

'Are we sure there isn't some new type of dust or some other light-dimming property (like photon-axion oscillations) at work here?' [a]

With his question Siegel reminds us that the teams led by Adam Riess and Saul Perlmutter did not actually *discover* recent acceleration, and they certainly didn't *discover* dark energy; these are both inferred from the data[b]. What tends to be forgotten amid all the hype is that, in fact, what the original teams found was ***a brightness anomaly***. Siegel strives for another cause of the light-dimming, one which might require a slightly less sledgehammer-to-nut approach. However none has been forthcoming.

Gravitational Lensing

The extent of uncertainties out there mean that scientists already try different things in different scenarios – for example, astronomers may interpret redshift[c] differently depending on which model of the universe they are using. In addition, effects known as strong and weak lensing are the result of gravitation, with the most distant galaxies the victims of nearer objects which distort space like frosted glass, making them very hard to study and often requiring the introduction of software. And whilst this is being harnessed by astronomers for the purposes of observing light we might not otherwise see, it is also an all-pervasive nuisance. As the journal *Nature* cautions,

'Future surveys will need to be designed to account for a significant gravitational lensing bias in high-redshift galaxy samples.' [d]

It is expected that the James Webb Space Telescope, scheduled for launch in October 2018, will fill in many of the gaps in our knowledge. Powerfully equipped to study redshift, it should be able to see right out to the edge of the observable universe, which, in terms of the twin demisphere model, is as far as we will ever need!

A Brightness Anomaly

All things considered, the universe is proving rather baffling to science at present, and so far impervious to a panoply of approaches involving:

- Changing expansion rates over the early/late universe.
- Changing composition and behaviour over the early/late universe.
- The idea that General Relativity may behave differently over distance.

However, the twin demisphere model offers an additional range of mechanisms which may be worthy of serious consideration – after all, the data already exists which will either fit the model or it won't.

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[a] https://medium.com/starts-with-a-bang/ask-ethan-83-what-if-dark-energy-isn-t-real-dd8b0a776704#.fvvxuztvh - Accessed 25th Nov 2015

[b] Inference and evidence are not the same. If recent acceleration was inferred, it cannot logically be considered to have *'provided much of the evidence of dark energy's existence'*, as *Hetdex* assert.

[c] A list of references in scientific papers, compiled between 1974-80 by HJ Reboul and ranging back to 1910, which details 772 anomalous (untrivial) redshifts – mainly from 1965-80 – generating a number of alternative theories, may be found at http://adsabs.harvard.edu/abs/1981A%26AS...45..129R - Accessed 8th Jan 2017

[d] http://www.nature.com/nature/journal/v469/n7329/full/nature09619.html - Accessed 27th Sept 2016

In an age in which billions of dollars are lavished on increasingly precise detectors[a] this should at least spare Eddington the expense of another trip to the island of Principe!

Although *Hetdex* confidently inform us that *'…the accelerating expansion of the universe… has provided much of the evidence of dark energy's existence'*, we must remember that recent acceleration is not, in and of itself, 'evidence', but was merely *posited* by the teams to explain the evidence of the brightness anomaly. Princeton's Paul Steinhardt – never afraid to speak his mind – told the journal *Nature* in July 2007, *"I'm disappointed with what most theorists are willing to accept."*[b]

To do the real science justice we must retain our calm foundation in reason, because it remains a very real possibility that dark energy is an assumption twice removed, which would explain its stubborn and ongoing, hobgoblin-like refusal to exist.

But enough of the Standard Model…

Travelling Light

Interestingly, both teams split the light's journey from the distant supernovae into two distinct subdivisions representing the first and second phases of the light's journey. Max Tegmark writes that*'our Universe spent about the first half of its time decelerating, then the rest of the time accelerating.'*[c] Within the twin demisphere model, this pivotal mid-point in our universe's observable history is of course the site of the 2-Dimensional equator which exists as the connecting surface of both demispheres, as described earlier[d]. Therefore, a major feature of the model is the ability to infer a distinction between the journeys experienced by nearby and distant light. Understood in terms of the twin demisphere model,

- ***Nearby light*** has travelled to us through only our own southern demisphere, whilst...
- ***Distant light*** has passed through a portion of the northern demisphere, then crossed the 2D equator before continuing on the same path as nearby light through the southern demisphere.

The question we need to ask is: *'Is this significant?'*

If light from a distant object has travelled through part of the northern demisphere, this should produce a small but measurable[e] effect similar to map projection which spreads it across a region of the 2D equator that is wider than the object's original width, stretching the light's angular area so that its apparent size (as viewed by the observer) is large relative to its distance. The culprit in this case would be a completely new manifestation of something with which astronomers are all too familiar: lensing.

This new phenomenon, which I have termed ***2D equatorial lensing***, entails the 'projection' of the galaxy's image onto the 2D equator. Although the light emanates from a single source, the observer views that source projected over an angular area on the sky corresponding to its width on the 2D equator, which acts as a 'shadow boxing' screen as though the light shines right through the back of it and we view it from

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[a] In the manner of the Texas Superconducting Super Collider the law of diminishing returns may already be upon us, http://www.scientificamerican.com/article/the-supercollider-that-never-was - Accessed 8th Jan 2017
[b] Michael Brooks, *13 Things That Don't Make Sense*, Profile Books 2010, P25
[c] Max Tegmark, *Our Mathematical Universe*, Penguin 2015, P46
[d] In Chapters 26-28
[e] Using standard candles.

the front. This is a vastly scaled-down, localised version of the ‘Antarctica effect’ we encountered earlier as it smeared the relic radiation of the CMB over the *entire* surface of the observer's 2D equator.

As an 'everywhere-event' the angular diameter of the CMB is 360º, but the angular diameter of a galaxy must be measured in tiny fractions of arc-seconds because it occupies a particular location[a] within the universe. To illustrate this I use the example of a galaxy located midway through the northern demisphere – about 10 BLY – viewed face-on and (for obvious reasons) greatly exaggerated in size:

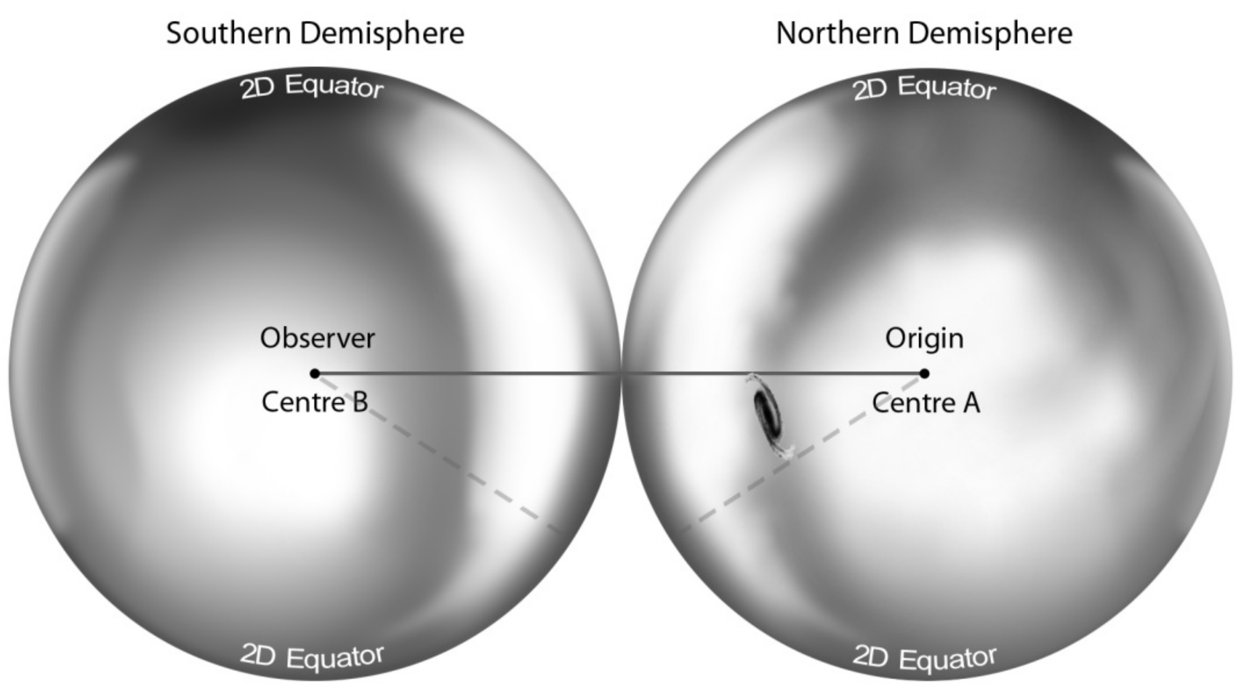

Fig.1 This shows the position in the sky of the **left edge** of the galaxy. The observer at *Centre B* views it in line with *Centre A*. We now 'roll the balls' (see Chapter 27)...

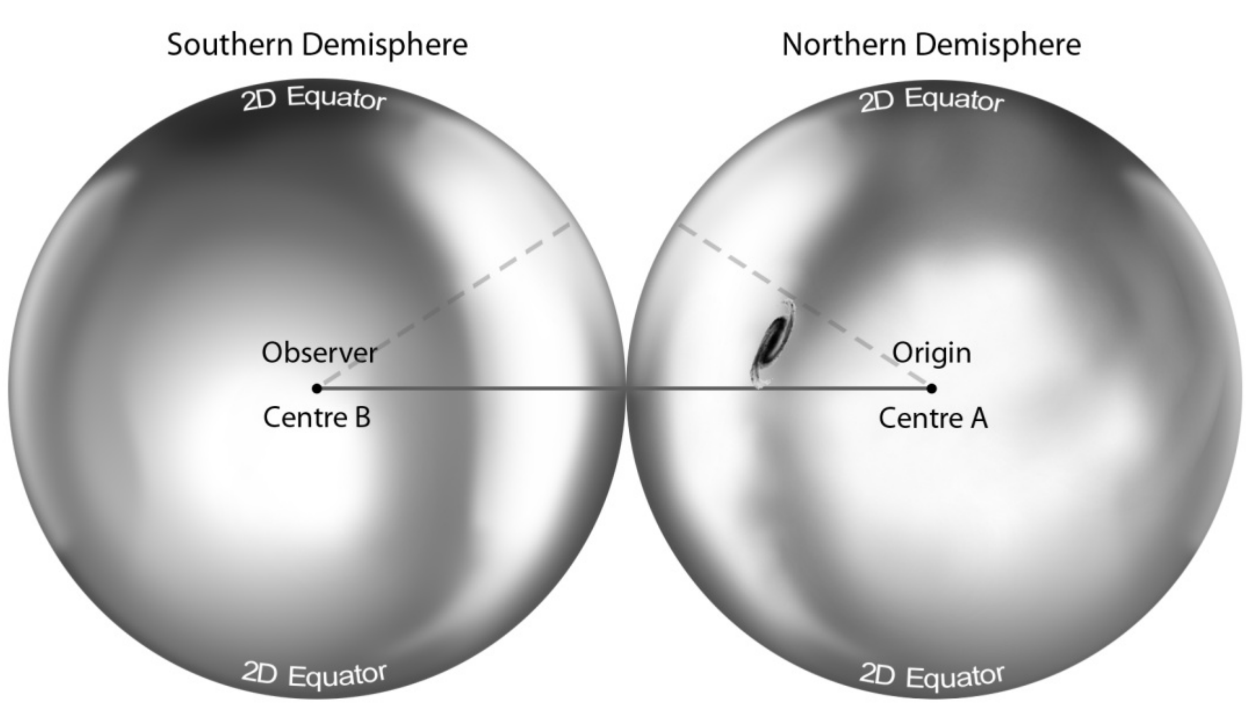

Fig.2 This shows the position in the sky of the **right edge** of the galaxy. With the demisphere surfaces in full contact, the observer at *Centre B* views *both edges* simultaneously in line with *Centre A*. (The dotted line represents the solid line from *Fig.1*)

[a] The ‘south pole’ observer at *Centre B* views the object in a 3D position at a specific 2-coordinate longitude + 1-coordinate (onion-skin) latitude between the 2D equator and the ‘north pole’ origin at *Centre A*.

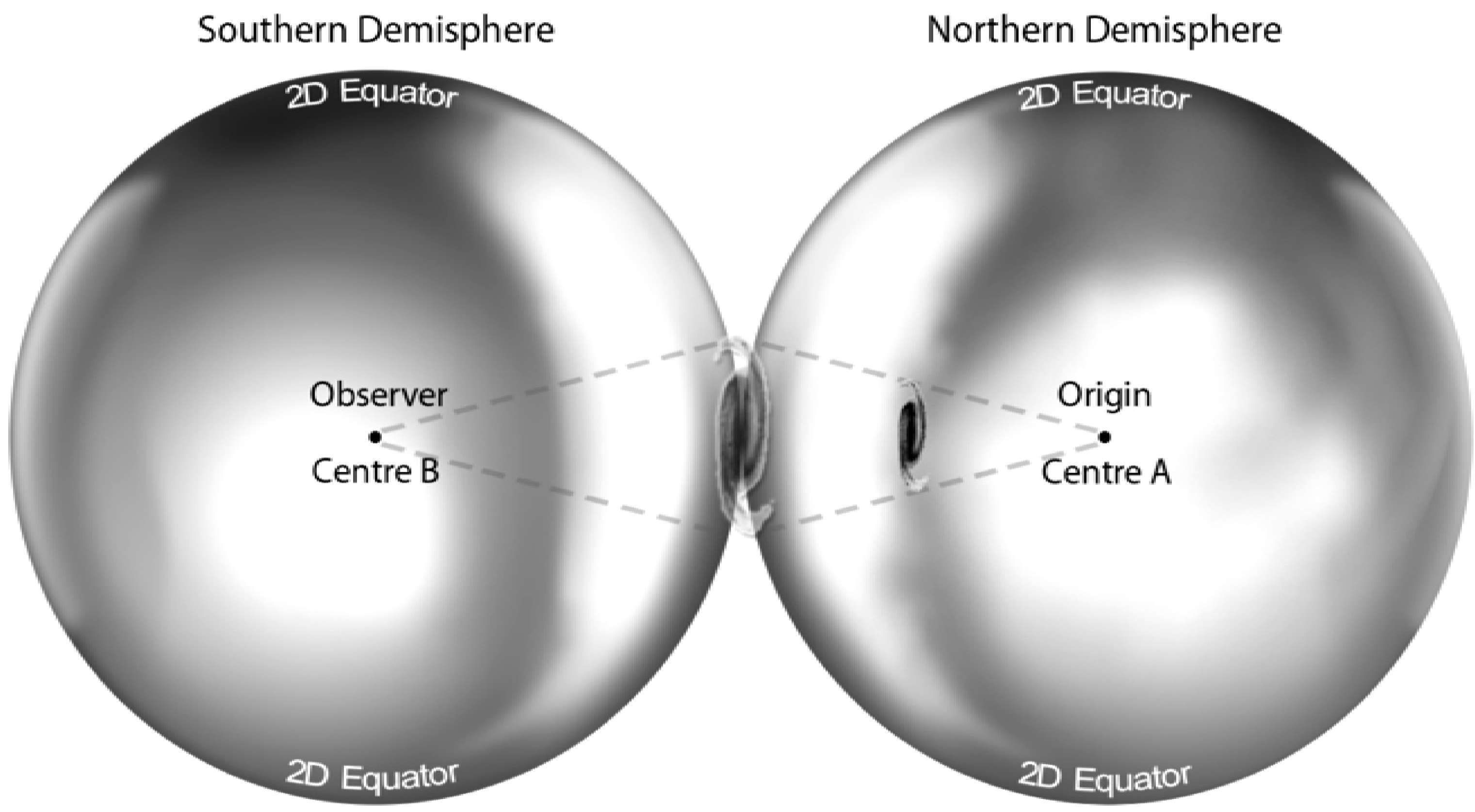

Fig.3 **2D Equatorial Lensing**. Because everything in space is in line with everything else along the *Centre A/B* axis[a], the observer at *Centre B* views the outer edges of the galaxy 'projected' onto the 2D equator as shown in Figs.1 and 2 above. Thus the observer views the galaxy magnified to the size of the projection.

Dark No More

As viewed by the observer, the galaxy's angular diameter has been magnified, causing it to appear larger than it should. Since its light has been spread over a wider area, the inverse square law tells us that it must appear dimmer than it would, were it not magnified. This effect (which is not merely optical, but dimensional) applies to everything located beyond the 2D equator and increases with distance[b]. Of course, galaxies come in all sizes so it is impossible to tell whether a galaxy's luminosity has dimmed, however, using the standard candle of the distant SNe Ia this dimming has already been discerned.

Thus the twin demisphere model of the universe furnishes us with an explanation for the brightness anomaly uncovered by the US teams in 1998 – 2D equatorial lensing – without any need to invoke changes to the expansion rate or introduce dark energy, because the high-redshift SNe Ia are not farther away than expected.

Persistent Visibility

Summarising, all objects located within the southern demisphere are observed from *Centre B* in the normal way, with no lensing[c]. Beyond the 2D equator, a distant galaxy is observed to experience an

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[a] In accordance with our earlier *Pac-Man Principle:* As viewed by an observer, the path of light is always along a section of the 3D longitudinal geodesic between the origin at *Centre A* of the northern demisphere and the observer at *Centre B* of the southern demisphere. See Chapter 31

[b] Going exponential at *Centre A*, behaving as the singularity.

[c] Whether 2D equatorial lensing exerts an influence on how light that left from within the observer's own demisphere is viewed, I cannot say for certain. For simplicity I have treated it as though it doesn't and describe this light as 'viewed as is'. However, as the gravitational influence of the northern demisphere acts as a 'negative pressure' throughout the observer's southern (tending to zero at *Centre B* as described in Chapter 37), the effect may in reality be more suffused. Should the twin demisphere model prove

increase in angular diameter due to a localised Antarctica effect, the result of projection across the surface of the equator before focussing in on the observer. This dimensional lensing effect increases with distance into the northern demisphere, enabling the largest of the farthest galaxies to remain visible to the observer longer than they ought, although lensing must cause their appearance to become increasingly diffuse, giving the impression that they are larger than they are, and yet dimmer than they ought to be for their redshift.

Online, *The Physicist*[a] mentions that just such an effect is observed,

> *'...beyond a certain distance galaxies no longer get smaller (the way things that are moving away should), instead they get redder and stay about the same size independent of distance…'*

2D equatorial lensing increases with distance, therefore a high-redshift galaxy, although it *should* appear to the observer to grow smaller, experiences greater lensing. This 'staying the same size' is to be expected from an object that is both decreasing and increasing at the same time – decreasing in luminosity with distance, and yet increasing in angular area by the effect of 2D equatorial lensing. The reddening is the redshift increase of this progressively more diffuse, steadily dimming yet ever-visible, extremely distant galaxy.

The Earliest Galaxies

Astronomers tell us that the earliest galaxies behaved differently from those that came later – they were more volatile and their stars passed through their life cycles faster, releasing heavier elements into expanding space to form other stars, galaxies and, ultimately, us and all this amazing world around us. In a Sept 2015 report from UC Irvine on new technologies used with the Hubble Space Telescope to study the signatures of these galaxies from just 500 million years after the Big Bang, cosmologist Asantha Cooray advises,

> *'…these primordial galaxies were very different from the well-defined spiral and disc-shaped galaxies currently visible in the universe. They were more diffuse and populated by giant stars.'* [b]

And commenting on *EGS8p7 Lyman-alpha*, in 2015 the most distant galaxy observed to date, NASA Hubble Post-doctoral Scholar in Astronomy, Adi Zitrin, expressed surprise that we see it at all,

> *'"We expect that most of the radiation from this galaxy would be absorbed by the hydrogen in the intervening space. Yet still we see Lyman-alpha from this galaxy." Caltech graduate student Sirio Belli added that EGS8p7 was "unusually luminous".'* [c]

The Cosmic Infrared Background

No doubt the earliest galaxies were different (see *Dimensional v Optical* below), but these observed properties of diffusion of light, persistent visibility and stretching of the electromagnetic spectrum are precisely as predicted by the phenomenon of 2D equatorial lensing.

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correct I have every confidence that my tentative guestimations will be swept aside and the correct position worked out in full by mathematicians.

[a] http://www.askamathematician.com/2014/03/q-how-can-the-universe-expand-faster-than-the-speed-of-light - Accessed 15th July 2015

[b] http://news.uci.edu/press-releases/parsing-photons-in-the-infrared-uci-led-astronomers-uncover-signs-of-earliest-galaxies - Accessed 15th Oct 2015

[c] http://www.theregister.co.uk/2015/09/05/farthest_away_galaxy_detected - Accessed 25th Nov 2015

From this we might expect that the most distant galaxies in our universe would begin to exhibit exceptionally wide angular diameters across the sky, with corresponding dimming, caused by the increasing angle of projection as they approach the distance of the CMB (and just behind it, *Centre A*). Unfortunately, as physicist Brian Cox reminds us[a], an era of total darkness lasting around 500 million years known as the 'cosmic dark ages' occurred between the release of the CMB and the lighting up of the first stars which ensures that no record of light survives from that period, 'conveniently' hiding the range over which the increase in dimensional lensing might be observed to go exponential.

However, a clear implication of this scenario is that there may have been no dark ages at all. Instead, just exponential diffusion and dimming into the range where distant light sources become visually undetectable due to their correspondingly increasing angle of projection. In such a case, the cosmic infra-red background (CIB) must represent our view of these primordial stars and galaxies – spread transparent around the sky like layers of fine filo pastry by 2D equatorial lensing, and smoothly bridging the look-back time gap – Cox's 'dark ages' – between the visible spectrum and the CMB.

In the general description within *Wikipedia*[b], the CIB is described as,

> *'in some ways analogous to the cosmic microwave background but at shorter wavelengths',*

And also,

> *'Since the CIB is an accumulated light of individual sources there is always a somewhat different number of sources in different directions in the field of view of the observer.'*

Data from these individual but accumulated light sources – occupying the frequency range between the CMB and the earliest, most distant visible objects – is (as Max Tegmark might say!) in beautiful agreement with the prediction of the twin demisphere model, caused by the increasing angle of projection with distance of 2D equatorial lensing. In their day, galaxies inhabiting the half billion year 'dark age' zone may have been just as bright in the visible spectrum as any that would follow, with extremely powerful star formation going perhaps right back to the 'last scattering'.

Dimensional v Optical

But, again, there is an elephant in the room… a particularly talkative elephant which is now asking the question, *'So if the stretching of the CMB is largely a lensing effect, how does this square with all the data which confirms the heat and nucleosynthesis of the Big Bang?'*

This is where it all gets seriously counter-intuitive because, unlike conventional optical and relativistic lensing effects such as gravitational lensing, what 2D equatorial lensing shows us out there in the universe, although 'lensed', is also real. It <u>happened</u>. This is what I was getting at earlier by making a clear distinction at the outset between the *ordinary* effects of light – optical phenomena of reflection, refraction etc. – and *dimensional* effects of light.

The universe out there is very real indeed, not in the straightforward objective sense with which we are familiar, but as a 3D spherical cross-section of the 4D hypersphere as viewed from a centre by an observer in accordance with the *Flatland*-derived *'Edge-On' Principle*[c]. As discussed in the last chapter, when the observer at *Centre B* views dimensional lensing in the northern demisphere, he or she may gather data (e.g. on the abundance of hydrogen, helium and lithium in the early universe) which, although the

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[a] Brian Cox, *Wonders of the Universe*, HarperCollins 2011
[b] https://en.wikipedia.org/wiki/Cosmic_infrared_background - Accessed 3rd Oct 2016
[c] *The 'Edge-On' Principle:* Each dimension is viewed from within itself one dimension lower.

product of an observer-centric experience of dimensional lensing, actually happened. This is not at all easy to get one's head around because the relationship between observer and observed loses all objectivity as one approaches the singularity – a process which begins less than a millimetre from your face! [a]

Alister McGrath of Oxford University recounts how when he first began to study Quantum theory in 1971 he was *'deeply challenged by its counterintuitive ideas, such as wave-particle duality.'* He continues,

> *'However, I soon came to see that what was counterintuitive for me was intuitive for those who were used to seeing the world through a quantum lens. My problem was that I was approaching quantum theory with a concept of rationality shaped by my experience of the everyday world…'* [b]

In precisely the same way we must let go of the everyday world as we approach observer-centricity, because it alters everything out there, dictating *not only how it appears to us, but what it has been through on the way to what it is to us now*. In *New Scientist*, whilst discussing a problem relating to Quantum Mechanics, physicist Joe Polchinski of UC Santa Barbara observes a general principle:

> *"In the history of science, things that seemed absolute in many important cases have turned out to be not absolute."* [c]

Einstein's breakthrough insight into the way the universe really works has destroyed forever the notion that what we see is what we get. In spite of the fact that there exists a mountain of observational data, the universe may not necessarily be interpreted solely by means of our natural physical senses.

Dimensional (i.e. 2D equatorial) lensing obeys dimensional principles rather than purely optical laws because, living as we do in our reference frame at the centre of only one demisphere, *the journey of distant light through both demispheres is impossible in terms of our natural 3D experience of length, width and height*. We must therefore brace ourselves for the prospect that a considerable element of counter-intuitivity may boggle our minds in a way not dissimilar to the workings of Special Relativity or the Quantum world.

Ultimately, the best way to describe all this will be through mathematics, at which point, sadly but necessarily, it will only be comprehensible to the specialists. That is the price of precision. But here, in fledgling form, we are all able to explore it conceptually. This is *dimensional* lensing – the lens which *actually grows the bug* – and it goes to the very heart of physics.

Ethan Siegel suggests,

> *'…it's possible that something happened to this light during their [the photons'] incredible travels from great distances to our eyes.'* [d]

I propose that 2D equatorial lensing happened.

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[a] Although, like the effects of Relativity on velocity, this remains virtually insignificant over the greater part of the distance. The reason for this is that dimensional lensing is relativistic, the product of SR (*Centre A/B*) and GR (*Centre B/B*) as described in Chapter 35.

[b] Alister McGrath, *Inventing the Universe*, Hodder & Stoughton 2015, P176

[c] *Entangled Universe*, Anil Ananthaswamy, *New Scientist*, 7th Nov 2015

[d] https://medium.com/starts-with-a-bang/ask-ethan-83-what-if-dark-energy-isn-t-real-dd8b0a776704#.fvvxuztvh - Accessed 25th Nov 2015

‘Lateral’ Redshift

Quite scarily, 2D equatorial lensing may – indeed must – play tricks with redshift[a]. As I understand it, the twin demisphere model appears to suggest that redshift may take several forms:

1) ‘Linear’ redshift due to expansion, and/or
2) ‘Lateral’ redshift due to 2D equatorial lensing.

The first of these is ‘normal’ redshift, caused by the expansion of space through which light is observed to have passed. The second may be a new phenomenon by which, because the twin demispheres share a surface, distant light arrives at us having been 'lensed at source'. This would be a dimensional phenomenon originating in the hypersphere’s 4D geometry whereby light is viewed by the observer as having been ‘emitted in a stretched state’.

However, it is also perhaps most likely to be:

3) Gravitational redshift.

As discussed in Chapter 37, if half the universe’s entire gravitational pull relates to the northern demisphere, there is bound to be a considerable effect on the observer from the stretching of the wavelength of distant light due to Relativity.

I make no pretence to understand it fully, but I believe the key to redshift lies in the outworking of *Centre A/B recession* coupled with *Centre B/B propagation* (see Chapter 35, The Information Lag). It is highly possible, in my opinion, that this could present us with scenarios requiring new physics to describe.

Behind the Glass Curtain

Clearly, if 2D equatorial lensing along the half circumference path[b] between origin and observer stretches not merely the angular size of an object in the sky but its wavelength, it must hold profound implications for our understanding of the universe. This is particularly poignant when we consider that we observe levels of redshift which have reduced relic radiation to microwaves and a temperature marginally above absolute zero.

Within the twin demisphere model, two separate but connected phenomena occur together to generate the observer’s experience of expansion, namely:

- Expansion due to *Centre A/B* recession, and
- Expansion due to 2D equatorial lensing.

The first applies to the journey of all light (as discussed over previous chapters), whilst the second applies only to light which travelled through our opposite demisphere (as discussed in this chapter)[c].

[a] I confess reticence at even suggesting this – like someone just handed me a crocodile and said, *“Hold this, I’m just nipping out to the shop.”*
[b] See Chapter 30
[c] The precise way that these two effects combine may be fairly subtle.

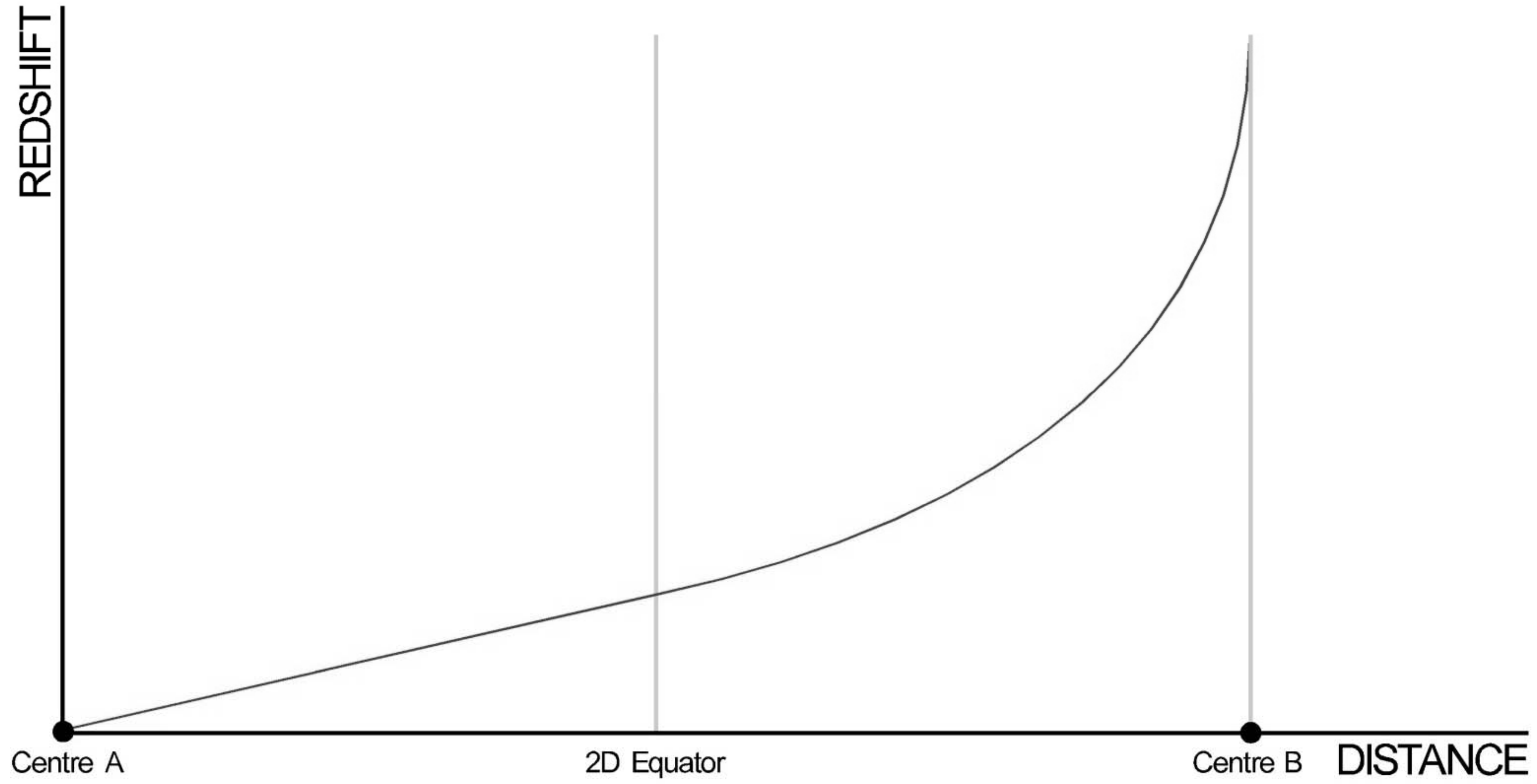

Fig.4 This curve shows the anticipated effect on redshift with distance. Redshift increases linearly between the observer at *Centre B* and the 2D equator, corresponding to the expansion of the universe due to *Centre A/B* recession at *c*. It then begins to curve due to the additional effect of 2D equatorial lensing within the northern demisphere. This effect increases exponentially as the line approaches the origin at *Centre A*, 'emerging from' the singularity which is spread uniformly across the extreme spherical surface by dimensional projection due to the 'Antarctica effect'.

At the moment we consider most distant redshift to be produced by expansion[a], however, if a form of 'compound redshift' is generated by the combination of these two it may require a serious overhaul of cosmic distance and, by implication, look-back time and the age of the universe, which could conceivably be out by several billion years[b].

Since the *Hetdex* 3D map of the observable universe out at 9 to 11 BLY will be a map of a considerable portion of the inside of the northern demisphere as viewed from the southern, I would anticipate it turning up a shedload of perplexing anomalies to add to the collection, all of which may find a reasonably straightforward explanation in terms of the twin demisphere model – if anyone is willing to accept it!

Aha!

The universe behaves overall according to the constraints of its shape, and its shape is governed by its dimensional relationship to everything in which it consists. Einstein initiated humanity's first few tentative steps into this from our 3D viewpoint with his *'four-dimensional continuum'* and we have all rested on his laurels, happy that the universe is *somehow* 4D. However – perhaps in an effort to prevent all the last remaining comfort blankets being pulled away from beneath our confidently deterministic feet – cosmologists have not yet taken on board the full implications of a 4-Dimensional viewpoint.

a Although questions have always hung over the precise causes of redshift.
b Though, I stress, not enough to render the Earth just 6,000 years old!

I believe the time has come to replace our somewhat piecemeal approach to the implications of our universe's 4D shape with something more definite (piecemeal in the sense that questions float around untethered such as… whether or not the universe is a hypersphere, whether or not the block universe exists, whether time may only be understood philosophically, etc...??)

Reflection… It is also highly likely that all these effects could be accounted for by existing effects of Relativity at work within the model, by the gravitational redshift of the northern demisphere.

Before we go on to look at whether the dimensional model can throw light on the Big Bang itself, I leave you with the words from 2003 of Nobel laureate Saul Perlmutter of UC Berkeley, leader of the Supernova Cosmology Project, one of the teams that discovered the Type Ia supernovae brightness/redshift anomaly,

> *'We live in an unusual time, perhaps the first golden age of empirical cosmology. With advancing technology, we have begun to make philosophically significant measurements. These measurements have already brought surprises. Not only is the universe accelerating, but it apparently consists primarily of mysterious substances. We've already had to revise our simplest cosmological models. Dark energy has now been added to the already perplexing question of dark matter. One is tempted to speculate that these ingredients are add-ons, like the Ptolemaic epicycles, to preserve an incomplete theory. With the next decade's new experiments, exploiting not only distant supernovae, but also the cosmic microwave background, gravitational lensing of galaxies, and other cosmological observations, we have the prospect of taking the next step toward that "Aha!" moment when a new theory makes sense of the current puzzles.'* [a]

The Twin Demisphere Model, Summarised

The universe exists as the spherical 3D cross-section of a 4D hypersphere (the block universe), breaking down into the two hemispheres (demispheres) of a hypersphere, with the origin located at *Centre A* and the observer at *Centre B.* [b]

The observer views the universe as a ball within a ball. The radius of the inner ball (the southern demisphere) is half the total radius to the surface of the observable universe. The surface of the inner ball, which Einstein termed the *'world-radius'*, behaves as a 2D equator. This equator is also the surface of the outer ball (the northern demisphere as it might theoretically be viewed from within itself) although, to the observer at *Centre B*, the northern demisphere appears 'turned inside out' as a spherical outer shell, with its 'mirror image' surface spread across the 2D equator (see the 'rolling balls' experiment of Chapter 27). This presents the observer with the dimensional 'illusion' of the centre of the northern demisphere as a single point (*Centre A*) projected by the 'Antarctica effect' over the entire surface of the observable universe.

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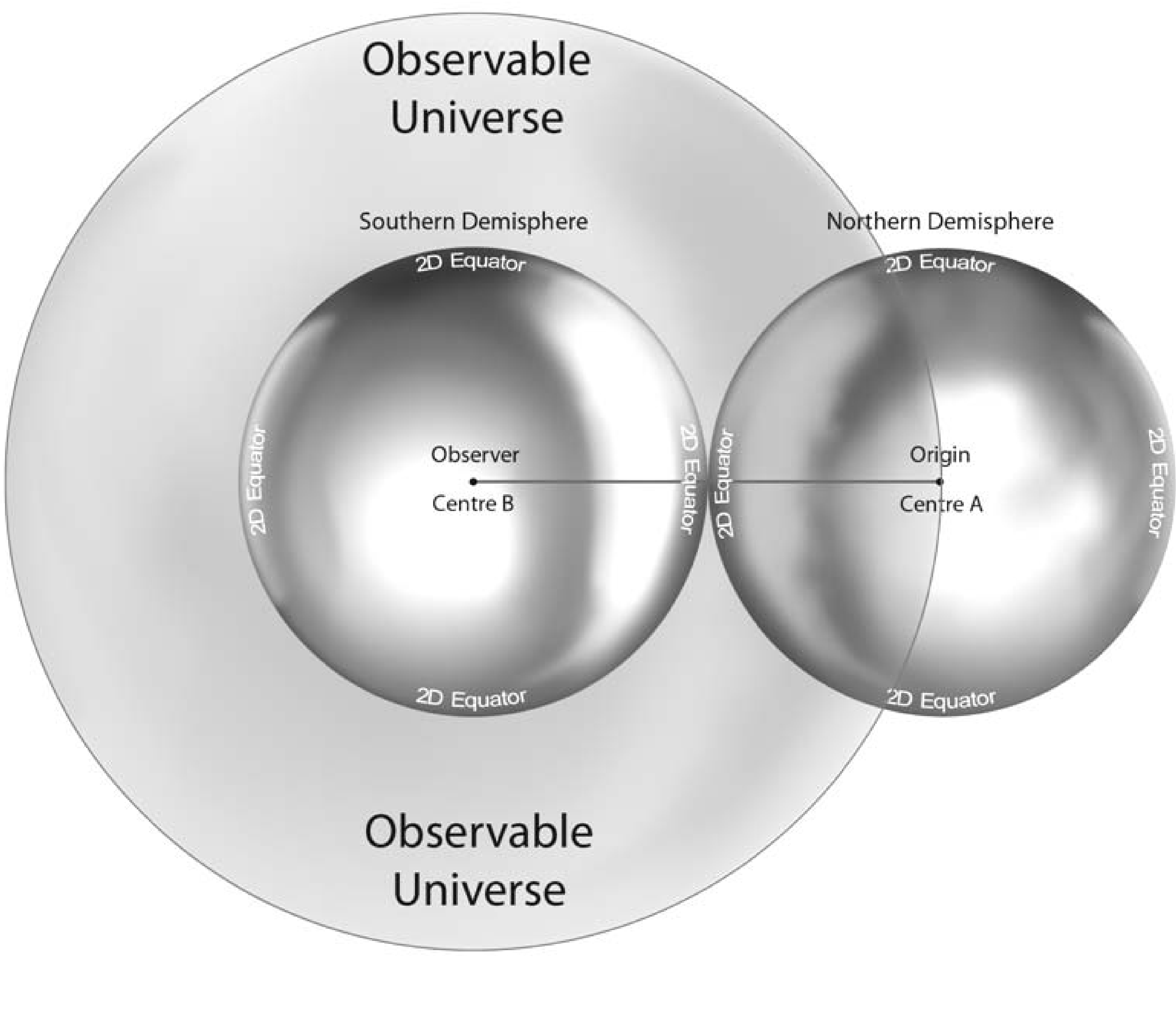
[a] http://www-supernova.lbl.gov/PDFs/PhysicsTodayArticle.pdf - Accessed 8th Jan 2017

[b] In mathematical terms, the 'twin demisphere model' describes the observable universe as a 3-sphere, the surface of a 4-ball, consisting of northern and southern 3-hemispheres with origin and observer located at opposite poles (antipodes).

The CMB was emitted 380,000 years after the origin, giving it a value of around 2.7K, suggesting that the surface just beyond it may approach absolute zero, resulting in a single theoretical radio wave from the singularity whose wavelength is the width of the universe (the distance from *Centre A* to *Centre B* – i.e. the combined radii of both demispheres = the radius of the observable universe). It is likely then that this wavelength constitutes the maximum distance between two points in the Pac-Man universe, which is what sets absolute zero at the value it has, *defining* the limit. The observed 'smoothness' of the CMB is the beginning of 'roughness' (fluctuations), with the surface itself *just beyond it* perfectly uniform (diving into *Centre A*) as it emerged from the singularity 380,000 years earlier.

Clearly a most interesting blend of classical and quantum phenomena arises within the twin demisphere model. Observer-centricity, expansion, redshift, the maximum width of the universe, the longest EM wavelength, absolute zero, the Big Bang singularity, SR, GR, and the speed of light and gravity all derive from the limit imposed by the *Centre A/B* relationship, which was itself derived from principles inherent within EA Abbott's 1884 *Flatland: A Romance of Many Dimensions*.



The Twin Demisphere Model