# Derivation of Time and Spatial Decaying of Schrodinger Equation Using Maxwell Electric Equation to Describe Scattering in Some Physical Systems

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**Abstract**:

Maxwell equation for the electric field has been solved for any medium by suggesting the wavenumber and angular frequency be complex quantities. This accounts for the field decay by interaction with the medium.

This expression for the time and special decay of the electric field in a medium is used to construct a new wave function sensitive to the medium physical properties. This new wave function, unlike the conventional one, differentiates between a beam of particles in a vacuum and that enters a medium which is an attenuated due to the scattering effect.

Another expression for time decaying electric field was obtained using Newton's laws for frictional medium. This expression shows that the electric field diminishes due to friction.

Fortunately, this time decaying part of the electric field is typical to that derived from Maxwell's equations. Finally, a new Schrodinger equation sensitive to the medium properties was derived. This equation, fortunately, describes some scattering processes for Protein scattering, scattering of x-rays, opto-acoustic phonons, and Raman scattering for some materials successfully

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Keywords:

Complex wave mek complex frequency, medium, electric field, the medium wave function, friction, relaxation time.

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## 1. Introduction:

Atoms are building blokes of matter, atoms and elementary particles are described by using quantum laws [1,2].

The formalism of quantum laws is mainly based on the wave bauit resulted from the wave function similar to that of the electric field in free space[3,4]Schrodinger, Klien-Gorden and Dirac equation which use this wave function together with the energy-momentum relation [5].

These formalisms succeeded in describing the behavior of individual atoms, lie atom spectra, and magnetic atom interaction. But unfortunately, it suffers from many setbacks in describing some properties of bulk matter like superconductivity [6,7]. It also has no general framework to describe the behavior of nanoparticles [8,9].this may be related to the fact that the wave function is driven from that of the electric field in free space. thus, the correct way to describe bulk matter is to the derived quantum equation from that of the electric field inside the medium. This makes it sensitive to medium properties.

Many attempts were made by M.Dirar and others [8,9] to account for the medium properties. but these attempts are complex are based on certain approximations. This work finds an exact simple wave from in section (2),(3) and (4) are devoted for discussion and conclusion the idea of dividing whole things into smaller pieces, fractions, is integral to our culture. It is embedded into our language in many ways: in the way we tell the time as 'quarter to' or 'half past' the hour; the way we write recipes with '½ a teaspoon' or 'a quarter of a cup' and how we buy our food using 'half or quarter kilos'. Understanding and using these terms in the everyday sense is an essential aspect of numeracy. Unfortunately, fractions have often been dealt with in such an abstract way in secondary schools that many students fear the very word. By focussing on commonly used, everyday fractions such as ½ , ¼ , ¾, this sections revisits fractions in everyday use to build students' confidence in relation to fractions. The section also outlines methods for using hands-on materials to clarify the meaning of fractions with a focus on how they are written in symbols and in words and how they are said. It also outlines activities to briefly explore how fractions relate to one another and what it means to combine or double quantities such as ½ or 1 ½ as they occur in practical situations, such as recipes. Revisiting basic meanings in this way can also be very useful for students from other culture and language backgrounds who may not have learned about fractions in the past, or may have met them differently within their own languages and cultures. Factions as a basis for decimals, percentages and measurement The 'fraction' concept of dividing things into smaller pieces also underpins our 'decimal' or 10-based systems of money and measurement in which whole units such as dollars, metres, or litres are divided into hundredths (centimetres and cents) and thousandths (millilitres). Making sense of the relationships between these units of measurement is much easier for people who have a grasp of basic fraction concepts. The idea of fractional parts also underpins 'percentages' which are so commonly used in our society for everything from analysing the population and their opinions, to advertising money-saving bargains. Whilst the main focus of this section is on common usage of fractions, it also provides optional opportunities for looking at the fractions 1/10 and 1/100 and thus for making links between the decimal system for writing numbers and measurements later on. These foundations also link directly to the percentages section which explores the meaning of percentages, makes links between common fractions and their percentage equivalents and uses the understanding of common fractions such as ½ and ¼ for 'in the head' or shortcut calculations of percentages.

**2. Friction Force from Mechanics to Thermodynamics**

Stuckelberge introduced thermodynamics in a way similar to mechanics [16]. In his work, energy and entropy consist of state function which was introduced in the first and second laws of thermodynamics. The second law consists of two parts, one related to the time evolution of general systems and the other to the approach to equilibrium for isolated systems. Stuckelberge studied thermodynamics by considering simple systems, which are known as an element of the system, for which the state can be described by only one non-mechanical, or thermal, variable – the entropy which is postulated in the second law together with the mechanical variables. He then considered general systems made of a finite or infinite number of interacting simple systems.

To show how mechanics can be extended to thermodynamics, Stuckelberge's approach is illustrated with the same simple mechanical systems subjected to friction force, where the structural properties are used, and the conservation of energy also assumed.

**3. The Theoretical Model:**

The time and spatial decaying wave function can be found using the electric field equation.

3.1 Diminished Decaying electric field

The Maxwell equation for the electric field is given by:

$$-\nabla^2 E + \mu\sigma \frac{\partial E}{\partial t} + \mu\varepsilon \frac{\partial^2 E}{\partial t^2} = 0 \tag{1}$$

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Consider The solution

$$E = E_0 e^{i(kx-\omega t)} \tag{2}$$

The effect of the medium can be incorporated in this equation by assuming

$$k = k_1 + ik_2 \quad , \quad \omega = \omega_1 + i\omega_2 \tag{3}$$

Thus from equation (2)

$$\nabla^2 E = -k^2 E$$

and

$$\frac{\partial E}{\partial t} = -i\omega E \quad , \quad \frac{\partial^2 E}{\partial t^2} = -\omega^2 E \tag{4}$$

Inserting equation (4) into equation (1) gives

$$\left(k^2 - i\omega\mu\sigma - \mu\varepsilon\omega^2\right)E = 0$$

$$k^2 - i\omega\mu\sigma - \mu\varepsilon\omega^2 = 0 \tag{5}$$

With the aid of equation (3), equation (5) becomes

$$\left(k_1 + ik_2\right)^2 - i\left(\omega_1 + i\omega_2\right)\mu\sigma - \mu\varepsilon\left(\omega_1 + i\omega_2\right)^2 = 0$$

$$k_1^{\,2} + k_2^{\,2} - 2k_1k_2 i - \omega_1\mu\sigma i + \mu\sigma\omega_2 - \mu\varepsilon\omega_1^{\,2}$$
$$+\mu\varepsilon\omega_2^{\,2} - 2\mu\varepsilon\omega_1\omega_2 i = 0 \tag{6}$$

Equating real and imaginary parts

$$k_1^{\,2} + k_2^{\,2} + \mu\sigma\omega_2 - \mu\varepsilon\omega_1^{\,2} + \mu\varepsilon\omega_2^{\,2} = 0 \tag{7}$$

$$2k_1k_2 - \mu\sigma\omega_1 - 2\mu\varepsilon\omega_1\omega_2 = 0 \tag{8}$$

Equation (7) can be simplified by taking into account the $k_1$ and $\omega_1$ are the wavenumber and angular frequency given by

$$\omega_1 = 2\pi f \quad , \quad k_1 = \frac{2\pi}{\lambda} \tag{9}$$

While the velocity $v$ is given by

$$v = \lambda f = \frac{\omega}{k} = \frac{1}{\sqrt{\mu\varepsilon}} \tag{10}$$

Thus

$$\mu\varepsilon = \frac{k^2}{\omega^2} = \frac{k_1^{\,2}}{\omega_1^{\,2}} \quad , \quad k_1^{\,2} = \mu\varepsilon\omega_1^{\,2} \tag{11}$$

Thus equation (7) becomes

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$$-k_2^{\ 2} + \mu\sigma\omega_2 + \mu\varepsilon\omega_2^{\ 2} = 0 \tag{12}$$

Thus

$$k_2 = \sqrt{\mu\varepsilon\omega_2^{\ 2} - \mu\sigma\omega_2} \tag{13}$$

To find $\omega_2$ equation (12) can be rewritten as

$$c_1\omega_2^{\ 2} + c_2\omega_2 + c_3 = 0 \tag{14}$$

With

$$a = c_1 = \mu\varepsilon \ , \quad b = c_2 = -\mu\sigma \ , \quad c = c_3 = -k_2^{\ 2} \tag{15}$$

Thus

$$\omega_2 = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{\mu\sigma \pm \sqrt{\mu^2\sigma^2 + 4\mu\varepsilon k_2^{\ 2}}}{2\mu\varepsilon} \tag{16}$$

$k_2$ can be found from equation (8) to be

$$k_2 = \frac{\mu\sigma\omega_1 + 2\mu\varepsilon\omega_1\omega_2}{2k_1} \tag{17}$$

The equations for $\omega_2$ and $k_2$ can be simplified by setting

$$k_2 = \alpha k_1 \ , \quad \omega_2 = \beta\omega_2 \tag{18}$$

A direct substitution in equation (8) with the aid of equation (11) gives

$$2\alpha k_1^{\ 2} - \mu\sigma\omega_1 - 2\mu\varepsilon\beta\omega_1^{\ 2} = 0$$

$$2\alpha k_1^{\ 2} - 2\mu\varepsilon\beta\omega_1^{\ 2} = \mu\sigma\omega_1$$

$$(\alpha - \beta)k_1^{\ 2} = \frac{\mu\sigma\omega_1}{2} \tag{19}$$

Inserting equation (18) in equation (12) gives

$$-\alpha^2 k_1^{\ 2} - \mu\sigma\omega_2 - \beta^2\mu\varepsilon\omega_1^{\ 2} = 0$$

$$-\alpha^2 k_1^{\ 2} + \beta^2 k_1^{\ 2} = \mu\sigma\beta\omega_1$$

$$-(\alpha - \beta)(\alpha + \beta)k_1^{\ 2} = \mu\sigma\beta\omega_1 \tag{20}$$

Inserting equation (19) in equation (20) yields

$$-\frac{\mu\sigma\omega_1}{2}(\alpha + \beta) = \mu\sigma\beta\omega_1$$

$$-\frac{1}{2}(\alpha+\beta)=\beta$$

$$(\alpha+\beta)=-2\beta$$

$$\alpha=-3\beta \tag{21}$$

$$\beta=\frac{-1}{3}\alpha \tag{21}$$

Thus from equation (18)

$$k_2=\alpha k_1 \quad , \quad \omega_2=\frac{-1}{3}\alpha\omega_1 \tag{22}$$

From (19) and (11)

$$\alpha-\beta=\frac{\mu\sigma}{2}\frac{\omega_1^{\,2}}{\omega_1 k_1^{\,2}}=\frac{\mu\sigma}{2}\frac{1}{\mu\varepsilon\omega_1}=\frac{\sigma}{2\omega_1\varepsilon} \tag{23}$$

From equations (21) and (23)

$$\alpha+\frac{1}{3}\alpha=\frac{\sigma}{2\omega_1\varepsilon}$$

$$\frac{4}{3}\alpha=\frac{\sigma}{2\omega_1\varepsilon}$$

$$\alpha=\frac{3\sigma}{8\omega_1\varepsilon} \tag{24}$$

Thus from equation (21)

$$\beta=\frac{-1}{3}\alpha=\frac{-\sigma}{8\omega_1\varepsilon} \tag{25}$$

Thus the electric field equation (2), with aid of equations (3), (18), (24) and (25) becomes

$$E=E_0 e^{-k_2 x}e^{\omega_2 t}e^{i(k_1 x-\omega_1 t)}$$

Setting

$$k_1=k \quad , \quad \omega_1=\omega$$

one gets

$$E=E_0 e^{-\alpha kx}e^{\beta\omega t}e^{i(kx-\omega t)}$$

$$E=E_0 e^{\frac{-3\sigma}{8\omega\varepsilon}kx}e^{\frac{-\sigma}{8\varepsilon}t}e^{i(kx-\omega t)} \tag{26}$$

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But

$$\frac{k}{\omega}=\frac{1}{\lambda f}=\frac{1}{v}=\frac{c}{v}\frac{1}{c}=\frac{n}{c} \tag{27}$$

Where $n$ stands for the refractive index

Thus equation (26) becomes

$$E=E_0 e^{\frac{-3\sigma}{8\varepsilon c}nx} e^{\frac{-\sigma}{8\varepsilon}t} e^{i(kx-\omega t)} \tag{28}$$

**4. Decaying velocity and electric field in a resistive medium:**

Consider a particle of mass m with initial velocity $v_0$ in a resistive medium of friction coefficient $\gamma$. The equation of motion of this particle is given by

$$m\frac{dv}{dt}=-\gamma v \tag{29}$$

Thus

$$\int\frac{dv}{v}=\frac{-\gamma}{m}\int dt+c$$

$$\ln v=\frac{-\gamma}{m}t+c$$

$$v=e^c e^{\frac{-\gamma}{m}t} \tag{30}$$

But at $t=0$, $v=v_0$ (31)

$$v_0=e^c \tag{32}$$

Hence

$$v=v_0 e^{\frac{-\gamma}{m}t} \tag{33}$$

Using the definition of current density $J$ and the conductivity $\sigma$, one gets

$$J=nev=nev_0 e^{\frac{-\gamma}{m}t}=\sigma E \tag{34}$$

Thus

$$E=\frac{nev_0}{\sigma}e^{\frac{-\gamma}{m}t}=E_0 e^{-\gamma t} \tag{35}$$

This means that the electric field decays exponentially in a frictional medium. However, equations (15) and (28) appears to be in conflict with each other. This conflict can be removed by remembering that

$$\gamma = \frac{m}{\tau} \tag{36}$$

The relaxation time $\tau$ is related to the fact that atoms absorb and re-emit light $v$ satisfies

$$v(t+\tau) = L \quad , \qquad ct = L \tag{37}$$

Therefore

$$v = \frac{L}{t+\tau} = \frac{L}{(L/c)+\tau} \tag{38}$$

For simplification, consider

$$L = 1 \quad , \qquad c \gg L \tag{39}$$

Thus

$$v = \frac{1}{\tau} \tag{40}$$

For nonmagnetic material

$$\mu = \mu_0 \tag{41}$$

As a result

$$v = \frac{1}{\sqrt{\mu_0 \varepsilon}} = \frac{\gamma}{m}$$

$$\frac{1}{\varepsilon} = \frac{\mu_0 \gamma^2}{m^2} \tag{42}$$

But the conductivity $\sigma$

$$\sigma = \frac{c_0}{\gamma} \tag{43}$$

A direct substitution of equations (42) and (43) in equation (28) gives

$$E = E_0 e^{\frac{-3\sigma}{8\varepsilon c} nx} e^{\frac{-c_0 \mu_0 \gamma^2}{8\gamma m^2} t}$$

$$E = E_m e^{-\gamma t} \tag{44}$$

Where one can choose

$$c_0 = \frac{8m^2}{\mu_0} \tag{45}$$

Thus equation (44) which is obtained from electromagnetic Maxwell equation conforms with equation (35) which was found from Newton second law.

(3.3) Schrodinger Equation for A certain Medium

Schrodinger Equation stems from the expression for electric a travelling in free space

$$E = E_0 e^{i(kx-\omega t)} \tag{46}$$

Where one assumes the wave function to be

$$\psi = \psi_0 e^{i(kx-\omega t)} = \psi_0 e^{\frac{i}{\hbar}(px-Et)} \tag{47}$$

Where one uses Planck's and de Broglie's hypotheses

$$E = \hbar\omega \qquad\qquad E = \hbar\omega \tag{48}$$

One uses Newton's energy-momentum relation

$$E = \frac{p^2}{2m} + V$$

$$E\psi = \frac{p^2}{2m}\psi + V\psi \tag{49}$$

Using equation (47), one gets

$$-\hbar^2\nabla^2\psi = p^2\psi$$

$$i\hbar\frac{\partial\psi}{\partial t} = E\psi \tag{50}$$

A direct substitution of equation (50) in equation (49) gives

$$i\hbar\frac{\partial\psi}{\partial t} = \frac{-\hbar^2}{2m}\nabla^2\psi + V\psi \tag{51}$$

Which is the ordinary Schrodinger equation. However, this equation backs form noticeable setbacks. First of all, the wave function in equation (47) is that of free space. Thus it is not useful for describing the behavior of particles in a medium. If we have two particles subjected to a potential V, one is in free space and other in inside a medium, equation (51) says that their energy and the probability distribution $|\psi|^2$ is the same which is in direct conflict with experimental observation for protons, electrons, neutrons beams passing through vacuum and inside any material. However, the wave function similar to equation (28) inside matter is sensitive to the medium conductivity $\sigma$ and friction $\gamma$ through the conductivity term, where

$$\sigma = \frac{ne^2}{\gamma} \tag{52}$$

It's also sensitive to the electrical and magnetic properties through the refractive index $n$, where

$$n = \frac{c}{v} = c\sqrt{\mu\varepsilon} \tag{53}$$

This wave function, in analogy to equation (28) can be written to be

$$\psi = Ae^{\frac{-3\sigma}{8\varepsilon c}nx}e^{\frac{-\sigma}{8\varepsilon}t}e^{i(kx-\omega t)} \tag{54}$$

Setting

$$\alpha_0 = \frac{3\sigma n}{8\varepsilon c} \qquad \beta_0 = \frac{\sigma}{8\varepsilon} \tag{55}$$

One gets

$$\psi = Ae^{-\alpha_0 x}e^{-\beta_0 t}e^{\frac{i}{\hbar}(px-Et)} \tag{56}$$

The Schrodinger equation for this new wave function can be found with the aid of equation (56) to get

$$\frac{\partial\psi}{\partial t} = -(\beta_0 + \frac{i}{\hbar}E)\psi$$

$$-(\frac{\partial\psi}{\partial t} + \beta_0\psi) = E\psi \tag{57}$$

$$\nabla\psi = (-\alpha_0 + \frac{i}{\hbar}p)\psi$$

$$\nabla^2\psi = (-\alpha_0 + \frac{i}{\hbar}p)\nabla\psi$$

$$\nabla^2\psi = (-\alpha_0 + \frac{i}{\hbar}p)^2\psi \tag{58}$$

Or

$$\frac{i}{\hbar}(\nabla\psi + \alpha_0\psi) = p\psi$$

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$$\frac{i}{\hbar}\nabla(\nabla\psi+\alpha_0\psi)=p\nabla\psi$$

$$\frac{i}{\hbar}\nabla[(-\alpha_0+\frac{i}{\hbar}p)\psi+\alpha_0\nabla\psi]=p\nabla\psi$$

$$\frac{i}{\hbar}[(-\alpha_0\nabla\psi+\frac{i}{\hbar}p\nabla\psi+\alpha_0\nabla(-\alpha_0+\frac{i}{\hbar}p)\psi]=p(-\alpha_0+\frac{i}{\hbar}p)\psi$$

$$\nabla^2\psi=(\alpha_0{}^2+\frac{2i}{\hbar}\alpha_0 p-\frac{p^2}{\hbar^2})\psi=\alpha_0{}^2\psi+\frac{2i}{\hbar}\alpha_0 p\psi-\frac{p^2}{\hbar^2}\psi$$

$$\nabla^2\psi=\alpha_0{}^2\psi+2\alpha_0\nabla\psi+2\alpha_0{}^2\psi-\frac{p^2}{\hbar^2}\psi \tag{59}$$

$$-\hbar^2(\nabla^2\psi-2\alpha_0\nabla\psi-2\alpha_0{}^2\psi)=-p^2\psi \tag{60}$$

A direct substitution of equations (57) and (60) in equation (49) yields

$$i\hbar\frac{\partial\psi}{\partial t}+i\hbar\beta_0\psi$$

$$=-\frac{\hbar^2}{2m}(\nabla^2\psi-2\alpha_0\nabla\psi-2\alpha_0{}^2\psi)+V\psi \tag{61}$$

**Discussion:**

The expression for the electric field inside a medium can be found by expressing $k$ and $\omega$ in a complex form as shown by equations (2) and (3). A direct substitution of this expression in equation (1) for the electric Maxwell equation part gives us the general relation in equation (6). Equating real and imaginary parts gives equation (7) and (8). The two equations can be simplified by assuming the imaginary parts $k_2$ and $\omega_2$ to be proportional to the real parts as pointed out by equation (18). A direct substitution and solution gives the imaginary parts of $k$ and $\omega$ (see equation (28)) to be dependent on the conductivity $\sigma$, refractive index $n$, and electric permittivity $\varepsilon$. The magnetic permittivity manifests itself through $n$ the relation

$$n=\frac{c}{v}=c\sqrt{\mu\varepsilon} \tag{62}$$

Even equation (28) feels the existence of friction through the conductivity $\sigma$, according to the relation

$$\gamma=\frac{ne^2}{\sigma} \tag{63}$$

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And via the speed of light in a medium $v$, which is given according to equation (42) by

$$v = \frac{\mu_0 \gamma^2}{a^2 m} \tag{64}$$

Even the atomic spacing *a*, can affect the wave function. It is very striking to note that the wave function of the free space equation (47) cannot differentiate between a particle beam in free space and inside a medium, because the probability $P_r$ is constant for both cases, i.e.

$$P_r = |\psi|^2 = |\psi_0|^2 = \text{constant} \tag{65}$$

But the wave function (56) gives different results. For free space $\sigma = 0$ and the probability

$$P_r(\text{free space}) = |\psi|^2 = |A|^2 = \text{constant} \tag{66}$$

However, for a certain medium having conductivity $\sigma$, equation (56) gives

$$P_r(\text{medium}) = |\psi|^2 = |A|^2 e^{-2\alpha_0 x} e^{-2\beta_0 t} \tag{67}$$

This equation (67) conforms with an observation which shows that the medium causes the incident beam to be diminished and decay due to the scattering process. Equation (67) states clearly that the number of particles (or probability) decreases as

$$x \rightarrow \infty \qquad t \rightarrow \infty$$

This completely agrees with observations which shows that the particle beam intensity remains constant in a vacuum and decays with time and distance when it enters a certain medium. Thus the correct way for bulk matter and free space is to use equation (67) which is analogous to the electric wave equation (26) in a medium. This equation was derived using Newton's energy-momentum relation (49) beside equation (56). Schrodinger equation (61) is sensitive to the medium properties, like conductivity, friction, electric and magnetic permeability beside atomic spacing as pointed out by equations (42), (62), (63) and (64). The effect of friction $\gamma$ only on the electric field in section (2.2). equation (35) shows a decaying mode dependent on $\gamma$ only. This expression coincides with that of Maxwell in (44)

**It is very interesting to note that this model can successfully be used to describe the** scattering from protein of......... beam as shown in figure 1,which shows relations between scattered beam and frequency for different temperatures and different protein types similar to the theoretical one shown in figure(10). In these figuresand the following ones the intensity S(I) is shown to be exponentially decaying with the frequency , angular frequency , and energy. Figure (2) for I versus photon energy resembles the theoretical one in figure (10).Fortunately figures (3,4,5) which describe the scattering of x-rays by Cr for positive photon energy, and the scattering of the photons by Be above 2960 ev also can be also by the theoretical relation in figure(10).The same similarity is observed in figures (6,7) for x-rays scattering by Cr and Sn above zero. Figure (8) for opto-acoustic phonos wave number K against the intensity also obeys the theoretical relation (10).This is not surprising as far as the wave number is proportional to the angular frequency . Even Raman spectra for ethanol obeys the theoretical relation.

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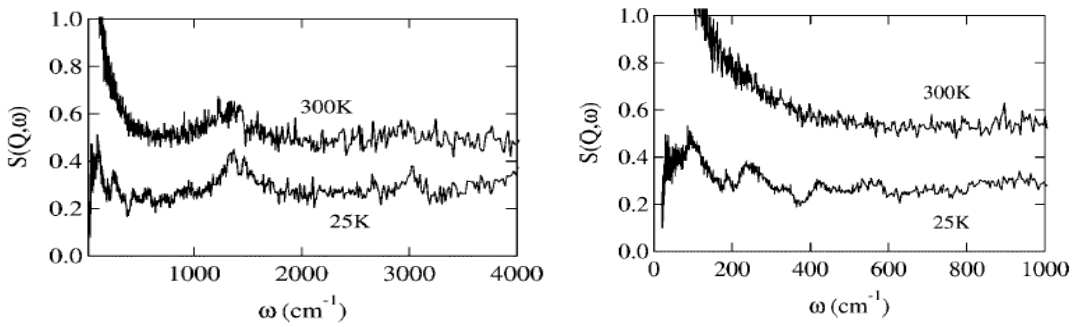


Fig.1: Experimental INS spectra of staphylococcal nuclease at 300 K and at 25 K. (Left) entire energy region, (right) lower energy region. For the sake of clarity, the 300 K spectrum is shifted 0.2 unit along S(Q, ω) axis.

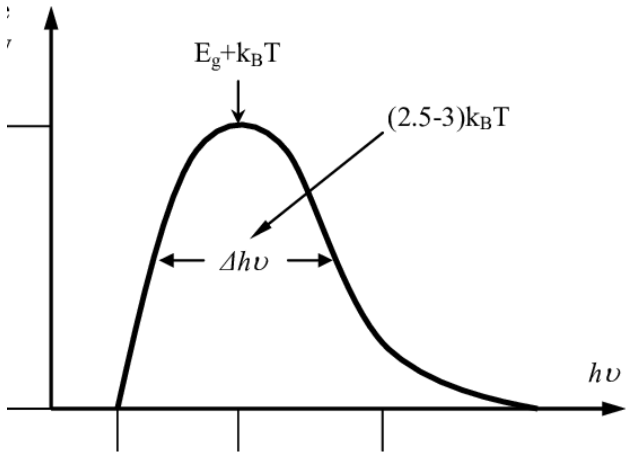


Fig.2: Relative intensity vs. the photon energy

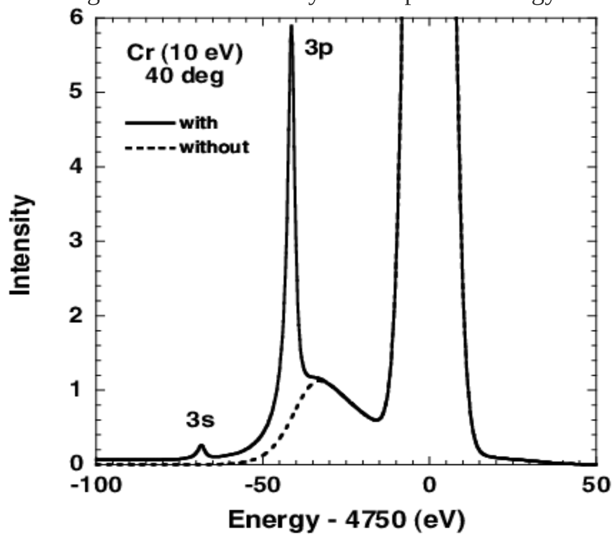


Fig.3: Intensity vs photon energy for calculation of scattering of a - 4750 eV X-ray line off 10 eV Cr at 40°. The case where the 3p and 3s bound electron contributions are included is shown by solid line.

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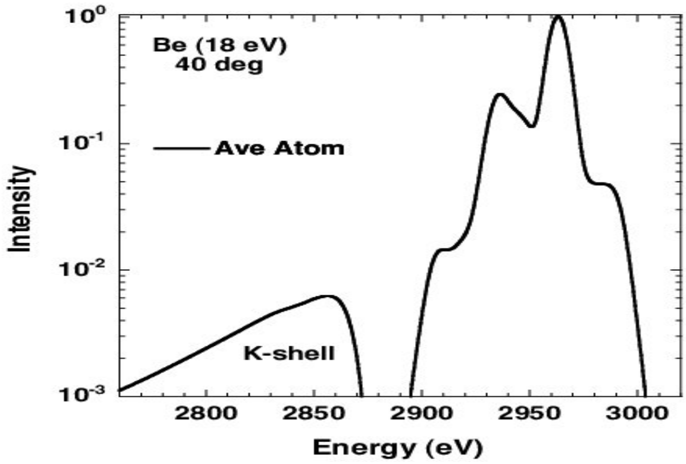


Fig.4: Intensity vs photon energy for calculation of scattering of a Cl Ly-α X-ray off Be at 40° for an electron temperature of 18 eV. The contribution from the K-shell bound electrons is shown.

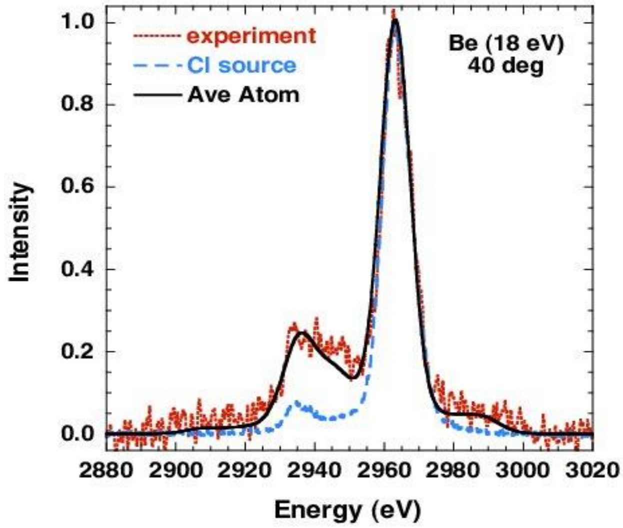


Fig.5: Intensity vs photon energy for scattering of a Cl Ly-α X-ray off Be at 40°. Dotted line is experimental data (see Ref. 6) while solid line is calculation for an electron temperature of 18 eV. The dashed line shows the Cl X-ray source.

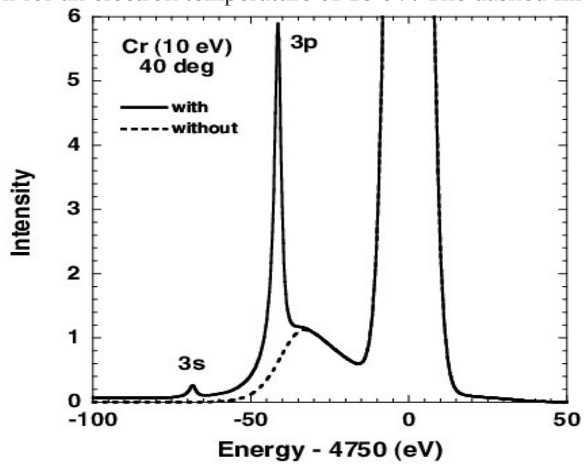


Fig.6: Intensity vs photon energy for calculation of scattering of a 4750 eV X-ray line off 10 eV Cr at 40°. The case where the 3p and 3s bound electron contributions are included is shown by solid line.

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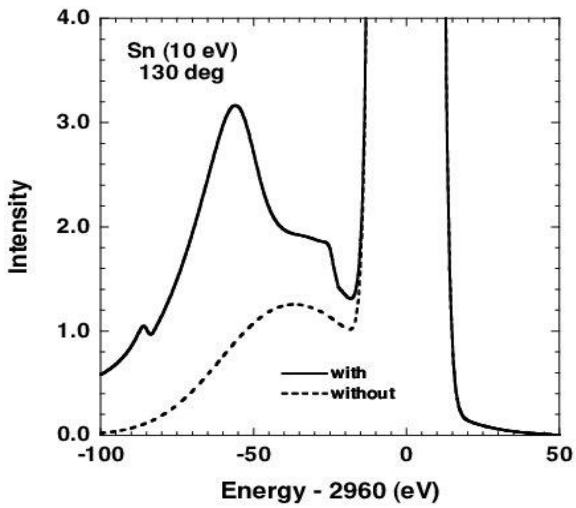


Fig.7: Intensity vs photon energy for calculation of scattering of a 2960 eV X-ray line off Sn at 130° for an electron temperature of 10 eV. The strong contribution from the 4d bound electrons are apparent for the case where the bound electrons are included (solid line) when compared with case without bound electrons (dashed line).

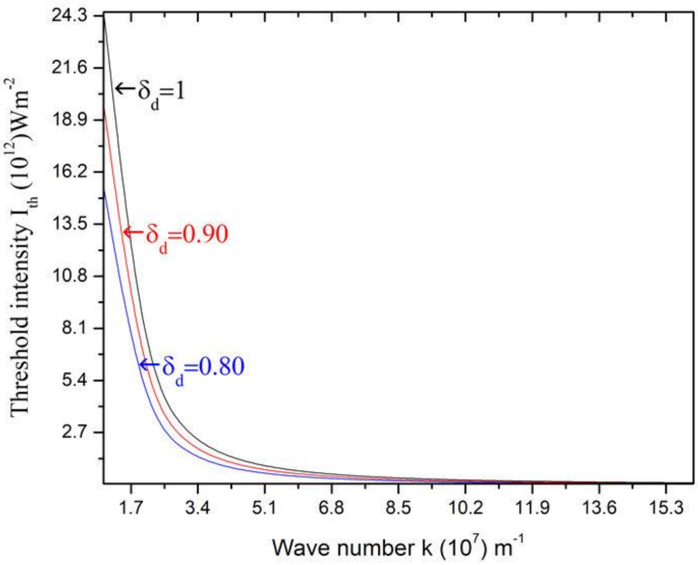


**Fig.8. Variation of threshold intensity I Vs wave number k.**

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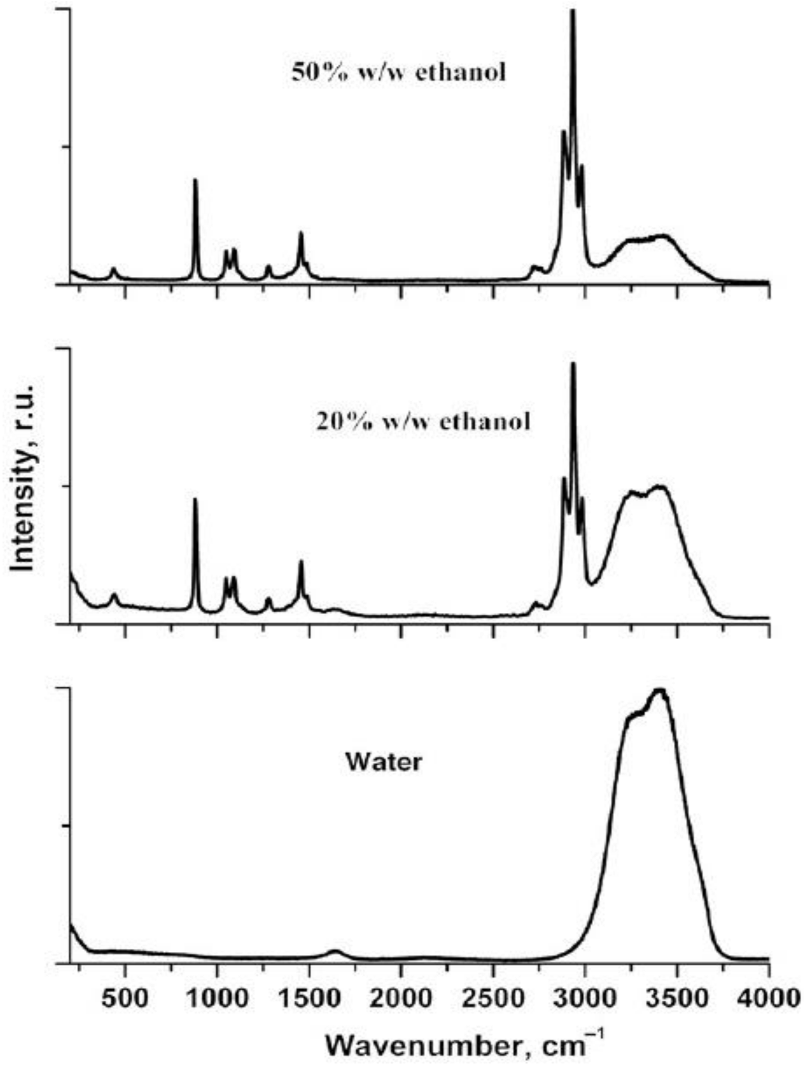


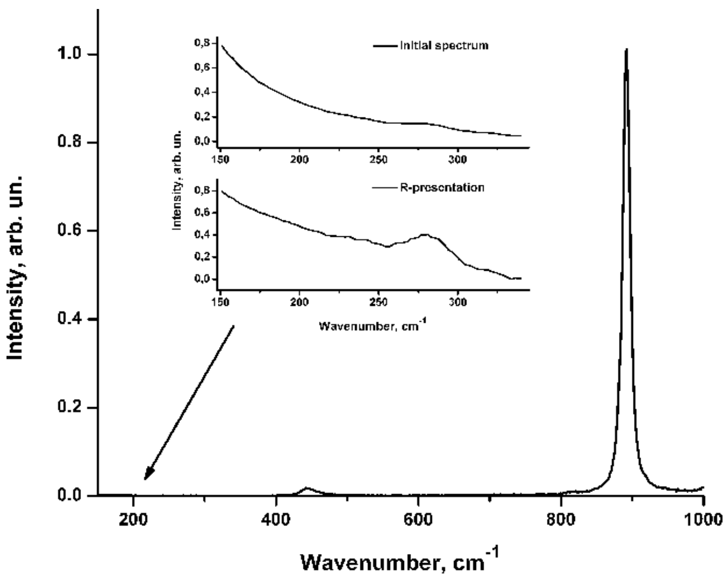


**Fig.9.Low-frequency area of the Raman spectra of ethanol. The inset demonstrates the extraction of the useful signal from Raman spectrum using the R-presentation. - "Raman Spectroscopy...**

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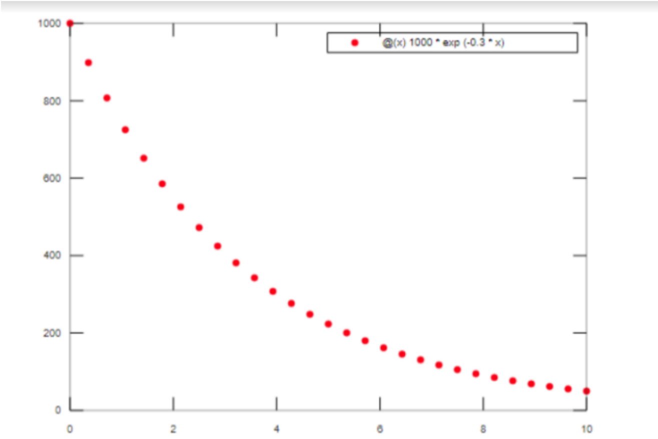


$$J = nev = ne\frac{dx}{dt} = \frac{d(nex)}{dt} = \frac{dp}{dt}$$

$$= x\frac{dE_0 e^{-iwt}}{dt} = -iwxE = -i(x_1 + ix_2)w =$$

$$wx_2 - iwx_1 \rightarrow \sigma E = (\sigma_1 + i\sigma_2)E_1$$

Thus

$$\sigma_1 = \omega x_2$$

In view of equation (28), for particles of thickness a, and time passage T

$$x = a \qquad t = \tau$$

The special depend part gives the intensity

$$I = E\overline{E} = E_0^2 e^{\frac{-3\sigma nd}{4\varepsilon c}} e^{-\frac{\sigma t}{4\varepsilon}} = I_0 e^{\frac{-3nd}{4\varepsilon c}x_2\omega} e^{\frac{-x_2 t\omega}{4\varepsilon}}$$

$$I = I_0 e^{-(\frac{3nd}{4\varepsilon c} + \frac{t}{4\pi})x_2\omega}$$

$$I = I_0 e^{-\mu_0\omega} \quad \text{where} \quad s = I$$

This relationcanbedisplayedgraphically in figure4.It is very interesting to note that the scattering spectrum for protein and the scattering of...... by........ can be easily explained by our model to a great extent.

**5. Conclusion:**

The scattering process and interaction of radiation with bulk matter can be described by deriving the wave equation of the quantum system with the aid of an electric wave equation in a medium. This new wave function shows that the passage of particle beams in a vacuum does not change the particles flux, while it shows that inside the medium it diminishes exponentially with distance and time in complete an agreement with experimental observation. The expression for the electric field derived from Newton's laws and electromagnetic are typical. They both show that the spatial decay rate is strongly dependent on the friction coefficient.

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