8 The nature of the early fourth-dimensional universe

8.1 Chance or inevitability?

As 3D and 5D remnant material dropped from the eighth dimensional lattice during what has been termed the 'big ping', its density would be dependent on the amount of stretching that the lattice experienced between the condensation of the tri-planar coordinates and the 'big snap'. As the 8D lattice expanded under the influence of fourth-dimensional scale, the 'expanse' of this embryonic universe would be increasing and the ultimate 'rebound' of the lattice boundary chords as they *ping* into 3D space, would produce a young, energetic and very crowded volume of finite space. There would be a direct relationship between the density of this embryonic cosmos and the amount of stretching experienced by these boundary chords prior to the break-up of the lattice. This initial density can be determined by a 'before stretching' and 'after-stretching' value for what was to become the whole surviving teddy and this will for the time being, coincide with the radius of nucleus and that of the electron shell respectively. This represents the rate of four-dimensional expansion during these early, but transitional periods, as the universe differentiated dimensionally. "Shear speculation", I hear the reader say - but we can't deny the fact that we *still* don't know why the atom exhibits the scale it so obviously does. It's all too easy to avoid the question completely as is so often the case and to state that it simply is what it is. Many would insist that this is all a matter of chance, but this is probably only partly true, for I believe that the processes of *provenance* have more to do with what the universe has become - now, in the present. The atom and the electron shell are the size they are not by chance, but because processes in the past made them so. In this *speculative* model at least (and I will concede that point), an attempt has been made to answer the headache inducing question of why?

The conventional 'big-bang' in this model, would herald the 'drop' of three-dimensional tri-planar coordinates into the supporting structure of the 4D universe – from their origin in what energy-wise would be the eighth-dimensional level. This 3D material would be comprised exclusively of whole surviving teddies and independent boundary chords at this stage; each of which would undergo their own (divergent) evolutionary development soon afterwards. The 4D universe in which this material was now supported, would be continuing its expansion because of its fourth-dimensional component of scale and would no longer be racing outwards at the break-neck speed that would have perhaps been evident prior to the vacuum collapse. It may indeed, have slowed to a rate that was a great deal *LESS* than that now occurring in the present. This would originally have been an expansion that occurred *without* the later influencing effects of gravity, which would not as yet, have made its presence felt. The conglomeration of material and the advent of the first hydrogen stars - followed by the evolution of galaxies, may have created what basically amounts to a steady increase in the rate of expansion over time, as gravity increased the component of 5D contraction. However, both whole surviving teddies and *IDBCs* would need to undergo their own unique forms of reconfiguration and collision, before these later five-dimensional effects of gravity would be felt by three-dimensional matter and four-dimensional expansion. More about this later though.

8.2 The early environment

These very important changes to the character of the teddies, the *IDBCs and* the structure of the four dimensional component in which they were buoyed, would lead to the evolution of multi-nucleon elements which in this model, could not have occurred by any other means. It would be the advent of hydrogen and this element's interaction with the 4D universe that both increased the rate of expansion further and allowed the process of nucleosynthesis to commence. There would be a price however and this would manifest itself as a brief period of element building that would be halted by the 'speeding-up' of expansion within the supporting 4D environment. It would then be down to gravity to continue the evolutionary process that would ultimately lead to observers such as ourselves in this multi-dimensional universe.

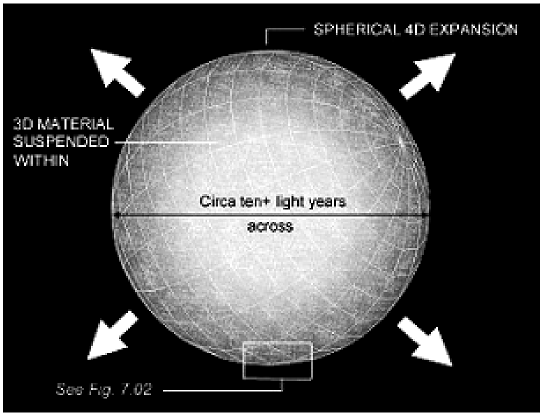

Figure 8.2.01 *The very early universe may have been no more than ten+ light years across and would therefore be extremely crowded. This would change however, with expansion.*

Not only were our own three-dimensional components evolving over time, the very fabric of this expansive fourth-dimensional environment that we now refer to as space, was also undergoing its own series of subtle transformations. It has been argued in an earlier chapter, that the embryonic universe may only have attained a radius of perhaps just a little over five light years or so at the time of the *big-ping*, when all the material that was to make up both baryonic, fermionic and all the other material we know to exist, *condensed* into what was to become our own three-dimensional part of the universe. This would be *crowding* on a grand scale, with all the matter that was to make the planets, stars, nebulae, clusters and galaxies all contained in a *minute* volume of space compared to the present (believed) size of our 3D/4D cosmos. Four-dimensional expansion would be well underway, even before the drop of teddies and *IDBCs* into what would become our part of the universe (see *Figure 8.2.01* in the previous column).

Hydrogen, deuterium, helium and even lithium are thought to have been produced in significant quantities not long after the big-bang[1], which in this model, will be seen to correspond to what has been called the *big-ping*. This crowding (putting it mildly), would produce collision, which would produce *dim-waves*; which would produce heat. The same kinds of elements were believed to have been produced within this early embryonic environment, as are *still* being synthesized within the core of hydrogen stars today. The inference therefore leads us to imagine a similarity in these two environments. Although the classic 'big-bang' does not figure as such within this model, extreme temperatures and their associated pressures (due to the close packing of teddies and IBC's) would certainly have been present and their effects would most definitely mirror (or at least be similar to), those of the early *pp1* sequence.

The synthesis of the elements at this time can be thought of as a series of distinct stages – although in reality, such events may have overlapped, depending on the physical conditions in one or another volume of 3D/4D space. Clumping will help to achieve this, as the first atomic hydrogen is synthesized (see Chapter 13). With a quantity of whole surviving teddies *pinging* into 3D space that would be approaching a figure of 10^{80} they would undergo what in this model has been christened as a *Stage 1* and a *Stage 2* reconfiguration (dealt with in the next chapter) after which, the teddies would settle down as true protons. Before examining the possibilities of just how - and more importantly *when* hydrogen was synthesized in our newly *pinged* embryonic universe, the effects and characteristics of the enclosing (and expanding) 4D component must first be understood in the context of this particular model. The expansion of the universe (again, as is relevant to the working of this model) is as a result of the four-dimensional effects of 'scale' (see again Chapter Four).

It has been argued here, that scale is the defining component of what we would consider to be the fourth physical dimension (instead of the usually allotted concept of time) and this affects all the other three dimensions (length, breadth and depth), to an equal degree. This results in a more or less spherically expansive action, but the 4D level was however, originally produced as a conglomeration of individually inflating spheres or bubbles and these ultimately joined together just prior to the *vacuum collapse* - to form a four-dimensional 'cellular' structure. Each four-dimensional boundary would come into violent contact with another four-dimensional boundary and this reaction would produce the 8D lattice from which our own 3D material would evolve.

The problem with the vacuum collapse is that it must *raise* the energy level of these impacting 4D boundaries to that of the eight-dimensional rung on the dimensional ladder – and this infers that the resultant fourth-dimension level has *lost* its previous bubble or spherical boundaries to the eighth-dimension itself. This means that the expansive 4D level is no longer cellular – and this is a logical conclusion, because there would not appear to be any observational evidence to suggest such a structure.

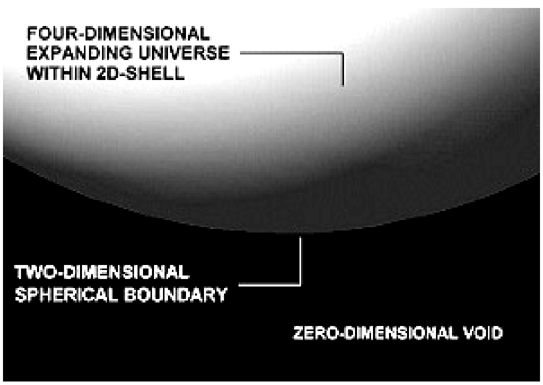

Figure 8.2.02 *The boundary surface of the 4D-expanding universe would exhibit two-dimensional characteristics on the outside surface where it meets what is effectively a zero-dimensional void (an area that doesn't actually exist in our terms).*

There would however, *still* be a hypothetical boundary that marks the 'limit' of four-dimensional expansion; very similar perhaps, to the surface of an inflating balloon; so often used as an analogy to illustrate the effects of the expanding universe (see *Figure 8.2.02* in the previous column). The internal surface of this boundary would be four-dimensional, whilst the exterior could be expected to show only *two-dimensional* characteristics (although it's not quite that straight-forward).

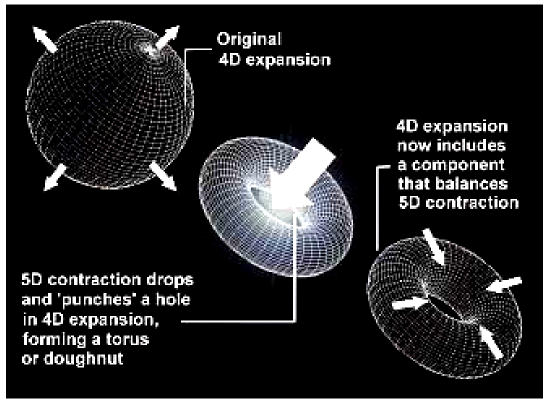

Figure 8.2.03 *Five-dimensional energy would drop to its own level after the big-snap. It would modify 4D spherical expansion to such a degree that its equivalent geometry (to us), may resemble a torus or doughnut.*

So far in this description (and in illustration), 4D expansion has for simplicity's sake, been shown to be perfectly spherical in its nature. Like the true shape of the original teddies however, this image of spherical expansion may not be quite as accurate a picture as one would at first expect. While a sphere can describe the spatial effects of expansion in probably the easiest of terms, not only may this be inaccurate in that such a universe may actually behave more like a (very large) shimmering and shifting soap bubble in this scenario; but there is another factor that must also be taken into account – and this is the concept of a contracting fifth dimensional level. This contraction may give our spherical expansion a definition that could be more akin to that of a torus - or doughnut (see *Figure 8.2.03* above). These are however, three-dimensional concepts that are trying to describe fourth and fifth-dimensional interactions. It should be remembered that *ALL* dimensions within this model, would exist together – inexorably linked in the same space and (probably) time – separated only by their difference in dimensional energy. Our own 3D material would be suspended within this enveloping energy.

Whilst the 4D universe's three-dimensional equivalent or nearest descriptive shape may more or less be likened to a torus, this may still be an *idealized* version of what really is. Perfect sphericity may not have existed at all and the torus image of the universe may itself, be distorted and constantly changing shape because of the interactions that occur within it. The concentration of mass, as the result of clumping due to gravitational attraction (dealt with in much more detail in a much later chapter), may distort, thicken or thin the walls of the torus in areas where there exists *more* 3D material. Expansion itself would as a consequence, vary too within these areas due to the *speeding-up* of this gravitational attraction (see *Figure 8.2.04* below).

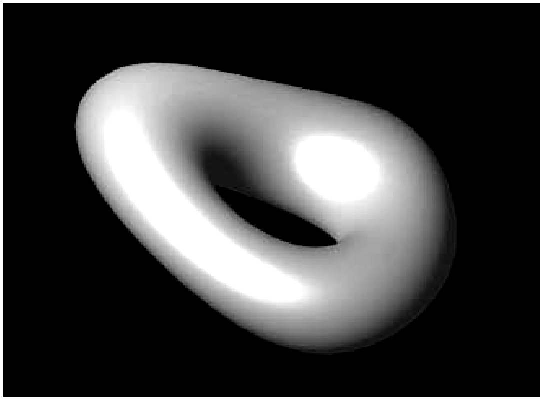

Figure 8.2.04 *The four-dimensional universe will shimmer and constantly change shape due to the interactions of the dimensional energy within. The clumping of 3D matter and the effects of gravity will also affect the rate of expansion in certain areas.*

The obvious question arises however as to why we as observers do not witness the effects of this torus (although we do witness the effects of clumping and subtle differences that we can put down to different rates of expansion). The answer to this puzzle may have everything to do with the *dimensional boundary surface waves* and the way we perceive dimensionality anyway.

8.3 The nature of expansion

Before tackling this phenomenon, the expansion of the 4D universe should be looked at in a little more detail. Chapter Four of this submission described the 'reef-knot' effect, where expansion occurred at the expense of the single dimensional strings from which each mini-expansion event was composed. This would have the effect of shrinking, or 'scaling-down' each of these component's, single-dimensional vectors. Each four-dimensional event could in turn, be considered as also comprising two 2D events etc.. In the early stages of this embryonic cosmos (pre-5D collapse), the conservation laws would be satisfied by the expansion of the fourth-dimension and contraction of the first and second.

At the moment of the *vacuum collapse*, which heralded the advent of the eight-dimensional lattice, these single dimensional string components would be so short and stretched, that the associated time-line would be (almost) instantaneous – or producing a time equivalence that was (almost) the same right across the entire expanse of the universe. In other words, the jumbled, spaghetti-like interposing and continuous time-line of the original string vector (where past, present and future could be viewed depending on the point of view), would now seem to exhibit the *SAME* but now very separate value. The above has been qualified a couple of times with the word 'almost' because at this stage, these strings may not as yet, have completely disappeared or shrunk to zero length. In our terms though, they may have already been close to the Planck scale.

Time then, may not have been quite that instantaneous; not yet. The final drop to zero length may have coincided with the big-snap itself, fuelled as it was by the continuation of expansion in both the fourth – and now eighth dimensions. This final shrinkage then *may* have actually caused the big-snap event. Consequently, the concept of time in one place would (almost) be in step with that of any other. This may be difficult to visualise effectively, so I will try to elaborate a little more.

The original ball of string that formed the initial, single-dimensional phase of the cosmos would comprise a series of condensed out time lines that theoretically, could be travelled in either direction; towards the future, or towards the past. Although completely impossible in our terms, any hypothetical observer (for this exercise), would be able to travel forward in time in the normal way, observing processes of cause and effect from his present to his future as we do. He would also however, have the ability of being able to turn round (empirically speaking) and travel from present to past, viewing effect and cause (in that order). The big-snap changed all this and what remained of the stretched out single-dimensional strings, *separated* completely as far as the boundary chords are concerned. Their time-line effectively re-set itself to zero and this would endow each *IDBC* or whole surviving teddy with what can be called its own ***time independence***.

Not so for the enveloping and supporting fourth dimension; his time-line would still correspond to that of the original ball of string *AND* still be continuous in nature. This could be defined as ***displaced time independence*** when compared to our own 3D existence and this would mean that expansion (and its time-line) had nothing to do whatsoever with our own three-dimensional concept of time. It is a completely separate entity. This would change slightly as the *IDBCs* and whole surviving teddies evolved in their new 3D environment. There would evolve a connection between them (or us) and the enveloping 4D expansion event, as dimensional boundary surface waves began to appear and propagate because of new physical processes that were to follow; but more about this phenomenon in a later chapter.

The description of dimensionality in this model was earlier likened to the concept of the 'set' and this was used as an attempt to keep track of the relationship between the first, second, fourth and eighth dimensions; together with what was called the (original) 'null-universe' (or *null-set*). With the evolution of the third and fifth dimensions (resulting as they did from the break-up of the eighth), we are now presented with more or less a continuum from null-universe to fifth-dimension that can more readily be described by this concept of the set. We can therefore, simply represent the results of this evolutionary (dimensional) sequence of events by:

$$\boldsymbol{\emptyset, \emptyset_1, \emptyset_2, \emptyset_3, \emptyset_4, \emptyset_5,}$$

where the latest event in the series:

$$\boldsymbol{\emptyset_5, = \{ \emptyset, \{ \emptyset_1 \}, \{ \emptyset_2 \}, \{ \emptyset_3 \}, \{ \emptyset_4 \}, \}}$$

We should remember that $\boldsymbol{\emptyset_5}$ is *contraction* and it is the contraction that is now being experienced by this new fifth dimensional level and would come into being at the exact moment of the *big-ping* – also experienced by our own material of course, as it differentiated from out of the 8D lattice. The fifth-dimensional level itself would be a 'remnant' energy (that was left-over from this 3D differentiation) and this can now be expressed as:

$$\frac{\boldsymbol{\{ \emptyset_5 \}}}{E} = \boldsymbol{\{ \emptyset, \{ \emptyset_1 \}, \{ \emptyset_2 \}, \{ \emptyset_3 \}, \{ \emptyset_4 \}, \}} \text{ x } E$$

which suggests that expansion will now be experienced by *ALL* of the sub-5D dimensional levels as a response to 5D contraction. We can also assume that the earlier shrinkage of the first and second dimensional levels ceased with the big-snap and subsequent big-ping, but because:

$$\boldsymbol{\{ \emptyset_4 \}, = \{ \emptyset, \{ \emptyset_1 \}, \{ \emptyset_2 \}, \{ \emptyset_3 \}, \}}$$

or the fact that the fourth-dimension in this description comprises *ALL* the lower dimensional levels that went before it; then:

$$\frac{\{ \emptyset_5 \}}{E} = E \boldsymbol{\{ \emptyset_4 \},}$$

which now gives a relationship between four-dimensional expansion and newly evolved fifth-dimensional contraction. This infers that 5D contraction takes over as the *source* of 4D expansion from these lower-dimensional levels and this may have also coincided with a change in the rate of expansion itself.

8.4 CMB (the cosmic microwave background radiation)

The observable universe appears both *homogeneous* (no preferred observing position) and *isotropic* (no difference in structure no matter which direction you look) and Edwin Hubble more or less settled the argument between *big-bang* (an expanding universe) and *steady-state* (a static one), with his paper on red shift[2] in 1929. It would take nearly another forty years before the 'big-bang theory' was widely accepted once and for all, when in 1965 Arno Penzias and Robert Wilson, two American radio astronomers[3]; claimed to have discovered a faint microwave emission that seemed to be emanating from every direction in space.

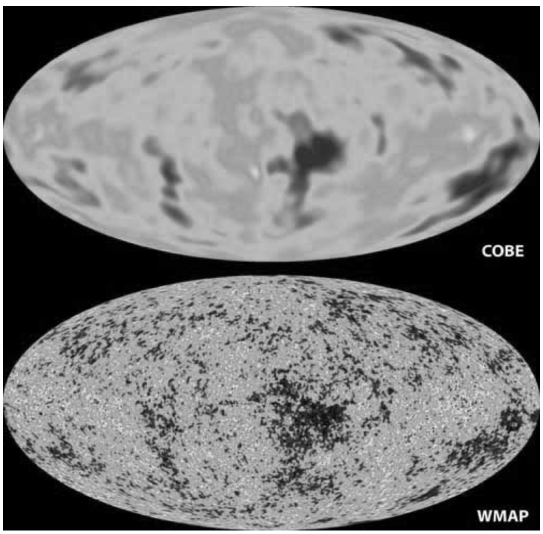

Figure 8.4.01 *The greater resolution of WMAP has given astronomers a much better tool with which to study the early history of the cosmos.*

This was of course, soon to be known as the *cosmic microwave background radiation* or *CMB* for short and it appeared to be the ghost of an almighty cosmic explosion that occurred at some time in the distant past. This 'afterglow' was calculated to have a temperature of some three degrees Kelvin (these days refined to *2.728 ± 0.004 °K* by measurement made from *COBE* satellite data[4]). Extrapolating backwards in time, this very uniform 'remnant' signature suggests that the universe was a much hotter place in its past and this tends to reinforce the case for an initial 'big-bang' type of event.

More recent observations from the *WMAP* satellite[5] (Wilkinson Microwave Anisotropy Probe), have detected some rather intriguing fluctuations in this background radiation, mainly due to the fact that this later probe has been built with a resolution that is some thirty-times better than *COBE's*. This has obviously given us a much clearer picture than we have ever had before and consequently, a much better idea of what might have been going on during the early history of our universe (see *Figure 8.4.01* in the previous column).

The *WMAP* data seemed to indicate a definite 'lumpiness' to this background radiation, but we already knew that the universe wasn't a perfect example of uniform structure. Not only do the stars, gas and even dark matter congeal into galaxies, but these structures too, can be found in clusters or groups and even within long, almost filamentary shaped super groups. The *COBE* satellite data was the first to confirm a very slight variation in the intensity of the *CMB*, but as can be seem from the comparison in *Figure 8.4.01* opposite, the *WMAP* data really makes it evident. This all seems to give us a glimpse of the evolving structure of the cosmos from a much earlier epoch and infers a clumping within its three-dimensional constituents that were no doubt in part, the result of gravity's influence (see *Figure 8.4.02* on the following page).

This too, may have contributed to a 'speeding-up' in the initial rate of expansion and this is allied to a debate that continues to rage to this day. Will this expansion continue forever, or will it come to an end? This has everything to do with what is known as the ***critical density*** and this can generally be defined as the density that sits between a universe with a total mass that is just enough to eventually bring expansion to an end and one that has just too little mass to stop it expanding.

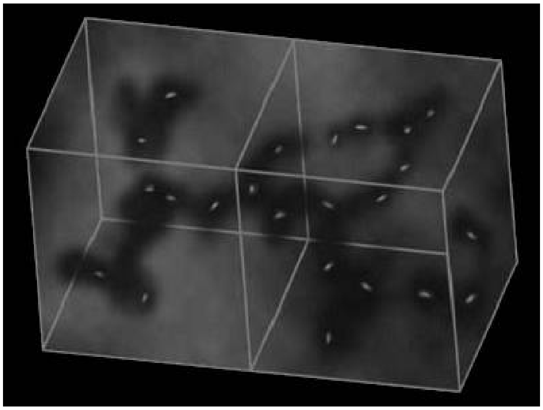

Figure 8.4.02 *Groups and super-groups of galaxies may be due to the clumping of matter and dark matter and may contribute towards the slowing of expansion.*

8.5 Initial cosmic densities

The current *critical density* stands at *circa* $1.06 \times 10^{-29}\ g/cm^3$ and this is equivalent on average, to about six hydrogen atoms per cubic metre of space[6]; in an observable universe that is believed to have a radius of some fourteen billion light years. If this *IS* the (current) average density of the observable universe now, then if expansion is to be believed, this density should have been much greater in the past.

From my attempts at illustrating a possible size for the pre-stretched and post stretched embryonic universe in the last chapter, the (assumed) *baryon number* can be used as a means of trying to estimate what this critical density may have been, not long after the *big-ping* itself. This could in turn, provide an indication as to what the cosmic radius should now be; by incorporating the currently accepted value of $1.06 \times 10^{-29}\ g/cm^3$ shown above. With a post-stretched lattice volume of *c.* $\mathbf{4.71 \times 10^{56}\ cm^3}$ and a baryon number of $\mathbf{1.0 \times 10^{80}}$ from Chapter Seven, we simply need to call on the tetrakaidecahedral unit mass value; which from page 52, was calculated as $\mathbf{1.687 \times 10^{-27}\ kg}$. This is for 'individual' teddies however and it should be remembered that they are all joined together in the eight-dimensional lattice and therefore 'share' boundary chords with neighbours. Looking again at *Figure 7.2.02* on page 47, the build-unit needs to be divided by two in order to glean a representative figure that will provide a realistic ratio for the number of resultant (whole surviving) teddy volumes and independent boundary chords that break free during the *big-snap*.

This provides what amounts to *thirteen* additional teddy volumes, or *two hundred and eighty-eight* independent boundary chords per whole surviving teddy. We also have a calculated mass for these *IDBCs*, so a total three-dimensional mass value for *ALL* the whole surviving teddies and the independent boundary chords at the moment of the big-ping, *should* be calculable. Looking at the whole surviving teddies first; this is simply the *tetrakaidecahedral mass unit* quoted above, multiplied by the believed current baryon number or basically:

$$1.687 \times 10^{-27}\ kg \times 1.0 \times 10^{80}$$

$$= \mathbf{1.68 \times 10^{53}\ kg.}$$

Independent boundary chords on the other hand, have been given a mass that was equivalent to $4.687 \times 10^{-29}\ kg$ (see again page 54) and there are two hundred and eighty eight times as many of these as there are *WSTs*. This will therefore amount to:

$$4.687 \times 10^{-29}\ kg \times (288 \times 1.0 \times 10^{80})$$

or:

$$4.687 \times 10^{-29}\ kg \times 2.88 \times 10^{82}$$

$$= \mathbf{1.34 \times 10^{54}\ kg}$$

and when added together, these figures should give us a total mass for all the three-dimensional material that in this model, appeared into the supporting structure of four-dimensional space at the moment of the big-ping - during this first, three-dimensional phase of the universe.

As density *(P)* has the relationship:

$$P = \frac{Nm}{V} \quad \text{then,}$$

$$\frac{(1.68 \times 10^{53}\ kg) + (1.34 \times 10^{54}\ kg)}{4.71 \times 10^{56}}$$

$$= \mathbf{0.003\ kg/cm^3}$$

Therefore, not long after this model's big-ping, our three-dimensional material would be suspended within a four-dimensional expansive universe that in this exercise, would have achieved a volume roughly equivalent to $4.71 \times 10^{56}\ cm^3$ and consequently, its average density could be said to equate to something like ***3.0 grams per cm^3*** or approximately three times the density of water.

This is an enormous figure when one considers the current value quoted on page 64 and returning to the *critical density*, it should now be possible to work backwards with these results to see what kind of volume the current critical density and estimated mass can give us. Therefore, from the expression above:

$$V = \frac{Nm}{P}$$

and as the current critical density *(P)* is *circa* $1.06 \times 10^{-29}\ g/cm^3$ and the overall mass *c.* 1.50×10^{57} grams (which should have more or less remained the same); we can calculate a current volume thus:

$$\frac{1.50 \times 10^{57}}{1.06 \times 10^{-29}} = \mathbf{1.41 \times 10^{86}\ cm^3}.$$

Therefore, using a known (estimated) *current density* and an estimated overall mass derived from a *baryon number* of 10^{80}, this model's universe would have expanded to an incredible radius of ***34 billion light years***.

This is something like twice the currently accepted estimate for the radius of our (known) universe and will no doubt be considered as highly speculative on the grounds that both the baryon number and the quoted densities are themselves far from certain at this stage. There is also the problem with communication and this needs to be explored in a touch more detail.

8.6 The horizon problem

It was hinted at on page 63, that observations of the cosmic microwave background *(CMB)* using *COBE* and *WMAP*, have shown the universe to be both homogeneous and isotropic and thus quite surprisingly 'smooth' in all directions[6]. As the *CMB* is the cooled, ghostly remains of the radiation density believed to date back to a radiation-dominated phase of the big-bang itself, the observed variation in its temperature range right across the sky are actually very small. It is believed that such radiation can only be as uniform as this, if the photons have been mixed up in a process known as ***thermalisation***, which occurs during particle collisions. This does seem to cause one or two problems for the conventional big-bang model because such particle collisions would not be able to move information around faster than the speed of light. Even in a universe with a radius of only some fourteen or fifteen billion or so light years, photons moving at the speed of light would not be able to get from one side of the universe to the other in time to account for this observed isotropy in the cosmic microwave background radiation. The distance a photon can travel as the universe expands is known as its ***horizon size*** and this is believed to be too small to account for the isotropy witnesses in the *CMB* and would therefore, not seem to have been able to evolve naturally by the afore mentioned process of *thermalisation*.

This has become known as the ***horizon problem*** and would be even more of a headache in a universe with over *twice* the currently accepted radius. There could however, be quite a simple and straightforward solution to this problem, although it involves a subject that has caused considerable debate over the last decade or so. It concerns the *constancy* of the speed of light.

Since the late nineteen-seventies at least, there have been dozens of published papers all asking the same question. “Is the speed of light really a universal constant?”; (Trottskii[7] 1987; Montgomery[8] 1990; Moffat[9] 1999; Albrecht & Magueijo[10] 1998; to name but a few). This often enters the realm of the ‘creationist’ and ‘evolutionist’, who are not usually regarded as ‘main-stream’ in their approach and are thus treated with a certain amount of caution. This is not a bad thing of course, because all new ideas should be open to criticism, but the concept of a changing speed of light over time – especially within an expanding medium, is an interesting one. If boundaries are added to this equation, a difference in (apparent) light speed as the result of a differing product of expansion becomes a logical conclusion. I will try to explain what I mean.

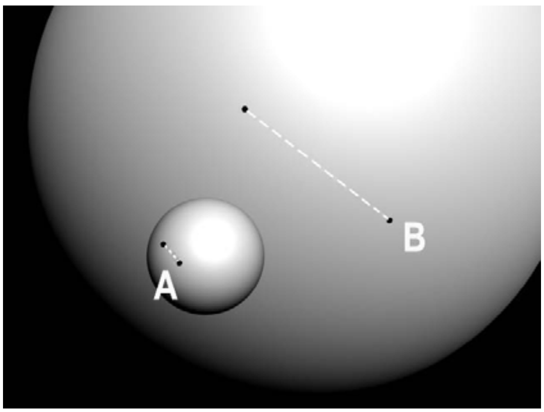

Figure 8.6.01 *The distance between two adjacent points will increase due to expansion. If this separation on sphere ‘A’ is one, it will be seven on sphere ‘B’.*

Imagine the familiar analogy often used to represent the expanding universe; a balloon. Any two points on its surface will move further apart as the balloon inflates (see *Figure 8.6.01* above). If we have a well-trained money spider who walks at a constant speed from one felt-tip point on the balloon’s surface to another, we can let him represent the speed of light as a universal constant – and this itself, doesn’t have to change. We also need to imagine the surface of our balloon as a *BOUNDARY* surface for in this model, light (as a *dimensional boundary surface wave*) will propagate *AT* this boundary; between third and fourth dimensional energy levels.

The two felt-tip points on sphere or balloon ‘A’ in the illustration can be given the value of *1.0* in this exercise and its radius will equate to approximately *2.3*. If our trained money spider is made to walk at constant speed from one point to the other, we can say that it will take our pet exactly 1.0 *unit of time* to get there. Sphere ‘A’ is then inflated to the size of sphere ‘B’ and as it expands to attain a radius of approximately *4.7 times* that of the original, the felt-tip points will move further away from each other as a consequence. Their separation now becomes approximately *7.2 times* greater than before and this means that our spider will (at the same constant speed), take *7.2 units of time* to cross the distance between these same, two points. Our spider hasn’t slowed down his pace; the distance he has to travel has increased.

This example is of course, on a very small scale and the expansion of our sphere or balloon has only involved an increase in radius amounting to a factor of just under five. The separation between our two felt-tip points has however, already increased by more than seven-fold. Within current convention, if ‘Spiddy’ had his own built-in speedometer, he would see no difference in his velocity while travelling across the surfaces of either sphere ‘A’ or sphere ‘B’. This is all very well, but if we take the ‘real’ universe into consideration there appears to be a flaw in this logic, because the separation between any two points always seems to *out-pace* the rate of radial expansion.

We are playing with three-dimensional geometry however and the ‘real’ universe doesn’t really work like this because of its extra-dimensional components. As felt-tip points on the surface of a hypothetical balloon universe ourselves, we do not experience this radial movement which in turn, creates the above example's increase in separation between any two points. Any boundary behaves as though it is two-dimensional in nature and the surface of our balloon is no different to this *IF* it too, is considered as the boundary between two very different energy levels. In this regard, the wave properties of light (and the rest of the electro-magnetic spectrum for that matter) will always be seen to travel at the same velocity across this boundary (in the proverbial vacuum) but, the hypothetical separation between any two points will increase because of continued expansion. This will be a purely fourth-dimensional phenomenon as this is the expansion of the universe itself. Our analogy of an increase in separation between any two points will in four-dimensional terms, relate to a *DECREASE* in this expansional phenomenon at the 3D/4D boundary; more expansion in a small, young environment, but *decreasing* with age.

This would have profound consequences on our *horizon problem*; in fact, the horizon problem completely disappears because light in this early, embryonic universe would have had much *less* (boundary) distance to traverse and would have therefore got to where it was going in a much shorter period of time. Its wave velocity in our terms would indeed appear to have slowed, but it is the boundary conditions that have really changed. Over time, one would therefore expect a change in the constancy of the speed of light, but this is simply illusional.

We also have to take into account the duality of light and its associated particulate nature and we shall continue this discussion within a later chapter. For now, these changes in the boundary conditions can allow for the possibility of a much larger universe and one that may indeed have attained a radius of some thirty-four billion light years. Its isotropy would be the result of early communication within a medium where light appeared to travel much faster due to the effects of four-dimensional expansion.

Returning to the ways in which we try to define the universe in the first place, another possible method of looking at the dimensional relationships within this model may be to borrow the concept of 'fibre-bundles'[11]. These have been used by theorists in the past, as a way of defining or describing the need for 'additional' spatial dimensions other than those with which we are more usually accustomed. The problem at the moment, is *HOW* to adequately picture this dimensional hierarchy in terms of a more conventional approach and there is the added headache of the original first and second dimensional levels, that must be allowed to 'shrink' due to conservation, as the fourth begins its scalar expansion in the opposite direction. There is also the added dilemma as to how the contractive fifth dimension should be handled as far as its value and functions go.

8.7 Illustrating dimensionality

It is of course still 'early days' in this model's evolution and this is an attempt to basically illustrate to others, just how these dimensional energy levels may best be shown to fit (naturally) together.

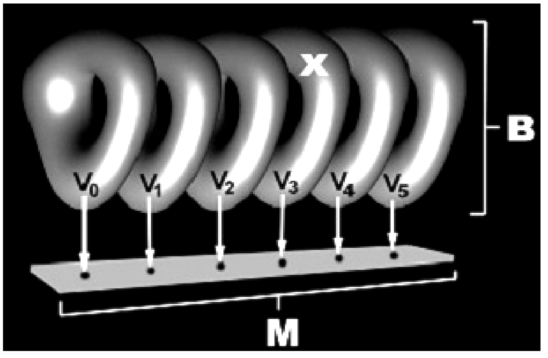

Figure 8.7.01 *The dimensional relationship within this model may perhaps be likened to 'fibre-bundles', where each currently remaining dimensional level is represented by an appropriate 'fibre' (shown as a series of V's in the illustration).*

The modified 'fibre-bundle' used here, should be regarded as merely a *further* layer within this illustration – and has been included in order to try and present a somewhat clearer picture of the relationship that exists within this model's multi-dimensional view of the universe. This illustration has been included as *Figure 8.7.01* on the previous page. This fibre-bundle is marked 'B' in the figure and can be defined in terms of two manifolds; namely the 'baseline' marked 'M' and each of the fibres (V_0, V_1 etc.), which together, make up manifold 'B'. Manifold 'M' represents the relationship *'space-time'* - which unusually for this model must therefore specifically involve an *observer*. The projection from each fibre (marked by an arrow), represents the collapse of each of these fibres (V_0, V_1 etc.) down to a single point.

The 'X' marks our own position within the sequence of manifold 'B' and in this context,

$$\mathbf{V_0 = Ø;\ V_1 = \{ Ø_1 \};\ V_2 = \{ Ø_2 \}\ .....}$$

but the bundles *do not* represent relative (evolved) sizes, only their relative positions at any particular moment in space-time. No matter how one extends manifold 'M', the 'now' points of each or any fibre, will always run parallel to each other and each will be just a moment ahead or behind a neighbour in time. They can never meet or coincide at the *SAME* point in either space or time and each particular fibre remains hidden from every other (which also has similar consequences for an observer) and this is what was meant by *displaced time independence* on page 62. These are still merely two or three dimensions concepts, attempting to describe a complex multi-dimensional universe in non-mathematical terms and the above are simple examples of illustration. What the 'torus' model infers however, is that observation itself may be slightly misleading. The last point that this chapter would argue is that the behaviour of the waves through this four-dimensional environment (which *doesn't* specifically include time in this context); are primarily the tools of the observer's trade.

We have not as yet, seen any indication of a *limit* to the observable universe, even though our instruments have increased in sensitivity many times over the years. If we can also believe my stab at the universe's present radius, then it would be a great deal larger than we originally thought anyway. We have observed 'unusual' phenomena close to the limit of these instruments' capabilities that because of distance and the speed of light, may lead us to conclude that we are witnessing events that occurred at some earlier evolutionary stage in cosmic history. We should be careful at jumping to conclusions however, because as inferred within the last couple of pages, wave propagation and expansion may not make easy bedfellows. Whilst we are completely comfortable with the 'speed of light' at relatively close ranges (i.e. within our own galaxy or local group); expansion (and therefore red-shift) may itself be a little misleading. The measurement of distance is pretty straight forward, but its association with time may not be quite so because we must take into account expansion *AND* the possibility of *differing* rates of expansion over time. A hot, young, relatively small embryonic universe may be expanding at a proportionally greater rate than an older, larger, cooler one and it has already been discussed that relative distance between two identical points will be seen to be greater in an older universe than in a younger one.

8.8 Expansion, distance & shape

Referring back to *Figure 8.2.01* on page 59; the points of the white arrows that label the diameter of this embryonic universe as *'circa* ten+ light years across' obviously infer that light will take '*circa* ten+ years' to travel from one point to the other. An observer at one point will see the light that left the other point ten+ years in the past. As expansion takes hold, one could theoretically choose an *EXACT* moment in time when the separation between these two points becomes twenty+ light years; but something a little unsettling is going on. It should now logically take a full twenty+ years for the light from point A (from this exact moment in time) to reach the observer at point B, but because of expansion and this observer's own measurement of the associated red-shift *(Doppler Effect)*, he already knows that point A is twenty+ light years away. The light reaching his eye (now) has not however, taken 'twenty+' light years to reach him, but instead - would have left point A at some time *BETWEEN* ten+ and twenty+ years beforehand. He can state quite confidently that he is correct with his calculation of distance but, because the change in red-shift (due to expansion) appears instantaneous, his estimation of the age of his image of point A, with reference to its apparent distance - is a little suspect.

We are used to saying "the light from that galaxy has take 'x' amount of years to reach us", when we should be saying "the light from that galaxy *WILL* take just over 'x' amount of years to reach us". Relative age would in reality, seem to be somewhat out of step with relative distance and this can again be illustrated by our examination of our balloon analogy shown within *Figure 8.6.01* on page 66.

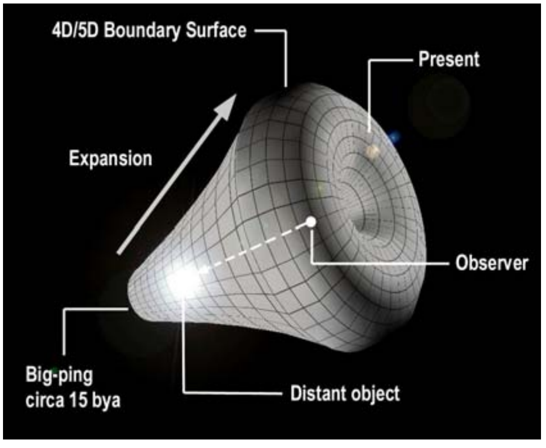

Figure 8.8.01 *To an observer looking at a distant object (and consequently looking back in time), the universe may appear to be trumpet, horn or cone shaped instead of the simple torus described earlier.*

This also raises the issue of what we perceive the 'shape' of the universe to be, as we peer backwards in time over greater and greater distances. There is no doubt that the further away we look, the further into the past we delve and in this context, the torus model may actually be more akin to a trumpet, cone - or what is also known as ***Gabriel's Horn***[12] (see *Figure 8.8.01* above). It may not be that surprising that a (hypothetical) limit to the extent of the observable universe is dimensional in nature. The internal volume of the three-dimensional torus or doughnut (or indeed cone or trumpet), does not in itself, play a part in this description of the 4D universe. Whilst one could theoretically speed around the inside in a never ending circle, passing 'go' many, many times, it is the *surface geometry* that defines just what the nature of 4D expansion actually is.

It is the *EXTERNAL* surface of this extended torus that defines expansive 4D space; whilst the *INSIDE* surface can be thought of as being the contractive fifth-dimension. Both surfaces (in three-dimensional terms), actually appear two-dimensional to us and, just like a boundary between two dissimilarly dense rock strata, *dimensional boundary surface waves* may be forced to propagate in a seemingly two-dimensionally way. In other words, as a dimensional boundary surface wave is produced, it will propagate radially outwards across the external surface of the torus like a ripple *AND* across that of the internal surface if its energy is high enough. Both surfaces will be seen to be 'infinite' in that they are not marked by any physical boundaries and without the natural process of attenuation, a dim-wave could be expected to ultimately return to its starting point at least once during its lifetime. Attenuation of course, either prevents this from happening – or the dim-wave becomes so weak as to make the detection of its return almost impossible.

What of the world that lies within the volume of the torus itself? Well, this is a three-dimensional trap and it should be remembered that the torus, horn or cone – or indeed the original picture of the inflating balloon – are all analogies which allow us to more easily picture higher dimensional concepts. It is the *behaviour* of the geometry and not the geometry itself that is relevant here. The fabric of 'space' itself is likened to the surface of an expanding balloon that we most usually picture as spherical. We can of course, get all kinds of other balloon shapes, like the long sausage types you make balloon poodles and reindeer from – and not forgetting the kids' rubber rings and swimming arm-bands, that are actually really just *torus-shaped* balloons; and what about car and bicycle tire inner tubes? An ordinary balloon or beach ball is simply spherical, but in this model, the drop of a five-dimensional component has altered this 'spherical' expansion to something that must include a component of contraction. The analogy of the torus shape allows this to occur, although it can of course open a whole shelf full of those proverbial 'can of worms'. A sphere can in theory, expand forever, but the torus has its limits. Sooner or later, the 'inside' surfaces of the torus ring must touch as expansion continues which in this analogy, would coincide with the depletion of contractive, five-dimensional energy. Remembering that it is this space (for want of a better word) inside the torus ring (and this space only) that represents 5D contraction; expansion could logically be expected to cease when this point is reached unless expansion can feed on something else. Once again, the difficulty is in trying to picture higher-dimensional concepts in our own three-dimensional terms.

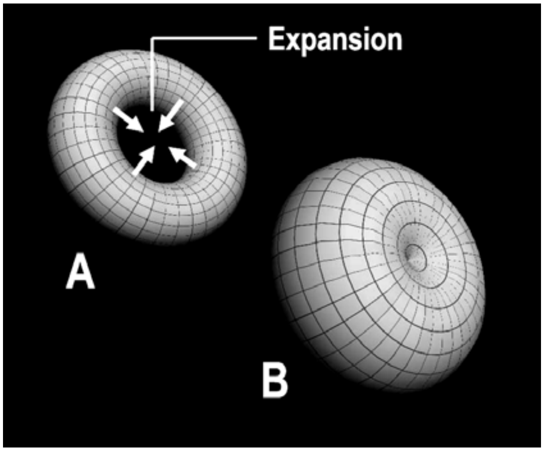

Figure 8.8.02 *As the torus expands outwards (A), the space within the ring will grow smaller and smaller, until the inside surfaces touch (B). This will coincide with the depletion of five-dimensional (contractive) energy.*

So what *would* lie within the volume of the torus? Well, one has to consider the geometry of this system as representing the entire multi-dimensional world from single, right the way up to eight dimensions. Its surroundings represent the null universe and nothing else exists. First, second and third dimensions can only be pictured as suspended within the surface that makes up the fourth-dimension which as stated earlier, can be thought of as comprising the enveloping skin of the torus's geometry; while the fifth becomes basically the hole in the middle.

The internal torus volume (its interior), can represent only one other concept – and this is the empty void left over from the differentiation of the eighth-dimension. This is where the 8D lattice used to be and I rather like this particular analogy, because it allows the room for 'other' possible phenomena such as warping, worm-holes and even Sci-Fi's 'hyperspace'. Within the context of dimensional evolution, this is a *real* empty space. It allows therefore, for *deformation* within the fabric of four-dimensional space; just as five-dimensional contraction has bored its way through the axis of the original sphere to form the central tunnel (or worm-hole if you like) of the torus itself. Such a connection between internal surfaces would provide the proverbial 'short-cut' across four-dimensional space, but this will not be explored in any great detail here.

In the present then, the universe would have evolved into an isolated, compact and perhaps inter-connected system of differentiated dimensions whose analogy may best be pictured as torus or trumpet shape in our more familiar three-dimensional terms. It will be a dynamic place where interactions occur across dimensional boundaries and of course, within them. These phenomena will not occur just out in the depths of space, but also right here on our own doorstep and especially within the confines of the atom and its nucleus. This would be the realm of the *dimensional boundary surface wave* and these interactions within the nucleus will be examined next.