1)

230(3): Mechanisms of Spacetime Absorption.

1) Photon Absorption

In this case the energy E of an incoming atom is incremented by:

$$E \rightarrow E + \hbar\omega \quad -(1)$$

where $\hbar\omega$ is a photon. If n photons are absorbed then:

$$E \rightarrow E + n\hbar\omega. \quad -(2)$$

The transmission coefficient is given in the WKB approximation by:

$$T = \frac{4}{\left(2\theta + \frac{1}{2\theta}\right)^2} \quad -(3)$$

with

$$\theta = \exp\left(\left(\frac{2\mu}{\hbar}\right)^{1/2}\int_a^b \left(V(r) - E - n\hbar\omega\right)^{1/2} dr\right) \quad -(4)$$

The reduced mass of the system is:

$$\mu = \frac{m_1 m_2}{m_1 + m_2} \quad -(5)$$

where m_1 and m_2 are the masses of the individual atoms 1 and 2.

In this type of experiment two atoms m_1 and m_2 are assumed to fuse by quantum tunnelling in the presence of electromagnetic radiation. It has been demonstrated numerically that low energy nuclear fusion may occur under these conditions.

2)

2) Phonon Absorption in a Lattice

In the simplest theory the energy absorbed in phonon absorption is

$$E = \hbar \omega_k \quad -(6)$$

where

$$\omega_k = \left(2\omega^2\left(1-\cos(ka)\right)\right)^{1/2} \quad -(7)$$

for a one dimensional lattice with periodic boundary conditions. Here ω is the natural frequency of harmonic potentials, k is the lattice wavenumber and a is the lattice spacing.

In an heuristic model it is conceivable that a photon and a phonon are absorbed at the same time by the interacting system of reduced mass μ. If the mass m_1 is moving and the mass m_2 is stationary, the non-relativistic kinetic energy is that of m_1, and is denoted E. If the incoming atom absorbs both a photon and a phonon then:

$$E \rightarrow E + \hbar\omega + \hbar\omega_k \quad -(8)$$

If there is n photon absorption:

$$E \rightarrow E + n\hbar\omega + \hbar\omega_k \quad -(9)$$

Under these conditions:

$$\theta = \exp\left(\left(\frac{2\mu}{\hbar}\right)^{1/2}\int_a^b \left(V(r) - E - n\hbar\omega - \hbar\omega_k\right)^{1/2} dr\right) \quad -(10)$$

3) Under these conditions low energy nuclear fusion can occur, i.e. the transmission coefficient becomes high enough for m_1 to have quantum tunnelled into m_2.

3) Plasmon Absorption

In the Drude Sommerfeld model the plasmon is a quantum of energy of a plasma:

$$E = \hbar \omega_p \quad -(11)$$

where

$$\omega_p = \left(\frac{N e^2}{m \epsilon_0} \right)^{1/2} \quad -(12)$$

where N is electron density, $-e$ is the charge on the electron, m is the mass of the electron and ϵ_0 the S.I. vacuum permittivity. It is conceivable that in a cavitation induced LENR, electromagnetic photons and plasmons are both absorbed, so:

$$E \rightarrow E + n\hbar\omega + \hbar\omega_p \quad -(13)$$

Under these conditions:

$$\theta = \exp\left(\left(\frac{2\mu}{\hbar}\right)^{1/2} \int_a^b \left(V(r) - E - n\hbar\omega - \hbar\omega_p \right)^{1/2} dr \right) \quad -(14)$$

The above are all non-relativistic theories. In the relativistic theory of note 230(2), the θ

factor is given in a well defined approximation by:

$$\theta = \exp\left(\left(\frac{2\omega_0}{\hbar}\right)^{1/2}\frac{1}{c}\int_a^b V^{1/2}\,dr\right) \quad -(15)$$

where

$$\mu = \frac{\hbar\omega_0}{c^2} \quad -(16)$$

If ω is the photon frequency and n photons are absorbed then:

$$\omega_0 \rightarrow \omega_0 + n\omega \quad -(17)$$

Most generally, if photons, phonons and plasmons are all absorbed then:

$$\omega_0 \rightarrow \omega_0 + n\omega + \omega_{ph} + \omega_p \quad -(18)$$

This is a simple first theory that is heuristic in nature, but already describes the main features of known LENR experiments.