*Journal of Scientific Exploration.* Vol. 6, No. 3, pp. 217–231, 1992 0892-3310/92


# Heim's Theory of Elementary Particle Structures

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Abstract — Heim's theory is defined in a 6-dimensional world, in 2 dimensions of which events take place that organize processes in the 3 dimensions of our experience. A very small natural constant, called a "metron", is derived, representing the smallest area that can exist in nature. This leads to the conclusion that space must be composed of a 6-dimensional geometric lattice of very small cells bounded on all sides by metrons. The existence of metrons requires our usual infinitesimal calculus to be replaced by one of finite areas.

The unperturbed lattice represents empty vacuum. Local deformations of the lattice indicate the presence of something other than empty space. If the deformation is of the right form and complexity it acquires the property of mass and inertia. Elementary particles are complex dynamical systems of locally confined interacting lattice distortions. Thus, the theory geometricizes the world by viewing it as a huge assemblage of very small geometric deformations of a 6-dimensional lattice in vacuum. The theory also has significant consequences for cosmology.

## Introduction

The present article provides an overview of Burkhard Heim's unified field theory of elementary particles and their internal structures (Heim, 1989, 1984; v. Ludwiger, 1979, 1981, 1983). Various old and new concepts enter into the theory, including cosmology, quantum field theory, organizing processes similar to Sheldrake's morphogenetic fields (Sheldrake, 1985), and the existence of a smallest area in a 6-dimensional world. The main results of Heim's theory are formulas for the masses of elementary particles. Results turn out to be in very good agreement with measured values.

This report is written with the aim of describing the basic architecture of Heim's theory in mainly non-technical terms for the benefit of the average JSE reader with a scientific background, who is not necessarily a physicist. For this reason the terminology of field theory is often replaced by less specific but more readily comprehensible expressions. In an Appendix selected topics are discussed in more technical terms for the benefit of physicists.

## The 6-Dimensionality of the World

It is well known in physics that energy is stored in the gravitational field surrounding any material object. Heim concludes that in accordance with Einstein's relation $E = mc^2$ (E = energy, m = mass, c = velocity of light = 300'000 km/s) this field energy must have associated with it a field mass, whose gravitation modifies the total gravitational attraction of an object. In addition, the field mass gives rise to a second gravitational field. The relation between the two fields is very similar to the relation between electric and magnetic fields (Auerbach, in press).

The result of this is a set of equations governing the two dissimilar gravitational fields quite analogous to those describing the electromagnetic fields (Maxwell's equations). The main difference is the appearance of the field mass in the gravitational equations in the place where zero appears in Maxwell's equations. The zero in the latter is due to the non-existence of magnetic monopoles.

This difference renders Heim's gravitational equations less symmetric than the electromagnetic ones. The same lack of symmetry also applies to a unified field theory, combining electromagnetism and gravitation, which cannot be more symmetric than its parts.

In the macroscopic world the general theory of relativity has introduced a new concept into physics. It assumes that the properties of space itself are modified in the presence of masses. The equations of relativity are restricted in the sense that they only govern gravitation. In addition, they are too symmetric to satisfy the above asymmetry criterion and they cannot be extended to the microscopic world of quantum theory. For this reason Heim regards relativity as an incomplete description of nature. He does, however, accept its basic philosophy of space being capable of deformation. How this can be visualized will be discussed in Section 5.

On passing from the macrocosm to the microcosm of elementary particles Heim relates quantities describing the deformation of space to the energy states of the system responsible for the deformation, in analogy to general relativity. Energy states are known to occur in discrete, so-called "quantum" steps, like the discrete energy levels of hydrogen atoms. These considerations determine the general form of equation describing the microscopic states of a system in Heim's theory.

Einstein's general relativity results in a set of 16 coupled equations (6 of which occur twice). The figure 16 is equal to the square of the number of dimensions. Hence, according to relativity, our world appears to be 4-dimensional (because $16 = 4^2$) and consists of 3 real dimensions and one dimension proportional to time.

In contrast, Heim finds 36 equations describing the microcosm. Again, this must equal the square of the number of dimensions, so that the microscopic world appears to be at least 6-dimensional. Since there can only be one set of laws in nature it must be possible by appropriate transformations to carry the microscopic equations over into the macroscopic world and vice versa. The conclusion, therefore, is that the universe we live in is at least 6-dimensional and not 4-dimensional.

## The 5th and 6th Dimensions

It can be shown that the number of real dimensions, i.e. those measurable with yardsticks, is limited to 3. All higher dimensions must be of a different nature entirely. The 4th dimension, for example, is proportional to time, which is measured with clocks and not yardsticks. The 5th and 6th dimensions will have to be something different again (Cole, 1980), and according to Heim they are associated with organizational properties. They will be called "transdimensions" or "transcoordinates" to distinguish them from the four dimensions with which we are all familiar.

Modern superstring theory describing the interactions between elementary particles also involves the use of more than 4 dimensions. However, following a suggestion by the mathematicians Kaluza and Klein, all but 4 of them curl up in such a manner that they exist only in dimensions of the order of $10^{-35}$ m. Thus they are hidden and do not manifest themselves in the macroscopic world.

There exists an analogy between Sheldrake's theory of morphogenetic fields and Heim's organizational 5th and 6th dimensions. Consider the following illustrative example: A house is a highly organized structure. Before it can be built, however, an architect has to draw up a construction plan. This plan is necessary, but not sufficient. Workmen and building material must be available, too, and all three in time combine to raise the structure whose details correspond to the original design. The house, when finished, exists in the usual 3-dimensional space and is connected only indirectly to the architect's plan and to the workers.

Events taking place in the 5th and 6th dimensions mirror the activities just described. The processes unfolding in the two transdimensions establish an organizational scheme for a certain structure and cause it to become reality. Both dimensions always act together, no event of any kind can involve only one of them. In fact, every event *must* involve both dimensions. Most structures being organized exist in the 3-dimensional world of our experience (4 if time is included), but extend into the two transdimensions.

Heim's theory is mathematical, but the organization of highly complex structures such as houses or living cells cannot be described by mathematics alone. Elementary particles, on the other hand, are organized structures, too, involving the two transdimensions, yet their complexity stays within limits and allows them to be treated mathematically.

## Maximum and Minimum Distance. The Metron

The existence of a field mass, mentioned in Section 1, leads to a modification of Newton's law of gravitation. Newton's law is simple and specifies the force between two masses in terms of the distance separating them. As is well known, the force is inversely proportional to the square of the distance.

Due to the existence of field mass the gravitational force in Heim's theory is the solution of a so-called "transcendental" equation, i.e. an algebraic equation having no simple solution. Nevertheless, approximate analytical solutions, i.e. formulas, can be found for various ranges of the distance between two masses. Purely numerical answers on a computer can, of course, be obtained for all distances.

As is to be expected, Heim's law is virtually indistinguishable from Newton's law out to distances of many light years (1 light year = 5.91 trillion ($10^{12}$) miles).

Thereafter, the force begins to weaken more rapidly than Newton's law and goes to zero at an approximate distance of 150 million light years. At still greater distances it becomes weakly repulsive. Finally, at a very great maximum distance it goes to zero and stays zero. This distance is significant for the size of the universe, because at distances exceeding it the force becomes unphysical. Hence, greater distances cannot exist. The greatest possible distance in 3 dimensions is the diameter of the universe, which will be denoted by the letter D.

A similar deviation from Newton's law also occurs at very small distances, and there exists a very small minimum distance beyond which the force again becomes unphysical. This distance turns out to be just about 4 times smaller than the so-called Schwarzschild radius of general relativity, which is closely related to the formation of black holes.

Even more significant than the maximum and minimum distances is a third distance relation derived from Heim's gravitational law. In the limit of vanishing mass, i.e. in empty space, a non-vanishing relation can be derived, involving the product of the minimum distance and another small length, known in quantum theory as the Compton wavelength of a given mass. This product of two lengths clearly is an area, measured in square meters ($m^2$). The product exists even when the mass goes to zero and turns out to be composed of natural constants only. It, therefore, is itself a constant of nature. Heim calls it a "metron" and designates it by the symbol $\tau$ (tau). Its present magnitude is

$$\tau = 6.15 \times 10^{-70}\ m^2.$$

The significance of a metron is the fact that it exists in empty, 6-dimensional space. The conclusion is that space apparently is subdivided into a 6-dimensional lattice of metron-sized areas. This is a radical departure from the generally held view that space is divisible into infinitely small cells. Independently of Heim, other authors in an attempt to quantize gravitation have found elementary areas of dimensions similar to that of a metron (Ashtekar et al., 1989).

## Metronic Mathematics

The result that no area in Heim's 6-dimensional universe may be smaller than a metron requires a revision of some branches of mathematics. For example, differentiation assumes that a curve or line can be decomposed into an infinite number of infinitely small segments. Conversely, integration recomposes the infinitely small segments back into a curve of finite length.

In Heim's theory differentiation and integration must be changed to comply with the metronic requirements mentioned above. A line cannot be subdivided into infinitely small segments, because an infinitesimal length cannot be part of an area of finite, metronic size. Similarly, integration is changed into a summation of finite lengths. While the mathematics of finite lengths has been developed in the literature (Norlund, 1924; Gelfond, 1958) the novel feature of Heim's metronic theory is that it is a mathematics of finite *areas*.

Obviously, the metronic area of $10^{-70}$ m$^2$ is exceedingly small. The surface area of a proton, for example, is much greater, i.e. about $3 \times 10^{-29}$ m$^2$. A metron is so tiny that for many applications it may be regarded as infinitesimal in the mathematical sense. In such cases Heim's metronic mathematics goes over into regular mathematics. There are instances, however, when it becomes obligatory to use metronic differentiation and integration.

## The Building Material of Elementary Structures

Empty space has been shown to consist of an invisible lattice of metronic cells. One can visualize them as little (6-dimensional) volumes, whose walls are metrons, touching each other and filling all of space. The orientation of the walls in space is important, because Heim shows that it is related to the quantum mechanical concept of spin, but this feature will not be further discussed in the present report.

Uniformity of the lattice signifies emptiness. Conversely, if the lattice is locally deformed or distorted, this deformation signifies the presence of something other than emptiness. If the deformation is complicated enough, it might, for example, indicate the presence of matter. This implies that there really is no separate substance of which particles are composed. What we term "matter" is nothing but a locally confined geometric structure in vacuum. Pure vacuum has the ability of deforming its 6-dimensional lattice structure into geometrical shapes. That portion of it, which extends into the 3-dimensional space of our experience is interpreted by us as matter.

The situation is somewhat analogous to the formation of a vortex in air. Still air corresponds to complete emptiness having no recognizable geometric properties. A tornado, on the other hand, is a fairly well defined geometric structure in air. Its funnel-like shape clearly differentiates it from the surrounding atmosphere, which is not in rotation, but it still consists of air only and not of any separate material.

The same is true of geometrical structures in vacuum. They clearly differ from complete emptiness, but their "construction material" nevertheless is vacuum. It should be emphasized, however, that a mere deviation from uniformity of the metronic lattice does not automatically constitute matter.

## Metronic Condensations

The term metronic "condensation" is frequently used by Heim in connection with the structure of elementary particles. Since the concept cannot be visualized in 6 dimensions it will be explained with the aid of a 3-dimensional model.

Figure 1 illustrates a transparent sheet with a central bulge. The sheet is covered with a square lattice of straight lines. Each of the many squares formed in this manner is supposed to represent a metron, so that the whole may be called a "metronic sheet". Note that the metrons are not distorted, although the sheet is. Also drawn are 3 rectangular coordinate axes denoted by x, y, and z. They may

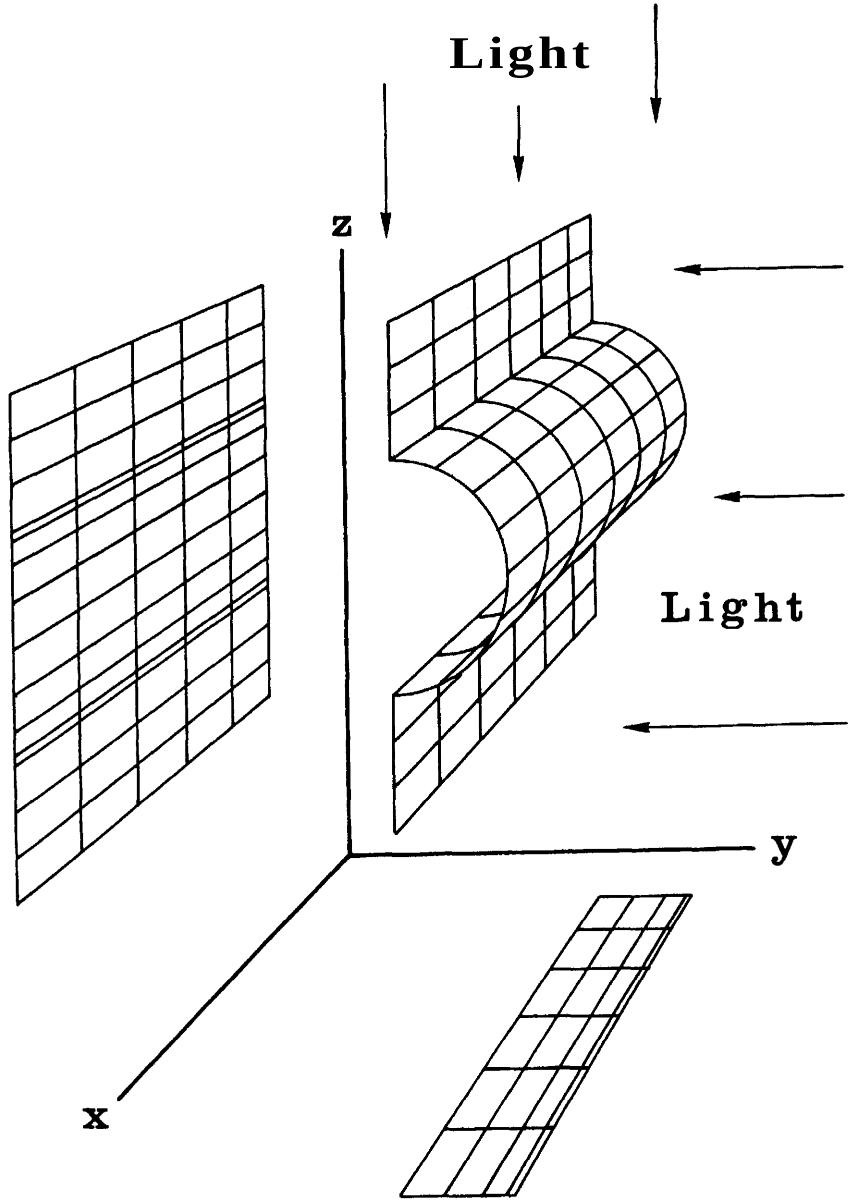


Fig. 1. Metronic condensations in **3** dimensions.

be thought of as marking three comers of a room whose floor is the x-y-plane, and whose 2 vertical walls are the x-z- and y-z-planes.

If the sheet is illuminated from above and from the right the grid lines on the sheet will cast shadows on the floor and on the left wall, as shown in the drawing. In technical language these shadows are called projections of the grid on the

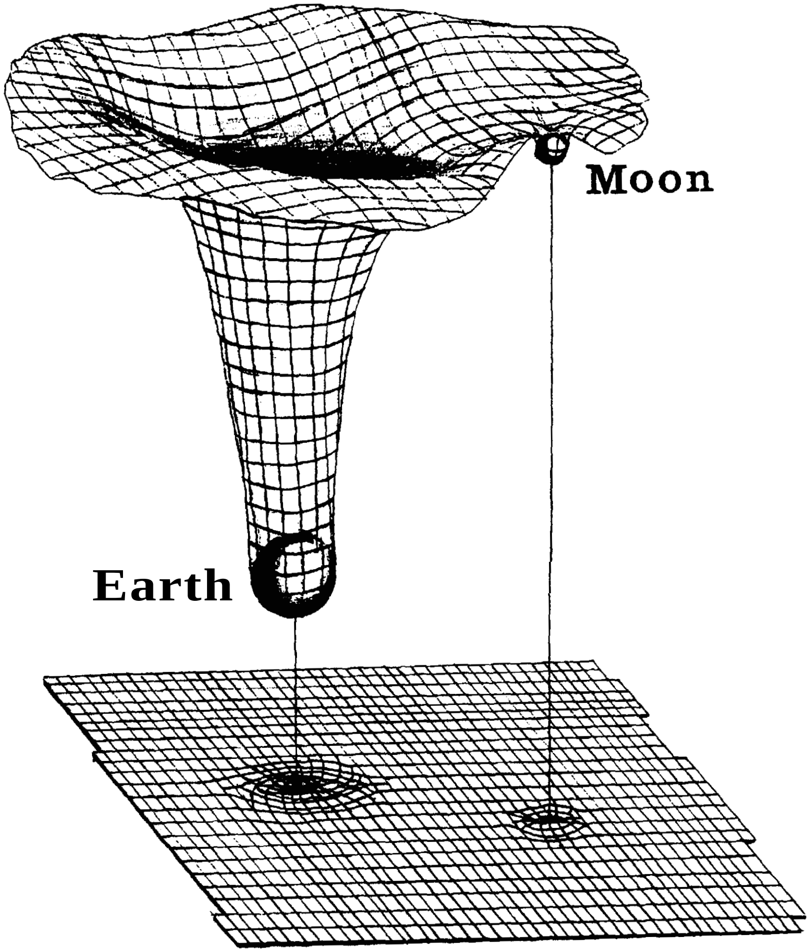


Fig. 2. Distortion of space and its metronic condensation caused by the earth-moon system.

respective walls. It is immediately evident that the square metrons in certain regions of the projected images become narrow rectangles. These regions are the metronic condensations referred to in the heading, because the squares are compressed, or condensed, in one direction. There exist areas of maximum condensation, where the projected metrons are compressed into thin lines, and other areas, where they project essentially as uncompressed squares. Note that some areas on the metronic sheet showing minimum condensation in the x-z-plane show maximum condensation in the x-y-plane. The importance of condensations lies in the fact that for some applications it is easier to describe the properties of a structure by referring to its projections on vertical walls rather than by considering its full description in **3** or more dimensions.

According to general relativity a material object distorts space. This is illustrated in Fig. 2 for the earth-moon system. Space is pictured as a kind of rubber sheet into which the heavy earth and the much lighter moon sink in to different depths. In Heim's theory the sheet is covered with a net of metronic squares. This enables one to express the space curvature, as the distortion is called in general relativity, by examining the density of compressed metrons in the projection of the sheet on a 2-dimensional plane, as shown in Fig. 2.

It should be emphasized that Figs. 1 and 2 even in 3 dimensions are convenient simplifications of the true situation. The unperturbed metronic lattice, as mentioned in Section 5, is a network of cubes. A disturbance would create a distorted volume which might be pictured as a sequence of distorted parallel sheets, the most deformed of which are pictured in the two drawings. The distortion diminishes with increasing distance of the sheets from the one drawn, until the undisturbed cubic lattice is reestablished.

The deformation need not be static. It can rotate or pulsate or change shape in some other dynamical way, and the projections will follow suit.

This picture can now be generalized to a 6-dimensional lattice with a localized static or dynamic deformation, forming a condensation, i.e. projecting a 3-dimensional pattern into our world. The 3-dimensional projections in 6-space are the generalizations of the 2-dimensional projections in 3-space illustrated in Figs. 1 and 2. Such condensations form the basis of matter and elementary particles. A piece of matter that can be seen and touched is merely the projection into our 3-dimensional space of the true, 6-dimensional lattice deformation, just as the shadow of a tree is the 2-dimensional projection of its true 3-dimensional structure.

## The 4 Types of Elementary Structures

The uniform metronic lattice characterizing empty space can be distorted in several fundamental ways, most of which involve fewer than 6 coordinates. This may be visualized by noting that the two projected areas in Fig. 1 are each compressed in one direction only. In this simple example one dimension is distorted, the other is not. A space consisting of fewer than 6 dimensions is called a "subspace". The statement at the end of Section 6 can now be reworded in the sense that what we regard as matter is nothing but a locally confined condensation in our 3-dimensional subspace due to a local deformation of the 6-dimensional metronic lattice. Heim finds that there exist 4 basic types of deformation in 6-space, which are discussed below.

a) The first type is a lattice deformation involving only the 5th and 6th coordinates. In the 4 remaining dimensions the metronic lattice remains undisturbed. Physically, this may be interpreted as a structure existing in the two transdimensions. Since our senses are not attuned to events in the two transdimensions this may be difficult to visualize.

   Although the deformation exists in dimensions 5 and 6 only, and does not project directly into our 3 dimensions, its effect may occasionally be felt in the rest of the world. Under certain conditions it may extend into the four remaining dimensions in the form of quantized gravitational waves, so-called gravitons. The equations show that gravitons should propagate with 4/3 the speed of light. Thus, according to Heim gravitational waves have a speed of 400'000 km/second.

The situation is somewhat analogous to a strong vortex like a tornado confined to a relatively narrow region in air, nevertheless sending sound waves out to very great distances, where the air is not yet affected by the vortex motion. Summarizing, the first type of deformation may be viewed as a structure in the 2 transdimensions capable of emitting gravitational waves that we should be able to register.

b) The second type of deformation again involves dimensions 5 and 6, and in addition time, the 4th dimension. Again, this particle-like structure does not project directly into our 3-dimensional world, but is felt here only in the form of waves. Heim derives the property of these waves and shows that they are identical to those of electromagnetic light waves or photons. It follows that case (b) describes a particle-like structure in the 4th, 5th, and 6th dimensions, extending into the remaining 3 dimensions in the form of photons.

c) The third possible deformation involves 5 dimensions, i.e. all coordinates except time. This 5-dimensional structure projects into the 3-dimensional space of our experience, i.e. it forms a condensation here, and it is reasonable to assume that we are sensitive to such condensations. This is indeed the case, and Heim shows that they give rise to uncharged particles with gravitational mass and inertia.

d) The final deformation involves all 6 coordinates. This again leads to 3-dimensional condensations, giving rise to particles, but, as in case (b), the inclusion of time leads to electric phenomena as well. Heim can show that 6-dimensional lattice distortions lead to charged particles.

## Cosmology

In Heim's theory both the metronic size $\tau$ and the largest diameter D depend on the age of the universe. The dependence is such that D is expanding and $\tau$ is contracting, so that D was smaller in the past and $\tau$ was larger. It stands to reason that at one time in the distant past the surface area of a sphere of diameter D in our 3-dimensional world was equal to the size of $\tau$. This instant marks the origin of the universe and of time.

The mathematical relation between D and $\tau$ is not simple, so that 3 different values of D are found to satisfy the criterion that the area of a sphere of diameter D be equal to $\tau$ at the beginning of time. Evidently, the universe started as a trinity of spheres, whose diameters turn out to be (in meters):

$$D_1 = 0.90992 \text{ m}, \quad D_2 = 1.06426 \text{ m}, \quad D_3 = 3.70121 \text{ m}.$$

This trinity of spheres has important bearings on the structure of elementary particles.

From the first moment on the universe began to expand, though at a slower rate than is presently predicted on the basis of the red shift of distant galaxies (see the Appendix). Heim's theory results in a present age of the universe approximately equal to $5.45 \times 10^{107}$ years, and a diameter D of about $6.37 \times 10^{109}$ light years. During most of its existence the universe consisted of an empty metronic lattice, whose metrons kept getting smaller as the universe grew larger. Eventually, metrons became small enough for matter to come into existence. This may have occurred some 15–40 billion ($10^9$) years ago, at which time matter was created throughout the volume of the universe. Hence, according to Heim matter did not originate very soon after a "big bang" explosion but more uniformly in scattered "fire-cracker"like bursts, perhaps of galactic proportions. Spontaneous uniform creation of matter, coupled with the partly attractive and partly repulsive force of gravity mentioned in Section 3 resulted in the observed large-scale galactic structure of the universe. Creation of matter continues to this day, though on a very much reduced scale.

## The Structure and Masses of Elementary Particles

More than three quarters of Heim's second volume are devoted to the derivation of his final formula for the masses of elementary particles in the ground state and in all excited states. Only the barest outline of the structural complexity of elementary particles can be presented here.

The interior of an elementary particle must be viewed as consisting of a number of metronic condensations in various subspaces. The configuration which is projected into our 3-dimensional physical world consists of 4 concentric zones occupied by structural elements. Maxima and minima of these condensations in the sense of Figs. I and 2 participate in a rapid sequence of periodic, cyclic exchanges. The internal structures undergo continuous modifications during this process until, after a certain short period of time, the original configuration is reestablished. This period is the shortest lifetime a particle possessing mass and inertia can have. In general, a lifetime consists of several such periods. If the initial configuration is not regained after the last period the particle decays. A particle is stable only if its structure *always* returns to its original form. The subdivision into 4 zones is a consequence of the original trinity of spheres characterizing the universe during the first instant of its existence.

The actual mass and inertia are not a property of the 3-dimensional structures themselves, as might be thought. Instead, they are the secondary result of exchange processes between the 4 internal zones described above. These processes are the actual carriers of mass and inertia. For this reason, Heim's elementary particles definitely are not composed of subconstituents such as quarks. The inner 3 structural zones are difficult to penetrate, the innermost being almost impenetrable. In scattering experiments they might create the illusion of 3 particles being present in the interior. Empirical predictions that have led to the formation of quark theory can be interpreted by Heim in geometrical terms.

All states of an elementary particle are characterized by 4 genuine quantum numbers. The first 3 are the baryonic number k (k = 1 or 2), the isotopic spin P, and the spin Q. The fourth number can only be either 0 or 1. In addition, there is a number +1 or –1 characterizing particle or antiparticle, a number indicating whether a particle is charged or not, and a number N = 1, 2, . . . specifying the state of excitation. 4 more quantum numbers refer to the 4 structural zones. These, however, cannot be chosen at will but are derived from the numbers listed above.

Results for the ground states are in excellent agreement with experiment. In addition to the known particles, Heim predicts the existence of a stable neutral electron and its antiparticle, with masses about 1% smaller than the masses of their charged counterparts. Furthermore, Heim predicts 5 neutrinos with masses ranging from 0.00381 eV to 207 keV (1 electron Volt is the mass equivalent of $1.7826 \times 10^{-36}$ kg, 1 keV = 1000 eV). On the other hand, the number of excited states each particle can have turns out to be much too large. So far Heim has not succeeded in finding a criterion which would limit the number of excited states to those actually observed.

## Summary and Outlook

The essence of Heim's theory is its complete geometrization of physics. By this is meant the fact that the universe is pictured as consisting of innumerable small, locally confined geometric deformations of an otherwise unperturbed 6-dimensional metronic lattice. The influence these deformations have on our 4-dimensional world, or the effects of their projections into it, constitute the structures we interpret as gravitons and photons, as well as charged and uncharged particles. The theory ultimately results in a formula from which the masses of all known elementary particles and a few unknown ones may be derived. In addition, it provides a picture of cosmology differing widely from the established one.

Despite the insight gained into particle physics, the theory is not entirely equivalent to modem quantum theory. For this reason Heim has extended the theory to 12 dimensions. Only this extension allows full quantization, and as a consequence it becomes possible to unite relativity and quantum theory. Even 6 dimensions are not sufficient to accomplish this. A more detailed account of these new developments will be published in a 3rd volume (Heim, personal communication).

While the organization of elementary particles still lends itself to mathematical treatment, higher structures, in particular living beings, are far too complex to be dealt with in this manner. Nevertheless, Heim has extended his theory to that territory as well by using the method of mathematical logic. This enables him to derive logically precise statements about the process of life, the origin of paranormal phenomena, and the structure of realms far transcending the

4-dimensional world of our experience (Heim, 1980, v. Ludwiger, 1979). This extension of the mathematical theory may, in fact, be regarded as Heim's most important contribution to the understanding of nature. Unfortunately, only non-mathematical summaries of the theory have been published so far. A fully mathematical formulation exists only in the form of an unpublished manuscript.

## Appendix

In this appendix a few selected topics are summarized in more technical detail.

### *The Field Equations*

In analogy to Einstein's attempt in 1946 to develop a unified field theory Heim works with non-symmetic, complex (i.e. non-Hermetian) metric tensors. Einstein used a single metric tensor, $g_{ik}$, where

$$g_{ik} = \bar{g}_{ik} + \hat{g}_{ik}. \quad (1)$$

The symmetric part of Eq. (1 ), $\bar{g}_{ik}$, was interpreted as gravitational potential, and the antisymmetric part, $\hat{g}_{ik}$, as electromagnetic potential. In contrast to this, Heim generates a basic metric tensor, $\gamma_{ik}$, in a 6-dimensional hyperspace by coupling together 3 interacting matrices, $g_{ik}^{(1)}$, $g_{ik}^{(2)}$, and $g_{ik}^{(3)}$, in the form of

$$\gamma_{ik}^{(\lambda\mu)} = \sum_{\alpha=1}^{6} g_{\alpha i}^{(\lambda)} g_{k\alpha}^{(\mu)}. \quad (2)$$

The three $g_{ik}$'s arise from the combination of various subspaces.

All operations require the use of metronic mathematics, so that differential equations and tensor equations are replaced by their metronic equivalents. The metronic size is

$$\tau = \frac{3\gamma h}{8c^3} = 6.151 \times 10^{-70}\ \mathrm{m}^2,$$

(y = gravitational constant, h = Planck's constant).

The field equations in Heim's theory are eigenvalue equations of the general form

$$O\psi = \lambda\psi, \quad (3)$$

where O is a metronic operator, $\lambda$ is an eigenvalue, and $\psi$ is an eigenfunction. $\lambda$ and $\psi$ characterize all permissible geometric configurations of the 6-dimensional metronic lattice.

In Einstein's field equations of gravitation the curvature tensor $R_{ik}$ in a 4-dimensional space geometry is proportional to the energy-momentum density tensor $T_{ik}$. For this reason space curvature in general relativity can exist only in the presence of energy and matter.

In contrast, Heim's operator O, Eq. (3), involves only terms consisting of purely geometric metronic partial derivatives and generates the structure states $\psi$ in Eq. (3). Matter and energy are generated by dynamic processes involving the metrons. The spectrum of all possible masses derived from Eq. (3) corresponding to the uncharged and charged particles mentioned under (c) and (d), Section 7, is nearly continuous. Most of Vol. 2 of Heim's books therefore is devoted to separating out the discrete spectrum of observed elementary particles from the nearly continuous background.

### The Red Shift

As mentioned in Section 3, matter exerts a weakly repulsive force over very great distances. Repulsion reduces the energy of light rays passing through these regions and results in a shift of the spectrum towards the red. According to Heim, this accounts for the entire observed red shift, the contribution of the expanding diameter D of the universe being insignificant. His calculation of the Hubble radius is in good agreement with observation if use is made of the somewhat uncertain density of matter in the universe.

### The Entropy Problem

Matter seems to be a relatively late by-product of a universe which remained empty for a very long period of time, except for the existence of geometric quanta in the form of metrons. For this reason the entropy problem arising in connection with the big-bang model is avoided.

This problem refers to the fact that, since entropy is known to increase with time, in the past it must have been much smaller than it is now. Conversely, the thermal order of the universe must have been greater. Calculations (Penrose, 1989) show that the degree of order in a near point-like universe shortly after the big bang must have been about $10^{10^{123}}$ times greater than now to produce the order existing today. This is avoided in Heim's theory, which postulates that matter came into existence only after the diameter of the universe already had reached a very large size.

### The ERP-Paradox

The Einsteln-Rosen-Podolsky (ERP) paradox of quantum theory (Einstein et al., 1935), has remained unresolved since its inception in 1935. Einstein and Bohm developed hypotheses of "hidden variables", i.e. processes on a subnuclear scale. These are not accessible to direct observation and for this reason appear to us as the uncertainties of quantum theory, although in reality they are determinate processes.

The hidden variable theory has not generally been accepted by physicists. Penrose (Penrose, 1989) surmises that only a quantized general relativity will properly resolve the wave-particle duality at the bottom of the ERP paradox. It should also explain the multitude of elementary particles and eliminate the infinities of quantum field theory.

Heim's theory fulfills these requirements. It explains the origin of particles and is devoid of infinities because its mathematics utilizes the finite size of metrons. Its "hidden variables" are organizational states resulting in a world that is neither wholly predictable nor wholly unpredictable.

*The Fine Structure Constant*

Dirac at one time pointed out that the right unified field theory may be identified by the fact that it correctly reproduces Sommerfeld's fine structure constant $a \approx 11137$. Heisenberg felt that he was on the right track when his spinor theory led to a value of 11120. The reader may check for himself that Heim's constant comes closer by several orders of magnitude to the measured (1987) value of $a = 1/137.035989(5)$.

$a$ turns out to be the solution of a fourth order equation, involving only $a^2$ and $a^4$. Its solution is

$$\alpha_{\pm}^2 = \tfrac{1}{2}\left(1 \pm \sqrt{1 - B^2}\right)$$

$$B = \frac{18\theta(1 - A_1 A_2)}{(2\pi)^5}$$

$$\theta = 5\eta + 2\sqrt{\eta} + 1$$

$$A_1 = \frac{1 - \sqrt{\eta_{11}}}{1 + \sqrt{\eta_{11}}}\eta_{11}^{s}, \qquad A_2 = \frac{1 - \sqrt{\eta_{12}}}{1 + \sqrt{\eta_{12}}}\eta_{12}^{s}, \qquad s = -\frac{\eta}{2(1 + \sqrt{5})}$$

$$\eta = \frac{\pi}{(\pi^4 + 4)^{1/4}}, \qquad \eta_{11} = \frac{\pi}{(\pi^4 + 5)^{1/4}}, \qquad \eta_{12} = \frac{\pi}{(\pi^4 + 6)^{1/4}}.$$

The numerical values of the fine structure constants are

$$\alpha_{-} = 11137.0360085$$

$$\alpha_{+} = 111.000026627.$$

## Outlook

An in-depth analysis of the trinity of spheres existing at time t = 0 reveals the possibility of deriving from set theory all well-known coupling constants plus a few additional ones. Work on this problem is currently in progress (Heim, Droscher, private communication).

## References


Ashtekar, A., Smolin L., Rovelli, C., & Samuel, J. (1989). Quantum Gravity as a Toy Model for the 3+1 Theory. *Classical Quantum Gravity 6,* (10) L 185–L 193.

Auerbach, T. The Generation of Antigravity. To be published in *MUFON-CES Report No.. 11, I.* v. Ludwiger editor, Feldkirchen-Westerham, Germany.

Cole, E.A.B. (1980). *Il Nuovo Cimento 55B,* 269–275.

Einstein, A., Rosen N., and Podolsky, B. P. (1935). *Phys. Rev.* 47, 777.

Gelfond, A.O. (1958). *Differenzenrechnung.* Hochschulbucher fur Mathematik, Vol. 41, Berlin, VEB Deutscher Verlag der Wissenschaften.

Heim, B. (1989 (revised)). *Elementarstrukturen der Materie, Vol. 1.* Resch Verlag, Innsbruck, Austria.

Heim, B. (1984). *Elementarstrukturen der Materie, Vol. 2.* Resch Verlag, Innsbruck, Austria.

v. Ludwiger, I. (1979). Die einheitliche 6-dimensionale Quanten-Geometrodynamik nach Burkhard Heim, in: *Ungewohnliche Eigenschaften nichtidentifizierbarer Lichterscheinungen,* 267–331, MUFON-CES, Feldkirchen-Westerham .

v. Ludwiger, I. (1981). in: *Heimsche einheitliche Quantenfeldtheorie,* Resch Verlag, Innsbruck, Austria.

v. Ludwiger, I. (1983). Die innere Struktur elementarer Subkonstituenten der Materie, in: *Seltsame Flugobjekte und die Einheit der Physik,* 271–403, MUFON-CES, Feldkirchen-Westerham.

Nörlund, N.E. (1924). *Vorlesungen über Differenzenrechnung,* Springer Verlag, Berlin.

Penrose, R.T. (1989). *The Emperor's New Mind—Concerning Computers, Minds, and the Laws of Physics,* Oxford University Press.

Sheldrake, R. (1985). *A New Science of Life,* Anthony Bond, London.