248(3): General Theory of LENR and Particle Collision Processes

In the general theory consider a collision of two particles to give any number of products with a release of energy E and momentum $\underline{p}$. Thus:

$$E_1 + E_2 = E_3 + E_4 + \dots + E_n + E \quad -(1)$$

and

$$\underline{p_1} + \underline{p_2} = \underline{p_3} + \underline{p_4} + \dots + \underline{p_n} + \underline{p} \quad -(2)$$

In a LENR process for example, eq. (1) means that there are many particles generated by a nuclear fusion. In general:

$$E^2 = c^2 p^2 + m^2 c^4 \quad -(3)$$

so

$$(E - mc^2)(E + mc^2) = c^2 p^2 \quad -(4)$$

and

$$E - mc^2 = \frac{c^2 p^2}{E + mc^2} \quad -(5)$$

If:

$$E \sim mc^2 \quad -(6)$$

as in a nuclear fusion reaction then:

$$E - mc^2 \sim \frac{p^2}{2m} \quad -(7)$$

which is the classical non-relativistic kinetic energy:

2)

$$H = T = \frac{p^2}{2m} \quad -(8)$$

with $\underline{p}$ as the non-relativistic momentum. Eq. (8) quantizes using:

$$\underline{p} = -i\hbar \underline{\nabla} \quad -(9)$$

to give the Schroedinger equation:

$$-\frac{\hbar^2}{2m}\nabla^2 \phi = T\phi \quad -(10)$$

More generally, eq. (3) gives the fermion equation as in previous UFT papers.

Now introduce the Coulomb barrier to low energy nuclear reactions. This is denoted by the potential energy V. So eq. (10) becomes:

$$\hat{H}\phi = \left(-\frac{\hbar^2}{2m}\nabla^2 + V \right)\phi = E\phi \quad -(11)$$

The theory of quantum tunnelling may now be introduced to any type of particle collision by writing eq. (1) as:

$$E_1 + E_2 + V = E_3 + E_4 + \dots + E_n + E \quad -(12)$$

So we obtain the result:

3)

$$E = \frac{p^2}{2m} + V$$
$$= E_1 + E_2 - E_3 - E_4 - \dots - E_n + V \quad -(13)$$

As in previous UFT papers a transmission function can be calculated from a model potential. The simplest one is:

$$\left.\begin{aligned} V &= 0, \quad x < -a, \\ V &= V_0, \quad -a < x < a, \\ V &= 0, \quad x > a \\ E &< V_0 \end{aligned}\right\} \quad -(14)$$

but any model of the nucleus can be used.

Any type of relativistic particle scattering theory can be developed with a Schroedinger equation. The typical data in a particle collider give peaks for $E_3, E_4, \dots, E_n$, so the quantized energy E can always be calculated. More accurately eq. (5) is a fermion equation in the SU(2) basis, so angular momentum theory can be introduced. This will be the subject of the next note.