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Comment on "Dependence of Gravitational Action on Chemical Composition: New Series of Experiments" by M. Nanni (*Apeiron* 7, p.195, 2000)

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In our comment we show that the application of appropriated statistical methods to the results of the author proves that the author in this article has not been able to reach his goal.

In article [1] the results of a very interesting fundamental experiment are described. The objective of the experiment is to statistically demonstrate that the following equation is reliable:

$$M = \frac{W_i}{W_k}(Torino) - \frac{W_i}{W_k}(Plateau\_Rosa) \neq 0$$

where W_i and Wk are correspondingly the weights of samples of two materials of different chemical compositions, measured in the city of Torino (180m above sea level) and in Plateau Rosa (3480m above sea level). This would seriously question the validity of the Weak Equivalence Principle (WEP). Our purpose is to show that the author

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has not been able to reach his goal in his article. With that purpose a standard statistical processing of the author's presented results has been completed in [1], using the same symbols. The following relationships have been used [2-4] (the letter "A" corresponds to Torino, the letter "B" corresponds to Plateau Rosa):

$$\Lambda W = \sqrt{\left[sda.t(P,n) \right]^2 + \Delta_d^2}$$

$$\Delta\left[\frac{W_i}{W_k}\right] = \frac{\overline{W_k}.\Delta W_i + \overline{W_i}\,\Delta W_k}{\overline{W_k^2}}$$

$$\Delta M = \Delta\left[\frac{W_i}{W_k}(A)\right] + \Delta\left[\frac{W_i}{W_k}(B)\right]$$

where *DW* is the experimental error of a series of measurements of the weight of a sample under certain conditions; *sda* is Standard Deviation Average for the same weight; *t (P,n)* is the Student's coefficient to confidence probability *P* and number measurements n; D_d is the scale error ($D_d = 3 \times 10^{-6}$g); *W* is the average of the corresponding sample weight; *DM* determines the limits of the confidence interval (*M - DM, M + DM*). With probability *P* the exact value of magnitude *M* is located within this interval.

From the results in [1] the accuracy with which the experiment should be carried out is seen, it is comparable with the accuracy of a metrological experiment. For following, in the statistical processing of the experimental data, the requirements of a metrological experiment should be respected. For that reason, a level of the confidence probability *P* has been accepted as 0.999. On the other hand, the noted confidence probability is required for each experiment that aspires to demonstrate invalidity in a fundamental physical principle. If the weight of a sample is measured 10 times in an experimental series and $P = 0.999$, the Student's coefficient is valued as t (0.999, 10) = 4.78. There are two possibilities:

1. If the digit “0” is outside the confidence interval, it can be confirmed with a probability of 0.999, that the exact value of magnitude M is different from “0”.
2. If the digit “0” is inside the confidence interval, nothing can be deduced.

The deviation limit DM, that is only due to the scale error Δ_d, equals 4 ´ 10^{-6}. Because of this, there is no reason to consider those combinations of chemical substances, where $M \leq 4$ ´ 10^{-6}, and only the cases where $M > 4$ ´ 10^{-6} will be dealt with. In Table 1 magnitude M (calculated by M. Nanni), ΔM , the confidence interval and the relative error for several chemical substance combinations have been presented:

Lead	Aluminum	Gold	Bronze	Silver	Brass-Sand
M(´ 10^{-6})	8	8	6	6	6
DM(´ 10^{-6})	9.07	8.11	9.42	8.79	6.26
Confidence interval	(–1.07; 17.07)	(–0.11; 16.11)	(–3.42; 15.42)	(–2.79; 14.79)	(–0.26; 12.26)
DM/M .100%	113%	101%	157%	146%	104%

It can be seen that digit “0” participates in all of the confidence intervals. This clearly indicates that magnitude M can be different or equal to “0”. In Table 1 it can be seen that the relative error for all of the combinations is bigger than 100%! In this case the standard formulas should not be used for a normal distribution, instead more general statistical formulas should be used. But this will considerably increase the width of the confidence interval. Finally, it is possible that some deviations of the WEP exist. Regrettably, the author has not been able to demonstrate this thesis in this article [1]. The results of the article can only justify the realization of a new series of measurements with a more precise scale and/or a higher number of the weight measurements for each sample and an appropriate statistical processing.

References

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