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The Elementary Gravitational Charge and Its Value

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Abstract: In the article "The Gravitational Force Quantum and its Value" [1], the author defined a gravitational force of the atomic unit ("the Gravitational Force Quantum") as a gravitational force which exerts one atomic unit of the Earth's mass on 1 kilogram of a mass on the Earth´s surface, and he calculated its value as: $GFQ_{Earth} = 1.4958 \times 10^{-54}$ N. In the present contribution, he extended the Gravitational Force Quantum concept to further Objects of the Solar Planetary System and for the Pluto. He calculated values of the GFQ_O on the analogous basis, i.e. of the mass and the standard acceleration of the gravity of individual objects and of the atomic unit of the mass. He received GFQ_O values for the Mercury 102.1427×10^{-55} N, the Venus $16{,}60012 \times 10^{-55}$ N, the Earth 14.97839×10^{-55} N, the Mars 52.91869×10^{-55} N, the Jupiter 0.124391×10^{-55} N, the Saturn 0.17929×10^{-55} N, the Uranus 0.945178×10^{-55} N, the Neptune 1.002845×10^{-55} N, for the Pluto 458.9124×10^{-55} N, and for the Sun 0.001257×10^{-55} N, respectively. He multiplied the GFQ_O values by second power of the radii of the individual objects (O), receiving values denoted as the "Elementary Gravitational Charge" (G_O). The Elementary Gravitational Charge represents a gravitational force of one atomic unit of mass in the (radius) distance of 1 meter. They were found of the same value: $G_{Me} = G_V = G_E = G_{Ma} = G_J = G_S = G_P = G_{Sun} = 6.079675463 \times 10^{-41}$ N. The values were the same as the calculated one on the basis of the "classical" Newton´s formula: $F_G = \varkappa \times M \times m / R^2$, for the gravitational force between the atomic unit mass and a mass of 1 kg at a distance of 1 meter, which value was calculated as $G = 6.079675463 \times 10^{-41}$ N. The quantity of the Elementary Gravitational Charge can be supposed to be analogous to the Elementary (Electric) Charge ($e = 1.6021766208(98) \times 10^{-19}$ C) quantity.

Key words: Gravitation, gravitational force of atomic unit, gravitational force quantum, elementary gravitational charge.

Nomenclature

M or m:	The mass.
$F_{Earth:}$:	The gravitational force 9,819962 N [4].
$M_{Earth:}$:	The mass of the Earth 5.97219×10^{24} kg [4].
$R_{Earth:}$	The radius of the Earth 6.371×10^{6} m [4].
$\varkappa$:	The Newton gravitational constant 6.67408×10^{-11} m^3 kg^{-1} s^{-2} [12].
AUM:	The atomic unit of the mass $9.10938356 \times 10^{-31}$ kg [12].
N_{AUM}:	The number of atomic units of mass of the Earth.
GFQ:	The gravitational force quantum.
G:	The elementary gravitational charge.

1. Introduction

In the previous article titled The Gravitational Force Quantum and its Value" [1], the author defined the gravitational force of the atomic unit (or "Gravitational Force Quantum") as a gravitational force which exerts one atomic unit of the Earth's mass on 1 kg of a mass on the Earth's surface, and he calculated its value as: $GFQ = 1.4958 \times 10^{-54}$ N, respecting the obvious fact, that the gravitation/gravity is an additive property of matter objects and taking into account other positivistic quantities like the mass of the Earth, the standard acceleration of the gravity, and the value of the atomic unit of the mass.

In the present contribution, the author extended the Gravitational Force Quantum (GFQ) concept to further objects of the Sun planetary system and for Pluto.

The author recalculated the values found by multiplying them by second power of the radii of the corresponding objects, receiving values, which he defined as the "Elementary Gravitational Charge" (G_O) of the (one) atomic unit of mass of individual objects in the (radius) distance of 1 meter. He also calculated the Elementary Gravitational Charge (G) on the basis of the classical Newton´s law for the atomic unit of the mass.

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2. Methodology

According to the Newton´s law, a mass of m = 1 kg exerts on the Earth´s surface a gravitational force F_{Earth} = 9.819962 N.

The mass of the Earth (5.97219×10^{24} kg [4]) can be expressed as:

$$M_{Earth} = AUM \times N_{AUMEarth} \quad (1)$$

where the AUM is the atomic unit of the mass, $9.10938356 \times 10^{-31}$ kg [12]), the $N_{AUMEarth}$ is a number of atomic units of the mass contained in the Earth, i.e.:

$$N_{AUMEarth} = M_{Earth}/AUM = 5.97219 \times 10^{24}/9.10938356 \times 10^{-31} = 0.655609 \times 10^{55} \quad (2)$$

The value of the gravitational force attributed to one atomic unit of the Earth's mass, i.e. a "GFQ_{Earth} (the Gravitational force quantum)" can be calculated as:

$$GFQ_{Earth} = F_{Earth}/N_{AUM} = 9.819962/0.655609 \times 10^{55} = 1.497839 \times 10^{-54}\ N \quad (3)$$

The value of the "Elementary Gravitational Charge" (G_O) of the Earth was calculated as:

$$G_{Earth} = GFQ_{Earth} \times R_{Earth}^2 = 1.497839 \times 10^{-54} \times (6.371 \times 10^6)^2 = 6.079675463 \times 10^{-41}\ N \quad (4)$$

The same procedures were followed with data for the planets of the solar system and Pluto given in the Table 1.

The value of the "Elementary Gravitational Charge" corresponding to the atomic unit of the mass G_{AUM} was calculated by definition as a gravitational force between the atomic unit mass and a mass of m = 1 kg at a distance of 1 meter using the formula:

$$G_{AUM} = \varkappa \times M_{AUM} \times m / R^2 = 6.67408 \times 10^{-11} \times 9.10938356 \times 10^{-31} \times 1 / 1^2 = 6.079675463 \times 10^{-41}\ N. \quad (5)$$

3. Results and Discussion

The author calculated values of the GFQ_O on the analogous basis, i.e. of the mass and the standard acceleration of the gravity of individual objects and of the atomic unit of the mass given in the Table 1.

He received GFQ_O values for: the Mercury 102.1427×10^{-55} N, the Venus 16.60012×10^{-55} N, the Earth 14.97839×10^{-55} N, the Mars 52.91869×10^{-55} N, the Jupiter 0.124391×10^{-55} N, the Saturn 0.17929×10^{-55} N, the Uranus 0.945178×10^{-55} N, the Neptune 1.002845×10^{-55} N, for the Pluto 458.9124×10^{-55} N, and for the Sun 0.001257×10^{-55} N, respectively (see the Table 1).

The GFQ_O values were multiplied by the square roots of the radii of the corresponding objects, receiving values, which were defined as the "Elementary Gravitational Charge" (G_O) of the (one) atomic unit of each object´s mass in the radius distance of 1 meter". They were found (see the Table 1) of the same values, i.e. $G_{Me} = G_V = G_E = G_{Ma} = G_J = G_S = G_P = G_{Sun} = 6.079675463 \times 10^{-41}$ N.

Table 1 Values of Mass (M_O), Radius (R_O), Gravity (F_O), Number of atomic units (N_{AUMO}), Gravitational Force Quantum (GFQ_O), and Elementary Gravitational Charge (G_O) of individual Objects of the Solar Planetary System and for Pluto.

Object	$M_O \times 10^{24}$kg	R_O, km	F_O, ms^{-2}	$N_{AUMO} \times 10^{55}$	$GFQ_O \times 10^{-55}$ N	$G_O \times 10^{-41}$ N
Mercury	0.330104	2439.7	3.701428	0.036238	102.1427	6.079675463
Venus	4.86732	6051.8	8.869766	0.534319	16.60012	6.079675463
Earth	5.97219	6371	9.819962	0.655609	14.97839	6.079675463
Mars	0.641693	3389.5	3.727756	0.070443	52.91869	6.079675463
Jupiter	1898.13	69911	25.91948	208.3709	0.124391	6.079675463
Saturn	568.319	58232	11.18562	62.38831	0.17929	6.079675463
Uranus	86.8103	25362	9.007322	9.529767	0.945178	6.079675463
Neptune	102.41	24622	11.27424	11.24225	1.002845	6.079675463
Pluto	0.1309	1151	6.594478	0.01437	458.9124	6.079675463
Sun	1989100	695508	274.4377	218357.3	0.001257	6.079675463
Sources	[2-11]	[2-11]	Own calcul.	Own calcul.	Own calcul.	Own calcul.

These values were the same as the one, which was calculated on the basis of the "classical" Newton´s formula: $F_G = \varkappa \times M \times m / R^2$, for the gravitational force between the atomic unit mass and a mass of 1 kg at a distance of 1 meter, i.e. $6.079675463 \times 10^{-41}$ N.

The verity of the values of the GFQ_O and G_O might be limited by correctness of the atomic unit of the mass, the objects´ gravitational forces, mass and radius values, which were used in the calculation of the gravitational force quantum and elementary gravitational charge values. It can be foreseen, that the value of GFQ and G_{AUM} will be revised in the future development of notion.

4. Conclusions

The gravitation/gravity should be considered as one of the immanent/in-born/distinguished property of the matter, like:

- a mass or a weight,
- an inertia,
- a space/volume,
- a structure,
- electric charge,
- and others, which were discussed in the work [1].

Respecting the obvious fact, that the gravitation/gravity is an additive property of matter objects and taking into account other positivistic quantities like the mass, and the radius of the Earth, and other objects of the Sun planetary system and the Pluto, and the value of the atomic unit of the mass, the author defined the gravitational force of the atomic unit (or "Gravitational Force Quantum") as a gravitational force which exerts one atomic unit of the objects' mass on 1 kg of a mass on the corresponding objects' surface, and he calculated their values as for the Mercury 102.1427×10^{-55} N, the Venus $16{,}60012 \times 10^{-55}$ N, the Earth 14.97839×10^{-55} N, the Mars 52.91869×10^{-55} N, the Jupiter 0.124391×10^{-55} N, the Saturn 0.17929×10^{-55} N, the Uranus 0.945178×10^{-55} N, the Neptune 1.002845×10^{-55} N, for the Pluto 458.9124×10^{-55} N, and the Sun 0.001257×10^{-55} N, respectively.

The author defined the Elementary Gravitational Charge (G) as a force which exerts one atomic unit of the mass on 1 kg of the mass in the distance of 1 meter, which value was calculated as $6.079675463 \times 10^{-41}$ N.

The parameter of the Elementary Gravitational Charge can be supposed to be analogous to the Elementary (Electric) Charge e =1.6021766208(98) $x10^{-19}$ C [13]. Namely, both of the quantities cannot be divided into smaller parts, both are additive, both can be measured on the basis of the force effects, both are well known from their apparent physical features and practical applications, however, origins and physical backgrounds of the both phenomena are hidden so far [13-15].

The quantity of the Elementary Gravitational Charge will probably be useful for the further development of the "quantum mechanical" approach to the description and to the general notion about the world.

The phenomenon of the gravitation might perhaps be connected with/caused/explained/etc. by the distortion of the space around the mass objects. It could be one of the main in-born/decisive/distinguish characteristics of material objects (or a matter/mass). For further (rather philosophical) discussion, see ref. [15].

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