Abstract

A unified 6-dimensional polymetric structure quantum theory by Burkhard Heim (1925-2001) will be described, which yields remarkably exact theoretical values for the masses, the resonances, and the mean lifetimes of elementary particles, as well as the Sommerfeld finestructure constant.

Since this paper is not an original contribution, the overview of the derivation of the mass formula within Heim's structure theory will not be printed in a journal, but published in the Internet. This paper is an attempt to present Heim's nearly 700 pages on a semi-classical unified field theory of elementary particles and gravitation in a more understandable form, because the results of this theory should be brought to the attention of the international scientific community.

In the beginning of the 1950s, Heim discovered the existence of a smallest area (the square of the Planck's length) as a natural constant, which requires calculations with area differences (called metrons) instead of the differential calculus in microscopic domains. Here we use selector calculus, which Heim employs exclusively in his books, only when its use is indispensable and maintain the general tensor calculus otherwise.

For comparison with the work of Heim, in the introduction we discuss briefly the state of the art in the domains of elementary particles and in structure theory.

Heim begins by adapting Einstein's field equations to the microscopic domain, where they become eigenvalue equations. The Ricci tensor in the microscopic domain corresponds to a scalar influence of a non-linear operator C_p on mixed variant tensor components of 3rd degree $\varphi^p{}_{kl}$ (corresponding to the Christoffel-symbols $\Gamma^p{}_{kl}$ in the macroscopic domain). In the microscopic domain the phenomenological part will become a scalar product of a vector consisting of the eigen values $\lambda_p(k,l)$ with mixed variant tensorial field-functions. These terms are energy densities proportional:

$$C_i \varphi^i{}_{kl} = \lambda_i(k,l)\, \varphi^i{}_{kl} \qquad (i, k, l = 1,...,4)$$

The non-linear structure relation describes „metrical steps of structure" because of the quantum principle. 28 of these 64 tensorial differential equations remain identical to zero. The remaining 36 equations can be written in a scheme of 6×6 elements of a tensor, whose rows and columns are vectors and therefore define an R_6 for the representation of the world. The two new coordinates x_5 and x_6 are interpreted by a collection of values which are organising events, since they can change the distributions of probabilities of micro states in space-time. The 6 coordinates will be unified in three semantic units which do not commute: $s_1 = (x_5, x_6)$, $s_2 = (x_4)$, $s_3 = (x_1, x_2, x_3)$, where s_1 and s_2 are imaginary and s_3 is real.

The metrical tensors which can be construed from these s_μ are partial structures $\kappa_{ik}^{(\mu)}$ (with
$\mu = 1,2,3$). The matrix trace of the tensorial product of the 9 elements, which each are construed by 2 of these lattice cores $\kappa^i_{m(\mu)}$

$$g^{ik}_{(\mu\nu)} = \sum_{m=1}^{6} \kappa^i_{(\mu)m} \kappa^k_{(\nu)m} \ ,$$

constitute a quadratic hyper-matrix, called „correlator" $\hat{g}^{ik}_{(\mu\nu)x}$, where $x = 1, ...,4$, depending on the kind of non-euclidian („hermetrical") groups of coordinates involved: : **a** = s_1, **b** = (s_1 s_2), **c** = (s_1 s_3), **d** = (s_1 s_2 s_3). This polymetry corresponds to a Riemannian geometry with a double dependency on coordinates. The solution of the eigen value equations for each of the 4 groups of coordinates ("hermetry-forms") can be interpreted physically in such a way that the self condensations **a** are gravitons, the time-condensations **b** are photons, the space-

condensations **c** are neutral particles, and the space-time-condensations **d** are electrical by charged particles.

The correspondences of the Christoffel-symbols in microscopical domains are tensorial functions, "condensors", of the 6 coordiantes i, k, l and of the μ partial structures:

$$\varphi_{kl}^{i(\mu\nu)} = 1/2 \sum_{\kappa,\lambda=1}^{3} g_{(\kappa\lambda)}^{is} \left(\sum_{\mu,\nu=1}^{3} \left(\frac{\partial g_{sk}^{(\mu\nu)}}{\partial x^m} + \frac{\partial g_{sm}^{(\mu\nu)}}{\partial x^k} - \frac{\partial g_{km}^{(\mu\nu)}}{\partial x^s} \right) \right) \hat{=} \overset{\frown}{\begin{bmatrix} \kappa\lambda \\ -+ \\ \mu\nu \end{bmatrix}} .$$

The law of variance steps for the destination of mixed variant forms holds only if the same correlator element is used. Otherwise the analogy to the Kronecker tensor will be described by the „correlation-tensor" $Q_k^i \left({}^{\kappa\lambda}_{\mu\nu} \right) = g_{(\mu\nu)}^{il} g_{(\kappa\lambda)lk}$. The condensor must be complemented by this part, since it is also possible to perform affine displacements with it:

$$\overset{\frown}{[\ ]} = \sum_{\kappa\lambda\mu\nu} (1 + spQ_{k(\mu\nu)}^{i(\kappa\lambda)}) \overset{\frown}{\begin{bmatrix} \kappa\lambda \\ -+ \\ \mu\nu \end{bmatrix}}$$

If $\rho_{klm(\kappa\lambda)}^{i(\mu\nu)}$ is the „structure compressor", which corresponds to the Riemannian curvature tensor, then Heim's field equations (after forming traces) read:

$$\rho_{kl(\kappa\lambda)}^{(\mu\nu)} = K_{kl(\kappa\lambda)}^{(\mu\nu)} \overset{\frown}{[\ ]} = \lambda_{kl(\kappa\lambda)}^{(\mu\nu)} \overset{\frown}{[\ ]}$$

with the operator K_{kl} , which constitutes the first derivatives and products of the $\overset{\frown}{[\ ]}$, respectively, as well as additionally a tensor which denotes the correlations, and which is set up by squares of the Q_i^k and of the condensors.

By this extension of the Riemannian geometry a very large manifold of solutions arises. Since the phenomenological part which appears in Einstein's field equations now is totally geometrizised, there is, according to Heim, no "big bang" with an infinitely dense energy. Instead, matter appears only after very long evolution of a world without any physical measurable objects, which only consists of a dynamics of geometrical area quanta.

In the solutions the exponential function $\varphi_{kl} = f\,(e^{-y\lambda_{kl}})$ with $y^2 = x_1^2+x_2^2+x_3^2$ or $y^2 = (x_4^2+x_5^2+x_6^2)$ i.e. appear. For real y static exponentially fading fields arise. In the case of imaginary y there will be periodically appearing maximal and minimal condensations of metrons, or structure curvatures, respectively. The maxima of structure deformations $\varphi_{kl}^{(\mu\nu)}{}_{max}$ coincide with the minima of internal correlations: $Q_k^i \left({}^{\kappa\lambda}_{\mu\nu} \right) = 0$. The extrema exchange with each other periodically. With the possible combinations of the four partial structures for the fundamental tensors, several correlation-tensors as extrema can be united each in a group. For gravitons only two groups of couplings exist; for photons and neutral particles there exist 6 groups with 30 condensors, and for charged particles there are 9 groups of couplings with 72 condensors. Between the groups there are "condensor bridges", which form complicate dynamical systems of networks.

For the minimum as well as for the maximum of condensations there exists a spin tensor. It is based on the non-hermitic part of the fundamental tensor, which forms an orientation of spins of the hyperstructure in the region of the involved condensor $\overset{\frown}{\begin{bmatrix} \kappa\lambda \\ \mu\nu \end{bmatrix}}$ as a "field-activation". There "fluxes of condensors" can be formed when 2 neighbouring condensors are such that the contra-signature of one and the basic-signature of the other are identical (i.e. $\overset{\frown}{\begin{bmatrix} \kappa\lambda \\ \mu\nu \end{bmatrix}}$ and $\overset{\frown}{\begin{bmatrix} \mu\nu \\ \kappa\lambda \end{bmatrix}}$), since then both condensor-minima have a joint maximum of couplings, and the joint field-activator activates the proto-field in the correlating basic-signature of the other condensor. That results in a movement of the condensor around the maximum of coupling in the sense of an exchange process. The structure condensations (condensor fluxes), which exchange periodically act against the principle of balance of the compressor, so that a balanced position arises (compressor-isostasy).

The structures of couplings of the possible hermetry-forms form 6 different classes of condensor fluxes in the possible subspaces of R_6 , which can generate flux aggregates, whose structure depends on the order of flux classes. Therefore, for a structure of coupling there exist at most 1956 structure-isomers. The cyclical fluxes always generate a spin. This ambigious condensor-spin additionally leads to spin-isomers.

A condensor flux is stable in time only if an initial condition for the involved condensor signature in the structure of coupling alters to a final state after a distinct time, which is identical with the initial condition. Such a condensor flux circles around the diameter of the aggregate (λ = h/cm) with a certain frequency. The masses are proportional to the eigenvalues of the composite condensation levels $\lambda_m(k,l)$. It is found that only such flux aggregates can exist for which the cyclic flux directions of condensation-levels are orthogonal to the so-called world-velocity **Y** (that is the sum of vectors of temporal changes of all R_6-directions): $\lambda_m(k,l) \perp \mathbf{Y}$, while the vectors of eigen values are parallel to each other.

Each alteration of the constant relative velocity in space has the effect that the $\lambda_m(k,l)$ must adjust themselves, which presents a complex rotation in R_4 (corresponding to the Lorentz matrix). The reactive resistance which is connected herewith acts as a pseudo-power, which appears as inertia. Therefore all condensor- and corresponding energy-terms behave inertially. Since all the hermetry-forms contain the condensor $[{}_1{}^1{}_1{}^1]$, which consists of the s_1 , they are sources of gravitation. Only gravitation fields can be transformed away, since in this condensor only one single partial structure occurs.

The 6 flux classes consist of the combinations of the hermetry-forms $[s_1]$, $[s_2]$, $[s_1\ s_2]$, $[s_1\ s_3]$, $[s_2\ s_3]$, $[s_1\ s_2\ s_3]$, for each of which the field equations have to be solved. They yield prototypical basic flux courses (prototrope) and appear in the heteronomous case (basic-signature different from contra-signature in a condensor) as basic fluxes of the flux-unit, a „flucton", in the underlying hermetry-space or as a spectrum of structure-levels in the stationary homonomous case, which are called "shielding fields" and are enveloping fluctons. Such a primordially simple structure consisting of a flucton and ashielding field, called "protosimplex," is a structural primordial form of material objects.

By correlation of several such prototropes by which the fluctonic elements of the protosimplexes will be joined to cyclic flux aggregates (conjunctives), material properties arise. Prototropes with the condensor which is built up from s_3 take on ponderability. Those in which combinations from s_2 and s_3 are contained have an electric charge, too. The $\lambda_m(k,l)$ assign to each protosimplex an inertial action as mass.

The spin number in R_6 (related to the action-quantum) is composed of the spin in the imaginary sub-space of R_6 and of the spatial spin in R_3. The imaginary spin component changes with integers P according to P/2 and shows how many spin-isomorphic matter field quanta of the involved hermetry form constitute a isospin family. The spatial spin is characterised by the integers Q and counts in the form Q/2 also imaginary but it appears with the factor of parity multiplied, i.e. by the number -1 in the power Q/2 . If Q is even, i.e. Q/2 is an integer number, then the tensor terms are bosons, which can superimpose in the same volume. If Q is odd, then the parity will be an imaginary factor, and the spatial spin of such matterfield quanta will be half-integers. Terms of this kind are fermions or spinor terms, respectively, which exclude each other in the same R_3-volume. The integral total-spin of an R_6 flux aggregate defines a screw-sense with respect to time. This axial vector take a parallel or anti-parallel direction with respect to the arrow of time. The two settings of the spin vector are two enantio-stereoisomeric forms of the same aggregate in R_4 , and each represents the anti-structure of the other one.

The determination of the particle masses means that a dynamical system has to be projected onto an algebraic structure. Heim restricts himself to the special case of the state condition of a dynamical equilibrium. The polymetric tensor relations are all defined on the the field of complex numbers and therefore can be split into a real and an imaginary part. Heim only analyses the real part, since in this case the restricted condition of a stationary state of dynamical equilibria can be used.

It was found that the physical R_3 of a **c**- or **d**- hermetry form has a fourfold contouring by correlating condensor fluxes or protosimplexes, respectively, which are ordered in 4 “configuration levels“ (n, m, p, σ) of different density. In the practically impenetrable central zone n the density grows with the cube of the occupation of protosimplexes; in the likewise dense zone m the density grows quadratically, and in the “mesozone“ p it grows linearly. From this mesozone the outwards directed interactions go out. For mesons there exist 2 quasi-corpuscular regions. For baryons there are three, which justifies an interpretation as quarks. The kind of occupations of the zones in case of the underlying unit structures always depends on the invariants which determine the complex hermetry, and which as quantum numbers determine the basic dynamics of the internal correlating aggregates of condensor fluxes and thus represent invariant basic pattern. The basic patterns correspond to a set of quantum numbers $(kPQ\kappa)C(q_x)$, where k is a “configuration number“, P is the double isospin, Q is the double spatial-spin, κ is the “doublet number“, C is the “structure distributor“ (strangeness) and q_x is the quantum number of charge.

According to this scheme there should exist a spin-isomorphic neutral counterpart of the electron. The masses of the basic states of the elementary particles with mean life times > 10^{-16} sec agree very well with the empirical values. Some particle masses (e, p, n, π^+, Λ, K^+, K^0, Σ^+ und Ξ^0) only deviate from the measured values relatively by nearly 10^{-6}, but the particle μ only by 10^{-7}, and the other by 10^{-5} (η is known to three places only). Also the mean life times of these basic states agree well with experimental data (the particles $\pi^\pm$, $\overline{K}^0$ and Σ^+ show a relative deviation by 10^{-5} , the remaining correspond to the third or fourth place, respectively, with measured values).

The masses of the excitation states (resonances) are located at the position or rather close to the measured values. But the theoretical values still follow each other too tightly (with distances going down to 20 MeV/c²), since a selection rule is still missing. The theory predicts a new particle o^+ (omicron), whose mass is about 1540 MeV/c². One of the resonances of the omicron is located at 2317.4 MeV/c², which is exactly the value for the particle $D_{SJ}^*(2317)$, which recently was detected by the Barbar Collaboration experiment at SLAC (2003).

An energetic excitation of a unit structure happens stepwise from of the external zone via the two internal to the central zone and lets the occupations of protosimplexes raise. In this case the quantity of the “protosimplex-generator“, which describes the invariant quadruple of the occupations parameters of all 4 zones and which is built up from quantum numbers, must be multiplied by an stimulation function, which depends on the integer numbers N. Each value N > 0 in relation to a basic pattern always generates a quadruple of numbers of occupation parameters of cunfiguration zones, whose energy-masses thus represented are interpreted as resonance stimulations of the pattern N = 0. If in the unit mass spectrum the particular frame structures provided with negative sign are inserted, then the protosimplexes will be extinguished, which would correspond to an empty-space condition. Nevertheless a non-zero mass term remains, which only depends on the involved basic patterns. These ponderable structures are neither defined by a coupling structure nor by any flux aggregate. These “field catalytes“ represent the “identity“ of an isospin family, which consists of P + 1 components, and can be identified with neutrino states. For k = 2 there are 4 neutrinos. For instance, the ß-neutrino has the mass $m(\nu_ß)$ = 0,003818 eV.

For further empirical tests Heim investigated proton-electron interaction in H-atoms. On this occasion a relation for the finestructure constant α could be derived, in which a correction must be performed, which is required by the existence of R_3-celles due to metrons, and which yields the numerical value: $1/\alpha = 137{,}03603953$.

An excellent confirmation of Heim's structure theory was established in 2002, when we computed Heim's mass formula anew. If of the three natural constants h, c, G which enter this theory the most recent values for the gravitation constant G are inserted, then some of the masses of basic states will become more exact (e, p and n up to 7 places, for instance), as would be expected for a correct theory.

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