Gravitational Energy Cannot Be Negative: a Comment on The Grand Design

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Abstract

The authors of The Grand Design treat the gravitational energy of a large astronomical object as a negative quantity. The formula used to calculate gravitational energy is GM^2/r, in which all quantities are positive. Even if mass were considered to be negative, the square of the mass is a positive quantity. All other quantities in the formula are positive because *G* is positive, and since there is no such physical thing as a negative radius, *r* is positive. The authors have simply affixed a negative sign in front of the formula, which is neither correct mathematically nor physically. We show in this paper that the correct treatment of gravitational energy leads to the conclusion that Earth's gravitational energy produces Earth's space. Earth has its own space, as does every astronomical object in the Universe. The general overall space of the Universe, therefore, is a series of interacting spaces.

We do not have to look far to find evidence that the region surrounding Earth contains energy. It is a physical fact that Earth is surrounded by magnetic energy. We interpret that fact to mean that Earth has its own space and carries its space around with it on its journey around the Sun.

The authors of The Grand Design [1] tell us that the pre-creation condition was a vacuum imbued with potential energy. There were pixelations in the vacuum that led to the creation of mass. In the regions where vacuum energy was siphoned off to create matter, there was left behind holes, i.e., regions of energy deficiency. These regions of energy deficiency became seats of negative gravitational energy. All of this constitutes good accounting, debits and credits, but the formula used to determine gravitational energy produces a positive quantity. The formula is

$$E_G = \frac{GM^2}{r} \tag{1}$$

where we observe a negative value is impossible because *G* is positive, the square of *M* is always positive, and there's no such physical thing as a negative radius *r*. The only way to make formula (1) negative is to place a negative sign in front of it. That, however, is a mathematical ruse, not a physical fact. The fact is that gravitational energy is very real and very positive. Reference [2] says that one-half of Earth's gravitational energy is in the gravitational field of the Earth. We employ that useful conclusion to calculate the mass density of Earth's gravitational space.

Considering a spherical mass object, such as the Earth, the gravitational energy in its field is proportional to the square of the potential gradient. Therefore we write

$$\int_{ro}^{\infty} \frac{K}{r^4} 4\pi r^2 dr = \frac{4\pi K}{r_0} = \frac{GM^2}{r_0} \tag{2}$$

where r_0 is the radius of the astronomical object. Solving for *K*, we find

$$K = \frac{GM^2}{4\pi} \tag{3}$$

Variation in gravitational energy density with elevation is found from

$$\frac{K}{r^4} = \frac{GM^2}{4\pi r^4} = \frac{1}{2} \bullet \frac{M}{4\pi r^3} \bullet \frac{2GM}{r} = \frac{1}{2} \rho v_{esc}^2 \tag{4}$$

We notice that the mass density of the region of space surrounding a large mass object is

$$\rho = \frac{M}{4\pi r^3} \tag{5}$$

Applied to Earth, we know that the mass density of the solid Earth is found from

$$\rho_{earth} = \frac{M}{\frac{4}{3}\pi r^3} \tag{6}$$

We see therefore that

$$\rho = \frac{1}{3}\rho_{earth} \tag{7}$$

which says that the mass density of the space of Earth is one-third the average mass density of the solid earth. By treating the gravitational energy of Earth as negative, the authors of The Grand Design completely missed to account for the space of the Earth. According to The Grand Design, the magnetic energy surrounding Earth does not exist.

References

1. Stephen Hawking and Leonard Mlodinow, The Grand Design, Bantam Books, New York, 2010, p.180.
2. Robert Leon Carroll, The Energy of Physical Creation, Carroll Research Institute, Columbia, South Carolina, 1985; "The Nature of Space", *Galilean Electrodynamics* **1** (4), 1990; "The Mass-Space Principle", *Galilean Electrodynamics* **4** (4), 1993.