

Quantities of Particles and Masses of Nuclei as Outcome from a Geometric Theory of Fields

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Abstract: It is possible to deduce quantities of particles and masses of nuclei from a geometry of gravitation and electromagnetism as found for the first time by Rainich. The theory is nothing else than General Relativity completed with a “simple idea” as foreseen by Wheeler. This “simple idea” leads to far reaching consequences and solves the problems of General Relativity. In addition, the omnipresent quantization is nothing else than a necessary consequence of the geometric theory. At this place, quantities of particles and masses of nuclei are depicted by means of numerical simulations according to geometric equations. The algorithm is linked with chaos, so that known obstacles of a geometric view like the singularity rule are revealed to be irrelevant.

Keywords: Numerical simulations, Algorithm, Theory of relativity, Einstein-Maxwell theory, Rainich theory, Quantization.

1 Introduction: On the theory

The geometry of fields is constituted in [4, 5]. Gravitation and electromagnetic fields are parameters of the time-like curve described by the test body in the four-dimensional space-time. It must be mentioned that already Rainich [2, 3] knew the geometry of electromagnetism. One should wonder why most physicists use to ignore this fact. The borderline case of electromagnetic waves (light &c.) can be understood from Maxwell’s theory alone [7].

The theory is based on the tensor equations [5]

$$R_{ik} = \kappa \left(\frac{1}{4} g_{ik} F_{ab} F^{ab} - F_{ia} F_k{}^a \right) \quad , \quad (1)$$

$$F_{ij,k} + F_{jk,i} + F_{ki,j} = 0 \quad , \quad (2)$$

$$F^{ia}{}_{;a} = 0 \quad , \quad (3)$$

in which g_{ik} are the components of metrics, R_{ik} those of the Ricci tensor and F_{ik} those of the electromagnetic field tensor. κ is Einstein’s gravitation constant. These equations are known as Einstein-Maxwell equations [1]. As well, here are used the *homogeneous* Maxwell equations, for force equilibrium and conservation of energy and momentum. The sources of related inhomogeneous equations are replaced by integration constants [4, 9]. Mass, spin, electrical charge, and magnetical momentum are the first integration constants.

The geometric equations do *not* define causality, because causality is not a geometric category. The geometric equations yield only 10 independent equations for 14 components g_{ik}, A_i , considering the special role of time. (The A_i are defined in Eq. (4).)

The geometry resulting from the Einstein-Maxwell equations was already found by Rainich [2, 3], and derived by a different method in [5]. Far reaching consequences of the geometric theory are described in [4, 9], for example a new view of tunnel effects and electrical conductivity as well as photons [7]. If we allow for constant curvature (cosmological constant) in Eq. (1), it follows a symmetric world model, where dark matter can be seen as antimatter, with reverse time arrow [6].

2 On numerical simulations

Analytic solutions (different from zero) based on integration constants lead commonly to singularities. This is seen like an obstacle, as a rule. However, these singularities come from impermissible integration of nonlinear equations, which do not meet superposition. Singularities are correct only in linear equations, but the world is even non-linear. See also a criticism of present interpretations of General Relativity by Crothers [11], who addresses the inner contradictions of these interpretations. – Numerical simulations according to the Einstein-Maxwell equations, which are explained in detail in [8], result in another picture [4]:

Numerical simulations using iterative, non-integrating methods lead always to a boundary at the conjectural particle radius. As well, any actual singularity appears always within a geometric limit. The area within this geometric limit *according to observer’s coordinates* is not locally imaged, i.e. does not exist. The geometric limit is the mathematical reason for the existence of discrete solutions. It has to do with marginal problems, and additionally with

chaos, see [4].

If we express the field tensor by a vector potential with

$$F_{ik} = A_{i,k} - A_{k,i} \quad , \quad (4)$$

Eq. (2) is identically met. Thus, we can go from quantities with potential character, that are metrics and electromagnetic vector potential.

In order to support or disprove the theory, one has to do lots of tests, because the particle quantities are integration constants and have to be inserted into the initial conditions (more see [4, 8]), which are set in the electrovacuum around the particle.

The basical idea consists in it to go from known area out of the particle and to successively make toward the unknown area. The geometric equations proved in the known area, and it is an artificial assumption that these be not valid everywhere. It will be demonstrated that this artificial assumption is false.

Basis of the computation are Eq. (1,3,4). For the sake of simplicity, we confine it to time independence and rotation symmetry. That results, with spherical coordinates

$$x^1 = r \quad , \quad x^2 = \vartheta \quad , \quad x^3 = \varphi \quad , \quad x^4 = jct \quad ,$$

in 6 independent equations for 8 components with potential character $A_3, A_4, g_{11}, g_{12}, g_{22}, g_{33}, g_{34}, g_{44}$, the rest vanishes.

Now, we give

$$g_{12} = 0 \quad (\text{with it } g^{12} = 0) \quad (5)$$

and

$$g = \det|g_{ik}| = r^4 \sin^2 \vartheta \quad . \quad (6)$$

That are *arbitrary* conditions, but they lead to reasonable results.

The integration constants from Eq. (1,3,4) result from development of series. Values of them are the input of the simulations and are inserted into the initial conditions [4]. The output is the number of iterations, which is a measure for the stability of the solution.

The first integration constants are

$$c_1 = - \frac{\kappa m}{4\pi} \implies \frac{\kappa m}{4\pi} \quad (7)$$

(mass),

$$c_2 = j \frac{\kappa s}{4\pi c} \implies \frac{\kappa s}{4\pi c} \quad (8)$$

(spin),

$$c_3 = -j \frac{\mu_o^{\frac{1}{2}} Q}{4\pi} \implies \frac{\kappa^{\frac{1}{2}} \mu_o^{\frac{1}{2}} Q}{4\pi} \quad (9)$$

(charge), and

$$c_4 = - \frac{\varepsilon_o^{\frac{1}{2}} M}{4\pi} \implies \frac{\kappa^{\frac{1}{2}} \varepsilon_o^{\frac{1}{2}} M}{4\pi} \quad (10)$$

(magnetic momentum).

The dimensionless terms toward the arrow are for computation, and have positive values. The imaginary unit

is included. The radius unit ($r = 1$) is 10^{-15} m. With it, the initial conditions become using $T = \frac{\pi}{2} - \vartheta$

$$g_{11} = 1 + \frac{c_1}{r} - \frac{1}{2} \left(\frac{c_3}{r}\right)^2 + \frac{1}{10} \left(\frac{c_4}{r^2}\right)^2 (1 + \cos^2 T) \quad , \quad (11)$$

$$g_{22} = r^2 \left\{ 1 + \left(\frac{c_4}{r^2}\right)^2 \left(\frac{1}{3} \cos^2 T - \frac{3}{10}\right) \right\} \quad , \quad (12)$$

$$g_{33} = r^2 \cos^2 T \left\{ 1 + \left(\frac{c_4}{r^2}\right)^2 \left(\frac{1}{15} \cos^2 T - \frac{3}{10}\right) \right\} \quad , \quad (13)$$

$$g_{44} = 1 - \frac{c_1}{r} + \frac{1}{2} \left(\frac{c_3}{r}\right)^2 + \frac{1}{2} \left(\frac{c_4}{r^2}\right)^2 \sin^2 T \quad , \quad (14)$$

$$g_{34} = r \cos^2 T \left(\frac{c_2}{r^2} - \frac{1}{2} \frac{c_3 c_4}{r^3} \right) \quad , \quad (15)$$

$$A_3 = r \cos^2 T \frac{c_4}{r^2} \quad , \quad (16)$$

$$A_4 = \frac{c_3}{r} \quad . \quad (17)$$

The actual computation is done with quantities performed from physical components, i.e. the unities in the equations are eliminated. Because the physical components have a magnitude of 10^{-40} . We have to insert the values of the integration constants into the modified initial conditions, see program in the “robust” package (available at author’s current website¹).

The conversion of physical into normalized (dimensionless) values and vice versa is described in detail in [4, 8]. Table 1 shows some values with the radius unit of 10^{-15} m. These examples grant convenient conversion.

	physical value	norm. value
proton mass	1.672×10^{-24} g	2.48×10^{-39}
\hbar	1.054×10^{-27} cm ² g/s	5.20×10^{-40}
elem. charge	1.602×10^{-19} As	1.95×10^{-21}
μ_B	1.165×10^{-27} Vs cm	3.70×10^{-19}

Table 1: Physical and normalized values for conversion

As well, higher momenta are missing for lack of knowledge, what could affect the correctness of the computation. We will insert known values and values deviating from them, and compare the results.

The algorithm consists in performing difference equations, in which the newly to quantifying quantity is on the left-hand side, and all previously quantified quantities are on the right-hand side. If we calculate spherical shells from outside to inside, the new quantity is $f_{m+2,n}$ in following difference equations (f stands for

¹<http://www.bruchholz-acoustics.de>

any potential-like quantity)

$$\frac{\partial f}{\partial r} \Big|_{r_m, T_n} = \frac{f_{m-1,n} - f_{m+1,n}}{2 \, dr} , \quad (18)$$

$$\frac{\partial^2 f}{\partial r^2} \Big|_{r_m, T_n} = \frac{f_{m+2,n} - 2f_{m,n} + f_{m-2,n}}{(2 \, dr)^2} , \quad (19)$$

$$\frac{\partial f}{\partial T} \Big|_{r_m, T_n} = \frac{f_{m,n+1} - f_{m,n-1}}{2 \, dT} , \quad (20)$$

$$\frac{\partial^2 f}{\partial T^2} \Big|_{r_m, T_n} = \frac{f_{m,n+1} - 2f_{m,n} + f_{m,n-1}}{dT^2} . \quad (21)$$

This quantity is linearly dissolvable in Eq. (19), and the whole adherent tensor equation is non-linear. Detailed formulae are to see in the Pascal codes. (The current code is in the “robust” package.)

When the program runs, the values of the several components are successively quantified in one spherical shell after the other (from previous four outer). The computation is done for all components along the inclination at a radius, and along the radius (with all inclination values) from outside to inside step by step until geometric limits are reached. As well, we get at first the values as expected from the initial conditions. That runs so a while. Suddenly, the values grow out all limits. The computation is broken when geometric limits are reached. The step count (iterations) until the first geometric limit of a metrical component (where the absolute value of the *physical* component becomes 1) depends on the inserted values of the integration constants. A relatively coarse grid reflects in strong dependences, however, the relevant values of the integration constants are imprecise. Computations with finer grid lead to smaller contrast of the step counts, but the values are more precise. As well, we get correct relevant values of the integration constants (with maximal step counts), when the geometric limit appears at the conjectural particle radius.

In order to see integration constants leading to maximal step counts, lots of tests were done with parameters more and less deviating from references. Output is mentioned number of steps. The (small) differences of the step numbers correlate with the known quantities of particles. As well, the correlations became highly significant when the raster distances were the same tangentially as well as radially ($dr = r \, d\theta$) just at the conjectural particle radius.

Fig.1 shows tests around the free electron with spin, charge, and magnetic momentum as parameters. As well, the step count above a “threshold” is depicted with a more or less fat “point”. The magnetic momentum of the electron arises specially sharply, for the dominant influence.

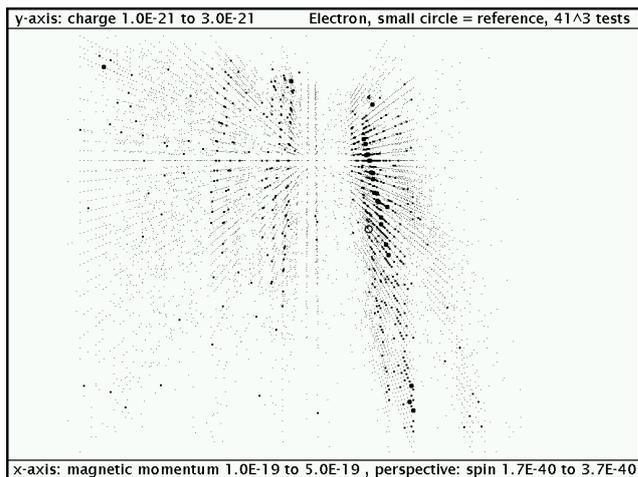


Figure 1: Tests around the electron. Parameters: Spin, charge, magn.momentum

3 How masses emerge

Similar results are to reach with the Helium nucleus, Fig.2, and also with the Oxygen nucleus [10], with mass and charge as parameters. (Spin and magnetic momentum are here zero.) The fact, that one can see the masses of proton and deuteron in Fig. 2, led to following idea :

The influence of mass to metrics prevails in a certain distance from the conjectural particle respectively nucleus radius. It proves to be possible to set the remaining parameters to zero. Fig.3 and 4 show related tests, with possible assignment of tops in the figures to nuclei.

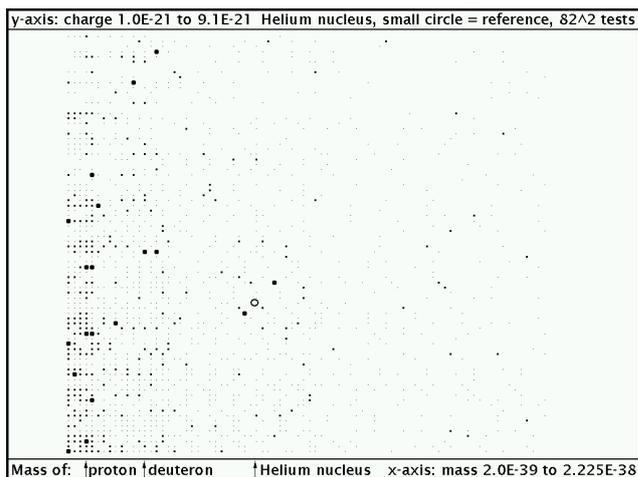


Figure 2: Tests around the Helium nucleus. Parameters: Mass and charge

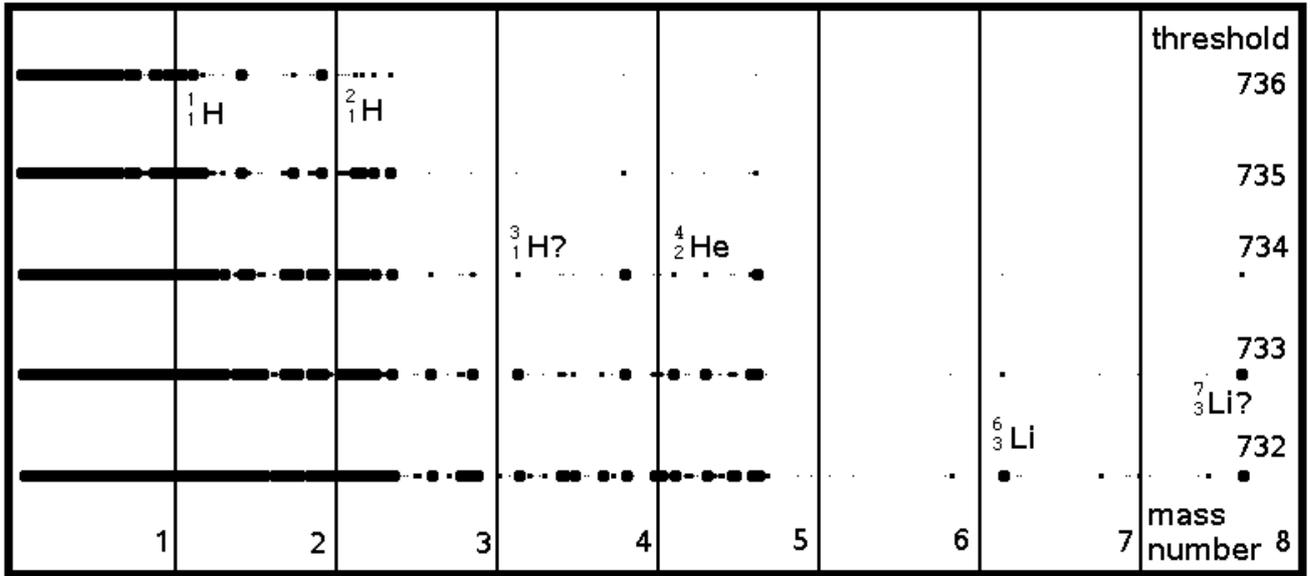


Figure 3: Tests for nuclei with mass numbers up to 8. Initial radius 4, 400 values, 4 times piled (1600 tests)

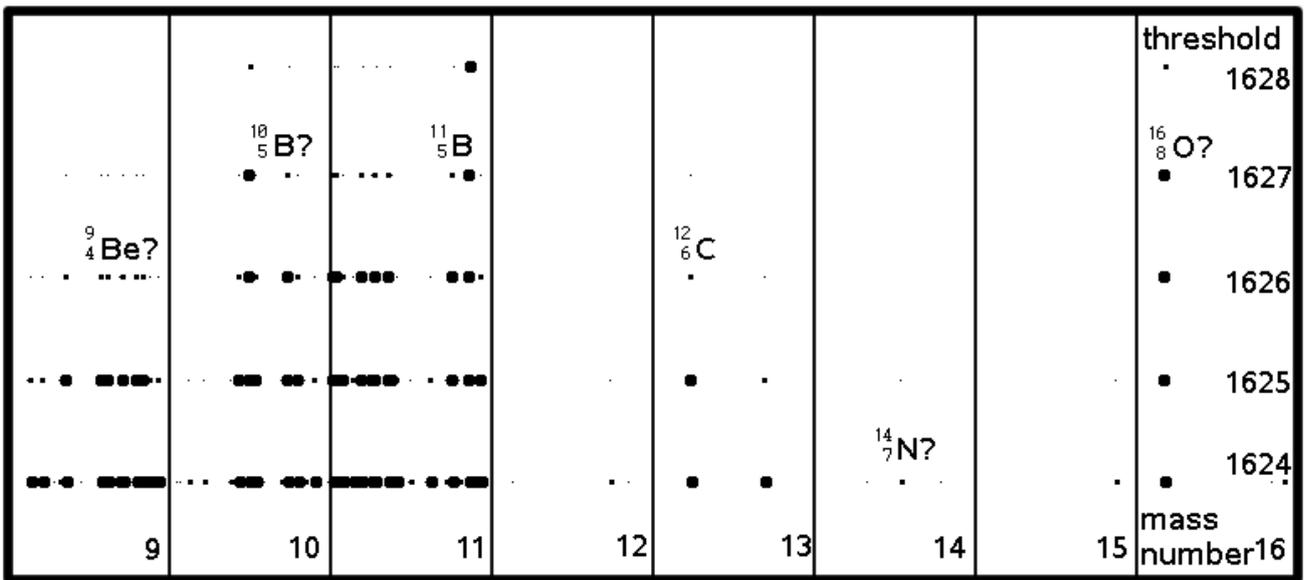


Figure 4: Tests for nuclei with mass numbers from 8 to 16. Initial radius 5, 400 values, 5 times piled (2000 tests)

It was necessary in the tests according to Fig. 3,4 to “pile up” the data. For it, several test series with *slightly* different parameters (mostly initial radius) have been done, and the related step counts (the output) have been added. So the “noise” from rounding errors is successively suppressed. With 80 bit floating point registers, the rounding error is in the 20th decimal. As well, the relative deviation of difference quotients from related differential quotients *in the first step* is roughly 10^{-20} – that is the limit, where one can see at all the influence of chaos. Consequently, simulations with 64 bit (double) lead to nothing.

It must be remarked that there is a limit to quantum models. A geometric theory of fields (General Relativity including classical electrodynamics without sources, see Sec.1) takes particles, nuclei, atoms, &c. as discrete solutions of the Einstein-Maxwell equations. So, only particles can be simulated, which can exist out of a nucleus respectively atom. The simulation is impossible with quarks and bosons with strong and weak interaction as well as the Higgs boson.

Addendum

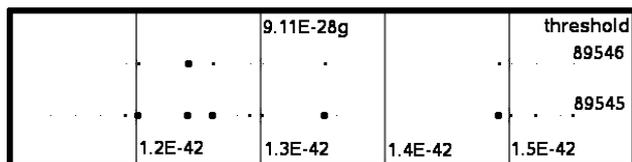


Figure 5: Tests for the free electron. Initial radius 400, 51 values, 9 times piled (459 tests)

It is fundamentally possible to deduce the masses of all free particles, if they are stable to some extent. Since the electron mass is relatively small, one needs an initial radius of ca 4×10^{-13} m, in order to be able to neglect the influence of spin, charge, magnetic momentum to some extent, see Fig. 5. The step maximum (piled) appears at -5% from experimental value. But a certain symmetry axis in the figure meets the experimental value fairly correctly.

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