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A THEORY OF SUPERLUMINAL PARTICLES WITH REAL MASS CONTENT IN AGREEMENT WITH EXPERIMENTAL EVIDENCE OF A NEW TYPE OF QUANTIZED MATTER

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The recently discovered new form of quantized, cold dark matter with quanta as integer multiples of the Planck mass which shows a "field-like" structure, complementary to the usual "point-like" structure of normal elementary particles can in a consistent way be described by a theory of superluminal particles (tachyons) with real mass content and well determined causality as two-dimensional relativistic disturbances of real space-time as seen by an observer in real space-time. Transformation equations for coordinates, velocities, momenta and energies of superluminal reference frames are given on the basis of an orthogonal four-dimensional space-time geometry for free quantized tachyons which is introduced as being superimposed on real space-time. The set of velocities $\{v\}$ as seen from an observer in real space-time is $\{c<|v|\leq\infty\}$ for free tachyons with rest masses different from zero, and $\{0\leq|v|<c\}$ for similar tachyons which are absorbed by normal matter, thus including the special theory of relativity as a special case. The theory also predicts, in principle agreement with observations, a form of free tachyonic matter with rest mass zero which moves with the speed of light, and when absorbed with $\{0\leq|v|<c\}$.

1 Introduction

Recent studies on the conservation of mass in chemical reactions within thermodynamically closed systems revealed the existence of time-dependent, long-range gravitational anomalies[1,2]. Under the basic assumption that the law of conservation of energy still can be applied to the systems tested, these results verify the existence of a so far unknown form of matter on laboratory scales. This new type of "cold", i.e. low energetic, "dark", i.e. non-visible, matter is not composed of normal bradyonic matter, i.e. quarks, protons, neutrons or nuclei of chemical elements, and electrons, and can thus be termed "non-bradyonic" matter. Opposite to the "point-like" structure of normal elementary particles, the new form of matter exhibits a spatially extended "field-like" structure ranging over distances of centimeters or more[1,2]. In the following, a theoretical description is deduced from special theory of relativity which is based on the assumed existence of superluminal particles (tachyons, moving with $|u|\geq c$) with real mass content which is, in principle, consistent with the experimental observations of the new type of matter.

2 Results and Conclusions

Tachyons have been predicted from special theory of relativity by introducing an imaginary rest mass $M_0=i\cdot m_0$ into the Lorentz transformations for particles with rest masses $m_0>0$, moving with subluminal velocities, i.e. $|v|<c$, where M_0 represents the "rest mass" of a tachyon[3,4]. In principle, this implies, however, the assumption that the predicted tachyons move in the usual space-time continuum, i.e. $D_1^{4n}=\{x_1, y_1, z_1, t_1\}$, as normal "point-like" particles do. Experimental searches for such particles have so far not been successful [4]. On the basic assumption of a four-dimensional space-time geometry, i.e. $D_2^{4o}=\{x_2, y_2/i, z_2/i, t_2\}$, which is introduced as being orthogonally superimposed on real space-time D_1^{4n} and with x_2 and t_2 as two further real coordinates which extend D_1^{4n} to D_1^{6n} as well as the two imaginary coordinates y_2/i and z_2/i a new form of matter is predicted. Free particles with rest mass $M_0>0$ and velocity $|u|>c$, exhibiting real mass content, real energy E and real momentum p, according to (1), with $\beta=\sqrt{u^2/c^2-1}$, ($E=p\cdot c$ for $M_0=0$ and $u=c$), should be observable in D_1^{4n} as two-dimensional relativistic disturbances of D_1^{4n}. Similar to the Lorentz transformations of special theory of relativity, for any two space-time events equations (2) give the coordinate transformations, (3) the velocity transformations, (4) and (5) the transformation equations for momenta and energies and (6) equations for "space expansion" and "time contraction". For a space-time interval ΔS (7) follows, and for the four momentum vector (8) holds.

$$M = M_0/\beta; \quad E = M\cdot c^2; \quad p = M\cdot u; \quad c^2\cdot p^2 - E^2 = M_0^2\cdot c^4 \tag{1}$$

$$x_2 = (x_1 - u\cdot t_1)/\beta; \quad y_2 = y_1/i; \quad z_2 = z_1/i; \quad t_2 = (t_1 - (u/c^2)\cdot x_1)/\beta \tag{2}$$

$$v_{x2} = (v_{x1}-u)/(1-(u/c^2)\cdot v_{x1}); \quad v_{\alpha 2} = v_{\alpha 1}\cdot\beta/(i\cdot(1-(u/c^2)\cdot v_{x1})); \quad \alpha = y, z \tag{3}$$

$$p_{x2} = (p_{x1} - (u/c^2)\cdot E_1)/\beta; \quad p_{y2} = p_{y1}/i; \quad p_{z2} = p_{z1}/i \tag{4}$$

$$E_2 = (E_1 - u\cdot p_{x1})/\beta \tag{5}$$

$$L = L_0\cdot\beta; \quad T = T_0/\beta \tag{6}$$

$$\Delta S^2 = -(x_2^2 + y_2^2 + z_2^2 - c^2\cdot t_2^2) = +(x_1^2 + y_1^2 + z_1^2 + c^2\cdot t_1^2) \tag{7}$$

$$-(p_{x2}^2 + p_{y2}^2 + p_{z2}^2 - (E_2/c)^2) = +(p_{x1}^2 + p_{y1}^2 + p_{z1}^2 - (E_1/c)^2) \tag{8}$$

In a Minkowski diagram, normal matter with $m_0\geq 0$ moves in a time-like region ($\Delta S^2<0$ with $0\leq|v|\leq c$) while the superimposed free tachyons with $M_0\geq 0$ appear to move in a space-like region ($\Delta S^2>0$ with $c\leq|u|\leq\infty$). It follows, in

addition, that both, normal matter and tachyonic matter, do not violate causality. The relative velocity of a tachyonic reference frame in D_2^{4o} in view of an observer in D_1^{4n} is given by $dE/dp=d\sqrt{c^2 \cdot p^2 - M_0^2 \cdot c^4}/dp=u$. Furthermore, the velocity of a superluminal particle with $v_2=p_2/M=\sqrt{p_{x2}^2+p_{y2}^2+p_{z2}^2}/M$ and $M_0>0$ as observed in D_1^{4n} follows by substitution of p_{x2}, p_{y2}, and p_{z2} by the transformation equations of (4). This leads with $v_1=p_1/M$ to a tachyonic velocity v_1 as observable in D_1^{4n} as given by (9).

$$v_1 = \sqrt{(v_{x1}-u)^2/\beta^2 - (v_{y1}^2+v_{z1}^2)}; \quad M_0>0; \quad and \quad 0 \leq |\, v_1 \,| < c \qquad (9)$$

Even though for tachyons ($|u|>c$, $M_0>0$) with $v_{x1}\neq 0$, $v_{y1}\neq 0$, and $v_{z1}\neq 0$, the observable velocity v_1 in D_1^{4n} can take any value in the interval $0\leq|v_1|<c$. While free tachyons, as mentioned, show always velocities u as observed in D_1^{4n} as $c\leq|u|\leq\infty$, this result implies that the form of tachyons with $M_0>0$ as described here can, when in any way associated to or absorbed by normal matter, in principle, exhibit relative velocities v_r for an observer in D_1^{4n} according to $0\leq|v_r|<c$. The fact that the center of mass of a tachyon which is stationarily bound to a bradyonic system of normal matter may be even at rest ($v_1=0$) while the velocity components of the tachyon, i.e. v_{x1}, v_{y1}, and v_{z1}, may at the same time be different from zero, even with velocities $|u|>c$, includes that also the x-, y-, and z-components of the tachyon must not be constant but must be varying in time, indicating that such tachyons are characterized by an internal, spatially extended "field-like" structure as observed in D_1^{4n}. Besides a gravitational interaction of tachyons with normal matter due to their real mass content also scattering and/or absorption processes can be expected, due to the fact that tachyons can be seen as two-dimensional space-time disturbances in D_1^{4n} at locations in D_1^{4n} where D_1^{4n} itself shows maximum space-time disturbances, i.e. at phase boundaries of normal matter. This implies that tachyons should be in a permanent absorption and emission equilibrium with normal matter. Furthermore, it can be shown that the mass of a system of normal matter shows stepwise positive or negative changes if it absorbs or emtis one or more tachyons with real mass content. In the case of an absorption process the translational velocity $|u_t|>c$ of the tachyon must change into an internal rotational velocity $|u_r|>c$, and vice versa for emission processes. This set of results fits, in principle, well to the observed results of the described [1,2] new form of matter as an ubiquitous "weighable ether" [2].

The existence of the new form of matter rises questions about the completeness of modern physics. Because the universe is understood as having emerged from the Planck scale, the observed quanta of the new form of matter as integer multiples of the Planck mass may lead to the necessity to introduce in

modern quantum field theories "between" the virtual vacuum ground states and the real level of subluminal, normal matter a real, superluminal tachyonic field as an ubiquitous background radiation and as the origin of matter as well as of space-time. Any elementary particle should thus have a spatially extended, non-local, real "Planck component" from which it is generated and annihilated in the form of *zitterberwegung* with the speed of light, a process which leads automatically to the principles of quantum mechanics and special theory of relativity. - The exchange of momentum between normal matter and tachyonic quanta of an isotropic background radiation with real mass content (as verified, in principle, by the results of the reported test during a partially visible sun eclipse [2]) can be seen as the basic mechanism for gravity, see "hypothesis of absorption" [5], while Einstein's general relativity should describe the selfconsistent gravitational interaction of these quanta with itself as the four-dimensional space-time continuum. This ubiquitous background radiation may be identical to Bohm's level of implicate order - the Veda - as a real level of non-local, hidden variables and correlations such as observed, for example, in the EPR-experiments, in the Pauli principle or in the double slit experiment of quantum mechanics. The fact that usually only D_1^{4n} (and not D_1^{6n}) is open to direct experience may rather be a result of the sensory conditioning of the mind than reflect physical reality.

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