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## PHYSICS OF MULTITASKING NANOMEDICINE

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### ABSTRACT

This research presents how physics can play an important rule in multitasking nanomedicine especially in developing human high quality life as a breakthrough in nanotechnology which already has a wide insight and wise improvement particularly related to a novel nanomedicine system in healing many types of problems in human body mainly caused by at least three deadly deceases world wide: (1). Heart Attact, (2). Tumour and Cancer, and (3). Viruses/ Parasites. The idea of a new invention contributed by a physicist illustrates how a collaborative scientist can incorporate a healthy environment with a good work based on a remarkable idea extracted from a smart process of study and the experiences transformation in conducting many integrated experiment in order to realize the scientific idea. Here, we propose nanotechnology multitasking techniques as the applied nanoscience to realize the understanding of scientific field in science and engineering in this 21<sup>st</sup> century that can make technology and engineering faster, smaller, sensitive and cheaper, so that in general, all people in society with various social levels including the improvement of effective health cure and care based on their joyful heart. A connection between individual stress and their strain of life was explained

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based on physical system in human body. In addition, a multitasking nanomedicine was introduced to solve the above mentioned 3 main problems in human being. Finally, the impacts of multitasking nanomedicine suggest a breakthrough development for future human life.

## INTRODUCTION

Physics of multitasking nanomedicine (PMN) is a novel developing science to face various sophisticated human problems in this 21<sup>st</sup> century in which human being had currently been dramatically increased in their numbers up to ~7 billions people in the whole earth due to many kinds of improvements in their life and technology. Nanoscience is a science of the size of one million times smaller than a millimeter device or any kind of material as well as food and medicine. Furthermore, nanotechnology is a technology developed based on nanoscience [1- 7]. Therefore, nanomedicine is a medicine which contains nanometer (nm) medicine particles. In this case, a particle of nanomedicine consists of about 100 to 1000 atoms of medicine. In order to fabricate a nanomedicine structure, such 100 to 1000 various atoms from different elements that make a nanostructure [1-16] have to be well synthesized using many different kinds of methods and techniques [2,11-13]. The advantages of nanomedicine in comparison with another conventional medicines are the ability to heal a disease in a very fast response time, its on target healing of human wound inside the body, and its small amount of medicine materials with multitasking healing impact of the injured or cells problems in human body. Many efforts have been conducted from various scientists in developing such nanomedicine especially focusing on medical diagnosis and therapy [2], biophysics structures and molecular biology [11], as well as the applications of advanced nanomaterials in nanomedicine [12]. Multitasking nanomedicine is a multitasking style of healing human body problem using a nanomedicine. The PMN actually involves various methods or techniques of nanotechnology by incorporating various types of fabricated nanomedicine, for examples: (1) optical techniques such as fluorescence and photoluminescence of nanomedicines [1-6], (2) surface plasmon resonance (SPR) of nanomedicines fabricated from metallic nanomaterials with their various nanostructures and nanosizes [1,13], (3) integrated photonics imaging technique with a combination of optics and photonics to investigate the inside characters of a nanomedicine, and (4) an advanced femtosecond

chemistry with four dimension imaging technique.

In this work, one presents how physics can play an important rule in multitasking nanomedicine particularly in investigating and understanding human high quality life as a breakthrough in nanotechnology. A simple sophisticated technique with a combination of optics and photonics method was used to study physical behaviors of nanostructure material. Our idea and method suggests that PMN can have a wide insight and wise improvement particularly related to the development of the understanding in a novel nanomedicine system for the healing of many types of problems in human body mainly caused by at least three deadly deceases world wide: (1). Heart Attack, (2). Tumour and Cancer, and (3) Viruses/ Parasites. The idea of a new invention contributed by a physicist can explain how a collaborative scientist carries out an integrated research based on a healthy environment with a good work using a remarkable idea extracted from a smart process of study and the experiences transformation in conducting many integrated experiment in order to realize the scientific idea [1-9]. Here, we propose nanotechnology multitasking techniques as the applied nanoscience to realize the understanding of scientific field in science and engineering in this 21<sup>st</sup> century that can make technology and engineering faster, smaller, sensitive and cheaper, so that in general, all people in society with various social levels including the improvement of effective health cure and care based on their joyful heart. A connection between individual stress and their strain of life was explained based on physical system in human body. In addition, a multitasking nanomedicine was introduced to solve the above mentioned 3 main problems in human being. Finally, the impacts of multitasking nanomedicine suggest a breakthrough development for future human life.

## Multitasking Research Method

Multitasking research method (MRM) is an integratsed method in which many different types of research methods can be carried out at a time or at the same time, for example human being can do many activities at the same time such as hearing nd enjoying musics, while conducting research works, observing the surrounding environment, and remembering another appointment. **Figure 1(a)** shows how the MRM works based on the integration of understanding of PMN involving 5 important points in nanomedicine impacts: (1) the size, (2) the density of states, (3) the dimensions (0-D of quantum dot medicine, 1-D of nanowire or

nanotube of medicine, **2-D** of nanosheet of medicine, and **3-D** of nanocube/ tetrapod nanomaterials and so forth), **(4)** the confinement effect or the ability of confined electrons in a nanomedicine structure or particle, and **(5)** wavelength ( $\lambda$ ) - light matters interaction. Furthermore, the author will introduce a simple physical technique to study a connection between individual stress and their strain of life explaining based on physical system in human body as depicted in **Fig. 1(b)**. The mechanical strengths [17] of novel fibers fabricated by using nanomedicine with different sizes are being investigated in our research center with a simple physical method which is based on the measurement of Young modulus ( $Y$ ) and/or bulk modulus ( $B$ ). In this case, we proposed an indirect research on mechanical characters of different sizes of nanomedicines by making them like a fiber, and then investigated their elasticity and another mechanical properties. Young modulus of a material normally happened when there is a force ( $F$ ) applied in an area of a surface ( $A$ ) of a material

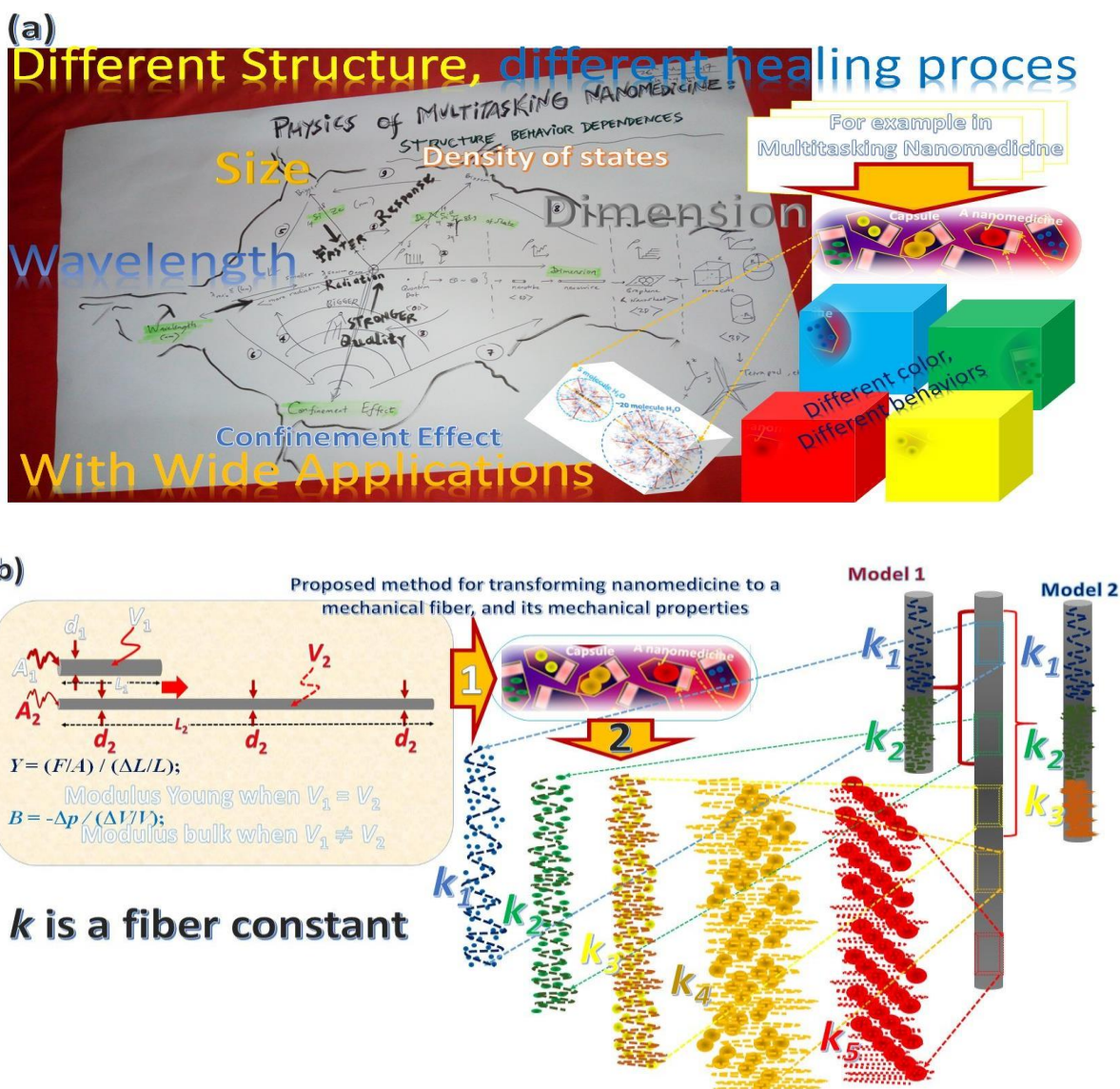
that makes it expands its length ( $L+\Delta L$ ). Therefore, we can define  $Y$  as [18-19]

$$Y = (F/A) / (\Delta L/L) = Y \text{ (Stress/ Strain)}.$$

When the fiber changes due to the changing of volume of the fiber as a result of a pulling pressure from a force applied on it, the bulk modulus,  $B$  can be measured by making a physical relationship between the pressure change ( $\Delta p$ ) in the surface area of the fiber that causes the volume change from  $V$  to  $V+\Delta V$ . Therefore, one can derive such  $B$  as

$$B = -\Delta p / (\Delta V/V) = B \text{ (Stress/ Strain)}.$$

**Figure 1(b)** depicts the simple description technique to measure parameters  $Y$  and  $B$ , respectively. While  $k$  is a spring constant of a fiber fabricated using nanomedicine particles.

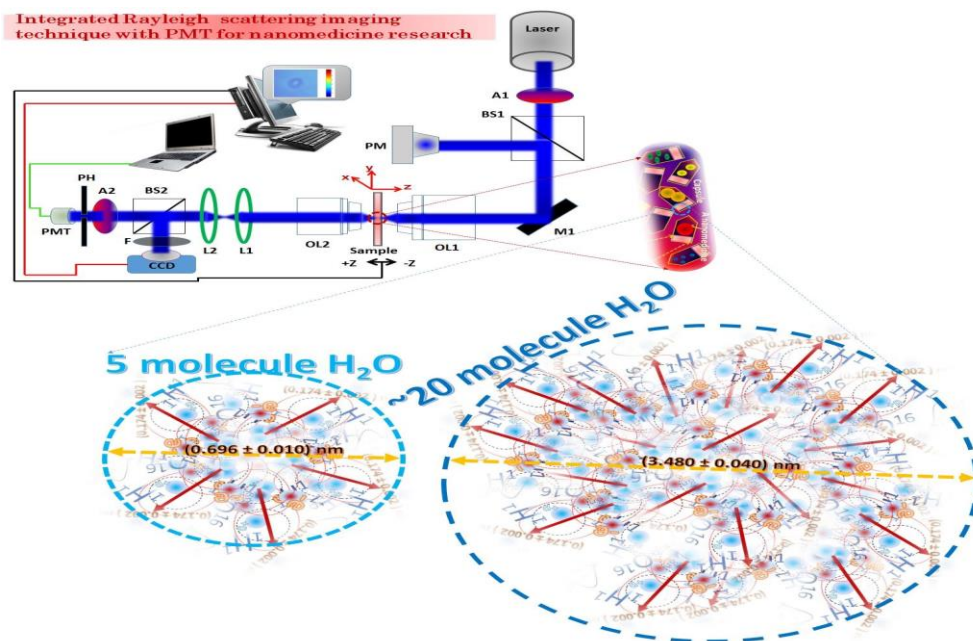


**Figure 1. (a)** The general picture of the method of multitasking nanomedicine research.

**(b)** A simple physical technique to study a connection between individual stress and their strain of a nanostructure by transforming it to be a fiber with two simple models (**Model 1** and **Model 2**) are proposed.

In order to realize the understanding of physics of nanomedicine, one setup an integrated photonics imaging technique with a combination of optics and photonics [4,6] as described in **Figure 2**. In such technique, the sample was put in the focus point of the laser induced light matter interactions, and the results of the interaction was then transmitted through another microscope lens connected into two ways of physical system: (1) **CCD** camera for the on target particles, and

(2) **PMT** connected with a laptop system for collecting the Rayleigh scattering data as a result of sample (nanomaterials) light interactions. By plotting the photon counting versus the nanostructure which produces the Rayleigh scattering, one can understand the physical behavior sensitivity of the observed nanostructure including another nanostructure sample such as nanomedicine.

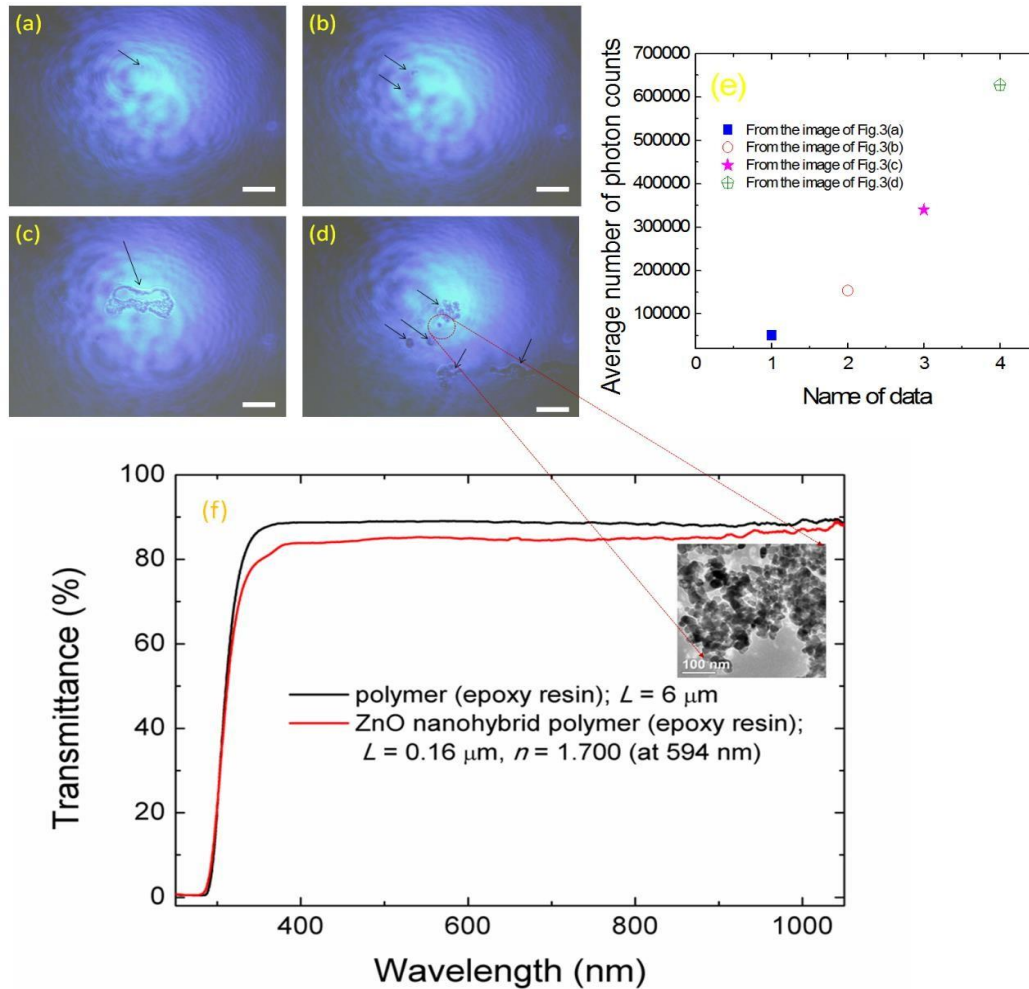


**Figure 2.** An integrated photonics imaging technique by incorporating optical and laser system with **CCD** camera and photomultiplier tube (**PMT**) for nanomedicine research.

## RESULTS

**Figure 3** depicts an example of the use of our technique described in **Fig. 2** for a nanohybrid material such as ZnO nanohybrid. As the number of nanostructures increase, the Rayleigh scattering also increases. This results indicate that there are density state

dependence ( $\rho$ ) and the number of particles aggregation of the scattering. As the  $\rho$  increased due to more nanoparticles presence in the nanostructure system, the Rayleigh scattering was then enhanced because of more photons were exposed in the nanostructure of nanohybrid system.



**Figure 3.** The observation of light matter interactions as shown in (a), (b), (c), and (d) is ZnO nanohybrid structure. While (e) and (f) are the photon counting observed for all the samples, and its UV-Vis spectrum comparison with the organic polymer matrix, respectively.

The success of our preliminary application of **MRM** based on **Fig. 1(b)**, for example in the setup as depicted in **Fig. 2** shows that such kind of typical method can also be applied to investigate physical properties of nanomedicine in the near future.

On the other hand, in order to fully understand

$$m \frac{d^2 y(t)}{dt^2} + k y(t) = 0, \tag{3}$$

where  $m$  is a vertically hanging mass on the fiber, and  $k$  is the string constant of the fiber. For **Model 1 of 2 different structures nanomedicine fiber** in **Fig. 1(b)**,

$$\begin{aligned} -k_1 y_1(t) - k_2 [y_1(t) - y_2(t)] &= 0 \\ -k_1 [y_2(t) - y_1(t)] &= m \frac{d^2 y_2(t)}{dt^2}, \end{aligned} \tag{4}$$

where  $k_1$  and  $k_2$  are the string constants for the top and bottom nanomedicine structures of the fiber. While for

the above mentioned physical behavior as depicted in **Fig. 1(b)**, we introduce a prompt theoretical analysis by making a starting point of the relationship between the classical mechanics rules derived by Newton and Hooke in the following second order differential equation

one can derive the following couple differential equation:

**Model 2** embedded in **Fig. 1(b)**, one can obtain 3 coupled differential equations in the following form:

$$\begin{aligned}
& -k_1 y_1(t) - k_2 [y_1(t) - y_2(t)] = 0 \\
& k_2 [y_1(t) - y_2(t)] - k_3 [y_2(t) - y_3(t)] = 0 \\
& k_3 [y_2(t) - y_3(t)] = m \frac{d^2 y_2(t)}{dt^2},
\end{aligned} \tag{5}$$

where  $k_1$ ,  $k_2$ , and  $k_3$  are the string constants for three different nanomedicine structures in one fiber.

The solution of **Eqs.** (4) and (5) can be easily solved by making them in matrix forms as follows

$$\begin{bmatrix} -(k_1 + k_2) & k_2 \\ k_2 & -k_2 \end{bmatrix} \begin{bmatrix} y_1(t) \\ y_2(t) \end{bmatrix} = \begin{bmatrix} 0 \\ m \frac{d^2 y_2(t)}{dt^2} \end{bmatrix}, \tag{6}$$

And

$$\begin{bmatrix} -(k_1 + k_2) & k_2 & 0 \\ k_2 & -(k_1 + k_2) & k_2 \\ 0 & k_3 & -k_3 \end{bmatrix} \begin{bmatrix} y_1(t) \\ y_2(t) \\ y_3(t) \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ m \frac{d^2 y_3(t)}{dt^2} \end{bmatrix}. \tag{7}$$

The solution of **Eq.** (6) can be derived by introducing a sinusoidal wave function with a periodical

wave function in the following form:

$$y_1(t) = A \sin(\omega t + \varphi), \text{ and} \tag{8a}$$

$$y_2(t) = B \sin(\omega t + \varphi), \tag{8b}$$

where  $A$  and  $B$  are the amplitudes for each wave function of  $y_1(t)$ , and  $y_2(t)$ ,  $\varphi$  is phase,  $T$  is a vertically simple harmonic oscillation periodic, and  $\omega$  is the inner

frequency, respectively. Therefore, by inserting **Eqs.** (8a), and (8b), we obtain

$$\begin{aligned}
& -(k_1 + k_2)A + k_2 B = 0, \\
& k_2 A + (m \omega^2 - k_2) B = 0,
\end{aligned} \tag{9}$$

This **Eq.** (9) can then be written in a matrix form as follow

$$\begin{bmatrix} -(k_1 + k_2) & k_2 \\ k_2 & -k_2 \end{bmatrix} \begin{bmatrix} A \\ B \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}, \tag{10}$$

with the exact solution of frequencies,  $\omega_{1,2}$  related to the values of string constants,  $k_1$  and  $k_2$

are extracted from the following short solution of **Eq.** (10):

$$\omega_{1,2} = \pm \left( \frac{\sqrt{k_t}}{m} \right), \tag{11}$$

where the total fiber constant ( $k_t$ ) of two different nanomedicine structures connected one another

vertically with a mass,  $m$  at their bottom is

$$k_t = \frac{k_1 k_2}{k_1 + k_2}. \tag{12}$$

Moreover, the  $\omega_{1,2}$  in **Eq. (11)** are actually the only possibility of the exact solution if the vibration of structure 1 and structure 2 in **the Model 1 nanomedicine fiber** as shown in **Fig. 1(b)** is independent one another. In fact, when the whole fiber is vibrating with a sinusoidal wave function, the two

different structures in the fiber will influence one another. Therefore, we propose another solution to find out the internal vibration frequency in each structure ( $\omega_1$  and  $\omega_2$ ) due to interconnection of the two different structures as follows

$$y_1(t) = A_1 \sin(\omega_1 t + \varphi_1) + A_2 \sin(\omega_2 t + \varphi_2), \quad (13a)$$

and

$$y_2(t) = B_1 \sin(\omega_1 t + \varphi_1) + B_2 \sin(\omega_2 t + \varphi_2). \quad (13b)$$

By substituting **Eqs. (13a)** and **(13b)** into **Eq. (6)**, we then obtain a set of equation in a matrix form

$$\begin{bmatrix} -(k_1 + k_2) & k_2 \\ k_2 & -k_2 \end{bmatrix} \begin{bmatrix} A_1 \sin(\omega_1 t + \varphi_1) + A_2 \sin(\omega_2 t + \varphi_2) \\ B_1 \sin(\omega_1 t + \varphi_1) + B_2 \sin(\omega_2 t + \varphi_2) \end{bmatrix} = \begin{bmatrix} 0 \\ m\{-\omega_1^2 B_1 \sin(\omega_1 t + \varphi_1) - \omega_1^2 B_2 \sin(\omega_2 t + \varphi_2)\} \end{bmatrix}. \quad (14)$$

The solution of the amplitudes  $A_1$ ,  $B_1$ ,  $A_2$ , and  $B_2$  embedded in **Eq. (14)** can be extracted using a

relationship between **Eq. (9)**, and **Eq. (14)** in the following two short cut equations:

$$\begin{aligned} -(k_1 + k_2)A + k_2 B = 0 &\Rightarrow \frac{A}{B} = \frac{k_2}{k_1 + k_2}, \\ k_2 A + (m\omega^2 - k_2)B = 0 &\Rightarrow \frac{A}{B} = \frac{-(m\omega^2 - k_2)}{k_2}, \end{aligned}$$

where  $A_1$ ,  $B_1$ ,  $A_2$ , and  $B_2$ , are amplitude vibration constants related to  $\omega_1$  and  $\omega_2$ . Therefore, one can solve it

shortly by introducing a parameter,  $\lambda$  in the following simple mathematics form:

$$\lambda_1 = \frac{(k_1 + k_2)}{(k_2)} \Rightarrow A_1 \left( \frac{(k_1 + k_2)}{(k_2)} \right) = B_1, \quad (15a)$$

and

$$\lambda_2 = \frac{(k_1 + k_2)}{(k_2)} = \lambda_2 = \Rightarrow A_2 \left( \frac{(k_1 + k_2)}{(k_2)} \right) = B_2; A_2 \lambda = B_2.$$

By substituting **Eq. (15a)** and **Eq. (15b)** into **Eq. (13a)**, and **Eq. (13b)**, we get

$$y_1(t) = A_1 \sin(\omega_1 t + \varphi_1) + A_2 \sin(\omega_2 t + \varphi_2), \quad \text{and} \quad (16a)$$

$$y_2(t) = \lambda \{A_1 \sin(\omega_1 t + \varphi_1) + A_2 \sin(\omega_2 t + \varphi_2)\} = \lambda y_1(t). \quad (16b)$$

Based on **Eqs. (16a)** and **(16b)**, the vibration wave functions ( $y_1(t)$  and  $y_2(t)$ ) of a fiber with two different structures on the top and bottom parts of the fiber shows just a different in their eigenvalue of  $\lambda$  that directly contributes to the amplitude of the fiber when it is vibrating. The indicator of our calculation in **Eqs. (15)** shows that  $\lambda_1 = \lambda_2 = \lambda$  are closely related to the same internal frequency in such two different structures of

nanomedicine fibers,  $\omega_1 = \omega_2$ . While as shown in **Eq. (11)**, this inner frequency,  $\omega$  has only two propagation directions which mean that the amount frequency is the same but the only change is its vertically moving direction either up or down.

Furthermore, by using the similar way of the solution in **Eq. (5)** associated with **Fig. 1(b)**, one can derive the exact solution of **Eq. (7)** associated with

**Model 2 of 3 different structures of nanomedicine fiber** as follows

$$\begin{bmatrix} -(k_1 + k_2) & k_2 & 0 \\ k_2 & -(k_2 + k_3) & k_3 \\ 0 & k_3 & -k_3 \end{bmatrix} \begin{bmatrix} A \sin(\omega_1 t + \varphi_1) \\ B \sin(\omega_2 t + \varphi_2) \\ C \sin(\omega_3 t + \varphi_3) \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ m \frac{d^2 y_3(t)}{dt^2} \end{bmatrix}, \quad (17)$$

where one supposes the solution of each part of the fiber's structures has the fiber vibration function as follows

$$y_1(t) = A \sin(\omega_1 t + \varphi_1), y_2(t) = B \sin(\omega_2 t + \varphi_2), \text{ and } y_3$$

$(t) = B \sin(\omega_3 t + \varphi_3)$ . The solution of **Eq. (17)** can be simplified as the following form:

$$\begin{bmatrix} -(k_1 + k_2) & k_2 & 0 \\ k_2 & -(k_2 + k_3) & k_3 \\ 0 & k_3 & m \omega_3^2 - (k_3) \end{bmatrix} \begin{bmatrix} A \sin(\omega_1 t + \varphi_1) \\ B \sin(\omega_2 t + \varphi_2) \\ C \sin(\omega_3 t + \varphi_3) \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \quad (18)$$

meaning the front matrix should be equal to zero as follow

$$\begin{bmatrix} -(k_1 + k_2) & k_2 & 0 \\ k_2 & -(k_2 + k_3) & k_3 \\ 0 & k_3 & m \omega_3^2 - (k_3) \end{bmatrix} = 0. \quad (19)$$

By solving **Eq. (19)**, we obtain

$$\omega_3 = \pm \sqrt{\frac{k_1 k_2 k_3}{m(k_1 k_2 + k_2 k_3 + k_1 k_3)}}. \quad (20)$$

If the frequency  $\omega_3 = \omega_2 = \omega_1 = \omega$  which means that the quality fiber just depended on its structure parts connected to its  $k_1, k_2$  and  $k_3$ , one can then get the only two possibilities of angular frequency of the fiber in two

directions (up or down paths) with its amount is as large as

$$\omega_{1,2} = \pm \left( \frac{k_t}{\sqrt{m}} \right). \quad (21)$$

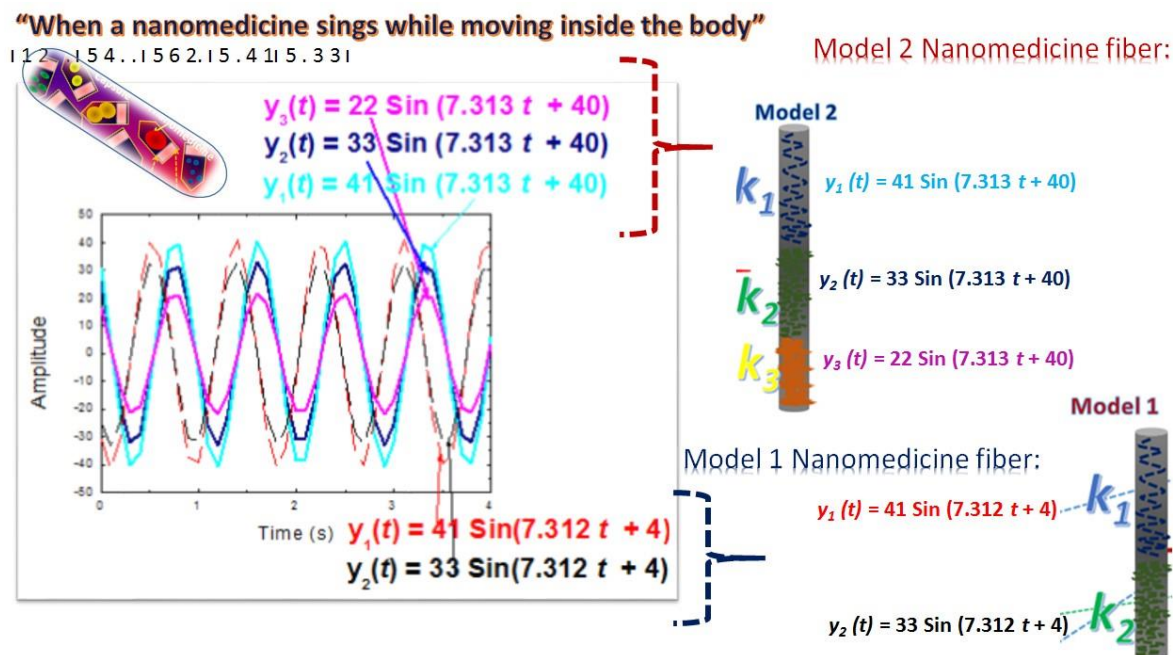
**Eq. (21)** shows that the total fiber constant ( $k_t$ ) with three different structures connected one another

vertically with a mass,  $m$  at their bottom is

$$\omega_t = \sqrt{\frac{k_1 k_2 k_3}{(k_1 k_2 + k_2 k_3 + k_1 k_3)}}. \quad (22)$$

**Figure 4** shows the wave functions of the two different Model 1 and Model 2 consisted of 2 and 3 different structures of nanomedicine fibers, respectively. According to such graphics, one can conclude that when nanomedicine

structure is moving in our body, they will produce a sound wave with certain amplitude, frequency and wavelength depending on their structure.



**Figure 4.** An illustration of how a nanomedicine makes sound in our body when they are moving.

## Summary

In summary, we have proposed and explained how physics can play an important role in developing the understanding of multitasking nanomedicine. We used few simple physical integrated experimental techniques and its simple theoretical model to rule out our understanding of such complicated nanomedicine structure. We found that by understanding physical scientific field and its multidisciplinary application in science and engineering as well as in medicine, this 21<sup>st</sup> century can be made as fruitful for others as possible particularly in making technology and engineering faster, smaller, sensitive and cheaper, so that in general, all people in society with various social levels including the improvement of effective health cure and care based on their joyful heart. A connection between individual stress and their strain of life was explained based on physical system in human body by introducing a simple transformation model of the nanomedicine into a fiber. In addition, a multitasking nanomedicine was introduced to solve the above mentioned 3 main problems in human being. Finally, the impacts of multitasking nanomedicine suggest a breakthrough development for future human life. Moreover, we suggest that this theory can be developed with more investigation with a complex structure of a novel fiber.

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## Biography



Dr. Hendry Izaac Elim, Lecturer & Senior researcher (Ph.D.-Physics; personal website: <http://fisika.fmipa.unpatti.ac.id/hendry-izaac-elim>), now is an experience Indonesia scientist of nanoscience and nanotechnology (rank 23<sup>rd</sup> in 2017 based on Webometrics (<http://www.webometrics.info/en/node/96>), head of the Nanotechnology Research Center and Innovative Creation (PPNRI-LEMLIT, website: <http://lemlit.unpatti.ac.id/pusat-pnri>) of the Pattimura University (UNPATTI), Chairman for Nanomaterials for Photonics Nanotechnology Laboratory (N4PN Lab), Physics Department, Faculty of Mathematics and Natural Sciences (FMIPA-UNPATTI), Ambon, Indonesia, and regular Member of the Indonesia Theoretical Physicist. He got his B.Sc (S.Si). in Theoretical Physics in 1995 at Gadjah Mada university (UGM), the oldest university in Indonesia, M.Si (M.Sc). in Theoretical Physics of Institut Teknologi Bandung (ITB) in 1999, Specialist in nanoscience and nanotechnology, Physics Doctor's degree (Ph.D.) at National University of Singapore (NUS), Singapore on 13<sup>th</sup> December 2005, Docent at FMIPA-UNPATTI since 2000 up to present. After his PhD at NUS, Dr. Elim worked as a postdoctoral fellow in physics department of NUS, and about 2 years later He moved to Tohoku university, Sendai, Japan working on superhybrid materials project at Institute of Multidisciplinary Research for Advanced Materials (IMRAM) from 2007 to 2012. In 2013, Dr. Elim worked as a scientist at Surya university, Indonesia for 3 months and then moved to STKIP Surya, Gading Serpong, Tangerang, Indonesia working as a physics lecturer for 1 year. Later in September 2014, Dr. Elim returned to FMIPA-UNPATTI and started building N4PN Lab as well as PPRI-LEMLIT until present time. The advancement of Science and technology development of Dr. Elim group started by educating the first 6 research B.Sc students and since that He already educated more than 30 graduated B.Sc in physics from all advanced research on novel superfibers fabricated from all types of garbage materials. The studies involved their mechanical and optical properties. Recently, Dr. Elim is leading research on water contaminated by CaCO<sub>3</sub>, the aggregation of salt behaviors in ocean water and energy research development. Furthermore, Dr. Elim educated few research students to work on biomembrane films and fibers fabricated using rubbish natural things. These studies involved their mechanical and optical behaviors. In addition, Dr. Elim had been invited to give international scientific talks especially related to the multitasking applications of nanoscience and nanotechnology in small islands and human characters. Based on the international community data recorded in Web of Science, Dr. Elim have published over 41 papers with h-index of 22, and citation more than 1800. **In addition, based on google scholar, his citations from about 66 international papers and proceedings have already reached over 2400 with h-index of 25.**

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