Theoretical Explanation of the Determination of the Oil Nano Size Using Laser Spectrum

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Abstract: ***Nano science is one of the most important branch of physics for opening a new horizon in developing appreciably the current technology.This gives nano tools first priority.One of the important tools is the determination of nano size.This encourages to do this work.In this work laser spectrum which was utilized to determine the nano size of oil has been explained theortically. Treating oil particles as strings vibrating with frequency equal to the applied laser frequency the laser spectrum showed intensity peaks at certain critical oil radii.This spectrum is explained using the string theory This indicated that the nano size of particles can be determined using the laser spectrum in terms of the intensity***

Keywords: nano, laser, string theory,oil, intensity

1. Introduction

Light is the oldest well known energy from.It stimulate the vision sence. Later on the development of the atomic theory lead to use the light emitted from atoms to identify the elements existing in any samples.This comes from the fact that the light frequency emitted from the atom is directly related to the electronic transfer between two atomic level s, where it is equal to the difference between the energy of the two atomic levels . This discovery leads to describe absorption, and emission on the atomic scale. The atomic transitions are thought to be resulting from two different mechanisms.one of them is the absorption which causes electron to jump from a lower yo a higher level. The other which is called spontaneous emission results from the electron transfer from a higher level to a lower leve [1]l. But later on this is modified by the Einstein discovery of the so called stimulated emission, on 1917 [2]. When a certain electron absorbs a photon, having energy equal to the difference between the ground level and excited level the electron to move from the ground to the excited level due to the absorption process [3]. After a certain time, known as the relaxation time, the electron spontaneously return back to the ground state, emitting a characteristics photon [4] leading to spontaneous emission [5]. The stimulated emission takes place before the relaxation time has been elapsed, where an incident photon, having energy equal to the differ between the energy of the two levels , forces the electron to return back to the lower level, emitting a photon having the same energy, phase and direction as the incident one [6]. Thes two coherent photons, being incident on two excited atoms four coherent photons emerge [7]. This process is repeated untill a very large number of highly concentrated single frequency coherent photons emerge as narrow energetic light beam known as laser [8]. This laser is now utilized in a wide variety of applications, in medicine,telecommunication, and industry [9].

The importance of laser in technology encourages scientists to do a lot of work for development of the laser technology[10].

One of them is the work of HassabAlla [11] where he showed , using Schrodinger equation , the possibility of fabricating nano amplifier . He found that the nano system acts as an amplifier by adjusting the medium potential . Another work was done by Elharam A. [12] using Maxwell's equations beside Schrodinger equation throughout the traveling wave solution . The imaginary part of the wave number is directly proportional to the amplification factor. The results obtained indicated that lasing and amplification takes place for super conductor and very good conductors under the action of internal magnetic field

In the work of Um Salama with others [13] Schrodinger and Maxwell’s equations were used to find that the the biophotons become coherent in the presence of external magnetic field. This means that the magnetic field helps in the amplification process

Using simulation S.Rajesh, et al, [14] showed that direct delay feedback can suppress hysteresis and bistability of the semiconductor laser and affect its performance. The results obtained by Michel, et al, [15] indicated that nano single-electron transistor (SET) act as an electronic amplifier and it can be used at the same time for ultra-noise applications

J. Smedley, et al, [16] used diamond for amplification . This takes place by emitting a large number of secondary electrons when few primary electrons are incident on it

The atomic spectra include also the absorption process

One of the papers concerned with the absorption process is the work of M.Schnaiter et al [17] .In his work a long path extinction spectrometer (LOPES) was utilized to obtain the absorption coefficient for aerosols. The results showed that the absorption coefficient decreases upon decreasing the frequency for smaller frequencies .In a similar work Giorgio Dall’Olmo, et al [18] showed that for the surface open ocean the absorption coefficient of chromophoric dissolved organic matter decreases with the frequency in the wavelength range (400-950nm). A third similar work of Babin et al [19] indicated that the absorption coefficient decreases upon decreasing the frequency in the range of (400-750nm) for phytoplankton, non algal particles, and dissolved organic matter in coastal waters around Europe. The work of Anette, Karlsson, et al [20] also indicated that the absorption coefficient decreased upon decreasing the frequency for mechanical pulps . Finally Ernesto, et al [21] studied the role of changing the concentration on the absorption coefficient.He found that increase of elemental carbon (EC) concentration cause the atmospheric absorption coefficient of light to increase also.

2. Theoretical model for the relation between particle Nano size and scattered intensity

Consider small particle of mass m moving and vibrating with velocity v, and with force constant k in moving in a resistive medium having coefficient of friction γ. Its equation of motion is given by

$$m\frac{dv}{dt} = eE + kx - \gamma v \quad (1)$$

One can solve this equation by suggesting the velocity v to be

$$v = v_0 e^{-i\omega t} \quad (2)$$

According to the relation of velocity with the acceleration a and displacement x , one gets

$$x = \int \quad vdt = \frac{v_0}{-i\omega} e^{-i\omega t} \quad (3)$$

$$x = \frac{iv}{\omega}$$

$$a = \frac{dx}{dt} = i\omega v \quad (4)$$

Using equation (4) and (3), in equation (1) one gets

$$i\omega m v = eE + \frac{k}{\omega} vi - \gamma v \quad (5)$$

Multiplying both sides by $i\omega$ gives

$$i^2\omega^2 m v = i\omega eE + ki^2 v - i\omega\gamma v \quad (6)$$

Rearranging and using the fact that

$$i^2 = -1$$
$$k = m\omega_0^2 \quad (7)$$

gives

$$[(\omega_0^2 - \omega^2)m + i\omega\gamma]v = ie\ \omega\ E \quad (8)$$

gives

$$v = \frac{ie\omega\ E}{[(\omega_0^2 - \omega^2)m + i\omega\gamma]} \quad (9)$$

For oscillating spherical body of radius a with frequency ω the speed is given by

$$v = a\omega \quad (10)$$

One can also use equation (3) to get

$$v = i\omega x$$
$$|v| = v_0 = \omega|x| = \ \omega x_0 = \omega a \quad (11)$$

The emitted scattered photons can be found by treating photons as strings having the same oil frequency. If the scattered photon volume density is n, and the speed of light is c, then the scattered intensity I is given by

$$I = n\hbar c\omega \quad (12)$$

The magnitude of the velocity can be found using equation (9) where

$$|v| = \sqrt{\quad}$$

Define now x, y and z to be

$$x = (\omega_0^2 - \omega^2)m$$
$$y = i\omega\gamma$$
$$b = e\omega\ E$$
$$z = x^2 + y^2 \quad (13)$$

$$v = \frac{ib}{x + iy}$$

$$v = \frac{ib(x\ -\ iy)}{(x - iy)(x + iy)} = \frac{ib(x\ -\ iy)}{x^2 + y^2} = \frac{ib(x\ -\ iy)}{z}$$

$$v^* = \frac{-ib(x + iy)}{z} \quad (14)$$

Hence

$$|v|^2 = vv^* = \frac{b^2}{z^2}(x - iy)(x + iy) = \frac{b^2}{z^2}(x^2 + y^2) = \frac{b^2}{z^2}z = \frac{b^2}{z} \quad (15)$$

Thus the magnitude of v is given by

$$|v| = \frac{b}{\sqrt{\quad}} \quad (16)$$

Assuming the photon frequency to be equal to the particle frequency, eqn (10) gives

$$\omega = \frac{|v|}{a} \quad (17)$$

Thus according to equation (13), (15), (17) and (12) one gets

$$I = n\hbar c\omega = n\hbar c\frac{|v|}{a} = n\hbar c\frac{b}{a\sqrt{\quad}} = \frac{n\hbar cb}{a\left[(\omega_0^2 - \omega^2)^2 m^2 + \omega^2\gamma^2\right]^{\frac{1}{2}}} \quad (18)$$

The spectrum peak is at maximum I. the intensity I is maximum when

$$\omega = \omega_0$$
$$\frac{v}{a} = \omega_0$$
$$a = \frac{v}{\omega_0} = a_0 \quad (19)$$

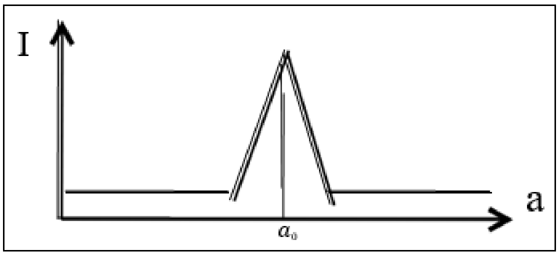

Figure 1: Relation between I and a for equation (18)

If photons are treated as classical oscillators, the photons intensity is given by

$$I = n\left(\frac{1}{2}m\omega^2\right)c = \frac{n}{2a^2}mv^2c = \frac{nmc}{2a^2}\frac{b^2}{\left[(\omega_0^2 - \omega^2)^2 m^2 + \omega^2\gamma^2\right]} \quad (20)$$

Again the intensity is maximum and the peak is observed at

$$\omega = \omega_0 \quad \frac{v}{a} = \omega_0$$
$$a = \frac{v}{\omega_0} = a_0 \quad (21)$$

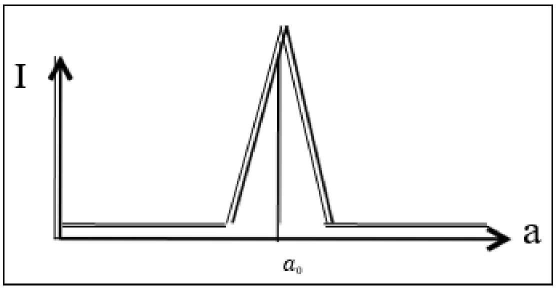

Figure 2: Relation between I and a for equation (20)

For more than one oil particles having different radii, the corresponding peaks appear

$$a_1 = \frac{v_1}{\omega_1}$$
$$a_2 = \frac{v_2}{\omega_2}$$
$$a_3 = \frac{v_3}{\omega_3} \quad (22)$$

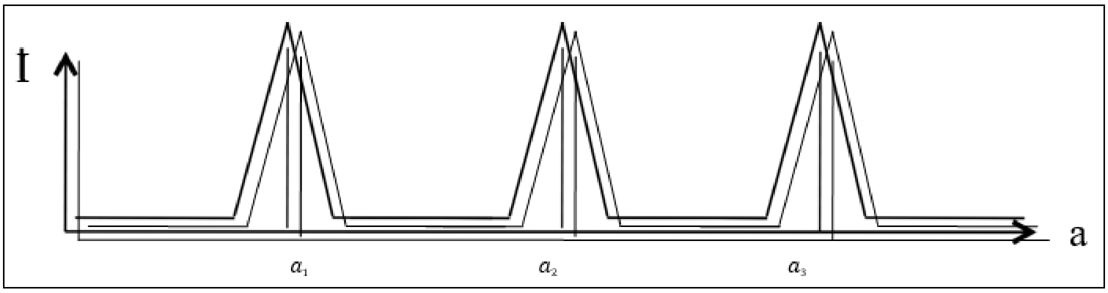

Figure 3: Relation between I and a for equations (18) and (22)

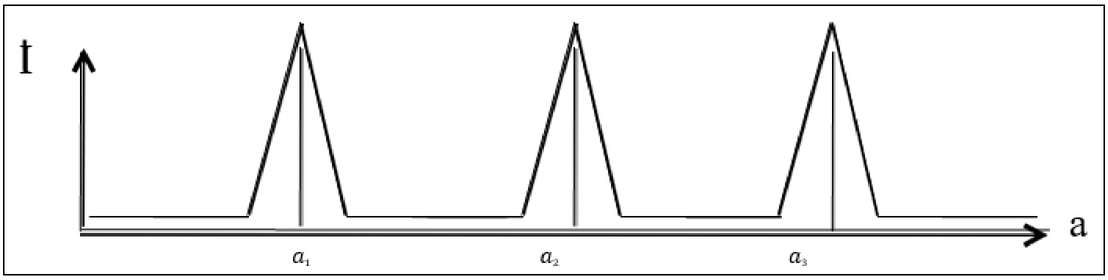

Figure 4: Relation between I and a for equations (20) and (22)

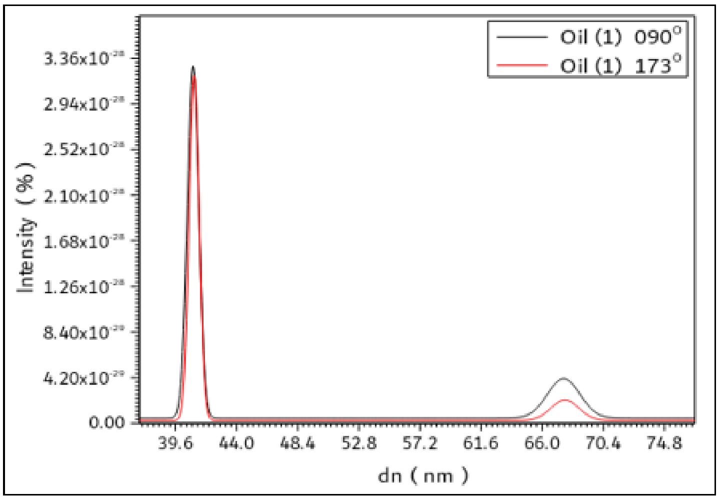

Figure 5: Relationship between scattered light intensity versus radius of size of Oil [22]

3. Discussion

According to figures (1, 2, 3,4) and 5 the intensity is maximum at certain radii.

It is very interesting to note that the intensity I and oil radius can be explained using string theory. First of all the oil particles are assumed to move in a resistive frictional medium acting as a vibrating spring or string under the action of an electromagnetic laser travelling wave see eqn (1). The particles are treated as strings according to equations (2,3,4).

Being recognizing the particle nature through Newtonian equation of motion and the wave nature through the string vibration, the quantum dual nature was manifested.Using this equation a frequency dependent speed was obtained in equation (16). The velocity was also related to the oil radius and the frequency in equations (10) and (17).Using plank quantum theory a useful expression for the scattered intensity was found treating laser as a stream of photons and treating photons as quantum string having the same oil frequency,as shown by eqn (18). according to equation (18) the intensity is maximum when the photon frequency ω is equal to the natural frequency ω_0. Using the relation between the particle

Paper ID: SR24421125546 DOI: https://dx.doi.org/10.21275/SR24421125546

radius a and frequency ω in equation (17), the radius at which the intensity is maximum was found (see eqn (19)). Fig (1) displayed the relation graphically.

The same result be found if one treat photons as quantum strings as shown by equation (20). Again the intensity I is maximum at a certain specific radius given by equation (21) and figure (2). for different particles having different Nano radii, one have different resonance peaks ω_1, ω_2 and ω_3 as shown by equation these relations were displayed graphically in figures(3,4)

4. Conclusion

Treating oil particles as strings vibrating with frequency equal to the applied laser frequency the laser spectrum showed intensity peaks at certain critical oil radii.This spectrum is explained using the string theory

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