The Reason of a realistic View to Particles and Atomic Nuclei

(In German: Die Begründung eines realistischen Teilchenbildes)

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1. Introduction

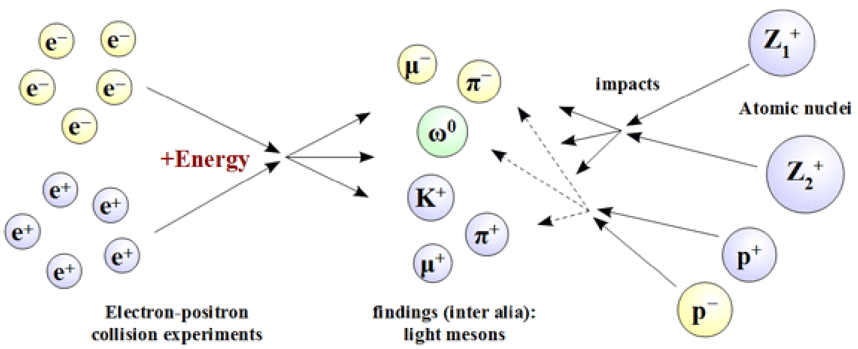
Electrons and positrons are elementary particles in the original sense of this word. They react with one another to short-lived positroniums. If they reacting at high energy then you can observe some different particles. Many research institutions confirmed this by electron-positron collision experiments. Muons, pions, kaons, omegas and other particles were detected. The step was not made towards the recognition, that electron and positron could be structural components of the light particles.

Otherwise muons, pions, kaons, omegas etc. arise by disintegrations of atomic nuclei as well as other particle interactions, e.g. the proton-antiproton-reaction according to the following equation:

(1.1) $$p^+ + p^- \rightarrow \omega^0 + \pi^+ + \pi^-$$

The presumption is that electrons and positrons are structural components of all heavier particles and atomic nuclei. Leight mesons (pions, kaons etc) are not only virtual particles in the sense of theorie. They are real particles in the substructure of all atomic nuclei and heavier particles like protons, neutrons, sigmas etc.

Fig. 1.1: Two paths of the emergence of light mesons (simplified)



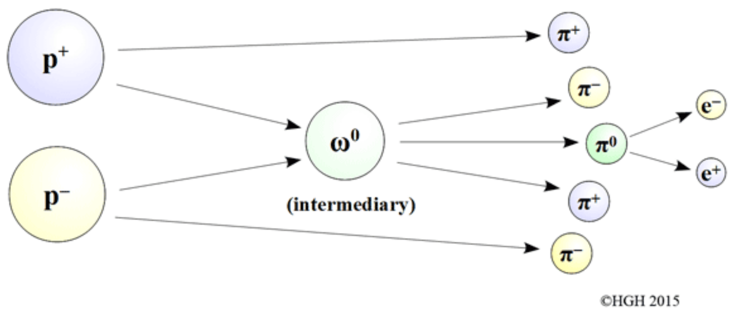
Light particles, especially light mesons arise on the one hand by high energetic interactions between electrons and positrons, on the other hand by nuclear fragmentations (as it were fragments of nuclear matter) or by interactions and disintegrations of heavy particles.

2. The fundamental structural Building of all real Particles and Atomic Nuclei

The structure of particles and nuclei is divided obvious into two levels: In elementary particle level and in sub-particle level. The elementary particle level (iow: elementary structure) included all electrons and positrons, the sub-particle level (iow: sub-structure) included all light particles wich are build by electrons and positrons. The duality of „particle zoo“ results evident from duality of electron and positron.

Electrons and positrons in bound states do not appear in their well defined ground state. They are energetic excited an they show new, altered properties. Their direct observation is impossible. You have to analyse the particle decays and their interactions to find out the real structures of particles and the quantities of electrons and positrons. A good first example is the interaction between proton and antiproton.

Fig. 2.1: Analysis of the proton-antiproton-reaktion



Particle-result for the first two reaction steps of the proton-antiproton-reaction:

(2.1) $p^{+} + p^{-} \rightarrow \omega^{0} + \pi^{+} + \pi^{-} \rightarrow 2\pi^{+} + 2\pi^{-} + \boldsymbol{\pi^{0}}$

Antiparticle with the exception of electron and positron do not annihilate immediately. First happens a structural decomposition. Then the released sub-particles decompose. At last the arised positrons and electrons annihilate. Every step of decay is accompanied by high amounts of energy. Therefore electron-positron pair production could happen and additional particles may appear. The particle balance („particle stoichiometry“) is frequently violated at reactions of particles and nuclei.

The charges of the protons must be explained obviously in consideration of the uncharged pion π^0. It shows almost always one of the following decays:

(2.2)	$\pi^0 \rightarrow$	2γ	„low numbered decay“, caused by „internal annihilation“
(2.3)	$\pi^0 \rightarrow$	$e^+ + e^-$	„rule decay“
(2.4)	$\pi^0 \rightarrow$	$\mu^+ + e^-$	„rule decay“

Reaction (2.2) must be considered as „internal annihilation“. The elementary structural particles of the uncharged pion, the electron and the positron annihilate like para-positronium, but much more energy is released. Many electromagnetic decays are internal annihilations. The Reactions (2.3) and (2.4) are rule decays, the elementary charged particles arise in exact match with the elementery structure.

You can deduce to the structures of the protons in a reversal of the proton-antiproton-reaction, in consideration of the decays of the uncharged pion π^0 and the two charged pions (see further below).

Fig. 2.2: Structure of the Proton

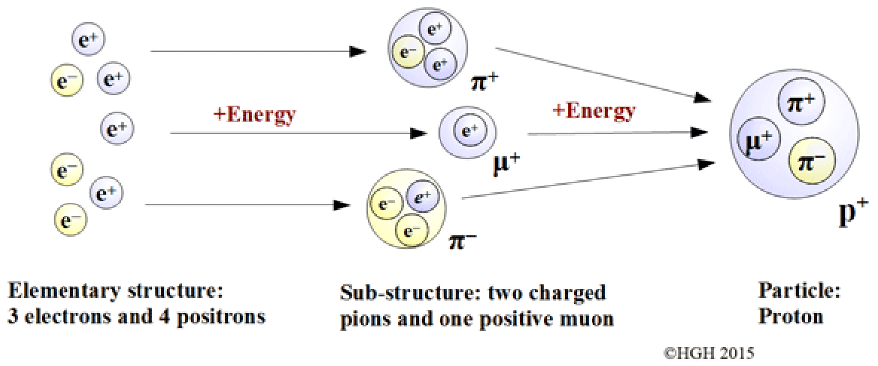
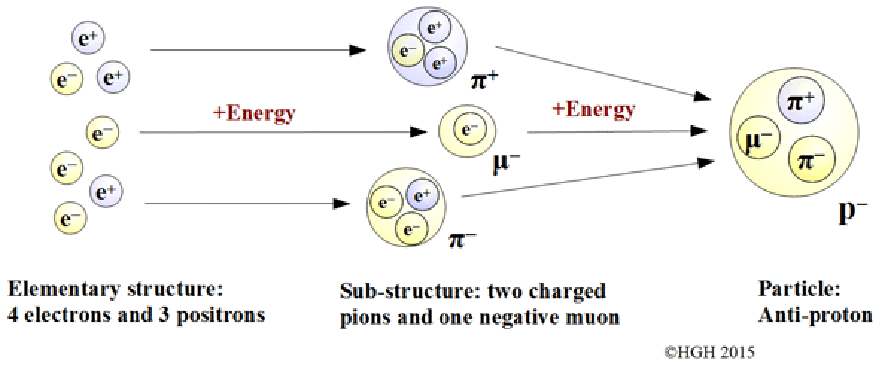


Fig. 2.3: Structure of the anti-proton (inverse Proton)



Proton and anti-proton have comparable structures, but positive and negative electrical charges are exchanged on sub-structural and elementary structural level. The opposite charges are caused by positive and negative muons and this particles also give the spin of the protons.

<u>Necessary excursus:</u> The question concerning neutrinos
It can be seen easily that neutrinos would violate the lepton number conservation. Furthermore, on the one hand neutrinos are structurally irrelevant, on the other hand you can lead every evidence of neutrinos back to other causes. All particles and atomic nuclei have an various inner energy. Therefore the β-electrons are emitted with different energies and atomic nuclei show sometimes transformations contrary to the usual decays.
The current neutrino-physics trace all those different obsevations back to „Neutrinos“ and is trying to unify it in one theoretical-mathematical model. But reality works without neutrinos as well as without theories.

3. The Structure of the Muons

Muons have a mass of 105,7MeV and spin ½. Positive muons are decaying with an almost 100% according to (3.1):

$$(3.1) \quad \mu^+ \quad \rightarrow \quad e^+ \quad + \quad E$$

This decay is pointing to the elementary structure (e^+) what means: muons are positrons or electrons in an excited state. The high mass of the muon is converted into energy during decay. This energy can be realised as radiation or by the process of pair-prduction as additional elementary-charged particles (termed as increase numbered decay).

$$(3.2) \quad \mu^+ \quad \rightarrow \quad e^+ \quad + \quad \gamma \qquad \text{„rule decay“}$$
$$(3.3) \quad \mu^+ \quad \rightarrow \quad e^+ + e^- + e^+ \qquad \text{„increase numbered decay“}$$

The parity of the elementary charges conserved in any decay or interaction. Electron and positron arise or vanish always as pair and never as single particle. The number of electrons and the number of positrons are the same in the whole universe.

Muons have as non-composite particles a special position among the table of particles. Their classification as leptons together with electrons and tauons in the standard model is right, but without realisation of causes. More highly-excited states of electron and positron are to be expect. The tauon is most likely a sub-structural brick of η-, f-, ϕ-, a-particles.

4. The Structures of more Particles and the Cause of Particle Duality

In Figures 2.2 and 2.3 is already visible that particle and antiparticle have an inverse structural building. It would be more correct to use the terms „inverse particles“ and „inverse matter“ instead of „antiparticles“ and „antimatter“. The duality of all real particles is based solely on the duality of electron and positron.

4.1. The structural Building of the Pions

Three pions are defined, they are designated as triplet of pions. Their characteristics are summarised in the following table.

Particle	T1/2	mass	spin
positive pion π^+	$2{,}6 \cdot 10^{-08}$s	139,6 MeV	1
uncharged Pion π^0	$8{,}4 \cdot 10^{-17}$s	135,0 MeV	0
negative pion π^-	$2{,}4 \cdot 10^{-08}$s	139,6 MeV	1

Charged pions have only one charge, therefore the difference between elementary electrons and positrons is one. In consideration of the decays (equations 4.1 - 4.5) and the known structures of muons and uncharged pions you can conclude on the structure of the charged pions.

(4.1) $\pi^+ \rightarrow e^+$ low numbered decay
(4.2) $\rightarrow \mu^+$ low numbered decay
(4.3) $\rightarrow e^+ + e^- + e^+$ rule decay
(4.4) $\rightarrow \mu^+ + e^- + e^+$ rule decay
(4.5) $\rightarrow \pi^0 + e^+$ rule decay

The elementary structures of the charged pions must be:

(4.6) $\pi^+ = (2e^+ e^-)$
(4.7) $\pi^- = (e^+ 2e^-)$

There is obvious contradiction between the spin 1 of the charged pion and the summary of the spins of the three elementary particles each one with spin ½. The spin of the particle in the minority is extinguished and the spins of the particles in majority are orientated parallel. This parallel orientation can also be observed at atomic nuclei and at electrons in atomic shells. However there is no final response to the contradiction. The theoretical point of view, that electron and positron are simply point-shaped, is in contradiction to the real substantially or materially causes of elementary charge and the so-called spin. There are more causes to say the elementary charge is structured and no symmetrical. The electrical charge appears only in far range spherical pursuant to the ideas of classical electrostatics.

The causative clarification of the structure or symmetry of electron and positron will contribute to the understanding the so-called spin, the two-way switchover between energy and mass and finally the concept of matter. The classical disciplines of physics prove themselves as special cases of physical legality which arise on particle level. In other words, all physics begins on the particle level.

4.2 The Structures of the Kaons

There are two charged kaons (K^+ and K^-) and two uncharged kaons K^0_S (S mean short living) and K^0_L (L means long living) classified. Their properties are summarised in the following table.

particle	τ	mass	spin
chaeged kaon K^+ / K^-	$1{,}2\times10^{-08}$s	493,7 MeV	1/2
uncharged kaon K^0_S	$0{,}9\times10^{-10}$s	497,6 MeV	0
uncharged kaon K^0_L	$5{,}1\times10^{-08}$s	497,6 MeV	0

The masses of the uncharged kaons differ slightly. The difference is according to the Particle Data Group [4] as follows: $m(K^0_L) - m(K^0_S) = 3{,}5\times10^{-12}$ MeV
This difference is greater in other sources which are not strictly bound by theoretical predictions. The Quark-hypothesis give the uncharged kaons the following structures:

$K^0_S = d\bar{s}$ $\qquad$ $K^0_L = \bar{d}s$

This structures cannot explain the different characteristics like mean life, mass, disintegration behavior and some others.

4.2.1 The Structure of the uncharged Kaon K^0_S

The uncharged kaon K^0_S shows two primary decays with a frequency of 99,89% (P means the probability concerning a decay):

(4.8) $K^0_S \rightarrow \pi^0 + \pi^0$ P = 30,69% rule decay
(4.9) $\rightarrow \pi^+ + \pi^-$ P = 69,20% increase numbered decay

The great mass (it is eaqual to energy) of all kaons in relation to the mass of the subparticles effected, that increase numbered decays very often occur, but low numbered decays occasionally. Electron-pair-productions happen during decay. The additional electrons and positrons arise mostly not in elementary form, but very often as temporary com-

binations, for example as pions. Therefore more particles are observed as in accordance with elementary structure and substructure to be expected.
The structures of the uncharged shortlived kaon have to be as follows:

elementary structure ($2e^+ 2e^-$)

substructure [$2\pi^0$]

There exist no inverse structure and consequently no anti-particle to the K^0_S.

4.2.2 The Structures of the uncharged Kaons K^0_L

The uncharged kaon K^0_L shows the following primary decays with a frequency of 99,65%:

(4.10)	K^0_L	$\rightarrow$	$\pi^+ + e^-$	P = 40,55%	rule decay
(4.11)		$\rightarrow$	$\pi^+ + \mu^-$	P = 27,04%	rule decay
(4.12)		$\rightarrow$	$3\pi^0$	P = 19,52%	increase numbered decay
(4.13)		$\rightarrow$	$\pi^+ + \pi^- + \pi^0$	P = 12,54%	increase numbered decay

The decays of the K^0_L compared to K^0_S are more varied because its structure is more differentiated. The structures of the uncharged longlived kaon have to be as follows. The elementary structure: ($2e^+ 2e^-$)

There are two possibilities for the substructure:

K^0_{L1} = [$\pi^+ \mu^-$]
K^0_{L2} = [$\pi^- \mu^+$]

This means that the K^0_L exists in two inverse forms as particle and anti-particle. This fact is incomprehensible by common understanding in physics. The experimental access is a bit difficult and probably still needed.
The uncharged longlived kaons consist of charged sub-particles, i.o.w. they have an inner charged status in contrast to the uncharged shortlived kaons. This give reasons for the different properties of K^0_S and K^0_L. All particles with an inner charged status showing a relative long lifetime, for example also the neutron. This fact will be considered in detail below.

<u>Summary of the uncharged kaons:</u>

The uncharged kaons forming a particle triplet with the same elementary structure, but various sub-structures:

$$K^0\ (2e^+ 2e^-) \quad \begin{cases} K^0_L = [\ \pi^+ \mu^-\ ] \\ K^0_S = [\ \pi^0 \pi^0\ ] \\ \overline{K}^0_L = [\ \pi^- \mu^+\ ] \end{cases}$$

The different substructures of K^0_S compared to both K^0_L founding the mass difference, the different lifetime and different decay behaviour. But there is still some need for experimental clarification and the need to interpret the available experimental data objective and not in compliance with theoretical predictions.

4.2.3 The Structures of the charged Kaons K^+ and K^-

The charged kaon K^+ shows the following primary decays with a frequency of 96,63%. The decays of the K^- are analogue:

(4.14)	K^+	$\rightarrow$	μ^+			P = 63,55%	lnd2
(4.15)		$\rightarrow$	π^0	+	e^+	P = 5,07%	lnd1
(24)		$\rightarrow$	π^+	+	π^0	P = 20,66%	rd
(25)		$\rightarrow$	π^+	+	$2\pi^0$	P = 1,76%	ind1
(26)		$\rightarrow$	$2\pi^+$	+	π^-	P = 5,59%	ind2

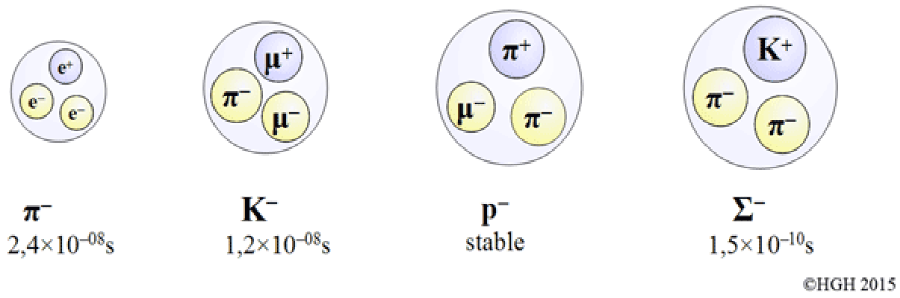
The abbreviations: „lnd“ means low numbered decay, „rd“ means rule dacay and „ind“ means increase numbered decay. „lnd1“ designate the inner annihilation (apparent disappearance) of one elementary charged pair, „lnd2“ the inner annihilation or two elementary charged pairs. This applies analogously to the increase numbered decays.
The fact is to emphasise, that much more energy is release at low numbered decays as at increase numbered decays. Further investigations concerning the reaction energy don't be made at this point.

The structures of the charged Kaons have to be as follows:

particle	elementary structure	sub-structure
K^+	$(3e^+ 2e^-)$	$[\pi^+ \mu^- \mu^+]$
K^-	$(2e^+ 3e^-)$	$[\pi^- \mu^+ \mu^-]$

In comparing charged pions $(e^+ e^- e^+)$, charged kaons $[\pi^+ \mu^- \mu^+]$ and protons $[\pi^+ \pi^- \mu^+]$ you can see that this particles comprise three charged particles. This particle-geometry is most likely the reason for the long period of existence or rather stability. The geometrical arrangement of subparticles emerge as on of the reasons of stability of particles and atomic nuclei. See figure 4.1 below.

Fig. 4.1: Substructurally similarity of some longlived particles



The restrictions of this paper don't allow to deduce the structures of the Σ^-. Moreover this figure could be expand by some more longlived particles with similar structure.

4.3. The Structures of the Omega ω^0_{782} and the Neutrons n and $\overline{n}$

Information: The numbering of the following equations contains acronyms: "e" means "elementarstructurally" transformation, "s" - "substructurally" and "i" - "internal" transformation, what means the relevant particle transformation.

The uncharged **Omega ω^0_{782}** decays with a frequency of approximately 90% according to:

(4.19)	ω^0	$\rightarrow$	π^+	+	π^-	+	π^0
(4.19e)	ω^0	$\rightarrow$	$(2e^+ e^-)$	+	$(e^+ 2e^-)$	+	$(e^+ e^-)$

Equation (4.19) describes the decay on substructural level and equation (4.19e) shows the elementary structure of the resultant particles. The elementary structure $(4e^+ \; 4e^-)$ and the substructure $[\pi^+ \; \pi^- \; \pi^0]$ must be assigned to the ω^0_{782}. Even all the other decays of the ω^0 can be explained by this structure. It don't exist any inverse to the structure $[\pi^+ \; \pi^- \; \pi^0]$ and therefore don't exist the anti particle $\overline{\omega}^0$. Uncharged Particles without inverse (resp. antiparticle) like the ω^0 and π^0 should be called as „axis particles“ because they are lie on one axis in the particle system.

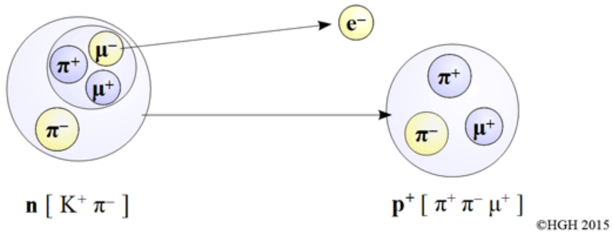
Neutrons n are decaying almost always according to equ. (4.20):

$$(4.20) \qquad n \rightarrow p^+ + e^-\uparrow$$

The elementary structure of the proton (see above Fig.2.2) is known as $(4e^+ \; 3e^-)$. Therefore the elementary structure of the neutron must be $(4e^+ \; 4e^-)$. Its substructure must be by analysis of the decays $[K^+ \; \pi^-]$:

(4.20s)	$n = [K^+ \; \pi^-]$	$\rightarrow$	$[\pi^+ \; \pi^- \; \mu^+]$	+	$e^-\uparrow$
(4.20i)	$n = [(\pi^+ \; \mu^- \; \mu^+) \; \pi^-]$	$\rightarrow$	$[\pi^+ \; \pi^- \; \mu^+]$	+	$e^-\uparrow$

Fig.4.2: β-decay of neutrons on substructural level and inner level



The substructural Kaon $K^+ = (\pi^+\ \mu^-\ \mu^+)$ decays inside the neutron. The small mass difference (=energy) of 1,293MeV between neutron (939,565MeV) and proton (938,272MeV) lead to the emission of an electron (0,511MeV) and not of the muon (105,658MeV). Negative myons are only very rarely observed:

$$(4.21) \qquad n = [(\pi^+\ \mu^-\ \mu^+)\ (\pi^-)] \quad \rightarrow \quad [\pi^+\ \pi^-\ \mu^+] \quad + \quad \mu^-\uparrow$$

To the structur $[\ K^+\ \pi^-\ ]$ exists the inverse structure $[\ K^-\ \pi^+\ ]$ as the antineutron. Uncharged particles like the neutrons and uncharged kaons K^0_L and $\overline{K}^0_L$ sould be called „plane particles" because they are located in the symmetrie plane of the particle system (see point 5: Particle systems).

<u>In summary:</u> Neutron and ω^0_{782} have identical elementary structures. The qualitative differences between both particles are caused by different substructures.

elementary structure ($4e^+\ 4e^-$)	Substruktur
neutron n	$[\ K^+\ \pi^-\ ]$
omega ω^0_{782}	$[\ \pi^+\ \pi^-\ \pi^0\ ]$
antineutron $\overline{n}$	$[\ K^-\ \pi^+\ ]$

There are no qualities resp. properties per se which are inherent in particles like „anti"-property of antiparticles, strangeness of strange particles and so on. The particles finds itself in the very best of company of the chemical elements. Their properties are also determined by different structures, in this case of the atomic shell.

5. Structural based Particle Classifications

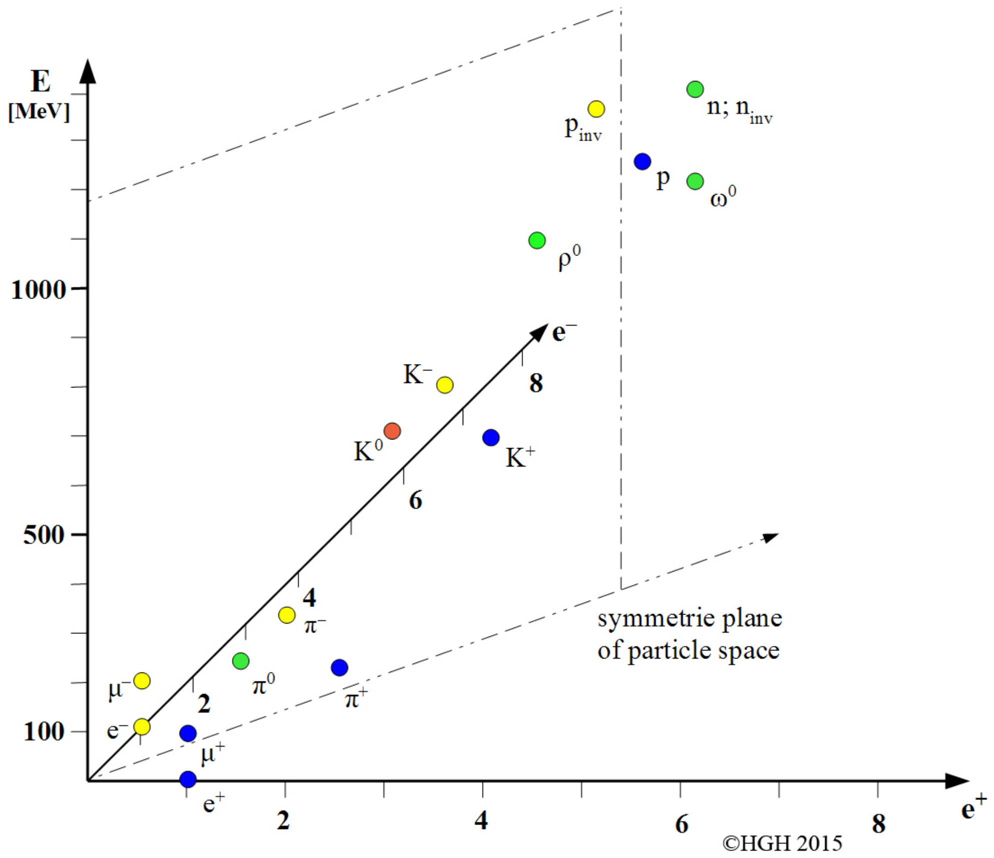
It can always be concluded from the few selected particle structures to particle classifications resp. particle systems. The classifications can be made by using elementary or rather substructural criteria. The elementary structural based classification is clear but easier.
The following table includes the most frequent particles up to the neutron. (Substructures are additional.) The number of electrons respectively positrons and the energy (or mass) indicate the coordinates of every particle in a three-dimensional „particle space".

Table 5.1: Particle structures up to the neutron

particle	elementary structure	energy resp. mass	substructure
positron / electron	(1 ; 0) / (0 ; 1)	0,511MeV	
muons	(1 ; 0) / (0 ; 1)	105,7 MeV	(μ^+) (μ^-)
uncharged pion	(1 ; 1)	135,0 MeV	(π^0)
charged pions	(2 ; 1) / (1 ; 2)	139,6 MeV	(π^+) (π^-)
uncharged kaon K^0_S	(2 ; 2)	497,5 MeV	$(\pi^0\ \pi^0)$
uncharged kaons K^0_L	(2 ; 2) / (2 ; 2)	497,5 MeV	$(\pi^+\ \mu^-)$ $(\pi^-\ \mu^+)$
charged kaons K^+ K^-	(3 ; 2) / (2 ; 3)	493,7 MeV	$(\pi^+\ \mu^-\ \mu^+)$ $(\pi^-\ \mu^+\ \mu^-)$
uncharged Rho ρ^0	(3 ; 3)	775,5 MeV	$(\pi^+\ \pi^-)$
protons p $\bar{p}$	(4 ; 3) / (3 ; 4)	938,3 MeV	$[(\pi^+\ \pi^-)\ \mu^+]$ $[(\pi^-\ \pi^+)\ \mu^-]$
omega ω^0_{782}	(4 ; 4)	782,6 MeV	$[\pi^+\ \pi^-\ \pi^0]$
neutrons n $\bar{n}$	(4 ; 4) / (4 ; 4)	939,6 MeV	$[K^+\ \pi^-]$ $[K^-\ \pi^+]$

These data allow to arrange the particles into a three-dimensional coordinate system. It should be named as „particle space“.

Fig.5.1: Elementary structural based classification of light particles - the „particle space“

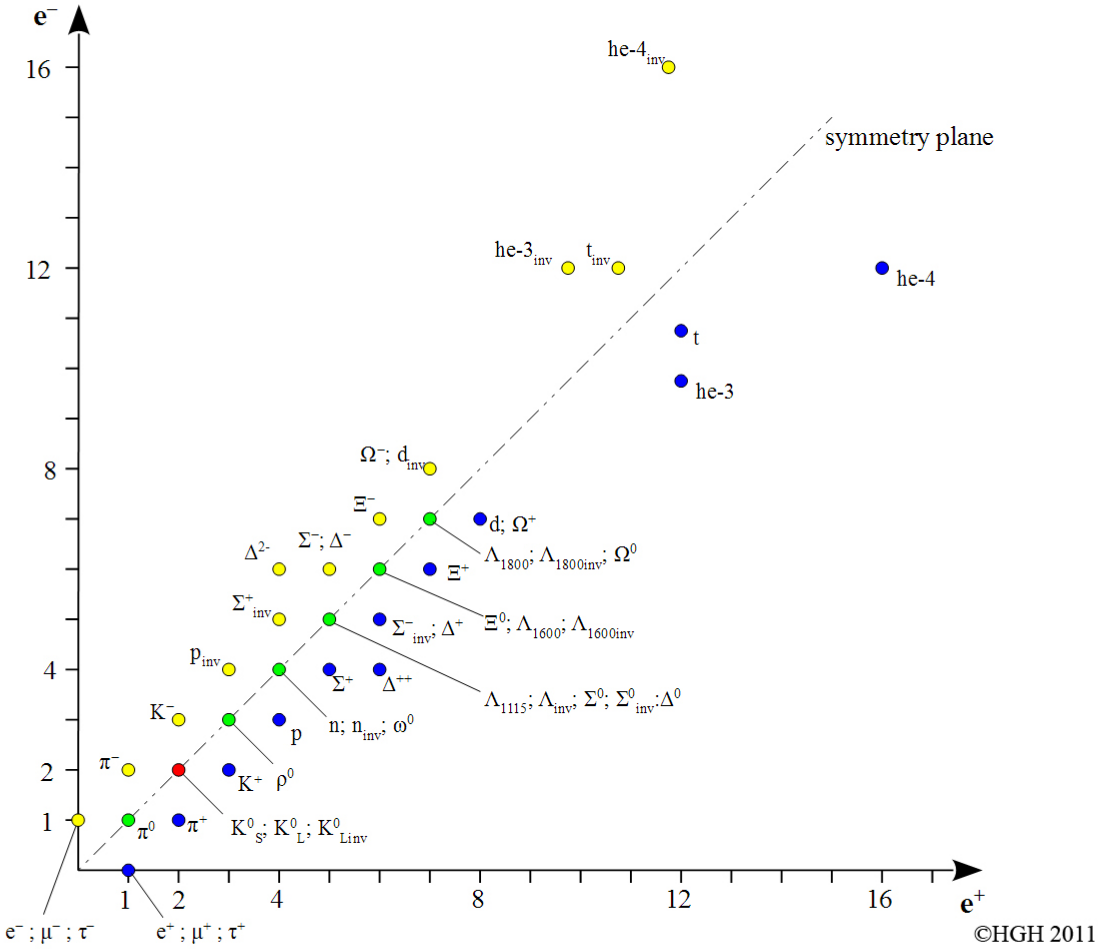


All **real particles** and atomic nuclei can be classified into this particle system.
Uncharged particles and nuclei (green marked, with exception of the red marked uncharged kaons) are located in the symmetry plane of the particle space. Positive charged particles and nuclei (blue) are located before it, ngative (yellow) behind it.

The depiction is restricted by the available graphical fundings. The distribution of particles in a space created by only positive coordinate axes is obvious. The „photon“ occupies the whole vertical energy axis what demonstrate its complete differentness from all other particles.

The particle system can be projected on the base area as well on the symmetrie plane. The projections indicate more correlations. Figure 5.2 shows the floor plan of the particle system. The number of particles is extended to the light nuclei 2-he-3 and 1-h-3. The precise derivation of its structures was made in a comprehensive paper, on which this abridged version based.

Fig.5.2: Particle space as floor plan



The acronym „inv“ stands for inverse particle resp. antiparticle. Particles with the same elementary structure lie ín this presentation on the same point, par example neutron, antineutron and ω^0_{782}. The perfectly symmetrical structure of the particle space is is clearly evident. A number of particles was left out because its structures are uncertain. However, the data situation is often insufficient.

5.1 Excursus: The Structure of the uncharged Lambda Λ^0_{1115}

This digression should demonstrate difficulties with structure determination of particles. The Λ^0_{1115} shows with a overall probability of 99,7% one of the both decays resp. transformations:

(5.1)	Λ	$\rightarrow$	n	+	π^0	P = 35,8%
(5.2)	Λ	$\rightarrow$	p	+	π^-	P = 63,9%

The following conclusions may be drawn:

- Because the Λ^0_{1115} decays not to antiproton or antineutron, it must be a „normal" particle and not a „anti" particle. It is obviously like the neutron a plane particle.
- All particle transformations leading almost always to the next stable or relatively stable particle.
- The transformation is favoured into the very stable proton.
- The mass difference to proton or neutron is about 176MeV. Therefore are to espect particles with the mass of pions.

Both transformations show the following picture on the elementar-structurally level :

(5.1e)	Λ	$\rightarrow$	$(4e^+ \, 4e^-)$	+	$(1e^+ \, 1e^-)$
(5.2e)	Λ	$\rightarrow$	$(4e^+ \, 3e^-)$	+	$(1e^+ \, 2e^-)$

They result concurringly in the elementary structure $(5e^+ \; 5e^-)$. But there are two possibilities for the substructure of the lambda:

(5.1s)	Λ	$\rightarrow$	$[K^+ \pi^-]$	+	π^0	$\Lambda = [K^+ \pi^- \pi^0]$
(5.2s)	Λ	$\rightarrow$	$[\pi^+ \pi^- \mu^+]$	+	π^-	$\Lambda = [\pi^+ 2\pi^- \mu^+]$

Both substructures belong to the elementary class $(5e^+ \; 5e^-)$. The substructure $\Lambda = (\pi^+ 2\pi^- \mu^+)$ is improbable, because the decay to neutrons would happen only occasionally and the particle mass by four charged subparticles would be approximately 1300MeV. The substructure $[K^+ \pi^- \pi^0]$ also explains the decay according to (5.2). In the process happens a inner transformation of subparticles.

(5.2s) $\qquad \Lambda = [K^+ \;\; \pi^- \;\; \pi^0] \;\rightarrow\; [\pi^+ \pi^- \mu^+] \;+\; \pi^-$

$\qquad\qquad\qquad\quad \downarrow \qquad\quad \downarrow$

$\qquad\qquad [(\pi^+ \mu^- \mu^+) \;\; \pi^- \;\; \pi^0] \;\rightarrow\; [\pi^+ \pi^- \mu^+] \;+\; \pi^-$

$\qquad\qquad\qquad\quad \downarrow \qquad\quad \downarrow$

(5.2i) $\qquad\qquad \mu^- \;+\; \pi^0 \;\rightarrow\; \pi^-$

The inner reaction takes place between the negative muon (in the kaon) and the uncharged pion. It results a negative pion. The inner transformation of the Λ leads not to the elementary level like the inner transformation of the β-decay of the neutron. To the structure of the Λ with [K^{+} π^{-} π^{0}] exist an inverse structure [K^{-} π^{+} π^{0}] of the $\overline{\Lambda}$.

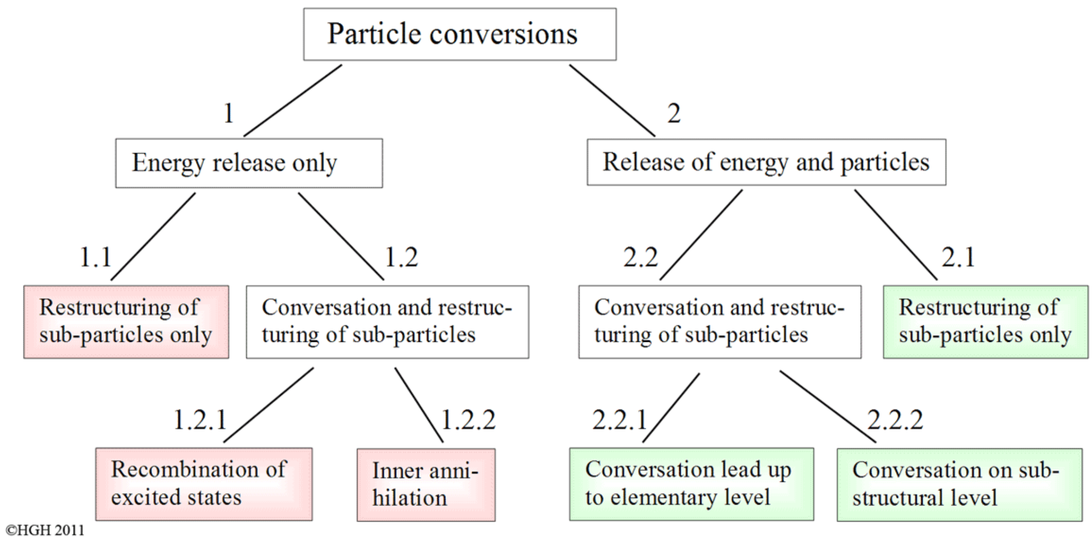
6. Classification of the Particle Transformations and Reactions

Every particle transformation resp. reaction is characterised by the following features:

- In any case is a energy balance to record.
- Particle emissions may occur.
- The transformation resp. reaction can take place on different structural levels (depth of reaction).

The two first characteristics are ascertainable by experiments. The depth of reaction has to be cleared up by analysis of all relevant datas and determining of the real particle transformations. Figure 6.1 shows a comprehensive classification of the particle transformations. Each possible particle transformation can be classified in one of the six classes highlighted with colour. The classes 1.1 and 2.1 can be also divided into two subclasses.

Fig.6.1: Classification of the particle transformations



The present division into three ways of particle interactions into strong, weak and electromagnetic is undifferentiated and not based on the causally processes. In particular transformations on substructural level resp. inner reactions between subparticles are not adequate described, therefore it leads to overlapping in the characterisation of particle interactions. Following a short comparison between present theory and reality:
<u>Strong interactions:</u> Processes, in which are subparticles only new arranged or restructured and no particles are transformed (low depth of reaction). This processes are very fast and show mostly a high amount of reaction energy.
<u>Weak interactions:</u> Processes with particle transformations up to the elementary level of electron and positron (high depth of reaction). These processes run relative slow and at lower energy difference.
<u>Electromagnetic interactions:</u> Processes like inner annihilations and recombinations of exited states. All processes with transformations and restructuring of subparticles have maen depth of reaction.

The following table contains examples to the classification of particle interactions according to figure 6.1. Every example is described on the particle level and the relevant structural level.

Table 6.1: Examples of the six types of particle interactions

Type of reaction	Example
to item 1.1	Rearrangement of the „nucleus grid“ (see point 7: Structures of the atomic nuclei). This can run gradually - so-called energy level schemes.
to 1.2.1	$\Sigma^0 \rightarrow \Lambda$ $[K^+ \pi^- \mu^+ \mu^-] \rightarrow [K^+ \pi^- \pi^0]$
to 1.2.2	$\pi^0 \rightarrow \gamma$ $(e^+ e^-) \rightarrow \gamma$
to 2.1	13-al-21 → 12-ne-20 + p^+ $[21(\pi^+ \pi^-) \{\mu^+ 12\pi^+\}] \rightarrow [20(\pi^+ \pi^-) \{12\pi^+\}] + [\pi^+ \pi^- \mu^+]$
to 2.2.1	$n \rightarrow p^+ + e^-$ $(4e^+ 4e^-) \rightarrow (4e^+ 3e^-) + e^-$
to 2.2.2	$\Lambda \rightarrow p + \pi^-$ $[K^+ \pi^- \pi^0] \rightarrow [\pi^+ \pi^- \mu^+] + \pi^-$

<u>Necessary note to the reliability of the data:</u>
It was noticeable by procuring data to analyse the particle transformations that less and less original data are available. The data are reprocessed increasingly by predictions of the current theory. Such data are unreliable or incorrect, it requires no further discussion.
For example: The Particle Data Group (PDG) described the decay of the four known Deltas Δ^-, Δ^0 , Δ^+ und Δ^{++} with only one reaction equation:

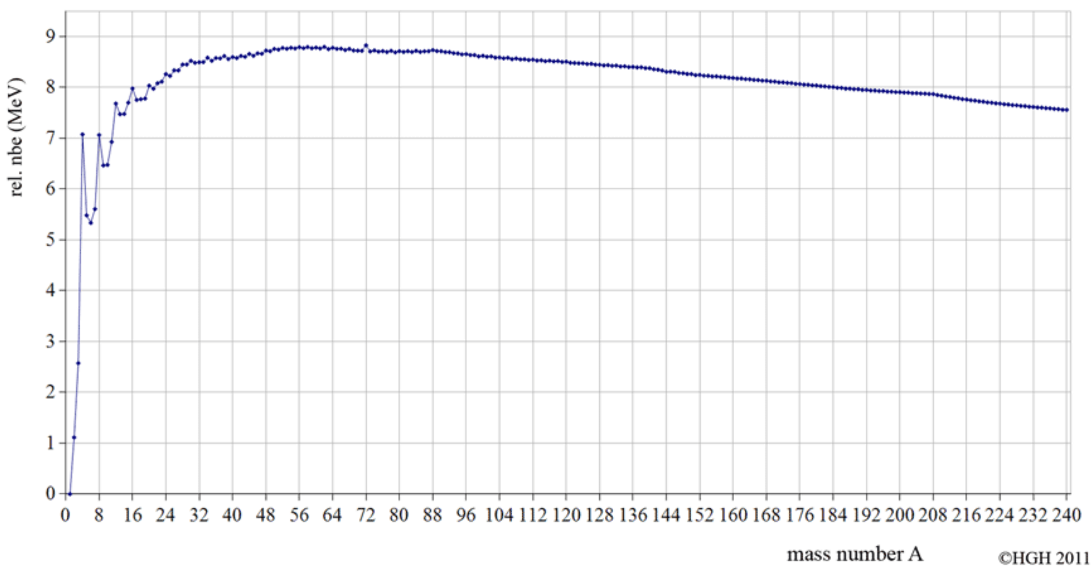
$$(6.1) \qquad \Delta \rightarrow N + \pi$$

Such undifferentiated data have only small scientific value. Each of the four deltas has a own structure and shows a characteristic decay behaviour. The statement (6.1) does not specify which of the four deltas decays, which of the „nucleons N“ results and which of the tree pions is emitted. (But it is reassuring that at least exactly known the structure of the deltas using the non-existent „quarks“.)

7. The Structures of the Atomic Nuclei

Currently, five models are used to describe atomic nuclei. This models are inconsistent and they correspond to reality only roughly (German: „in recht grober Weise“, [1], S.521). The course of the relative nuclear binding energy (see Fig.7.1) shows a continuous periodicity and pronounced maxima. As even atomic nuclei built from subparticles it can be assumed that a high geometrical order prevailed. In other words: Atomic nuclei are three-dimensional particles grids (resp. particle lattices). On this base you can develop a „grid model of the atomic nucleus“ (in German: „Kerngittermodell“) which explained all the properties of atomic nuclei.

Fig.7.1: Course of the relative nuclear binding energy



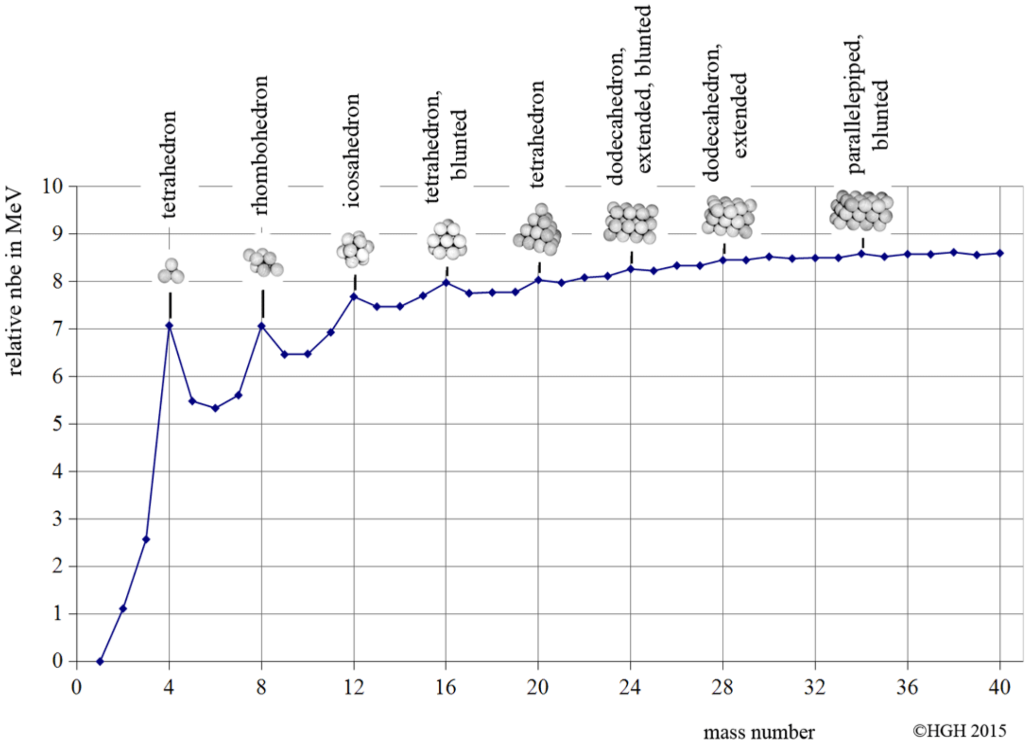
7.1 The Nucleus Grid

The nucleus lattice is composed from two components: The grid of mass particles A and the integrated binding grid of charged particles Z. Both grid components are closely interrelated energetically and geometrically.

7.1.1 The Mass Particles Grid

Mass particles are uncharged and spinless particles which consist of one positive and one negative pion $(\pi^+ \pi^-)$. The proton shows always a similar structure $[(\pi^+ \pi^-)\ \mu^+]$. The number of mass particles corresponds to the mass number. It is obvious that a certain number of mass particles requires a certain particle lattice. Particle lattices with high symmetry values lead to nuclei with high binding energy. The first nucleus gird with excellent symmetry is nucleus 2-he-4 (resp. the α-particle). It's mass particle lattice is a tetrahedron. Figure 7.2 illustrates the connection between the nuclear binding energy and geometry of some nucleus lattices.

Fig.7.2: Course of the relative nuclear binding energy and the geometry of some nucleus grids up to mass number 40

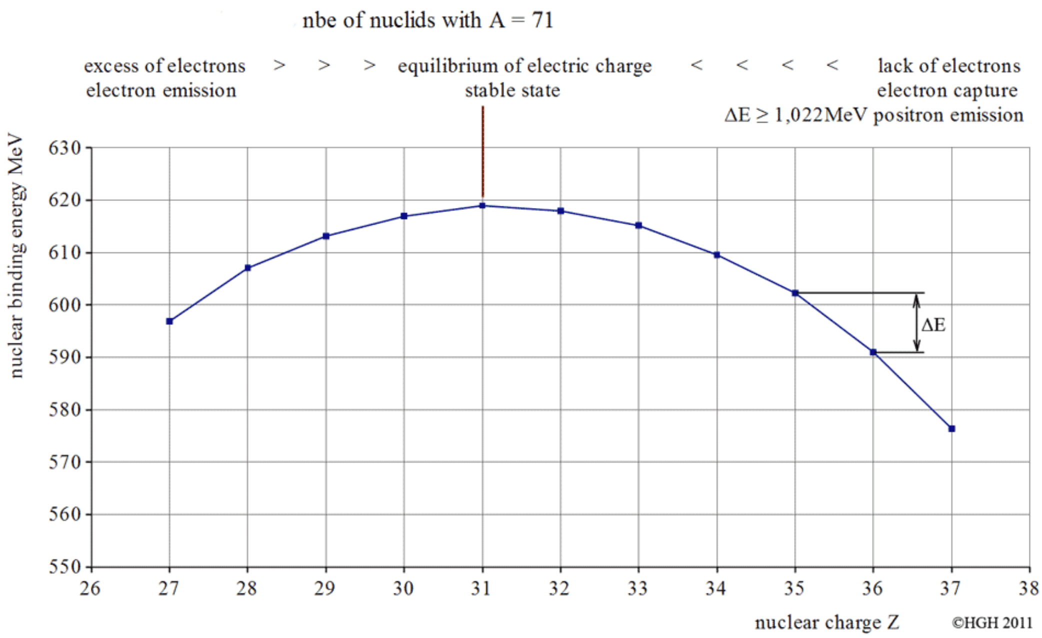


The complete instability of the nucleus grid 8 does not conflict with the model of nucleus grids: It is unstable because it decays immediately by simple restructuring of subparticles (according to transformation 2.1 in Fig. 6.1) into two tetrahedrons resp. two he-4-nuclei while released a little energy. The energetically unfavourable nuclei 6 (octahedral grid) and 7 (a flat and discus shaped grid) are stable, because the restructuring would reqire radical changes on particle and structural level associated with particle emissions.

7.1.2 The Binding Particles Grid

Charged particles Z are integrated with highest geometrical order into the lattice of mass particles. Its number is equal to the nuclear charge Z. The binding resp. charged particles are charged pions, which are substituted at increasing mass number by charged kaons. Each nucleus with odd mass number has at least one charged kaon within the binding grid. The sufficient number of charged particles and its symmetrical order leads to more or less stability of the nucleus.
The binding grid change step by step through receiving or transmitting electrons to the state of equilibrium resp. the atomic nucleus is becoming more and more stable by emission or capture of electrons. Between mass particles grid and binding particles grid can take place an exchange of particles. This is one of of the reasons of the stability of nuclei and ultimately of particles.

Figure 7.3 illustrates how the the nuclear binding energy is dependending on the number of charged particles as the example of nucleus 71



The nuclear binding energy is dependent on the number of charged particles by given number of mass particles. Remarkable is the fact that positron-emission needs a minimum energy ΔE of 1,022MeV. This is exactly the same minimum energy which requires the electron-positron pair production. It has to be concluded that the reason for the positron emission is a concealed pair production. The electron is integrated into the nucleus grid and the positron is emitted. The emission of positrons and the capture of electrons are basically identical processes. Only the origin of the electron is different.

The particles of the binding grid have spin and cause the nuclear spin. Table 7.1 contains the structures and spins of some light nuclei. The derivation of the structures is described under point 7.2. Explanation of terminology: The substructural entirety of the atomic nucleus is summarized in square brackets, the mass particles in round brackets in green font color and the binding particles in curly brackets in red font color.

Table 7.1: Elementary and sub-structures and spins of some light nuclei

Nucleus	Elementary structure	Substructure	Spin
1-2 (deuteron)	$(8e^+ \; 7e^-)$	$[2(\pi^+ \; \pi^-) \; \{\pi^+\}]$	1+
2-3 (he-3-nucleus)	$(12e^+ \; 10e^-)$	$[3(\pi^+ \; \pi^-) \; \{\pi^+ \; \mu^+\}]$	½+
1-3 (triton)	$(12e^+ \; 11e^-)$	$[3(\pi^+ \; \pi^-) \; \{K^+\}]$	½+
2-4 (he-4-nucleus)	$(16e^+ \; 14e^-)$	$[4(\pi^+ \; \pi^-) \; \{2\pi^+\}]$	0
3-6 (3-li-6)	$(24e^+ \; 21e^-)$	$[6(\pi^+ \; \pi^-) \; \{3\pi^+\}]$	1+
5-12 (5-b-12)	$(48e^+ \; 43e^-)$	$[6(\pi^+ \; \pi^-) \; \{3\pi^+ \; 2K^+\}]$	1+
6-12 (6-c-12)	$(48e^+ \; 42e^-)$	$[12(\pi^+ \; \pi^-) \; \{6\pi^+\}]$	0
7-12 (7-n-14)	$(48e^+ \; 41e^-)$	$[6(\pi^+ \; \pi^-) \; \{5\pi^+ \; 2\mu^+\}]$	1+
6-13 (6-c-13)	$(52e^+ \; 46e^-)$	$[13(\pi^+ \; \pi^-) \; \{5\pi^+ \; K^+\}]$	½–
7-14 (7-n-14)	$(56e^+ \; 49e^-)$	$[14(\pi^+ \; \pi^-) \; \{7\pi^+\}]$	1+

Between the particles of the binding grid happens spin pairing, this means particle pairs are formed which are linked by spin (analogous to „Cooper“-pairs). The formation of such particle pairs is depending on the geometrical situation of the nucleus grid. Only neighbouring particles are able to form spin pairs, not paired particles are alligning its spins parallel. Electrons show analogous behaviour in atomic shells.

7.2 Presentation of the Structures of Atomic Nuclei

7.2.1 The Structure of the Deuteron as simple Example

The fusion of proton p and neutron n to the deuteron 1-d-2 or the fission of the deuteron d to proton and neutron are well documented processes. The problem is the understanding of the underlying particle changes. The well-known equations (7.1) and (7.2) showing only the observable initial states and final states of the reaktions.

(7.1) Fusion:	p	+	n	$\rightarrow$	d
(7.2) Fission:	d	$\rightarrow$	p	+	n

The elementary structures of proton ($4e^+ 3e^-$) and neutron ($4e^+ 4e^-$) are known. These reactions show themselves on elementary level (e) as following:

(7.1e)	($4e^+ 3e^-$)	+	($4e^+ 4e^-$)	$\rightarrow$	($8e^+ 7e^-$)
(7.2e)	($8e^+ 7e^-$)	$\rightarrow$	($4e^+ 3e^-$)	+	($4e^+ 4e^-$)

The substructures of proton [$\pi^+ \pi^- \mu^+$] and neutron [$K^+ \pi^-$] are also known. These reactions show themselves on substructural level (s) as following:

(7.1s)	[$\pi^+ \pi^- \mu^+$]	+	[$K^+ \pi^-$]	$\rightarrow$	[$2(\pi^+ \pi^-) \{\pi^+\}$]
(7.2s)	[$2(\pi^+ \pi^-) \{\pi^+\}$]	$\rightarrow$	[$\pi^+ \pi^- \mu^+$]	+	[$K^+ \pi^-$]

The substructural muon of the proton and the substructural kaon of the neutron are involved in the reaction, all other subparticles remain unchanged. It happens an inner transformation (i) on substructural level as in many other particle reactions:

(7.1i)	μ^+	+	K^+	$\rightarrow$	$2\pi^+$
(7.2i)	$2\pi^+$	$\rightarrow$	μ^+	+	K^+

Reactions (7.1i) and (7.2i) are also comprehensible on elementary level:

(7.1ie)	($1e^+ 0e^-$)	+	($3e^+ 2e^-$)	$\rightarrow$	$2(2e^+ 1e^-)$
(7.1ie)	$2(2e^+ 1e^-)$	$\rightarrow$	($3e^+ 2e^-$)	+	($1e^+ 0e^-$)

Atomic nuclei are not simple the sum of protons and neutrons, but the substructural particles of protons and neutrons are formed up by substructural transformations and restructuring to an uniform particle grid, which is termed „nuclear matter“. It shows entirely new properties in comparison with protons and neutrons. The whole is more than just the sum of its parts.

7.2.2 The Structural Representation of Atomic Nuclei

Every particle of the mass particles grid contributes to the elementary structure ($3e^+ 3e^-$) and to the substructure ($\pi^+ \pi^-$). The binding grid contains in large part positive pions p, furthermore kaons k and muons m. Its total number is eaqal to the nuclear charge. There exists never muons and kaons simultaneous in a nucleus. The number of the several particles is depending on the quotient of nuclear charge and mass number: Z/A. Therefore a distinction is to made between tree cases:

Table 7.2: Substructural representation of atomic nuclei

1th case: $Z = A/2$	2nd case: $Z < A/2$	3rd case: $Z > A/2$
binding grid contains only positive pions p	binding grid contains positive pions p and kaons k	binding grid contains positive pions p und muons m
it is valid: $p = Z$ $2p = A$	it is valid: $p + k = Z$ $2p + 3k = A$	it is valid: $p + m = Z$ $2p + m = A$
binding particles: $p = Z$	binding particles: $p = 3Z - A$ $k = A - 2Z$	binding particles: $p = A - Z$ $m = 2Z - A$

Two stable nuclei and their unstable neighboring nuclei are selected as case examples for the structural representation of nuclei.

Table7.3: Choice of odd and even nuclei

stable nucleus	lower nuclear charge	higher nuclear charge
13-al-27	12-mg-27	14-si-27
14-si-28	13-al-28	15-p-28

It should be noted that an atomic nucleus is clearly defined by nuclear charge and mass number; the mention of the element name is needless and only owed historical context.

Table 7.4: Substructures of the nuclei with A = 27 to table 7.3

nucleus	13-al-27	12-mg-27	14-si-27
mass particles	$27(\pi^+ \pi^-)$	$27(\pi^+ \pi^-)$	$27(\pi^+ \pi^-)$
binding particles	$Z < A/2$ $p = 3 \cdot 13 - 27 = 12$ $k = 27 - 2 \cdot 13 = 1$	$Z < A/2$ $p = 3 \cdot 12 - 27 = 9$ $k = 27 - 2 \cdot 12 = 3$	$Z > A/2$ $p = 27 - 14 = 13$ $m = 2 \cdot 14 - 27 = 1$
substructure	$[27(\pi^+ \pi^-)\ \{12\pi^+\ 1K^+\}]$	$[27(\pi^+ \pi^-)\ \{9\pi^+\ 3K^+\}]$	$[27(\pi^+ \pi^-)\ \{13\pi^+\ 1\mu^+\}]$
elementary structure	$(108e^+\ 95e^-)$	$(108^+\ 96e^-)$	$(108e^+\ 94e^-)$

Table 7.5: Substructures of the nuclei with A = 28 to table 7.3

nucleus	14-si-28	13-al-28	15-p-28
mass particles	$28(\pi^+ \pi^-)$	$28(\pi^+ \pi^-)$	$28(\pi^+ \pi^-)$
binding particles	Z =A/2 p = 14	Z < A/2 p = 3·13 - 28 = 11 k = 28 - 2·13 = 2	Z > A/2 p = 28 - 15 = 13 m = 2·15 - 28 = 2
substructure	$[28(\pi^+ \pi^-)\ \{14\pi^+\}]$	$[28(\pi^+ \pi^-)\ \{11\pi^+\ 2K^+\}]$	$[27(\pi^+ \pi^-)\ \{13\pi^+\ 2\mu^+\}]$
elementary structure	$(112e^+\ 98e^-)$	$(112e^+\ 99e^-)$	$(112e^+\ 97e^-)$

It is valid for the elementary structure of each atomic nucleus Z-A:
Number of elementar-structurally positrons: 4A
Number of elementar-structurally elektrons: 4A - Z

It is visible that each atomic nucleus, whether stable or unstable has typical and once only existing structures.

7.3 The Representation of Nuclear Transformations

The condition of the exact description of all transformations of nuclei and particles is the knowledge of their real structures. To resolve this comparable problem in chemistry how to describe the conversions of materials has taken many centuries. It is amazing how self-confident the physicians stay and belive in their very first theories.

7.3.1 Emissions of Protons und Neutrons

Table 7.6: Observation, condition and reaction process of emissions of protons and neutrons

emission of:	protons $[(\pi^+ \pi^-)\ \mu^+]$	neutrons $[K^+ \pi^-]$
only observable at:	Z > A/2	Z < A/2
structural condition:	muons μ^+ in the nuclear grid	kaons K^+ in the nuclear grid
reaction process:	mass particle $(\pi^+ \pi^-)$ and muon μ^+ reacting to proton: $(\pi^+ \pi^-) + \mu^+ \rightarrow [(\pi^+ \pi^-)\ \mu^+]$ type of reaction: 2.1	negat. pion π^- from mass particle and kaon K^+ reacting to neutron, pos. pion switched into binding grid type of reaction: 2.2.2

The structural condition is only a necessary condition, furthermore the nucleus has to be far from its stable state what means that ΔE is more than about 7MeV.

7.3.2 β-Transformations of Nuclei

Particle transformations within the binding grid are the causes of β-Transformations. If you name the nucleare charge of the stable state with Z_s, then it is always to observe the following transformation behaviour:

electron emission	$Z < Z_s$
stable	$Z = Z_s$
electron capture	$Z > Z_s$

If the reaction energy ΔE is is equal to or greater than 1,022MeV then you can observe instead of electron capture also positron emission. In this case the captured electron is derived from a hidden inner electron-positron pair production.

The typical reaction processes of β-transformations are described below on the examples of the structures in tables 7.4 and 7.5.

nucleus 13-al-28 with $Z < Z_s$: electron emission

β-transformation:	13-mg-28 → 14-al-28 + e^-
substructural:	$[28(\pi^+ \pi^-)\ \{11\pi^+\ 2K^+\}] \rightarrow [28(\pi^+ \pi^-)\ \{14\pi^+\}] + e^-$
internal transformation:	$2K^+ \rightarrow 3\pi^+ + e^-$

nucleus 15-p-28 with $Z > Z_s$: electron capture

β-transformation:	15-p-28 + e^- → 14-si-28
substructural:	$[28(\pi^+ \pi^-)\ \{13\pi^+\ 2\mu^+\}] + e^- \rightarrow [28(\pi^+ \pi^-)\ \{14\pi^+\}]$
internal transformation:	$2\mu^+ + e^- \rightarrow \pi^+$

nucleus 12-mg-27 with $Z < Z_s$: electron emission

β-transformation:	12-mg-27 → 13-al-27 + e^-
substructural:	$[27(\pi^+ \pi^-)\ \{9\pi^+\ 3K^+\}] \rightarrow [27(\pi^+ \pi^-)\ \{12\pi^+\ 1K^+\}] + e^-$
internal transformation:	$2K^+ \rightarrow 3\pi^+ + e^-$

nucleus 14-si-27 with $Z < Z_s$: electron capture

β-transformation:	14-si-27 + e^- → 13-al-27
substructural:	$[27(\pi^+ \pi^-)\ \{13\pi^+\ \mu^+\}] + e^- \rightarrow [27(\pi^+ \pi^-)\ \{12\pi^+\ 1K^+\}]$
internal transformation:	$\pi^+ + \mu^+ + e^- \rightarrow K^+$

The most common internal reaction is as following at β-transformations:

(7.3)	$2K^+$	↔	$3\pi^+$	+	e^-
(7.3e)	$2(3e^+ 2e^-)$	↔	$3(2e^+ 1e^-)$	+	e^-

This particle transformation is reversible. It occurs also as electron capture in heavier nuclei because in such nuclei are existing always kaons. All examples of β-transformations below show far-reaching changes on substructural stage up to elementary level. β-transformations happen also at low energy differences ΔE because they are dependent on the statistical distribution of the internal energy of the disintegrating nuclei.

8. The Reliability of the presented Picture of Particles an Nuclei

The fundamental simple dual structure of the material world underpin the presented knowledge, that all particles are constituted by electrons and positrons under accumulation of high amounts of energy. The light subparticles myons, pions and kaons are the substructural building blocks of heavier particles and atomic nuclei. Therefore it becomes visible a wide particle variety at disintegrations and collisions. This variety is caused by combinatory possibilities in accordance with certain rules.

The knowledge of the particle structures excludes that an ever greater number of particles are introduced in theory based on „convincing theoretical arguments“ ([1], S.102). But the variety of already invented particles and their theoretical necessity will serve to negate new insights. It is not just about quarks and gluons. It is about many particles existing only in the heads of scientists, but nowhere in the universe.

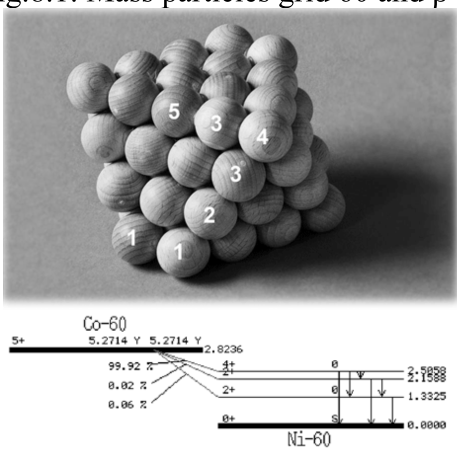
All particles and nuclei can be sorted according to elementarstructural and substructural criteria. The elementary system were developed in particular in this paper. If the particles are sorted according to substructural criteria similarities between particles become visible. Structural characteristics repeat on different mass states comparable with the atomic structures in the PSE. This structural characteristics are obviously the reason of specific particle properties. Therefore this paper exhausts not all possibilities of the presented knowledge, it is just a bare, incomplete and simply statement.

Some more examples are mention to underline the efficiency the nuclear grid model:

- A „well defined nuclear surface“ was proven by electron scattering experiments ([1] S.163). This trait can be well explained with a crystal-like structures. The experimental results can be used to calculate the precise nuclear measurments.
- Oscillations and resonances of atomic nuclei are based on lattice vibrations. This trait is especially visible in the Mößbauer-spectrometry. Resonances are particularly well between identically grids for example 76-os-191 (emitter) und 77-ir-191 (resonator).

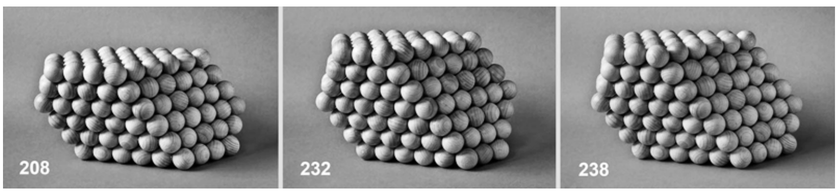
- The reason of the nuclear fission is „recrystallization“ of the nuclear lattice after incorporation of a neutron. The recrystallisation fails before reaced the whole grid and a splitting happens in two smaller and stabel nuclei. α-decays and cluster decays are also crystallisations of small and very stable nuclei from large and less stable nuclei.
- β-decays can take place on different geometric positions of the nuclear grid. This is the reason of the energy level schemes at β-transformations. Figure 8.1 illustrates this on the example of the nucleus 27-co-60. The mass particles grid 60 has distinguishable particle relations. The particles of the binding grid can transform on different geometric-energetic levels. The restructuring of the binging particles happens gradual until the binding grid reaches its ground state.

Fig.8.1: Mass particles grid 60 and β-level scheme of nucleus 27-co-60



99,92% of all β-transformations happen obvious on the exposed relation 11 of the mass particles grid, 0,06% on 3-4 and 0,02% on 1-2.
- It was always referred to the nuclear spin. Current theories are based on the presumption, that the nuclear spin is caused by spins of protons and neutrons. The spin is actual caused by the spins of the binding particles. For example the deuteron with substructure $[2(\pi^+ \pi^-) \{\pi^+\}]$ has spin 1+ like the pion π^+. Nucleus 6-c-12 with its substructure $[12(\pi^+ \pi^-) \{6\pi^+\}]$ has spin 0+ and the nucleus 7-n-14 must have spin 1+ because its substructure is $[14(\pi^+ \pi^-) \{7\pi^+\}]$. No nucleus is on permanent excited state to prove an incorrect theory.
- Quadrupole moments of nuclei are reduced to a static and symmetric distribution of electric charges within the nuclear grid. Figure 8.2 pictured the mass particles grids of the nuclei 82-208 (stable), 90-232 and 92-238 (both are relative stable). Such geometrical particle structures are inevitably leading to nuclei moments.

Fig.8.2: Mass particles grids 208, 232 and 238



- All particles and nuclei are built up from charged particles. This structural composition explains, that the predominant part of mass is energy, which is accumulated in electrical fields. You can name this as „elementary condensers“ in the sense of smallest possible electrical condensers. This way of energy accumulation conditioned, that the internal energy of a particle stands not firm because the relations between the elementary and sub-particles are not rigidly. For this reason all emitted particles have different energies and many transformations of particles have different possibilities.

A few final remarks: The presented work is a first representation and in no way comprehensive. It is the excerpt of a more extensive paper: „The Structures of the Microcosm“. This paper analysed and described the structures and transformations of particles and nuclei more differentiated and having regard to some energetic aspects.
The current theories in physics about particles and nuclei are undubted substitutable by a plausible and consistent description. This has important consequences for theoretical physics, physics research and the world view of physics. It must not remain unmentioned that some significant corrections become visible about the structures of the atomic shell and the causes of the chemical bond.

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2015/16

Source citation:

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