5. Spatial-connections of the proton and neutron planes and Coulomb force

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In the following, elementary particles should no longer be spheres, but two fixed planes in space. They exchange themselves with other planes by reducing or enlarging the space by an order of magnitude. The difference between electrical and gravitational exchange does not exist in different exchange particles, but only by the condition that electrical charges refer to solid countercharges. Two countercharges belong together and form a whole that is electrically neutral to the outside. Gravitational exchange processes are of the same kind, but they are networked with a statistically large number of other particles, to which there was contact at some point in time. Charges show repulsive forces, if they are equally charged. But also impacts of electrically neutral masses, lead to movements away from each other, which are slowly cancelled out in a closed system by a continuous attraction. So we see attracting forces as well as repulsive forces also in the area of neutral masses. When two neutral particles are exchanged, the spatial exchange does not lead to an approach, but to a distance that is gradually reduced again.

This will not be discussed further here, but we will now exclusively consider the electrical sequence of two particles under the assumption that particles are two planes. Instead of the description about a space exchange between two corresponding planes, we assume again the familiar classical charge picture. Now only with the difference, that the positive or negative charge should be distributed on two planes R_e^2 of the same size. We are interested in, whether in the near range the bonds can be described without the strong interaction and whether higher atomic nuclei can be successively built up.

We do not want to describe in detail the dynamic processes that occur when two charges approach each other, but only the forces and energies that affect the particles. We therefore neglect the magnetic fields and consider the charges to be approximately electrostatic.

The basic equations are then the Maxwell equations of electrostatics.

$$rotE = 0 \quad (1) \text{ and } div\varepsilon_0 E = \lambda \quad (2)$$

or in integral form $\oint_C E \cdot ds = 0$ (4) and $\oint_F \varepsilon_0 E \cdot df = Q$ (5).

C or F are a piece-wise smooth, arbitrarily closed curve or surface.

E_k is the electric field of a system of point charges $q_1,...,q_N$. If we divide the exerted force between q_k and q_i by q_i, then we obtain the electric field of the k-th charge at the location of the i-th charge

$E_k(r_i) = \frac{q_k}{4\pi\varepsilon_0} \frac{r_i - r_k}{|r_i - r_k|^3}$ (6). This results in the vector sum to

$E(r_i) = \frac{1}{4\pi\varepsilon_0} \sum_{k \neq i} q_k \frac{r_i - r_k}{|r_i - r_k|^3}$ (7). The total force is then $F(r_i) = q_i E(r_i)$.

Thereby the position of the i-th particle was arbitrary, so any r_i point in space can be arbitrary and we can write generally

$$F(r) = qE(r) \quad (8)$$

Let us write the point charge as space charge density $q_l = \lambda(r_l)\Delta\tau_l$ with λ as space charge density and τ as volume then follows from (7) $E(r_i) = \frac{1}{4\pi\varepsilon_0} \sum_{l=1}^{N} \frac{\lambda(r_l)(r_i - r_k)}{|r_i - r_k|^3} \Delta\tau_l$ (9) and from it the integral form $E(r) = \frac{1}{4\pi\varepsilon_0} \int_{R^3} \frac{\lambda(r')(r - r')}{|r - r'|^3} d\tau'$ (10). This results in the Maxwell equation of electrostatics.

Since we want to calculate further with surfaces, we also introduce the surface charge density σ. As above we get with $q_l = \sigma(r_l)\Delta f_l$ for $N \to \infty$ the electric field in integral form as

$E(r) = -\frac{1}{4\pi\varepsilon_0}\nabla\int_F \frac{\sigma(r')}{|r-r'|}df'$ (11) where $\nabla\frac{1}{|r-r'|} = -\frac{(r-r')}{|r-r'|^3}$ is used.

Also here applies ($rotE = 0$)

$div\varepsilon_0 E = \int_F \left(-\frac{1}{4\pi\varepsilon_0}\Delta\frac{1}{|r-r'|}\right)df' = \int_F \sigma(r')\delta(r-r')df' = 0$ in $IR^3\backslash F$ (11).

F lies in the finite |E| converges evenly towards zero for $r \to \infty$ and we can write $\varepsilon_0 E = -\frac{1}{4\pi}\nabla\int_F \frac{n'\cdot[\varepsilon_0 E']}{|r-r'|}df' + \frac{1}{4\pi}rot\int_F \frac{n'\times[\varepsilon_0 E']}{|r-r'|} = 0$ (12). From the divergence of this equation follows out in the whole space

$\phi = \int_F \frac{\sigma' - n'\cdot[\varepsilon_0 E']}{|r-r'|}df'$ (13) $\Delta\phi = 0$. And from rotation with

$A = \int_F \frac{n'\times[\varepsilon_0 E']}{|r-r'|}$ $rotrotA = -\Delta A = 0$ (14).

For an area-wide load distribution σ the following therefore applies

$rotE = 0 \text{ in } IR^3\backslash F,\ n\times[E] = 0 \text{ on } F$ (15)

and $div\varepsilon_0 E = 0\ IR^3\backslash F,\ n\cdot[\varepsilon_0 E] = \sigma \text{ on } F$ (16).

In the question of the binding energy of particles, the strong interaction force is to be attributed to the Coulomb force. We assume that the force with which two charges attract each other is proportional to $1/r^2$ as long as it keeps its 3-dim connection to other particles. Only in the close range or still later, the degrees of freedom should jump to only one connection dimension and with this geometry jump, the $1/r^2$-dependence should change into a linear one. This means that we are then in the force influence area of the strong interaction.

A point charge in the range $r = 0$ makes little sense physically, but it is important that $div\varepsilon_0 E = 0$ for mathematical reasons applies, because only an exact $F \propto 1/r^2$ proportionality fulfills this condition. If we had a connection $F \propto 1/r^{2+\varepsilon}$ with

$\varepsilon << 1$, we could show that it follows $div\varepsilon_0 E \neq 0$ from it. It turns out that a correction would have to result in a factor $\varepsilon < 10^{-15}$.

Also in quantum electrodynamics it is shown that photons only have a rest mass of zero if $|E| \propto 1/r^2$ is exactly true.

Otherwise one would expect from the Yukawa potential $\phi \propto e^{-\mu r}/r$ the field $|E| \propto |\nabla e^{-\mu r}/r|$ with a rest mass of a photon of $m_\gamma = \mu\hbar/c$. According to today's measurement accuracy, $1/\mu \geq 2{,}5 \cdot 10^8 m$ this would make the mass smaller than $m_\gamma \leq 8 \cdot 10^{-52} kg$. The deviation of the potential would thus remain at least in the range of $r \geq 2{,}5 \cdot 10^8 m$. For our considerations the micro range is more interesting, here the validity of the $F = 1/r^2$ dependence shows up with scattering tests of electrons at positrons up to the range of approximately $10^{-17} m$. This value lays around two orders of magnitude under the assumption we postulated above. Nevertheless, this is not a contradiction, but only states that whenever free particles do not form a bond, i.e. even the strong interaction does not take effect, such particles behave with $F \propto 1/r^2$, as they do. If electrons and positrons scatter only, then they remain independent the whole time. They do not see the opposite as antiparticles; otherwise they would form a bond and extinguish themselves as photons. That the particles jump from a $1/r^2$ three-dim geometry into a constant one-dim dependence is supposed to go along with the strong interaction and their influence lies only in the range of less than one R_e.

The repulsion of two point charges can be used for work. This work was then put into the system in form of potential energy. It is called as electrical interaction energy during charge shifts.

With a system of N point charges, the total electrical interaction energy of the system can be calculated from the contributions of all different pairs (1,2), (1,3), ...,(1,N), (2,3), ,(N-1,N)

$$W_e = \frac{1}{4\pi\varepsilon_0} \sum_{i=1}^{N-1} \sum_{j>i} \frac{q_i q_j}{|r_i - r_j|} = \frac{1}{8\pi\varepsilon_0} \sum_{\substack{i,j=1 \\ i \neq}} \frac{q_i q_j}{|r_i - r_j|} \quad (17).$$

Let us now make the transition from individual point charges to continuous charge distributions

$$r_i \to r \qquad q_i \to \lambda(r)dr$$

$$r_j \to r' \qquad q_j \to \lambda(r')dr'$$

so we obtain for electrical energy $W_e = \frac{1}{8\pi\varepsilon_0}\int_{IR^3}\int_{IR^3}\frac{\lambda(r)\lambda(r')}{|r-r'|}d\tau d\tau'$ (18).

With $\lambda = div\varepsilon_0 E = -\varepsilon_0 div\nabla\phi$, the electric potential $\phi_i = \frac{1}{4\pi\varepsilon_0}\frac{q_i}{|r_i - r_j|}$ (19) and a partial derivation we get

$$W_e = -\frac{\varepsilon_0}{2}\int_{R^3}\phi div\nabla\phi d\tau = -\frac{\varepsilon_0}{2}\int_{R^3} div(\phi\nabla\phi)d\tau + \frac{\varepsilon_0}{2}\int_{R^3}(\nabla\phi)^2 d\tau \quad (20)$$ or according to the Gaussian theorem $\boxed{W_e = \int_{R^3}\frac{\varepsilon_0}{2}E^2 d\tau}$ (21).

In this the integrant can be regarded as energy density $w_e = \frac{\varepsilon_0}{2}E^2$ (22).

If we apply the field energy to a point charge $E = qr/(4\pi\varepsilon_0 r^3)$, then we get $W_e = \frac{\varepsilon_0}{2}\frac{q^2}{16\pi^2\varepsilon_0^2}\int_0^\infty \frac{d\tau}{r^4} = \infty$ (23) what was to be expected, but makes no sense. One way to avoid infinite energy would be to assume that particles are not singular. In doing so, we continue to follow the approach that what we regard as charge is not distributed on a sphere, but on two planes at a certain distance. We compare the geometric structure with that of an ideal plate capacitor, which, however, behaves like a point potential at some distance, whereby the distance of the plates is determined by the basic conditions of the space. The two planes themselves are immovable.

If we compare the levels with an electrical conductor, then E=0 applies to the space between the planes, and $n \times E = 0$ and $\varepsilon_0 n \cdot E = \sigma$ applies to the planes themselves. So it is valid for the potential in the conductor and on the surface $E = -\nabla\phi$,

therefore applies $\phi = const.$. Due to the special nature of the elementary particles, the comparison with a plate capacitor can be regarded as ideal. There are no losses at the edges. The electric field is therefore perpendicular to the surfaces $n_{\pm} \cdot \varepsilon_0 E = \pm\sigma$ (24). Outside the conductor is E=0. The energy stored in the capacitor results in $W_e = \frac{1}{2}\int \sigma\phi df$ (25).

For the total force on a conductor applies $F = \frac{\varepsilon_0}{2}\int_F E^2 n df$ (26). The force on the positive charge of a plane leads to $F_+ = -\frac{\varepsilon_0}{2}\int_F E^2 n df = -\frac{Q^2}{2\varepsilon_0 F} e_z$ (27) or related to one plane each of proton and electron to $F = -\frac{\left(e/2\right)^2}{2\varepsilon_0 R_e^2}$ (28). This force is constant in the range of its validity, i.e. from a distance of one R_e, because then there is no space in between in which the particle could escape. If we add the energy that enters the system, then $W_C = \int F \cdot ds = -\frac{\left(e/2\right)^2}{2\varepsilon_0 R_e^2}(R_e - d_p)$ (29) applies.

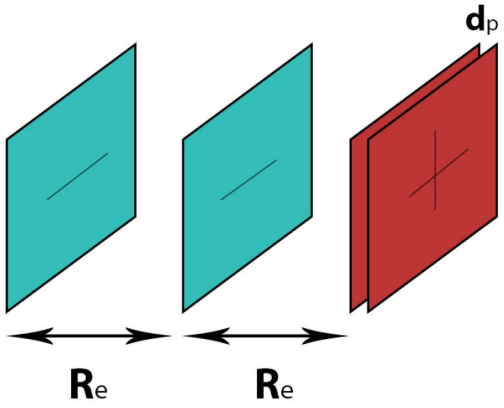

Fig. 1

This energy must therefore be applied at least to free a proton from the electron, i.e. to make it independent again. Only as long as a particle can be regarded as independent, the charge should start from the whole particle and appear like a spherical field. It seems than as a point charge. This should be the case up to a distance of $R = R_e + R_e/2 + d_p/2 \approx 1{,}5 R_e$

(Fig.1). First the energy $W_e = e\int_{\infty}^{1,5R_e} E(r)ds = \frac{e^2}{4\pi\varepsilon_0 r}\Big|_{\infty}^{1,5R_e} = \frac{e^2}{4\pi\varepsilon \cdot 1,5R_e}$ (30) has to be applied. Quantitatively this would be $W_e = 0,34MeV$. This value will be much lower, because the point potential form is probably already earlier not given and the part of the outer planes disappears with it already earlier. At the latest starting from a distance of the planes from one R_e the space is fixed and only the geometry of the two near planes should make a contribution (fig. 1). The two outer planes must now be bound to the outside for a while, then the particles would continue to approach, but now like capacitor plates. The energy for this is then $W_e = \frac{(e/2)^2}{2\varepsilon_0 {R_e}^2} R_e(1-\frac{1}{\sqrt{1836}}) = 0,78MeV$ (31). Thus, the particles which are in the system as binding energy, became $W_e < 1,1MeV$ free.

The arrangement of the two particle planes can be further transformed with a small additional expenditure of energy because the proton planes can also be located within the electron planes.

One difficulty is that only certain areas of the room are allowed. The proton cannot take a further d_P step, because otherwise electrons and proton planes lay on top of each other - occupy the same space. This means that the electron jumps by one R_e, therefor energy must be supplied, at the same moment the proton jumps d_P closer. In the next time step the electron stays where it is and the proton jumps d_P forward by another step and in a third step the electron jumps back, loses its energy again and the proton is inside the electron. The energy balance for this is relatively low, but there must be special conditions so that the electron can absorb and release energy for a short time. This means that for a free neutron that is far from other charges, there is stability between electron and proton (Fig. 2).

The numerical value for the binding energy is remarkable because it corresponds to that of the neutron, which is now derived solely from the electrical interaction. If the proton planes have exceeded the negative charge plane, they remain reasonably stable within the negative charges. So far it would be possible to escape laterally, this is not allowed with a

fixed space structure so any longer. Only if both particles are independent all three dimensions are to them again at disposal.

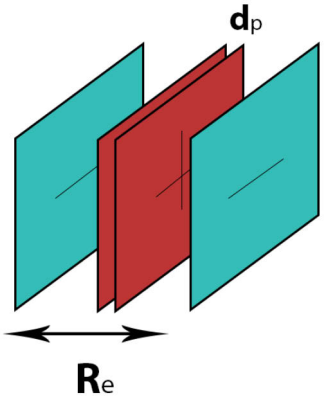

Fig. 2

For the next higher element, deuterium, which consists of a neutron and a proton, we assume that the neutron in its closed form is electrically neutral towards the outside. This means that a proton can approach to about one R_e without energy loss (Fig. 3).

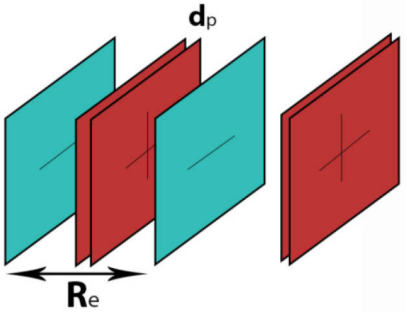

Fig. 3

From about one R_e onward, there is a high probability that the electron will jump towards the new proton by one R_e and that the old proton will thus be about $R_e / 2$ outside it (Fig. 4). During this jump, the system loses energy, which holds the particles together afterwards as binding energy.

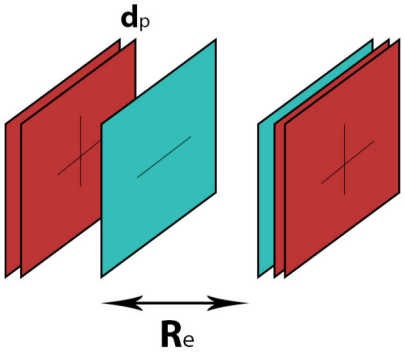

Fig. 4

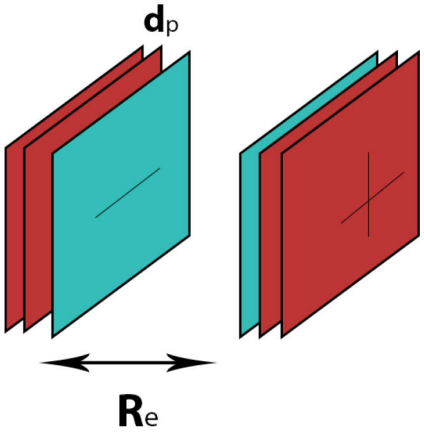

Fig. 5

If we assume that in the one-dimensional shift there are only two sides with half a charge opposite each other than the system $W_e = \frac{\left(\frac{e}{2}\right)^2 R_e}{2\varepsilon_0 R_e^2} \approx 0{,}81 MeV$ (32) loses pairs of the two right planes $W_e = \frac{\left(\frac{e}{2}\right)^2 R_e}{2\varepsilon_0 R_e^2}$ and pairs of the left ones. Then it loses energy over the distance from $R_e / 2$ the left proton pair that can approach d_P to the left electron plane $W_e = \frac{\left(\frac{e}{2}\right)^2 \frac{R_e}{2}}{2\varepsilon_0 R_e^2} \approx 0{,}4 MeV$ (Fig. 5). The total binding energy is then 2.2 MeV and is thus as large as the empirically measured binding energy.

The space between the particles is not arbitrarily dense existent. For the electrons it is in the range of R_e steps, for the protons it is in d_P units. When two electrons approach each other, they feel the repulsive forces up to a distance of one

R_e. If it is possible to bring the two charges even closer, then only space in sizes d_P exists. I.e. the particles can approach each other further, but suddenly do not exert any force on each other, because they do not "see" each other anymore. There are no more integer R_e steps between them. The closest proximity would therefore be a distance of d_P. But these connections are instable and would quickly leave the inner area again and thus come into the repulsive part. It would be different if protons were present. The levels of the protons and the electrons continue to exert attracting forces on each other and lead to a stability of the atoms. Thus, a deuterium atom and a neutron can combine to form a tritium and together assume an extremely compact form, which is only slightly above that of R_e (Fig. 7). Although this expansion is very compact, it also determines a limit that cannot be exceeded. In general, it would also mean that under conditions, such as after a Super Nova, which can lead to a black hole, at a density at which the entire possible space is exhausted, at the latest, a new stability is achieved, solely due to the restriction of space in the elementary region.

Let us assume that with the connection from ${}^{2}_{1}H$ to ${}^{3}_{1}H$ the neutron (1MeV) approaches the deuterium (2,2MeV) up to one R_e distance without loss of energy. Then it should compress linearly from about 3 to 4 R_e (Fig. 6) to about 1 R_e. But not with 2 half charges each, but all four charge halves should participate, so that we get $\approx 2 \cdot 3 \cdot 0{,}8MeV = 4{,}8MeV$ (Fig. 7). So in the compact structure about eight MeV are bound to energy, which must be overcome in order to decompose all particles again into their basic building blocks. This also corresponds to the experimentally measured value.

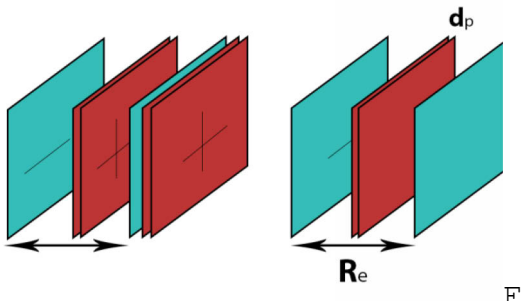

Fig. 6

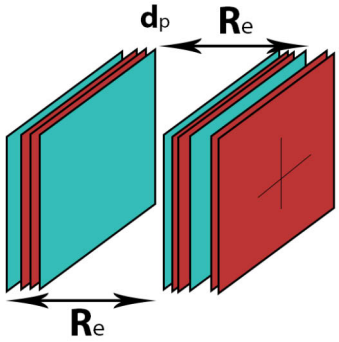

Fig. 7

The structure of the elements could be continued in this simple form, but there is an increasing discrepancy in the one-sidedness of space compression, which would lead to ever longer one-dimensional space concentration, although other space dimensions could be occupied.

For this reason, the further linkage of the particles will not be continued here, but some dynamic processes would have to be examined more closely beforehand.