226(2): Hamilton Jacobi Equation for the General Interaction of Matter Fields.

Consider the interaction of a matter wave of four momentum $\hbar \kappa^\mu$ with a particle of four momentum p^μ. Let the measured or laboratory mass of the particle be m_0. The Hamilton Jacobi equation for the interaction is

$$(p^\mu - \hbar\kappa^\mu)(p_\mu - \hbar\kappa_\mu) = m_0^2 c^2 \quad -(1)$$

as in UFT182. Here:

$$p^\mu = \left(\frac{E}{c}, \underline{p}\right), \quad \kappa^\mu = \left(\frac{\omega}{c}, \underline{\kappa}\right) \quad -(2)$$

Eq. (1) is written as:

$$p^\mu p_\mu - \hbar^2 R_1 = m_0^2 c^2 \quad -(3)$$

Denote by p_1^μ the four momentum of particle 1, and by κ_2^μ the wave four vector of matter wave 2. Particle 1 is also a matter wave by the Planck / de Broglie postulate:

$$p_1^\mu = \hbar \kappa_1^\mu \quad -(4)$$

The Hamilton Jacobi equation for the interaction of particle 1 with matter wave 2 is:

2) $$\left(p_1^\mu - \hbar\kappa_2^\mu\right)\left(p_{\mu 1} - \hbar\kappa_{\mu 2}\right) = m_{10}^2 c^2 \quad -(5)$$

where m_{10} is the measured mass of particle 1, i.e. its ordinary mass. The left hand side of eq. (5) is written as:

$$-\hbar^2 R_2 = p_1^\mu p_{\mu 1} - \hbar\left(\kappa_2^\mu p_{\mu 1} + p_1^\mu \kappa_{\mu 2}\right) + \hbar^2 \kappa_2^\mu \kappa_{\mu 2} \quad -(6)$$

in which: $p_1^\mu = \hbar\kappa_1^\mu, \; p_{\mu 1} = \hbar\kappa_{\mu 1}. \quad -(7)$

Therefore:

$$R_2 = 2\left(\frac{\omega_1\omega_2}{c^2} - \kappa_1\kappa_2\right) - \left(\frac{\omega_2^2}{c^2} - \kappa_2^2\right) \quad -(8)$$

The interacting mass is now defined as:

$$R_2 = \left(\frac{m_2 c}{\hbar}\right)^2, \quad -(9)$$

so

$$m_2 = \frac{\hbar}{c}\left[2\left(\frac{\omega_1\omega_2}{c^2} - \kappa_1\kappa_2\right) - \left(\frac{\omega_2^2}{c^2} - \kappa_2^2\right)\right]^{1/2} \quad -(10)$$

3) and the wave equation of interaction is:

$$\left(\square + R_2 + \left(\frac{m_{10} c}{\hbar} \right)^2 \right) \phi_1 = 0 \quad -(11)$$

i.e

$$\left(\square + \left(\frac{M_2 c}{\hbar} \right)^2 \right) \phi_1 = 0 \quad -(12)$$

where:

$$M_2 = \left(m_2^2 + m_{10}^2 \right)^{1/2} \quad -(13)$$

Similarly:

$$\left(\square + \left(\frac{M_1 c}{\hbar} \right)^2 \right) \phi_2 = 0 \quad -(14)$$

where

$$M_1 = \left(m_1^2 + m_{20}^2 \right)^{1/2} \quad -(15)$$

Eqs. (12) and (14) are examples of the ECE wave equation:

$$\left(\square + R \right) q_\mu^a = 0 \quad -(16)$$

which is a re expression of the tetrad postulate:

$$D_\mu q_\nu^a = 0. \quad -(17)$$

Therefore M_1 and M_2 are properties of spacetime.

The classical equivalents of eqs.

4) (13) and (14) are:

$$p_1^\mu p_{1\mu} = m_2^2 c^2 \quad -(18)$$

and

$$p_2^\mu p_{2\mu} = m_1^2 c^2 \quad -(19)$$

i.e.

$$E_1^2 = p_1^2 c^2 + m_2^2 c^4 \quad -(20)$$

$$E_2^2 = p_2^2 c^2 + m_1^2 c^4 \quad -(21)$$

The rest energies of these equations are:

$$\boxed{\begin{aligned} E_1 &= m_2 c^2 \\ &= (m_2^2 + m_{10}^2)^{1/2} c^2 \end{aligned}} \quad -(22)$$

and

$$\boxed{\begin{aligned} E_2 &= m_1 c^2 \\ &= (m_1^2 + m_{20}^2)^{1/2} c^2 \end{aligned}} \quad -(23)$$

The usual, non-interacting, rest energies are:

$$E_1 = m_{10} c^2 \quad -(24)$$

$$E_2 = m_{20} c^2 \quad -(25)$$

Therefore during interaction the total rest energy:

5)

$$E_T = E_1 + E_2$$
$$= (m_{10} + m_{20}) c^2 \quad -(26)$$

is changed to:

$$\boxed{E_T = \left((m_2^2 + m_{10}^2)^{1/2} + (m_1^2 + m_{20}^2)^{1/2} \right) c^2 \quad -(27)}$$

In low energy nuclear reaction the energy E_T is enough to cause transmutation. It is inputted from spacetime and released as measurable excitonic energy.

The tetrad postulate (17) is:

$$D_\mu q^a_\nu = \partial_\mu q^a_\nu + \omega^a_{\mu b} q^b_\nu - \Gamma^\lambda_{\mu\nu} q^a_\lambda$$
$$= 0 \quad -(28)$$

where $\omega^a_{\mu b}$ is the spin connection and $\Gamma^\lambda_{\mu\nu}$ is the gamma connection. Eq. (28) is:

$$\partial_\mu q^a_\nu + \omega^a_{\mu\nu} - \Gamma^a_{\mu\nu} = 0 \quad -(29)$$

i.e.

$$\partial_\mu q^a_\nu = \Gamma^a_{\mu\nu} - \omega^a_{\mu\nu} \quad -(30)$$
$$:= \Omega^a_{\mu\nu}$$

Therefore:

$$\partial_\mu q^a_\nu = \Omega^a_{\mu\nu} \quad -(31)$$

and

$$\partial^\mu \partial_\mu q^a_\nu = \Box q^a_\nu = \partial^\mu \Omega^a_{\mu\nu} \quad -(32)$$

Define:

$$\Box q^a_\nu := -R q^a_\nu \quad -(33)$$

Then:

$$R = -q^\nu_a \partial^\mu \Omega^a_{\mu\nu} \quad -(34)$$

i.e

$$\boxed{R = q^\nu_a \partial^\mu \left(\omega^a_{\mu\nu} - \Gamma^a_{\mu\nu}\right)} \quad -(35)$$

It follows from eqs. (12), (14) and (35) that M_1 and M_2 are defined by the spin and gamma connections.

Various types of resonances can be worked into this theory. For example the usual theory of atomic absorption depends on the transfer of a photon of energy $\hbar\omega$ so that an electron is shifted up from one energy level to another. In analogy, a

1) quantum of energy $\hbar\omega$ from spacetime can be transferred to an atom during interaction with a matter wave. This theory can be applied to the electrons and the nucleus. The theory of chemical reactions and nuclear fusion can be thought of in this way.

In order that low energy nuclear fusion may occur, the energy E_T must be greater than the total energy of a scattering process, and the excess energy comes from spacetime.
