ON THE GENERAL COVARIANCE OF MASS:

LENR AS A SCATTERING THEORY.

by

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ABSTRACT

It is argued that mass is a generally covariant quantity defined by geometry. The ECE duality equations of particle scattering theory show that wave particle dualism is self consistent in particle scattering if and only if one particle is theoretically massless. When a particle of mass m is scattered from an initially stationary particle of the same mass m, wave particle dualism becomes severely self inconsistent. This problem is addressed with the concept of covariant mass in order to seek a self consistent theory and applied to low energy nuclear reactions (LENR).

Keywords: ECE theory, wave particle dualism, scattering theory, Compton scattering.

UFT 246

1. INTRODUCTION

In recent papers of this series of two hundred and forty five papers to date {1 - 10} it has been shown that wave particle dualism becomes severely self-inconsistent in the foundational theory of relativistic particle scattering. The concept of wave particle dualism appears to be self consistent if and only if a massless particle is scattered from a particle with mass. If the massive particle is initially stationary the resultant theory is that of the well known Compton effect. However, in the more general case {1 - 10} of relativistic scattering of a particle of mass m_1 from a particle of mass m_2, wave particle dualism collapses entirely, the theory becomes wildly self inconsistent. This was first shown in 2010 in UFT158 to UFT170 of this series. In UT244 it was shown that wave particle dualism in general violates the law of conservation of total energy at a foundational level, and therefore at all levels up to quantum electrodynamics and other more elaborate theories of particle scattering, including Higgs theory. So there can be no Higgs boson in nature, as is well known and accepted by the great majority of objective scientists.

In order to begin to address the problem of the collapse of wave particle dualism, ECE unified field theory was applied in UFT158 to UFT170 using the concept of generally covariant mass. This course was pursued in order to retain intact the theories of special relativity and quantum mechanics. These two famous theories work very well when considered in certain contexts in physics, and for this reason are thought to be precise in those albeit narrowly defined contexts. Wave particle dualism rests on quantum mechanics as is well known. However, in UFT158 to UFT170 the ECE duality equations were introduced, these are based straightforwardly on the well known de Broglie equation for the rest mass of a particle, including the photon with mass:

$$E_0 = \hbar \omega_0 = mc^2 \quad -(1)$$

It is well known {1 - 10} that Eq. (1) puts together quantum mechanics and special relativity. Here E_0 is the total energy, $\hbar$ the reduced Planck constant, ω_0 is the angular frequency of the matter wave, m is the rest mass and c is the universal constant defined in standards laboratories and known as the vacuum speed of light.

The duality equations of ECE theory {1 - 10} are:

$$\underline{p} = \hbar \underline{\kappa} = \gamma m \underline{v} \quad -(2)$$

$$E = \hbar \omega = \gamma mc^2 \quad -(3)$$

and develop Eq. (1) straightforwardly to a more general theory of wave particle dualism. They are based on the well known argument {11} that the most fundamental concept in special relativity is the relativistic momentum $\underline{p}$ defined in the first duality equation (2). Here $\underline{v}$ is the velocity and

$$\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2} \quad -(4)$$

is the well known Lorentz factor {11}. Note carefully that $\underline{p}$ is a kinetic concept. The potential energy does not appear in Eqs. (2) and (3). The momentum $\underline{p}$ in the wave particle dualism of de Broglie is $\hbar$ multiplied by the wave vector $\underline{\kappa}$. So Eq. (2) follows immediately. It is well known that the total relativistic energy E in special relativity is obtained directly from the relativistic momentum $\underline{p}$. The well known details are given in Note 246(10) accompanying this paper. Note 246(10) also contains other well known details of the fundamentals of special relativity. The total, kinetic, relativistic energy E in special relativity is a re expression of the total, kinetic, relativistic momentum $\underline{p}$, so it is important to realize that $\underline{p}$ and E express the same thing precisely, in different ways. Therefore:

$$\underline{p} = \gamma m \underline{v} \Rightarrow E = \gamma m c^2 \quad - (5)$$

and

$$E^2 = \gamma^2 m^2 c^4 = c^2 p^2 + m^2 c^4 \quad - (6)$$

The rest energy

$$E_0 = m c^2 \quad - (7)$$

emerges from the kinetic momentum, and is part of the re expression of kinetic momentum manifested in the format (6). So the rest energy is a kinetic concept. The second duality equation of ECE, Eq. (3) follows immediately. Comprehensive background detail is given as usual in the Notes accompanying UFT246 on www.aias.us.

In Section 2 the concept of generally covariant mass is developed by considering the well known general covariance of Cartan geometry {12}. It is shown that mass is a generally covariant concept that is defined straightforwardly by Cartan geometry. In special relativity, mass is an invariant of the Poincaré group {1 - 10}, the first Casimir invariant. The concept of massless particle violates geometry in ECE theory. In the second duality equation (3) the concept of massless particle leads to a well known mathematical indeterminacy known as the hyper relativistic limit, in that a massless particle travels at c. The massless particle is well known to cause multiple difficulties {1 - 10}, such as an unphysical E(2) little group of the Poincaré group, and the massless photon leads to a four dimensional geometry that contains only two transverse dimensions. This is complete nonsense, or cult science. It is now well known that much of what is optimistically claimed to be standard physics is cult physics. There has been a catastrophic loss of realism in natural philosophy caused by neglecting the Baconian fundamentals and the bizarre overuse of adjustables and unknowables. A short review is given of the violation of conservation of energy in particle scattering, and a new theory of scattering is initialized, one based on covariant mass. Therefore equal mass scattering is accompanied in this theory by transmutation, and this may have a bearing on low energy nuclear reactions.

In Section 3 some graphics and numerical analysis of the new theory is given.

2. GENERAL COVARIANCE OF MASS IN PARTICLE SCATTERING

Consider the tetrad postulate of Cartan geometry {1 - 10, 12}:

$$D_\mu q^a_\nu = 0. \quad -(8)$$

This is generally covariant, i.e. it is true in all frames of reference (Note 246(3)), so:

$$D_{\mu'} q^{a'}_{\nu'} = 0. \quad -(9)$$

It follows that:

$$\partial_{\mu'} q^{a'}_{\nu'} = \Gamma^{a'}_{\mu'\nu'} - \omega^{a'}_{\mu'\nu'} \quad -(10)$$

where:

$$\omega^{a'}_{\mu'\nu'} = \omega^{a'}_{\mu' b'} q^{b'}_{\nu'} \quad -(11)$$

$$\Gamma^{a'}_{\mu'\nu'} = \Gamma^{\lambda'}_{\mu'\nu'} q^{a'}_{\lambda'}. \quad -(12)$$

By differentiating Eq. (10):

$$\square' q^{a'}_{\nu'} = \partial^{\mu'}\left(\Gamma^{a'}_{\mu'\nu'} - \omega^{a'}_{\mu'\nu'}\right). \quad -(13)$$

Now define the quantity R' by:

$$R' := q^{\nu'}_{a'} \partial^{\mu'}\left(\omega^{a'}_{\mu'\nu'} - \Gamma^{a'}_{\mu'\nu'}\right) \quad -(14)$$

to obtain the ECE wave equation {1 - 10} in the transformed frame of reference:

$$(\square' + R') q^{a'}_{\nu'} = 0. \quad -(15)$$

The generally covariant mass m' in the transformed frame is defined by:

$$R' := \left(\frac{m'c}{\hbar}\right)^2 \quad -(16)$$

so mass is the geometrical quantity:

$$m'^2 = \left(\frac{\hbar}{c}\right)^2 q^{\nu'}_{a'} \partial^{\mu'}\left(\omega^{a'}_{\mu'\nu'} - \Gamma^{a'}_{\mu'\nu'}\right). \quad -(17)$$

The frame invariant quantity of the tetrad postulate is zero, so:

$$(\square + R) q^{a}_{\nu} = (\square' + R') q^{a'}_{\nu'} = 0 \quad -(18)$$

and the general covariance of the ECE wave equation is therefore:

$$D_\mu q^{a}_{\nu} = D_{\mu'} q^{a'}_{\nu'} = 0. \quad -(19)$$

In general:

$$R' \neq R, \; \square' \neq \square, \; q^{a}_{\nu} \neq q^{a'}_{\nu'} \quad -(20)$$

so in general:

$$m'^2 \neq m^2. \quad -(21)$$

The mass of a particle can change if the quantity R (loosely known as "curvature") changes. So when two particles collide, the curvature may change and their mass may change.

If a particle is initially at rest, i.e. is not moving with respect to a frame of reference, its mass is known as the rest mass m. If the mass moves with respect to the frame, the frame moves with respect to the mass, and there is a frame transformation from a static to a moving frame. It follows that:

$$\frac{R'}{R} = \left(\frac{m'}{m}\right)^2 = \frac{q^{\nu'}_{a'}\, \partial^{\mu'} \left(\omega^{a'}_{\mu'\nu'} - \Gamma^{a'}_{\mu'\nu'}\right)}{q^{\nu}_{a}\, \partial^{\mu} \left(\omega^{a}_{\mu\nu} - \Gamma^{a}_{\mu\nu}\right)} \quad -(22)$$

The individual quantities transform as {1 - 10, 12}

$$\partial^{\mu'} = \frac{\partial x^{\mu'}}{\partial x^{\mu}}\, \partial^{\mu}, \quad q^{\nu'}_{a'} = \frac{\partial x^{\nu'}}{\partial x^{\nu}}\, \Lambda^{a}_{a'}\, q^{\nu}_{a} \quad -(23)$$

where $\Lambda^{a}_{a'}$ is the Lorentz transform matrix {12}. The connections transform as:

$$\Gamma^{\nu'}_{\mu'\lambda'} = \frac{\partial x^{\mu}}{\partial x^{\mu'}} \frac{\partial x^{\lambda}}{\partial x^{\lambda}} \frac{\partial x^{\nu'}}{\partial x^{\nu}}\, \Gamma^{\nu}_{\mu\lambda} - \frac{\partial x^{\mu}}{\partial x^{\mu'}} \frac{\partial x^{\lambda}}{\partial x^{\lambda}} \frac{\partial^2 x^{\nu'}}{\partial x^{\mu} \partial x^{\lambda}} \quad -(24)$$

and

$$\omega^{a'}_{\mu b'} = \Lambda^{a'}_{a}\, \Lambda^{b}_{b'}\, \omega^{a}_{\mu b} - \Lambda^{c}_{b'}\, \partial_{\mu}\, \Lambda^{a'}_{c} \quad -(25)$$

with:

$$\omega^{a'}_{\mu' b'} = \frac{\partial x^{\mu}}{\partial x^{\mu'}}\, \omega^{a'}_{\mu b'}. \quad -(26)$$

To apply this fundamental geometry to particle scattering consider, firstly, equal particle scattering as in UFT160 and UFT244. For the scattering of a particle of mass m_1 from an initially stationary particle of mass m_2, the equations of conservation of total energy and momentum are:

$$\gamma m_1 c^2 + m_2 c^2 = \gamma' m_1 c^2 + \gamma'' m_2 c^2 \quad -(27)$$

and

$$\underline{p} = \underline{p}' + \underline{p}'' \quad -(28)$$

where the Lorentz factors are defined by:

$$\gamma = \left(1 - \frac{v^2}{c^2}\right)^{-1/2}, \quad \gamma' = \left(1 - \frac{v'^2}{c^2}\right)^{-1/2}, \quad \gamma'' = \left(1 - \frac{v''^2}{c^2}\right)^{-1/2} \quad -(29)$$

Here $\underline{v}$ is the initial velocity of the incoming particle m, $\underline{v}'$ is the scattered velocity of particle m_1, and $\underline{v}''$ is the scattered velocity of particle m_2. The initial momentum of particle m_2 is zero, and the scattered momenta are $\underline{p}'$ and $\underline{p}''$. Solving Eqs. (27) and (28) simultaneously using the ECE duality equations (2) and (3) leads to the expression first derived in UFT160:

$$x_2 = \frac{1}{\omega - \omega'}\left(\omega\omega' - \left(x_1^2 + (\omega^2 - x_1^2)^{1/2}(\omega'^2 - x_1^2)^{1/2} \cos\theta\right)\right) \quad -(30)$$

where:

$$x_1 = \frac{m_1 c^2}{\hbar}, \quad x_2 = \frac{m_2 c^2}{\hbar}. \quad -(31)$$

The complete details are given for ease of reference in Note 246(6) accompanying UFT246 on www.aias.us.

In the special case:

$$x_1 = 0 \quad -(32)$$

the Compton formula is regained correctly:

$$x_2 = \frac{\omega\omega'}{\omega - \omega'}(1 - \cos\theta) \quad -(33)$$

For ease of reference the original Compton theory is given in Note 246(9), and leads to the famous Eq. (33) for which Compton was awarded the Nobel Prize for proving that the photon is a particle. So the ECE wave particle duality equations (2) and (3) reduce to the Compton formula when one particle is massless. However a massless particle causes multiple difficulties in other contexts as reviewed already in the introduction. Physics must always be looked at in all contexts. However, wave particle dualism collapses completely when we consider Eq. (30) with:

$$m = m_1 = m_2 \,, \quad \theta = \frac{\pi}{2} \qquad -(34)$$

i.e. when we consider equal mass scattering at right angles. This was first done in UFT160. Then Eq. (30) gives:

$$x_1 = \omega' \,, \text{ or } x_1 = -\omega \,. \qquad -(35)$$

In UFT244 it was shown that Eq. (35) leads to a violation of the theorem of conservation of total energy. If the physical solution is taken to be:

$$x_1 = \omega' \qquad -(36)$$

then from the second ECE duality equation (3):

$$x_1 = \gamma' \frac{mc^2}{\hbar} \qquad -(37)$$

However, from Eq. (31):

$$x_1 = \frac{mc^2}{\hbar} \qquad -(38)$$

Solving Eqs. (37) and (38) simultaneously gives the result:

$$v' = 0. \qquad -(39)$$

From Note 246(1) accompanying UFT246 on www.aias.us the equal mass scattering equations give:

$$\cos^2\theta = \frac{x^2 - (\omega' - \omega)x - \omega\omega'}{x^2 + (\omega' - \omega)x - \omega\omega'} \quad -(40)$$

where

$$x = x_1 = x_2 = mc^2/\hbar. \quad -(41)$$

In order that:

$$0 \leq \cos^2\theta \leq 1 \quad -(42)$$

it follows that:

$$\omega' \geq \omega. \quad -(43)$$

From Eq. (36):

$$x = \omega' \quad -(44)$$

so it follows self consistently for right angle scattering that:

$$\cos^2\theta = 0. \quad -(45)$$

However:

$$x = \omega_0 = mc^2/\hbar \quad -(46)$$

where ω_0 is the rest frequency of the electron, so:

$$\omega' = \omega_0 \quad -(47)$$

and:

$$\omega_0 < \omega \quad -(48)$$

so

$$\omega' < \omega \quad -(49)$$

in contradiction to Eq. (43), and it follows that:

$$\cos^2\theta >?\ 1 \quad -(50)$$

which is absurd. Therefore wave particle dualism becomes absurd when a particle of mass m is scattered at right angles from another particle of mass m.

In order to apply the idea of generally covariant mass to this newly discovered foundational problem in physics consider the equations:

$$\gamma mc^2 + mc^2 = \gamma' m_1 c^2 + \gamma'' m_1 c^2 \quad - (51)$$

and

$$\underline{p} = \underline{p}' + \underline{p}'' \quad - (52)$$

which mean that if the mass is originally the rest mass m, it is transmuted by collision to scattered particles of mass m_1 with conservation of total energy and momentum. Complete details of the simultaneous solution of Eqs. (51) and (52) are given in Note 246(7) accompanying UFT246 on www.aias.us. , and this solution was checked by computer algebra.

Denoting:

$$x_1 = m_1 c^2 / \hbar \quad - (53)$$

and:

$$x = mc^2 / \hbar \quad - (54)$$

then the solution is:

$$x_1^2 = \omega'^2 - \frac{(\omega' - \omega_0)^2 (\omega + \omega_0)}{(\omega - \omega_0)\cos^2\theta} \quad - (55)$$

The mass of the particle after scattering is:

$$m_1 = \frac{\hbar}{c^2} x_1 \quad - (56)$$

so the change in mass caused by scattering is:

$$\Delta m = \frac{\hbar}{c^2} x_1 - m = m_1 - m . \quad - (57)$$

From Eq. (55) it is seen that x_1^2 is negative valued because:

$$\omega' > \omega_0 , \quad \omega > \omega_0 \quad - (58)$$

and

$$0 \leq \cos^2\theta \leq 1 \quad - (59)$$

It is always possible however to define:

$$R := -\left(\frac{mc}{\hbar}\right)^2 \quad - (60)$$

in which case the ECE equation becomes:

$$(\square - R)\, q^a_\mu = 0 \quad - (61)$$

and the covariant mass after scattering becomes the positive valued:

$$m_1 = \frac{\hbar}{c^2}\left(\frac{(\omega' - \omega_0)^2(\omega + \omega_0)}{(\omega - \omega_0)\cos^2\theta} - \omega'^2\right)^{1/2} \quad - (62)$$

This is plotted in Section 3 for various parameters. So the scattering process can be viewed as a low energy nuclear reaction (LENR). If mass decreases, i.e. if:

$$m_1 < m \quad - (63)$$

then energy is released:

$$E = (m - m_1)c^2 \quad - (64)$$

and may be used in the laboratory. Scattering theory of this type is the simplest type of LENR theory.

3. NUMERICAL ANALYSIS OF THE SCATTERED MASS FROM EQ. (62).

ACKNOWLEDGMENTS

The British Government is thanked for a Civil List Pension to MWE and the staff of AIAS and others for many interesting discussions. Dave Burleigh is thanked for posting, Alex Hill for translation and Robert Cheshire for broadcasting.

REFERENCES

{1} M .W. Evans, Ed., "Definitive Refutations of the Einsteinian General Relativity" (Cambridge International Science Publishing, CISP, www.cisp-publishing.com, 2012), special issue six of ref. (2).

{2} M. W. Evans, Ed., Journal of Foundations of Physics and Chemistry, (CISP 2011 onwards).

{3} M. W. Evans, S. J. Crothers, H. Eckardt and K. Pendergast, "Criticisms of the Einstein Field Equation" (CISP 2011).

{4} M. W. Evans, D. W. Lindstrom and H. Eckardt, "Generally Covariant Unified Field Theory"(Abramis Academic, 2005 to 2011), in seven volumes.

{5} L. Felker, "The Evans Equations of Unified Field Theory" (Abramis 2007, Spanish translation by Alex Hill on www.aias.us)

{6} M. W. Evans and J.-P. Vigier, "The Enigmatic Photon" (Kluwer, 1994 to 2002) in ten volumes, hardback and softback.

{7} M .W. Evans and L. B. Crowell, "Classical and Quantum Electrodynamics and the B(3) Field" (World Scientific, 2001).

{8} M. W. Evans and S. Kielich (Eds.), "Modern Nonlinear Optics" (Wiley Interscience, 1992, 1993, 2001) in eighteen volumes hardback and softback and e book and two editions.

{9} M .W. Evans, H. Eckardt and D. W. Lindstrom, papers in Found. Phys. Lett., Physica B, Acta Physica Polonica, Serbian Academy of Sciences and other journals.

{10} M .W. Evans and A. A. Hasanein, "The Photomagneton in Quantum Field Theory" (World Scientific 1994).

{11} J. B. Marion and S. T. Thornton, "Classical Dynamics" (Harcourt, New York, 1988, Third Edition) chapter 15.

{12} S. M. Carroll, "Spacetime and Geometry: an Introduction to General Relativity" (Addison Wesley, New York, 2004 and online notes, 1997) chapters 1 - 3.

On the general covariance of mass: LENR as a scattering theory

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3 Numerical analysis of the scattered mass from Eq.(62)

In this paper it has been assumed that the masses two particles of equal type have pairwise the same values before and after the scattering process. The scattered mass m_1 is given by Eq.(62):

$$m_1 = \frac{\hbar}{c^2}\sqrt{\frac{(\omega'-\omega_0)^2(\omega+\omega_0)}{(\omega-\omega_0)\cos^2\theta}-\omega'^2}. \tag{65}$$

The scattered mass depends on four parameters ω_0, ω, ω', and θ. The rest frequency ω_0 is given by

$$\hbar\omega_0 = mc^2. \tag{66}$$

In Figs. 1 and 2 we present the dependence of m_1 from ω and ω' for fixed $\theta = 0$, i.e. scattering in input direction, which is identical to scatterin in direct throughput because of $\cos^2(0) = \cos^2(\pi/2) = 1$. As explained in section 2, the expression below the square root, given originally by Eq.(55), is negative in most cases, therefore the alternative definition (60) with negative sign of R was made. From Fig. 1 we can see that this is essentailly true. The frequencies are given in units of $10^{20}/s$, and the mass m_1 in units of the electron mass. because of $\omega_0 \approx 7.8 \cdot 10^{20}/s$, ω and ω' must be greater than this value. In Fig. 1 the definiton (60) with positive sign was used. One can see that m_1 has a sharp limit at $\omega = \omega_0$ and is essentially not defined in the triangular region $\omega' > \omega$. If the negative sign in (60) is used (Fig. 2), m_1 takes well defined values for $\omega' > \omega$ as expected. m_1 takes multiple values of the electron mass.

Figs. 3 and 4 show alternative plots for varying scattering angle θ and fixed input frequency $\omega = 15 \cdot 10^{20}/s$. Values of m_1 are mostly near to the electron mass in case of a positive sign of R, see Fig. 3. When the negative sign is taken, m_1 undergoes a resonance for $\theta \to \pi/2$. Therefore scattering experiments with this angle should give interesting results.

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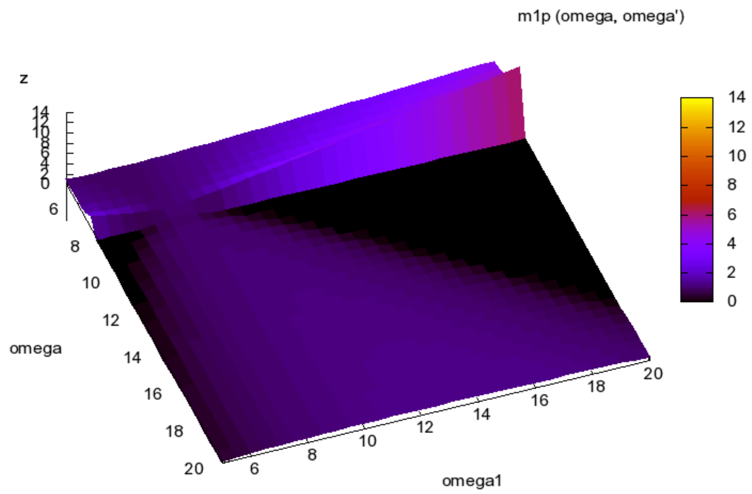

Figure 1: Scattered mass m_1 with $R > 0$ for $\theta = 0$.

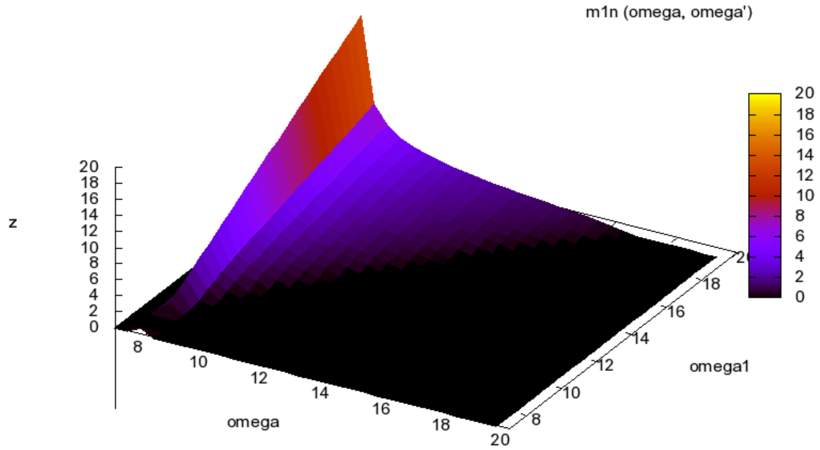

Figure 2: Scattered mass m_1 with $R < 0$ for $\theta = 0$.

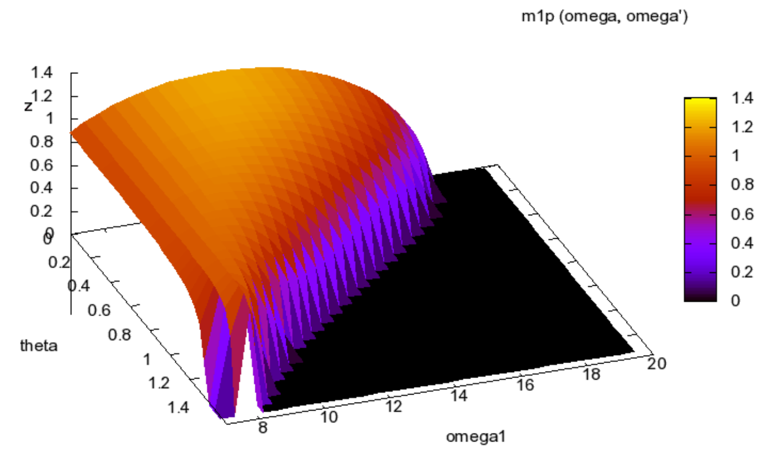

Figure 3: Scattered mass m_1 with $R > 0$ for $\omega = 15 \cdot 10^{20}/s$.

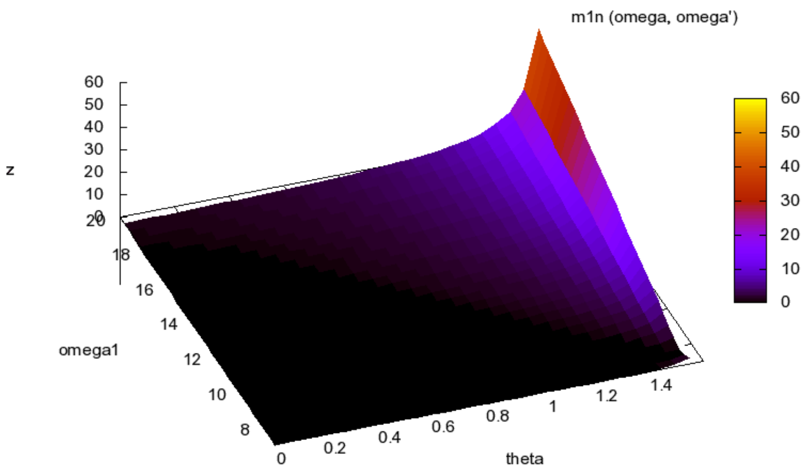

Figure 4: Scattered mass m_1 with $R < 0$ for $\omega = 15 \cdot 10^{20}/s$.