6 Dimensional boundary surface waves and their mode of propagation

6.1 Electro-magnetic radiation

The electro-magnetic spectrum is clearly our window on the universe and we are using more and more of it these days as an investigative tool within our continuing journey of exploration. Not only are our own mammalian eyes attuned to it for everyday use but, the majority of the physical processes that occur around us, so obviously involve EM radiation; from energetic gamma rays, right through to the radio continuum and our modern twenty-first century society would be lost without our manipulation of the electro-magnetic spectrum. All electro-magnetic radiation travels at the speed of light (in a vacuum), which isn't really that surprising, when one considers that *light* is a series of integral wavelengths within this spectrum anyway.

Our modern, scientific examination of this phenomenon really took-off with Galileo's experiments in *circa* 1638, but it was the ground-breaking work of Newton and Huyghens that showed that light seemed to exhibit some rather strange and conflicting properties. Newton was convinced that it was particulate in nature, hence his 'corpuscular theory of light'; while Huyghens was of the opinion that it was more of a wave form. At the time, the greater reputation won through and the 'corpuscular theory' was more widely accepted; for the time being at least. Maxwell's later examination of the electro-magnetic spectrum seemed to settle things once and for all, although, the argument about light's somewhat strange *duality* continues to this day.

The relationship between electric current and magnetic field is one of those fundamental principles learnt in secondary school physics. The very fact that there is a relationship at all, not only suggests that each of these components (the electro and the magnetic) is just one part of the whole, but that something far more interesting is going on within the overall scheme of things. When the author was at school, a 'waveform' could always be considered as a means of transferring energy from one point to another, without there being any (apparent) transfer of matter between these points and there were only certain specific ways in which such a waveform could propagate (see *Figure 6.1.01* below).

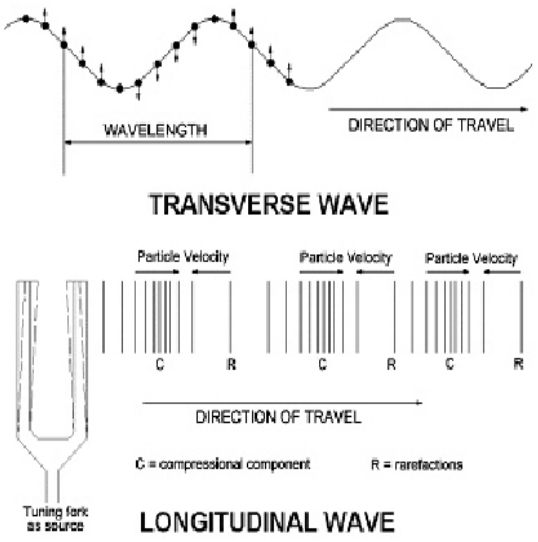

Figure 6.1.01 *Transverse and longitudinal waveforms.*

There has however, always been something a little disconcerting about the definitions applied to the waves. The majority of waveforms that propagate within a 'single-medium' (such as sound waves in air and compressional waves in solids), can usually be categorised as ***longitudinal*** in nature. Electro-magnetic waves on the other hand, although supposedly assumed to *still* live within a single medium that we call 'space', are found to be ***transverse***. While something of an over-simplification here, waves may be classified as either *mechanical* or *electro-magnetic* in this context and it is the mechanical waves that require a material medium for their propagation.

Electro-magnetic waves have always been assumed to have the capability of being able to travel through a vacuum, whilst mechanical waves cannot ("In space, no-one can hear you scream", goes the trailer to Ridley Scott's blockbuster of a film '*Alien*'). If a waveform is

not electro-magnetic, it must be mechanical and 'single-medium' mechanical waves are usually always longitudinal in nature, where vibrations are along the direction of travel; such as with sound waves; compressional waves in springs; or within the earth. Mechanical waves *CAN* be transverse however, but there is a subtle difference between them and their longitudinal relatives. For example, when a sound wave in air enters water, it becomes transverse (even at some depth), but this oscillatory motion is actually the result of the water mass acting as a surface wave, which in this case, travels across the surface of the water as familiar ripples. It is actually travelling at the boundary of *TWO* dissimilar media – air and water – and this in essence, is exactly what a transverse wave is – it's the propagation of wave energy at the boundary between *TWO* dissimilar media.

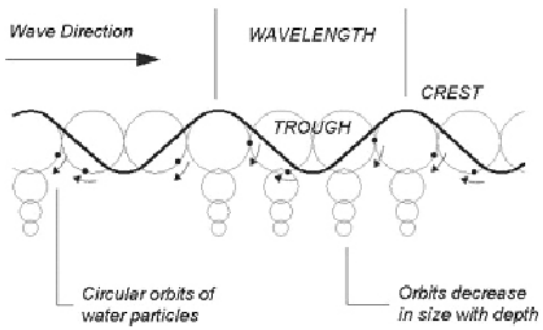

Figure 6.1.02 *Water waves can produce an 'orbital motion' of particles in deep water. Each wave particle orbits about the same position as the wave travels. These orbits become smaller in radius with depth.*

The transverse characteristic of the ripples on a pond or indeed with larger scale ocean waves, is due to the fact that this water wave *IS* a ***surface wave***. Transverse wave motion also occurs within the Earth, but these too are *surface waves*, where propagation is always at the boundary between two dissimilar solid media, such as between two different densities of rock. These are known as ***Rayleigh*** waves and in a similar fashion to their water wave counter-parts, they include what is known as an associated *orbital* or *particle motion* about the same position while the waveform travels (see *Figure 6.1.02* above). In water, this motion is circular, while in rock it is elliptical and has an opposite rotational direction to its fluid counterpart. *Rayleigh* waves are also different to water waves, in that there exists an element of shear strain, which tends to restrict them to solid media anyway. A similar phenomenon occurs with waves at the Earth's surface and these of course, are transverse waves too. Transverse wave motion always seems to suggest the presence of a boundary between two dissimilar media, but electro-magnetic waves – transverse as they surely are, seldom seem to be considered with all these other transverse examples.

6.2 Wave propagation in a vacuum

There have always been questions about wave propagation within a vacuum - and what is a realistic definition of a vacuum is in the first place? There seem to be two main trains of thought as far as our modern understanding goes and one's first response is possibly the most logical. We would all probably agree that a vacuum can be defined as empty space or an empty void or volume with *absolutely* nothing in it whatsoever. This is often referred to as a ***bare vacuum***[1]. One can imagine a suitable container attached to the most powerful pump ever invented, which sucks not only all the air out, but also isolated atoms, molecules and other residual particles of matter so that to all intents and purposes, the container is *COMPLETELY* empty. Such experiments were frequently conducted during the seventeenth and eighteenth centuries and while these versions of the vacuum wouldn't transmit sound (the 'Alien' reference made earlier), they *still* transmitted light and other wavelengths of the electro-magnetic spectrum.

As experiments (and experimenters) became more refined, it was realised that the resulting vacuum could still contain thermal energy in the form of heat and this too was eventually isolated as attempts at its removal were made by cooling to as near 'absolute-zero' as possible. Observations indicated however, that EM radiation could *still* be transmitted through this supposed 'near perfect' vacuum. Such volumes

still seemed to contain measurable amounts of energy and this was eventually given the label ***zero-point energy*** or 'ZPE' for short. It wasn't until the advent of quantum theory that a new explanation could be offered and it is now the general consensus in many a stable of thought, that at the quantum scale (at around the Planck length of circa 10^{-33} cm and less) space itself can be pictured as a seething mass of energy. This is our second definition of a vacuum and is more usually referred to as a ***physical vacuum***[2].

This hypothesis cannot of course, be experimentally verified because of the tiny scales that such a conjecture seems to imply. It should be remembered that the very nature of any QED derived explanation, is still but an approximation or simulation of what the real world may really be like. This is not to say that it is not an all-powerful tool, but it doesn't bring us any closer to a feasible answer that explains why EM radiation *still* propagates through a supposed vacuum. The quantum hypothesis actually creates more questions than it answers; such how is a wave supposed to propagate in such a tiny seething environment anyway? There is a much simpler explanation however – and this is to consider EM radiation as the transverse waveform that it surely is *AND* to recognise that all transverse waveforms are actually *surface waves*.

The last few chapters have attempted to describe this model's view that the universe is multi-dimensional and has resulted in a form of differentiation that has evolved some specific dimensional levels. These levels are separated purely by their difference in dimensional energy and as such, there would need to be areas of demarcation that define one particular level from the next. Simply put, there would need to be dimensional boundaries. The fourth rung on the dimensional ladder would in this model, evolve much earlier than our own and include the component of *scale* as its fourth physical dimension (later to include our own three dimensions of length, breadth and depth which as well as us, would come later). The boundary between our (3D) world and the fourth, would not be recognisable in our sense of the word, but may be accessible when energy levels are considered. The energy of an electro-magnetic wave is usually as the result of excitation and it is this that may produce a transverse wave with an energy level that has been raised sufficiently high enough during such physical processes, to correspond to that of the boundary area. Fourth-dimensional characteristics may then play a part in the propagation of the waveform, which in the case of EMR emissions may contribute an expansive quality which is interpreted by an observer in our 3D universe, as the outward propagation of an electro-magnetic burst.

It should again be noted that at this stage, any discussion about possible dimensional levels *does not* include the dimension or vector of time. Our own part of the universe is still more often than not, defined as comprising a total of *FOUR* dimensions – the x, y and z-axes *AND* this component of time. Throughout this and subsequent chapters, time has been left on the sidelines. Our own world therefore, can be said to comprise just three of the physical dimensions that in the universe taken as a whole, has evolved to a stage that in this model, has accumulated at least *SIX* physical levels (or of course seven if you *DO* include time separately within the overall scheme of things). The boundary between 3D and 4D worlds cannot be visualised in the same way as we view the surface of a pond, or indeed a discontinuity within the earth. These boundary surfaces are all linear (almost two-dimensional in fact). A dimensional boundary between three and four dimensional worlds, would exist at each and every point in space and the wave front of a dimensional boundary surface wave, would in essence, always be travelling *ON* the dimensional boundary as it propagates outwards through space from its original source (see *Figure 6.2.01* on the following page).

It is the very nature of the fourth-dimensional universe, with its extra characteristic of scale, that allows the waveform its ability to expand outwards in the first place, thus providing the wave propagation we observe today. The electro-magnetic spectrum is characterized by energy levels, which define the radiation concerned; be it

gamma radiation (the most energetic), or long wavelength radio waves at the other end of the spectrum. While frequency, wavelength and therefore energy can vary and do, (although there is of course a direct relationship between these parameters), they propagate at the same speed in the perfect vacuum. In this context – and in this model, this implies the same mechanism for their outward propagation – and this would be the influence of the fourth dimensional characteristic of scale, at the boundary where these waveforms live.

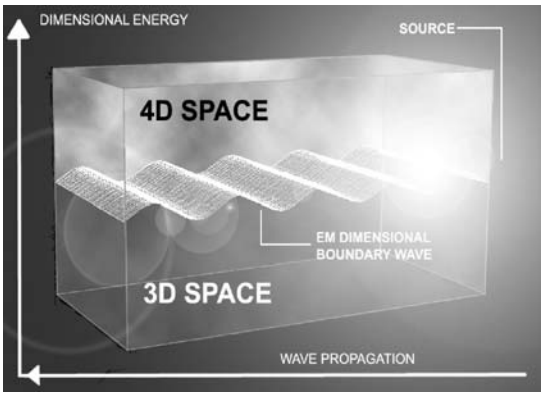

Figure 6.2.01 *The propagation of an electro-magnetic wave with low dimensional energy, will occur at the boundary of third and fourth dimensional space.*

6.3 Magnetism

Magnetism on the other hand, appears to be a somewhat different kettle of fish. Magnets, on first impression (an introduction that usually occurs when one is a child), seem to be endowed with almost magical properties; as powerful forces snap bar magnets together as one tries to see just how close you can get them before the inevitable. Alternatively, you could always invisibly shunt one away from the other, right across the kitchen table and try to ponder just how they could do that. Often an attention grabber for ooh, minutes on end, those toy magnets and the miraculous forces that drove them, could seem a million miles away from that now rather mundane light, emitted from the torch that also arrived that same birthday morning. It would be difficult to reconcile the fact that these two apparently very different forces of nature were in reality, so inexorably linked. The laws of electro-magnetic induction, best illustrate this relationship between electric and magnetic components, and this phenomenon has been put to good use in our technology. The obvious difference between these two facets is the component of attraction that exists within a magnetic field – opposite poles attract, while like poles repel. It is the attractive force of the magnet that is of interest here.

An ‘attractive’ or ‘compressive’ component may already exist within this multi-dimensional scenario (examined briefly in the preceding chapter). A secondary condensate of eighth-dimensional membrane energies would produce a mesh of three-dimensional ‘tri-planar coordinates’ *AND* provide a residual percentage of now *differentiated* energy as a resultant five-dimensional ‘ghost’ shell, once the 3D component (the independent boundary chords and whole surviving teddies) had dropped to its appropriate energy level. This (now five-dimensional) shell would exhibit a characteristic of compression or contraction, that would be the result of what in Chapter Five, was christened the *big-snap*; as the tetrakaidecahedral lattice (complete with condensed-out boundary chords), snapped back to its original size after its episode of 4D induced expansion.

This five-dimensional remnant of the eighth dimensional level, would drop to *ITS* appropriate energy level too – which coincidently, will exactly balance the ‘expansive’ nature of four-dimensional scale that it must lie directly adjacent to; (this was called the ‘piston-effect’ in Chapter Five). There must logically be a boundary area that exists between the expansive fourth and the compressive fifth dimensions, as they would be fundamentally dissimilar to each other. In a way that would almost seem to mirror that propounded for the boundary between our 3D universe and the fourth dimension, this may be an area of active transverse wave propagation, all as a result of the physical processes going on around us and as hinted at in *Figure 6.3.01* on the following page.

This graphic representation is *inaccurate* however, because unlike the 3D/4D boundary version illustrated within *Figure 6.2.01*, there would appear to be no direct connection to the waveform's three-dimensional origin and this causes an obvious problem. This description is also hindered by the fact that it is trying to illustrate a four and five dimensional phenomenon in just a two dimensional figure and this would be difficult to convey adequately at the best of times.

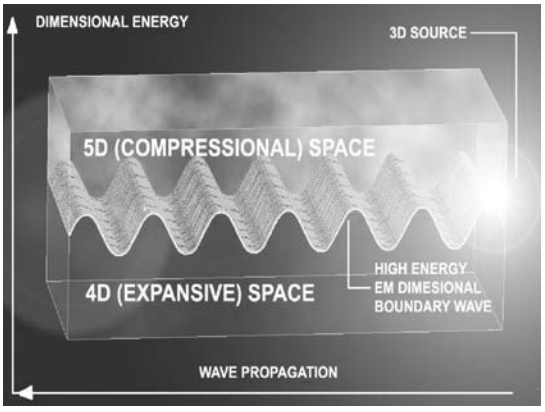

Figure 6.3.01 *An electro-magnetic dimensional boundary surface wave that propagates between the fourth and fifth dimensions will be endowed with characteristics from both.*

As these (transverse) waves can be made to propagate at specific dimensional boundaries within this model, they will be called ***dimensional boundary surface waves*** from now on, or ***dim-waves*** for short. As they are still somewhat abstract at the moment, perhaps the best way of looking at this 4D/5D higher dimensional form, is to try and imagine it in terms of what will be called a ***coaxial waveform*** (see *Figure 6.3.02* in the next column opposite). Just like the cable that connects your TV to its aerial, a *coaxial waveform* will comprise (at least), an inner and an outer component. This characteristic will be as a result of dimensional energy levels emitted from a source; the higher the dimensional energy, the shorter the wavelength. Consequently, *dim-waves* that travel at the 4D/5D boundary will be of higher dimensional energy and thus at a shorter wavelength than those travelling at the lower energy 3D/4D boundary. Within this model, *dim-waves* will be the product of dimensional boundary chord excitation, caused primarily by string or chord vibration. The greater the vibration, the higher the energy and so on.

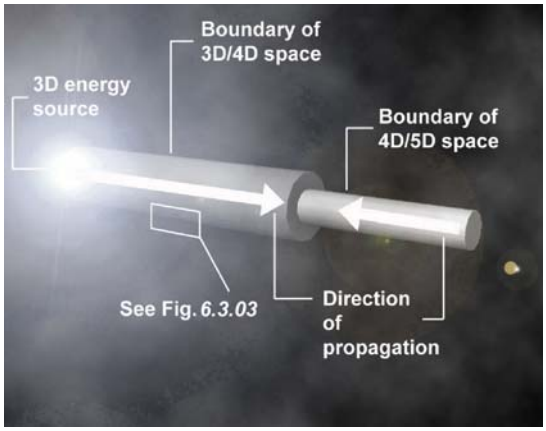

Figure 6.3.02 *A simplified impression of a coaxial dimensional boundary surface wave.*

The inherent rules of hierarchy as far as dimensional energy levels are concerned, would not easily allow direct contact between out of sequence dimensions such as the first and third; or indeed, the third and fifth. The propagation of a dim-wave with an energy level that corresponds to the 3D/4D boundary is easy enough to picture, but the higher energy signature of a waveform that travels at the 4D/5D boundary as a consequence would in this scenario, need to be carried by an *existing* 4D vehicle – and this could only occur if a lower energy 3D/4D dim-wave was already present. Unlike the picture painted within *Figure 6.3.01*, these circumstances *WOULD* provide the connection between three and five dimensional space by way of an existing four-dimensional conduit that was itself, a component of a 3D/4D coaxial waveform that was already being emitted from a three-dimensional source or body.

The illustration within *Figure 6.3.02* shows a simplified representation of the fourth-dimensional energy level (the outer sleeve of this

coaxial form) and the fifth-dimensional level (the inner sleeve). Our own third-dimension space would be represented by the surroundings in which this 'whole' coaxial section is suspended. The dim-waves themselves, would propagate at the boundaries shown and with a surface direction illustrated by the arrows. Although pictured as circular in the figure for simplicity's sake, any 3D cross section would be quite meaningless because of its dimensional boundary characteristic. Being expansional in nature, the 4D component propagates 'outwards' and away from the source (in the direction of the arrow), simply because this dimensional level is expansional. Likewise, the 5D component's arrow of propagation shows an 'inward' (or attractive) direction, because of the fifth-dimension's compressive or contractive nature. Where the two coaxial sleeves meet, there will exist a boundary between the fourth and fifth dimensions and both directions of propagation will occur simultaneously.

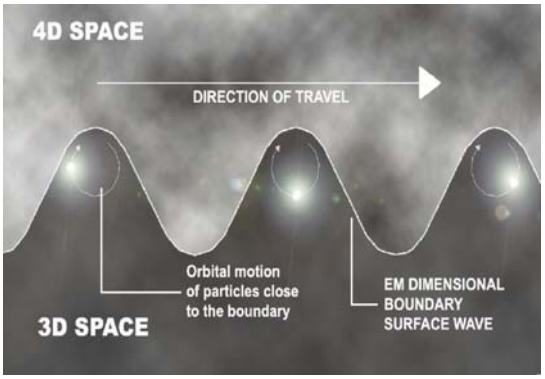

Figure 6.3.03 *As a dim-wave propagates through space at the boundary between 3D and 4D worlds, it creates orbital motion that excites fundamental 3D or 4D particles it meets. Of low dimensional energy, this wave does not penetrate far into 4D space and therefore cannot influence the 4D-5D boundary.*

This important characteristic of dual direction during wave propagation, will define both the 'expansive' and 'attractive' nature of the electro-magnetic spectrum. *Figure 6.3.03* above, shows an enlarged detail of the area at the 3D/4D boundary, highlighted within the white rectangle in *Figure 6.3.02* on the previous page. With a layering of dimensional areas one over the other, (dependent on their energy levels), there would seem to be *TWO* distinct kinds of possible dimensional boundary surface waves that could be generated from this coaxial form. Our closest boundary (between three and four dimensional space), would in this model, produce a dim-wave that would be purely expansive in nature because it propagates *only* at our boundary with the fourth dimension. This type of wave would not comprise any compressive or contractive elements whatsoever; because *ITS* dimensional energy would not be of a sufficient magnitude to pass beyond the 4D level itself. The described orbital motion, observed as a consequence of both water and seismic Rayleigh wave propagation; (also shown in *Figure 6.3.03*), may also occur on the three-dimensional side of the 3D/4D boundary and this will be explored in both the next section and more fully in a later chapter.

The other possible type of dim-wave would be one that exhibits a substantially more energetic and therefore a much higher level of dimensional energy, corresponding to that of the 4D/5D dimensional boundary layer. A dim-wave such as this, would be influenced by the nature of both the fourth – and now the fifth dimensional levels and this will produce a wave propagation that would be able to display both an expansive *AND* a contractive (or attractive) nature. Such a waveform would therefore exhibit a 'duality of opposites', with components that display *BOTH* of these characteristics.

It could be argued at this stage in the game that if this (attractive) propagation occurs at a boundary that is apparently 'detached' from any contact with our own 3D world, then *HOW* could it affect three dimensional material in the first place; like how does one bar magnet attract another? A good and logical question, but I will try to show that such interference occurs *within* the nucleus itself, where these 3D/4D *AND* 4D/5D dim-waves are occurring all the time. Such interactions will occur between many high-energy sources and not simply as the result of propagation from a single or isolated source. This subject will be tackled in a subsequent chapter where the structure and

nature of the whole surviving teddy is examined in much greater detail. The fundamental difference between these two kinds of waveform (3D/4D and 4D/5D) is energy level – and this will be found to be closely linked to the frequency and also the 'size' of the *vibrational* components involved. As boundary chords are excited by the input of energy from an external source or physical process, they will vibrate if their energy levels rise beyond a certain point – or in other words, when the input is greater than their ***energy threshold***. Such vibrations, or ***resonance*** will be the source of the dimensional boundary surface wave and the physical 'size' of the source will also play its part. The more energetic the *resonance*, the higher will be the frequency and so on. Lower frequencies and therefore lower energy levels will be confined to 'weaker' vibrational sources. In either case, resonance and therefore the propagation of dim-wave energy will continue until the source returns to its natural ground state. Through this process of resonance, the excess energy (i.e. that greater than the source's energy threshold); will be converted into dimensional boundary surface wave energy.

6.4 Attenuation

As with any waveform, ***attenuation*** will eventually occur and dimensional boundary surface waves will be no exception in this respect. As a dim-wave propagates at the dimensional boundary, it will lose energy and this will occur in the form of ***wave condensation***. It should be remembered that energy within this model should more correctly be defined as *dimensional energy* and any change in this energy level (either up or down), will necessitate a *change* in the *dimensional energy signature* accordingly.

A resonating boundary chord has merely 'gained' energy; perhaps through collision – and this rise in its energy level is translated into a new *dimensional energy signature* that is manifest as a dim-wave, or as an energy whose level corresponds to that of a particular dimensional boundary. The opposite will occur as the waveform attenuates and loses energy. In this case, its dimensional energy signature is lowered. This attenuation is gradual and is dependent on the energy source to begin with and a helpful method of illustrating this concept is by way of yet another simple analogy and this has been provided here as *Figure 6.4.01* below. The blackboard in this example, can be likened to the 3D/4D dimensional boundary and 'our side' of this blackboard, should be thought of as representing three-dimensional space, as it most obviously is anyway. The dimensional boundary surface wave - or more correctly, its energy; can be represented by the stick of chalk as it is drawn across the surface of the board. The longer the stick of chalk, the greater or more prolonged the dimensional energy. As we draw a line on the blackboard, we are actually propagating the dim-wave along the dimensional boundary and as we do so, the wave is attenuating. The movement of the stick of chalk from one side of the blackboard to the other is the progression of the wave, while the chalk-line it leaves in its wake is its attenuation.

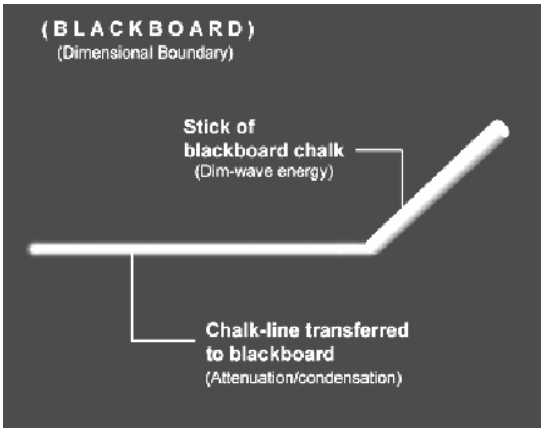

Figure 6.4.01 *A dimensional boundary surface wave can be likened to a stick of chalk drawn across the surface of a blackboard (the boundary surface). As it propagates, it leaves a chalk-line behind, which represents the wave's attenuation.*

A dimensional boundary surface wave's attenuation will take the form of *wave condensation* - as a proportion of its energy is translated back into a lower (dimensional) energy

form, which will tend to lie on our side of the 3D/4D dimensional boundary. This condensation produces minute amounts of three-dimensional matter, just like the tiny chalk particles that make up the line on the blackboard. If this blackboard was wide enough, we could transfer *all* of the chalk to the blackboard and the energy that it represents would be attenuated completely. All of this energy would be translated back into three-dimensional form through a process of condensation. There will be a direct relationship between the rate of attenuation and the energy level of the dim-wave - and this will be dealt with in much more detail within a later chapter. Although only touched upon briefly here, *dimensional boundary surface waves* will play what amounts to the most important of roles in the further evolution of both the independent dimensional boundary chords and the whole surviving teddies.

This model is perhaps attempting to *re-define* the definition we have for *ALL* energy. We already take very much for granted these days, the fact that matter and energy are interchangeable and we may at the moment be defining just a small, visible part of a larger *energy spectrum*, which may better be defined as *dimensional energy*. Matter itself may simply be one of this energy's phases and after all, we are already used to dividing this into its three most familiar forms, i.e. solid, liquid and gas (or four, if we include plasma). It may be advantageous to modify these divisions a little further to include the probability of different *dimensional* manifestations, for if we extend our horizons in this way, we may find that the physical effects of certain natural phenomena begin to make more sense, because we can then include the possibility of very real boundaries that separate these different energy levels – and this of course, will also allow the propagation of dimensional boundary surface waves too.

We do not need to invent new processes or new theories to explain existing observations, but if we simply broaden our outlook, such a new look at the nature of the waves might also shed a little light on that old headache that is wave-particle duality. Although this will be given a chapter of its own later on, it may be helpful at this stage to look briefly at what the concept of dim-waves and associated phenomena might mean to this old paradox. The work of Newton and Huyghens not only advanced considerably our understanding of the nature of light, but also raised this question of duality. The later works of Einstein and de Broglie amongst others, compounded this quandary still further by verifying that particles too also possessed a wave characteristic. Experiments by researchers such as Otto Stern[3] (1929) seemed to show that larger particles like the protons and neutrons also displayed a wave property and this particular topic will be expanded upon later when boundary chord interactions within the nucleus are examined.

Quantum mechanics has gone further still in quantifying this wave-like property of matter into a wave function that contains all the information about the particle in question. Particle-like behaviour however, has more to do with attempted measurement in quantum theory, where the *probability* of where a particle is, can be described as a sharp 'peak' in this function at some point in space. Quanta on the other hand can be defined as discrete 'packets' of energy, which are said to be the result of 'standing wave interactions'. What may be interesting is the possibility of wave condensation within this model and the *orbital* or *particle motion* that is often associated with transverse wave motion. If this can be argued for successfully, we may be able to look at wave-particle duality in a slightly different light, but more about this in due course.