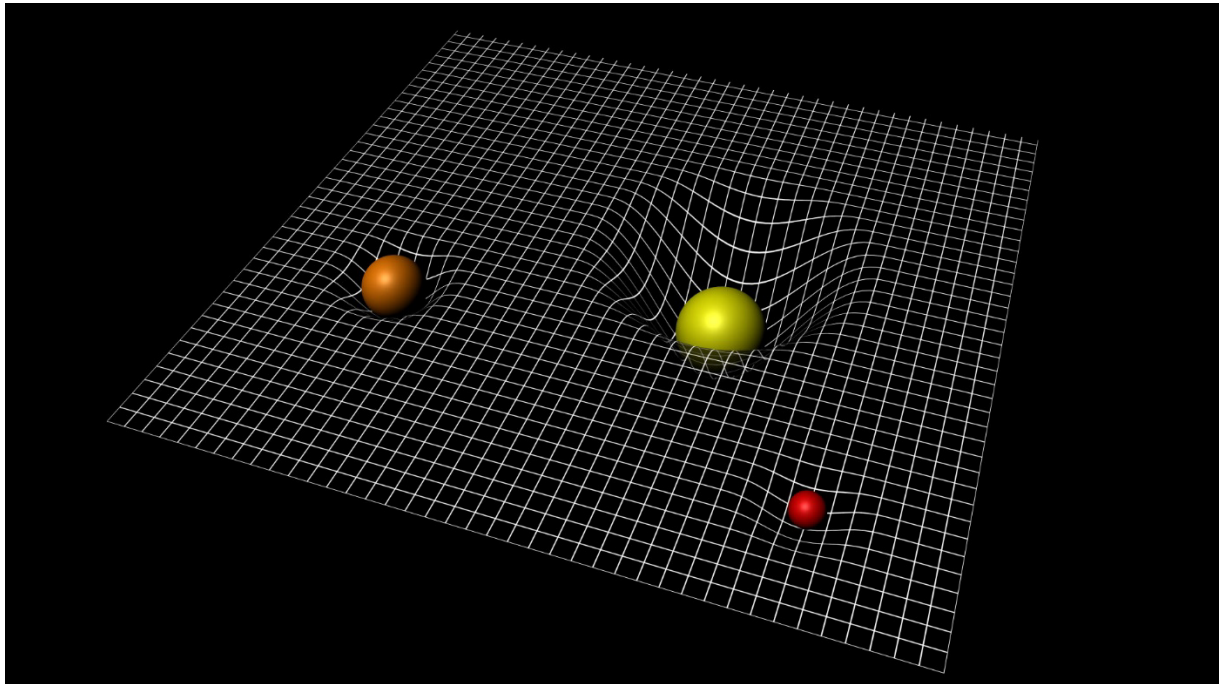


Against the Physicists, #1: On the Non-Conservation of Energy in the Curved Einsteinian Dogma

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1. Introduction

In physics, it is commonly taught that energy is conserved—the most sacred of all physical laws, the alpha and omega of natural scientific piety. Yet, in the cathedral of modern physics, General Relativity Theory (GRT) quietly dethrones this deity. The curvature of spacetime, it seems, bends not only light but logic itself. In this essay, we reconstruct the skeptical argument—in the spirit of Sextus Empiricus—that GRT both asserts and denies the law of conservation of energy. The result is equipollence (equal force of argument) between the dogmatist and the skeptic: there is no criterion to decide, and therefore we must suspend judgment (*epochē*). Ataraxia is achieved—not by faith in equations, but by disbelief in their supposed necessity.

2. When the Law Breaks the Law

Among the physicists, there is no greater commandment than this: “Energy cannot be created or destroyed.” It has survived the fall of caloric, the rise of quantum fields, and the paradigm of symmetry. Even schoolchildren repeat it as catechism.

Yet the general relativity theory—Einstein’s magnum opus—makes a quiet exception, much as an emperor declares himself above the law. For in curved spacetime, where geometry itself is dynamic, there is no global time symmetry, and thus no global energy conservation. The universe, apparently, may lose or gain energy as it pleases.

The physicist, of course, denies this — or rather, equivocates. “Energy is conserved *locally*,” he/she insists, meaning that within an infinitesimal region of spacetime, the covariant divergence of the energy-momentum tensor vanishes:

The Covariant Derivative of the Energy-Momentum Tensor is Zero.
(Symbolically: $\nabla_{\mu} T^{\{\mu\nu\}} = 0$.)

But this is a bookkeeping identity, not a global law. The skeptic therefore begins his attack.

3. The Dogmatist’s Position

The physicist, like the Stoic of old, defends his doctrine with an appeal to order. “Nothing is lost,” he proclaims, “for Noether’s Theorem guarantees that every continuous symmetry corresponds to a conserved quantity. Time translation symmetry gives energy conservation.”

In special relativity theory, this seems irrefutable. Minkowski spacetime admits a global time-like “Killing” vector; energy conservation follows cleanly. The energy-momentum tensor’s divergence vanishes, and integration over space yields a constant total energy.

Even in the general relativity theory (GRT), the physicist seeks refuge in special cases: asymptotically flat spacetimes, where infinity behaves itself. There, he defines total energy via the ADM mass (Arnowitt, Deser, and Misner, 1962) or the Bondi–Sachs mass for radiating systems. Misner, Thorne, and Wheeler assure him that “energy is a global concept defined at infinity” (Misner, Thorne, and Wheeler, 1973). The believer rests easy.

To the skeptic, however, this is theological hair-splitting: infinity is a long way to go for a definition.

4. The Skeptic’s Counter-Argument

The skeptic, in the manner of Sextus Empiricus, points out that the dogmatist’s confidence exceeds his/her comprehension.

(4a) No Global Time-like “Killing” Vector

In a generic curved spacetime, there is no global symmetry under time translation. Without such a symmetry, Noether’s theorem provides no conserved charge. To insist otherwise is to demand invariance where none exists — an act of metaphysical optimism.

(4b) Pseudotensors and Coordinate Idolatry

Unable to define energy covariantly, the physicist invents “energy–momentum pseudotensors” — objects whose values depend on coordinate choice. As Landau and Lifshitz warned, these are not true tensors (Landau and Lifshitz, 1975). Feynman admits: “There is no unique way to define the energy of the gravitational field in general relativity” (Feynman, 1995: p. 227. This is not a law, but a confession.

(4c) Cosmological Expansion and the Vanishing Sum

In the expanding Friedmann–Lemaître–Robertson–Walker universe, total energy is undefined. As the cosmos expands, photons redshift; their energy drains away; comoving energy density scales as a^{-4} ; total energy undefined due to lack of time-like Killing vector.

Where does it go? “Into the expansion of space,” say the faithful — as if space were a cosmic piggy bank. Yet no global ledger exists to balance the books.

(4d) Gravitational Waves and the Phantom Ledger

When LIGO detects gravitational waves, physicists say they carry energy. But where was that energy “stored” before emission, if the gravitational field itself has no localizable energy density? The answer is a shrug, or a pseudotensor.

Thus, the skeptic concludes: GRT offers *appearances* of conservation, but no substance.

5. Equipollence: The Equal Strength of Opposites

Following the Pyrrhonian method, we now balance appearance against appearance.

(5a) Dogmatist's Assertion and Skeptic's Reply

Dogmatist's Assertion

Energy is conserved locally via $\nabla \cdot T = 0$.

ADM and Bondi masses define total energy.

Pseudotensors provide energy-momentum density.

Experiments confirm GRT.

Skeptic's Reply

The river conserves, locally, water, yet the sea gains what the river loses.

Only in asymptotically flat spacetimes—an exceptional class. The cosmos is not one of them.

They depend on coordinates; by a clever choice, energy may appear or vanish.

They confirm curvature, not conservation. No experiment measures "total gravitational energy."

In short:

Dogmatist's Assertion: " $\nabla_{\mu} T^{\{\mu\nu\}} = 0$ guarantees local conservation; integrate via Komar or ADM at infinity."

Skeptic's Reply: "The integral vanishes in FLRW; "infinity" is a coordinate mirage, not a physical ledger." In the face of such equipollence, judgment must be suspended.

The physicist's belief and the skeptic's doubt are equally supported; therefore, neither can claim certainty.

6. The Self-Undermining of GRT

Here the skeptic turns the blade inward: even if we grant GRT's truth, it subverts its own coherence.

If energy is not conserved globally, then what ensures the causal order of events? If spacetime can "gain" or "lose" energy without account, might not effects arise without causes? Yet GRT is prized for its deterministic field equations. The theory thus rests on the stability it cannot justify.

Moreover, the physicist who denies absolute conservation in curved spacetime nevertheless invokes it in practice—when computing orbits, interpreting radiation, or maintaining that "nothing comes from nothing." This double life, between theory and application, is precisely the inconsistency Sextus delighted to expose among the Dogmatists.

7. The Sextus Resolution

The skeptic does not seek to destroy physics, but instead only to loosen its grip on belief. He observes that “energy” is not an observable in GRT, merely a convenience imported from the flat world of habit. As Sextus wrote of the philosophers, “They affirm what is not evident and deny what appears,” i.e., “οὔτε τὸ εἶναι οὔτε τὸ μὴ εἶναι.”

Likewise, the physicist affirms that energy is conserved, though his own equations deny him the means to define it universally. He speaks of the “energy of spacetime,” yet spacetime, having no material substrate, possesses no measurable energy.

Therefore, the wise stance is suspension of judgment—not denial, but freedom from dogma. The universe appears orderly enough for our purposes; whether energy is truly conserved or not is a question without answer, and thus without anxiety.

8. Conclusion: Ataraxia in the Age of Einstein

When the ancient skeptic looked upon the quarrels of the philosophers, he saw that each refuted the other with equal force. From this equipollence arose ataraxia—peace of mind.

So too today: the physicists quarrel about the energy of the gravitational field, invent pseudotensors, and retreat to infinity to preserve a symmetry that reality denies.

The skeptic, observing their confusion, smiles.

He/she drives no stake through the heart of relativity; he/she merely points out that its heart cannot be found. And from this recognition—that even our most brilliant theories contradict their own idols—he/she attains a serenity unknown to the dogmatist. The dogmatist clutches his pseudotensor; the skeptic points to the vanishing integral. One sees law where the other sees ledger. Both arguments stand in perfect opposition—*isostheneia*. The wise person, therefore, suspends: energy is neither conserved nor destroyed, for in curved spacetime it is not even defined. Thus, in the curved spacetime of thought, conservation of certainty fails as surely as conservation of energy.

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