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Algorithm of Nature

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Abstract

Numerical simulations of elementary gravitation and electromagnetic fields are done with an amazingly simple algorithm. But this algorithm renders nature correctly. As well, the material world is revealed to be completely Riemannian-geometrical without exception. Mathematics is based on the Geometric theorie of fields, which refers to Einstein and Rainich. The correctness of the theory is manifested in it that known particles appear as discrete solutions of geometric field equations. The results involve new understanding of mathematical principles.

Keywords: *Numerical simulations, Algorithm, Geometric field theory.*

1 Introduction

[1]

Physicists commonly believe in four "forces", if not more. Author's experience of life consists in only two, namely gravitation and electromagnetism. Other "forces" are tied to specific models introduced to save the energy balance of the model. Is a model, that needs hidden forces or virtual particles for the energy balance, viable at all ?

The geometric view provides consistent energy balance without need to invent additional terms, let alone inconsistent models. It is based on General relativity [2]. The obstacle consisted in the lack of an algorithm, which is suited to naturally solve geometric field equations. This gap is filled.

2 Mathematics

The complete theory is based on the tensor equations [7]

$$R_{ik} + 3K_\circ \; g_{ik} = \kappa \; (\frac{1}{4} \; g_{ik} F_{ab} F^{ab} - F_{ia} F_k{}^a) \qquad , \quad (1)$$

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

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

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. $K_\circ$ is the constant part of the Riemannian curvatures [3], and meaningful for global solutions, e.g. [8]. κ is Einstein's gravitation constant.

Einstein quoted these equations already in his Four lectures [2]. As well, any sources (distributed charges and currents) in Eq. (3) would not meet the Bianchi identities [3]. The Bianchi identities are mathematical expression of force equilibrium respectively energy conservation. We shall see that sources are replaced by integration constants in the solutions [6]. Mass, spin, charge, magnetic momentum are first integration constants.

Analytic solutions (different from zero) based on integration constants lead commonly to singularities. Physicists use to see this as an obstacle. However, numerical simulations according to Eq. (1),(3),(4) result in another picture. [6]

If we express the field tensor by a vector potential

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

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

The geometry of fields is constituted in [6, 7]. 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 [4, 5] knew the geometry of electromagnetism. This fact seems to be not omnipresent. The borderline case of electromagnetic waves (light &c.) can be understood from Maxwell's theory alone [9].

The geometric equations do *not* define causality, because causality is not a geometric category. Any dialectic philosophy is not sufficient to understand this. Smarandache provides an approach to describe this issue with his "Neutrosophics" [10, 11]. It meets the fact that the geometric equations yield only 10 independent equations for 14 components g_{ik}, A_i , considering the special role of time.

[1] This paper is an enhanced version of a contribution to ICMSA-2011, New Delhi [1].

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3 Numerical Simulations

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

$$x^1 = r \ , \ x^2 = \vartheta \ , \ x^3 = \varphi \ , \ x^4 = \mathrm{j}ct \ ,$$

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

Now, we give

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

and

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

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

The integration constants to insert in the initial conditions result from development of series. The first integration constants are

$$c_1 = -\frac{\kappa \ m}{4\pi} \Longrightarrow \frac{\kappa \ m}{4\pi} \tag{7}$$

(mass),

$$c_2 = \mathrm{j}\ \frac{\kappa \ s}{4\pi c} \Longrightarrow \frac{\kappa \ s}{4\pi c} \tag{8}$$

(spin),

$$c_3 = -\mathrm{j}\ \frac{\mu_\circ{}^{\frac{1}{2}} \ Q}{4\pi} \Longrightarrow \frac{\kappa^{\frac{1}{2}} \ \mu_\circ{}^{\frac{1}{2}} \ Q}{4\pi} \tag{9}$$

(charge), and

$$c_4 = -\frac{\varepsilon_\circ{}^{\frac{1}{2}} \ M}{4\pi} \Longrightarrow \frac{\kappa^{\frac{1}{2}} \ \varepsilon_\circ{}^{\frac{1}{2}} \ M}{4\pi} \tag{10}$$

(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 $T = \frac{\pi}{2} - \vartheta$

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

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

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

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

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

$$A_3 = r \cos^2 T \ \frac{c_4}{r^2} \ , \tag{16}$$

$$A_4 = \frac{c_3}{r} \ . \tag{17}$$

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 in the modified initial conditions, see program in the "robust" package (available at author's current website). Table 1 shows examples, used as reference values.

	Proton	Free electron
c_1	2.48×10^{-39}	1.30×10^{-42}
c_2	2.60×10^{-40}	2.60×10^{-40}
c_3	1.95×10^{-21}	1.95×10^{-21}
c_4	5.7×10^{-22}	3.7×10^{-19}
	Deuteron	Helium nucl.
c_1	4.96×10^{-39}	9.9×10^{-39}
c_2	5.2×10^{-40}	0
c_3	1.95×10^{-21}	3.9×10^{-21}
c_4	1.76×10^{-22}	0

Table 1

As well, the higher momenta are missing for lack of knowledge, what affects 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 *any* potential quantity)

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$$\left.\frac{\partial f}{\partial r}\right|_{r_m,T_n} = \frac{f_{m-1,n} - f_{m+1,n}}{2\ \mathsf{d}r}\ , \tag{18}$$

$$\left.\frac{\partial^2 f}{\partial r^2}\right|_{r_m,T_n} = \frac{f_{m+2,n} - 2f_{m,n} + f_{m-2,n}}{(2\ \mathsf{d}r)^2}\ , \tag{19}$$

$$\left.\frac{\partial f}{\partial T}\right|_{r_m,T_n} = \frac{f_{m,n+1} - f_{m,n-1}}{2\ \mathsf{d}T}\ , \tag{20}$$

$$\left.\frac{\partial^2 f}{\partial T^2}\right|_{r_m,T_n} = \frac{f_{m,n+1} - 2f_{m,n} + f_{m,n-1}}{\mathsf{d}T^2}\ . \tag{21}$$

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). 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 tendency is following: If we halve the differences, we get noway double number of steps (until appearance of this effect) but clearly less. That would mean: There are no solutions at all. But there are exceptions for certain values of the integration constants ! – That has to do with chaos, and it is the job of mathematicians to class this.

In order to see these exceptions, lots of tests were done with parameters more and less deviating from the references (Table 1). Output is mentioned number of steps. The differences of the step numbers are small but 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 ($\mathsf{d}r = r\ \mathsf{d}\vartheta$) just at the conjectural particle radius.

Fig. 1 and 2 show visualized results from these tests. The number of steps above a "threshold" is depicted with a more or less fat "point".

4 Conclusion

We can understand nature completely Riemannian-geometrically as far as we own to the fact that nature follows neither analytic solutions nor models invented to explain special effects. A natural solution of partial differential equations goes always from finite differences. That leads to a new understanding of partial differential equations, and the Leibniz calculus in general: The transition to differences towards zero may be done first at the end of all calculations. But Konrad Zuse [12] asked the question if this transition is possible at all. However, a discretized space-time suffers from the problem of preferred coordinates. These were not verified in nature.

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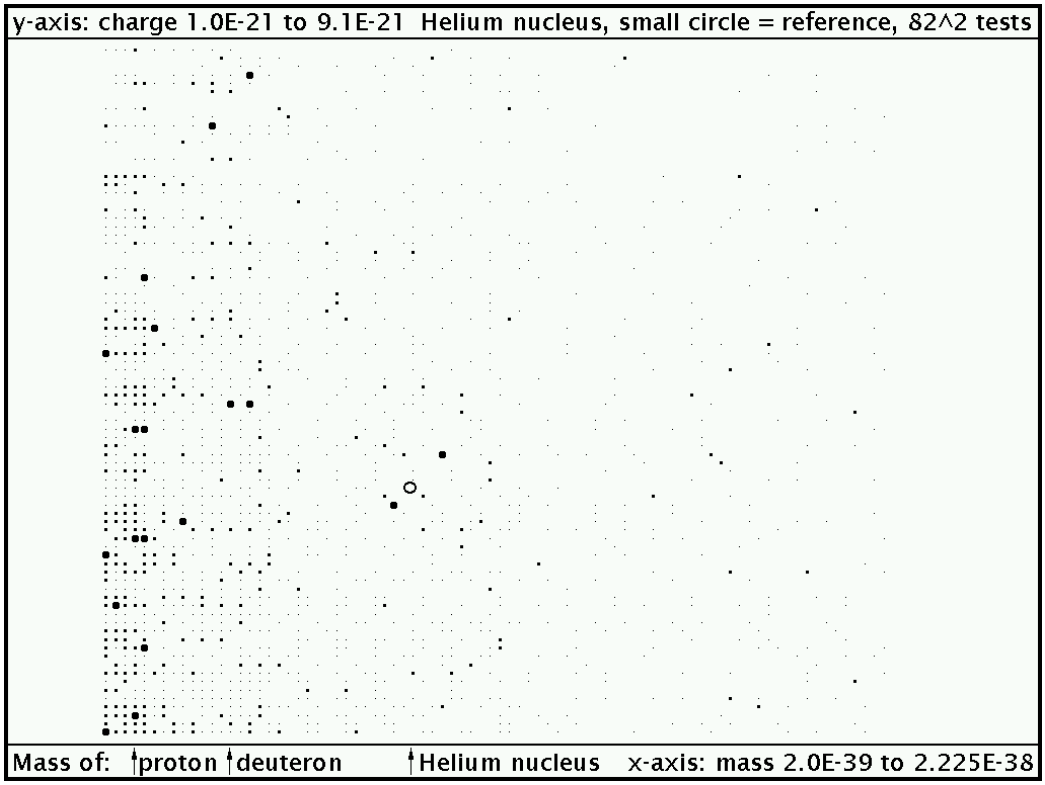

Figure 1: Tests with parameters around the Helium nucleus

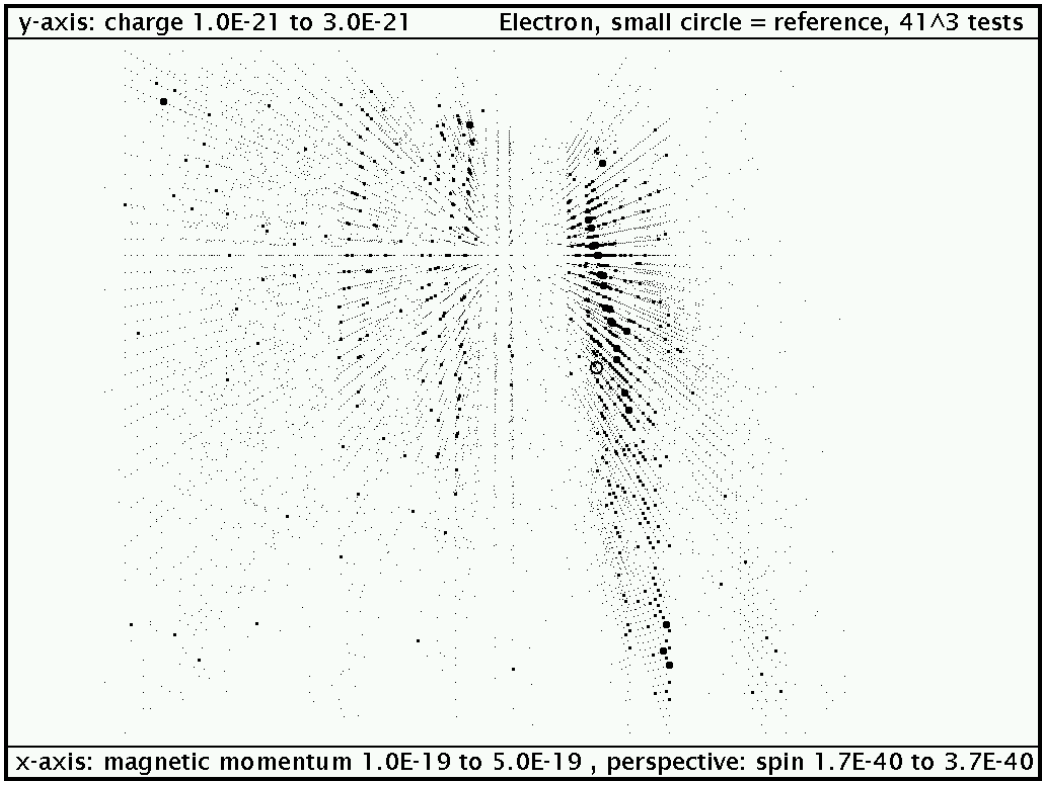

Figure 2: Tests with parameters around the electron