Experimental Evidence of a New Type of Quantized Matter with Quanta as Integer Multiples of the Planck Mass

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This paper reports the results of careful and systematic experiments to check the law of conservation of mass in a special chemical reaction in which metallic silver is generated from two homogeneous solutions. 50 ml glass flasks, closed gas-tight, were used as thermodynamically closed systems. Modern, sensitive and automatic weighing techniques were applied, including intensive artifact research, to compare the mass of test and reference flasks with and without the chemical reaction. The results obtained reveal reproducible, highly significant gravitational irregularities compared to baseline pretests without chemical reaction, during which the law of conservation of mass was confirmed within experimental error. Mass deviations were observed of >2000 µg which are up to a factor of 420 times larger than the 95% confidence interval $c_T = \pm 5$ µg of the baseline pretest and which are by a factor of 10^{15} larger than expected relativistic mass effects. The detected gravitational anomalies indicate an apparent violation of the law of conservation of mass in this special chemical reaction. If the validity of the law of conservation of energy is assumed, the apparent violations of the law of conservation of mass indicate the existence of a previously unknown form of low energetic (*i.e.*, cold), and non-visible (*i.e.*, dark) matter which has been detected by the systems. Stepwise mass changes indicate the existence of free quanta of the new form of matter with a real mass content as integer multiples of the Planck mass, *i.e.* $n\cdot(hc/(2\pi G))^{0.5}$ or $n\cdot 21.7$ µg, with $n = 1, 2, 3$ ec., and in general, according to $\Sigma_S\{n_S\cdot(hSc/(2\pi G))^{0.5}\}$, with $S = 1/2, 1, 3/2, 2, 5/2, 3, 7/2$ and $n_S = 1, 2, 3$ ec. which were absorbed and emitted by the detectors. Consequences in general, and special consequences for the basic mechanism of gravity and the existence of a weighable ether as a ubiquitous background radiation are discussed.

Introduction

The conservation of mass in chemical reactions is a basic law in chemistry. Although relativistic effects are in principle known in chemistry[1], [2] the mass changes predicted by the special theory of relativity during chemical reactions in isothermal systems are below the range of today's experimental detectability. In the exothermic reaction described in the following, the temperature first rose adiabatically by about $\Delta T = +0.2$ K. This corresponded, with a sample mass of $m = 0.1$ kg and a maximal heat capacity of $C_p = 4.3\cdot 10^{-3}$ J/(kg·K), to a relativistic mass loss (Δm) into the surroundings during the following thermal equilibration, of less than $\Delta m = -mC_p\Delta T/c^2 = -9.4\cdot 10^{-22}$ kg or $-9.4\cdot 10^{-13}$ µg. This small relativistic mass loss cannot be detected by present-day weighing systems.

The most precise experimental tests of the law of conservation of mass are the studies of Landolt[3], [4], [5], [6] and others[7], [8] between 1890 and 1913. Landolt tested the law of conservation of mass in 10 different types of chemical reactions. If for two subsequent experiments using the same chemical reaction, no pre-post weight difference was larger than ± 0.03 mg, *i.e.* the maximum experimental error, the experiment was not repeated. Most types of chemical reactions tested by Landolt (8 out of 10) fell into this category. Assuming constancy of the terrestrial gravitation during an experiment, Landolt concluded constancy of mass for chemical reactions in general.

However, for the formation of metallic silver from homogeneous solutions, and for reactions involving dissolved and solid forms of iodine, the majority of the repeatedly performed experiments showed mass differences in the pre-post comparison far larger than the experimental error of ±0.03 mg, including values as high as +0.105 mg, –0.127 mg and –0.199 mg. These differences were up to a factor of 6 larger than the experimental error. By averaging out such independently obtained results and by subjective assessments, however, Landolt discarded these deviations after Einstein's publication of his special theory of relativity in 1905. In the following, results which have already been obtained[9] are verified in a set of further experiments, applying again the reaction[10]

$$\underset{\text{Glucose}}{(C_5H_{11}O_5)\text{–}CHO} + \underset{\text{Tollen's reagent}}{2[Ag(NH_3)_2]OH} \longrightarrow (C_5H_{11}O_5)\text{–}COOH + 2Ag + 4NH_3 + H_2O \qquad (1)$$

which leads to a perfect internal silverplating of all the test flasks. The results obtained previously indicate the existence of a so far unknown form of matter.[9] This "cold" (*i.e.* low energetic) and "dark" (*i.e.* non-visible) matter has other properties than the proton, the neutron or nuclei of the chemical elements or leptons such as the electron which together are usually called "bradyonic" matter. The new form of matter may be termed "non-bradyonic matter". The experiments described in the following, further support these conclusions and indicate, in addition, that free quanta of non-bradyonic matter exist whose mass is in the order of magnitude of the Planck mass $M_P = 21.77\ \mu g$.

Experimental

The same experimental method was followed as described in earlier work[9], and the same electronic comparator from Sartorius AG (type C 1000) was used which exhibits a reproducibility of $c_R = \pm\, 0.002$ mg and where the total load can be varied stepwise from 100, to 200, to 500 or 1000 g ±0.1 g, respectively, *cf.* pages 243 through 249[9] The weighing compartment of the comparator contained four weighing positions, N, P_1, P_2, and P_3 for the measurement of four weights, w_N, w_1, w_2, and w_3, respectively. The positions P_1 and P_3 were reserved for test samples, and the positions N and P_2 for reference samples. The two test samples and the two reference samples, respectively, were in their weight, volume and external shape as identical as possible. The weights of the four samples were determined automatically in the sequence (w_N, w_1, w_N), (w_N, w_2, w_N), and (w_N, w_3, w_N). For further evaluation, averages w_{N1}, w_{N2}, and w_{N3} of the w_N-values prior to and after each value of w_1, w_2, and w_3 were taken and the weight differences $d_1(i) = w_1(i) - w_{N1}(i)$, $d_2(i) = w_2(i) - w_{N2}(i)$, and $d_3(i) = w_3(i) - w_{N3}(i)$ were printed for each weighing cycle i together with the individual w-values. In the process of further evalutation, after selecting a "starting weighing cycle" (after reaching thermal equilibrium of the weighing system), resulting in $d_1(st) = w_1(st) - w_{N1}(st)$, $d_2(st) = w_2(st) - w_{N2}(st)$, and $d_3(st) = w_3(st) - w_{N3}(st)$, the measuring effects $M_1(i)$ and $M_2(i)$ for the two test samples at positions P_3 and P_1 were determined as defined by

$$M_1(i) = [d_3(i) - d_2(i)] - [d_3(st) - d_2(st)] = [d_3(i) - d_3(st)] - [d_2(i) - d_2(st)] \qquad (2a)$$

$$M_2(i) = [d_1(i) - d_2(i)] - [d_1(st) - d_2(st)] = [d_1(i) - d_1(st)] - [d_2(i) - d_2(st)] \qquad (2b)$$

and were plotted against i. By this evaluation of $M_1(i)$ and $M_2(i)$, the various fluctuations of the mass differences in the weighing compartment of the comparator due to minute external changes in at-

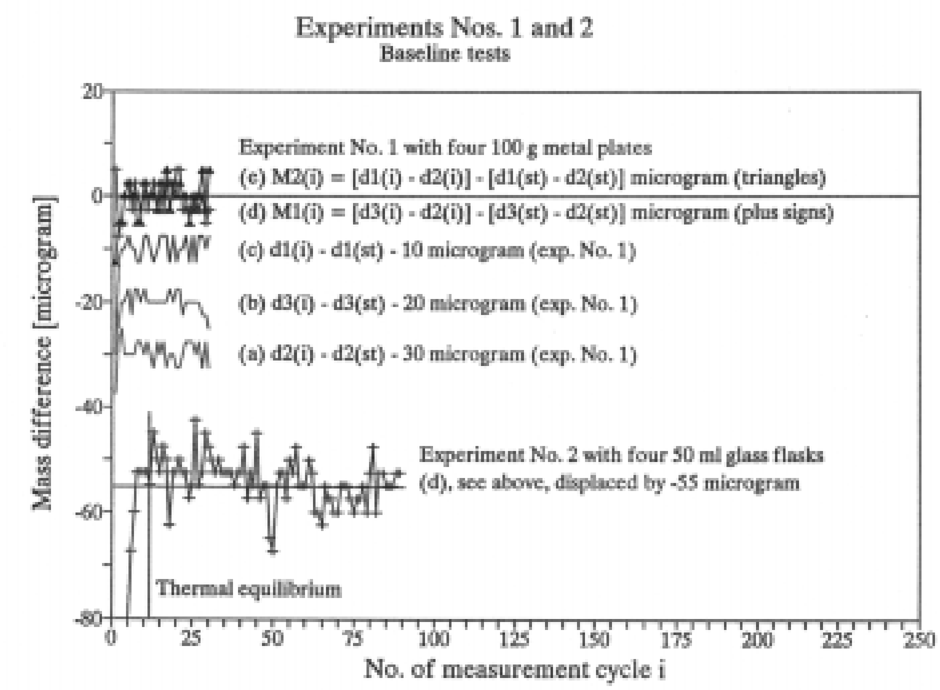

Fig. 1: The perfect baseline results of experiment No. 1 with four identical 100 g metal plates yield a reproducibility of the comparator of $c_T = \pm 1$ µg ($0 < i < 50$ is equal to 38 *h*, 38 min). The results of experiment No. 2 (for the experimental set-up of all experiments see Table 1) depict the baseline from $i = 0$ through 90 of an experiment with silverplated 50 ml test flasks at positions P_3 (measuring effects $M_1(i)$ according to (2a), marked by plus signs, as in all other figures) and P_1 (measuring effects $M_2(i)$ according to (2b), marked by triangles, as in all other figures) against similar reference flasks at positions N and P_2 which were partially filled with water ($c_T = \pm 1.1$ µg, $0 < i < 50$ is equal to 33 *h*, 8 min). Significant deviations from the baseline (which are not shown above) were observed in experiment No. 2 after 4 days, 0 h, 34 min, starting from $M_1(225) = 0$ µg to $M_1(245) = +100$ µg, following a continuous linear increase. Similar results were obtained in this test for $M_2(i)$. As in all other experiments, in a comparator test the measuring effects $M_1(i)$ and $M_2(i)$ of the two test flasks at positions P_3 and P_1 showed similar but not identical results with regard to (a) the times needed to reach significant deviations from the baselines after start-up of the test and (b) the general patterns of the set of measuring effects of $M_1(i)$ and $M_2(i)$ (smooth drifts and/or stepwise mass changes in the case of significant deviations from the baselines). Further experimental details of the experiments are given in Table 1. (Original numbering of the experiments was Nos. 8 and 16.)

mospheric conditions are eliminated. For conditions under which the law of conservation of mass is fulfilled $M_j(i) = 0 \pm c_T$ µg, $j = 1$, and 2, should thus result, according to (2a,b), c_T being the statistical error of the test results. Any measuring effects $|M_j(i)| >> |c_T|$ µg thus should indicate statistically significant deviations from the law of conservation of mass on a non-relativistic laboratory scale.

Experimental Results

Baseline pretests: Fig. 1 shows the baseline test results of experiments Nos. 1 (4 identical 100 g metal weights, see Table 1) and 2 (4 identical 50 ml glass flasks, see Table 1). The straight and horizontal lines obtained for the “measuring effects” M_j(i) of the “test flasks” at positions P_1 and P_3

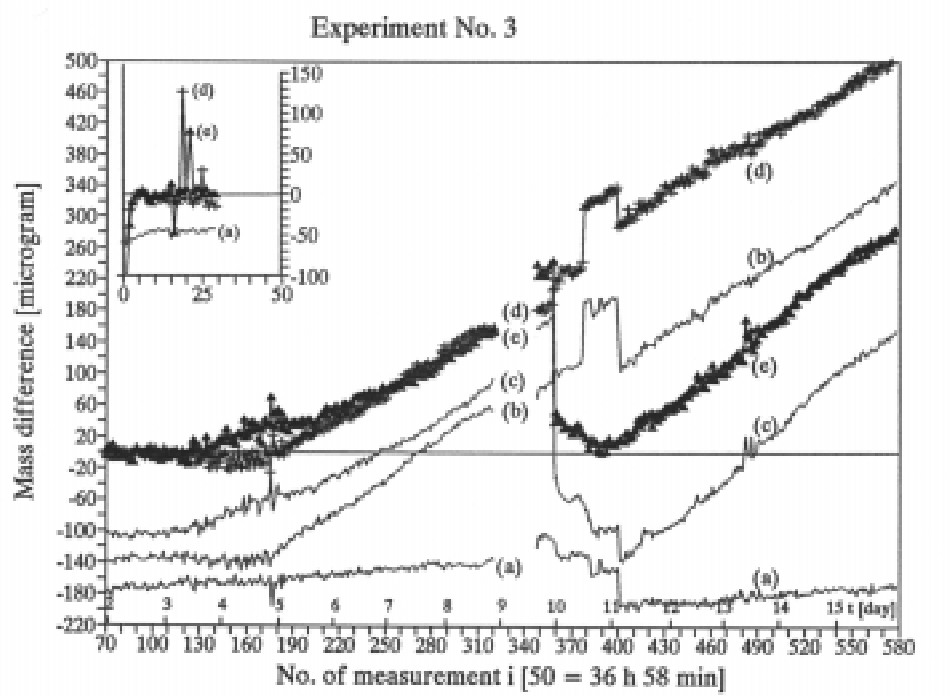

Fig. 2: Results of experiment No. 3 using 2 pre-used, internally silverplated 50 ml glass flasks. Curves (a), (b), and (d) are similar to those in Fig. 1 and are displaced by –175 µg, –140 µg, and –100 µg to avoid superposition with curves (*c*) and (d) which depict the final measuring effects $M_j(i)$ of the two test flasks j = 1, and 2. Highly significant mass anomalies $M(i)$ >> 5 µg were observed. Besides a contiuous drift of the measuring effects $M_1(i)$ and $M_2(i)$ of the two test flasks at postions P_3 and P_1 to final values of up to +500 µg, spontaneous stepwise mass changes can be observed. A statistical analysis reveals that the stepwise mass changes are integer multiples of a basic mass in the order of magnitude of the so-called Planck mass M_P = 21.77 µg, indicating that free quanta of the new form of matter $M_Q = nM_P$ (n = 1, 2, 3 ec.) exist which have been detected by the test flasks. (Original numbering was No. 15.). The artifact research described in Table 2 as well as the obtained perfect baseline pre-tests and post-tests has shown that known classical effects can be excluded in view of an explanation of the "measuring effects" of $|M_j(i)|$ >> 5 µg observed after starting the chemical reaction[9].

compared to the "references" at positions N and P_2 during these baseline pretests, as depicted in Fig. 1, indicate:

(1) The reproducibility of the comparator with metal plates is $c_T = st/n^{0.5} = \pm 1$ µg ($s = \pm 2.8$ µg, n = 29, t = 2.05). With 50 ml glass flasks it is $c_T = \pm 1.1$ µg ($s = \pm 3.9$ µg, n = 79, t = 1.99).

(2) The law of conservation of mass is, within the error of the experimentation method used, confirmed during the baseline pretests. The baseline pretests thus confirm that experimental artifacts which could interfere with the weighing technique cannot be used to explain the following test results, see also Table 2 for further artifact research, *cf.*[9].

Experimental results with significant gravitational anomalies: As depicted in Fig. 1, with the silverplated test flasks of experiment No. 2 a perfect baseline was observed for the interval $0 < i = 225$, *i.e.* $M(i < 225) = 0 \pm 1.1$ µg (95% confidence interval), over a period of 4 days, 0 h, 34 min. After this period a continuous linear deviation of the measuring effect from the baseline was

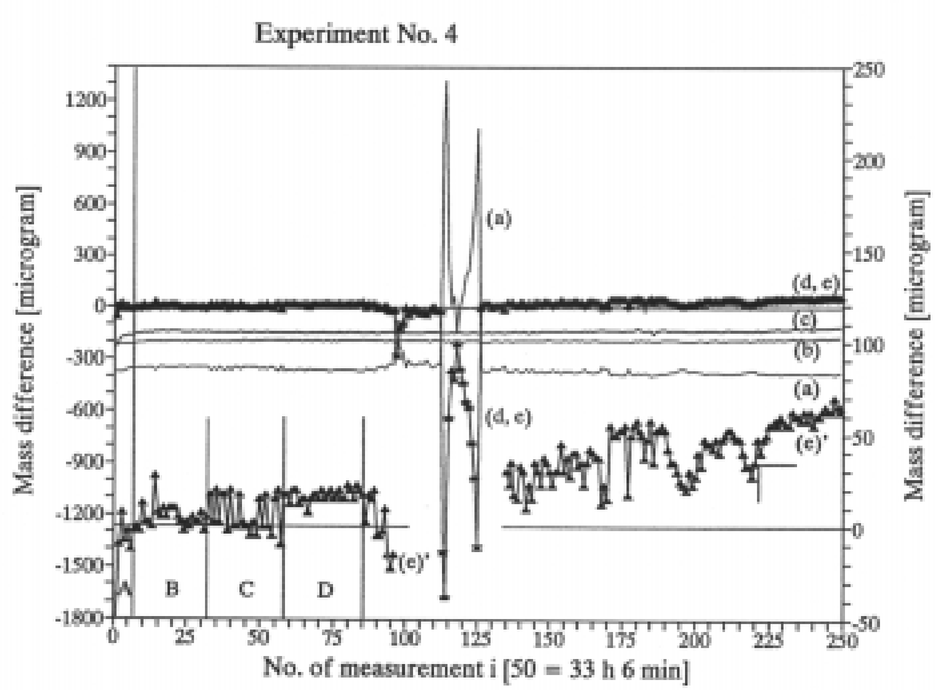

Fig. 3: Results of experiment No. 4 using 4 pre-used, internally silverplated glass flasks, see Table 1. This experiment is a repetition of experiment No. 3 with the same experimental set-up as experiments Nos. 2 and 3. Each flask contained about 30 ml of glass balls each of 0.95 cm diameter to increase the internal surface area and was mounted in a stainless steel frame with a total weight of the final sample of 200 ± 0.7 g. The steel frame was made of a 4 mm thick circular bottom plate (diameter 4.5 cm), with three 7.5 cm diameter high and 0.6 mm thick bolts which were welded in an upright position at the circumference of the bottom plate at three positions which formed an isosceles triangle. The same frames were used in experiment No. 2. The lower curve (e)' refers to the right-hand ordinate and gives curve (e), *i.e.* the measuring effect $M_2(i)$ of the test flask at position P_1, in higher resolution. Period A is needed to reach thermal equilibrium. The difference between the average measurement effects $M_2(i)$ of periods B (except the outlier at $i = 14$) and D reveals again, as the stepwise mass changes in Fig. 2, a stepwise mass change in the order of magnitude of the Planck mass $M_P = 21.7$ µg. In period C the values systematically alternate between the two plateau values of periods B and D (as in case of the outlier at position $i = 14$). This indicates that the relaxation time for the absorption of free quanta of the new form of matter by the test samples is in the order of magnitude of up to 20 minutes. The negative values of the measuring effects $M_j(113 < i < 127)$ are caused by the positive change of the reference line (a), *i.e.* term $d_2(i)$ of (2a) and (2b), due to the absorption of free quanta of the new form of matter by the water filling of the reference sample of position P_2, *cf.*[9] (Original numbering was No. 14.)

detected, up to $M_j(245) = +100$ µg for both test flasks, as compared to the two reference flasks. In a manually operated experiment performed within a period of 3 to 4 days, doing measurements twice per day, in the morning and in the evening, such a deviation would not have been detected. This may explain why from 135 manually operated experiments reported in [9] only 96 showed significant mass deviations. In all automatically run tests using the comparator, all silverplated test samples showed highly significant gravitational anomalies—sometimes, however, after up to 5 days, see below. Thus, for a systematic reproducibility of the described gravitational irregularities experiments must be performed with a comparator. It can be expected that with such automatic weighing condi-

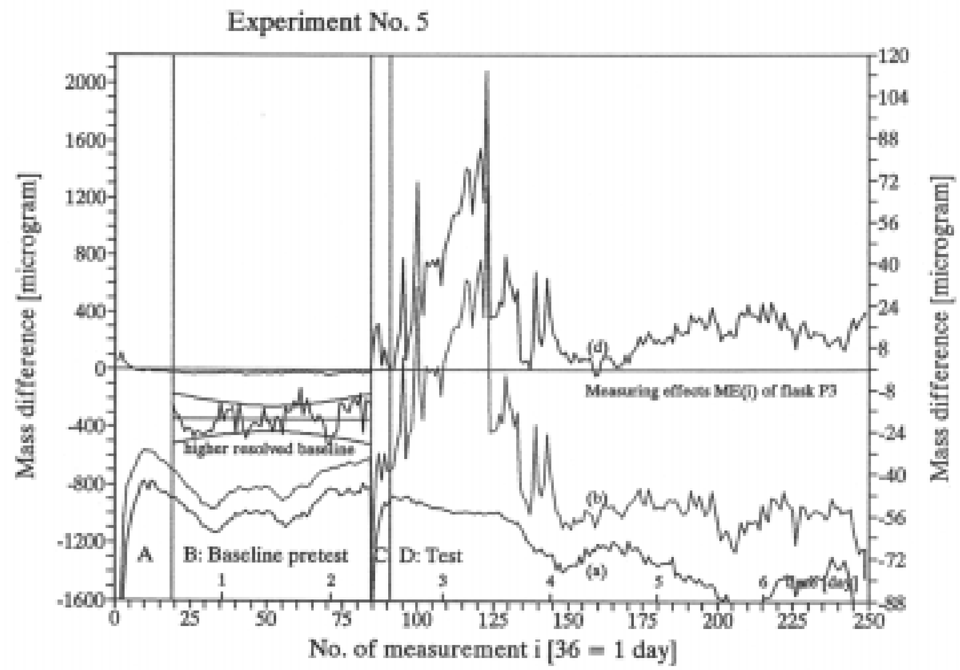

Fig. 4: Results of experiment No. 5 using 4 pre-used, internally silverplated glass flasks with flat bottom. Each flask contained about 25 ml of Raschig rings (small pieces of glass pipes, 8 x 8 mm) and 0.2 g of a finely ground chemically inert crystalline material (diamond dust) to increase the internal surface area and weighed after preparation 100.025 ± 0.04 g. The flasks were mounted in a standing, upright position, without stainless steel frame, in the compartment of the comparator. Periods A and C were needed for the system to reach thermal equilibrium of the system. Period B depicts a baseline pretest without chemical reaction while storing the two chemical components in two different compartments in the test flasks, period D shows the actual test after silverplating the internal surface of the test flask at position P_3 after the reaction. (As starting value $i = st = 19$, *i.e.* the 19th measuring cycle was chosen, after reaching thermal equilibrium of the weighing system. Due to individual fluctuations of the weights of each measuring cycle, this value was not identical with the zero line of the graph in the above figure which could have been achieved, however, by taking the average of the baseline as starting value). The test flask at position P_1 showed a similar behaviour[9] The enlarged baseline with the two 95 % confidence margins refers to the right hand ordinate and is displaced by –17 µg. (Original numbering was No. 12.)

tions and weighing cycles of 20 to 30 minutes intervals over total test periods of 6 to 30 days a 100% reproduction rate of the described effects can be achieved.

Fig. 2 gives the results of experiment No. 3, a repetition, in principle, of experiment No. 2, see Table 1, except that the test flasks were pre-used in another similar experiment and contained about 30 ml of glass balls each with a diameter of about 0.95 cm. As in experiment No. 2, both test flasks showed significant mass deviations, starting after about 3 to 4 days. In addition to the smooth linear increase of the measuring effects, stepwise mass changes $M_j >> 5$ µg can be seen. Similar stepwise mass changes occured at the beginning of the test, see inset in Fig. 2.

Fig. 3 depicts the results of experiment No. 4, a repetition, in principle, of experiment No. 3, see Table 1. As in the former experiment, both test flasks showed significant mass deviations, starting after about 3 to 4 days. As in experiment No. 3, highly significant stepwise mass changes were detected besides smooth drifts of the measuring effects $M_j(i)$, both to positive and negative values.

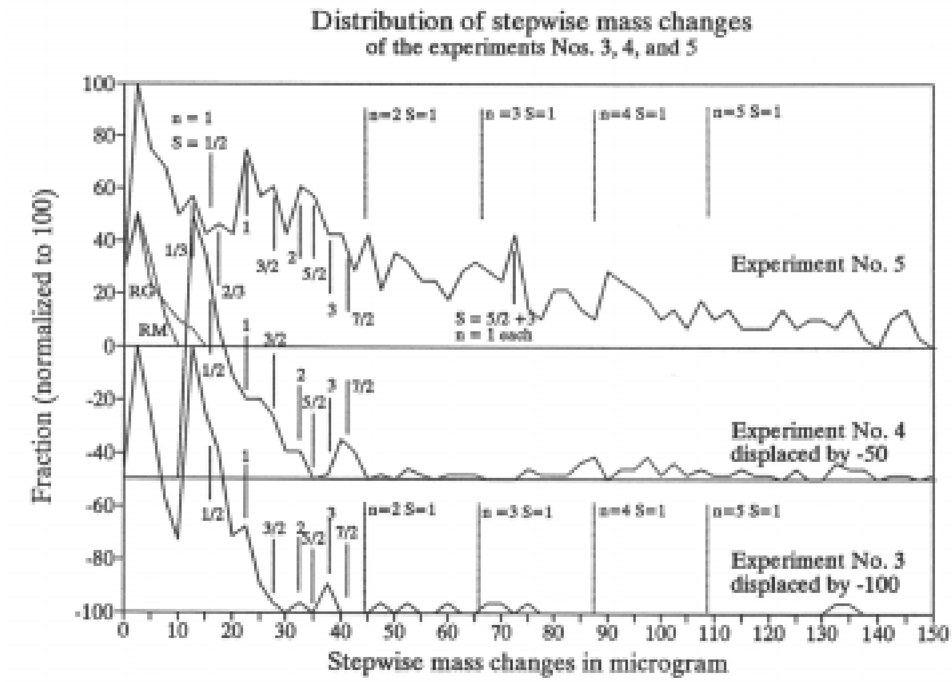

Fig. 5: Distribution of the fraction of stepwise mass changes $M_j(i)$, j = 1, and 2, within the intervals of $|2.5|$ n_Q µg (n_Q = 1, 2, 3 ...up to 64) for experiments Nos. 3, 4, and 5. The maxima are normalized to 100. The ordinate values of experiments Nos. 3 and 4 are multiplied by a factor of 9.6 for x-values $M_j(i) \geq 12.5$ µg, and for experiment No. 4 the results for $M_j(i) \leq 12.5$ µg are omitted but are running similar to those of experiment No. 3. RM and RG characterize similar distributions for four identical metal weights (RM) and glass flasks (RG) from baseline tests, for comparison. The distribution maxima of the stepwise measuring effects $M_j(i)$ in the range of 15 µg $\leq M_j(i) \leq$ 32.5 µg are consistent with a modified Planck mass $M_P(S) = (Shc/(2\pi G))^{0.5}$, with S = 1/2, 1, 3/2, and 2. The corresponding values $M_P(S)$ coincide with the first four maxima of the distribution:

$M_P(S)$ in µg:	12.6	15.4	17.8	21.8	26.7	30.8	34.4	37.7	40.7
S:	1/3	1/2	2/3	1.0	3/2	2.0	5/2	3.0	7/2

The maximum at $M_j(i)$ = 44 µg coincides with $2M_P(S = 1) = 2 \cdot 21.77 = 43.54$ µg. Similarly, the maximum at $M_j(i)$ = 72.5 µg coincides with $M_P(S = 5/2) + M_P(S = 3) = 34.4 + 37.7 = 72.1$ µg. This indicates that also larger values of S than S = 2, such as S = 5/2 and S = 3, seem to be possible, describing the mass content of free quanta of the new form of matter. S may be interpreted as a spin-quantum number which modifies not only the Planck mass but also the Planck length and the Planck time which raises questions about the absolute constancy of the Planck scale.

Fig. 4 gives the results of yet another test, experiment No. 5. In this experiment the silverplating was not done before the test flasks were sealed gas-tight. Rather, the homogeneous glucose solution and the Tollen's reagent of reaction equation (1) were stored inside the gas-tightly closed test samples in separate compartments, see Table 1. Furthermore, the internal surface area in the two test flasks was increased by adding chemically inert materials, about 25 ml of small glass pipes (8×8 mm Raschig rings) and about 0.2 g of diamond dust, finely ground to micrometer-sized particles. Before mixing the two stored solutions, a baseline pretest was done, see period B in Fig. 4 ($18 < i < 85$, 22 h). As in all other tests, 3 to 6 hours were needed, in Fig. 4 period A ($0 < i < 19$, 6 h), to reach thermal equilibrium of the weighing system after mounting the samples in the compartment of the comparator and after closing the comparator as well as an additional insulation box around the weighing system, made of wood. The higher resolved baseline is displaced in Fig. 4 by –18 µg to avoid superposition with curve (d) and refers to the right-hand ordinate.

After measuring cycle $i = 84$, the four flasks were mounted in a frame outside the comparator and tilted slowly, so that the two chemical components in the test flasks were mixed, see Table 1. Due to the exothermic chemical formation of metallic silver, the temperature rose within about 6 minutes to the maximum value (as revealed by independent calorimetric measurements). After remounting the four samples in the compartment of the comparator the test was continued after an interruption of about 10 minutes. Period C ($84 < i < 93$, 2 h, 40 min) in Fig. 4 again indicates the numbers of measuring cycles which were required to reach thermal equilibrium after start-up of the system.

While in experiments Nos. 2 (no internal filling with chemically inert materials), 3, and 4 (both with glassball filling) significant deviations from the law of conservation of mass occurred after about 3 to 4 days, in experiment No. 5 (with Raschig rings and inert micrometer-sized particles) highly significant deviations, as compared to the baseline pretest, were observed, even without sophisticated statistical analysis, within a few minutes after starting the chemical reaction for both test flasks. Deviations of >2000 µg were observed, which are up to a factor of 420 times larger than the 95% confidence interval c_T of the baseline pretest, *i.e.* $c_T = \pm 5$ µg, and which are by a factor of $2000/9.4 \cdot 10^{-13}$ = about 10^{15} larger than expected relativistic mass effects, see the introduction where the relativistic mass loss for this experiment was determined.

The perfect baseline in this test ($M(18 < i < 85) = -26.106$ µg ±5 µg, 95% confidence interval) again reveals that external fluctuations in atmospheric conditions cannot be used to explain the highly significant mass deviations of the test results so far described. That the mean value of the baseline must not be identical to zero is explained in the legend of Fig. 4.

It can be assumed that the increase in the measuring effects $M(i)$ with regard to the size as well as to the shortening of the time needed to reach significant measuring effects was due to the increase in the internal surface area as well as to the change in size distribution of the added inert material. This is a major argument that the postulated quanta of non-bradyonic matter[9] (see below), absorbed by the test samples, associate at newly formed phase borders with normal matter by a form of physical interaction which was termed as form-specific ("topological")[9].

Fig. 5 shows the number of spontaneous stepwise mass changes of $\Delta M(\Delta i{=}1)$ of the test flasks of experiment No. 5 which occurred with $\Delta M(\Delta i) = \|2.5|\, n_Q$ ($n_Q = 1, 2, 3...$) µg, in comparison to similar distributions of experiments Nos. 3 and 4. The maxima of the distributions were normalized to 100. The maximum of the distribution of experiment No. 5 is at $\Delta M(\Delta i) = |22.5|$ µg, with a mean of +22.9 µg ± 0.77 µg (95% confidence interval, $s = \pm 3.42$ µg, $n = 79$, $t = 1.99$, including the values of the interval |17.5| µg to |27.5| µg). By taking into account similar stepwise mass changes of experiments Nos. 3 (see Fig. 2) and 4 (see Fig. 3) a mean value M_Q was obtained according to (3). Further evaluation of the original data reveals that the majority of the observed stepwise mass changes can be explained within experimental error by absorption or emission of $n_Q = \pm 1, \pm 2, \pm 3$ ... quanta of the proposed non-bradyonic matter with the positive mass $+M_Q$. The confidence interval of M_Q includes the Planck mass M_P[11], see (4a) of the Planck scale (4a, b, and *c*), where $h = 6.626 \cdot 10^{-34}$ J·s is Planck's quantum of action, $c = 2.997 \cdot 10^{8}$ m/s is the velocity of light, and $G = 6.672 \cdot 10^{-11}$ N·m^2/kg^2 is Newton's gravitational constant.

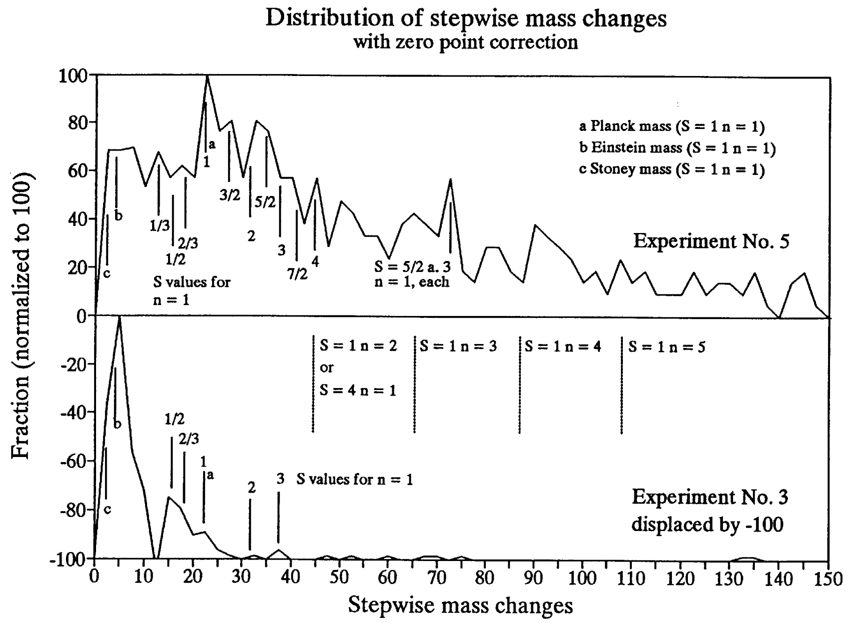

Fig. 5a: Distribution curves of the stepwise mass changes of experiments Nos. 3 and 5 from Fig. 5 after correction of natural zero-point fluctuations. To achieve this, the distribution curve for glass flasks (RG) from Fig. 5 without measuring effects $|M_j(i)| >> |c_T|$ µg, $j = 1$, and 2, according to (2a, and b), was removed from the upper and lower curve of Fig. 5 to show the net-effects. This was done by, first normalizing the ordniate value of RG for $M = 0$ µg to the corresponding values of the upper and lower distribution curves in Fig. 5, and second, by substracting the resulting RG-curves from these distributions. In Fig. 5a again the values of various masses from Natural Units are given. In addition to the "Planck scale", see (4), and "Stoney scale", see (8), two more basic masses, (9a) and (10a), can be formulated by substitution of Newton's gravitational constant, G, in (4) and (8) by Einstein's gravitational constant $\kappa = 8\pi G/c^4 = 2.076\cdot10^{-43}$ s^2/(m·kg) resulting in the two additional Natural Units which may be termed "Einstein scale", (9a, b, and *c*), and "Stoney-Einstein scale", (10a, b, and *c*):

$$M_E = (hS/(2\pi\kappa c^3))^{0.5} = M_P/(8\pi)^{0.5} = 4.34\cdot10^{-9}\cdot S^{0.5}\text{ kg} = 4.34\cdot S^{0.5}\ \mu\text{g} \quad (9a)$$

$$L_E = (h\kappa c/(2\pi))^{0.5} = L_P(8\pi)^{0.5} = 8.10\cdot10^{-35}\cdot S^{0.5}\text{ m} \quad (9b)$$

$$T_E = (h\kappa/(2\pi c))^{0.5} = T_P(8\pi)^{0.5} = 2.70\cdot10^{-43}\cdot S^{0.5}\text{ s} \quad (9c)$$

$$M_{SE} = (e^2S/(4\pi\varepsilon_0\kappa c^4))^{0.5} = M_S/(8\pi)^{0.5} = M_P\cdot(\alpha/(8\pi))^{0.5} = 3.7\cdot10^{-10}\cdot S^{0.5}\text{ kg} = 0.37\cdot S^{0.5}\ \mu\text{g} \quad (10a)$$

$$L_{SE} = (\kappa e^2S/(4\pi\varepsilon_0))^{0.5} = L_S(8\pi)^{0.5} = L_P(8\pi\alpha)^{0.5} = 6.92\cdot10^{-36}\cdot S^{0.5}\text{ m} \quad (10b)$$

$$T_{SE} = (\kappa e^2S/(4\pi\varepsilon_0 c^2))^{0.5} = T_S(8\pi)^{0.5} = T_P(8\pi\alpha)^{0.5} = 2.31\cdot10^{-44}\cdot S^{0.5}\text{ s} \quad (10c)$$

The mass of the "Stoney-Einstein scale", *i.e.* $M_{SE} = 0.37\cdot S^{0.5}$ µg, cannot be resolved by the balance used, due to the reproducibility c_R of only $c_R = \pm2$ µg, but may, due to a possible ongoing absorptive accumulation of such quanta by the test samples, allow an explanation for the observed "continuous" drifts of the measuring effects, see for example Fig. 2. By refinement of the reproducibility of the balance used this hypothetical statement is open to further experimental verification or falsification. *S* values as given in Fig 5.

$$M_Q = +21.3\ \mu\text{g} \pm 1.42\ \mu\text{g (95\% confidence interval}, s = \pm 4.20\ \mu\text{g}, n = 36, t = 2.03) \quad (3)$$

$$M_P = (hc/(2\pi G))^{0.5} = +2.177\cdot10^{-8}\text{ kg or } M_P = +21.77\ \mu\text{g} \quad (4a)$$

$$L_P = (hG/(2\pi c^3))^{0.5} = +1.616\cdot10^{-35}\text{ m} \quad (4b)$$

$$T_P = (h\cdot G/(2\pi c^5))^{0.5} = +5.590\cdot10^{-44}\text{ s} \quad (4c)$$

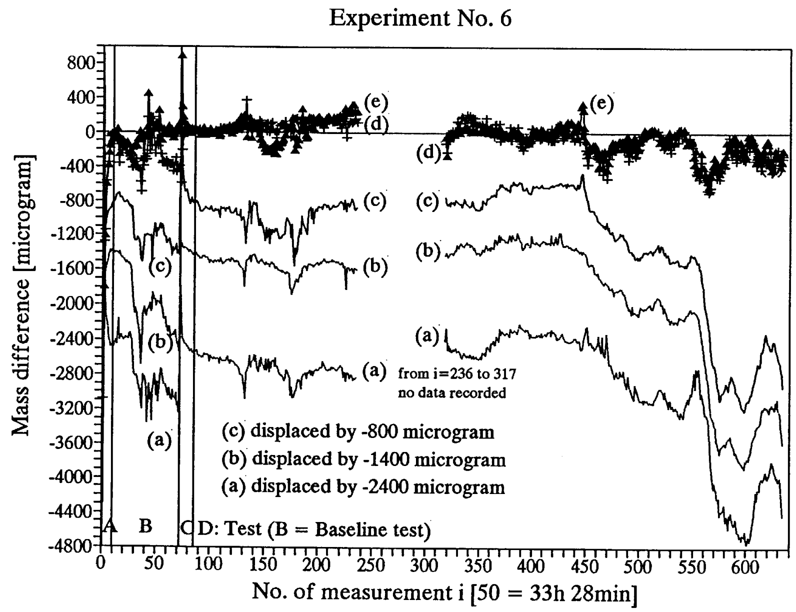

Fig. 6: Results of experiment No. 6, a repetition of experiment No. 5 with the same experimental set-up and using the same flasks. After thermal equilibration ($0 < i < 10$, period A), in the baseline pretest ($9 < i < 72$, period B, without generation of metallic silver) highly significant measuring effects $|M(i)| >> 5$ µg were already observed (*i.e.* $M(i = 36)_{max} = -695$ µg, see curve (d)) without starting the chemical reaction, while in experiment No. 5 a perfect baseline was obtained under the same conditions. After starting the chemical reaction at the beginning of period C, and after reaching thermal equilibrium again at the end of period C, in period D highly significant deviations from the law of conservation of mass were observed, eventhough the general patterns were different as compared to those of experiment No. 5, see Fig. 4. These findings may indicate that the glass of pre-used flasks shows a kind of a "memory effect". Further details are given in the text (Original numbering was No. 13.)

As has already been demonstrated[9], the emission of quanta of non-bradyonic matter from systems is induced after their absorption by the detectors if the samples are subjected to mechanical shocks. Thus the observed spontaneous emissions in the experiments described, see Figs. 2, 3, and especially 4, may be caused by the unavoidable mechanical movements and resulting mechanical shocks of the samples in the compartment of the comparator by the mechanical lifting and turning device.

In Fig. 5 in the distributions of experiments Nos. 3 and 4, the maximum is at $\Delta M(\Delta i) = |15|$ µg, a value which is statistically significantly different from 22.9 µg ± 0.77 µg, *i.e.* the position of the distribution maximum in experiment No. 5. This indicates that free quanta of non-bradyonic matter not only can show masses M_Q, according to (3), but also of M_{Q1}, according to (5). The value of (5) follows from the 27 stepwise mass changes of experiments Nos. 3 and 4 with $\Delta M(\Delta i) = |12.5|$ µg, the 51 stepwise mass changes with $\Delta M(\Delta i) = |15|$ µg, and the 39 stepwise mass changes with $\Delta M(\Delta i) = |17.5|$ µg. M_{Q1} of (5) is in agreement with a modified Planck mass M_{P1}, according to (6), in which the factor 2π in the denominator of (4) has been changed to 4π.

$$M_{Q1} = +15.3 \text{ µg} \pm 0.34 \text{ µg (95\% confidence interval}, s = \pm 1.87 \text{ µg}, n = 117, t = 1.98) \quad (5)$$

$$M_{P1} = (h \cdot c/(4\pi G))^{0.5} = +1.539 \cdot 10^{-8} \text{ kg or } M_{P1} = +15.39 \text{ µg} \quad (6)$$

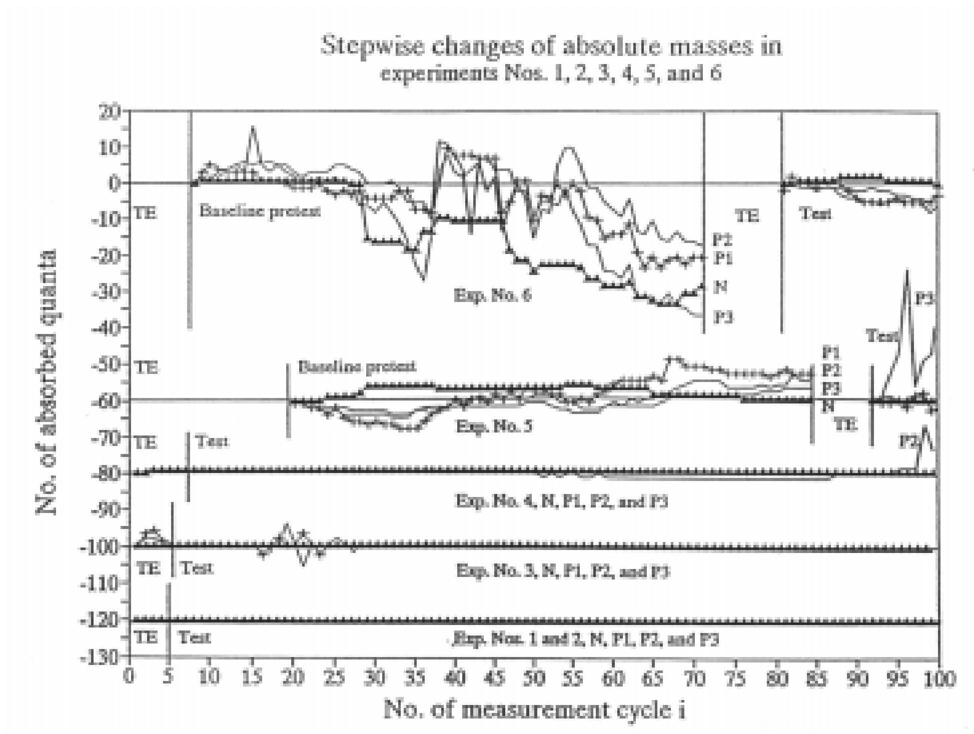

Fig. 7: Stepwise changes of the mass of the samples at positions N, P_1, P_2, and P_3 from experiments Nos. 1, 2, 3, 4, 5, and 6, indicated by the number of absorbed quanta per sample for the first $i = 100$ measuring cycles. TE indicates periods needed to reach thermal equilibrium. In experiments Nos. 1 and 2, *i.e.* with metal samples and so far unused flasks, no stepwise mass changes were observed at all. In experiments Nos. 3 and 4, with flasks which were pre-used in silverplating experiments, only a few stepwise mass changes were seen. In experiments Nos. 5 and especially 6 with test flasks which were used and cleaned several times before in similar tests very significant stepwise mass changes occurred even during the baseline pretests. The test flasks of experiment No. 6 had been pre-used with finely ground inert particles (diamond powder) and reveal in the baseline test obviously the existence of a "memory effect" of the glass flasks. The negative mass values in experiment No. 6 are consistent with the interpretation that quanta of the new form of matter exist with negative mass and are absorbed by the pre-used test flasks. Further details are given in the text.

A detailed analysis of the results of Fig. 5 reveals that, in general, stepwise mass changes $M_Q(S)$ can be observed which can be described by single quanta of the new type of matter, according to (7), and furthermore as associates of quanta of the new form of matter, either by integer multiples of $M_Q(nS, S)$, according to (7a), or linear combinations of integer multiples of $M_Q(n_S, S)$, according to (7b).

$$M_Q(S) = (hcS/(2\pi G))^{0.5} \text{ with } S = 1/3, 2/3, 1/2, 1, 3/2, 2, 5/2, 3, \text{ and } 7/2 \quad (7)$$

$$M_Q(n_S, S) = n_S \cdot (hSc/(2\pi G))^{0.5}, \text{ with } S = 1/3, 1/2, 2/3, 1, 3/2, 2, 5/2, 3, 7/2 \; n_S = 1, 2, 3... \quad (7a)$$

$$M_Q(n_S, S) = \Sigma_S\{n_S \cdot (hSc/(2\pi G))^{0.5}\}, \text{ with } S \text{ and } n_S \text{ as in (7a)} \quad (7b)$$

Similarly, the peaks at about 2 µg can be described by a "Stoney mass" (8a) from a "Stoney scale"[12] (8a, b, and *c*), another possibilty to formulate Natural Units, again modified by the quantum number S (with S as above), by using the elementary charge $e = 1.60219 \cdot 10^{-19}$ C and

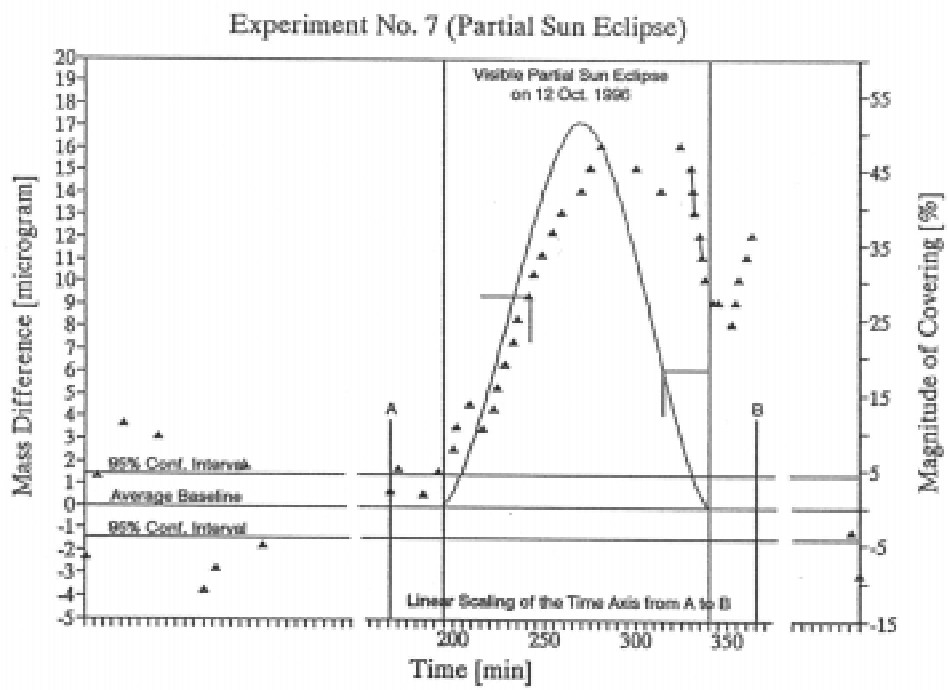

Fig. 8: Mass changes of an internally silverplated test sample compared to a reference sample filled with water during the partial sun eclipse on 12 October 1996 which was visible at the test site in Germany. From A to B the time axis follows a continuous linear scaling while the 8 baseline values prior to the sun eclipse were taken a few days before and the last 2 after the eclipse more than 12 hours later. The dotted curve refers to the right-hand ordinate and gives the magnitude of covering of the eclipse. The eclipse started at 3:15 pm and ended at 5:41 pm. (Original numbering was No. 17)

$4\pi\varepsilon_0 = 1.11265\cdot10^{-10}$ $C^2/(J\cdot m)$ instead of Planck's quantum of action h and with Sommerfeld's fine structure constant $\alpha = e^2/(4\pi\varepsilon_0 ch/(2\pi)) = 1/137.034 = 7.297\cdot10^{-3}$.

$$M_{St}(S) = (e^2S/(4\pi\varepsilon_0 G))^{0.5} = M_P\alpha^{0.5} = 1.85\cdot10^{-9}\cdot S^{0.5} \text{ kg or } 1.85\cdot S^{0.5}\ \mu\text{g} \tag{8a}$$

$$L_{St}(S) = (e^2GS/(4\pi\varepsilon_0 c^4))^{0.5} = L_P\alpha^{0.5} = 1.37\cdot10^{-36}\cdot S^{0.5} \text{ m} \tag{8b}$$

$$T_{St}(S) = (e^2GS/(4\pi\varepsilon_0 c^6))^{0.5} = T_P\alpha^{0.5} = 4.58\cdot10^{-45}\cdot S^{0.5} \text{ s} \tag{8c}$$

A detailed statistical analysis of the linear increase of the measuring effects, see for example the results in Fig. 2 of experiment No. 3, furthermore reveals that such deviations are due to the absorption of the new form of matter with a mass content of ≤ 2 µg. A comparison of the the distribution curves marked with RM (4 identical 100 g metal weights) and RG (4 identical 50 glass flasks, 100 g, closed gas-tight, without silverplating) with the results from experiments Nos. 3, 4, and 5 in Fig. 5 gives support to this result. Furthermore, in Fig. 5a, the distribution curve (RG) for glass flasks without measuring effects $|M_j(i)| >> |c_T|$ µg, $j = 1$, and 2, according to (2a, and b), has been removed from the upper and lower curve of Fig. 5 to show the net-effect of the distributions of step-wise mass changes of experiments Nos. 3 and 5 after correction of natural zero-point fluctuations.

Fig. 6 shows the results of experiment No. 6**,** a repetition of experiment No. 5 with an identical experimental set-up and using the same flasks after cleaning with concentrated nitric acid, distilled water and acetone, and after careful drying, as in other cases where test flasks have been re-used.

The results are significantly different from the results of experiment No. 5, see Fig. 4. As can be seen in Fig. 6, after thermal equilibration ($0 < i < 10$, period A), in the baseline pretest ($9 < i < 72$, period B, without generation of metallic silver) highly significant measuring effects $|M(i)| >> 5$ µg were already observed (*i.e.* $M(i = 36)_{max} = –695$ µg, see curve (d)) while in experiment No. 5 a perfect baseline was obtained which can be reproduced by using un-used glass flasks. This indicates that the glass of pre-used flasks shows a kind of a "memory effect". After the start of the chemical reaction at $i = 72$, see Fig. 6, and the following period C ($71 < i < 80$) which was needed again to reach thermal equilibrium, during the actual test ($79 < i < 636$, period D) maximum measuring effects of $M(i = 564) = –690$ µg were observed after a very smooth start compared to experiment No. 5.

A further analysis of experiments Nos. 1, 2, 3, 4, 5, and 6 is given in Fig. 7. In this figure the stepwise mass changes $n_{QN} = \pm1, \pm2, \pm3$ ..., $n_{QP1} = \pm1, \pm2, \pm3$ ..., $n_{QP2} = \pm1, \pm2, \pm3$ ..., and $n_{QP3} = \pm1, \pm2, \pm3$ ... of the samples at positions N, P_1, P_2, and P_3, *i.e.* not their differences as in the figures discussed above, are shown for the first $i = 100$ measuring cycles. In this analysis only stepwise mass changes in the order of magnitude of $\pm n_Q M_Q$, with M_Q according to (3) and (5) were determined from the mass differences (P_1–N), (P_2–N), and (P_3–N) as well as the $M_j(i)$-measuring effects. This was done in such a way that between several consistent sets of values of n_{QN}, n_{QP1}, n_{QP2}, and n_{QP3} the one with the smallest number of absorption and emission processes was chosen. From the 327 sets studied 325 definite integer sets of n_Q-values were determined. The graphics for experiments Nos. 1, 2, 3, 4, and 5 are displaced in Fig. 7 to negative values parallel to the *x*-axis to avoid superposition.

As can be seen from Fig. 7, in experiments Nos. 1 and 2, *i.e.* with metal samples and so far unused flasks which were not filled with chemically inert materials, no stepwise mass changes were observed at all. In experiments Nos. 3 and 4, with flasks which were pre-used without internal filling, only a few stepwise mass changes were seen. In experiments Nos. 5 and especially 6 with pre-used test flasks—even during the baseline pretests—very significant stepwise mass changes occurred. The test flasks of experiment No. 6 had been pre-used with finely ground inert particles (diamond powder).

During the actual tests of experiments Nos. 4 and 5 the stepwise mass changes are consistent with M_Q of (3) and (5) and $n_Q = \pm1, \pm2, \pm3$ ... (A continuous drift of the measuring effects of the experiments is not reflected in the curves of Fig. 7, as mentioned). In some tests, especially in experiment No. 6, however, sets of values with $M_Q = –21.7$ µg or -15.4 µg, *i.e.* $M_Q < 0$ and $n_Q = \pm1, \pm2, \pm3$ ... were also observed when the curves dropped below the zero line to negative values of the ordinate. The accumulation of such phenomena in experiment No. 6 during the baseline pretest (*i.e.* $9 < i < 72$) is indicative of a memory effect, as mentioned, existing in the pre-used test and even reference flasks and that this memory effect may lead to the absorption of quanta of non-bradyonic matter with *negative mass*, yielding negative measuring effects. Such test results with negative mass deviations have already been described, in principle, by Landolt [3], [4], [5], [6].

Experiment During a Visible Partial Sun Eclipse

Experiment No. 7: During the visible partial sun sclipse on October 12, 1996, the mass of an internally silverplated, spherical glass flask (sealed gas-tight, 38 ml of volume) was compared on an automatic electronic two pan balance (Sartorius M25 D-V, total load 30 g, reproducibility ±1 µg) with a similar glass flask which contained only water and had the same volume, shape and mass (25.7 g). The results of this test[13] are shown in Fig. 8. Before and after the sun eclipse, the mass differences varied around a baseline (which was put to zero) within a 95% confidence interval of

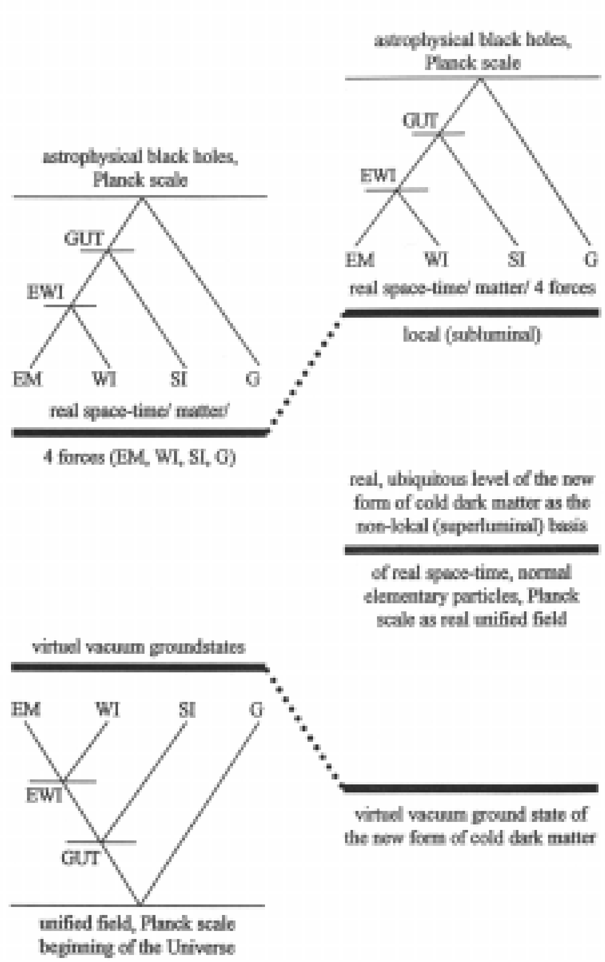

Fig. 9: Schematic energy model of the present scientific paradigm (left hand side) and its modification to a new model of reality (right hand side) after inclusion of the new form of matter as a real, ubiquitous cosmic background radiation which may be the basis of real space-time and the known forms of elementary particles and matter as well as the four forces. In the new model present day high energy paticle physics, quantum field theories as well as unified field theories are exploring the processes which occur when normal matter is absorbed by a black hole. The search for new standard models of elementary particles and of cosmology may lead to models which differ significantly from present day understanding[19].

±1,44 µg ($s = \pm 2.40$ µg, $n = 14$). During the sun eclipse the mass of the silverplated flask increased to a maximum of about 16 µg, following highly significantly the increasing magnitude of coverage of the partial sun eclipse. After passing the maximum deviation, the mass differences dropped down to the baseline value after about 12 hours, exhibiting fluctuations directly after the maximum deviation. Possible consequences regarding the basic mechanism of gravity are discussed in Table 4, points 1 and 2. Also during other eclipses, very strong measuring effects were detected.[9] Compared to the research on the no longer accepted existence of the fifth force[14] which focused on verification of a time-independent, short-range correction of Newton's law of gravity, the experiments described here verify the existence of previously unknown, time-dependent, long-range gravitational effects.

Conclusions

The observed gravitational anomalies suggest, as mentioned, the existence of a previously unknown form of matter with real mass content which is detected in the systems described above.[9] A summary of hypotheses drawn from the experimental observations is given in Table 3. The new form of matter has a "field-like" character[9] with a density of $\rho \leq 10^{-6}$ g/cm^3 and can thus be called "soft matter" (soma), complementary to the "point-like" and high-density structure of normal elementary particles, and can be understood, as discussed, as a type of non-bradyonic, cold dark matter.[15], [16], [17] This implies, in principle, that it can be assumed that the number of atoms in the test and reference systems which determine the “heavy mass”[18] of the systems remains constant, while the total mass may change, thus implying that so-called thermodynamically closed systems, and in principle, the universe of normal matter as a whole, must in a thermodynamic sense be understood as an open systems. It can further be concluded that the new form of “field-like”, cold dark matter forms as a cosmic background radiation an ubiquitous weighable ether, see point 2 of Table 4, which may be the basis of space-time geometry as well as the elementary particles[19],[20],[21], see Fig. 9, and points 7 and 8 of Table 4.

Besides the experimental results described, additional similar experimental findings have been reported in scientific literature which are in principle predictable from the conclusions given in Table 3, especially from the two forms of interaction of the described form of cold, dark matter with normal matter. These reports deal with reproducible irregularities in pendula[22], [23], chemical systems[24], and biochemical systems[25], [26], and give independent support to the above given results.[9] Further similar “non-classical” effects at cosmic[13], macroscopic, and microscopic scales can be predicted from the conclusions of Table 3 in physical, chemical or biochemical systems in connection with the new formation or dissolution of phase borders, implying tests of theoretically predicted but so far not experimentally observed effects, see Table 4.

Acknowledgments

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Table 1: Experimental set-up of the described experiments Nos. 1 through 6.

Experiment No. 1: Baseline pretest using 4 similar, cylindrical test samples, made of stainless steel, diameter 3.5 cm, height 1.31 cm, density 7.96 g/cm^3, mass 100.33 g, started on Oct. 23, 1991, 6:50 pm (Original No. 8). As in all experiments, and also in the following tests, the outside surface of the samples were cleaned carefully with acetone to remove any traces of organic materials (except the ring of high-vacuum grease at the glass stoppers, see below) and were handled afterward with cotton gloves and with 30 cm long stainless steel tweezers.

Experiment No. 2: 4 spherical, new 50 ml glass flasks were used with ground joint neck (NS 14.5), without chemically inert content to increase the internal surface area, sealed gas-tight, with glass stoppers with ground joint cone, using high-vacuum grease and steel springs to hold the stoppers in place. All flasks were mounted in a stainless steel frame (see legend of Fig. 3a) with the ground joint necks pointing downward, respectively. Total mass 200 ± 0.07 g, each, with similar external shape and deviations in volume of less than ± 0.5%. The two test flasks at positions P_1 and P_3 were internally silverplated before being mounted into the frame while the two reference samples at positions N and P_2 contained water. The experiment was started on April 25, 1992, 8:00 pm, (Original No. 16).

Experiment No. 3: The same experimental set-up was used as in experiment No. 2, except that the 4 glass flasks were pre-used and contained as a chemically inert filling about 30 ml of glass balls each having a diameter of 0.95 cm. The two test flasks were internally silverplated while the two reference samples contained water. The experiment was started on March 9, 1992, 1:30 am, (Original No. 15).

Experiment No. 4: The same experimental set-up with pre-used flasks was used as in experiment No. 3. The experiment was started on Feb. 5, 1992, 3:00 am (Original No. 14).

Experiment No. 5: 4 spherical, pre-used 50 ml glass flasks with a flat bottom, sealed gas-tight as in experiment No. 2, standing upright in the comparator without metal frame. Total mass 100.025 ± 0.04 g each. Test and reference flasks contained as chemically inert filling about 25 ml of small pieces of glass pipes, 8x8 mm (Raschig rings), to increase the internal surface area. To further increase of the internal surface area, each test flask contained 0.2 g of micrometer-sized ground diamond dust. The two test flasks were prepared in such a way that the two homogeneous solutions for the generation of metallic silver were stored in two separate compartments so that a baseline pretest could be performed before the actual test. After the baseline pretest the 4 flasks were mounted in a frame outside the comparator and tilted slowly, so that the two chemical components in the test flasks mixed. The chemical reaction was finished within 6 minutes. After the flasks had been mounted in the comparator the test was continued after a total interruption of about 10 min. The experiment was started on Nov. 17, 1991, 3:08 am (Original No. 12).

Experiment No. 6: The same experimental set-up was used as in experiment No. 5, with the cleaned flasks from test No. 5. The experiment was started on Nov. 27, 1991, 1:30 am, (Original No. 13).

Table 2: Summary of artifact research to check for known explanations of the observed gravitational anomalies[9].

Careful experimental artifact studies have been systematically performed to evaluate possible disturbances by such known factors as:
(*a*) uncontrolled disturbing electromagnetic effects [9]
(*b*) varying light absorption [9], or other known physical or chemical influences such as
(*c*) temperature, in the tests described above temperature varied within ±0.3 K [9], or
(*d*) external atmospheric pressure variations [9], or
(*e*) internal pressure variations (up to 3 barg) [9], including
(*f*) leakages of the flasks (up to 3 barg internal pressure) [9], as well as
(*g*) different rates of influences of static water vapor (humidity, max. ±7%) [9], or
(*h*) different rates of dynamic water adsorption processes on the samples [9]

Furthermore, quantitative evaluations have been done in view of:

(*i*) Maximum buoyancy fluctuations[27] Δm_B within a 10 minute time period needed to weigh every sample within a weighing cycle which could lead to apparent measuring effects ($\Delta m_{Bmax} = \Delta M_{app.} = \pm 0.4$ µg)[11]

(*j*) Acceleration of the Earth[28] varies within a 10-minute time period. This again could lead to maximum apparent measuring effects $\Delta M_{app.}$ for a sample mass of 100 g of $\Delta M_{app.} = \pm 1.2$ µg which cannot disturb the observed results[16]

(*k*) Dynamical free convection effects[29] due to minor temperature differences between the samples can be quantitatively ruled out after the above reported time periods of several hours needed for reaching temperature equilibrium within the compartment of the comparator after every opening and periods of time of 3 to 5 days needed to achieve significant measuring effect $M_j(i)$, $j = 1$, and 2.

(*l*) In addition, the carefully performed baseline tests[9] given in Figure 1 (with glass flasks as well as identical 100 g metal samples), and the recorded mass differences between the two reference samples (which must be interpreted as further baselines, see Figures 2, 3, and 4) indicate that the experimental method is not influenced by known physical effects which could have caused deviations from the baselines with measuring effects $M_j(i >> 5$ µg, and especially up to 2000 µg.

(*m*) Maximum atmospheric changes, even during a thunderstorm, could not influence the baseline of an experiment performed during such a period.

Table 3: Hypotheses resulting from the described experimental observations [9]

Hypothesis 1*:* The observed measuring effects,$|ME(\mathrm{i})| >> 2.5$ µg, indicating significant time-dependent and long-range deviations from the law of conservation of mass on non-relativistic scales, relate to the formation of microscopic and/or macroscopic new phase boundaries, *i.e.* in the experiments described here due to the formation of metallic silver from two homogeneous liquid solutions.

Hypothesis 2*:* The observed significant mass changes of the test samples, where a new solid phase has been generated, occurred due to the absorption of a kind of "matter". This implies that the described test samples can act as detector systems to accumulate this form of "dark" (*i.e.* non-visible) and "cold" (*i.e.* low-energetic) "matter" which does not seem to be composed of baryons (*i.e.* protons, neutrons, or the nuclei of chemical elements) or leptons (*i.e.* the electron) which together are termed "bradyonic" matter. The new form of matter may thus be termed "non-bradyonic" matter (NBM).

Hypothesis 3*:* Non-bradyonic matter exists in quantized form with mass M_Q of such free quanta in the order of magnitude of $M_Q = +\ 21.3$ µg ±1.42 µg (95% confidence interval) including the value of the Planck mass $\underline{M_P} = (hc/(2\pi G))^{0.5} = 21.77$ µg. Also the following values $M_Q(\mathrm{S}) = (hSc/(2\pi G))^{0.5}$ were observed experimentally, with $S = 1/2$, 1, 3/2, 2, 5/2, and 3, as well as $M_{St}(S) = (e^2S/(4\pi\varepsilon_0 G))^{0.5} = 1.85 \cdot S^{0.5}$ µg. S may be interpreted as spin-quantum number. Further results reveal the existence of the new form of matter with mass $M_Q \leq 1$ µg and of quanta with negative mass $M_Q = -21.77$ µg, and in general of $M_Q(S) < 0$.

Hypothesis 4*:* Quanta of non-bradyonic matter can interact with normal bradyonic matter in two ways: First, by gravitational interaction, due to their real mass content; second, by a "topological" (*i.e.* form-specific) interaction at newly formed phase boundaries according to hypothesis No. 1.

Hypothesis 5*:* Relaxation times for the emission, absorption or reabsorption of quanta of non-bradyonic matter by normal, bradyonic matter can be in the order of magnitude of 20 to 40 min.

Hypothesis 6: Emission of quanta of NBM after absorption by normal matter can be induced by applying a weak mechanical shock to the bradyonic system. From tests with varying mechanical shock energies the strength of the topological binding energy E_{top} can be estimated relative to the gravitational binding energy E_G of quanta of the new form of matter due to their topological binding to normal matter as being about $E_{top}/E_G = 10^{15}$.

Hypothesis 7: Water, as a purely physical system, is able to absorb or emit quanta of non-bradyonic matter which is consistent with hypothesis No. 1. There it is stated that both macroscopic phase borders, such as, for example, newly generated metallic silver, and/or microscopic phase borders, such as boundaries between clusters within the liquid water structure, may be active in absorbing the postulated non-bradyonic quanta. Furthermore all biological systems must be regarded as excellent detectors of NBM[9], as has been confirmed independently[25], [26] due to the ongoing formation of new cell membranes, which have to be seen here as newly generated solid phase borders.

Hypothesis 8: Bradyonic matter, such as the glass container of a test, which has already been involved in absorbing NBM quanta may show certain memory effects in further tests.

Hypothesis 9: Free quanta of non-bradyonic matter, see hypothesis No. 3, can form associates of integer multiples with real mass $\pm\Sigma_S\{n_S(hSc/(2\pi G))^{0.5}\}$, (with $n_S = +1, +2, +3$ ..., and $S = 1/2$, 1, 3/2, 2, 5/2, 3, 7/2) without losing the individual character of the individual quanta which are associated.

Hypothesis 10: The patterns of the monotonous and stepwise mass changes of normal matter due to the absorption or emission of free quanta $\pm\, n_Q M_Q$ of non-bradyonic matter, see hypotheses Nos. 1, 2, and 8, seem to be correlated.

Table 4: Special and General Conclusions from the Obtained Results

Point 1. According to the gravitational interaction of the new form of matter, every celestial body should have a stationary field of non-bradyonic matter bound gravitationally around its center of mass. The sun and other fix stars should be in a steady state between absorption and emission processes and should in addition emit an ongoing stream of free quanta of the new form of matter due to intensive mechanical shock waves in its interior which lead to the release of the new form of matter, see Hypothesis 6 of Table 3.

Point 2. The existence of free quanta of non-bradyonic matter implies, for example, the existence of a cosmic background radiation of this form of matter, with free quanta which have a real mass content and which can interact with normal matter at newly created phase borders or gravitationally, as mentioned. This implies the existence of a "weighable ether" as already discussed by Landolt[3], [4] and also includes in principle the ongoing exchange of momentum between free quanta of non-bradyonic matter and normal matter, as revealed by the results of Fig. 8. From this it may be concluded that the effect of gravity arises due to the exchange of momentum from the ubiquitous isotropic field of non-bradyonic matter to normal matter. [13] Such a dynamic process was in principle proposed as a basic mechanism for gravity more than 100 years ago as the "hypothesis of absorption,"[30], [31], while modern physics prefers the so-far not verified theoretical concept of the exchange of virtual gravitons, as predicted from quantum field theories or superstrings[32]. In the case of a sun eclipse, as observed in experiment No. 7, described above, according to the "hypothesis of absorption", the free quanta of non-bradyonic matter, radiated from the sun (see point 1 above) should by the mass of the moon be focused in a process of gravitaional lensing on an observer on Earth when the shadow of the moon passes during the eclipse over the site of observation. In the case of experiment No. 7, the mass of the silverplated test flask should thus during the eclipse increase proportionally to the magnitude of covering due to the flow of quanta of non-bradyonic matter which is increased temporarily by this lensing effect. Because such an increase could be observed in experiment No. 7 the results given support the "hypothesis of absorption". Further similar studies during sun as well as moon eclipses may contribute to further clarify this conclusion.

Point 3. Usually it is assumed in quantum field theories that a particle with Planck mass $M_P = (hc/(2\pi G))^{0.5} = 21.77\cdot 10^{-9}$ kg exists at the Planck scale with typical spatial distances of the so-called Planck length $L_P = (hG/(2\pi c^3))^{0.5} = 1.616\cdot 10^{-35}$ m. Because M_P and L_P virtually fulfil the condition for the event horizon $R_{BH} = 2GM_P/c^2 = 2G(hc/(2\pi G))^{0.5}/c^2 = 2(hG/(2\pi c^3))^{0.5} = 2L_P$ of a black hole, a particle with Planck mass should thus be a mini black hole. According to the "Hawking theorem" every black hole emits due to relativistic quantum mechanical processes spontaneously a stream of real particles ("Hawking radiation"). A mini black hole with Planck mass M_P or integer multiples of this value should thus be unstable and should spontaneously evaporize be emitting "Hawking radiation."[33] The above described experimental detection of stable particles with real mass content of the Planck mass does not confirm this theoretical and so-far experimentally not verified conclusion.

Point 4. Stable particles with real Planck mass do not only violate "Hawking's evaporation theorem" but also contradict Prigogine's assumption of instable mini black holes with Planck mass in the early cosmological phase of the universe[34],[35].

Point 5. The described memory effect, see Hypothesis No. 8 of Table 3, defines a direction of time in events in which new phase boundaries are generated or dissolved. Thus, the permanently ongoing exchange of quanta of the new form of matter in connection with the form-specific absorption and emission processes can be seen as the basic cause of the "arrow of time" at cosmic scales and at local evolutionary processes in living and also in non-living systems. While this reason for the evolutionary "arrow of time" may thus be the origin of "irreversibility" at various universal scales, "chronological time", *i.e.* "time" in common sense, usually does not appear in the fundamental conservation laws of physics ("descriptive reversibility") and should be basically connected to the spontaneously ongoing *zitterbewegung* of every elementary particle due to its uninterruptedly ongoing annihilation- and creation-processes. For a phenomenological description of the two aspects of time see work by Prigogine[34].

Point 6. The existence of a real cosmic background radiation of the new form of matter can in principle be seen as consistent with David Bohm's quantum mechanical level of an "implicite order" and as a basis of hidden variables (as observed in the non-classical correlations of the EPR-experiments, in the Pauli principle or in the double slit experiment of quantum mechanics) as seen from systems being composed of normal matter[19],[36],[37],[38].

Point 7. In modern physics elementary particles as well as the whole universe are understood as finally emerging from the level of the Planck scale which is defined by the Planck mass M_P, the Planck length L_P and the Planck time $T_P = L_P/c$, see (4a, b, and *c*). A real particle with Planck mass was so-far not known in physics. Given the above described existence of a real cosmic background radiation of the new form of matter with quantized masses in the order of magnitude of the Planck mass, it is plausible to assume that this basis may be the origin of the elementary particles as well as the space-time continuum of the universe, and as described above, as the driving force of its evolution according to the "arrow of time". General theory of relativity may describe the internal geometrical and cosmic as well as local distribution of this cosmic background radiation in the sense of the curved space-time structure, see Fig. 9.

Point 8. Because $M_P c^2 T_P = h/(2\pi)$ fulfill Heisenberg's uncertainty principle, it can furthermore be assumed that the cosmic background radiation of the new form of matter is itself emerging from an underlying vacuum ground state, see Fig. 9.

Point 9. The existence of a real cosmic background radiation of the new form of quantized cold dark matter, as mentioned above, where the quanta can show positive and negative signs, includes many significant conclusions for astrophysics[13], such as: On local scales at a non-relativistic classical level, gravitational repulsive forces between differently charged particles should exist, while on cosmological intra- and intergalactic large scales the total energy content E_{total} of the involved positive and negative quanta with total mass should in general lead, according to $E_{total}^2 = c^4\cdot\Sigma(m^2) + p^2\cdot c^2$, to gravitational attractive forces, leading to a general increase of the density of cold dark matter, as detected.[39] According to the same formula for E_{total} and (7b), the mass $M_Q(n_S, S)$ of the total number of quanta of cold dark matter in a bound state can be described as $M_Q(n_S, S) = (Ac/(2\pi G))^{0.5}$, where A characterizes a new quantum of action, according to $A = \{h\cdot[\Sigma(n_S^2\cdot S)]\}$, for each bound state. This can lead to effects of a cosmic quantization of cold dark matter at scales where cold dark matter is concentrated, especially in connection with normal matter. Such effects can occur during early and late states of star evolution[13],[40],[41], but similarly on the levels of galaxies, quasars or black holes, leading or contributing, for example, to the formation of bipolar jets [13]. Any interaction of the new form of matter with forms of electromagnetic radiation can, besides the well known cosmological redshift, give rise to a second redshift mechanism[13], according to $\Delta\nu/\nu = (G/c^2) \int\phi(r)\, \rho(\mathrm{r}) r\, \mathrm{d}r$, with integration limits from $r = 0$ to $r = r_0$ (where $\rho(r)$ describes the density of the new from of matter as a function of the distance r, $\phi(r)$ represents the coupling factor relative to gravitational coupling as well as deviations from the $1/r^2$ dependency, and r_0 gives the distance of an observer to the cosmic object under observation) which can explain already observed anomalies[42]. Under the assumption presented above under Point 2 that gravity arises due to the exchange of momentum from the ubiquitous isotropic field of non-bradyonic matter to normal matter, the observed bending of electromagnetic radiation in the gravitational field of the sun or of galaxies (leading to the formation of "Einstein rings") indicates that such an interaction between electromagnetic forms of radiation and the described new form of matter must exist. Furthermore, Einstein's General Theory of Relativity (GTR) seems to be a "cover" or "envelope" theory which correctly describes gravity in a geometrical way by "bending" of space-time-geometry. Einstein himself once suggested that the GTR had a type of ether associated with it[43]. Space-time itself thus should be understood as the set of all existing free quanta of the new form of matter and their interactive and self-interactive properties. While GTR describes the behaviour of space-time in a "thermodynamic" geometrical way, the "kinetics", *i..e*. the mechanistic details which lead to the effect of gravity and of space-time must be seen as due to the properties of the ubiquitous cosmic background radiation (real "weighable ether") of the new form of matter and its gravitaional interactions with normal matter and itself. What is so far not part of GTR is the topological interactive behaviour of the new form of matter with bradyonic systems as well as the possible storage of information in "space-time", *i.e.* in the cosmic ether, due to the observed interaction of free quanta of the new form of matter with other such quanta to build up associates. Such associate forms of the new form of matter may cause special effects on the level of normal matter, in guiding the behaviour and structure of bradyonic non-living as well as living systems.

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