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Diseased cell-diluted homeopathic medicine interaction mechanism leading to the remediation of the disease

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Abstract
It was proposed earlier that hydrogen (H) bonded nanoclusters are formed in the high dilute homeopathic medicine (Homed) during its preparation by rigorous agitation (succussion) of the pure raw medicinal molecules with a liquid. To cure a disease, these H-bonded nanoclusters (hereafter termed as NAMs) composed of ionic charges (like O^+ , H^+ and other ions) interact with the diseased cells (DCs) having different charge distribution patterns. The different types of NAMs created in different types of Homeds differ in their surrounding charge distribution character (patterns) and H-bonding carrying different healing information necessary for curing different diseases. In this paper, we proposed, for the first time, a simple phenomenological model to demonstrate the type of interaction between NAMs and the diseased cell (DC) which might be plausible to cure the disease. This interaction mechanism is highly complicated where hydrogen ion (H^+ or proton) tunneling between the NAM and the diseased cell enzyme molecules takes place. During proton tunneling, interesting information or communication between NAM and DC takes place and NAM can distinguish signals received from the DC charge distributions and interactions (due to differences in gene expressions between the DC and normal cells structures).The DC-NAM interaction normalizes the asymmetric charge distribution around DC and hence related entropy of the system minimizes. The charge ordering occurring, during this interaction, the entropy charges which is associated with the information change (responsible for cell-to cell communication) between NAM and the DC (in according to quantum information theory). Any change of entropy leads to information change (communication between NAM and DC). It may be concluded from the present theoretical understanding that disease healing by NAM is a quantum biological phenomenon. Enhancing the NAM-DC interaction strength, by externally stimulating agents, the NAM clusters might be energized to enhance the healing process using homeopathic medicine.

Keywords: H-bonded nano-clusters, electrostatic interaction, entropy, high dilution, diseased cells, cell signaling

Introduction
It is well known that there is practically no acceptable mechanism for understanding the disease curing mechanism using a high diluted homeopathic medicine (Homed) [1-4]. The healing power of homeopathic medicine in human clinical trials are often disregarded as placebo effects or self-healing [3, 4]. To put forward a plausible mechanism how a Homed cure a disease, it was demonstrated earlier [5] that hydrogen bonded nanoclusters (NAMs) are formed in the homeopathic medicine (Homed) during the preparation of Homed from the extract of raw medicine by a process known as succussion. The interaction between the H-bonded ionic NAMs in diluted Homed and the diseased cells (DCs), associated with H-bonded enzymes and proteins, is responsible for the cure of the diseases which might be comparable to that done by the human "stem cells". Recently Almirantis and Tsitinids [6] proposed that the capability of highly diluted homeopathic remedies is to provoke tangible biological changes in whole organisms. Such concept also indirectly supports the biological activity of NAM [5]. In modern biology, diseased cells of different organs or tissues are repaired or regenerated by tissue engineering [7] where stem cell or progenitor cell engraftment, differentiation, and long term replacement of damaged or dead tissue are performed.
It is to be noted that during cell-cell interaction or communication between them, cells secret several small molecule proteins [8, 9] such as cytokines, chemokines (signaling molecules), and growth factors which act in a peregrine or endocrine manner to repair the cells. Cells (even the DCs where H-bonded NAM acts) that secrete such factors facilitate angiogenesis,

anti-inflammation, and anti-apoptosis [10-13]. The NAMs interact with the ionic charges around DCs and act favorably to cure the disease. To describe this interaction process, we consider electrostatic interaction between the charges around the H-bond NAMs and those around the DCs. NAM-DC interaction stabilizes the asymmetric charge distribution around the DCs along with other parameters (like pH, entropy etc.). The charge distribution pattern around the H-bonded NAM and its behavior depend on the different medicinal molecules use for the preparation of NAM. Each NAM possesses certain physicochemical properties borrowed from the raw medicinal materials (or chemicals) used to prepare Homed and H-bond structural patterns signify their interconnectedness. It might be conjectured that the charge distribution pattern around DC is governed by different proteins, enzymes and other cellular materials secreted by DC and such distribution is quite different from that of a typical NAM.

In the present article our plan is mainly to suggest a probable electrostatic interaction between the charge distributions around NAMs and those around DCs which is considered to be responsible for curing the disease by Homed. This interaction depends on the charge distribution patterns and H-bonded arrangements around DC and NAM and is governed by the surrounding thermodynamic conditions (temperature, entropy etc.) of the system. Therefore, we also briefly discussed the thermodynamics of dynamic living cells associated with dynamic entropy (S) and information (I) (responsible for cell-cell, DC–NAM communication or cell signaling) which execute the overall remediation process. The charge distribution pattern around DC is actually produced by the different types of proteins and other ions (Na, K, Ca etc.) secreted [8] by the cells during growth and communication. Such proteins are disease specific, different for different diseases.

Physics of interaction mechanism between the NAM and the diseased cell

There are several possible ideas to explore the mechanism how Homed works in the body to cure a disease as discussed in [5]. The H-bonded ionic NAMs created in a Homed which was considered to be responsible for the cure of a disease [5] was shown schematically in Figure- 1. NAM can restore the tolerance of the diseased cells, by interacting with it, leading to disease cure. It is considered that a diseased cell differs from that of the normal one mainly in their disordered charge distribution patterns related to different proteins and the environment. For curing a disease, cell signaling process is also invoked in case of DC -NAM interaction. NAMs recognize DCs through quantum tunneling of H ions (or protons) between NAM and DC[14]. The NAMs, when comes in contact with the above mentioned diseased (with disordered ions and H-bonds) cells, receives the desired healing information through electrostatic interaction and proton transfer and as a consequence there is indication of remediation from the disease. It might also happen that the NAMs due to proton transfer can regulate the immune system, that is, immunoregulatory T-cells. It had not probably been tested if there was an increase and improvement in regulatory T-cells after intake of Homo drugs by a patient.

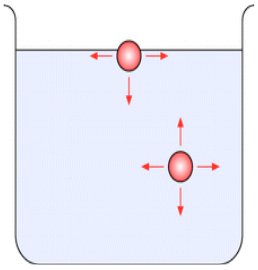

Fig 1: A Schematic representation of the H-bonded NAMs (as indicated by arrows and spheres) produced and embedded in a highly diluted Homeopathic medicine. Arrows are attached to the positive or negative ions, H^+, O^+ etc. forming the nano clusters. The NAM molecules are transiently hydrogen-bonded to their neighbors (water molecules). A NAM or water molecule in contact with the cell walls has fewer neighbors with which to form hydrogen bonds, so its energy is higher to stimulate the cell.

As mentioned earlier [5], the NAMs consisting of H-bonds are ionic in character with unique charge distribution pattern different for different Homeds and dilutions. The aqueous fluid media of the cell carry a multitude of charged groups (both cationic and anionic groups), for instance, negatively charged Glu- and positively charged Lys^+ which may penetrate the cell wall and interact with the ionic NAMs. A charge distribution on the NAMs can be schematically represented as in Figures 2a and 2b. As different kinds of proteins are secreted [8] by DC (different from the normal cell), the charge distribution pattern surrounding the DC (Fig. 2c) is non uniform with quite different distribution (disordered with higher entropy) pattern compared to that of the normal cell or the NAM. Temperature (related to entropy) and pH around the DCs are also higher compared to those of the normal cells. Before interaction between a NAM and the DC, the uniform charge distributions on the surfaces of NAM and the noun-uniform charge distribution around DC are shown schematically, respectively, in Figures –2b and 2c. Between the initial and the final states of charge redistribution around DC caused by DC-NAM interaction, there are many possible states of gradual remediation of the DCs with continuous changes of charge distributions patterns as shown schematically in Figures 3 and 4.

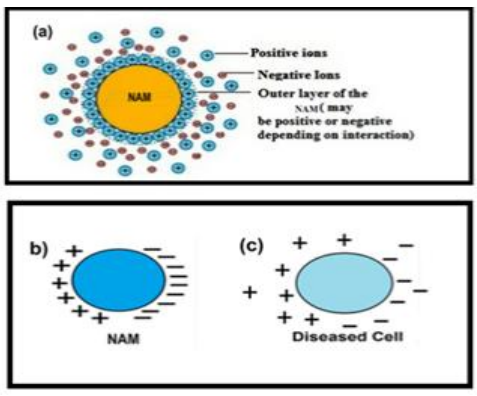

Fig 2: Schematic representations of the proposed charge as distributed around NAM (a). Just before interaction, positive and negative charges are re-arranged around the NAM (b) and the diseased cell (c). As the DC secretes more small molecular proteins, the charge density is more around the diseased cells (i.e.

more polar in character) as a consequence NAMs are attracted towards the diseased cells. Due to the electrostatic interaction, charges are rearranged. The charge ordering –disordering process is involved with entropy and information changes.

In Figure 3, the initial DC was represented by blue color. During NAM-DC interaction, DC was gradually surrounded by NAMs and cured it to normal state (pink colored cell). Here cell to NAM–DC communication occurred following cell signaling process which was triggered by the entropy change.

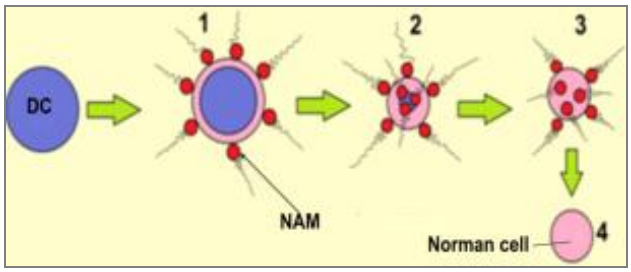

Fig 3: A suggested mechanism of transformation of DC (blue) to normal cure cell by NAMs. Gradual remediation of DC through different intermediate stages (1-3). The final cured cell (pink) is represented by (step 4 in Fig.3a and step IV in Fig.4).

In the whole remediation processes were represented in Figure 3 and 4 (steps 1-4 and I-IV, respectively, in Figures 3 and 4). In the above mentioned electrostatic interaction between NAMs with their symmetrical charge distribution patterns were first attracted towards the DC with asymmetric charge distribution patterns. NAM changes gradually surrounded the whole surface of the DC, as shown in Figure- 3, to normalize (by tunneling of protons [14]) the asymmetric charge distribution pattern around DC. In this way DC become cured. Different remediation states, are considered to be associated with gradual changes of electrostatic interactions patterns between DC and NAM. The NAMs gradually transfer protons to the DC through tunneling [14] which orders/stabilizes the surface charge around DC and regenerate the new cured cells (states 4 and IV in Figures 3 and 4, respectively). The whole process of remediation is schematically represented by Figure -4.

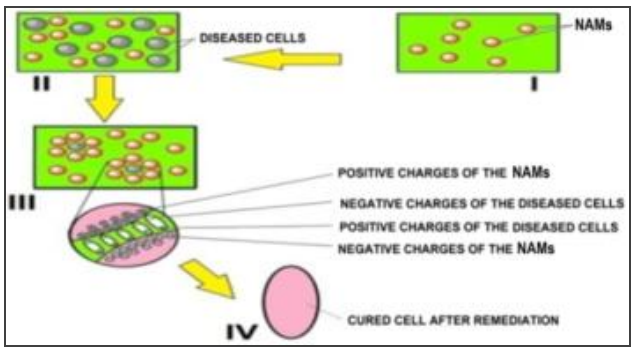

Fig 4: Schematic representation of different intermediate stages of cell remediation by NAMs: (I) NAMs approaching towards the diseased cells. (II) NAMs surround the diseased cells to repair. (III) Electrostatic interaction takes place between NAMs and diseased cell (IV) The repaired alive cell (after remediation).

The macromolecules including proteins and nucleic acids are associated with H-bonds and ionic character These molecules carry multitude of charged groups (both cationic and anionic groups), for instance, negatively charged Glu^- and positively charged Lys^+, a mentioned above, which took parts in the interaction process with the ionic H-bonded NAMs. The NAM –DC interaction was favored compared to those of the DC-DC or NAM-NAM interactions. This is because of the fact that the DCs secretes many small molecules along with K^+, Ca^+, Na^+ or similar ions and as a consequence DC's surface charges are more polar (which means difference of +ve and – ve charges are not uniformly distributed over the DC and asymmetric). There is large ionic concentration of disordered charges around DC compared to those of NAM or a normal cell. As a consequence, proton (H^+) around NAMs are attracted towards DCs. Due to ordering of the charges around DC by interaction with those around NAM, there were entropy changes which in turn related to information change and the cell signaling process. It is to be noted that the disordered charges possessed higher entropy. The mechanism, how entropy and information are related, is a quantum biological phenomenon [15-17] which will be discussed in our subsequent communications.

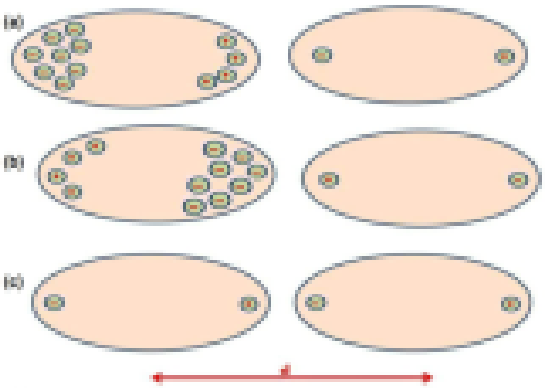

Fig 5: Dipole formation in the NAMs (right) and the DCs (left).The positive and negative charges associated with NAMs ad DC can move during remediation (a and b) and uniform charge distribution takes place between the NAM and the DC (c).

The strong and spontaneous dipolar interaction between the DCs and the NAMs was depicted schematically in Figure-5. The energy, temperature and entropy of dynamic living cells actually govern the MAN-DC interaction process and the cell to cell communication necessary for curing the disease cell as discussed is the preceding sections.

NAM-DC electrostatic interaction leading to disease cure

It has already been mentioned that during cell growth and cell to cell communications, cells secreted some low molecular weight chemicals [8] (proteins associated with different H- bonds) which changes entropy of the system. Such molecules (or proteins) have different ionic charges which interact electrostatically with those around NAM (Fig 6). NAM distinguishes DC from the normal cells due to the differences in gene expressions between DC and the normal cells structures. MAM received different information from the said interaction process and rearranged the disordered and asymmetric charge distribution pattern around DCs with transfer of protons (tunneling from NAM to DC). As mentioned above, this ordering changed entropy of the system which in turn equivalent to information changes. The said NAM-DC interaction depends on different types of diseased cells (i.e. different types of NAMs created in different Homeds are to be used to cure different types of

DCs). Different DCs have different charge distribution patters and different entropies and information. A typical NAM in a Homed might be used to repair only a particular DC or other DCs with similar charge distributions. The signals received by the NAM from the DC is electronic/and or electrochemical in nature (like that of photosynthesis) which helped NAM to understand the signature of the diseased cell to be cured.

The nature of classical DC-NAM interaction can be described by the Coulomb's type of lows. The electrostatic energy of interaction between two ions, one with effective charge $e_1$associated with the charge distribution pattern around NAM and the other e_2 associated with that around DC can be represented by

$$U = (e_1e_2/€_r) \quad (1)$$

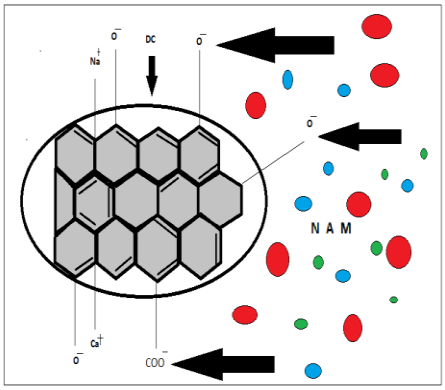

Fig 6: A schematic representation showing electrostatic interaction between NAMs and the disease cell. Red: +ve ions related to NAM and Green and Blue: Other ions related to the NAM.

where r is the separation between NAM and DC; € is the dielectric constant of the cell medium. € is a measure of the extent to which a DC concentrates electric flux (number of electric lines of force per unit area of the DC) from the charges around the NAM. The dipolar interactions of the charges associated with the NAMs and the DCs were schematically presented as shown in Figures 2 and 6. The effective dipole moment p of a small molecule or atomic group or ions is equal, in order of magnitude, to the product of the electronic charge (4.8×10^{-10} esu) by the length of chemical bond. The traditional unit for dipole moment is the Debye (D) and D= 10^{-18}esu. The energy of orientational interaction between two dipoles associated with NAM and DC is inversely proportional to the cube of their separation:

$$U_{or} = (1/r^3)[\mathbf{p_1p_2} - 3(\mathbf{p_1r})(\mathbf{p_2r})/r^3] \quad (2)$$

For adequate functioning of the NAMs, the dipoles should line up in a tail-to-tail fashion, i.e. all the three vectors $\mathbf{p_1}$, $\mathbf{p_2}$ and **r**are needed to be collinear, and then

$$U_{or} = -2[p_1p_2/r^3] \quad (3)$$

It has already been mentioned that NAMs, because of their specificity, can recognize the signature of the specific DCs structure to be cured and gradually transform the cell surrounding by rearranging the charge distribution to regenerate the normal charge distribution of the DCs and minimization of entropy and finally repair (cure) the diseased cell as shown in Figure -4. However, the process depends on various factors including pressure, temperature and surrounding environment NAMs and DCs inside the body. The proposed mechanism only qualitatively demonstrated NAMs (in a Homed) - DC interaction process for the diseased remediation which stimulate entropy and information changes as discussed below.

NAM-DC interaction, entropy and information associated with the healing process

The above mentioned NAM-DC interaction process is controlled by the cell thermodynamics associated with energy flow and heat (entropy) transfer. Entropy, information and cell signaling cooperatively execute their functions in the complicated disease healing process. It is to be noted that the thermodynamics of dynamic (time dependent property) living cells is quite different from that of usual static thermodynamics of our surrounding environmental systems. In living system, we are concerned with open system thermodynamics or no equilibrium thermodynamics [18], because the concepts of energy flow, growth and entropy change are not static, far from equilibrium. The thermodynamic disorder of the charge distribution around DC or the NAM is associated with entropy changes which provide information change. Entropy is related to the measurement of disorder of the atoms/ions or charges around DC or NAM. In all irreversible process, entropy is always positive [13] which cannot even be zero [19-24]. Entropy can be defined macroscopically as well as microscopically (microscopic or quantum nature associated with quantum information and quantum bit or qbit-quantum bit) [14, 16]. Macroscopically, the entropy (S) for a thermodynamically reversible process is defined by the following equation as a function of heat (Q) and uniform temperature (T).

$$S = Q/T \quad (1)$$

Thermodynamics of the living organisms is associated with the entropy production or destruction (minimization) in the cell. But knowing that entropy is a function of state (quantum phenomena in a living cell) and it can be considered with the change in entropy defined as:

$$\Delta S = \int \boldsymbol{\delta} Q/T \quad (2)$$

In the modern microscopic interpretation of entropy in statistical mechanics, entropy is logarithmic measure of the number of energy states (Ω_i) with significant probability of being occupied:

$$S = k_B ln\Omega_i \quad (3)$$

k_B being the Boltzmann constant = $1.38\text{x}10^{-23}$J K^{-1}

As mentioned above, quantum bit (or qbit) is the basic unit of quantum information (which is the information of states of a quantum system). Quantum information, like classical information (where bit is the unit of information), can be processed using digital computers. Quantum information differs strongly from classical information with bit as unit of information. Classical information is measured using Shannon entropy, while the quantum mechanical analogue is Von Neumann entropy. Given a statistical ensemble of quantum mechanical systems with the density matrix ρ,

quantum entropy is given by $S(\rho) = -Tr(\rho \ln \rho)$ [19]. However, in the present study, for the sake of simplicity, we used classical form of information theory provided by Shannon entropy [25]. In 1940 Shannon developed his theory of communication where information (I) was shown to have the same expression as that of entropy (the information entropy $I = \ln 2$ where $\Omega_i = 2$ and $k_B = 1$ in Eq.2). (In our present system, communication means cell–cell communication or cell signaling process). Therefore, thermodynamic entropy (Eq.2) is equivalent to Shannon information entropy (I) multiplied by k_B). The cell signaling which is information change is associated with the entropy change of the cell with release of energy. One bit of information is associated with $k_B \ln 2$ $\sim 10^{-16}$erg/K. Living organisms are highly organizational and, therefore, it seems that it feeds from "negative entropy" [18, 24, 26] or, by other words, maintaining and getting to a stationary condition where the entropy level is low. Nevertheless, it is necessary to understand that the proper definition of the second law of thermodynamics says that the entropy of an adiabatically isolated system never decreases. In this context a living cell or organism is not an isolated system, since it gets the nutrients from the external sources, that is, there is an exchange of energy (heat) or cellular matter with the environment [17-20]. Though entropy is a physical concept which can be applied in many non-living systems, entropy is not easy to quantize in a living cell. Its measure, in case of living cells, appears to be negative entropy, not zero which is not possible, and here disorder becoming more and more organized. Interestingly, entropy becomes negative without becoming zero. The negative entropy of the cell is also supported from the modern concept that the sum of entropy and information (in energy units) of the universe is conserved [19] where increase of one (S, say) decrease the information (I) (keeping in mind that information, I, cannot be negative and S cannot be zero).

Along with electrochemical interaction, entropy (associated with the ordering and disordering of the charges associated with the molecules as mentioned above) and information theory (associated with the cell-cell communication process) take important part in the healing process using NAMs. The dynamic entropy change (ΔS, Eq. 2) of a living cell is associated with the cell signaling which is actually information (or information change ΔI) transfer. Therefore, as mentioned above, entropy and information are interrelated functions. They are closely associated with the functioning of living cells while curing the diseased cell (DC with higher disorder and entropy). It has been pointed out that in biological system, there is strong correlation among entropy, information theory and cell signaling process [24] and information[21]) and entropy are equivalent and interdependent. This is similar to the case of equivalence of mass (M) which can be shown to be equivalent to information (in energy units) and energy (E)(equivalent to entropy) through the relation $E = Mc^2$, where c is the velocity of light~ 3×10^{10}cm/sec (according to Einstein's mass–energy relation). In the living body, the cells posses high negative entropy indicating perfect ordering (otherwise there would be large disorder and cell death, as in case of a DC entropy is high and positive). Surprisingly, following uncertainty principle, entropy of the cell fluctuates between positive (highly disorder) and negative (highly ordered) without becoming zero! During this process cell-cell communication (cell signaling) occurs with the ordering of the charge distribution around the DCs (occurring due to electrostatic interaction). A minimum unit of information (or cell signaling unit) is called a bit of information carried by an ordered DC and this information in entropy unit is equal to $\sim k_B \ln 2$ or $\sim 1.3 \times 10^{-16}$ erg/K (where K is degree Kelvin and body temperature~300K) which is very small energy (or information) transferred to the NAMs from the DC and such information is also transferred to DC to cure a diseased cell. This is also the minimum energy equivalent of information sending by a normal cell in the body. This means, the minimum energy of a dynamic NAMs that received as information (in unit of bit) from the DC is equivalent to $\sim 1.3 \times 10^{-16}$ erg/K $\sim 10^{-23}$J/Kin entropy (or energy) unit. In fact NAM carries more energy in multiple of and it is more active with higher degrees of freedom with increased entropy content. This information or energy/K carried by the NAM is transferred (during cell signaling or cell-cell communication process [24] as mentioned above) to the DC through hydrogen ion tunneling through the barrier between the NAM and the DC (a quantum mechanical process) [14]. This is an example of quantum biology [26]. Recently quantum mechanical approach [27] is emerging to understand homeopathy. The cell communicate this information to the brain (through neurons and electrochemical reaction) and the brain sends the necessary information to cure the diseased cell (having different proteins with capabilities of receiving the information which acts as medicine) by ordering and stabilizing the charge distribution around DC. Modern biology also explains the cell to cell signaling/communication process by communication theory [24, 25] which in turn related to the entropy acquired by the cells. As mentioned earlier, different small molecular weight protein chemicals are secreted by the cells while cell to cell commutation/signal takes place causing entropy chance. The said entropy change during cell-cell communication is associated with information change (cell signaling). During NAM-DC interaction, the charge distribution patterns around the DC changes causing changes of entropy and information. NAMs with their different charge distribution patterns are associated with entropy-information correlation and react with the DCs and cure them.

Summary and conclusion

We have proposed, for the first time, a phenomenological model to demonstrate how hydrogen bonded NAMs created in the Homed interact with the diseased cell and ultimately cure the disease. Such interaction orders the charge distribution pattern around the diseased cell with change of entropy which in turn involved with information or cell signaling process sending information to the brain through neurons. NAM might change size and shape by tunneling H^+ ions associated with the H-bonds to the DC. Elaborate investigation of the properties and control of the charge distribution patterns around NAM and DC by experimental methods are necessary for future development. Stimulating the NAM clusters by external means, they could be more energized. The NAMs behave like dynamic quantum particles embedded in the Homed which cure the disease unlike other usual medicine molecules. NAM is some sort of magic bioactive nano cluster which might dissociate interacting with other NAM or the DCs into smaller NAM clusters. The hydrogen ion or proton tunneling from NAM to diseased cells takes place to order the charge distribution

pattern around DC and cure the disease. Thus the creation of NAM and the subsequent disease healing process appear to be non-classical phenomena. In the next communication, we shall discuss that the cure of disease by NAM present in a Homed is not a classical attribute, but a *quantum biological phenomena*. Finally, it might also be concluded that the above discussion from classical point of view appears to be quite justified and the NAM-DC interaction mechanism might also be extended to other pharmaceutical drug molecules (instead of NAMs) which cure a disease.

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