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Problems of Negative Field Energy in Electrostatics and Gravitation

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Abstract

There is no negative mass, and the speed of light is not a complex quantity. In this regard, the energy in accordance with the famous Poincaré formula, in principle, cannot be negative, which cannot be said about the potential energy of the electrostatic interaction of two differently charged spheres and the energy of gravitational interaction. This is the first paradox of the corresponding field interactions. The paradox associated with negative energy arose due to the fact that the integration constant in the calculation of energy is voluntaristic, unproven and erroneously taken equal to zero. As a result, the potential energy of the interaction of charges (textbook) with an infinitely large distance between them became zero. Whereas in reality it is maximum. After all, it is in this position that the work that the field can potentially do is maximum. The electrostatic interaction of the electric charges of the same name is not paradoxical. The electrostatic interaction of opposite electric charges is irreconcilably paradoxical. Gravitational interaction is irreparably paradoxical.

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Artifacts

The potential energy of the electrostatic interaction of two equally and SIMILARLY charged spheres is

$$U_1 = \frac{1}{4\pi\varepsilon_0\varepsilon}\frac{q^2}{r}$$

The potential energy of DIFFERENTLY charged spheres is

$$U_2 = -\frac{1}{4\pi\varepsilon_0\varepsilon}\frac{q^2}{r} \qquad (1)$$

The potential energy of the gravitational interaction of two identical massive round bodies is

$$U_3 = -\gamma \frac{m^2}{r} \qquad (2)$$

There is no negative mass and the speed of light is not a complex value [1-3]. In this regard, the energy according to the famous Poincaré formula

$$E=mc^2 \qquad (3)$$

in principle cannot be negative, which cannot be said about (1) and (2). Only the energy DIFFERENCE can be negative, but not the energy itself. However, the values (1) and (2) are not energy differences [4-6].
This is the first paradox of the corresponding field interactions.
But the paradox is manageable. The correct choice of integration constants eliminates this paradox [7, 8].

Method (using the example of charges of the same name)
The energy density of the electrostatic field is

$$w = \frac{\varepsilon_0 \varepsilon}{2} E^2 = \frac{\varepsilon_0 \varepsilon}{2} \left(\frac{q}{4\pi\varepsilon_0 \varepsilon r^2} \right)^2 = \frac{q^2}{32\pi^2 \varepsilon_0 \varepsilon r^4} \qquad (4)$$

The field energy of a charged sphere of radius a is

$$W = \int_V w dV = \frac{q^2}{32\pi^2 \varepsilon_0 \varepsilon} \int_a^\infty \frac{4\pi r^2}{r^4} dr = \frac{q^2}{8\pi\varepsilon_0 \varepsilon} \int_a^\infty \frac{dr}{r^2} = \frac{q^2}{8\pi\varepsilon_0 \varepsilon a}$$

The field energy of two identical charged spheres with an infinitely large distance between them is

$$W_\infty = 2W = \frac{q^2}{4\pi\varepsilon_0 \varepsilon a} \qquad (5)$$

The field energy of two identically and identically charged spheres at zero distance between their centers is

$$W_0 = \frac{(2q)^2}{8\pi\varepsilon_0 \varepsilon a} = \frac{q^2}{2\pi\varepsilon_0 \varepsilon a}$$

$$W_0 = 2W_\infty$$

When the field of work (when removing charges), its energy decreases

$$A_{0\infty} = W_0 - W_\infty = \frac{q^2}{4\pi\varepsilon_0 \varepsilon a} = W_\infty$$

[8] shows that the potential energy of electrostatic interaction of two equally and similarly charged spheres at zero distance between their centers is

$$U_0 = \frac{q^2}{4\pi\varepsilon_0 \varepsilon a}$$

At the same time

$$U_0 = W_0 - W_\infty = A_{0\infty}$$

The relationships between the potential interaction energy U, the field energy W and the work A do not contradict common sense and the law of conservation of energy. In other words, the electrostatic interaction of the same electric charges is not paradoxical.

Field Interaction ff Different Charges

The field energy of two identical differently charged spheres with an infinitely large distance between them coincides with (5).
The energy of the field of the same spheres at zero distance between their centers is zero.
When the field of work (when the charges approach), its energy decreases

$$A_{\infty 0} = W_{\infty} - W_0 = \frac{q^2}{4\pi\varepsilon_0 \varepsilon a} = W_{\infty}$$

[8] shows that the potential energy of electrostatic interaction of two identical differently charged spheres at an infinitely large distance between them is

$$U_{\infty} = \frac{q^2}{4\pi\varepsilon_0 \varepsilon a} \qquad (6)$$

At the same time

$$U_{\infty} = W_{\infty} - W_0 = A_{\infty 0} \qquad (7)$$

The relationships between the potential interaction energy U, the field energy W and the work A do not contradict common sense and the law of conservation of energy. There remains a paradox associated with negative energy (1).

N.B. It arose because the integration constant in calculating energy is voluntaristic, unproven, and ERRONEOUSLY taken to be zero. As a result, the potential energy of the interaction of charges (textbook) with an infinitely large distance between them became ZERO. While in reality it is MAXIMUM and equal to (6). Indeed, it is in this position that the work (7) that the field can POTENTIALLY do is maximum. Some kind of evil irony – everything is turned upside down.
[8] shows that the potential energy of electrostatic interaction of two differently charged spheres is

$$U = \frac{1}{4\pi\varepsilon_0 \varepsilon} \frac{q_{1\pm} q_{2\mp}}{r_2} - \frac{1}{4\pi\varepsilon_0 \varepsilon} \frac{q_{1\pm} q_{2\mp}}{r} \quad r \geq r_1 + r_2, r_2 \geq r_1 \qquad (8)$$

Under all circumstances, $U \geq 0$.
With respect to the same spheres and equal charges, the integration constant coincides with (6).
The negative energy paradox is eliminated.

Gravitational Interaction

Let two identical substantially massive stationary (astronomical) bodies be kept at a considerable distance from each other, such that the potential energy of their interaction is NEGLIGIBLE SMALL. At some point, the bodies are given freedom, and they very slowly rush towards each other. As they approach, the force of attraction between them increases, their acceleration and speed increase. At the end of the path, their kinetic energy is no LONGER NEGLIGIBLE, which is unambiguously confirmed by the deformation of bodies in a collision.

From this simple experiment, it follows that in the process of rapprochement, the bodies acquired energy that they DID NOT POSSESS before this process [9].In this regard, bewilderment MUST arise – where did the essential kinetic energy of approaching bodies come from, if initially there was essentially no energy? This is the SECOND paradox of gravitational interaction (the first is negative energy (2)).

The Origin of Kinetic Energy. Option One (textbook)
At an infinite distance from each other, two massive identical round bodies of radius a the potential energy of

their interaction U∞ is zero. When bodies come into contact, it is

$$U_{a+a} = -\gamma \frac{mm}{a+a} = -0,5\frac{\gamma m^2}{a}$$

The kinetic energy at the contact of bodies is

$$\mathrm{K} = 0,5\frac{\gamma m^2}{a} \qquad (9)$$

Energy balance

$$\mathrm{K} = U_{\infty} - U_{a+a} = 0 - \left(-0,5\frac{\gamma m^2}{a}\right) = 0,5\frac{\gamma m^2}{a}$$

Mathematicians in this expression will not be embarrassed.
Physics SHOULD be uncomfortable that positive energy converted to positive work is extracted from NOTHING (from zero).[1]

Origin of Kinetic Energy. Option Two

According to [7], at an infinite distance from each other, two massive identical round bodies of radius a the potential energy of their interaction U_{∞} is equal to

$$U_{\infty} = 1,2\frac{\gamma m^2}{a}$$

When bodies come into contact, it is

$$U_{a+a} = 0,7\frac{\gamma m^2}{a}$$

Kinetic energy (energy balance)

$$\mathrm{K} = U_{\infty} - U_{a+a} = 1,2\frac{\gamma m^2}{a} - 0,7\frac{\gamma m^2}{a} = 0,5\frac{\gamma m^2}{a}$$

(compare with (9)).
There is no mysticism in this version, and energy does not arise from NOTHING. The second paradox is eliminated.

The Paradox Associated With Negative Energy (2)

has exactly the same cause as in the case of differently charged spheres (1) (see N.B.). [7] shows that the potential energy of the gravitational interaction of two round massive bodies is

$$U = \frac{\gamma m_1 m_2}{r_2}\left(1,5 - 0,3\frac{r_1^2}{r_2^2}\right) - \frac{\gamma m_1 m_2}{r} \quad \mathrm{r} \geq \mathrm{r1} + \mathrm{r\,2}\ ,\ \mathrm{r\,2} \geq \mathrm{r1}.$$

In all circumstances, U ≥ 0.
The negative energy paradox (first paradox) is eliminated.
But That's Not All

The energy density of the gravitational field outside the body of radius a is

$$w_2 = \frac{k}{2\gamma}g^2 = \frac{k}{2\gamma}\left(\gamma\frac{m}{r^2}\right)^2 = \frac{k\gamma m^2}{2r^4} \qquad (10)$$

Here k is a dimensionless coefficient, the value of which for the purposes of the present work does not matter. The energy of the field outside the body is

$$W_2 = \int_V w_2 dV = \frac{k\gamma m^2}{2} \int_a^\infty \frac{4\pi r^2}{r^4} dr = 2\pi k\gamma m^2 \int_a^\infty \frac{dr}{r^2} = \frac{2\pi k\gamma m^2}{a}$$

The energy density inside the body is

$$w_1 = \frac{k\gamma}{2r^4}\left(m\frac{r^3}{a^3}\right)^2 = \frac{k\gamma m^2 r^2}{2a^6}$$

The energy of the field inside the body is

$$W_1 = \int_V w_1 dV = \frac{k\gamma m^2}{2a^6} \int_0^a r^2 4\pi r^2 dr = \frac{2\pi k\gamma m^2}{a^6} \int_0^a r^4 dr = \frac{2}{5}\frac{\pi k\gamma m^2}{a}$$

The total energy of the gravitational field of one body is

$$W = W_1 + W_2 = 2{,}4\frac{\pi k\gamma m^2}{a}$$

The field energy of two identical massive round bodies with an infinitely large distance between them is

$$W_\infty = 2W = 4{,}8\frac{\pi k\gamma m^2}{a}$$

The field energy of these two bodies at zero distance between their centers is

$$W_0 = 2{,}4\frac{\pi k\gamma (2m)^2}{a} = 9{,}6\frac{\pi k\gamma m^2}{a}$$

When a field does work (when bodies approach from infinity to zero), its energy MUST DECREASE. And it INCREASES. Twice.
This is the THIRD paradox of gravitational interaction
AND THIS PARADOX IS IRREPARABLE.

About Negative Mass

In the energy density formulas (4) and (10), the field strength is squared. Therefore, the energy density cannot be negative. Therefore, its integral (field energy W) also cannot be negative (which supports the previously obtained conclusion that negative energy is impossible). According to (3)

$$m = \frac{W}{c^2}$$

In other words, the mass cannot be negative.

Discussion

Magnetic charges of the same name are also attracted. But there a paradox similar to the third (an increase in the field energy when it performs positive work) does not arise due to the saving effect of electromagnetic induction, due to which the magnetic charges, and, consequently, the energy of their field, decrease [10].Needless to say, gravity does not have a frontal mechanism. Physics, of course, were confused and embarrassed by negative energy, negative firewood, negative eggs and one and a half diggers. But they are FORCED to come to terms with them. Not from a good life. UNTIL NOW, they liked to think that negative energy could eliminate the unrecoverable paradox of gravitational interaction.But! An unrecoverable paradox, it is therefore unrecoverable that it CANNOT be eliminated. After all, energy cannot be negative. And kinetic energy during a collision

of bodies from NOTHING (zero) cannot arise (the second paradox. In other words, an attempt to resolve the third paradox through unnatural negative energy necessarily gives rise to a second paradox However, there is a way out of this delicate situation.

Conclusion

The electrostatic interaction of the eponymous electric charges is NOT paradoxical. The electrostatic interaction of opposite electric charges IS paradoxical. Formula (8) eliminates this paradox. Gravitational interaction is irreparably paradoxical. This paradox (the third/second), like most paradoxes, is productive. But this is the subject of consideration for the next publication. To be continued.

Conflict of Interest

The author declare that they have no conflicts of interest.

References

1. Young A (2022) Resolving electron mass inconsistency using negative mass. Journal of Modern Physics 13: 1287-1294
2. Waegell M, Cohen E, Elitzur A, Tollaksen J, Aharonov Ya (2023) Quantum reality with negative-mass particles. Proceedings of the National Academy of Sciences of the United States of America 120
3. Beloglazova, S Yu (2026) Periodically Varying Mass Defect. Engineering Physics 3: 26-29.
4. Czarnecki A (2022) Negative energy states in pionic hydrogen. Acta Physica Polonica B, Proceedings Supplement 15: 1.
5. Yoshida Y, Suzuki Yu (2025) Optimization of a mutual induction circuit that separates zero energy into positive and negative energy. IEEJ Journal of Industry Applications 14: 888-901.
6. Bezdenezhnykh VI (2025) Comparison of strong nuclear and electric dipole interactions. Physics Education in Higher Education Institutions 31: 36-43.
7. Popov IP (2024) Full Account of the Energy of the Gravitational Field in Cosmology and Spacecraft Ballistics. Technical Physics 69: 5356.
8. Popov IP (2020) Calculation of the total energy of the electrostatic field. Proceedings of the Krylov State Scientific Center 2: 107-114.
9. Pavlov VD (2025) Modeling the mechanisms of certain gravitational effects. Mathematical and software support for systems in industrial and social spheres 13: 12-16.
10. Popov IP (2025) Theoretical and experimental discovery of the magnetic monopole and magnetic charge. Physics of Complex Systems 6: 110-115.

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