11. **ILLEGAL STATICS**

Sometimes we want to jump over the troubles. We have just a little chance on a kind of success here. Let us violate (8.9'). On the boundary with vacuum (8.9') provides two conditions: μ^2 and its derivative across the boundary both should be zero. There are two basic ways to violate (8.9'):

1. **Soft Violation**. If μ^2 continuous across the boundary but its derivative has a jump. In this case equation (8.3') will be violated in the point of a boundary and its left part will be finite value instead of zero. A finite violation in just one point (surface) won't bear on volume integrals.

2. **Hard Violation**. If μ^2 has a jump across the boundary and its derivative go infinite. In this case equation (8.3') will be so violated that its left part will be infinite instead of zero. In this case some volume integrals can acquire an unexpected but finite value (like rest mass will be different from inertial mass). We are about to use a hard violation. How bad is this venture? It is the same order like the use of a point charge but even better because the integral of energy will not turn infinite. As an advantage we will get a static model for any particle with any charge, spin, mass, and magnetic moment.

In general it is a "question of the future". What we can say about it now? The Gauss theorem (6.3) should be rewritten for the case if a vector U^k has a jump on some surface S which is inside our V_4:

$$\int_{V_4} U^k{}_{|k} dV_4 + \int_S [(U^k n_k)_+ - (U^k n_k)_-] dS = \int_{V_3} U^k \varepsilon(N) N_k dV_3 \tag{6.3'}$$

where n_k.. is a covariant normal to the surface S which is a 3-d surface. If $U^k=e_iT^{ik}$ then taking explicit form of T^{ik} from (8.2) we get:

$$(U^k n_k)_+ - (U^k n_k)_- = 2\pi / (k_0^2 c^2) e^i n_i (\mu_+^2 - \mu_-^2)$$

which is proportional to the scalar: $e^i n_i$ (11.1)

(We used the continuity of E-M field across S). If $U^k= e^m g^n e_{mnij} x^i T^{jk}$ then the same difference will be proportional to the scalar:

$$e^m g^n e_{mnij} x^i n^j \tag{11.2}$$

These scalars often can be zero and even if not the integral over S still can be zero due to the symmetry of the surface S. One case where the integral over S is not zero we will discuss in the section 13. If we consider IP+ in an external electric field it will accelerate. The proportionality coefficient between force and acceleration defines yet another "acceleration mass". The good news are: the acceleration mass appear to be equal to the rest mass of IP+.

Let us turn attention to the particle defined in (9.3) (9.5) with z1 an arbitrary value. This is not ideal particle. Calling it IP+notIP or simply IP+ let us apply to it the same logic that we used in section 7 part I. First of all we can check that the integral over S for IP+ (whether moving or at rest) equal to zero. If so then we can apply

Gauss theorem in the sense that it was used in section 7 and find:

$$P^0 = \int_{x^0=0} T^{00} dV = \gamma[\int \bar{T}^{00} d\bar{V} + v^2 \int \bar{T}^{33} d\bar{V}]$$
$$P^3 = \int_{x^0=0} T^{03} dV = \gamma v[\int \bar{T}^{00} d\bar{V} + \int \bar{T}^{33} d\bar{V}] \tag{11.3}$$

which is true because T^{ik} does not depend on time. Let us calculate all the integrals (7.4). Taking $\alpha = 1$, $k_o= 1$ for simplicity we get:

$$A = \int \bar{T}^{00} d\bar{V} = -8\pi^2 w_1^2 R_1(w_1)\cos(w_1)$$
$$B = \int \bar{T}^{11} d\bar{V} = \int \bar{T}^{22} d\bar{V} = \int \bar{T}^{33} d\bar{V} = -(8/3)\pi^2 w_1^3 R_0^2(w_1) \tag{11.4}$$

The rest mass and inertial mass that can be retrieved from (3) are significantly different if w_1 not equal $n\pi$, $R_o(w_1)$ not equal to zero. What does it mean? It means that inertial mass should not be used. Further in this section we use the rest mass as a mass of the classical models of elementary particles.

Can we build up a model of an electron or proton? Yes, but these models will be not ideal particles. The positive energy of the whole solution comes mainly from the vacuum field. In order to describe electron and heavy particles like proton using the same model we have to include a vacuum chamber inside our IP+. Having this in mind let us take the currents:

$$j^0 = c\begin{cases} \alpha R_0(z) \\ 0 \\ \alpha_3 R_0(z) \\ 0 \end{cases} \quad \vec{J} = \begin{cases} \beta R_1(z)\sin(\theta)\vec{a}_\varphi \\ 0 \\ 0 \\ 0 \end{cases} \quad \begin{cases} 0 \le z \le \pi, I \\ \pi < z < z_2, II \\ z_2 \le z \le z_3, III \\ z_3 < z < \infty, IV \end{cases} \tag{11,5}$$

where $\vec{a}_\varphi$ is a unit vector of the spherical coordinate system. We have divided the whole space on four spherical regions: I and III are not vacuum, II and IV are vacuum. Everything here is good except jumps of the currents on three free boundaries $z=\pi$, $z= z2$, and $z= z3$. Anyway, let us calculate all the global parameters of this particle. This model will give the electron if we take $z2=\pi$. In this case, the inside vacuum region II disappears. Using the currents (5) and formulas (9.1) we can find the electromagnetic field in the inside regions I and III. Taking the vacuum electric field in the regions II and IV and the vacuum magnetic field in the regions II, III, IV, we have:

$$E_r = \frac{4\pi}{k_0}\begin{cases} \alpha R_1(z) \\ \alpha\pi / z^2 \\ \alpha_3 R_1(z) \\ \alpha_3 z_3^2 R_1(z_3)/z^2 \end{cases} \quad \begin{cases} 0 \le z \le \pi \\ \pi < z < z_2 \\ z_2 \le z \le z_3 \\ z_3 < z < \infty \end{cases}$$

$$\vec{H} = \frac{4\pi\beta}{k_0}\begin{cases} (2/z)R_1(z)\cos(\theta)\vec{a}_r + [(1/z)R_1(z) - R_0(z)]\sin(\theta)\vec{a}_\theta \\ \pi\left[(2/z^3)\cos(\theta)\vec{a}_r + (1/z^3)\sin(\theta)\vec{a}_\theta\right] \end{cases} \begin{cases} 0 \le z \le \pi \\ \pi \le z < \infty \end{cases} \tag{11.6}$$

Because the electric field should be continuous at $z= z2$, we have:

$$\alpha_3 = \frac{\alpha\pi}{z_2^2 R_1(z_2)}$$

The total charge of the regions I and III is:

$$e = \frac{4\pi^2 \alpha z_3^2 R_1(z_3)}{k_0^3 z_2^2 R_1(z_2)} \tag{11.7}$$

The magnetic moment that corresponds to the magnetic field (6) is:

$$\mu = \frac{4\pi^2 \beta}{k_0^4} \tag{11.8}$$

Let us calculate the rest mass of this particle.

$$c^2 m = \int T^{00} r^2 \sin(\theta) dr d\theta d\varphi =$$

$$\frac{8\pi^2}{k_0^2}\int [k_0^2 E^2 - (J^0)^2] r^2 dr + \frac{4\pi^2}{k_0^2}\int [k_0^2 H^2 - (J^\varphi)^2] r^2 \sin(\theta) dr d\theta$$

Let us take the second integral which represents the energy of the magnetic field and circular current:

$$\frac{4\pi^2\beta^2}{k_0^5}\left\{\begin{array}{l} \int_0^\pi \{4R_1^2(z)\cos^2(\theta) + [R_1^2(z) - 2zR_0(z)R_1(z) + \\ z^2 R_0^2(z) - z^2 R_1^2(z)]\}\sin^2(\theta) dz d\theta + \\ \int_\pi^\infty [\frac{4}{z^4}\cos^2(\theta) + \frac{1}{z^4}\sin^2(\theta)]\sin(\theta) dz d\theta \pi^2 \end{array}\right\}$$

Integrating over θ and leaving out a constant factor, we have:

$$\int_0^\pi [3R_1^2(z) - 2zR_0(z)R_1(z) + z^2 R_0^2(z) - z^2 R_1^2(z)] dz + \pi^2 \int_\pi^\infty \frac{3dz}{z^4} =$$

$$[-zR_1^2(z) + z^2 R_0(z) R_1(z)]_0^\pi - \frac{\pi^2}{z^3}\Big|_\pi^\infty = 0$$

That means that magnetic energy inside and outside the particle compensate each other. Each of these parts is tremendous compared to the mass of the particle. For example, the vacuum magnetic energy of the electron exceeds its mass equivalent by about $4\mathrm{x}10^5$ times! This energy can be calculated in conventional electrodynamics (vacuum field). This fact requires the existence of negative energy inside the particle and, consequently, confirms the credibility of the chosen energy-momentum tensor (8.2).

The first integral gives:

$$\frac{8\pi^2\alpha^2}{k_0^5}\{\int_0^{\pi}[R_1^2(z)-R_0^2(z)]z^2dz+\pi^2\int_{\pi}^{z_2}\frac{dz}{z^2}+\frac{\pi^2}{z_2^4R_1^2(z_2)}\int_{z_2}^{z_3}[R_1^2(z)-$$

$$R_0^2(z)]z^2dz+\pi^2\frac{z_3^4R_1^2(z_3)}{z_2^4R_1^2(z_2)}\int_{z_3}^{\infty}\frac{dz}{z^2}\}=\frac{8\pi^2\alpha^2}{k_0^5}\{-z^2R_0(z)R_1(z)|_0^{\pi}-$$

$$\frac{\pi^2}{z}|_{\pi}^{z_2}-\frac{\pi^2}{z_2^4R_1^2(z_2)}z^2R_0(z)R_1(z)|_{z_2}^{z_3}-\pi^2\frac{z_3^4R_1^2(z_3)}{z_2^4R_1^2(z_2)}\frac{1}{z}|_{z_3}^{\infty}\}$$

Finally, we have:

$$m=\frac{8\pi^4\alpha^2}{k_0^5c^2}[\frac{1}{\pi}+\frac{\cos(z_2)}{z_2^2R_1(z_2)}-\frac{z_3^2R_1(z_3)\cos(z_3)}{z_2^4R_1^2(z_2)}] \tag{11.9}$$

Let us calculate the mechanical angular momentum (spin). We have a density of a linear momentum along $\vec{a}_{\varphi}$:

$$T^{0\varphi}=\frac{4\pi}{k_0^2}[k_0^2E_rH_{\theta}-J^0J^{\varphi}]$$

If we multiply this on the arm: r.sin(θ) and integrate it over the volume then we get a spin:

$$cS=2\pi\int T^{0\varphi}r^3\sin^2(\theta)drd\theta=\frac{8\pi^2\alpha\beta}{k_0^6}\int_0^{\pi}\{\int_0^{\pi}[z^2R_1^2(z)-$$

$$2z^3R_0(z)R_1(z)]dz+\pi^2\int_{\pi}^{z_2}\frac{dz}{z^2}+\frac{\pi^2}{z_2^2R_1(z_2)}\int_{z_2}^{z_3}R_1(z)dz+$$

$$\frac{\pi^2z_3^2R_1(z_3)}{z_2^2R_1(z_2)}\int_{z_3}^{\infty}\frac{dz}{z^2}\}\sin^3(\theta)d\theta=\frac{32\pi^2\alpha\beta}{3k_0^6}\{-z^3R_1^2(z)|_0^{\pi}-$$

$$\frac{\pi^2}{z}|_{\pi}^{z_2}-\frac{\pi^2}{z_2^2R_1(z_2)}R_0(z)|_{z_2}^{z_3}-\frac{\pi^2z_3^2R_1(z_3)}{z_2^2R_1(z_2)}\frac{1}{z}|_{z_3}^{\infty}\}$$

Finally, we have:

$$S=\frac{32\pi^4\alpha\beta}{3ck_0^6}\frac{\cos(z_2)-\cos(z_3)}{z_2^2R_1(z_2)} \tag{11.10}$$

Now we are in a position to apply these formulas. Our first objective is an **electron**. Let us take z2=π and define some dimensionless constant:

$$A=\frac{3eS}{4mc\mu}=1+\frac{1}{\cos(z_3)};\quad z_3=arctg\left(\pm\sqrt{A(A-2)}\right) \tag{11.11}$$

Another combination of these formulas gives:

$$k_0=\frac{2mc^2z_3^2R_1(z_3)}{e^2\cos(z_3)} \tag{11.12}$$

$$\alpha = \frac{ek_0^3}{4\pi z_3^2 R_1(z_3)}; \quad \beta = \frac{\mu k_0^4}{4\pi^2} \tag{11.13}$$

The equation (11) for z3 has many solutions. We have chosen the one which produces the minimum radius for the electron: r3= $1.20468\text{x}10^{-13}$cm. The other parameters of the electron are:

$$\alpha = -2.341547 \bullet 10^{30} g^{1/2} cm^{-3/2} \sec^{-1}$$
$$\beta = 5.7271421 \bullet 10^{33} g^{1/2} cm^{-3/2} \sec^{-1}$$
$$k_0 = 7.024747 \bullet 10^{13} cm^{-1}; \quad z_3 = 8.462573$$

The constant of this theory ko is now definite and we will use it for other particles as a given value.
For the charged heavy particles we can define two other dimensionless constants:

$$A_1 = \frac{3cS}{2e\mu k_0}; \quad A_2 = \frac{2c^2 m}{e^2 k_0} \tag{11.14}$$

By solving the corresponding transcendent equations with the help of a computer we can find the solutions for a given particle's parameters (charge, mass, spin, magnetic moment). Since the transcendent equations have many roots, we usually have to choose between the first and second root. My guiding principle is to have a particle of the smallest possible size. I have found two possible structures for the proton: Proton Structure I:

$$\alpha = 2.1646046 \bullet 10^{31}; \quad \beta = 8.701979 \bullet 10^{30}$$
$$z_2 = 4.50135157; \quad z_3 = 7.72436426$$

Proton Structure II:

$$\alpha = -1.6094377 \bullet 10^{33}; \quad \beta = 8.701079 \bullet 10^{30}$$
$$z_2 = 7.63413278; \quad z_3 = 7.72548748$$

For a neutral heavy particle we can define another constant:

$$A_3 = \frac{9S^2}{8m\mu^2 k_0} \tag{11.15}$$

According to (7), the radius of the outside free boundary of a neutral particle will be the solution of: $R_1(z_3) = 0$. The two possible structures for a neutron is also found.

Neutron Structure I:

$$\alpha = -1.6795028 \bullet 10^{31}; \quad \beta = -5.96039 \bullet 10^{30}$$
$$z_2 = 4.49766806; \quad z_3 = 7.725252$$

Neutron Structure II:

$$\alpha = 2.3556845 \bullet 10^{33}; \quad \beta = -5.96039 \bullet 10^{30}$$
$$z_2 = 7.63471008; \quad z_3 = 7.725252$$

The outside radius of a neutron is r3 = $1.09972.10^{-13}$cm . The outside radius of all the structures of proton and neutron are almost the same and less than the radius of the electron. Both the proton and neutron have a core of the radius $r1= 0.447218.10^{-13}$cm which is surrounded by the vacuum. This core can be positive or negative in a proton as well as in a neutron. The outside charged spherical layer of a heavy particle can be thin or thick. We do not know which structure is closer to reality unless we discover how comes about a stability of these particles. It is quite clear that we can build a structure for any known particle. For example, let us build a particle that has magnetic moment and spin, but its charge and mass are zero. From (7) we get the zero charge when $R1(z3)= 0$ or when $z3= 4.49340946$, $z\_3= 7.725252$, and so on. Taking into account that $R1(z3) = 0$ and using (9) we find that the mass is zero if $z2$ satisfies sin (z2)= (z2-π)\cos (z2) the solutions of which is $z2=\pi$, $z2= 7.635062111$, and so on. If $z2=\pi$ and $z3= 4.49340946$ then we have a neutrino without a vacuum chamber --- electron neutrino. We could take $z2 =\pi$ and $z3= 7.725252$. This electron neutrino would be unnecessarily large. If we take $z2 = 7.635062111$ and $z3= 7.725252$, then we have a neutrino with a vacuum chamber --- muon neutrino. Given a spin and magnetic moment, we can find α and β for these neutrinos. Contrary to the existing perception of neutrinos, these particles can be at rest and can be used only for a spin balance otherwise we should consider neutrinos with a very small mass.

Can we build a nucleus of the atom? Definitely so. For example, the proton of the second structure and the neutron of the first structure both have a negative core and positive charge density on the outside free boundary. This positive outside layer can unite for many protons and neutrons. Each proton and neutron will preserve its core and vacuum chamber (a small deformation should be expected). Due to the lack of spherical symmetry, we will be forced to use a whole infinite series of the solutions of Helmholz equation.

I consider the illegal operation is a success and our choice of rest mass as a real mass of the particles is correct. In section 14 we will show that for the particles that violate (8.3’) on the boundary of disruption “inertial mass” (defined on $p.13)$, that also can be calculated by integration, is different from the rest mass. We will prove in the section 13 that yet another “acceleration mass” for small velocities coincides with the rest mass which also indicates that the choice of rest mass is correct.

We showed that the very same dynamics equation (8.13) can explain electron and much heavier proton as well --- we do not need any special “forces” or modification of dynamics equation with another special constant to explain heavy particles.

The section 13 shows that all static solutions are unstable. The stability comes about by introducing a High Frequency Strong Cosmic Background Radiation so that real particles radiate and absorb at the same rate. That means that lot of dynamics processes go around the described above static models. May be these dynamics currents bring μ^2 to zero on the boundaries of disruption, may be the boundaries themselves participate in some circles of motions that help to avoid the violation of (8.3’). We just do not know.