4 The evolution of fourth dimensional expansion

4.1 Transition to four dimensions

The release of single-dimensional energy during our higher-dimensional matrix de-gassing event and its subsequent evolution into two-dimensional membrane energy, provides the *mechanism* that kick-starts the next transformation in the differentiation of this hypothetical embryonic universe. It is somewhat difficult to picture such dimensional states in the mind's eye, although we can imagine what a two-dimensional concept is like (basically a flat surface), because we have the advantage of an *extra* dimension, which gives us a kind of overview. Likewise, we have previously assumed the fourth-dimension to comprise either the concept of 'time' or the curvature of space, depending on your views; although there is considerable debate regarding the need for a visible, observer friendly ‘3+1’ dimensional space-time anyway. It is here that this model begins to diverge somewhat from the conventional path.

Another way of looking at these transformations (and in a way that seems to perfectly describe them), is to borrow the very familiar concept of the 'reef-knot'. Returning to our dimensionally differentiating model; the *intersection difference* (between two now two-dimensional intersection points) shrinks closer to zero because in order to satisfy conservation laws, this new 2D *membrane energy* must tap energy from the single-dimensional strings *between* the intersection difference. The membrane values themselves can be considered as ‘point’ values, in as much as they occur only where two single-dimensional strings or vectors cross each other. Each loop area will therefore comprise *TWO* membrane values and the separation between these points will diminish until a point must be reached when these two previously independent values must eventually combine.

This will occur because the timelines that previously separated them (single-dimensional string segments) will have shrunk to zero, placing them effectively within the *SAME* time-span. Using the reef knot as the analogy, we arrive at a new compressed area that includes the intersection of *FOUR* single-dimensional strings and these now form what could be likened to an extremely 'tight' reef knot (see *Figure 4.1.01* below).

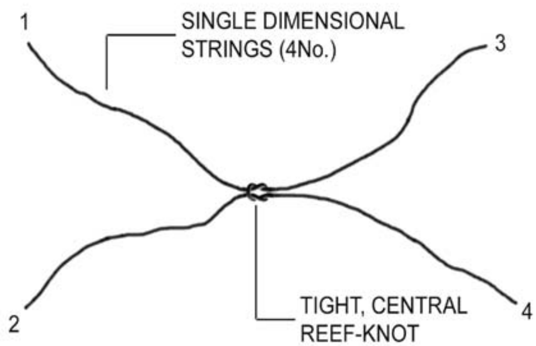

Figure 4.1.01. *As the intersection difference shrinks to zero, the tight central knot has the characteristics of a four-dimensional entity, equivalent to the four, single-dimensional string energies to which it is connected.*

The knot becomes a singular entity (because it can now be considered as a single time-span) and will also be equivalent to a total of *FOUR* single-dimensional string values to which it is connected. This central knot is now in essence, *four-dimensional* in nature and again, we need to be able to define it in terms of dimension energy. Up until now we have been using our humble cube to help us, but there now appears to be an obvious problem, because our cube has only got three degrees of freedom so it doesn’t really help here at all.

This transition from two to four would also seem to create another problem as far as *our* place in this hierarchy is concerned. Each of the original two-dimensional intersection points would have inherited *TWO* physical dimensions, (one from each of the strings involved in the intersection event). It is not therefore, unreasonable to expect that a reaction between any two of these individuals (the 2D membrane values that were originally separated by and at the same time both components of an intersection difference); to follow suit and result in the formation of a new entity that will evolve with a total of *FOUR* physical dimensions - the sum of those derived from each of the two approaching intersection points.

Perhaps the most puzzling outcome of this event, is that this would seem to *JUMP* a rung on the ladder of hierarchy; missing out as it were, the dimensional part of the universe in which we would expect to find ourselves (setting aside for the moment the currently allotted fourth dimensional concept of time which is not now of course, defined as such within this model). It seems rather unlikely that the universe would purposely just lose a physical dimension along the way, when two lower dimensional entities collide or combine. This seems to suggest that there is something rather subtle going on within this evolutionary process and we will come to this point shortly. Continuing logically along this line of thought, this 2D + 2D event must logically produce a higher dimensional state, now with a total of *FOUR* conserved physical dimensions, which would at first glance, appear to skip a level. A four dimensional universe (sans time), would seem to have a *surplus* physical dimension when compared to ourselves. If this is not the dimension of time, how would such a phenomenon manifest itself and how could we best describe it? How could we as three-dimensional observers, best compare this new set of characteristic to?

4.2 Scale

This question as to ‘what is’ the fourth-dimension, has been debated for centuries and although we tend to these days think immediately of 'time' as the fourth-dimension, this has not always been the case. The works of Aristotle and Euclid are perhaps the earliest references we have on the subject, although they both more or less dismissed the possibility out of hand. Later, Ptolemy even went as far as to provide proof against the concept, by inviting his reader to draw three lines each perpendicular to each other - and then asked them to try and add a fourth, perpendicular to the original three. This is of course, impossible. The cusp of the nineteenth and twentieth centuries produced a flurry of interest in the fourth-dimension and perhaps its most famous proponent was the mathematician Charles Hinton who is often better remembered for his colourful and somewhat unorthodox private life. He did however, produce a lasting legacy, by inventing a name for what is known as the 4D 'hypercube[1]' which was often used as a tool in trying to visualize the fourth-dimension by first examining how a simple cube might be experienced by two-dimensional beings. This he called the ***tesseract*** and can basically be described as a generalization of our own 3D version of this box. One way of projecting this geometry into two-dimensionality is known as the *shadow method* and a version of this will be borrowed here in order to help illustrate what will be this model's definition of its own evolved fourth-dimensional level (see *Figure 4.2.02* below).

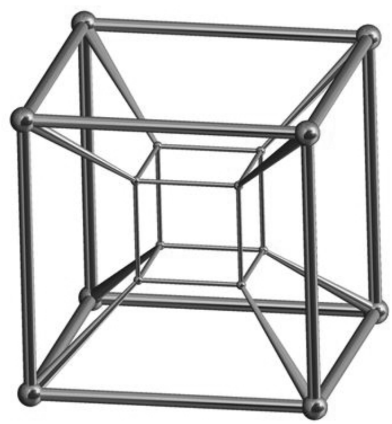

Figure 4.2.01 *The 'shadow method' version of Charles' Hinton's tesseract clearly illustrates this model's definition of the fourth-dimensional level.*

The *tesseract* actually defines this model's four-dimensional concept rather well, because this needs to be a characteristic that affects the other three dimensions all to an equal degree. Ptolemy showed that it didn't work by attempting to add another perpendicular to the equation, but it is *still* possible to add a definitive parameter that will satisfy all these requirements and this will be seen to be the concept of ***SCALE***.

This new dimensional parameter would have the ability of being able to influence the three degrees of freedom (3D) that we are so familiar with; namely that of length, breadth and depth. The magnitude of this scale would itself, be determined by the integral dimension (or actually vector) of time, which as already mentioned, would be an inclusive property of single-dimensional strings in the first place. An important consequence of this last statement is that while scale can and does influence all three degrees of freedom within what has become our own three-dimensional world, it is *not* an addition to what was an already existing three-dimensionality. Scale (as a separate 4D world, came first and was three-dimensionality's evolutionary forerunner from which it was later differentiated. I will try to elaborate upon this in due course however.

Our own perception of *scale* is a separate property however. In its basic form, scale in our terms, can simply be considered as the size of an object or event - although in this context, it simply describes what has *already* happened in the construction of an object or event in our world. It has already been shown that a three-dimensional object in our world can usually be defined by its position along three planes, namely an 'x'-axis; a 'y'-axis and a 'z'-axis; each of which are of course the perpendiculars that Ptolemy referred to earlier. They will provide a coordinate that dictates where they are in three-dimensional space. Using this always-present (now) uni-dimensional vector we call time, we can construct any object we please, through manipulation of any one, or indeed all three of these axes. We could for example, build a cube, a sphere or a pyramid or whichever solid we care to choose, simply by applying time to each of these coordinates (all translated into work of course).

We can also undertake a more abstract example, by producing a drawing of a cube, a sphere, a pyramid or even a building for that matter and add whichever scale we desire. The drawing may represent an object at full size, one-twentieth its actual size, or indeed any scale we wish to choose. It doesn't change any three-dimensional characteristic (or ratio) of the object or event, because this has already occurred in the past when we produced the drawing in the first place. Scale as the fourth physical dimension, in what could now be defined as the fourth-dimensional state $\{Ø_4\}$, would provide a very real characteristic that would affect *all* the other three dimensions in real-time. The illustration of the tesseract that comprises *Figure 4.2.01* shows this very clearly, as the inner and outer component all have exactly the same proportions - apart from their size - or their scale. The reasons that scale *CAN* be applied in this way, is similar to why we were able to do our parlour trick with the two-dimensional hexagon in Chapter 2. There is a provenance that connects all our evolved dimensions.

Returning to our own evolving embryonic universe; still governed by the *inclusive* vectors or timelines incorporated into the original single-dimensional strings, *scale* as a real component within these newly emerging four-dimensional events (of zero intersection difference), would become an integral part of length, breadth and depth. We should therefore, have a more detailed look at this particular episode of dimensional differentiation in order to understand more fully not only why this model claims scale as the fourth-dimension, but why it came about in the first place.

Unlike the other three with which we are more accustomed to dealing with in our day-to-day experiences; our fourth physical dimension of scale would be determined by its need to use energy. It should again be remembered that at this stage, there is actually no such thing as three-dimensionality and the effects of scale will be caused directly by the interaction of the zero intersection differences and the four, single-dimensional string values from which they are comprised. The fourth-dimensional *reef-knot* analogy described in Section 4.1 would evolve from 'zero' time (this zero intersection difference), along the only direction it can and this is determined by the four available vectors to which this event will now be attached. These four connections will now fuel this evolving 4D 'scalar' characteristic.

Looking once more at our 'reef-knot' (see again Figure *4.1.01* above), it is clear that there is only *ONE* possible direction in which any scalar characteristic can operate - and this is 'outwards'. To produce such a scaling effect, one can imagine picking at a taut reef knot in real-life and pulling its loops apart. This produces what in essence is *still* a 'reef-knot', but one that is obviously a great deal looser and one that therefore takes up much more apparent volume within the bounds of the knot itself.

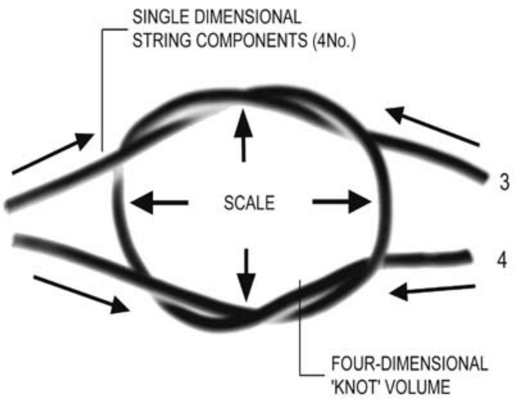

Figure 4.2.02 *As the four-dimensional 'knot' expands as a result of 'scale', the single-dimensional vectors to which it is connected will shrink (arrows 1, 2, 3 & 4 in the figure).*

This increase in volume (literally the 'size' of the knot and analogous with the event's requirement for energy in this model) cannot just come from nowhere. Instead, this is gained at the expense of the four, single-dimensional strings from which the knot is constructed. As with any real-life reef knot, these strings (or vectors) will tend to naturally diminish in length as the knot expands. In the case of this now four-dimensional equivalent entity - an increase in 'scale' will mean that in order to obey the conservation laws, the knot must *absorb* single-dimensional string energy (labelled 1, 2, 3 and 4 in *Figure 4.2.02* above).

This has a two-fold effect. Firstly, each single-dimensional string vector shrinks as its energy is transferred to - or absorbed by the knot and secondly, each string vector will also be connected to another knot and because of the way in which these strings are probably orientated in the first place, this means that any particular '4D' event may be connected (via these strings), to either another two, three or four neighbouring events. The consequence of this shrinkage or ***retraction*** as it can be called, is that adjacent 4D events will be drawn closer and closer together as the component of scale uses single-dimensional string energy (see *Figure 4.2.03* below).

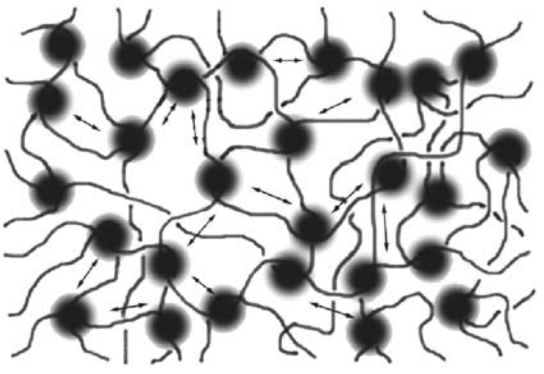

Figure 4.2.03. *As the constituent string energies are absorbed by the expansion events, each would be drawn closer and closer in time to its neighbours.*

Considering the fact that these single-dimensional string vectors also represent 'time-lines' in their own right, this mass of four-dimensional events will also be drawn closer and closer together in time as they physically expand. The resultant exponential increase in all three of the physical dimensions that we would recognise would produce in-built inflation and the overall appearance of such an event would mirror that of the original single-dimensional 'ball of string' we met earlier. It would thus, more than likely be spherical. This emerging fourth-dimensional state $\{\varnothing_4\}$, would soon seem to be full of mutually approaching, almost uniformly inflating 'bubbles' as the connecting time-lines or string vectors grow shorter and shorter as their energy was absorbed. It would be this configuration; this apparently smooth percolation; that would ultimately be responsible for the next stage in the evolution of this multi-dimensional universe.

4.3 Multiple inflationary events

These now mutually connected and expanding 'bubbles' will in a way, behave almost like mini big-bang events in their own right and could quite logically be defined as such, because their individual inflationary characteristics become the natural result of their inherited extra dimension of scale.

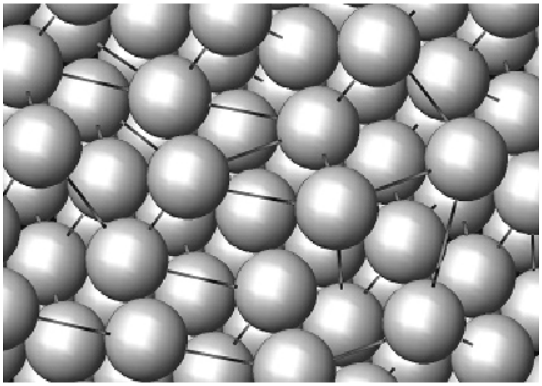

Figure 4.3.01 *As 4D events undergo expansion, they are each still connected to a total of four, single-dimensional strings. These shrink as these 'scalar' events inflate and pull them all closer and closer together.*

The space we recognise would not exist outside each of these tiny, expanding universes and their packing (or distance apart), would be determined by the amount of energy they had absorbed from their integral and connective single-dimensional component strings (which are effectively positioned two rungs down the dimensional ladder from them). They would all be connected together by these 1D-strings and the more these events expanded; the *closer* will each be drawn towards its neighbours because of retraction - until all of these connective *string energies* are exhausted. With a mechanism in place that now provides the fuel, that in turn fires a four-dimensional outward expansion of ***mini big-bang events***, individual scalar expansion will continue and the boundary surfaces of each of these events will be drawn closer and closer together.

Many cosmologists do not seem to like the idea of 'bubbles' within theories of an expanding universe[1] - but this is just what these four-dimensional expansion events appear to be. There is also another problem with such entities in that because they are all undergoing expansion (because of scale in this model); they would also be subject to 'phase-transitions' and associated 'cooling' effects, which many theorists like even less than the bubbles themselves. The problem has always been with the way in which such events were supposed to 'join-up' during the expansion or more correctly; what was thought to be the inflationary phase of the universe - and some have argued that such bubbles would be continually playing 'catch-up' as the rate of expansion exhibited by the universe as a whole *always* matched that of the bubbles themselves. In other words, the boundaries of any two adjacent bubbles would never be able to meet in a fast, inflationary universe. Many theorists argue that such bubbles would need to be travelling at the speed of light[2] and as far as we are aware, this would probably have been unlikely.

It will be argued that this model's own particular version of these bubbles is subtly different in that although initially of a random configuration, these spherical events are still mutually connected via their original single-dimensional threads. They will jostle for space therefore (but not technically the space we perceive as such) and achieve equilibrium as the outward pressure of expansion repels those similar surfaces of neighbouring events. There is actually a built-in limiting factor within this scenario in that these particular bubbles are held in close proximity to one another by the still shrinking, single-dimensional strings to which they are still mutually connected. These bubbles are not expanding in space either, or certainly not the space we would recognise. This is *still* a period of dimensional differentiation and the ‘space’ in which they find themselves could still theoretically be considered as part of the null-universe that was originally a null-dimensional inequality. We will discover that the space we recognise as such is actually contained *within* each of these mini inflationary events.

Thus far, this dimensional evolution has produced a 'hierarchy' of dimensional energy levels that increase with complexity. Expansion (or inflation) at this stage, must use energy from the less complex dimensions that sit lower down, on what may be called the 'ladder of dimensional hierarchy’. In the previous chapter, the fourth-dimensional level was assigned the (set) label $Ø_4$ in our attempt to keep some sort of track on these events and consequently:

$$Ø_4 = \{ Ø_2 , Ø_2 \},$$

where $Ø_2$, is the set that represented the lower two-dimensional level that evolved via the loop variable operation. This in turn, combined the null-universe and the original single-dimensional vector thus:

$$Ø_2 = \{ Ø, \{Ø\} \},$$

The rate of expansion at this point will be proportional to the amount of energy used and can at this particular stage in these proceedings, simply be expressed by ‘E’. Therefore:

$$E\,Ø_4 = \frac{\{ Ø_2 , Ø_2 \},}{E}$$

Both lower dimensional states will lose energy to expansion and the conservation laws should be satisfied. The consequence of this, is that as the expansion events are drawn closer and closer together, they will exhibit what can only be described as an ***elastic tension*** as the single-dimensional strings lose energy and therefore shorten.

Cooling would seem to have a universal affinity with expansion, as our own gas laws illustrate and as these four-dimensional results of 2D-to-2D combination inflate over time, the energy contained therein, will tend to rarefy and some of this energy *must* be dissipated. It should be remembered however, that as already stated above, these events are still within a null-universe setting, in that any movement of energy *can only* occur within the material that makes up these expansion events and the single-dimensional strings that feed them. This dissipation of expansional energy can only take the form of a phase-change, or a *condensation*.

These expansion events could now definitely be likened to a myriad of inflating bubbles, now all becoming very closely packed together *and* they are at the same time, quickly differentiating as their volumes increase. This phase change or *condensation*, might better be defined as the conversion of kinetic to potential energy as dimensionally speaking, this young universe has not yet evolved enough to allow this phase change the room to do any thing else. Due to the *elastic tension* brought about by the connection of single-dimensional threads, the *packing* of these bubbles in relation to one another will strive for equilibrium and their spherical surfaces must ultimately make contact. There will however, be a natural repulsive effect as all exhibit an outward expansive push. They will also tend to jostle themselves into such a configuration that will allow them to occupy the *least* possible volume. A similar thing will happen if you pour a quantity of glass beads (or golf balls or any spherical objects) into a suitable container; they will all occupy the smallest possible volume. Whilst this analogy actually has everything to do with gravity, the effects will be similar here, in that it is *still* the single-dimensional threads that create this elastic tension that pulls them towards one another.

There is however, a fundamental problem with spheres when they become very tightly packed together. Two-dimensional circles, or three-dimensional spheres, create ***pore spaces*** between their surfaces. These are at the inevitable boundary between three or more adjacent spheres, where the surfaces of neighbours are in almost perfect contact with one another. There is always a curved triangular space between them; or pyramidal in three dimensions (see *Figure 4.3.02* below) and it is this that causes the problem.

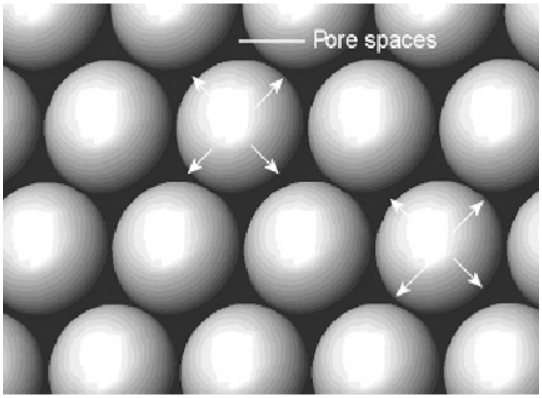

Figure 4.3.02 *The pore spaces that form between inflating mini big-bang events, will eventually become vacuums that pull spherical boundaries out of shape.*

It's these pore spaces that instigate the next stage in the evolution of this multi-dimensional universe in which we seem to find ourselves an integral part. These spherical objects would be continuing newly acquired 4D inflation, even though the energy from which they are made is depleting and shortening the single dimensional strings to which they are attached. The pore spaces, (which to all intents and purposes, will still be *null-dimensional* space), will be increasing their own volume as they keep pace with the inflating spherical boundaries of these individual 4D expansional events. They would in essence, be the perfect definition of a vacuum.

With continuing inflation, condensation is taking place within these bubbles and this internal environment is becoming more and more rarefied. A moment would be reached when the pull of the vacuum making up these pore spaces was able to over come the resistance of the expansive component and spherical boundaries would soon lend themselves to being pulled out of shape. This situation would contribute to what would be the next stage in the dimensional differentiation of this young evolving universe.