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A Quantum Mechanical Approach to the Existence of Negative Mass and Its Utilization in the Construction of Gravitationally Neutralized Bodies

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SUMMARY PARAGRAPH

A quantum mechanical theory of negative mass is developed, based on the assumptions that gravitational interactions obey the laws of quantum mechanics, and that all possible interactions of negative and positive mass with themselves and each other follow the well known inverse square law. This theory explains the experimental fact that negative mass has never been observed, and outlines plausible experimental methods of determining the existence of negative mass and utilizing it in the construction of gravitationally neutralized bodies.

Since the overwhelming majority of electrostatic quantum mechanical effects rely for their existence on an interplay of attractive and repulsive forces arising from two types of charge, few, if any, fruitful results could come from a quantum mechanical investigation of gravity, unless there should be two types of mass. The first type, positive mass, (hereafter denoted as posimass)retains all the properties attributed to ordinary mass, while the second type, negative mass (hereafter denoted as negamass) differs only in that its mass is an inherently negative quantity. By considering the quantum mechanical effects of the existence of these two types of mass, a fruitful theory of gravity will be developed. This theory will explain why negamass has never been observed, and will offer a theoretical foundation to experimental methods of detecting the existence of negamass and utilizing it in the production of gravitationally neutralized bodies.

To achieve these results, recourse will be made to Schroedinger's time independent equation with the center of mass motion removed. This equation is:

$$-\hbar^2/2\mu \, \nabla^2 \Psi + V \Psi = E \Psi$$

where all symbols represent the conventional quantum mechanical quantities. Particular attention will be paid to the reduced mass $\mu = \frac{m_1 m_2}{m_1 + m_2}$, where m_1 and m_2 are the masses of the two interacting bodies.

One can approach the first obstacle that any theory of negamass faces, namely the explanation of why negamass has never been observed, by a consideration of how material bodies would be formed if a region of empty space were suddenly filled with many posimass and negamass quanta. To proceed along these lines, one must first understand the nature of the various possible quantum mechanical interactions of posimass and negamass.

Inserting the conventional gravitational interaction potential into Schroedinger's equation and solving for the wave function Ψ, yields the result that the probability of two posimass quanta being close together is greater than the probability of their being separated. Hence, there is said to be an attraction between pairs of posimass quanta. By a similar calculation it can be shown that while the potential form is the same two negamass quanta repel each other. This arises from the fact that the reduced mass term in Schroedinger's equation is negative in this latter case. The type of negamass-posimass interaction is found to depend on the relative sizes of the masses of the interacting posimass and negamass quanta, being repulsive if the mass of the negamass quantum is greater in absolute value than the mass of the posimass quantum, and attractive in the opposite case. If the two masses are equal in absolute value, the reduced mass is infinite and Schroedinger's equation reduces to $(V-E)\psi = 0$. Since the solution $\psi = 0$ is uninteresting physically, it must be concluded that $V = E$, and, hence, there is no kinetic energy of relative motion. Thus, while there is an interaction potential between the equal mass posimass and negamass quanta, it results in no relative acceleration and thus, no mutual attraction or repulsion. While much could be said about the philosophical implications of the contradiction between this result and Newton's Second Law, such discussion is out of the scope of the present paper, and the author shall, instead, return with the above series of derivations to a consideration of the construction of material bodies in a region suddenly filled with many posimass and negamass quanta.

Because of the nature of the posimass-posimass and negamass-negamass interactions, the individual posimass quanta soon combine into small posimass spheres, while nothing has, as yet, united any negamass quanta. Since it is reasonable to assume that a posimass sphere weighs more than a negamass quantum in absolute value, it will attract negamass quanta and begin to absorb them. This absorption continues until the attraction between a sphere and the free negamass quanta becomes zero due to the reduced mass becoming infinite. The reduced mass becomes infinite when the sphere absorbs enough negamass quanta to make the algebraic sum of the masses of its component posimass and negamass quanta equal to the negative of the mass of the next incoming negamass quantum. Thus, the theory predicts that all material bodies after absorbing as many negamass quanta as they can hold, weigh the same very small amount, regardless of size.

Since this prediction is in violent disagreement with experimental fact, one must conclude that the equilibrium arising as a result of the reduced mass becoming infinite has not yet been reached. That is, assuming that negamass exists at all, there are not enough negamass quanta present in the universe to allow posimass spheres to absorb all the negamass they can hold. One is thus able to explain the experimental fact that negamass has never been observed by deriving the above mechanism in which the smaller amounts of negamass that may be present in the universe are strongly absorbed by the greater amounts of posimass, producing bodies composed of both posimass and negamass, but which have a net positive, variable, total mass.

Having thus explained why negamass has never been observed in the pure state, it is next desirable to derive an experimental test of the existence of negamass through considering the internal quantum mechanical problem of small amounts of negamass in larger posimass spheres. One is able to gain much physical insight into this problem by simplifying it to the qualitatively similar problem of one negamass quantum in the field of two posimass quanta that are a fixed distance apart. Further simplification from three dimensions to one dimension and replacement of the posimass quanta potentials by square barriers, yields a solution in which the ground state energy E_o, of the negamass quantum in the field of one posimass quantum, is split into two energy levels in the field of the two posimass quanta. These two levels correspond to even and odd parity solutions of the wave equation, where E_{even} lies higher and E_{odd} lower than E_o. The magnitudes of the differences $E_{even}-E_o$ and E_o-E_{odd} depend on the separation distance between the two posimass quanta, being zero for infinite separation and increasing as this separation distance is decreased.

Since the energy of a system involving negamass tends to a maximum in the most stable quantum mechanical configuration, the negamass quantum will normally be in state E_{even}. When the system is excited into state E_{odd}, the negamass quantum will favor the situation in which the two posimass quanta are as far apart as possible, since E_{odd} increases with increasing separation distance between the two posimass quanta, and the system tends toward the highest energy state. Thus, independent of, and in addition to the attractive posimass-posimass gravitational interaction, there is a repulsive quantum mechanical exchange interaction between pairs of posimass quanta, when the system is in state E_{odd}. The result of these two oppositely directed interactions is that the two posimass quanta are in stable equilibrium at some separation distance. Since this equilibrium occurs between all posimass pairs in an elementary particle, a necessary consequence of the existence of negamass is that, when in the first excited state, elementary particles have a partial crystal structure.

This theoretical conclusion is capable of experimental verification by performing a Bragg analysis of the elementary particle crystal structure through shining high energy gamma rays on hydrogen. Part of the gamma ray energy will be utilized in lowering the system from energy E_{even} to E_{odd}, and if selective reflection is observed, it will constitute a striking verification of the existence of negamass. An order of magnitude calculation shows that, if the equilibrium distance between pairs of posimass quanta is one-one millionth the radius of an electron, 100 bev gamma rays will be required to perform this experiment.

Having discussed why negamass has never been observed, and having derived an experimental test of its existence, it is next desirable to develop an experimental method of utilizing negamass in the production of gravitationally neutralized bodies by further consideration of some ideas previously advanced. It has been pointed out that if a source of negamass is present, a posimass sphere continues to absorb negamass quanta until equilibrium is reached as a result of the reduced mass becoming infinite. Because the sphere thus produced is practically massless, and because the gravitational interaction between two bodies is proportional to the product of their respective masses, it follows that the sphere is practically uneffected by the presence of other bodies. And thus, the problem of making gravitationally neutralized bodies is reduced to the problem of procuring a source of negamass quanta. This will be the next problem discussed.

The binding energy of a negamass quantum in a posimass sphere may be obtained as one of the eigenvalue solutions to Schroedinger's Equation. If the negamass quanta in a body are excited to energies in excess of this binding energy by shining sufficiently energetic gamma rays on the body, these negamass quanta will be emitted and a negamass source will thus be obtained.

To estimate the gamma ray energy required to free a negamass quantum from a posimass body, certain assumptions must be made concerning the size and mass of posimass and negamass quanta. Since these quantities are extremely indefinite, and since the whole theory is at best qualitative, attempting to estimate the energy would be a senseless procedure. Suffice it to say that, because of the intimate, sub-elementary particle nature of the posimass-negamass interaction, it seems reasonable to assume that quite energetic gamma rays will be required to break this strong bond.

To briefly review what has been shown, a quantum mechanical theory of negamass has been developed, based on the assumptions that gravitational interactions obey the laws of quantum mechanics and that all possible interactions of negamass and posimass with themselves and each other follow the well known inverse square law. This theory explains the experimental fact that negamass has never been observed, and outlines plausible experimental methods of determining the existence of negamass and utilizing it in the construction of gravitationally neutralized bodies. While these experimental methods may perhaps be out of the realm of practicality at the present, there is every reason to hope that they will be performable in the future. At that time, the plausibility of the existence of negamass and the theory behind the construction of gravitationally neutralized bodies from it, will meet their final tests.