TUNNEL RESONANCE OF ELECTRON WAVE AND FORCE OF FLUCTUATION

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We propose that cool fusion is fluctuation of the resonance which happens to the electron wave. When electricity is discharged, a special crystal is made from free particles by the tunnel phenomenon of the electron wave. If free particles line up in the arrangement of the crystal, and the particle shifts, the line makes a wave. When alignment fluctuates, phase transition occurs in crystal. There is a possibility that the distribution of energy is converted into all the combinations for the phase transition of the crystal. The phenomenon of CF appears variously for that.

1 Introduction

It is pointed out that cold fusion (CF) is responsible for the configuration of deuterium atoms in crystal. The CF is connected to three kinds of resonance occurring in electron discharge. The CF is a type of electron resonance, which occurs in the dc circuit. In the dc circuit, the charge causes the alignment of the free particle [1, 2, 3, 4, 5]. We found a force that the electric charge assists to form in line for deuterium atoms in crystals.

In this study, we investigate a relation between matter wave resonance occurring in dc discharge current and cold fusion in view of variation of the resonance. For dc electric discharge three noises interchange in the same condition [6] (see Figure 12,13).

The noise, which occurs in power spectral density P(f), fluctuate white, 1/f square and 1/f noises. These noises are exchangeable. We propose that the phenomenon must be a phase transition of the crystal from the investigation. Nano carbons, nano tubes and Fullerene are produced at a phase transition by dc discharge circuit [7]. Since phase conversion of crystals awes to dc discharge, we consider phase conversion for cold fusion. We explain the relation for cold fusion, using change of resonance matter wave [8].

We describe more an outline. Maeda et al. successfully found that the noise component of 1/f and 1/f square was observed at discharge portion in graphite electrode [9], and took out the noise of the electric discharge portion from demodulation controlled by the electric discharge distance [1 0] (see p.2141) In this case, the two kinds of noise occur alternately in the circuit. Maeda's P(f) can analyze the feature as $P(f) f^{d} = C$ or $P(f) f^{2} = C$.

Therefore, three kinds of phenomena exist in the electrical discharge part together with $P(f) f^0 = C$ of the white noise. In general, it is well known that the white noise always exists as J. B. Johnson Noise. Indeed, the three kinds of noises occur continuously and alternately at least. This is responsible for tunneling in discharge at part of discharge.

Thus the tri-stable of tunneling phenomena occurs alternately. The free electrons in discharge are emitted from metal surface into the air by tunneling. And the electron makes standing waves and traveling waves in the electric discharge [8].

In other words, existence of the standing and traveling waves make assist to form in line for deuterium atoms in crystals, leading to cold fusion. Such phenomena will occur in plasma dust from direct current glow discharge as plasma crystal [1].

Furthermore, since dust makes line up as some crystal, we propose that phase change exists in resonance of the de Broglie wave.

2 Particle alignment by tunneling

We think that CF occurs because of the tunnel phenomenon of the electron wave, and the reason is announced here. In experiment of F. Fujita et al., a plasma dust phenomenon occurs in a glow discharge part [1]. The power which led dust to the plasma crystal can



Figure. 1 Tunneling out from Cathode at discharge

be considered based on a tunnel phenomenon (see Figure.1). It is thought that movement draws Lissajous figure of wave motion when dust is led to the formation. The Lissajous figure will be carried out based on the traveling wave and standing wave of a tunnel phenomenon.

Fujita's circuit is equal to Maeda's tunnel microscope in the composition and the voltage of the electric circuit. The theory of electricity is never changed because of the distance in the electrical discharge section. The particulate is caught also by STM. The tunnel phenomenon of the electron has occurred together in these electrodes. When the carbon graphite was observed in the experiment on STM by Maeda et al., two kinds of power spectrum densities P(f) were observed from the electrical discharge in the same frequency band region.

Maeda's P(f) can analyze the feature as $P(f) f^{2}=C$ or $P(f) f^{2}=C$. Therefore, three kinds of phenomena exist in the electrical discharge part together with $P(f) f^{0}=C$ of the white noise. The feature of a nonlinear phenomenon is found from tri-stable of the power spectrum.

Fullerene and a nano-tube is actually manufactured from the phase transition by uniting the file of a new crystal from the carbon caught by the electrical discharge. An atom moves because a force is applied in the phase transition. A wave fluctuates and changes for these three sorts at the time of a phase transition, and it is guessed that motion by the force is born to a particle. Therefore, it is important in the research of CF to observe a power spectrum density especially.

3. White noise and 1/f square noise

An expectation of energy can be obtained from a transition probability of quantum mechanics. When analogy of a fluid and the electricity of direct current are used, the formula of electric current can be made from a variable of time. That time it is possible to

change the operational order of integral calculus and square root extraction by making use of orthogonality concerning integral calculus for square of momentum [8]. Then, the momentum calculates from the square root of power. Eq.(1) is displayed from Eq.(9) of a paper [8].

$$i(t) = \varepsilon \rho_{vol} S_{\sqrt{\frac{2h}{m\pi} \int_{-\infty}^{\infty} \frac{\sin \omega}{\omega}}} e^{i\omega t + (t)} d\omega$$
(1)

The 1/f square characteristic of a power spectrum density appears in the expression. Because it is a linear algebra, the same power spectrum density as the expression cannot be shown at the same time by other expressions. Therefore the current of 1/f square was decided to this expression. However, the electron makes the white noise when generated from the cathode, and the signal of the Poisson distribution becomes Rayleigh distribution. And, when the signal is 1/f square characteristic, the following electron in the period should synchronize initial phase $\theta(t)$. Let's pay attention to 1/f square noise having been against nature of this Rayleigh distribution. In Rayleigh distribution, amplitude strength R is normal distribution p(R) because of the random probability process. Rayleigh distribution formula is shown in Eq.(2) and Eq.(3).

$$p(R) = \frac{2R}{\Omega} \exp\left(-\frac{R^2}{\Omega}\right) \quad \dots \quad (2), \quad i(t) = C(t) \cos\left\{\omega_0 t + \theta(t)\right\} \dots \quad (3)$$

The current of narrowband i(t) is expressed with alternating current and the feature is in a random jump change of initial phase $\theta(t)$. However, when initial phase $\theta(t)$ of the electron is synchronized for a long period, the quantum resonance makes 1/f square noise of Eq.(1). Therefore we conclude that 1/f square noise is nature of the quantum resonance.

Then there will be many standing waves of the electron wave by the tunnel phenomenon in the discharge. If the initial phase is a steady value for each wave in the period, 1/f square noise is synthesized from the standing wave



that the amplitude is in inverse proportion to frequency f. The frequency vs. power spectrum density can be written in Figuer.2, and the envelope curve be shown in both logarithm graph by the straight line proportional to -2.

The harmonic component from

a basic wave of $m\pi$ radian is synthesized to the electrical discharge, and many electrons are made to exist in the electrode. If amplitude is inversely proportional to order of harmonics, and the wave number is proportionate to the order, a special standing wave is synthesized. If amplitude is proportional to 1/f when the number of basic waves in the electrical discharge layer is $m\pi$ radian, it is made sure that self-organization become caused to a row of electrons. Also it is in 1/f square too. If the electron of the electrical discharge organizes the row, the lattice of the



crystal is synthesized from existing probability as Figure.3 [8].

There is a barrier in the electrical discharge region, that barrier shapes a potential well. Electron wave includes wave packet and standing wave in the potential well. From the harmonic that have the quality of 1/f in amplitude, the wave is synthesized inside the well as Figure. 3. Function sin x/x is used for the harmonic component because it is a nature that the amplitude is in inverse proportion to the frequency at the phase proportional to wave number. It is a condition that there is wave number of $m\pi$ in a basic wave between the

cathode and the anode discharging electricity. Then, the row of the subdivided small well can be made in the bottom of a big well between cathode and anode. The existence probability is set to the electrode side high. When the harmonic component of the standing wave is synthesized on an easy condition, the line of the particle is found from the free particle group[8]. When harmonic of the standing wave are synthesized, the free particle getting together, it lines up [1]. If the electron propagates into the crystal on any condition, Nakamura's calculation of power spectrum density is always 1/f square [11]. The crystal was selforganized from the tunnel resonance of the electrical discharge. And the electrode in a carbon graphitized layer exists in that Maeda's experiment [9, 1 0], so the amplification of the resonance is promoted. Therefore the layer of the electrode helps the resonance, and the result also makes the multiple layers in the electrical discharge part. In the row of barrier on potential well, whenever the quantum propagates, 1/f square noise must be made [1 1]. The difference between 1/f noise and white noise is caused from the initial phase $\theta(t)$ of Eq.(1). If the freedom of the phase is excluded, then 1/f square can be considered to be a basic character of the electrical discharge circuit. White noise and 1/f square noise have been explained basically.

4. Force of resonance

Alignment appears at Y_{ham} in Figure. 3 and the electron wave build the aligned power. And in our paper [8], the power of the electron wave was settled in simple Eq.(4).

$$\hbar \frac{dk}{dt} = F \quad \dots \quad (4) , \qquad \therefore Fv = \frac{dE}{dt} = \frac{dE(k)}{dk} \frac{dk}{dt}, \qquad v = \frac{1}{\hbar} \frac{dE(k)}{dk}$$

This is thought from the relational expression when the electron propagates in the semiconductor.

The free particle moved by the force *F* make the row at the position in which Y_{ham} is shown in Figure. 3 [8]. Therefore, tunnel resonance is made and it becomes the relation of Eq.(1) [11]. If initial phase of the wave is does not fluctuate, in the discharge circuit, character of power spectral density is inverse proportion to square of the frequency *f*. For example if the electrode is the graphite in Maeda's experiment, expansion of resonance furthermore is promoted because of the graphite, and resonance makes the layer of the graphite in the electrode [9, 10]. Therefore the layer of the electrode helps the resonance, and the result also makes the layer by itself.

5. 1/f noise

1/f noise will be explained next from principle of 1/f square noise. 1/f noise is explained also on the basis of the column of particles, which shows in Figure. 3 of 1/f square noise. This row is same as a crystal. Therefore the row is harmonic oscillators. If wave packets propagate into the harmonic oscillator, the output of signal is integrated because of Virial theorem. The meaning of integration is a low-pass filter if it is explained as working of the electric circuit. As the result, the square of 1/f becomes 1/f depending upon operation. However action does not work always uniformly. There will be such a resonance, and the resonance changes in tri-stable. The structure of a repetition is increasing resonance.

Accordingly resonance of electron wave by power of 1/f may be promoted by surface structure of an electrode. For instance, it can be expected that a graphitized layer structure promote the resonance more. Promoting resonance, it can expect the type of stratified structure of graphite. As an example, if perylene is observed with STS, there is negative resistance [1 2]. In the experiment there is negative resistance from resonance.

6. Parametric amplification

The crystal is made as a free particle queues up in the electrical discharge. Then, the quantum can propagate under the crystal similarly to a semiconductor as Figure 4. Then, the soliton u propagates while shaking the lattice. The lattice is made up of Shrodinger equation and the propagation of u is made up of Soliton equation.



There is an answer according to a paper by Kimio Ueno [1 3].

$$\left(\begin{array}{cc} \frac{\partial L}{\partial t} - \left[B, L\right]\right)\phi = 0, \qquad u(x,t) = 2\left(\frac{\partial}{\partial x}\right)^2 \log \tau(x,t)$$

It is settled to a nonlinear equation ($\partial L / \partial t - [B,L]$) $\varphi = 0$ that causes the amplitude modulation wave and the parametric amplification.

The lattice of the crystal consists of the array of the particle. Each particle vibrates. Then, the amplification arises if the quantum passes many potential barriers by the tunnel phenomenon. When three waves become complete in the condition for the resonance, the wave is amplified in the parametric nonlinearly [1 4] (Fig.5).

Fig.5 Harmonic Oscillator
$$\begin{cases}
\frac{d^2 x_0}{dt^2} + \omega^2 x_0 = -\beta x_1 x_2 \\
\frac{d^2 x_1}{dt^2} + \omega^2 x_1 = -\beta x_0 x_2 \\
\frac{d^2 x_2}{dt^2} + \omega^2 x_2 = -\beta x_0 x_1 \\
\frac{d^2 x_2}{dt^2} + \omega^2 x_2 = -\beta x_0 x_1
\end{cases}$$

The condition for amplification is quite same as the amplitude modulation composed of carrier wave, signal wave, and modulated wave.

If there is resonance, it can calculate conservation of energy in even the wave $[1 \ 4]$. The condition of an insufficient quantum in the wave is supplemented because of the parametric amplification. There is a multiplication product of the wave in term $u\varphi$ if the potential of Schrodinger equation is assumed to be a soliton at that time. When the term from multiplication of the wave is explained from theory of communications engineering, it is amplitude modulation. An envelope curve from the signal of amplitude modulation is always seen. Therefore, because it is visible with anytime, one of feature of fluctuation is explained well.

7. Characteristic of resonance

When it is P(f) = 1/f, Power spectral density P is in inverse proportion to frequency f in 1/f noise. If we display in formula, it becomes P(f)=C/f. The C is constant. By the way, white noise indicates P(f) = C. Also it can rewrite to $P(f)f^0=C$. And $1/f^2$ noise is $P(f) = 1/f^2$, it can be written to $P(f)f^2 = C$. There is always an equation $P(f)f^{n}m = C$ that it looks like the equation $P(f)f^{n}0 = C$ of the oscillator at Planck's black body radiation. White noise occurs from law of equipartition of energy. Therefore the feature of $P(f)f^{n}m = C$ like law of equipartition of energy is every resonance.

8. Conclusion

Free electron is discharged by tunneling at the time of electric discharge to the air by the cathode. Therefore free particle and matter wave exist in tunneling.

And at least three kinds of resonance exist in electron. When it fluctuates alternately with 3 interspecific, phase change occurs in "plasma crystal" of the electron wave.

In electric discharge of a direct current, the feature of a phase transition is found in many examples. The conduction of heat with a sudden temperature change occurs to the electrical discharge as an example of the phase transition at the electrostatic cooling phenomenon [1 5]. Graphite in electric discharge is changed into fullerene or nano

tube [7]. There is a technology to control single atom when the atom is transported with the tunnel microscope [16]. Similarly, "the plasma Crystal" is made from the gravitation of the electron wave. We would like to propose that these features prove phase transition.

When free particles are contained in the material placed between the electrodes, the material wave is the same condition even if it is not an electrical discharge. For example, if the tunnel phenomenon has occurred in a solid solution, a semiconductor, electrolysis liquid, and gas, a phenomenon of same class will occur. We would like to propose that cold fusion is fluctuation of the resonance which happens to the material like a semiconductor.

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