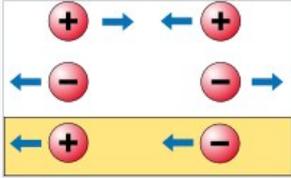


Chapter 17

Negative Mass in General Relativity

Hermann Bondi



In general relativity there is no obvious reason why masses shouldn't be negative, so we will investigate this concept. We can get three definitions of mass: inertial mass, passive gravitational mass on which the field acts and active gravitational mass which is the source of the field. In Newtonian theory, due to action and reaction, passive and active gravitational masses must be the same. The fact that passive and inertial masses are the same is the consequence of experiments. In general relativity, passive and inertial masses are the same due to the principle of equivalence. The first place where active gravitational mass occurs is the m in the Schwarzschild solution. There is no action and reaction principle, and we know that active and passive masses may not be equal. In Newtonian theory, the most obvious notion of a negative mass is similar to charge; like masses attract and unlike repel. In general relativity, a negative mass repels all masses, a positive attracts all. If we have a system with one mass of each type, the system will uniformly accelerate. I have constructed an exact solution of the field equations which shows these properties. The solution fills only one-fourth of space-time. I have found a method of continuing the solution into the other regions.

BERGMANN: I think one can show that within the general theory, it is not possible to have the active and passive masses different.

BONDI: This is a question of conservation of momentum, which means integrals over extended regions of space. But what do you say about the Schwarzschild interior solution where the m is certainly not just the integral of the g_{00} ?

GOLD: What happens if one attaches a negative and positive mass pair to the rim of a wheel? This is incompatible with general relativity, for the device gets more massive.

BONDI: The purpose of this is to show that negative mass is incompatible, but I haven't got there yet.

Two questions to 'Negative Mass in General Relativity', by Hermann Bondi. In *The Role of Gravitation in Physics*. Report from the 1957 Chapel Hill Conference, p. 159.

With the benefit of the hindsight, may I ask two questions.

Why (i) "passive gravitational mass on which the field acts" and (ii) "active gravitational mass which is the source of the field" (Hermann Bondi) are considered 'the same', despite the faulty principle of equivalence (John Synge) and the perpetual energy-momentum *non-conservation* due to "the *intangible* energy of the gravitational field" (Hermann Bondi)?



I believe the passive (i) and active (ii) masses *might* be 'the same' (Peter Bergmann) iff Peter Bergmann or any of his colleagues at the 1957 Chapel Hill Conference had rigorously proven the geodesic hypothesis under perpetual energy-momentum *non-conservation* (Hans Ohanian). Is this an open question in GR?

Read p. 6 in my online article [Can Geometry Produce Work?](#) and notice the *fusion* of passive & active positive mass as 4D "glove" denoted Q, from P → Q relation explained at p. 2 [therein](#).



This is the path to quantum gravity – read my endnote [here](#). Regrettably, the old days of 1950s, when theoretical physicists were genuinely interested in Physics, will never come back. People are now interested only in their petty hobbies, claiming that have captured some 'essential germ of truth'. They publish "[academic studies](#)" and speculate about some "[mystery matter](#)" only to get their [Nobel Prize](#), after which they focus on food and toilet paper, or on [renormalizable](#) perturbative quantum gravity based on "[gravitons](#)" with mass $m_g \leq 7.7 \times 10^{-23} \text{ eV}/c^2$, whichever comes first. The latest feedback to my work came eight years ago from Prof. Dr. [Maurice de Gosson](#) at the University of Vienna: "Buzz off, idiot!" (Mon, 21 May 2012 18:47:46 +0200). So be it.

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