Part IV

Simple Model of Subatomic Particles

When Ernest Rutherford analyzed the gold foil experiment, quantum mechanics was not known. Consequently, Rutherford's analysis is based on the assumption that the same laws which hold true at the classical macroscopic level also govern the interactions between the penetrating alpha particles and the constituents of the gold atoms. Under this assumption, it is deduced that every atom has a tiny dense core in which nearly all the mass of the atom is concentrated. About this positively charged nucleus, point-like electrons are believed to rotate. Rutherford's atomic model explains the observed probabilities of different interactions in the gold foil experiment in terms of miniatures of macroscopic rigid bodies—an explanation which is definitely false. Rutherford's atomic model is analogous to Lorentz's interpretation of the Michelson-Morley experiment; both explain very well specific experimental facts but are essentially misleading. The misleading conviction in the correctness of Rutherford's atomic model has engendered a reproducing chain of superfluous and misleading concepts. First the *strong force hypothesis* was conceived. This hypothesis generated the *separation rule*, which excludes the coexistence of baryons and leptons in the same subatomic particle. The separation rule, when confronted with observations gave birth to the superfluous concept of *subatomic decay*: particles, which are believed to be non-composite, vanish and are replaced by particles which apparently did not exist before. Rutherford's atomic model is a misleading description of the reality of atoms; it is the ultimate reason for contemporary false interpretations of subatomic observations. In Periodic Physics, this model is abandoned together with all its consequent chain of superfluous and misleading concepts. This abandonment is the starting point of the Simple Model of Subatomic Particles (SMSP).

1. Subatomic Chemistry—Six Building Blocks

The Standard Model regards all the six known quarks and all the six known leptons as non-composite particles. The Simple Model describes nine of these twelve fermions and their nine antiparticles as compositions of the other three fermions and their three antiparticles. The composite fermions are the five quarks other than the up-quark and the four leptons of the second and the third generations. The other three fermions and their three antiparticles are the **fundamental fermions**, they are: the up-quark, the up-antiquark, the electron, the positron, the electron-neutrino, and the electron-antineutrino.

Table IV.1 — the Fundamental Fermions

$$\begin{array}{ccc} u & e^- & \nu_e \\ \bar{u} & e^+ & \bar{\nu}_e \end{array}$$

Table IV.2 — Designating the Fundamental Fermions by Indexes

$$\begin{array}{ccc} f_1 & f_2 & f_3 \\ \bar{f}_1 & \bar{f}_2 & \bar{f}_3 \end{array}$$

Beta plus processes, in which up-quarks “disappear”, are fusion processes in which up-quarks are integrated with other fundamental fermions to create down-quarks. Electron capture processes, in which electrons “disappear”, are fusion processes in which electrons are integrated with other fundamental fermions to create down-quarks. Neutrino “oscillations” are fusions and fissions of composite neutrinos. Fundamental fermions can be integrated into composite sub-atomic particles; composite sub-atomic particles can disintegrate. Subatomic reactions may involve production and/or annihilation of fundamental pairs, but replacement of fundamental fermions by other particles never happen.

A fundamental fermion is annihilated or produced only together with its antiparticle; unless annihilated, a fundamental fermion is eternally stable.

Consequently, the following ultimate conservation rule holds true:

Conservation of Single Fundamental Fermions
In a closed system, the number of single fundamental fermions of each kind is conserved.

The number of single fundamental fermions of a certain kind in a system is the difference between the number of its fundamental particle-constituents of that kind and the number of its fundamental antiparticle-constituents of that kind: $\#si(f_i) = \# f_i - \# \bar{f}_i$

The conservation of baryon and lepton quantum numbers is an ultimate consequence of the conservation of single fundamental fermions. Fundamental fermions and only fundamental fermions carry baryon/lepton quantum numbers. The up-quark and the up-antiquark, and only them, carry baryon quantum numbers (one third and minus one third, respectively). Only the electron, the electron-neutrino and their antiparticles, carry lepton quantum numbers (plus one for the electron and for the electron-neutrino, minus one for the positron and for the electron-antineutrino). Three units of electron-lepton number in one lepton is one unit of muon-lepton number (this is the case of the muon-neutrino and the muon). Five units of electron-lepton number in one lepton is one unit of tau-lepton number (this is the case of the tau-neutrino and the tauon). Consequently, the muon-lepton number and the taw-lepton number are not necessarily conserved in all reactions. Quark "flavor" quantum numbers (strangeness, charm, bottomness, and topness) are carried by certain combinations of fundamental pairs; these quantum numbers are not necessarily conserved in all reactions.

The conservation of electric charge is also an ultimate consequence of the conservation of single fundamental fermions. The up-quark, the up-antiquark, the electron and the positron, and only them, are electrically charged. The up-quark and the up-antiquark carry electric charges of $2/3$ elementary unit and $-2/3$ elementary unit, respectively. The electron and the positron carry electric charges of -1 elementary unit and 1 elementary unit, respectively.

Let us apply the conservation of single fundamental fermions to the basic beta minus process: $d \rightarrow u + e^- + \overline{\nu}_e$

The products of this process are three single fundamental fermions; thus these three fermions are necessarily the single fundamental constituents of the down-quark. Fundamental pairs can be additional constituents, which are annihilated during disintegration. Fundamental pair constituents, however, result in high instability,[1] which is not the case for the down-quark, thus: $d \equiv ue^-\overline{\nu}_e$

In the beta plus process $u \rightarrow d + e^+ + \nu_e$ one single fundamental fermion is involved, an up-quark. This process is a fusion process which requires the production of two pairs: e^-e^+ and $\nu_e\overline{\nu}_e$. In terms of fundamental fermions:

$$u \rightarrow ue^-\overline{\nu}_e + e^+ + \nu_e$$

- Lepton fundamental pairs of zero lepton number are constituents of all the composite quarks. Quarks fundamental pairs of zero baryon number are constituents of all the composite leptons. The two kinds of fundamental pairs are the constituents of W-bosons. The false interpretation by which the W-bosons, all the quarks, and all the leptons are non-composite particles is derived from a misleading dynamics which spoils the interpretation of subatomic observations.

- The fundamental constituents of composite quarks and of composite leptons interact only internally between themselves. This is the reason that the composite nature of composite quarks and of composite leptons cannot be experimentally demonstrated. However, any unstable

[1] Pairs of "sea quarks" result from the strong force hypothesis; they do not exist.

massive particle is necessarily a composite particle no matter whether or not this can be experimentally demonstrated.

It is convenient to describe the fundamental composition of sub-atomic particles by the Fundamental Fermions quasi tensor $\underset{\substack{i=1,2,3\\ j=1,2}}{F_{ij}}$. Each of the three columns F_i corresponds to one fundamental fermion, in the order given in table IV.1. The first entry of the i_{th} column is the number of single fundamental fermions of the i_{th} kind: $F_{i1} = \# f_i - \# \bar{f}_i$

The second entry of the i_{th} column is the number of fundamental pairs of the i_{th} kind: $F_{i2} = \# pair_i = \dfrac{\# f_i + \# \bar{f}_i - \left| \# f_i - \# \bar{f}_i \right|}{2}$

The FF quasi tensors of the fundamental fermions are:

$$F(u) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \quad F(e^-) = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix} \quad F(\nu_e) = \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$$

$$F(\bar{u}) = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \quad F(e^+) = \begin{pmatrix} 0 & -1 & 0 \\ 0 & 0 & 0 \end{pmatrix} \quad F(\bar{\nu}_e) = \begin{pmatrix} 0 & 0 & -1 \\ 0 & 0 & 0 \end{pmatrix}$$

The fundamental composition of hadrons is represented by detailed FF quasi tensors in which each quark is displayed separately; some examples:

$$F(p) = F(uud) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 1 & -1 \\ 0 & 0 & 0 \end{pmatrix}$$

$$F(n) = F(udd) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 1 & -1 \\ 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 1 & -1 \\ 0 & 0 & 0 \end{pmatrix}$$

$$F(\pi^-) = F(\bar{u}d) = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 1 & -1 \\ 0 & 0 & 0 \end{pmatrix}$$

The fundamental compositions of composite quarks and of composite leptons are attained by applying the conservation of single fundamental fermions to observations. In each up-type quark there is one single fundamental fermion—an up-quark. In each down-type quark there are three single fundamental fermions: an up-quark, an electron, and an electron-antineutrino. In each second generation lepton there are three single fundamental fermions: an electron and two electron-neutrinos in the muon, and three electron-neutrinos in the muon-neutrino (three units of lepton number in one composite lepton are one unit of muon-lepton number). In each third generation lepton there are five single fundamental fermions: an electron and four electron-neutrinos in the tauon, and five electron-neutrinos in the tau-neutrino (five units of lepton number in one composite lepton are one unit of tau-lepton number). The other constituents of the composite quarks and of composite leptons (not including the down-quark) are fundamental pairs. A modification of the leptons-quarks symmetry associates a fourth-generation up-type quark, the **awesome-quark**, to the currently known leptons and quarks. It is explained hereafter.

Table IV.3 — Compositions of Composite Quarks

$$F(c)=\begin{pmatrix}1 & 0 & 0\\ 2 & 1 & 1\end{pmatrix}\quad F(t)=\begin{pmatrix}1 & 0 & 0\\ 3 & 1 & 2\end{pmatrix}\quad F(a)=\begin{pmatrix}1 & 0 & 0\\ 4 & 1 & 3\end{pmatrix}$$

$$F(d)=\begin{pmatrix}1 & 1 & -1\\ 0 & 0 & 0\end{pmatrix}\quad F(s)=\begin{pmatrix}1 & 1 & -1\\ 1 & 0 & 1\end{pmatrix}\quad F(b)=\begin{pmatrix}1 & 1 & -1\\ 2 & 0 & 2\end{pmatrix}$$

Table IV.4 — Compositions of Composite Charged Leptons

$$F(\mu^-)=\begin{pmatrix}0 & 1 & 2\\ 1 & 0 & 0\end{pmatrix}\quad F(\tau^-)=\begin{pmatrix}0 & 1 & 4\\ 2 & 0 & 0\end{pmatrix}$$

Table IV.5 — Compositions of Composite Neutrinos

$$F(\nu_\mu)=\begin{pmatrix}0 & 0 & 3\\ 1 & 0 & 0\end{pmatrix}\quad F(\nu_\tau)=\begin{pmatrix}0 & 0 & 5\\ 2 & 0 & 0\end{pmatrix}$$

The content of the leptons-quarks symmetry in the Standard Model is: To each pair of a charged lepton and its neutrino, there correspond the down-type quark and the up-type quark of their generation. In the Simple Model this rule is modified:

Leptons-Quarks Modified Symmetry

To each neutrino there correspond the charged lepton and the down-type quark of its generation and the up-type quark of the successive generation.

The electron-neutrino and the electron first appear in the down and the charm quarks (1, 1, 2, 4 fundamental leptons correspondingly). To the muon-neutrino there correspond the muon and the strange and the top quarks (3, 3, 4, 6 fundamental leptons correspondingly). To the tau-neutrino there correspond the tauon, the bottom-quark and the awesome-quark (5, 5, 6, 8 fundamental leptons correspondingly). All the sub-atomic particles involved in this symmetry have leptons constituents. Up-quark, the fundamental quark, is "out of this game".

The rules that govern the compositions of quarks and leptons are given below. The index n denotes the generation.

Table IV.6 — Composition Rules of Quarks and Leptons

$$F(uptype_1) = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \qquad \underset{n\geq 2}{F(uptype_n)} = \begin{pmatrix} 1 & 0 & 0 \\ n & 1 & n-1 \end{pmatrix}$$

$$F(downtype_n) = \begin{pmatrix} 1 & 1 & -1 \\ n-1 & 0 & n-1 \end{pmatrix}$$

$$F(charglep_n) = \begin{pmatrix} 0 & 1 & 2n-2 \\ n-1 & 0 & 0 \end{pmatrix}$$

$$F(neutrino_n) = \begin{pmatrix} 0 & 0 & 2n-1 \\ n-1 & 0 & 0 \end{pmatrix}$$

There is no theoretical limit to the number of generations of quarks and leptons; this number is limited only by the highest energies available in nature. The energies in which new generations appear are indispensable part of the relevant dynamics. An arbitrary limit of not more than three generations is used in the Standard Model to wrongly interpret higher generation particles such that they "confirm" predictions of this model.

Composite neutrinos are composed from three different building blocks. Composite charged leptons are composed from four different building blocks. Down-type quarks, from the second generation on, are composed from five different building blocks. Composite up-type quarks are composed from all the six different building blocks.

Table IV.7 — Rules of Leptons-Quarks Modified Symmetry

$$F(\nu_n) + F(e_1) - F(\nu_1) = F(e_n)$$

$$F(e_n) + F(u_1) - (n-1)F(\nu_1) + nF(\bar{\nu}_1) = F(d_n)$$

$$F(d_n) + 2F(u_1\bar{u}_1) + F(\bar{e}_1) + F(\nu_1) = F(u_{n+1})$$

Mesons

Each quark carries one third baryon number and each antiquark carries minus one third baryon number. Quarks and antiquarks constitute particles of +1, 0, or -1 baryon numbers. Three quarks or three antiquarks can, correspondingly, compose a baryon or an antibaryon. A meson is a massive boson which is composed of a quark and an antiquark. Mesons are of zero baryon number and their electric charge is +1 elementary unit for an up-type quark composed with a down-type antiquark, -1 elementary unit for the opposite composition, and zero for a mono-type composition.

W-bosons

The Standard Model wrongly regards virtual bosons that appear at intermediate stages of "weak" reactions as elementary particles which “mediate” the “weak interaction”.[2] This view is derived from the superfluous rule, which excludes the coexistence of quarks and leptons in one subatomic particle, and from the misleading conviction that all interactions are mediated. It is shown hereafter, by many examples of “weak” reactions, that the so-called “W-bosons” are actually composite particles, their fundamental constituents are the same as the fundamental constituents of certain charged mesons but, unlike mesons, W-bosons are not quark-composed. A relevant principle is introduced:

Principle of Non-Composite Massive Particles

A non-composite massive particle is annihilated or produced only together with its antiparticle; unless annihilated, a non-composite massive particle is eternally stable.

All the massive bosons do not satisfy the above requirements. Thus, all the massive bosons are composite particles.

W-bosons are an indispensable part of “weak” reactions; like any other unstable massive particles they are also composite particles. W-bosons are involved in intermediate stages of “weak” reactions, and each one of them splits to a fermion and an antifermion. The intermediate stages of “weak” reactions are the reason that these reactions are slower than “strong” reactions which are preformed in one stage. The single fundamental constituents of W^- are: an electron and an electron-antineutrino. The single fundamental constituents of W^+ are: a positron and an electron-neutrino. The fission of a W-boson requires internal annihilation of at least one $pair_1$. The number of up-quark—up-antiquark pairs in the composition of a W-boson is its generation; this number is also half the number of the fundamental leptons constituents of this W-boson.

Table IV.8 — the Composition Rule of W-Bosons

$$F(W_n) = \begin{pmatrix} 0 & 1 & -1 \\ n & 0 & n-1 \end{pmatrix}$$

[2] W-bosons do not interact with detectors; their existence is deduced from their products.

The following rule holds true: $F(W_n) = F(d_n) + F(\bar{u}_1)$

Thus, certain charged mesons are constituted of the same fundamental constituents as certain W-bosons/W-antibosons; their different name indicates that, unlike W-bosons, the fundamental constituents of mesons are arranged in a quark and an antiquark.

The so-called "Z-bosons" own their "existence" to the false conviction that all interactions are mediated. The elastic and inelastic collisions between neutrinos and electrons do not require mediators (this is explained in the dynamical section). Apparent observations of Z-bosons are, actually, observations of **Z-mesons** which disintegrate to pairs of a charge lepton and its antiparticle. The term Z-Mesons refers here to mesons which are composed of a quark and its antiparticle. There are no single fundamental constituents in Z-mesons, their baryon quantum number and their electric charges vanish, and unless disintegrated to fermion-antifermion, they are annihilated to two photons. This means that a composite quark/antiquark interacts as one particle with the other quarks/antiquarks in its hadron. The index n in Table IV.9 designates the generation of the quark involved.

Table IV.9 — the Composition Rules of Z-Mesons

$$F(Z_1^{up}) = F(\bar{u}_1 u_1) = \begin{pmatrix} -1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

$$\underset{n\geq 2}{F(Z_n^{uptype})} = F(\bar{u}_n u_n) = \begin{pmatrix} -1 & 0 & 0 \\ n & 1 & n-1 \end{pmatrix}\begin{pmatrix} 1 & 0 & 0 \\ n & 1 & n-1 \end{pmatrix}$$

$$F(Z_n^{downtype}) = F(\bar{d}_n d_n) = \begin{pmatrix} -1 & -1 & 1 \\ n-1 & 0 & n-1 \end{pmatrix}\begin{pmatrix} 1 & 1 & -1 \\ n-1 & 0 & n-1 \end{pmatrix}$$

The particle observed in the LHC in 2012 that is claimed to be a Higgs boson should be a Z-Meson of a generation that has not been observed before.

Only a high-generation Z-meson can assume such high rest-energy, and still be totally annihilated to two photons.

Production of composite charged leptons from mesons

1) $\pi^- \to \mu^- + \bar{\nu}_\mu$ $(\bar{u}_1 d_1 \to \underset{1,0,1}{\bar{U}}{}^1 d_2 \to W_3 \to e_2 + \bar{\nu}_2)$

$$\begin{pmatrix}-1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix}\begin{pmatrix}1 & 1 & -1\\ 0 & 0 & 0\end{pmatrix}\to\begin{pmatrix}-1 & 0 & 0\\ 1 & 0 & 1\end{pmatrix}\begin{pmatrix}1 & 1 & -1\\ 1 & 0 & 1\end{pmatrix}\to\begin{pmatrix}0 & 1 & -1\\ 3 & 0 & 2\end{pmatrix}\to\begin{pmatrix}0 & 1 & 2\\ 1 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & -3\\ 1 & 0 & 0\end{pmatrix}$$

In the first intermediate stage of this "weak" fusion, the down-quark of the reacting pion is extended to a strange-quark and the up-antiquark is extended by a strange-boson (one $pair_1$ and one $pair_3$). In the second intermediate stage the strange-quark and the extended up-antiquark are fused together to a third generation W-boson. In the final stage one $pair_1$ is internally annihilated and the boson splits to a muon and a muon-antineutrino. The fact that the quark-composed pi-meson is of higher rest-mass than a charged lepton and its antineutrino (in spite of the fact that six fundamental constituents are added to the system) should be taken into account in the evaluation of the relevant dynamics. The rest-mass of the reacting pi-meson is about $139.570 MeV/c^2$, the rest-mass of the muon is about $105.658 MeV/c^2$, the rest-mass of the muon-antineutrino is thought to be smaller than $0.17 MeV/c^2$.

2) $K^- \to \tau^- + \bar{\nu}_\tau$ $(\bar{u}_1 d_2 \to \underset{2,0,2}{\bar{U}}{}^1 d_3 \to W_5 \to e_3 + \bar{\nu}_3)$

$$\begin{pmatrix}-1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix}\begin{pmatrix}1 & 1 & -1\\ 1 & 0 & 1\end{pmatrix}\to\begin{pmatrix}-1 & 0 & 0\\ 2 & 0 & 2\end{pmatrix}\begin{pmatrix}1 & 1 & -1\\ 2 & 0 & 2\end{pmatrix}\to\begin{pmatrix}0 & 1 & -1\\ 5 & 0 & 4\end{pmatrix}\to\begin{pmatrix}0 & 1 & 4\\ 2 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & -5\\ 2 & 0 & 0\end{pmatrix}$$

Similarly to the former fusion, the K-meson (kaon) which is composed of a strange-quark and an up-antiquark is fused to a tauon and to its antineutrino.

The hypothetical, third reaction in this sequence can be real only if the rest-mass of its products is smaller than the rest-mass of the reacting meson:

3) $\bar{u}_1 d_3 \rightarrow \underset{3,0,3}{\bar{U}}^{1} d_4 \rightarrow W_7 \rightarrow e_4 + \bar{\nu}_4$

$$\begin{pmatrix} -1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 1 & -1 \\ 2 & 0 & 2 \end{pmatrix} \rightarrow \begin{pmatrix} -1 & 0 & 0 \\ 3 & 0 & 3 \end{pmatrix}\begin{pmatrix} 1 & 1 & -1 \\ 3 & 0 & 3 \end{pmatrix} \rightarrow \begin{pmatrix} 0 & 1 & -1 \\ 7 & 0 & 6 \end{pmatrix} \rightarrow \begin{pmatrix} 0 & 1 & 6 \\ 3 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -7 \\ 3 & 0 & 0 \end{pmatrix}$$

The general reaction of this sequence:

$$\bar{u}_1 d_n \rightarrow \underset{n,0,n}{\bar{U}}^{1} d_{n+1} \rightarrow W_{2n+1} \rightarrow e_{n+1} + \bar{\nu}_{n+1}$$

$$\begin{pmatrix} -1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 1 & -1 \\ n-1 & 0 & n-1 \end{pmatrix} \rightarrow \begin{pmatrix} -1 & 0 & 0 \\ n & 0 & n \end{pmatrix}\begin{pmatrix} 1 & 1 & -1 \\ n & 0 & n \end{pmatrix} \rightarrow \begin{pmatrix} 0 & 1 & -1 \\ 2n+1 & 0 & 2n \end{pmatrix} \rightarrow \begin{pmatrix} 0 & 1 & 2n \\ n & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -(2n+1) \\ n & 0 & 0 \end{pmatrix}$$

It might be that modified reactions of the above sequence are wrongly interpreted as an experimental demonstration of the existence of the hypothetical $W^{\pm}$ intermediate vector boson (Arnison, 1983) (in modified reactions more fundamental pairs are annihilated at the last stage, and the products are an electron and its antineutrino or a muon and its anti neutrino). W-bosons are intermediate stages in "weak" reactions; they can be detected only by their products. The mass of a W-boson of a certain generation is about $80 GeV/c^2$, this W-boson had been chosen because it fits the predictions of the electro-weak theory. In the Simple Model there are no gauge bosons other than photons[3]; subatomic reactions occur not due to forces, but due to the principle of attaining the lowest possible rest-mass.

"Weak" reactions of quarks

In the following descriptions quarks appear as virtually free particles. This, of course, is a simplification; quarks cannot be observed directly, but only

[3] The different kinds of photons and their interaction properties are discussed in Part II.

indirectly as constituents of hadrons. "Weak" reactions of quarks take place in three steps:

1. Fundamental pairs are produced and integrated with the reacting quark to form a **virtual extended quark** $\underset{i,j,k}{U^n}/\underset{i,j,k}{D^n}$ (the capital letter denotes the type of the quark, the upper index is its generation, and the bottom indexes denote the numbers of produced pairs).
2. A W-boson/W-antiboson is ejected, which reduces the virtual extended quark to a quark of the opposite type.
3. The W-boson/W-antiboson splits to a lepton and an antilepton or to a quark and an antiquark. The splitting of a W-boson/W-antiboson involves internal annihilation of fundamental pairs (at least of one $pair_1$).

$d_1.1)\quad d \to u + e^- + \overline{\nu}_e \qquad (d_1 \to \underset{1,0,0}{D^1} \to u_1 + W_1 \to u_1 + e_1 + \overline{\nu}_1)$

$$\begin{pmatrix}1 & 1 & -1\\ 0 & 0 & 0\end{pmatrix} \to \begin{pmatrix}1 & 1 & -1\\ 1 & 0 & 0\end{pmatrix} \to \begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & 1 & -1\\ 1 & 0 & 0\end{pmatrix} \to \begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & 1 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & 0 & -1\\ 0 & 0 & 0\end{pmatrix}$$

In this fission a down-quark is disintegrated to its fundamental constituents. In the process one $pair_1$ is produced and annihilated. The available energy here is the rest-energy of a neutron minus the rest energies of a proton, an electron, and an electron-antineutrino. Neglecting the rest-energy of the electron-antineutrino, this available energy is about $0.78233MeV$.

$u_1.1)\quad u \to d + e^+ + \nu_e \qquad (u_1 \to \underset{1,1,1}{U^1} \to d_1 + \overline{W_1} \to d_1 + \overline{e}_1 + \nu_1)$

$$\begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix} \to \begin{pmatrix}1 & 0 & 0\\ 1 & 1 & 1\end{pmatrix} \to \begin{pmatrix}1 & 1 & -1\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & -1 & 1\\ 1 & 0 & 0\end{pmatrix} \to \begin{pmatrix}1 & 1 & -1\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & -1 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & 0 & 1\\ 0 & 0 & 0\end{pmatrix}$$

In this reaction a down-quark is fused from an up-quark. This fusion requires the production of three fundamental pairs, one of each kind. In the last stage one $pair_1$ is annihilated.

$d_2.1)\quad s \to u + e^- + \bar{\nu}_e \qquad (d_2 \to \underset{1,0,0}{D^2} \to u_1 + W_2 \to u_1 + e_1 + \bar{\nu}_1)$

$$\begin{pmatrix}1 & 1 & -1\\ 1 & 0 & 1\end{pmatrix} \to \begin{pmatrix}1 & 1 & -1\\ 2 & 0 & 1\end{pmatrix} \to \begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & 1 & -1\\ 2 & 0 & 1\end{pmatrix} \to \begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & 1 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & 0 & -1\\ 0 & 0 & 0\end{pmatrix}$$

The strange-quark, d_2, is disintegrated to its single fundamental constituents. For the creation of a second generation W-boson, one $pair_1$ is produced. Then, in the disintegration process of this boson two $pair_1$ and one $pair_3$ are annihilated. The energy released in internal annihilations does not directly generate gamma rays but is delivered to the products. This energy exits the baryon in which the process takes place which results in emission of a gamma photon.

$d_2.2)\quad s \to c + e^- + \bar{\nu}_e \qquad (d_2 \to \underset{2,1,0}{D^2} \to u_2 + W_1 \to u_2 + e_1 + \bar{\nu}_1)$

$$\begin{pmatrix}1 & 1 & -1\\ 1 & 0 & 1\end{pmatrix} \to \begin{pmatrix}1 & 1 & -1\\ 3 & 1 & 1\end{pmatrix} \to \begin{pmatrix}1 & 0 & 0\\ 2 & 1 & 1\end{pmatrix} + \begin{pmatrix}0 & 1 & -1\\ 1 & 0 & 0\end{pmatrix} \to \begin{pmatrix}1 & 0 & 0\\ 2 & 1 & 1\end{pmatrix} + \begin{pmatrix}0 & 1 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & 0 & -1\\ 0 & 0 & 0\end{pmatrix}$$

In this reaction two $pair_1$ and one $pair_2$ are produced; at the last stage one $pair_1$ is annihilated.

$d_2.3)\quad s \to u + \bar{u} + d \qquad (d_2 \to \underset{1,0,0}{D^2} \to u_1 + W_2 \to u_1 + \bar{u}_1 + d_1)$

$$\begin{pmatrix}1 & 1 & -1\\ 1 & 0 & 1\end{pmatrix} \to \begin{pmatrix}1 & 1 & -1\\ 2 & 0 & 1\end{pmatrix} \to \begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}0 & 1 & -1\\ 2 & 0 & 1\end{pmatrix} \to \begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}-1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix} + \begin{pmatrix}1 & 1 & -1\\ 0 & 0 & 0\end{pmatrix}$$

In this fission of the strange-quark one $pair_3$ is annihilated and one $pair_1$ is produced and annihilated.

$u_2.1)\quad c \to s + e^+ + \nu_e \qquad (u_2 \to \underset{0,0,1}{U^2} \to d_2 + \overline{W_1} \to d_2 + \bar{e}_1 + \nu_1)$

$$\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\2&1&2\end{pmatrix}\rightarrow\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}+\begin{pmatrix}0&-1&1\\1&0&0\end{pmatrix}\rightarrow\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}+\begin{pmatrix}0&-1&0\\0&0&0\end{pmatrix}+\begin{pmatrix}0&0&1\\0&0&0\end{pmatrix}$$

In this fission of the charm-quark one $pair_1$ is annihilated and one $pair_3$ is produced.

$u_2.2)\quad c \rightarrow s+\mu^+ +\nu_\mu \qquad (u_2 \rightarrow \underset{2,0,3}{U^2} \rightarrow d_2+\overline{W}_3 \rightarrow d_2+\overline{e}_2+\nu_2)$

$$\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\4&1&4\end{pmatrix}\rightarrow\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}+\begin{pmatrix}0&-1&1\\3&0&2\end{pmatrix}\rightarrow\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}+\begin{pmatrix}0&-1&-2\\1&0&0\end{pmatrix}+\begin{pmatrix}0&0&3\\1&0&0\end{pmatrix}$$

In this fission of the charm-quark two $pair_1$ and three $pair_3$ are produced. One $pair_1$ is annihilated in the disintegration of the W-antiboson.

$u_2.3)\quad c \rightarrow s+u+\overline{d} \qquad (u_2 \rightarrow \underset{1,0,2}{U^2} \rightarrow d_2+\overline{W}_2 \rightarrow d_2+u_1+\overline{d}_1)$

$$\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\3&1&3\end{pmatrix}\rightarrow\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}+\begin{pmatrix}0&-1&1\\2&0&1\end{pmatrix}\rightarrow\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}+\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}+\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}$$

$u_2.4)\quad c \rightarrow d+e^+ +\nu_e \qquad (u_2 \rightarrow \underset{0,0,1}{U^2} \rightarrow d_1+\overline{W}_2 \rightarrow d_1+\overline{e}_1+\nu_1)$

$$\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\2&1&2\end{pmatrix}\rightarrow\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}+\begin{pmatrix}0&-1&1\\2&0&1\end{pmatrix}\rightarrow\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}+\begin{pmatrix}0&-1&0\\0&0&0\end{pmatrix}+\begin{pmatrix}0&0&1\\0&0&0\end{pmatrix}$$

In this rather rare fission of the charm-quark two $pair_1$ are annihilated. One $pair_3$ is produced and annihilated.

$d_3.1)\quad b \rightarrow c+e^- +\overline{\nu}_e \qquad (d_3 \rightarrow \underset{2,1,0}{D^3} \rightarrow u_2+W_2 \rightarrow u_2+e_1+\overline{\nu}_1)$

$$\begin{pmatrix}1&1&-1\\2&0&2\end{pmatrix}\rightarrow\begin{pmatrix}1&1&-1\\4&1&2\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}0&1&-1\\2&0&1\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}0&1&0\\0&0&0\end{pmatrix}+\begin{pmatrix}0&0&-1\\0&0&0\end{pmatrix}$$

In this fission of the bottom-quark one $pair_2$ is produced, and one $pair_3$ is annihilated.

$d_3.2)\quad b \to c + \mu^- + \bar{\nu}_\mu \qquad (d_3 \to \underset{3,1,1}{D^3} \to u_2 + W_3 \to u_2 + e_2 + \bar{\nu}_2)$

$$\begin{pmatrix}1&1&-1\\2&0&2\end{pmatrix}\to\begin{pmatrix}1&1&-1\\5&1&3\end{pmatrix}\to\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}0&1&-1\\3&0&2\end{pmatrix}\to\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}0&1&2\\1&0&0\end{pmatrix}+\begin{pmatrix}0&0&-3\\1&0&0\end{pmatrix}$$

$d_3.3)\quad b \to c + \tau^- + \bar{\nu}_\tau \qquad (d_3 \to \underset{5,1,3}{D^3} \to u_2 + W_5 \to u_2 + e_3 + \bar{\nu}_3)$

$$\begin{pmatrix}1&1&-1\\2&0&2\end{pmatrix}\to\begin{pmatrix}1&1&-1\\7&1&5\end{pmatrix}\to\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}0&1&-1\\5&0&4\end{pmatrix}\to\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}0&1&4\\2&0&0\end{pmatrix}+\begin{pmatrix}0&0&-5\\2&0&0\end{pmatrix}$$

In this fission of the bottom-quark four $pair_1$, one $pair_2$ and three $pair_3$ are produced.

$d_3.4)\quad b \to c + d + \bar{u} \qquad (d_3 \to \underset{2,1,0}{D^3} \to u_2 + W_2 \to u_2 + d_1 + \bar{u}_1)$

$$\begin{pmatrix}1&1&-1\\2&0&2\end{pmatrix}\to\begin{pmatrix}1&1&-1\\4&1&2\end{pmatrix}\to\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}0&1&-1\\2&0&1\end{pmatrix}\to\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}+\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}$$

In this fission of the bottom-quark, one $pair_1$ and one $pair_2$ are produced, and one $pair_3$ is annihilated.

$d_3.5)\quad b \to c + s + \bar{u} \qquad (d_3 \to \underset{3,1,1}{D^3} \to u_2 + W_3 \to u_2 + d_2 + \bar{u}_1)$

$$\begin{pmatrix}1&1&-1\\2&0&2\end{pmatrix}\to\begin{pmatrix}1&1&-1\\5&1&3\end{pmatrix}\to\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}0&1&-1\\3&0&2\end{pmatrix}\to\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}+\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}$$

This fission of the bottom-quark requires five pair-productions: three $pair_1$, one $pair_2$ and one $pair_3$.

$u_3.1)\quad t \to b + e^{+} + \nu_e \qquad (u_3 \to \underset{0,0,1}{U^3} \to d_3 + \overline{W_1} \to d_3 + \bar{e}_1 + \nu_1)$

$$\begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & 2 \end{pmatrix} \to \begin{pmatrix} 1 & 0 & 0 \\ 3 & 1 & 3 \end{pmatrix} \to \begin{pmatrix} 1 & 1 & -1 \\ 2 & 0 & 2 \end{pmatrix} + \begin{pmatrix} 0 & -1 & 1 \\ 1 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 1 & 1 & -1 \\ 2 & 0 & 2 \end{pmatrix} + \begin{pmatrix} 0 & -1 & 0 \\ 0 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$$

In the simplest fission of the top-quark one $pair_1$ is annihilated and one $pair_3$ is produced.

$u_4.1)\quad a \to d_4 + e^{+} + \nu_e \qquad (u_4 \to \underset{0,0,1}{U^4} \to d_4 + \overline{W_1} \to d_4 + \bar{e}_1 + \nu_1)$

$$\begin{pmatrix} 1 & 0 & 0 \\ 4 & 1 & 3 \end{pmatrix} \to \begin{pmatrix} 1 & 0 & 0 \\ 4 & 1 & 4 \end{pmatrix} \to \begin{pmatrix} 1 & 1 & -1 \\ 3 & 0 & 3 \end{pmatrix} + \begin{pmatrix} 0 & -1 & 1 \\ 1 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 1 & 1 & -1 \\ 3 & 0 & 3 \end{pmatrix} + \begin{pmatrix} 0 & -1 & 0 \\ 0 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$$

In this fission of the hypothetical awesome-quark one $pair_1$ is annihilated and one $pair_3$ is produced. The product quark is the hypothetical fourth generation down-type quark.

$u_4.2)\quad a \to b + \mu^{+} + \nu_\mu \qquad (u_4 \to \underset{1,0,2}{U^4} \to d_3 + \overline{W_3} \to d_3 + \bar{e}_2 + \nu_2)$

$$\begin{pmatrix} 1 & 0 & 0 \\ 4 & 1 & 3 \end{pmatrix} \to \begin{pmatrix} 1 & 0 & 0 \\ 5 & 1 & 5 \end{pmatrix} \to \begin{pmatrix} 1 & 1 & -1 \\ 2 & 0 & 2 \end{pmatrix} + \begin{pmatrix} 0 & -1 & 1 \\ 3 & 0 & 2 \end{pmatrix} \to \begin{pmatrix} 1 & 1 & -1 \\ 2 & 0 & 2 \end{pmatrix} + \begin{pmatrix} 0 & -1 & -2 \\ 1 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 3 \\ 1 & 0 & 0 \end{pmatrix}$$

In this second-type fission of the hypothetical awesome-quark one $pair_1$ is annihilated and two $pair_3$ are produced.

Disintegrations of composite charged leptons

A $E^n_{2n-3} - fermion$ is fused of a composite n_{th} generation charged lepton and a $(2n-3)\,pair_1$ $(2n-3)\,pair_3$ boson.

$$\underset{n\ge 2}{F(E^n_{2n-3})} = \begin{pmatrix} 0 & 1 & 2n-2 \\ n-1 & 0 & 0 \end{pmatrix} \cup \begin{pmatrix} 0 & 0 & 0 \\ 2n-3 & 0 & 2n-3 \end{pmatrix} = \begin{pmatrix} 0 & 1 & 2n-2 \\ 3n-4 & 0 & 2n-3 \end{pmatrix}$$

A $E_{2n-3}^{n} - \textit{fermion}$ is the first intermediate stage in the fission of a composite charged lepton to its neutrino and to the lower generation charged lepton and its antineutrino. All the lepton quantum numbers are conserved in E-fermions fissions.

$e_2.1)\quad \mu^- \to \nu_\mu + e^- + \bar{\nu}_e \qquad (e_2 \to E_1^2 \to \nu_2 + W_1 \to \nu_2 + e_1 + \bar{\nu}_1)$

$$\begin{pmatrix} 0 & 1 & 2 \\ 1 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 0 & 1 & 2 \\ 2 & 0 & 1 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 3 \\ 1 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 1 & -1 \\ 1 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 3 \\ 1 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -1 \\ 0 & 0 & 0 \end{pmatrix}$$

$e_3.1)\quad \tau^- \to \nu_\tau + \mu^- + \bar{\nu}_\mu \qquad (e_3 \to E_3^3 \to \nu_3 + W_3 \to \nu_3 + e_2 + \bar{\nu}_2)$

$$\begin{pmatrix} 0 & 1 & 4 \\ 2 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 0 & 1 & 4 \\ 5 & 0 & 3 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 5 \\ 2 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 1 & -1 \\ 3 & 0 & 2 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 5 \\ 2 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 1 & 2 \\ 1 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -3 \\ 1 & 0 & 0 \end{pmatrix}$$

$e_4.1)\qquad e_4 \to E_5^4 \to \nu_4 + W_5 \to \nu_4 + e_3 + \bar{\nu}_3$

$$\begin{pmatrix} 0 & 1 & 6 \\ 3 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 0 & 1 & 6 \\ 8 & 0 & 5 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 7 \\ 3 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 1 & -1 \\ 5 & 0 & 4 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 7 \\ 3 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 1 & 4 \\ 2 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -5 \\ 2 & 0 & 0 \end{pmatrix}$$

A $E_{2n-5}^{n} - \textit{fermion}$ is fused of a composite n_{th} generation charged lepton and a $(2n-5)\,pair_1$ $(2n-5)\,pair_3$ boson.

$$\underset{n\geq 3}{F(E_{2n-5}^{n})} = \begin{pmatrix} 0 & 1 & 2n-2 \\ n-1 & 0 & 0 \end{pmatrix} \cup \begin{pmatrix} 0 & 0 & 0 \\ 2n-5 & 0 & 2n-5 \end{pmatrix} = \begin{pmatrix} 0 & 1 & 2n-2 \\ 3n-6 & 0 & 2n-5 \end{pmatrix}$$

A $E_{2n-5}^{n} - \textit{fermion}$ is the first intermediate stage in the fission of a composite charged lepton (from the third generation on) to its neutrino and to the second lower generation charged lepton and its antineutrino.

$e_3.2)\quad \tau^- \to \nu_\tau + e^- + \bar{\nu}_e \qquad (e_3 \to E_1^3 \to \nu_3 + W_1 \to \nu_3 + e_1 + \bar{\nu}_1)$

$$\begin{pmatrix}0&1&4\\2&0&0\end{pmatrix}\to\begin{pmatrix}0&1&4\\3&0&1\end{pmatrix}\to\begin{pmatrix}0&0&5\\2&0&0\end{pmatrix}+\begin{pmatrix}0&1&-1\\1&0&0\end{pmatrix}\to\begin{pmatrix}0&0&5\\2&0&0\end{pmatrix}+\begin{pmatrix}0&1&0\\0&0&0\end{pmatrix}+\begin{pmatrix}0&0&-1\\0&0&0\end{pmatrix}$$

$e_4.2)$ $\qquad e_4 \to E_3^4 \to \nu_4 + W_3 \to \nu_4 + e_2 + \bar{\nu}_2$

$$\begin{pmatrix}0&1&6\\3&0&0\end{pmatrix}\to\begin{pmatrix}0&1&6\\6&0&3\end{pmatrix}\to\begin{pmatrix}0&0&7\\3&0&0\end{pmatrix}+\begin{pmatrix}0&1&-1\\3&0&2\end{pmatrix}\to\begin{pmatrix}0&0&7\\3&0&0\end{pmatrix}+\begin{pmatrix}0&1&2\\1&0&0\end{pmatrix}+\begin{pmatrix}0&0&-3\\1&0&0\end{pmatrix}$$

Neutrino capture

$$n+\nu_e \to p+e^- \qquad (udd+\nu_e \to u\overset{0,0,1}{D}d \to uud+e^-)$$

$$\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}+\begin{pmatrix}0&0&1\\0&0&0\end{pmatrix}\to\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&0\\0&0&1\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\to$$
$$\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}+\begin{pmatrix}0&1&0\\0&0&0\end{pmatrix}$$

Electron capture

$$p+e^- \to n+\nu_e \qquad (uud+e^- \to u\underset{0,0,1}{\overset{0,1,0}{U}}d \to udd+\nu_e)$$

$$\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}+\begin{pmatrix}0&1&0\\0&0&0\end{pmatrix}\to\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&0\\0&0&1\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\to$$
$$\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}+\begin{pmatrix}0&0&1\\0&0&0\end{pmatrix}$$

Fusions and fissions of neutrinos (neutrino "oscillations")

A $N_{2m}^{n}-fermion$ is fused of a n_{th} generation neutrino and a $2m\cdot pair_1$ $2m\cdot pair_3$ boson.

$$\underset{n,m=1,2,3...}{F(N_{2m}^{n})}=\begin{pmatrix}0 & 0 & 2n-1\\ n-1 & 0 & 0\end{pmatrix}\cup\begin{pmatrix}0 & 0 & 0\\ 2m & 0 & 2m\end{pmatrix}=\begin{pmatrix}0 & 0 & 2n-1\\ n-1+2m & 0 & 2m\end{pmatrix}$$

N-fermions are the intermediate stages of fusions of neutrinos to higher generation neutrinos. It is typical of N-fermions and of composite neutrinos that each one of them splits to three neutrinos. Unlike the prime lepton number (which is conserved in any closed system) the secondary lepton numbers, muon-lepton number and tau-lepton number, are not conserved in neutrino "oscillations".

$\nu_1.1)\quad \nu_e \to \nu_\mu + \bar{\nu}_e + \bar{\nu}_e \qquad\qquad (\nu_1 \to N_2^1 \to \nu_2 + \bar{\nu}_1 + \bar{\nu}_1)$

$$\begin{pmatrix}0 & 0 & 1\\ 0 & 0 & 0\end{pmatrix}\to\begin{pmatrix}0 & 0 & 1\\ 2 & 0 & 2\end{pmatrix}\to\begin{pmatrix}0 & 0 & 3\\ 1 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & -1\\ 0 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & -1\\ 0 & 0 & 0\end{pmatrix}$$

$\nu_1.2)\quad \nu_e \to \nu_\tau + \bar{\nu}_\mu + \bar{\nu}_e \qquad\qquad (\nu_1 \to N_4^1 \to \nu_3 + \bar{\nu}_2 + \bar{\nu}_1)$

$$\begin{pmatrix}0 & 0 & 1\\ 0 & 0 & 0\end{pmatrix}\to\begin{pmatrix}0 & 0 & 1\\ 4 & 0 & 4\end{pmatrix}\to\begin{pmatrix}0 & 0 & 5\\ 2 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & -3\\ 1 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & -1\\ 0 & 0 & 0\end{pmatrix}$$

$\nu_1.3)\qquad\qquad \nu_1 \to N_6^1 \to \nu_4 + \bar{\nu}_2 + \bar{\nu}_2$

$$\begin{pmatrix}0 & 0 & 1\\ 0 & 0 & 0\end{pmatrix}\to\begin{pmatrix}0 & 0 & 1\\ 6 & 0 & 6\end{pmatrix}\to\begin{pmatrix}0 & 0 & 7\\ 3 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & -3\\ 1 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & -3\\ 1 & 0 & 0\end{pmatrix}$$

$\nu_2.1)\quad \nu_\mu \to \nu_\tau + \bar{\nu}_e + \bar{\nu}_e \qquad\qquad (\nu_2 \to N_2^2 \to \nu_3 + \bar{\nu}_1 + \bar{\nu}_1)$

$$\begin{pmatrix}0 & 0 & 3\\ 1 & 0 & 0\end{pmatrix}\to\begin{pmatrix}0 & 0 & 3\\ 3 & 0 & 2\end{pmatrix}\to\begin{pmatrix}0 & 0 & 5\\ 2 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & -1\\ 0 & 0 & 0\end{pmatrix}+\begin{pmatrix}0 & 0 & -1\\ 0 & 0 & 0\end{pmatrix}$$

$\nu_2.2)\qquad\qquad \nu_2 \to N_4^2 \to \nu_4 + \bar{\nu}_2 + \bar{\nu}_1$

$$\begin{pmatrix} 0 & 0 & 3 \\ 1 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 3 \\ 5 & 0 & 4 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 7 \\ 3 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -3 \\ 1 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -1 \\ 0 & 0 & 0 \end{pmatrix}$$

$\nu_2.3)\quad \nu_\mu \to \nu_e + \nu_e + \nu_e \qquad\qquad (\nu_2 \to \nu_1 + \nu_1 + \nu_1)$

$$\begin{pmatrix} 0 & 0 & 3 \\ 1 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$$

$\nu_3.1)\quad \nu_\tau \to \nu_\mu + \nu_e + \nu_e \qquad\qquad (\nu_3 \to \nu_2 + \nu_1 + \nu_1)$

$$\begin{pmatrix} 0 & 0 & 5 \\ 2 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 3 \\ 1 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \end{pmatrix}$$

$\nu_3.2) \qquad\qquad \nu_3 \to N_2^3 \to \nu_4 + \overline{\nu}_1 + \overline{\nu}_1$

$$\begin{pmatrix} 0 & 0 & 5 \\ 2 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 5 \\ 4 & 0 & 2 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 7 \\ 3 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -1 \\ 0 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -1 \\ 0 & 0 & 0 \end{pmatrix}$$

$\nu_3.3) \qquad\qquad \nu_3 \to N_4^3 \to \nu_5 + \overline{\nu}_2 + \overline{\nu}_1$

$$\begin{pmatrix} 0 & 0 & 5 \\ 2 & 0 & 0 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 5 \\ 6 & 0 & 4 \end{pmatrix} \to \begin{pmatrix} 0 & 0 & 9 \\ 4 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -3 \\ 1 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & 0 & -1 \\ 0 & 0 & 0 \end{pmatrix}$$

Neutral kaons

Mesons which are composed of a strange quark/antiquark and a first generation antiquark/quark are called kaons. The neutral kaons, when expressed in terms of quarks, are apparently two different particles:

$$K^0 = d\overline{s} \qquad \overline{K}^0 = s\overline{d}$$

However, neutral kaons behave as superpositions of neutral kaons and their antiparticles. An anti-phase superposition yields a short-life neutral kaon, and an in-phase superposition yields a long-life neutral kaon. The strange behavior of the neutral kaons is explained by evaluating the fundamental compositions of the neutral kaon and of its antiparticle; these two fundamental compositions are identical:

$$F\left(K^0\right)=F\left(d\bar{s}\right)=\begin{pmatrix}1 & 1 & -1\\0 & 0 & 0\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\1 & 0 & 1\end{pmatrix}$$

$$F\left(\overline{K}^0\right)=F\left(s\bar{d}\right)=\begin{pmatrix}1 & 1 & -1\\1 & 0 & 1\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\0 & 0 & 0\end{pmatrix}$$

$$F^{d+\bar{s}}=F^{s+\bar{d}}=\begin{pmatrix}0 & 0 & 0\\2 & 1 & 2\end{pmatrix}$$

The type of a quark is determined by its single fundamental fermions, which are the same for all the quarks of the same type (and of opposite signs for all the antiquarks of the same type). The generation of quarks and antiquarks is determined by their fundamental pairs, which are the same for a quark and its antiquark (the compositions of the first generation quarks include no fundamental pairs). A neutral kaon is a superposition of two states: in one state the second generation fundamental pairs are affiliated with the down-type antiquark, and in the other they are affiliated with the down-type quark. In the case of the anti-phase superposition the disintegration is preformed in one stage:

$$\frac{d\bar{s}-s\bar{d}}{\sqrt{2}}=K_S^0\to\pi^++\pi^-$$

$$\frac{1}{\sqrt{2}}\left[\begin{pmatrix}1 & 1 & -1\\0 & 0 & 0\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\1 & 0 & 1\end{pmatrix}-\begin{pmatrix}1 & 1 & -1\\1 & 0 & 1\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\0 & 0 & 0\end{pmatrix}\right]\to\begin{pmatrix}1 & 0 & 0\\0 & 0 & 0\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\0 & 0 & 0\end{pmatrix}+\begin{pmatrix}1 & 1 & -1\\0 & 0 & 0\end{pmatrix}\begin{pmatrix}-1 & 0 & 0\\0 & 0 & 0\end{pmatrix}$$

$$F^{\pi^++\pi^-}=\begin{pmatrix}0 & 0 & 0\\2 & 1 & 1\end{pmatrix}$$ One $pair_3$ is annihilated in this process.

Due to the phase difference, a W-boson cannot be generated and the system stays at the quark-composed level and cannot develop to a lower level.

In the in-phase superposition the disintegration is preformed in two stages and a proceeding virtual preliminary stage:

$$\frac{d\bar{s}+s\bar{d}}{\sqrt{2}} = K_L^0 \to Z_1^{downtype} + S^{boson} \to \pi^+ + W_2^- \to \pi^+ + e^- + \bar{\nu}_e$$

$$\frac{1}{\sqrt{2}}\left[\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\1&0&1\end{pmatrix}+\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}\right]\to\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+\begin{pmatrix}0&0&0\\1&0&1\end{pmatrix}\to\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+\begin{pmatrix}0&1&-1\\2&0&1\end{pmatrix}$$

$$\to\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+\begin{pmatrix}0&1&0\\0&0&0\end{pmatrix}+\begin{pmatrix}0&0&-1\\0&0&0\end{pmatrix}$$

$F^{\pi^+ + e^- + \bar{\nu}_e} = \begin{pmatrix}0&0&0\\1&1&1\end{pmatrix}$ One $pair_1$ and one $pair_3$ are annihilated in this process.

The disintegration of the long-life neutral kaon requires a preliminary stage in which the kaon's wave-function is a sum of a virtual first generation down-type Z-meson and an in-phase **virtual strange-boson.**

The wave-function of a long-life neutral kaon can be presented as a superposition of a virtual first generation down-type Z-meson and an in-phase virtual strange-boson:

$$\Psi\left(K_L^0\right) = e^{-i\omega t}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+e^{-i\omega t}\begin{pmatrix}0&0&0\\1&0&1\end{pmatrix}$$

The down-quark disintegrates to an up-quark, and its electron and antineutrino integrate with the strange-boson to a second generation W-boson (one $pair_1$ is produced):

$$e^{-i\omega t}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+e^{-i\omega t}\begin{pmatrix}0&1&-1\\2&0&1\end{pmatrix}\to$$

Then, the W-boson disintegrates to its fundamental single constituents:

$$e^{-i\omega t}\begin{pmatrix}1 & 0 & 0\\ 0 & 0 & 0\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\ 0 & 0 & 0\end{pmatrix}+e^{-i\omega t}\begin{pmatrix}0 & 1 & 0\\ 0 & 0 & 0\end{pmatrix}+e^{-i\omega t}\begin{pmatrix}0 & 0 & -1\\ 0 & 0 & 0\end{pmatrix}$$

In this case, all parts of the system are in-phase; this enable evolution below the quark-composed level.

Neutral B-mesons

$B^0 = d\overline{b}$ $\qquad \overline{B}^0 = \overline{d}b$

In the oscillations of neutral B-meson a virtual **bottom-boson** oscillates inside a first generation down-type Z-meson, and alternately increases and reduces the generation of the down-type quark/antiquark from the first generation to the third generation and backward:

$$F(B^0 \leftrightarrow \overline{B}^0) = virtual\begin{pmatrix}1 & 1 & -1\\ 0 & 0 & 0\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\ 0 & 0 & 0\end{pmatrix}+virtual\begin{pmatrix}0 & 0 & 0\\ 2 & 0 & 2\end{pmatrix}$$

$$\begin{pmatrix}1 & 1 & -1\\ 0 & 0 & 0\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\ 2 & 0 & 2\end{pmatrix}\begin{matrix}\rightarrow\\ \leftarrow\end{matrix}\begin{pmatrix}1 & 1 & -1\\ 2 & 0 & 2\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\ 0 & 0 & 0\end{pmatrix}$$

Neutral B-s-mesons are composed of a bottom-antiquark/quark and a strange-quark/antiquark: $B_s^0 = s\overline{b}$ $\qquad \overline{B}_s^0 = \overline{s}b$

In the oscillations of B-s-mesons a virtual strange-boson and a virtual bottom-boson are involved; they alternately replace each other:

$$F(B_s^0 \leftrightarrow \overline{B}_s^0) = vir\begin{pmatrix}1 & 1 & -1\\ 0 & 0 & 0\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\ 0 & 0 & 0\end{pmatrix}+vir\begin{pmatrix}0 & 0 & 0\\ 1 & 0 & 1\end{pmatrix}+vir\begin{pmatrix}0 & 0 & 0\\ 2 & 0 & 2\end{pmatrix}$$

$$\begin{pmatrix}1 & 1 & -1\\ 1 & 0 & 1\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\ 2 & 0 & 2\end{pmatrix}\begin{matrix}\rightarrow\\ \leftarrow\end{matrix}\begin{pmatrix}1 & 1 & -1\\ 2 & 0 & 2\end{pmatrix}\begin{pmatrix}-1 & -1 & 1\\ 1 & 0 & 1\end{pmatrix}$$

Neutral D-mesons

$D^0 = \bar{u}c \qquad \overline{D}^0 = u\bar{c}$

In these oscillations a virtual **charm-boson** is involved:

$$F(D^0 \leftrightarrow \overline{D}^0) = virtual\begin{pmatrix} -1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} + virtual\begin{pmatrix} 0 & 0 & 0 \\ 2 & 1 & 1 \end{pmatrix}$$

$$\begin{pmatrix} -1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}\begin{pmatrix} 1 & 0 & 0 \\ 2 & 1 & 1 \end{pmatrix} \begin{matrix} \rightarrow \\ \leftarrow \end{matrix} \begin{pmatrix} -1 & 0 & 0 \\ 2 & 1 & 1 \end{pmatrix}\begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

Fissions and an annihilation of a Z-meson

$$b\bar{b} = Z_3^{downtype} \rightarrow \tau^- + \tau^+, \mu^- + \mu^+, e^- + e^+, \gamma + \bar{\gamma}$$

$$\begin{pmatrix} 1 & 1 & -1 \\ 2 & 0 & 2 \end{pmatrix}\begin{pmatrix} -1 & -1 & 1 \\ 2 & 0 & 2 \end{pmatrix} \rightarrow \begin{pmatrix} 0 & 1 & 4 \\ 2 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & -1 & -4 \\ 2 & 0 & 0 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 1 & -1 \\ 2 & 0 & 2 \end{pmatrix}\begin{pmatrix} -1 & -1 & 1 \\ 2 & 0 & 2 \end{pmatrix} \rightarrow \begin{pmatrix} 0 & 1 & 2 \\ 1 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & -1 & -2 \\ 1 & 0 & 0 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 1 & -1 \\ 2 & 0 & 2 \end{pmatrix}\begin{pmatrix} -1 & -1 & 1 \\ 2 & 0 & 2 \end{pmatrix} \rightarrow \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 0 \end{pmatrix} + \begin{pmatrix} 0 & -1 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 1 & -1 \\ 2 & 0 & 2 \end{pmatrix}\begin{pmatrix} -1 & -1 & 1 \\ 2 & 0 & 2 \end{pmatrix} \rightarrow \gamma + \bar{\gamma}$$ [4]

Strangeness-antistrangeness production

[4] The concept of photons antiphotons annihilation is introduced in Part II.

1) $\pi^- + p \to K^0 + \Lambda^0 \qquad (\bar{u}d + uud \to \bar{s}d + usd)$

$$\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}+\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\to\begin{pmatrix}-1&-1&1\\1&0&1\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}+\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}$$

2) $\pi^+ + p \to K^+ + \Sigma^+ \qquad (u\bar{d} + uud \to u\bar{s} + uus)$

$$\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\to\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\1&0&1\end{pmatrix}+\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}$$

3) $\bar{p} + p \to K^- + K^0 + \pi^+ + \pi^0 + \pi^0 \qquad (\bar{u}\bar{u}\bar{d} + uud \to \bar{u}s + d\bar{s} + u\bar{d} + u\bar{u} + d\bar{d})$

$$\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\to\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}+\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\1&0&1\end{pmatrix}$$
$$+\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}+\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}$$

Strangeness "evaporation"

1) $K^+ \to \pi^+ + \pi^- + \pi^+$

$$K^+ \equiv u\bar{s} \to u\bar{d} + d\,\underset{1,0.0}{\bar{D}^2} \to u\bar{d} + d\bar{u} + \overline{W}_2 \to u\bar{d} + d\bar{u} + u\bar{d} \equiv \pi^+ + \pi^- + \pi^+$$

$$\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\1&0&1\end{pmatrix}\to\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\2&0&1\end{pmatrix}\to\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}+\begin{pmatrix}0&-1&1\\2&0&1\end{pmatrix}\to$$

$$\to\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}+\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}+\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}-1&-1&1\\0&0&0\end{pmatrix}$$

2) $\Lambda^0 \to p^+ + \pi^-$

$$\Lambda^0 \equiv uds \rightarrow ud \underset{1,0,0}{D}{}^{2} \rightarrow udu + W_2 \rightarrow udu + \bar{u}d \equiv p^+ + \pi^-$$

$$\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\2&0&1\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}+\begin{pmatrix}0&1&-1\\2&0&1\end{pmatrix}\rightarrow$$

$$\rightarrow\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}+\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}$$

3) $\Lambda^0 \rightarrow n^0 + \pi^0$

$$\Lambda^0 \equiv uds \rightarrow ud \frac{1}{\sqrt{2}}[\underset{1,1,1}{D}{}^{1} + \underset{1,0,0}{D}{}^{1}] \rightarrow \frac{1}{\sqrt{2}}[(udd + d\bar{d}) + (udd + u\bar{u})] \equiv n^0 + \pi^0$$

4) $\Lambda^0 \rightarrow p^+ + e^- + \bar{\nu}_e$

$$\Lambda^0 \equiv uds \rightarrow ud \underset{1,0,0}{D}{}^{2} \rightarrow udu + W_2 \rightarrow udu + e^- + \bar{\nu}_e \equiv p^+ + e^- + \bar{\nu}_e$$

$$\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\2&0&1\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}+\begin{pmatrix}0&1&-1\\2&0&1\end{pmatrix}\rightarrow$$

$$\rightarrow\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}+\begin{pmatrix}0&1&0\\0&0&0\end{pmatrix}+\begin{pmatrix}0&0&-1\\0&0&0\end{pmatrix}$$

Charmonium-pentaquark

$$\Lambda_b^0 \rightarrow P_c^+ + K^- \rightarrow p^+ + J/\psi + K^-$$

$$(udb \rightarrow uduc\bar{c} + \bar{u}s \rightarrow udu + c\bar{c} + \bar{u}s)$$

$$\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\2&0&2\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}\begin{pmatrix}-1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}\rightarrow$$

$$\rightarrow\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\0&0&0\end{pmatrix}\begin{pmatrix}1&0&0\\0&0&0\end{pmatrix}+\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}\begin{pmatrix}-1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}-1&0&0\\0&0&0\end{pmatrix}\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}$$

In this process two quark-pairs are produced, and a bottom-quark is generation-reduced to a strange-quark. The five quarks and the two antiquarks are firstly rearranged to a charmonium-pentaquark and a charged kaon; then the pentaquark disintegrates to a proton and a charmonium Z-meson. Another possibility is that a "weak" reaction is involved in this process. But, due to lake of an electron-positron pair, disintegration of a regular W-boson cannot create a second generation up-type particle. Thus, only if enriched W-bosons exist, the following reaction is possible:

$$b\rightarrow c+\overset{enriched}{W}\rightarrow c+\bar{c}+s$$

In this case the bottom-quark undergoes the following process:

$$b\rightarrow \underset{5,2,1}{D^3}\rightarrow c+\overset{enriched}{W_5}\rightarrow c+\bar{c}+s$$

$$\begin{pmatrix}1&1&-1\\2&0&2\end{pmatrix}\rightarrow\begin{pmatrix}1&1&-1\\7&2&3\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}0&1&-1\\5&1&2\end{pmatrix}\rightarrow\begin{pmatrix}1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}-1&0&0\\2&1&1\end{pmatrix}+\begin{pmatrix}1&1&-1\\1&0&1\end{pmatrix}$$

And the whole process is:

$$udb\rightarrow ud\underset{5,2,1}{D^3}\rightarrow udc+\overset{enriched}{W_5}\rightarrow uduc\bar{c}+\bar{u}s\rightarrow udu+c\bar{c}+\bar{u}s$$

2. Sub-Atomic Dynamics—the Internal Mode

An interaction other than gravitation and electricity does not exist. Inside atoms, ions, and subatomic composite particles the two interactions operate at the internal mode. The internal mode is governed by the following principle:

Principle of Internal Mode
The independent variable on which the internal influence on a participant depends is its variable charge. Inside a composite quark/lepton the participants are its fundamental constituents; inside a quark-composed particle/leptonic-shell the participants are its quarks/leptons; inside an atom/ion the participants are its nucleus and its leptonic-shell.[5]

Inside atoms and composite subatomic particles "distance between the constituents" has no physical significance. In this domain the independent variables of interactions are the variable charges of the participants in the internal interaction. The variant-rate time is not the only fundamental quantity which is not known to Modern Physics; the other is the variable charge. The variable charge of a participant in an internal interaction varies such that the different internal influences on this participant assume an extermum or a local extermum. The variable charge of a quark is not the sum of the variable charges of its fundamental constituents; the variable charge of a nucleus is not the sum of the variable charges of its quarks. Shell leptons interact individually with external particles/photons, but internally they form one leptonic shell which interacts as one participant with the baryonic nucleus.[6] The spatial components of all the wave-functions of an atom/subatomic particle are at one quanta of space they differ in their quantum numbers and in their w-components (the last difference is relevant only to interactions with external particles/photons).

Inside atoms and inside composite subatomic particles, gravitation is not geometry and electricity is not a force field. The energy which corresponds

[5] Quark-composed particles are mesons, nucleons, nuclei, and hyperons.

[6] The leptonic shell of an atom in a molecule includes, in a superposition, the leptons it shares with other atoms.

to internal interactions is the energy of rest-mass increments. ***Internal "work" generates negative rest-mass increments; it converts rest-mass to higher-entropy forms of energy. When "work" is done against internal interactions, positive rest-mass increments are generated; higher-entropy forms of energy are converted to rest-mass.*** Internal "work" is done in the following reactions: radioactive reactions, thermonuclear fusions, nuclear and subatomic fissions, and transitions of excited atoms or nuclei to lower energy levels. "Work" is done against internal interactions in the following reactions: recycling processes of heavy nuclei back to hydrogen (Part II), creation of higher-generation sub-atomic particles, and transitions of atoms and nuclei to higher energy levels (only the rest-mass produced in recycling processes is of a stable nature). The rest-mass of a composite atomic/subatomic particle is the sum of the rest-masses of its participants plus the total rest-mass increments due to internal interactions (which is negative in stable particles) plus contributions due to the internal kinetic energy of the participants. Orbital angular momentum in this case is not generated by motion in space but by motion in the w-space. Internal kinetic energy is, for any external frame, an indispensable part of the inertial energy.

The magnitude of a participant's contribution to the total rest-mass increment due to "attractive" internal influences of the other participants is inversely proportional to its squared variable charge. The magnitude of a participant's contribution to the total rest-mass increment due to "repulsive" internal influences of the other participants is proportional to its squared variable charge. In most cases, the sum of all the internal influences on each participant includes at least one "attractive" influence and at least one "repulsive" influence. Thus, in most cases, the magnitude of the total internal influence on each participant has an extermum in which the "attractive" and the "repulsive" influences balance each other. That extermum determines the magnitude of the contribution of that participant to the total rest-mass increment. The value of the variable charge in that extermum is the value of the participant's variable charge in the composition under consideration. Except of total annihilations, the variable charge of a participant does not vanish even when all the internal interactions on it are attractive. In these cases (e.g. the down-quark in a free proton, or the up-quark in a free neutron) the variable charge drops to a minimal non-zero magnitude. Participants, between which all the internal interactions are repulsive, do not enter the internal mode and do not constitute together a subatomic composite particle (e.g. a proton and a positron).

$F_i(Q_j)$ is a composite function of the interaction's level, of the quantum state of the affected *ith* participant, and of the quantum state of the affecting *jth* participant. The function $F_i(Q_j)$ determines the sign of the *ith* contribution to the total rest-mass increment and together with the variable charge of the *ith* participant determines the magnitude of this contribution. In most cases $F_i(Q_j)$ is negative. It is positive for participants at non-ground energy levels in quarks/leptons of non-first generations. At excited states of subatomic composite particles or of atoms, the function $F_i(Q_j)$ of each non-ground level participant varies such that the excited particle's rest-mass assumes discrete values which are higher than its rest-mass at the ground state. According to the principle of gravitational mass, the gravitational mass of an excited particle does not depend on its energy content and its magnitude is always proportional to the particle's time-symmetric rest-mass at the ground state.

The variant matter-quantities, inertial mass and variable charge, have the same sign for matter and for its antimatter. The variable charge of quarks, antiquarks, nuclei and antinuclei is designated by a positive sign, while the variable charge of leptons and antileptons is designated by a negative sign. Two internal participants whose variable charges are of the same sign gravitationally "attract" each other; two internal participants whose variable charges are of opposite signs gravitationally "repel" each other. Unless it is annihilated by its antiparticle, the variable charge of a fundamental fermion never vanishes. Fissions of composite particles may involve internal annihilations of fundamental pairs. In such annihilations the energy of the annihilated particles is delivered to the products and not emitted as gamma photons (when this energy excites a nucleus, gamma rays are emitted in a secondary reaction). A clear indication that a sub-atomic particle is a composite particle is the appearance of massive products at least in some of the reactions with its antiparticle. Only fundamental fermions are always entirely annihilated by their antiparticles. Composite quarks might be entirely annihilated by their antiparticles, but can also undergo partial annihilation.

Let us consider an internal interaction of N participants. A participant can be subject to four different kinds of internal influences which determine its contribution to the total rest-mass increment. The rest-mass of the *ith* participant is denoted M_i, m_i is its gravitational mass, and e_i is its electric charge. The following is a crude and simplified description of the possible different internal influences on the *ith* participant:

An "attractive" gravitational influence when g_i and g_j, the corresponding variable charges, are of the same sign:

$$\frac{M_i}{N-1}(F_i(Q_j)G_{at}|m_i m_j|g_i^{-2})$$

A "repulsive" gravitational influence when g_i and g_k, the corresponding variable charges, are of different signs:

$$\frac{M_i}{N-1}(F_i(Q_j)G_{re}|m_i m_k|g_i^{2})$$

An "attractive" electric influence when e_i and e_l, the corresponding electric charges, are of different signs:

$$-\frac{M_i}{N-1}(F_i(Q_j)E_{at}e_i e_l g_i^{-2})$$

A "repulsive" electric influence when e_i and e_m, the corresponding electric charges, are of the same sign:

$$\frac{M_i}{N-1}(F_i(Q_j)E_{re}e_i e_m g_i^{2})$$

G_{at} , G_{re} , E_{at}, and E_{re} are universal constants. The gravitational mass of the i[th] fundamental constituent is denoted m_i. The gravitational mass of an internal participant is an invariant quantity whose magnitude is proportional to the participant's time-symmetric rest-mass. $F_i(Q_j)$ is a function of the quantum state of the *ith* participant, and its independent variable is the quantum state of the *jth* participant. This function determines the sign of the contribution of the *ith* participant to the total rest-mass increment. The contribution is negative when internal "work" was done on the *ith* participant and it is positive when "work" was done on the *ith* participant against internal interactions. $F_i(Q_j)$ is also involved in determining the magnitude of the *ith* contribution. The expressions in brackets are pure numbers. The mathematical expressions in this section are but reflections of the hypothesis of the internal-mode dynamics; they are drafts, and as such should be examined and be elaborated in light of the empirical data.

The above four preliminary terms are summed up in Equation IV.1 for the contribution of the *ith* participant to the total rest-mass increment due to "work" done by internal interactions or against them. The *ith* contribution is the extermum of the resultant internal influence of all the other participants. In the first case the change is negative and the extermum is a maximum; in the second case the change is positive and the extermum is a minimum.

$$\Delta M_i = \frac{M_i}{N-1}\cdot Exterm\sum_{j\neq i}^{N} F_i(Q_j)\left(G_{at}^{\frac{1+\frac{g_i g_j}{|g_i g_j|}}{2}} G_{re}^{\frac{1-\frac{g_i g_j}{|g_i g_j|}}{2}} |m_i m_j| (g_i)^{-2\frac{g_i g_j}{|g_i g_j|}} + E_{at}^{\frac{1-\frac{e_i e_j}{|e_i e_j|}}{2}} E_{re}^{\frac{1+\frac{e_i e_j}{|e_i e_j|}}{2}} |e_i e_j| (g_i)^{2\frac{e_i e_j}{|e_i e_j|}} \right) \tag{IV.1}$$

To avoid ambiguity in cases of vanishing electric charge(s), we add the following definition:

$$e_i, e_j = 0 \rightarrow \quad \frac{e_i e_j}{|e_i e_j|} \equiv 1$$

The variable charge of internal participants vanishes only in the case of a total annihilation; $F_i(Q_j)$ in this case is a kind of Dirac's delta and for each of the two particles involved $\Delta M_i = -M_i$.

Let us consider an internal-mode composite particle (in the ground state); it can be an atom, a nucleus, a baryon, a meson, a composite quark/lepton, a W-boson, a N-fermion or their antiparticles. The particle is composed of *N* participants. Each participant interacts with all the other participants, and these interactions determine the total rest-mass increment of the relevant composite particle. The rest-mass of an atom or of a composite sub-atomic particle is:

$$M_{co.p} = \sum_{i=1}^{N}\left(M_i + \Delta M_i + \frac{1}{c^2} K_i \right) \qquad \text{(IV.2)}$$

Where K_i denotes the internal kinetic energy of the ith participant.

It seems that the best system to start with in testing the internal mode work-hypothesis, is the hydrogen atom. This system is of just two participants, and of rich data. Appling Equation (IV.1) to the hydrogen atom we get:

$$\Delta M_p = Exterm M_p F_p(Q_e)(G_{re} m_p m_e g_p^2 + E_{at}\left|e_p e_e\right| g_p^{-2})$$

$$\Delta M_e = Exterm M_e F_e(Q_p)(G_{re} m_e m_p g_e^2 + E_{at}\left|e_e e_p\right| g_e^{-2})$$

$$\frac{d}{dg_p}\Delta M_p = M_p F_p(Q_e)(2G_{re} m_p m_e g_p - 2E_{at}\left|e_p e_e\right| g_p^{-3}) = 0$$

$$\Rightarrow g_p = \sqrt[4]{\frac{E_{at}\left|e_p e_e\right|}{G_{re} m_p m_e}}$$

$$\frac{d}{dg_e}\Delta M_e = M_e F_e(Q_p)(2G_{re} m_e m_p g_e - 2E_{at}\left|e_e e_p\right| g_e^{-3}) = 0$$

$$\Rightarrow g_e = -\sqrt[4]{\frac{E_{at}\left|e_e e_p\right|}{G_{re} m_e m_p}}$$

Thus, in the hydrogen atom (also in the excited states) the magnitude of the variable charge of the electron equals to the magnitude of the variable charge of the proton. Let us define the variable charge of the proton in the hydrogen atom as one unit of variable charge.

This definition yields: $\frac{E_{at}}{G_{re}} = \frac{m_p m_e}{e^2}$

And from Equation (IV.2) we get:

$$M_H = M_p + M_e + \Delta M_p + \Delta M_e + \frac{1}{c^2} K_e$$

$$\Delta M_p + \Delta M_e = M_p F_p(Q_e)(G_{re} m_p m_e g_p^2 + E_{at} \left| e_p e_e \right| g_p^{-2}) + M_e F_e(Q_p)(G_{re} m_e m_p g_p^2 + E_{at} \left| e_e e_p \right| g_e^{-2})$$

$$\Delta M_p + \Delta M_e = M_p F_p(Q_e)(G_{re} m_p m_e + E_{at} \left| e_p e_e \right|) + M_e F_e(Q_p)(G_{re} m_e m_p + G_{re} \frac{m_p m_e}{e^2} e^2)$$

$$\Delta M_p + \Delta M_e = M_p F_p(Q_e)(G_{re} m_p m_e + G_{re} \frac{m_p m_e}{e^2} e^2) + M_e F_e(Q_p)(G_{re} m_e m_p + G_{re} \frac{m_p m_e}{e^2} e^2)$$

$$\Delta M_p + \Delta M_e = 2 G_{re} m_p m_e (M_p F_p(Q_e) + M_e F_e(Q_p))$$

In an annihilation of a fundamental fermion (and a composite quark sometimes) with its antiparticle only "attractive" influences exists, the variable charge vanishes, and the total energy of the system is converted completely to photons or delivered to the other internal participants in case of internal annihilations. The electric energy, in this case, is attractive also in the macro mode (except for neutrinos), which pushes the system to pass into the internal mode. In an annihilation of a composite particle, which is not a quark, with its antiparticle also repulsive influences are involved. Due to this fact proton and antiproton, for example, are transformed to mesons and not directly to gamma rays. Neutrinos do not interact electrically and their internal-mode gravitational interactions, due to their tiny gravitational mass, are small; these facts explain their extremely weak interaction with matter.

Energy levels

Rules for the occupation of energy levels in quarks, leptons, and intermediate-stage particles (first level composite particles):

1. Each energy-level of these particles should be populated by an odd number of fundamental fermion(s).

2. A fundamental fermion and its antiparticle cannot share the same energy-level, and should be separated by at least one energy-level.

A first generation W-boson is composed of four fundamental fermions two of them are an up-quark and its antiparticle. The electron-antineutrino of this W-boson should be used for separation; this and the exclusion on two fundamental fermions at one energy-level results in four energy-levels each occupied by one fundamental fermion. The composition of a muon differs from the composition of a first generation W-boson by two neutrinos instead of one antineutrino. The additional neutrino of the muon occupies the second energy-level and enables three fundamental fermions in the ground energy-level, and just three energy levels. The above two rules also explain why the rest-energies of the up-type quarks of the second and third generation are greater than the rest-energies of their corresponding down-type quarks. Composite up-type quarks have two more fundamental constituents than the down-type quarks of their generation. Consequently the fundamental constituents of a composite up-type quark occupy two more energy-levels than the fundamental constituents of its down-type partner.

Interaction properties of sub-atomic particles

All the fundamental fermions interact at the internal mode. These interactions create composite quarks and composite leptons. Quarks internally interact between themselves to create baryons, nuclei, and mesons. It seems that the reason that a free quark has not been detected is that quarks interact *only* at the internal mode. Nuclei, including single proton nuclei, internally interact with their shell charged leptons to create atoms. Nuclei and ions interact also with external particles (at least electrically). It seems that mesons interact only with external particles. Unlike quarks, leptons keep their "individuality" for external interactions; they interact between themselves, but they do not create united wave-functions for external interactions. Two or more leptons do not react like one particle (positronium is an exception; the positron in this case function as a nucleus). Composite charged leptons, besides of interacting internally with nuclei, interact also electrically with external pails. Do charged leptons and neutrinos interact also gravitationally at the length-dependent mode? This question still waits to its experimental answer.

Earth's furnace

Collisions of primary cosmic rays with nuclei in the upper layers of Earth's atmosphere produce secondary cosmic rays. In the most common process one primary proton produces two antipions, one pion, and one neutron.

$$p \rightarrow \pi^{+} + \pi^{+} + \pi^{-} + n \qquad (uud \underset{collision}{\rightarrow} u\overline{d} + u\overline{d} + \overline{u}d + udd)$$

After short travels antimuons, muon-neutrinos, muons, and muon-antineutrinos are fused from the antipions and the pions. Muons and antimuons are highly penetrable and due to their relatively long life-time (2.2 microseconds) and the relativistic time-dilation effect, most of them disintegrate only when they are at Earth's core. The energy released in disintegrations, together with the energy released in the consequent electron-positron annihilations, is delivered to the hot core of the planet. Through each squared meter of Earth's surface there pass about ten thousands muons during each minute. Inside the planet their energy (about 5 Gev each) is completely converted to heat, and this preserves the temperature of the planet's core, which is of the order of the Sun's surface temperature. No matter how thick Earth's crust is, it can only slow down the outward flow of heat from hotter regions to cooler ones; to preserve a hot core for billions years, there should be energy supply. Observations of muons deep inside Earth show a clear shadow of the Moon. These observations indicate that the cosmic rays, which generate the muons, are pointed towards Earth's core. Thus, the appearance of cosmic rays is a controlled process, which in this case is designed to stabilize the inner hot temperature of Earth. The source of that heat is thought to be radioactive matter, but the crucial-for-life energy supply to Earth's core is guarantied in a much more elegant and ever-lasting way.

The continuous flow of cosmic rays, which are mainly protons, continually transfers positive electric charge into Earth's core (the process results in access of positrons which annihilate electrons of Earth's core). Positively charged core accounts for Earth's magnetosphere. But this process should have some balancing process which keeps the positive charge at some constant level. This is probably done by the charged particles which generate the aurora (polar lights) which are mostly electrons. These electrons are part of the solar wind, but the solar thermonuclear process does not create access of electrons. These electrons are probably the electrons missing from the radial cosmic rays which "visit" the sun for cooling down (by numerous collisions) and then sent to earth to penetrate it mainly through the polar region where life is minimal. The whole process is supremely designed and controlled; no single detail is an accident.

Mixed particles

Mixed particles are subatomic composite particles of the second and third level of internal interaction which contain matter and antimatter participants. Subatomic composite particles of the first level of internal interaction are not mixed particles even though they contain matter and antimatter participants. Examples of mixed particles are: Positronium and antiprotonic-helium. The wave-function of a mixed particle is a superposition of two states; in one state the gravitational mass of the mixed particle is positive, in the other state it is negative.[7] The squared amplitudes of each state are proportional to the contributions of the matter/antimatter participants to the particle's rest mass.

Appendix: Rutherford's atom and the "Strong mistake"

The gold foil experiment yields the probabilities for different interactions between nuclei in a given gold foil and alpha particles in a certain beam. This information tells about the interaction properties between gold nuclei and alpha particles, but tells nothing about the internal geometry of the atom, and nothing about the internal interactions between the atom's constituents. Treating sub-atomic particles as miniatures of macroscopic particles is a classical, state-invariant, approach which does not fit the quantum level. At the time of Rutherford's interpretation of this experiment, Quantum Mechanics was not known, but strangely enough his method of interpretation had a profound, century long, misleading impact on subatomic physics. Distances inside atoms and inside subatomic particles have no physical significance. Experiments which are wrongly interpreted as evidences for spatial structures of atoms and of subatomic particles are

[7] Principle of Gravitational Mass; see Part II of this book.

evidences for the structure of the involved wave-functions and should be reinterpreted. The strong force which is derived from Rutherford's misleading interpretation is nothing but a strong mistake. The abandonment of Rutherford's picture of the atom and all its consequent false concepts is the starting point of the Simple Model of Subatomic Particles.

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