Review of: "On the Mass of (Gravitational) Potential Energy"

Carlos Álvarez-Macías[1]

1 Instituto Tecnólogico de La Laguna, Torreón, Mexico

Potential competing interests: No potential competing interests to declare.

As for the format, the figures are listed in the text (on pages 2, 4, 5, 6, 9, and 11), but the legend of each figure is missing. As for equation 1, it is repeated in the enumeration.

As for the abstract, the general structure for the introduction effectively sets up the problem, but you might consider ending it with a more explicit statement of your paper's goals or hypothesis, such as, “In this paper, we argue that potential energy does increase the mass of the bodies in a system and propose a framework for understanding how this mass is distributed.”

Your first example is effective in demonstrating the apparent conflict between the field energy interpretation of potential energy and the constraints of special relativity. However, you could strengthen the argument by explicitly stating how this contradicts the relativistic requirement of causality. You’ve already established that the potential energy cannot be retrieved instantaneously from beyond the radius (Equation 2). To emphasize the inconsistency, you might add: "This suggests that if potential energy were genuinely stored in the field, it would imply superluminal (faster-than-light) propagation of energy retrieval, directly violating the principles of causality upheld by special relativity." This clarification would make your argument more accessible and reinforce why this poses a fundamental problem.

The derivation leading to “ mh ≃ m+mgh c^2” is a crucial result that connects the change in mass with gravitational potential energy. While you correctly recover the classical expression for small hhh, it might be helpful to briefly comment on the physical implications of the exponential form for larger hhh. For example, you could add: "The exponential relationship suggests that at larger distances, the contribution of gravitational potential energy to the total mass becomes increasingly significant, reflecting the inherently relativistic nature of energy-mass equivalence in gravitational fields. This result highlights how even in classical systems, relativistic effects can subtly influence the total energy-mass relationship."

As for the conclusion, the argument connecting kinetic and potential energy transfer and how it affects mass distribution, particularly using the relation (Equation 16), is well-developed. However, you might want to emphasize how this is consistent with the principle of conservation of momentum and energy, reinforcing the plausibility of your hypothesis. You could add: "This proportionality not only emerges naturally from our thought experiments but also upholds the principles of energy and momentum conservation in closed systems, lending further credibility to the idea that potential energy manifests as increased mass in direct relation to the displacement and mass ratios of interacting bodies."

To add the work, it is suggested: "While our analysis has predominantly used the weak-field approximation consistent with classical mechanics, it is worthwhile to consider how general relativity treats energy in gravitational fields. In Einstein's field equations, the stress-energy tensor encompasses all forms of energy, including potential energy contributions. Thus, our suggestion that potential energy contributes to the mass of a body aligns with the relativistic treatment of energy as an inseparable component of a body's gravitational influence."